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Smallpox as a Bioweapon Should We Be Concerned

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THESIS

SMALLPOX AS A BIOWEAPON: SHOULD WE BE CONCERNED?

by

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March 2012

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13. ABSTRACT (maximum 200 words)

There is debate in the weapons of mass destruction and bioterrorism literature over whether the threat from smallpox is exaggerated or realistic; however, there has been insufficient evaluation of the factors that indicate whether the threat is valid or overblown. Insufficient weight has been given to whether there are groups or individuals who are capable or have demonstrated the intent to use smallpox as a weapon, which should be key factors in evaluating the level of threat posed by the virus.

To address the issue of the gap in the specific risk assessment of a smallpox attack, the following issues will be considered: (1) capability—whether smallpox is a realistic agent for terrorists to use; (2) motivation—what types of terrorists might pursue smallpox as a bioweapon; and (3) deterrence—whether current U.S. and international policies are likely to impact this decision.

I conclude that the threat the United States faces from a smallpox attack is more remote than is implied by the amount of concern it generates in reports and preparedness exercises. Terrorists are unlikely to be able to master the acquisition, production, weaponization and dissemination of the virus, and would likely pursue other types of weapons.

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SMALLPOX AS A BIOWEAPON: SHOULD WE BE CONCERNED?

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Submitted in partial fulfillment of the
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LIST OF ACRONYMS AND ABBREVIATIONS

BSL-4	Biosafety Level Four
BW	Biological Warfare
BWC	Biological and Toxin Weapons Convention
CB	Chemical and Biological
CBRN	Chemical, Biological, Radiological, Nuclear
CIA	Central Intelligence Agency
CW	Chemical Warfare
CWC	Chemical Weapons Convention
CDC	Centers for Disease Control and Prevention
DIA	Defense Intelligence Agency
DTRA	Defense Threat Reduction Agency
DNA	Deoxyribonucleic Acid
FBI	Federal Bureau of Investigation
FSU	Former Soviet Union
HEPA	High-Efficiency Particulate Air
HIV	Human Immunodeficiency Virus
ICBM	Intercontinental Ballistic Missile
IED	Improvised Explosive Device
MIT	Massachusetts Institute of Technology
NIE	National Intelligence Estimate
NSSAB	U.S. National Science Advisory Board for Biosecurity
QDR	Quadrennial Defense Review
RPG	Rocket Propelled Grenade
UN	United Nations
U.S.	United States of America
USAMRIID	United States Army Medical Research Institute of Infectious Diseases
USFK	United States Forces Korea
VIG	Vaccinia Immune Globulin
WHO	World Health Organization
WMD	Weapon(s) of Mass Destruction

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I. INTRODUCTION

A. SMALLPOX AS A THREAT

There is debate in the weapons of mass destruction (WMD) and bioterrorism literature over whether the threat from smallpox is exaggerated or realistic.[1] The debate among novices and experts alike over the actual level of threat presented by smallpox reappears periodically each time government reports, congressional testimony, or terrorism preparedness exercises mention the virus as a possible terrorist weapon or assess that certain terrorists or states could have bioterrorism capabilities. Surprisingly, despite the recurrence of the debate, there has been insufficient evaluation of the factors that indicate whether such concerns are valid or overblown.

Because the ramifications of a bioterror attack would be severe, there are many alarmist "what if" or "worst case" stories circulating in both academic literature and the mainstream media about bioterrorism in general. Yet, there has been little evaluation of the factors that indicate whether such concerns related specifically to smallpox are valid. Generalization across bioterror agents often occurs, causing people to assume that a threat from bioterror implies a threat from smallpox. This contributes to the perception that a threat exists without necessarily showing that one does. Insufficient weight has been given to whether there are groups or individuals who are capable or have demonstrated the intent to use smallpox as a weapon, which should be key factors in evaluating the level of threat posed by the virus.

To address the issue of the gap in the specific risk assessment of a smallpox attack, I will study whether terrorists could or would be able to carry out a biological

[1]Martin Enserink, "How Devastating Would a Smallpox Attack Really Be?" *Science* 296, no. 5573 (May 31, 2002): 1592–1595; J. Michael Lane and Lila Summer, "Smallpox as a Weapon for Bioterrorism," in *Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century*, ed. I.W. Fong and Kenneth Alibek (New York: Springer, 2005), 156–158; Martin Weiss, Peter Weiss, Glenn Mathisen, and Phyllis Guze, "Confronting Biological Weapons: Rethinking Smallpox," *Clinical Infectious Diseases* 39, no. 11 (December 1, 2004): 1668–1672; Ben Harder, "The Vaccinia Dilemma," *Science News* 163, no. 14 (April 5, 2003): 218–220; Peter B. Merkle, "Smallpox and Public Health: A Reality Check," *Science* 298 (October 4, 2002), 57.

attack using smallpox, whether they would be likely to prefer this method over their alternative options (if they were able to master it), and what factors should be considered when making this evaluation. I will address the question of the extent to which the United States should be concerned with the threat of terrorist actors using smallpox as a weapon of bioterrorism, focusing specifically on whether such protection is necessary based on: (1) whether smallpox is a realistic agent for terrorists to use; (2) what types of terrorists might pursue it as a bioweapon; and (3) whether current U.S. policies are likely to impact this decision.

I will argue that the threat the United States faces from a smallpox attack is more remote than is implied by the amount of concern it generates in reports and preparedness exercises. Terrorists are unlikely to be able to master the acquisition, weaponization and dispersal of the virus, and would likely pursue more conventional types of weapons.

1. Smallpox Has Been Eradicated; Is It Still a Concern?

In 1980, the World Health Organization (WHO) announced a major global triumph: smallpox, a devastating and extremely contagious disease that had plagued mankind for thousands of years, had been eradicated. No longer would humans suffer the fear of contracting this highly lethal disease or the risks from the vaccination to protect against it. Doctors, scientists, and governments from around the world agreed either to destroy their remaining stocks of live smallpox virus, or to transfer them to one of two highly controlled laboratories in the Soviet Union or in the United States of America. There the virus would remain secured, yet available to fulfill future scientific needs.[2] The only remaining declared stores of the smallpox virus today are held at the State

[2] Martin Enserink and Richard Stone, "Dead Virus Walking," *Science* 295, no. 5562 (March 15, 2002): 2001; Harder, "The Vaccinia Dilemma," 218–220; Michael Scardaville, "Public Health and National Security Planning: The Case for Voluntary Smallpox Vaccination," *The Heritage Foundation Backgrounder*, no. 1616 (December 6, 2002): 1–3.

Research Center for Virology and Biotechnology in Koltsovo, Russia, and at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia.[3]

In the years since eradication, bioterrorism has become a growing concern. In 1997, the Department of Defense concluded in its Quadrennial Defense Review (QDR) that biological weapons are a "likely condition of future warfare."[4] Two years later, the Secretary of Defense published an article in *The Washington Post* in which he mentioned his worry that foreign militaries might still possess smallpox.[5] D.A. Henderson, an expert in smallpox epidemiology who was instrumental in the WHO eradication program, maintains that the September 2001 terrorist attacks were a further wake-up call for those concerned about smallpox. He cited as proof that, in contrast to the lack of attention paid to *Smallpox and Its Eradication* at the time of its publication in 1988, after the 2001 attacks, "remaining copies were quickly sold out."[6] In 2002, President George W. Bush announced the National Smallpox Vaccination Campaign and public opinion polls showed concern over the threat posed by smallpox attack.[7] Both bioterrorism in general, and smallpox specifically, were becoming greater areas of concern for government officials and the public.

Part of this renewed concern surrounding smallpox comes from the suspicion that live smallpox virus existed outside the two authorized laboratories. There have been

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[3] Alan Zelicoff and Michael Bellomo, *Microbe: Are We Ready For The Next Plague?* (New York, NY: AMACOM, 2005), 111; Jonathan B. Tucker, *Scourge: The Once and Future Threat of Smallpox* (New York: Atlantic Monthly Press, 2001), 176; Ken Alibek and Stephen Handelman, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World –Told From the Inside by the Man Who Ran It* (New York: Random House, 1999), 117, 148.

[4] Al Mauroni, *Chemical and Biological Warfare*, 2nd ed. (Santa Barbara, CA: ABC-CLIO, Inc., 2007), xvii.

[5] William S. Cohen, "Preparing for a grave new world," *Washington Post*, July 26, 1999.

[6] Henderson, *Smallpox: The Death of a Disease*, 252.

[7] Robert Blendon, John Benson, Catherine DesRoches, and Melissa Hermann, "Survey Project on Americans' Response to Biological Terrorism: Study 3: Public Attitudes About the Threat of a Smallpox Attack" (Harvard School of Public Health, June 5, 2002). http://www.hsph.harvard.edu/research/horp/project-on-the-public-and-biosecurity/ (accessed May 17, 2011).

indications that North Korea, Iraq, and Israel possess illegal stores of the smallpox virus.[8] Other sources cite al Qaeda or Iran as potential sources of biological weapons programs.[9] Even more worrying are the reports from a high-level former Soviet military scientist named Ken Alibek who was intimately involved in the huge smallpox weaponization program that the Soviet government secretly operated for years. He suspects that all instances of the virus and the scientists involved in its research were not accounted for after the fall of the Soviet Union.[10] If the virus is present outside the known controlled environments, or if it is being studied in ways that violate international agreements, it is possible that terrorists could use it to cause widespread harm.[11]

Unauthorized storage and research is dangerous because much of the population in the United States is no longer protected from smallpox. Widespread vaccination in the United States ceased in 1972 when the threat from smallpox was determined to be small enough not to warrant the continued use of what was commonly accepted to be a vaccine with high risk of serious side effects.[12] Furthermore, post-vaccination immunity to smallpox wears off over the years.[13] Those who were once fully protected are now vulnerable. Additionally, because it has been over three decades since the last case of smallpox was seen by medical professionals and "[f]ew physicians are alive today who

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[8] House Committee on International Relations, *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapons: Hearing before the Committee on International Relations*, 107th Cong., 1st sess., December 5, 2001, 7; Barton Gellman, "Four Nations Thought to Possess Smallpox; Iraq, North Korea Named, Two Officials Say," *Washington Post*, November 5, 2002; Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 158.

[9] Barton Gellman, "Revealing a Reporter's Relationship with Secrecy and Sources," *Neiman Reports* 58, no.2 (Summer 2004): 45; Joby Warrick, "Iran Said to be Producing Bioweapons," *Washington Post*, May 15, 2003.

[10] Tim Weiner, "Soviet Defector Warns of Biological Weapons," *New york times*, February 25, 1998; Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 156; House Committee on International Relations, *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapon*, 8–9, 12.

[11] William Broad and Judith Miller, "Report Provides New Details of Soviet Smallpox Accident," *New york times*, June 15, 2002.

[12] Brenda J. McEleney, "Smallpox: A Primer," in *The Gathering Biological Warfare Storm*, ed. Jim A. Davis and Barry R. Schneider (Maxwell Airforce Base, Alabama: USAF Counterproliferation Center, 2002), 146–149.

[13] Donald A. Henderson, "The Looming Threat of Bioterrorism," *Science* 283, no. 5406 (February 26, 1999): 1281.

have seen cases outside of a textbook,"[14] diagnosis and containment are likely to be slow. This could be seen as a benefit to terrorists seeking to spread disease.

Former Senator Bill Frist, M.D., has written a book in an attempt to educate the public about biological terrorism from to his unique perspective of being both a medical doctor and a legislator. In his book, he chooses to include only biological agents that have "been identified by our intelligence and public health experts as a potential bioterrorist weapon."[15] Smallpox is among them. His answer to the question of whether smallpox could really be used as a biological weapon is that "[t]he threat must be taken very seriously…. [I]t's suspected that nations with bioterror programs, including Iraq and North Korea, may have gained access to the virus, increasing the likelihood that it could fall into the hands of terrorists."[16] Although he does not elaborate on the sources of these suspicions, it is clear that he intends the reader to feel his claims are legitimate based upon his knowledge gained as a member of Congress.

The concerns that terrorists could possibly have acquired stores of smallpox or could be able to manufacture the virus in a laboratory, combined with the fact that the United States of America has a significantly vulnerable population, puts the country at risk if there are actually terrorists who are motivated to orchestrate this type of attack. The actual level of this risk should be determined by the capability and intentions of these terrorist actors. Is the threat of the occurrence of a smallpox attack exaggerated unnecessarily simply because of these vulnerabilities and the potentially grave consequences of such an attack? Are non-state actors capable of successfully meeting the technical laboratory and safety requirements required to complete an attack of this level of sophistication? Are there groups in the world that would be likely to choose this type of attack over their conventional alternatives? Is it likely that the threat of the United States' retaliation would deter them? If smallpox is a threat, what is the level of risk? Although some of these questions have been considered and debated surrounding the

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[14] D.A. Henderson, *Smallpox: The Death of a Disease: The Inside Story of Eradicating a Worldwide Killer* (New York: Prometheus Books, 2009), 32.

[15] Bill Frist, *When Every Moment Counts: What You Need to Know about Bioterrorism from the Senate's Only Doctor* (Lantham, MD: Rowman & Littlefield Publishers, Inc., 2002), xiv.

[16] Ibid., 75.

general topic of bioterrorism, there has not been sufficient evaluation of these questions devoted specifically to the study of the use of smallpox as an agent of bioterror and to the degree of risk of a smallpox attack.

To address the questions of whether a smallpox attack is realistically something that the United States should be concerned with and whether it is indeed suitable as a weapon of bioterror, I will begin with an overview of the characteristics of the disease and the virus responsible for it, and its method transmission.

2. Background of the Disease

The *Variola* virus, more commonly called smallpox, had been continually spreading disfigurement and death from person to person for at least the last 3,500 years until it was stopped from spreading beyond Ali Maow Maalin in Somalia in 1977.[17] He was the last person to contract smallpox naturally. Because smallpox is a virus, it requires a living host to reproduce. Humans are the only organisms that meet this particular virus' requirements; there are no reservoirs for the virus in nature.[18] This characteristic allowed eradication to be successful.

Before the eradication milestone, epidemics commonly killed approximately thirty percent of those who contracted the disease.[19] The disease's profound impact was recorded in Japan between the years 735 and 737 when thirty percent—and in some

[17] Henderson, *Smallpox: The Death of a Disease*, 240.

[18] Irwin Sherman, *Twelve Diseases That Changed Our World* (Washington, D.C.: American Society of Microbiology Press, 2007), 56; Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148.

[19] Although fatality rate is not constant across epidemics or across different types of smallpox, the range is often described as anywhere from 20% to 60%, with 30 to 40% being the most commonly cited. See: Richard Crowell, "Likely Threat Pathogens in Biological Terrorism," in *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, ed. Potomac Institute for Policy Studies (Arlington, VA: Oceana, 1999), 136; Donald Henderson and Luciana Borio, "Smallpox and Monkeypox," in *Tropical Infectious Diseases: Principles, Pathogens, and Practice*, 2nd ed., ed. Richard Guerrant, David Walker, and Peter Weller (Philadelphia, PA: Elsevier, 2006), 621; Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 147; U.S. Library of Congress, CRS, *Smallpox: Technical Background on the Disease and its Potential Role in Terrorism*, by Frank Gottron, CRS Report RS21288 (Washington, D.C.: Office of Congressional Information and Publishing, January 10, 2003), 1; Thomas Mack, "Smallpox in Europe, 1950–1971," *Journal of Infectious Diseases* 125 no. 2 (February 1972): 168; J.N. Hays, *Epidemics and Pandemics: Their Impacts on Human History* (Santa Barbara, CA: ABC-CLIO, 2005), 31; Susan Scott and Christopher Duncan, eds., *Human Demography and Disease* (Cambridge, UK: Cambridge University Press, 1998), 281.

places sixty percent—of the population was killed in a smallpox epidemic.[20] Similar devastation occurred in Iceland in 1241 when 20,000 members of the country's 70,000 did not survive the virus and again in 1707 when 25 percent of the population died of smallpox in two years (making smallpox responsible for two-thirds of all deaths in those years).[21] At about the same time, two-thirds of the population of Greenland succumbed to the disease.[22] In the sixteenth century when smallpox began to spread in North and South America, "[m]ortality rates of 50 to 80 percent were common."[23]

In London, census data and Bills of Mortality revealed a mean fatality rate of nearly 19 percent with a range from nine to 36 percent after the 1720 epidemic.[24] Shortly thereafter, "[i]noculation against smallpox was more widely administered… and vaccination was introduced in 1796 and became compulsory for infants in 1853."[25] Even with the introduction of these protective measures, in the eighteenth century, cities in Europe such as London and Copenhagen typically experienced a minimum of between 300 and 350 deaths per 100,000 people each year and smallpox reached the milestone of surpassing "plague, leprosy, and syphilis as the continent's foremost pestilence."[26] During the same time period, 10 percent of all Swedish infants were dying as a result of the disease.[27] The most serious outbreak in the West in the nineteenth century occurred in Europe between 1870 and 1876, killing 500,000 people.[28]

D.A. Henderson summarizes how these historical statistics relate to modern vulnerability to the disease using North America as an example:

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[20] J.N. Hays, *Epidemics and Pandemics: Their Impacts on Human History* (Santa Barbara, CA: ABC-CLIO, 2005), 31.

[21] Henderson, *Smallpox: The Death of a Disease*, 39; Hays, *Epidemics and Pandemics*, 131.

[22] Susan Scott and Christopher Duncan, eds., *Human Demography and Disease* (Cambridge, UK: Cambridge University Press, 1998), 281.

[23] Henderson, *Smallpox: The Death of a Disease*, 40.

[24] Scott and Duncan, eds., *Human Demography and Disease*, 281.

[25] Ibid., 172.

[26] Donald Hopkins, *The Greatest Killer: Smallpox in History* (Chicago, IL: Chicago University Press, 2002), 32, 41; Hays, *Epidemics and Pandemics*, 151–152.

[27] Hays, *Epidemics and Pandemics*, 151–152.

[28] Ibid., 287.

> During the seventeenth and eighteenth centuries, none of the cities in North America were large enough to sustain transmission. Instead, smallpox was periodically reintroduced, resulting in large epidemics every seven to twelve years…. But in remote and rural areas, decades might pass without a trace of smallpox. It became apparent that the longer the period of freedom from smallpox, the larger the number of vulnerable people and the more disastrous the epidemic.[29]

Smallpox survivors were left scarred and often blind, but immune from re-infection.[30] Because of this immunity, smallpox could only continue to be transmitted as long as there were previously uninfected people available in close proximity to serve as hosts for the virus. When smallpox reached an area that had never been infected, or that had experienced the passage of enough time since the last outbreak, the disease would rage.[31] These fatality rates and epidemiological patterns from the past are relevant today because in the modern era, most people are not vaccinated to protect against smallpox, and those who were vaccinated in the past likely remain only partially immune. If smallpox were reintroduced and not immediately contained today, widespread epidemics similar to those in the past would be a realistic possibility.

3. Virus Characteristics

Those who study biological weapons have noted that "[s]ome factors that are important for microorganisms to be used as biological weapons are virulence, infectivity, stability/ruggedness, ease of producibility, and ease of controllability."[32] Several of these characteristics clearly apply to smallpox.

Smallpox is a virus of the *Orthopox* genus and the Poxviridae family, also known by the scientific name of *Variola*. It is easy to grow, can be dried to make it susceptible

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[29] Henderson, *Smallpox: The Death of a Disease*, 43.

[30] Irwin Sherman, *Twelve Diseases That Changed Our World* (Washington, D.C.: American Society of Microbiology Press, 2007), 56; Rohit Puskoor and Geoffrey Zubay, "Smallpox," in *Agents of Bioterrorism: Pathogens and their Weaponization*, ed. Geoffrey Zubay (New York, NY: Columbia University Press, 2005), 240.

[31] Sherman, *Twelve Diseases That Changed Our World*, 56–57.

[32] Kathleen Vogel and Sonia Ben Ouagrham, "Conversion at Stepnogorsk: What the Future Holds for Former Bioweapons Facilities," *Peace Studies Program Occasional Paper #28* (Ithaca, NY: Cornell University, 2003), 1.

to breakdown by heat, and can be transmitted via aerosol means.[33] Furthermore, it is "relatively resistant to environmental conditions, persisting in aerosolized form for up to 1 week and in crusts for several years."[34] Smallpox's genome is large, very stable, and "is theoretically amenable to modification."[35] Modification of the genome means that the virus could be altered by scientists to enhance these characteristics.[36]

The facts that smallpox is a severe disease that is transmissible between humans, has a stable genome, and can survive in the environment make it suitable for potential use as a bioweapon. Some have claimed that these attributes make *Variola* "attractive as a terrorist weapon."[37] Its attractiveness to terrorists remains to be examined; however, its viral characteristics do make *Variola* amenable to use as a biological weapon.

The attributes of smallpox have been assessed by a working group at Johns Hopkins convened in 1998 to develop a report about the most concerning biological agents that, if used as bioweapons, "had the potential to cause catastrophic epidemics,"[38] or that "were serious enough to threaten the integrity and functioning of the government."[39] Smallpox warranted inclusion in the list based upon "its high fatality rate, its capacity to spread widely, the large number of vulnerable people, the lack of available vaccine to curtail outbreaks—and, not least, the high ranking given to it by Soviet biological weapons experts."[40] Academics and public health officials have rated the characteristics of the smallpox virus as more of a concern than others, from the standpoint of potentially severe consequences of an outbreak.

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[33] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148; Crowell, "Likely Threat Pathogens in Biological Terrorism," 138.

[34] Puskoor and Zubay, "Smallpox," 240.

[35] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148; Puskoor and Zubay, "Smallpox," 247.

[36] Selgelid, "A Tale of Two Studies," 35; Bloche, "Rogue Science," 1263; Puskoor and Zubay, "Smallpox," 247; Joshua Epstein et al., *Toward a Containment Strategy for Smallpox Bioterror*, 38–39; Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148.

[37] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148.

[38] Henderson, *Smallpox: The Death of a Disease*, 279.

[39] Ibid.

[40] Ibid., 279–280.

4. Disease Characteristics

The *Variola* virus is found in two forms: *Variola minor* and *Variola major*. *Variola minor* causes a less severe form of the disease with much higher survival rates; for example, in a 1920s outbreak of *Variola minor* in Switzerland, of over 5,000 cases in three years, there were only ten fatalities.[41] In the past, 1 percent or less of those who contracted *Variola minor* died as a result of the disease.[42] Survival of *Variola minor* provides lifelong immunity from all forms of *Variola*.

Variola major, on the other hand, is much more debilitating, in terms of fever, rash, and eventual fatality.[43] *Variola major* is responsible for "four major clinical types of smallpox: the ordinary type, the modified type, the flat type, and the hemorrhagic type."[44] Ninety percent of smallpox cases are ordinary-type *Variola major*.[45] Of the four clinical types, the hemorrhagic form is the most severe, the most transmissible, kills the fastest, and has a nearly 100 percent fatality rate even among vaccinated individuals.[46] Which clinical type a person contracts depends on the individual's response, not on the virus, and patients do not necessarily develop the same form as the individual from whom they were infected.[47] All forms of *Variola major*, hereafter simply referred to as *Variola* or smallpox, will be the focus of this paper, as, comparatively, *Variola minor*'s characteristics makes it an unlikely candidate to be preferred as a bioweapon.[48]

From the time smallpox is inhaled and begins to replicate inside the infected person's cells, several days will pass before any symptoms are felt; this is called the

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[41] Hopkins, *The Greatest Killer: Smallpox in History*, 97.

[42] Henderson and Borio, "Smallpox and Monkeypox," 624.

[43] Ibid., 626.

[44] Puskoor and Zubay, "Smallpox," 240.

[45] Shmuel Shapira, Jeffrey Hammond, and Leonard Cole, eds., *Essentials of Terror Medicine* (New York, NY: Springer, 2009), 203.

[46] Henderson and Borio, "Smallpox and Monkeypox," 629; Shapira, Hammond, and Cole, eds., *Essentials of Terror Medicine*, 204; Centers for Disease Control and Prevention, Division of Bioterrorism Preparedness and Response, "Smallpox Fact Sheet: Smallpox Disease Overview," http://www.bt.cdc.gov/agent/smallpox/overview/disease-facts.asp (accessed February 10, 2012).

[47] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 149.

[48] Ibid., 147.

incubation period. Twelve to fourteen days is the average incubation period, with a range of seven to seventeen days.[49] A person is not contagious during this time.[50] For two to four days after the end of the incubation period, people are sometimes contagious and begin to experience initial symptoms of the disease.[51] Symptoms that are expressed during this time period begin with:

> Malaise, fever, rigors, vomiting, headaches and backaches; 15 percent of patients develop delirium. Some 2 to 3 days later, an enanthem [rash on a mucous membrane] appears concomitantly with a discrete rash about the face, hands and forearms. The rash then spreads to the trunk over the next week, and lesions progress quickly from macules to papules, eventually to pustular lesions. From 8 to 14 days after infection, the pustules form scabs which leave depressed depigmented scars upon healing.[52]

In fatal cases, these symptoms are usually followed by death between the first and second weeks of illness.[53]

Smallpox's initial symptoms and incubation periods are relevant to the decision of whether to choose the virus as a bioterror agent. Because one who becomes infected with smallpox does not immediately display any outward symptoms, a terrorist who has conducted an attack would be provided with time to escape the scene of the smallpox release.

The fact that the disease has no other potential reservoirs in nature solves part of the attribution dilemma faced by other potential biological weapons;[54] that is, since any outbreak of smallpox can no longer be attributed to natural causes, a terrorist attack

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[49] Frederick Sidell et al., *Jane's Chem-Bio Handbook*, 2nd ed. (Alexandria, VA: Jane's Information Group, 2002), 207; Centers for Disease Control and Prevention, Division of Bioterrorism Preparedness and Response, "Smallpox Fact Sheet: Smallpox Disease Overview," http://www.bt.cdc.gov/agent/smallpox/overview/disease-facts.asp (accessed February 10, 2012).

[50] Centers for Disease Control and Prevention, Division of Bioterrorism Preparedness and Response, "Smallpox Fact Sheet: Smallpox Disease Overview," http://www.bt.cdc.gov/agent/smallpox/overview/disease-facts.asp (accessed February 10, 2012).

[51] Ibid.

[52] Sidell et al., *Jane's Chem-Bio Handbook*, 207.

[53] Henderson and Borio, "Smallpox and Monkeypox," 627.

[54] Anne Clunan, "Identifying Biological Agents, Characterizing Events, and Attributing Blame," in *Terrorism, War, or Disease: Unraveling the Use of Biological Weapons*, ed. Anne Clunan, Peter Lavoy, and Susan Martin (Stanford, CA: Stanford University Press, 2008), 8–11.

would be implicated as soon as smallpox was definitively diagnosed. Standard epidemiological methods for investigating infectious disease origin and spread can be used in a smallpox outbreak, although their effectiveness will depend on details of dissemination:

> The expected outcome resulting from this form of release [spreading smallpox through the air] would most likely be large numbers of cases with clustered onsets. Establishing epidemiologic association among these cases could be problematic, depending on the site and extent of virus dispersion. If introduced through intentionally infected persons, the origin of the virus (i.e., the index case) and the extent of the outbreak could likely be tracked using standard epidemiologic and laboratory methods.[55]

Epidemiological methods that are currently in use can track the disease's spread and attempt to determine its source, but the characteristics of the disease are such that this investigation would not take place until multiple days after the attack had taken place. If a terrorist group did not claim credit for its attack, smallpox's long incubation period could help it escape detection as the source. Some doctors have assessed that due to the disease's initial stages presenting with a rash similar to chickenpox, in conjunction with the fact that smallpox is unlikely to be suspected due to its status as an eradicated disease, the diagnosis of smallpox is unlikely to be made "until the fourth or fifth day of the rash."[56] Although an outbreak would certainly be attributed to an intentional release, there is likely to be little remaining evidence at the scene of the release by the time the disease is diagnosed and the attack's location is discovered because the disease is not stable in the environment indefinitely. Without a human host in which to take refuge, the virus would likely only remain viable for one day, and would be undetectable by the time cases began to appear one to two weeks later.[57]

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[55] Centers for Disease Control and Prevention Division of Bioterrorism Preparedness and Response, "Guide F: Environmental Control of Smallpox Virus," *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/files/guide-f.pdf (accessed February 11, 2012).

[56] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 151; Henderson and Borio, "Smallpox and Monkeypox," 628.

[57] Centers for Disease Control and Prevention Division of Bioterrorism Preparedness and Response, "Guide F: Environmental Control of Smallpox Virus," *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/files/guide-f.pdf (accessed February 11, 2012).

5. Transmission

Smallpox is transmitted from person to person through the air; it is so infective that until vaccination was practiced almost no one escaped catching the disease at some point in his or her life.[58] Although the exact amount of virus one must inhale in order to be infected is unknown, it "is believed to be only a few virions."[59] Among unvaccinated individuals, the chance of an infected person spreading the disease to a close contact has been measured at 40 to 90 percent.[60] This variation occurs, in part, due to the differences in virulence of each individual strain of the disease and in part by definition of "close" contact.

For example, studies in the 1960s and 1970s determined that smallpox:

> Does not ordinarily spread rapidly. Transmission requires prolonged face-to-face contact, such as that which occurs among family members or caregivers. Transmission is most efficient when the index patient is less than 6 feet from the recipient, so that the large-droplet respiratory secretions can be inhaled.[61]

Cases in a German hospital in 1972 proved that face-to-face contact is not always required for transmission; in this instance, the virus was determined to have traveled through the air to another floor of the hospital.[62] This case is generally accepted as a rare means of transmission; usually, "[p]atients spread smallpox primarily to household members and friends; large outbreaks in schools, for example, were uncommon."[63]

The reason for the most common pattern of transmission—only between "persons who have had close, prolonged (not casual or distant) contact with a sick person"[64]—is

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[58] Puskoor and Zubay, "Smallpox," 247; D.A. Henderson et al., "Smallpox as a Biological Weapon: Medical and Public Health Management," *JAMA* 281, no. 22 (June 9, 1999): 2128.

[59] D.A. Henderson et al., "Smallpox as a Biological Weapon," 2129.

[60] Puskoor and Zubay, "Smallpox," 245.

[61] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 153.

[62] Ibid., 153.

[63] Henderson et al., "Smallpox as a Biological Weapon," 2129.

[64] Lane and Goldstein, "Evaluation of 21st-Century Risks of Smallpox Vaccination and Policy Options," 492.

partly due to the effects that catching the disease has on the infected person. Once the infected person is contagious (which does not occur until the rash has appeared, usually seven to ten days after inhaling the virus[65]), he or she is often in no condition to carry on normal daily activities. Usually by the time an infected person would be capable of transmitting smallpox, he or she would have "been confined to bed because of the high fever and malaise of the prodromal illness."[66]

This is often part of the reason that those who do not believe a terrorist could use his own infection as a weapon of transmission cite for this method being unlikely.[67] There are others, however, who claim this is not a limiting factor:

> Smallpox could be delivered by aerosolization or by infected "suicide carriers." Although it seems likely that infected carriers would be too ill and the rash too noticeable for terrorists to be able to infect a large number of people without detection, the disease is mild enough in its early stages that the rash could be disguised and an infected carrier could be given drugs to moderate symptoms. A few infected individuals in densely packed cities distant from one another could infect enough people to cause major epidemics. The geographical separation would add to the straining of public health resources within the target nation.[68]

Other medical professionals have taken a middle ground, believing that patients with less severe cases could, theoretically, be mobile enough to spread their disease; however, these milder cases have generally been found to be "not efficient transmitters."[69]

The balance of information seems to support that while it would be possible for a terrorist to infect himself and attempt to spread smallpox to his contacts, it is likely that he would be unsuccessful due to his own symptoms either revealing his illness or preventing him from socializing, or because his milder case of smallpox would not be highly transmissible.

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[65] Mauroni, *Chemical and Biological Warfare*, 161; Puskoor and Zubay, "Smallpox," 245.

[66] Henderson et al., "Smallpox as a Biological Weapon," 2129.

[67] Enserink, "How Devastating Would a Smallpox Attack Really Be?" 1593; Henderson et al., "Smallpox as a Biological Weapon," 2129; Zelicoff and Bellomo, *Microbe*, 105.

[68] Puskoor and Zubay, "Smallpox," 247.

[69] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 149.

B. VACCINATION AND ITS IMPACT ON THREAT PERCEPTION

Although there was a time when smallpox vaccination was recommended for all American children at age one, the disease's eradication gave occasion to cease this practice.[70] When it was believed that the threat of contracting the disease was minimal, the risks of the vaccination were no longer seen as necessary. The last vaccinations given in the U.S. were performed in 1972, but immunity provided by vaccination—unlike that which is gained by contracting the disease—is not life-long.

Although it is not known exactly the degree of immunity that remains after forty or more years have passed since vaccination, it is believed that most of the people who were previously vaccinated are no longer immune.[71] Having been previously vaccinated decades ago would likely cause a greater chance of surviving a smallpox infection, but would likely not prevent contraction of the disease.[72] Vaccination is generally thought to provide protection for three to ten years, although the duration seems to vary between individuals.[73] Repeated vaccination, or booster shots, increases protection.[74] These facts have contributed to a "highly susceptible, largely unvaccinated global population"[75] in which, today, "vaccination immunity in the population has waned … substantially."[76] This condition makes the United States vulnerable, but does not necessarily have any bearing on whether there is a threat.

Some countries have assessed that this vulnerability is unacceptable in their military forces or medical professionals. The United States, the United Kingdom, and Israel continue to vaccinate those who "might be at higher risk of coming in contact with

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[70] Henderson et al., "Smallpox as a Biological Weapon," 2131.

[71] Ibid.

[72] Puskoor and Zubay, "Smallpox," 246.

[73] Sidell et al., *Jane's Chem-Bio Handbook*, 239; Tucker, *Scourge*, 30–31.

[74] Tucker, *Scourge*, 30-31; Henderson et al., "Smallpox as a Biological Weapon," 2131.

[75] Henderson, *Smallpox: The Death of a Disease*, 255.

[76] Henderson et al., "Smallpox as a Biological Weapon," 2129.

a smallpox patient by virtue of their professions if the virus were used as a bioterrorism agent."[77] After the 9/11 terrorist attacks, the CDC:

> Vaccinated about 140 members of special teams of disease detectives who are ready to be sent at a moment's notice to investigate a suspected [smallpox] outbreak anywhere in the country. In addition, the CDC has been training local and state health officials to prepare them to respond to a potential smallpox outbreak.[78]

When compared to the risks of contracting and (potentially not) surviving smallpox, the risks from the vaccine are seemingly minimal. But when there is no risk of contraction, there is no need to experience the risks of vaccination. Although the side effects from vaccination can be severe, the chances are greater of surviving the vaccine than of surviving full-blown smallpox. Risks from the vaccine include adverse skin reactions such as eczema vaccinatum (comprising inflammation, eruptions, and a high temperature), progressive vaccinia (lesions that do not heal and sometimes spread), or general vaccinia (usually characterized by high fever and malaise along with multiple lesions similar to the vaccination pustule).[79]

Although eczema vaccinatum has a fatality rate of only 1 percent, today's population would be three times more likely to experience this adverse reaction (as compared to studies in the 1960s) due to greater numbers of people in today's population who have eczema.[80] In persons with immune deficiency disorders, progressive vaccinia frequently resulted in death.[81] Although progressive vaccinia was rare in the past, more

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[77] Henderson and Borio, "Smallpox and Monkeypox," 633.

[78] Frist, *When Every Moment Counts*, 84.

[79] Henderson and Borio, "Smallpox and Monkeypox," 632; Shapira, Hammond, and Cole, eds., *Essentials of Terror Medicine*, 204; Henderson et al., "Smallpox as a Biological Weapon," 2135.

[80] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 159; J. Michael Lane and Joel Goldstein, "Evaluation of 21st-Century Risks of Smallpox Vaccination and Policy Options," *Annals of Internal Medicine* 138, no. 6 (March 18, 2003): 489.

[81] Henderson et al., "Smallpox as a Biological Weapon," 2134.

cases would be likely to occur if vaccination were reintroduced due to the increased prevalence in modern times of immune systems issues such as HIV, chemotherapy, and organ transplants.[82]

More serious complications can include postvaccinal nervous system diseases such as postvaccinal encephalopathy, encephalitis, or encephalomyelitis,[83] which can cause any combination of the following: fever, vomiting, headache, malaise, disorientation, convulsions, coma, paralysis, mental impairment, death, or a full recovery after two weeks.[84] Based upon data collected by the CDC in 1968, postvaccinial encephalitis occurred in one of every 300,000 vaccinations and one-quarter of these resulted in death.[85] Other vaccinees have suffered from heart problems such as myopericarditis, angina, and myocardial infractions.[86] Myocarditis has been shown in one in every 18,000 people who were vaccinated; its fatality rate is unknown.[87]

Based upon past statistics of adverse responses to smallpox vaccinations, it has been predicted that if 300 million people were vaccinated, "at least 1,500 people would develop a serious side effect from the vaccine and at least 300 people would likely die."[88] Others have calculated that "if 1 million persons were vaccinated, as many as 250 persons would experience adverse reactions of a type that would require administration of VIG."[89] Vaccinia immune globulin (VIG) is given to smallpox vaccine recipients who suffer adverse reactions to the vaccine.[90] Extrapolations of earlier vaccination data to

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[82] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 159; Lane and Goldstein, "Evaluation of 21st-Century Risks of Smallpox Vaccination and Policy Options," 489.

[83] Lane and Goldstein, "Evaluation of 21st-Century Risks of Smallpox Vaccination and Policy Options," 489.

[84] Henderson and Borio, "Smallpox and Monkeypox," 632.

[85] Henderson et al., "Smallpox as a Biological Weapon," 2134.

[86] Henderson and Borio, "Smallpox and Monkeypox," 632–633.

[87] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 159.

[88] Frist, *When Every Moment Counts*, 81.

[89] Henderson et al., "Smallpox as a Biological Weapon," 2132.

[90] Ibid.

Americans in 2003 shows that "we should expect a minimum of 125 deaths"[91] and that "death rates could be much higher than in 1968."[92]

In spite of these risks, U.S. government officials considered re-commencing vaccination. Smallpox expert D.A. Henderson was repeatedly called to the White House in 2001 and 2002 to meet with Vice President Richard Cheney about the threat of smallpox.[93] Henderson advised against recommencing mass vaccination because the risk of vaccine posed a high cost that was, in his opinion, not outweighed by what he perceived as a small chance of smallpox being used as a bioterror weapon. Furthermore, Henderson believed that, provided with sufficient quantities of vaccine, the means that were perfected during the eradication program could be used again to control any smallpox outbreak that did occur.[94] As history supports, smallpox spreads slowly enough under natural conditions that "a reasonable mix of judicious vaccination of close contacts and effective isolation of patients can readily stop an outbreak within two infective generations (about 4 weeks) after recognition of initial cases."[95] In spite of this, Henderson felt that his advice fell on deaf ears and that "Vice President Cheney and his aides… saw smallpox as being highly likely, an almost certain catastrophic event"[96] that could not be ignored. The actual level of risk, however, is much lower.

1. National Smallpox Vaccination Campaign

In December 2002, President George W. Bush announced the government's plan to begin a new smallpox vaccination campaign.[97] Civilians were asked to submit to the high-risk vaccine, even though the president acknowledged that there was no indication

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[91] Lane and Goldstein, "Evaluation of 21st-Century Risks of Smallpox Vaccination and Policy Options," 491.

[92] Ibid.

[93] Henderson, *Smallpox: The Death of a Disease*, 293–297.

[94] Ibid., 293.

[95] Lane and Goldstein, "Evaluation of 21st-Century Risks of Smallpox Vaccination and Policy Options," 492.

[96] Henderson, *Smallpox: The Death of a Disease*, 295.

[97] Richard W. Stevenson and Sheryl Gay Stolberg, "Bush Lays Out Smallpox Plan; Military is First," *New york times*, December 14, 2002.

of an impending attack.[98] At the time of his announcement, there was a significant debate surrounding the risks and benefits of smallpox vaccination. Experts in the fields of intelligence and security studies could not agree on whether there was or was not a credible threat of smallpox attack, and the medical community was at odds over whether the vaccine posed too many risks to be given in light of the questionable chance of becoming infected. The debate surrounding the president's new plan, the threat of attack, and the threat from the vaccine were covered extensively in the media and contributed to the perception that there was a significant threat.[99]

If the threat of a smallpox attack is indeed exaggerated, why did President Bush launch the National Smallpox Vaccination Campaign? Does the fact that it was allowed to stall out after completing only the military (not the civilian) portion of the campaign give any indication of the level of threat on the part of the government?[100] The presidential attention to this issue and the surrounding media coverage inflated the perception that the threat from smallpox attack was credible, without providing additional information on the actual plausibility or likelihood of an attack.[101]

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[98] Judith Miller and Eric Schmitt, "Pentagon Plans Smallpox Shots for Up To 500,000," *New york times*, October 12, 2002; Richard Perez-Pena, "Voting for Bush, Voting to Get a Smallpox Shot," *New york times*, May 18, 2003; William Broad, "Bush Signals He Thinks Possibility of Smallpox Attack is Rising," *New york times*, December 14, 2002.

[99] Carol Morello, "Inoculating Health Care Workers for Smallpox; Experts Split on Need for Terror Precaution," *Washington Post*, February 18, 2003; Lawrence K. Altman, "The Bioterror Threat; Panel Rejects Immunizing All Against Smallpox Outbreak," *New york times*, June 21, 2002; Ceci Connolly, "Bush Plan for Smallpox Vaccine Raises Medical, Fiscal Worries; Public Availability Criticized as Risk to Health, Spending," *Washington Post*, December 15, 2002; Kate Stone Lombardi, "Vaccine Program Raises Questions," *New york times*, February 9, 2003. Ceci Connolly, "Focus on Smallpox Threat Revived; Experts Say Immunization Program is Crucial to Homeland Security," *Washington Post*, July 17, 2003; Denise Grady, "Scientists Favoring Cautious Approach to Smallpox Shots," *New york times*, December 20, 2002; David Brown, "Panel Alters Advice on Smallpox Shots; Wider Use for Health Workers Backed," *Washington Post*, October 17, 2002. Donald McNeil, Jr., "Mixed Reaction to Inoculations but Doubts Raised," *New york times*, December 15, 2002; Lawrence Altman, "Panel Debates Revising U.S. Policy on Smallpox Shots," *New york times*, June 20, 2002.

[100] U.S. General Accounting Office, *Smallpox Vaccination: Implementation of National Program Faces Challenges*, GAO-03-578 (Washington, D.C.: GPO, April 2003); U.S. General Accounting Office, *Smallpox Vaccination: Implementation of National Program Faces Challenges. Recommendations for Executive Action*, GAO-03-578 (Washington, D.C.: GPO, April 2003) GAO http://www.gao.gov/products/GAO-03-578#recommendations (accessed May 17, 2011); Henderson, *Smallpox: The Death of a Disease*, 297.

[101] William Broad, "Threats and Responses: The Bioterror Threat; Bush Signals He Thinks Possibility of Smallpox Attack is Rising," *New york times*, December 14, 2002.

2. Public Opinion and Vaccination

Smallpox as a bioweapon continues to be a concern of many. A poll conducted in 1999 indicated that a majority of Americans believed the United States would be attacked biologically or chemically within the next fifty years.[102] Two years later, Americans were presented with two highly visible examples that terrorism was a threat: the World Trade Center attacks and the following week's anthrax mailings. In the months following these terrorist attacks, a significant number of volunteers contacted medical facilities and research centers across the country requesting to participate in trials of smallpox vaccines, in some cases even before the requests for volunteers had been published.[103] However, as time passed, the public's general feelings toward the need for preparation changed.

In a May 2002 telephone poll, fifty-nine percent of those surveyed reported that they would be vaccinated as a precautionary measure against a terrorist smallpox attack.[104] By 2003, the public opinion polls indicated that Americans were losing confidence in the government's ability to protect them against terrorist attacks.[105] It would seem, then, that the National Smallpox Vaccination Program would be hailed as a welcome addition to the bioterrorism-protection arsenal and that there would be a positive response to the availability of previously unavailable protective measures, but this was not the case.

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[102] The Pew Research Center for the People and the Press, "Optimism Reigns, Technology Plays Key Role." http://people-press.org/report/51/optimism-reigns-technology-plays-key-role (accessed May 18, 2011).

[103] Amy Argetsinger, "Smallpox Vaccine Studies Swamped with Volunteers," *Washington Post*, October 27, 2001; New York Times, "A Nation Challenged: The Vaccine; Volunteers Line Up to Test Smallpox Protection," *New York Times*, November 3, 2001.

[104] Blendon, et al., "Survey Project on Americans' Response to Biological Terrorism: Study 3: Public Attitudes About the Threat of a Smallpox Attack" (Harvard School of Public Health, June 5, 2002). http://www.hsph.harvard.edu/research/horp/ project-on-the-public-and-biosecurity/ (accessed May 17, 2011).

[105] Yaeli Bloch-Elkon, "The Polls—Trends: Preventing Terrorism After the 9/11 Attacks," *Public Opinion Quarterly* 71, no. 1 (Spring 2007): 142–163.

Some believed that this vaccine, hailed as a necessary protective measure, was not necessary at all.[106] One commonly cited claim is that the nature of the virus itself makes it unsuitable for use as a biological weapon. Just to handle the virus, sophisticated laboratory equipment, top security facilities, and highly specific knowledge of microbiology and virology are required. To turn it into a weapon requires even greater skill and funding than terrorists are likely to possess.[107] Given the small probability of terrorists being able to accomplish an attack with smallpox, many claim that there is little reason to be vaccinated. Yet these claims are made without sufficient studies conducted to determine whether this threat perception is valid.

Others believe that there may be a threat, but that the United States is adequately prepared to respond to it. They maintain that the public health infrastructure and emergency response preparedness plans, combined with the efficacy of vaccination after an attack, are sufficient to protect the population.[108] The fact that the smallpox vaccine can be effectively given up to three or four days after exposure, they claim, makes it most reasonable to wait to receive the vaccine until there is proof of a threat.[109] To these people, the question of threat is less of a concern, but more accurate information surrounding the likelihood of an attack would be beneficial to informing their preparedness measures.

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[106] Lawrence K. Altman, "The Bioterror Threat; Panel Rejects Immunizing All Against Smallpox Outbreak," *New york times*, June 21, 2002; Ceci Connolly, "Bush Plan for Smallpox Vaccine Raises Medical, Fiscal Worries; Public Availability Criticized as Risk to Health, Spending," *Washington Post*, December 15, 2002; Kate Stone Lombardi, "Vaccine Program Raises Questions," *New york times*, February 9, 2003; Denise Grady, "Scientists Favoring Cautious Approach to Smallpox Shots," *New york times*, December 20, 2002; Donald McNeil, Jr., "Mixed Reaction to Inoculations but Doubts Raised," *New york times*, December 15, 2002; Lawrence Altman, "Panel Debates Revising U.S. Policy on Smallpox Shots," *New york times*, June 20, 2002; Carol Morello, "Inoculating Health Care Workers for Smallpox; Experts Split on Need for Terror Precaution," *Washington Post*, February 18, 2003.

[107] U.S. Library of Congress, CRS, *Smallpox: Technical Background on the Disease and its Potential Role in Terrorism*, by Frank Gottron, CRS Report RS21288 (Washington, D.C.: Office of Congressional Information and Publishing, January 10, 2003).

[108] Scardaville, "Public Health and National Security Planning," 1; Weiss, Weiss, Mathisen, and Guze, "Confronting Biological Weapons," 1668–1673.

[109] Christian Davenport, "Smallpox Strategies Shifting," *Washington Post*, May 12, 2003; Henderson, "The Looming Threat of Bioterrorism," 1281; Henderson and Borio, "Smallpox and Monkeypox," 631; Sidell et al., *Jane's Chem-Bio Handbook*, 239; Puskoor and Zubay, "Smallpox," 245.

Opponents to this view claim that America is dangerously ill-prepared to face a bioterrorist attack.[110] They believe the risks of the vaccine are acceptable when weighed against the risks of an unprotected population. In light of the possibility that terrorist actors possess smallpox virus and America's low immunity to it, they believe it is only a matter of time before an attacker takes advantage of this critical vulnerability; therefore, a sensible step toward protection is pre-attack vaccination. A better understanding of the actual threat would inform this debate and would help guide the needed protections.

This debate among novices and experts alike was played out in the media at the time of the vaccination campaign, and continues to reappear periodically.[111] These debates have become the basis for most of the current opinions that an attack is possible. In response to the widespread vaccination debate, the Johns Hopkins School of Public Health undertook a study in 2004 that addressed the question of who should be vaccinated and when this should occur, concluding that proposed vaccination models were insufficient and proposing a new hybrid vaccination strategy.[112]

The persistence of the debate over re-commencing vaccination in the United States has muddled the issues of threat plausibility and preparedness. It is partly responsible for assumptions that there is a credible threat of smallpox attack but does not examine the factors that influence whether this is actually the case.

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[110] Stephen Flynn, *America the Vulnerable: How Our Government is Failing to Protect Us from Terrorism* (New York: HarperCollins, 2004); Gary Hart, Warren Rudman, and Stephen Flynn, *America—Still Unprepared, Still in Danger*: *Report of an Independent Task Force Sponsored by the Council on Foreign Relations* (Council on Foreign Relations Press, 2002); Sheryl Gay Stolberg, "A Nation Challenged: The Biological Threat; Some Experts Say U.S. is Vulnerable to a Germ Attack," *New York Times*, September 30, 2001.

[111] Centers for Disease Control and Prevention Division of Bioterrorism Preparedness and Response, "What We Learn About Smallpox from Movies: Fact of Fiction," http://www.bt.cdc.gov/agent/smallpox/disease/movies.asp (accessed February 17, 2012).

[112] Joshua Epstein et al., *Toward a Containment Strategy for Smallpox Bioterror: An Individual-Based Computational Approach* (Washington, D.C.: Brookings Institution Press, 2004), 1–4.

C. MISPERCEPTIONS AND EXAGGERATIONS IN GOVERNMENT PREPAREDNESS EXERCISES

1. Dark Winter

According to D.A. Henderson, one of the leaders of the Johns Hopkins Center for Civilian Biodefense Studies, the organization sought to convey to government officials the catastrophic potential that an attack using biological weapons would have. The organization believed that:

> Until members of the US Congress and others at the highest levels of government fully understood the potential for disaster and the need to be prepared, they would not commit the necessary resources. We decided that the best way to illustrate this would be to dramatize it.[113]

For this reason, in June 2001, an exercise called Dark Winter was developed in coordination with the Center for Strategic International Studies, the Homeland Security Institute, and the Oklahoma Memorial Institute for the Prevention of Terrorism.[114]

Because "few could imagine the repercussions from a major epidemic of a deadly infectious disease,"[115] the authors of the exercise sought to educate about the need for the government to address the issue of potential biological warfare. They chose to use smallpox in the exercise as a means to demonstrate this. Senators, governors, and other government officials assembled at Andrews Air Force Base to conduct the scenario, in which "the hypothetical epidemic spread to twenty-five states and ten other countries, with 16,000 cases and 1,000 deaths."[116] It immediately became clear that an attack using biological weapons was a serious issue, and smallpox's starring role in the exercise caused immediate concern over whether such an epidemic was possible.[117]

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[113] Henderson, *Smallpox: The Death of a Disease*, 284.

[114] Ibid.

[115] Ibid., 285.

[116] Frist, *When Every Moment Counts*, 167.

[117] Enserink, "How Devastating Would a Smallpox Attack Really Be?" 1592–1593.

In the scenario, the specific terrorist organization responsible was unknown, but the FBI assessed that only a state or state-sponsored terrorist actor was likely to have the resources to have conducted this type of attack.[118] Although it was unconfirmed, the exercise explained the most likely state involved in starting the fictional outbreaks was Iraq and that former-Soviet bioweaponeers were involved.[119]

The exercise did much to cause general concern over whether government was prepared to deal with a major public health crisis, and raised public awareness of the potential for a bioterror attack involving smallpox.[120] Some scientists involved in the smallpox eradication program, however, have claimed that the exercise caused undue alarm because it incorrectly portrayed characteristics of the disease, which heightened the catastrophic results.[121] The dispute centers around the manner in which mathematical models simulate the spread of the disease; the modelers design the scenario based upon a certain transmission speed of the virus and, in the case of smallpox, experts cannot agree on this number.[122]

Those who claim that Dark Winter was unrealistically inflammatory and predicted casualties in excess of numbers that are likely have called the exercise's portrayal of smallpox silly, and Martin Meltzer of the CDC has described the scenario's premise (that a terrorist could spread a smallpox epidemic by first infecting himself and then interacting with people in a public place) as "absolutely preposterous."[123] If these experts are to be believed, this and similar portrayals of smallpox have raised the alarm unnecessarily high and have contributed to excessive fear surrounding the potential for smallpox to be used as a bioweapon.

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[118] Johns Hopkins Center for Civilian Biodefense, "Dark Winter Exercise Script: Final Script," http://www.upmc-biosecurity.org/website/events/2001_darkwinter/dark_winter.pdf (accessed January 27, 2012), 29.

[119] Ibid., 3, 17, 44.

[120] Tara O'Toole, Michael Mair, and Thomas Inglesby, "Shining Light on 'Dark Winter,'" *Clinical Infectious Diseases* 34, no.7 (April 1, 2002): 979–983.

[121] Enserink, "How Devastating Would a Smallpox Attack Really Be?" 1592.

[122] Ibid., 1592–1593.

[123] Ibid., 1593.

2. Atlantic Storm

Another government exercise in which terrorism-by-smallpox played a lead role was organized in Washington in 2005. It was based upon the premise that such an epidemic would be a concern for the international community, and focused on implications of initial smallpox cases in Istanbul, Frankfurt, Rotterdam, Warsaw, Los Angeles, and New York resulting from a terrorist attack.[124]

In the scenario, a "radical al Qaeda splinter group that is small, well-funded, fanatical, and well-educated"[125] is led by a man with a Ph.D. in microbiology who has been assessed as being "fully capable of weaponizing and mass producing the variola virus."[126] The group controls a small laboratory and has been in contact with scientists who formerly worked in the Soviet Union's biological weapons program.[127]

Arms-control expert Milton Leitenberg takes issue with this exercise on two counts: first, a lack of evidence that any terrorist group can even manufacture a working biological weapon, and second, that the scenario's description of how this might occur is implausible.[128] In the scenario, terrorists sprayed smallpox out of back-pack sized aerosol sprayers in public places.[129]

The authors of the exercise point out on its website the disclaimer that:

> While the exercise scenario was based on the events that might follow a bioterrorist attack with smallpox, *Atlantic Storm* was not about smallpox *per se*. Rather, the exercise was designed to highlight the numerous

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[124] Center for Biosecurity of the University of Pittsburgh Medical Center, "Atlantic Storm Exercise Materials: Assumptions; Smallpox Epidemiology," http://www.atlantic-storm.org/materials.html (accessed January 27, 2012).

[125] Center for Biosecurity of the University of Pittsburgh Medical Center, "Atlantic Storm Exercise Materials: Briefings; Intelligence Brief," http://www.atlantic-storm.org/flash/pdf/brief_0910.pdf (accessed January 27, 2012).

[126] Ibid.

[127] Ibid.

[128] Martin Enserink and Jocelyn Kaiser, "Has Biodefense Gove Overboard?" *Science* 307, no. 5714 (March 4, 2005): 1398; Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, 51–59.

[129] Center for Biosecurity of the University of Pittsburgh Medical Center, "Atlantic Storm Exercise Materials: Assumptions; Method of Attack," http://www.atlantic-storm.org/materials.html (accessed January 27, 2012).

> complicated global challenges that would arise in the event of any large-scale epidemic of infectious disease, whether caused by a bioterrorist attack or a naturally occurring outbreak.[130]

Although raising smallpox attack awareness was not a stated goal of the exercise, major world leaders gathering in Washington to discuss the issue did not escape the notice of the media.[131] In addition, the exercise was observed by more than 100 international professionals in the fields of national security, public health, medicine, and government.[132] With this level of attention, the issue of smallpox itself was bound to be noticed, and it is probable that the average media consumer drew conclusions that a bioterror attack using smallpox was both possible and perhaps even probable.

This is a second example in which the realities of smallpox transmission and weaponization may have been exaggerated in order to demonstrate the effect of a biological attack on an unprepared population. Although the authors of the study intentionally modeled the scenario using "a conservative disease transmission rate of 1 to 3"[133] for the initial cases, their assumptions of terrorist capabilities were very generous. Government officials were said to have left with the perception that "[e]normous changes will be needed if the world community is to be prepared to cope with what many feel are inevitable crises engendered by biological weapons attacks."[134] It is likely that, in addition, they left with an artificial sense of the actual threat that posed by terrorists using smallpox.

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[130] Center for Biosecurity of the University of Pittsburgh Medical Center, "Atlantic Storm Interactive," http://www.atlantic-storm.org/flash/index.html (accessed January 27, 2012).

[131] Eighty-seven instances of international reporting on Atlantic Storm (newspaper, internet, journal, and television) are catalogued here: Center for Biosecurity of the University of Pittsburgh Medical Center, "Atlantic Storm In the Press: Media Coverage of Atlantic Storm" http://www.atlantic-storm.org/media_coverage.html (accessed January 27, 2012).

[132] Bradley Smith et al., "After Action Report: Navigating the Storm; Report and Recommendations from the *Atlantic Storm* Exercise," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 3, no. 3 (2005): 257–258.

[133] Smith et al., "After Action Report," 259.

[134] Henderson, *Smallpox: The Death of a Disease*, 299.

D. CONCLUSION

In the following chapters, I will address this issue of actual risk of a smallpox bioterror attack. Examining whether smallpox is realistic for terrorists to use will show that acquisition, production, weaponization, and dissemination of smallpox are challenging and complex procedures. Addressing whether there are terrorists who are likely to prefer smallpox over other weapons will demonstrate that smallpox does not meet many of the criteria that terrorists are likely to value when choosing their means and methods of attack. Reviewing the claims of state and non-state actors regarding biological weapons and outside assessments of their likelihood of possessing smallpox demonstrates that possession of the virus is often uncertain, or is not distinguished separately from other capabilities using other biological agents. Examining whether the current policies, laws, and treaties are likely to act as a deterrent to choosing smallpox as a bioweapon will show that domestic and international legal regimes as they relate to bioterror are insufficient. These factors inform the assessment of actual threat from smallpox attack and will show that the risk is less than many would suppose.

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II. IS SMALLPOX REALISTIC FOR TERRORISTS TO USE?

According to the Congressional Research Service, "most experts feel that the barriers posed by acquisition and successful deployment of smallpox virus are high enough to make such an attack very unlikely. Furthermore, because of these hurdles, most experts feel that a terrorist organization would require a state sponsor in order to successfully obtain and deploy smallpox."[135] Evidence from the Soviet Union supports this conclusion by demonstrating that clandestine weaponization is possible with the benefit of the significant resources that were devoted to its state bioweapons project.[136] The question remains whether terrorist actors today who are not provided with state sponsorship would be able to similarly overcome the barriers to smallpox weaponization.

This chapter addresses the technical details and laboratory requirements associated with smallpox weaponization and dispersal and the possibility that terrorists might be capable of synthetically engineering the virus versus acquiring stored stocks.

A. ACQUIRING SMALLPOX

Obtaining smallpox is not likely to be easy. The WHO-authorized laboratories in Atlanta, Georgia, and Koltsovo, Russia, are the only places on earth where smallpox is known to be stored. These are maximum containment laboratories, guarded against unauthorized entry.[137] Physical security measures, identity badges, and two-person access rules all contribute to the difficulty a terrorist would have in acquiring smallpox from either of the known repositories.[138]

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[135] U.S. Library of Congress, CRS, *Smallpox: Technical Background on the Disease and its Potential Role in Terrorism*, by Frank Gottron, CRS Report RS21288 (Washington, D.C.: Office of Congressional Information and Publishing, January 10, 2003), 5.

[136] House Committee on International Relations, *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapons*, 8; Richard A. Falkenrath, Robert D. Newman, and Bradley A. Thayer, *America's Achilles' Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack* (Cambridge, MA: MIT Press, 1998), 45, 203.

[137] Kathleen Vogel, "Pathogen Proliferation: Threats from the Former Soviet Bioweapons Complex," *Politics and the Life Sciences* 19, no. 1 (March 2000), 6.

[138] Vogel, "Pathogen Proliferations," 6–8.

Some scientists have claimed, however, that those two laboratories are not likely to be the only places still holding stocks of smallpox.[139] Scientists Alan Zelicoff and Michael Bellomo explain their assessment that the presence of smallpox is more widespread:

> If not by intent, then smallpox is likely to be in several countries by accident, kept in freezers in hundreds of places around the world. During the WHO global smallpox eradication program, medical professionals from many different countries both vaccinated and treated thousands of people for smallpox. And it is a fact that biologists and physicians tend to keep samples of everything, out of habit if nothing else. When these folks die, they don't exactly leave a will and testament that says, 'Please destroy my smallpox samples.' A medical center may go for years before getting around to cleaning out samples collected by long-dead physicians and tucked away in a basement freezer. Therefore, it's quite probable that there are collections, compiled intentionally or otherwise, of smallpox in places outside of the two official repositories in the United States and Russia.[140]

Even if smallpox is stored in a long-forgotten freezer, terrorists are unlikely to be aware of its existence and location. The problem of acquisition of the smallpox virus would necessarily prevent many terrorists from doing more than considering its use.

B. SYNTHETIC ENGINEERING OF THE SMALLPOX VIRUS

1. Is it Possible?

Based upon the scientific research that has been carried out and publicized since its eradication, it is plausible that the smallpox virus can be genetically engineered. In order to genetically engineer a virus, one first has to determine the make-up of its DNA (called sequencing the genome), and then to assemble the pieces, called nucleotides, in the correct order. In 1994, the first step of this process was completed for one particular strain of smallpox.[141] By 2001, the sequencing of the genome of several strains of

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[139] Zelicoff and Bellomo, *Microbe,* 114.

[140] Ibid.

[141] Jonathan Tucker, "Breaking the Deadlock Over Destruction of the Smallpox Virus Stocks," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 9, no. 1 (2011): 56.

Variola major had been completed.[142] Although using this information to recreate the virus by synthesizing its DNA would be "time consuming and highly technical,"[143] it is nonetheless simple to find, through a simple Internet search, where complete nucleotide sequences of *Variola major* have been made available for download.[144]

Richard Preston, a journalist and best-selling author, researched smallpox for his book *The Demon in the Freezer* and came to the conclusion that these issues are not just science-fiction. Regarding synthetic engineering of the virus, he summarizes:

> The DNA of smallpox has been decoded. The genetic sequence of the virus is known; the smallpox genome is in the public domain. You can look it up on the Internet. Even if all the stocks were destroyed, we—the human species—would still possess the recipe for making it. It might be possible some day to re-create smallpox in a laboratory, although this would not be easy. It would require, at the very least, fast gene-synthesis machines—machines that could string together thousands of letters of DNA into genes rapidly and accurately.[145]

D.A. Henderson agrees that, "the virus itself eventually might be synthesized."[146] Jonathan Tucker concurs that as "DNA synthesis technology continues to progress at a rapid pace, it will soon become possible for cutting-edge scientists to re-create any virus whose genetic sequence has been determined, including the smallpox virus."[147] It is clear that scientific advances are changing the nature of the threat.

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[142] Bernard Moss, "Poxviridae: The Viruses and the Replication," in *Fields Virology*, 5th ed., ed. David Knipe and Peter Howley (Philidelphia, PA: Lippincott, Williams, and Wilkins, 2007), 2907.

[143] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148.

[144] Two examples of such websites, one made available by the Poxvirus Bioinformatics Resource Center (http://www.poxvirus.org/sequence.asp) and one by the National Center for Biotechnology, (http://www.ncbi.nlm.nih.gov/sites/entrez?Db=Nucleotide&Cmd=Search&Term=txid10240[Organism%3Aexp]+AND+100000+%3A+1000000[SLEN]AND%20%22Variola%20virus%22[porgn:__txid10255]) list the genomic nucleotide sequencing of 50 strains of *Variola*. All information is freely available for download, without log-in or affiliation. (Accessed January 29, 2012).

[145] Richard Preston, forward to *Smallpox: The Death of a Disease: The Inside Story of Eradicating a Worldwide Killer*, by D.A. Henderson, (New York: Prometheus Books, 2009), 17.

[146] Henderson, *Smallpox: The Death of a Disease*, 263.

[147] Jonathan B. Tucker, "The Smallpox Destruction Debate: Could a Grand Bargain Settle the Issue?" *Arms Control Today* (March 2009): 11.

Because the process of synthesizing smallpox virus DNA is thought to be technologically feasible,[148] the problem of initially acquiring the smallpox virus could be significantly altered from the terrorist point of view: instead of relying on finding or stealing historically stored samples, they might have the option to create the smallpox virus synthetically.

2. Is it Realistic to Think that Terrorists are Capable of This?

One scientist from the Massachusetts Institute of Technology's Biomedical Engineering department has studied the challenges terrorists would likely face when attempting to synthesize smallpox. He has assessed that, while the project is scientifically feasible, staffing might be problematic:

> The procedures involved in viral synthesis require a professional knowledge of biology and a confirmed proficiency in biotechnology. Competent assistants could do much day-to-day work, but something like a smallpox-from-scratch project would require considerable innovation, not just at its inception but repeatedly, long-term. Recruiting and retaining a capable director and a clever, committed, and behaviorally stable staff is hard enough in normal science; it must be even harder in apocalyptic terrorism.[149]

Legitimate scientific research, unrelated to smallpox, has left other scientists wondering how close modern science is to engineering the smallpox virus. Two studies show that scientific advances can have impact on making bioweapons and on engineering smallpox, even when that was not the intent of the research. In the first study, scientists at the Cooperative Research Center for Biological Control of Pest Animals in Australia inadvertently altered the mousepox virus, which is very similar to smallpox, in such a way that the virulence and lethality of mousepox in mice was significantly raised because of the way the immune system was suppressed.[150] If the same gene were to be added to

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[148] Tucker, "The Smallpox Destruction Debate," 6–15.

[149] Aleksander Rabodzey, "Biosecurity Implications of the Synthesis of Pathogenic Viruses," *Politics and the Life Sciences* 22, no. 2 (September 2003): 47.

[150] Michael Selgelid, "A Tale of Two Studies: Ethics, Bioterrorism, and the Censorship of Science," *Hastings Center Report* 37 no. 3 (May-June 2007), 35; M. Gregg Bloche, "Rogue Science," *Georgetown Law Journal* 91, no. 6 (August 2003): 1263; Puskoor and Zubay, "Smallpox," 247.

the smallpox virus, it is assumed that a similar strengthening of the virus' ability to defeat current vaccines could occur, causing an exceptionally lethal version of the smallpox virus.[151]

The second study, involving polio, proved that scientists could use information about the disease's DNA from the Internet to map out how to piece together strands of DNA that are available to be purchased from legitimate scientific institutions. Scientists have noted the implication this has for nefarious scientists interested in genome sequencing, stating "the concern here is that similar techniques might be used to produce other dangerous pathogens such as smallpox."[152] Although such a concern is valid, it is important to note that *Variola* is a much larger and more complex virus than the poliomyelitis virus.[153] Because the *Variola* virus is twenty-six times larger, assembling the virus would be "an exceedingly slow process" that would likely takes months or years to complete.[154]

In spite of these seeming scientific advances, some reputable scientists remain unconvinced. A professor of immunology at University of California at Los Angeles believes that these claims are exaggerated: "It is almost inconceivable that any terrorist organization we know of [could develop] a bioweapon capable of causing mass casualties on American soil."[155]

There is no reason to assume that well-equipped terrorists are inherently less capable than well-equipped scientists. Once it is scientifically possible, anyone with the right knowledge and equipment would be capable of synthesizing the *Variola* virus. One scientist has assessed the cost of additional equipment (beyond standard laboratory supplies) that would be required in order to synthesize a virus. He calculated that buying

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[151] Selgelid, "A Tale of Two Studies," 35; Bloche, "Rogue Science," 1263; Puskoor and Zubay, "Smallpox," 247; Epstein et al., *Toward a Containment Strategy for Smallpox Bioterror*, 38–39.

[152] Selgelid, "A Tale of Two Studies," 35.

[153] Rabodzey, "Biosecurity Implications of the Synthesis of Pathogenic Viruses," 45.

[154] Ibid.

[155] Leonard Cole, "Bioterrorism: Still a Threat to the United States," *Combating Terrorism Center Sentinel* 5, no. 1 (January 2012): 11.

the required nucleotide sequences for *Variola* through the mail would cost $50,000.[156] The equipment required to assemble the pieces (a DNA synthesizer, a DNA sequencer, a thermocycler, centrifuges, hoods, and sterilization equipment) would cost an additional four- to five-hundred thousand dollars.[157] This amount of money would not be prohibitive to all terrorist organizations; for example, Aum Shinrikyo managed to raise between $300 million and $1.4 billion in assets for its terrorism projects.[158]

The case of Aum Shinrikyo also demonstrates that funding is not the sole hurdle that must be overcome in chemical or biological attack. As with smallpox, there are other barriers to weaponization that must be addressed by scientists with biotechnical backgrounds. Following the proper procedures and precautions to grow smallpox safely and correctly while remaining undetected is one challenge that the terrorists would likely find difficult to resolve. They must also choose a means of weaponization, and either resort to using infected suicide volunteers, or perfect the required procedures to disseminate smallpox in a liquid or dry form. All three dissemination methods present barriers to success due to either the low chance of transmission, large amount of technological accessories required, or danger to weaponizers during the process.

Although the Soviet Union was able to overcome these difficulties, its weaponization program was funded by the state, provided with multiple well-equipped laboratories designed for bioweapons research, supplemented with a high-tech missile inventory to aid in dissemination, and staffed with credibly trained scientists. It is probable that these benefits would not be available to individual bioterrorists; this makes it less likely that one could successfully weaponize smallpox. Additionally, the Soviet

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[156] Aleksander Rabodzey, "Biosecurity Implications of the Synthesis of Pathogenic Viruses," *Politics and the Life Sciences* 22, no. 2 (September 2003): 46.

[157] Ibid., 47.

[158] Jessica Stern, "Terrorist Motivations and Unconventional Weapons," in *Planning the Unthinkable: How Powers Will Use Nuclear, Biological, and Chemical Weapons* , ed. Peter Lavoy, Scott Sagan, and James Wirtz (Ithaca, NY: Cornell University Press, 2000), 206; S. Paul Kapur, "Deterring Nuclear Terrorists," in *Complex Deterrence: Strategy in the Global Age*, ed. T.V. Paul, Patrick Morgan, and James Wirtz (Chicago, IL: University of Chicago Press, 2009), 121.

government devoted resources to protecting the secrecy of its program. A non-state program trying to hide its activities would be more susceptible to discovery, which could act as an additional deterrent.

C. WEAPONIZING SMALLPOX

There are several factors that would influence whether or not terrorists would choose to weaponize smallpox as a bioterror weapon above their other options. The prediction that a "clandestine aerosol release of smallpox, even if it infected only 50 to 100 persons to produce the first generation of cases, would rapidly spread in a now highly susceptible population, expanding by a factor of 10 to 20 times or more with each generation of cases"[159] might seem to heighten the appeal of smallpox as a way of meeting terrorist goals. There are, however, challenges that a terrorist must overcome in order to make this feasible. Studies of the Soviet biological weaponization program have shown that:

> Key steps involved in obtaining a potent BW capability causing large-scale deaths include: (1) acquiring virulent strains; (2) growing biological agents; (3) formulating the biological agents for weaponization; (4) developing a means of delivery; and (5) effectively disseminating the agent. Achieving all of these steps is difficult. A study of state-sponsored offensive programs indicates that production of potent and effective biological weapons has involved a significant investment of expertise, infrastructure, and resources.[160]

Difficulties that might prevent terrorists from successful weaponization include the facts that the virus is likely to be difficult to obtain, that smallpox is challenging to work with safely during the weaponization process, and that dispersal of the virus does not necessarily guarantee infection.[161] On the other hand, an attack using smallpox is likely to go undiscovered for days until people begin showing symptoms: this would give

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[159] Henderson et al., "Smallpox as a Biological Weapon," 2132.

[160] Vogel and Ouagrham, "Conversion at Stepnogorsk," 1.

[161] Falkenrath, Newman, and Thayer, *America's Achilles' Heel*, 94–95; Tara O'Toole, "Smallpox: An Attack Scenario," *Emerging Infectious Diseases* 5, no. 4 (July-August 1999): 540.

the terrorist time to conduct multiple attacks or to escape the affected area.[162] These criteria may or may not make smallpox an appealing weapon, depending on terrorist goals and intent. Regardless of its appeal, however, an actor who decides to pursue the use of smallpox as a weapon must first ensure that a sufficient quantity of the virus is in a state that is stable and capable of being spread.

1. Laboratory and Scientific Requirements

In order to work with *Variola*, a potential bioterrorist would need an equipped laboratory, adequate biohazard containment and decontamination measures, and a means to protect himself from infection (preferably vaccination). He would also need to ensure that suspicious biohazard waste or unusually thorough decontamination precautions did not cause inquiry into his laboratory activities.[163]

A potential bioterrorist would either have to conduct smallpox weaponization procedures secretly in an equipped laboratory to which he already possessed access, or would have to build and equip a new laboratory specifically for this purpose. It is not outside the realm of possibility to set up one's own laboratory environment. By taking advantage of the dual-use nature of scientific equipment, Soviet scientists were able to build a functioning microbiology lab "from scratch"[164] that was first used to weaponize *Brucella* bacteria.[165] They did this near Moscow in four months in the 1970s with laboratory equipment bought from Japan, Czechoslovakia, France, Great Britain, and the United States.[166]

The equipment required to build a scientific laboratory to be used for bioweapons is commercially available; however, the Soviet project was conducted many years ago.

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[162] Robert Kupperman and David Siegrist, "Strategic Firepower in the Hands of Many?" in *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, ed. Potomac Institute for Policy Studies (Arlington, VA: Oceana, 1999), 48.

[163] Peter Hinkle, "The Case for a Special Operations Response to Biological Terrorism" in *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, ed. Potomac Institute for Policy Studies (Arlington, VA: Oceana, 1999), 42.

[164] Alibek and Handelman, *Biohazard*, 60.

[165] Ibid.

[166] Ibid.

In order to determine whether a similar project could succeed in today's environment of heightened awareness, in 1998 and 1999 the Defense Threat Reduction Agency (DTRA) set out to build a "factory capable of making germ weapons with commercially available materials."[167] The goal was to determine whether this could be done without signaling to intelligence agencies that equipment that could be used for biological warfare was being purchased in the U.S. and overseas.[168] With a $1.6 million budget and several months, the team was able to outfit a laboratory that produced simulated anthrax (harmless bacteria and biopesticides); their purchases went undetected.[169]

After laboratory equipment is acquired, safety concerns must be addressed. Both of the WHO-authorized laboratory facilities that store smallpox virus are rated at Biosafety Level Four (BSL-4), which is considered a maximum containment facility. According to the CDC, BSL-4 laboratories are used for "agents that pose a high risk of life-threatening disease, which may be transmitted by the aerosol route and for which there is no vaccine or therapy."[170] Some of the safety measures present in BSL-4 laboratories that prudent bioterrorists would be concerned with replicating in their own smallpox laboratory include: a negative-pressure controlled air system with high-efficiency particulate air (HEPA) filtration, Class III biological safety cabinets[171] or protective suits with self-contained breathing apparatus, an autoclave for decontamination, and an emergency power supply.[172] Guidelines for constructing a BSL-4 laboratory are available on the Internet; although these are designed with the

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[167] Judith Miller, Stephen Engelberg, and William Broad, *Germs: Biological Weapons and America's Secret War* (New York: Simon & Schuster, 2001), 297.

[168] Ibid., 296–299.

[169] Ibid., 297–298.

[170] Centers for Disease Control and Prevention, Special Pathogens Branch, "Glossary of Terms," http://www.cdc.gov/ncidod/dvrd/spb/mnpages/glossary.htm (accessed February 11, 2012).

[171] Class III Microbiological Safety Cabinet: "A safety cabinet by which the operator is separated from the work by a barrier, e.g., by gloves mechanically attached to the cabinet, and from which escape of any airborne particulate contamination is prevented by an exhaust filtration system." Definition from: *Bioaerosols Handbook*, ed. Christopher Cox and Christopher Wathes (New York, NY: Lewis Publishers, 1995), 476.

[172] World Health Organization, *Laboratory Biosafety Manual*, 3rd ed., (Geneva: World Health Organization, 2004) http://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf (accessed February 11, 2012), 25–27, 56–57.

safety and eventual certification of legitimate research facilities in mind, there is nothing preventing a bioterrorist from using this information to design a laboratory that is safe for handling smallpox virus.

Assuming one has the proper equipment and safety measures in place, the next step toward weaponization is to turn a small sample of virus into an amount great enough to be used as an effective weapon. In nontechnical media reporting, the weaponization process is sometimes erroneously generalized as though all biological agents are grown in the same way;[173] in these cases, the process that is usually described is that for bacteria. The weaponization process for bacteria requires less scientific know-how and can be completed in fermenters of the kind that would be found in a brewery.[174] Viruses, on the other hand, are more complicated to work with and "need to be grown in eggs or commercially available bio-reactors rather than the relatively more easy fermenting process needed for bacteria."[175] Referring to techniques used for weaponizing bacteria when discussing viruses further confuses the issue of accurate threat assessment.

In order to grow viruses in a laboratory, tissue cultures are needed. As compared to the easier task of growing bacteria, "handling the virus necessitates a more specialized knowledge of laboratory procedures, and the developer puts himself at risk if extreme safety precautions are not taken. Hence, Ebola and other viruses that cause lethal hemorrhagic diseases are agents less likely to be used by terrorists."[176] The fact that growing and handling viruses is more difficult may not be sufficient to deter all actors.

In the case of smallpox, the "virus grows well on many tissue cultures and on the chorioallantoic membrane of embryonated chicken eggs."[177] Although this sounds quite technical, it was accomplished in the Soviet Union with 1940s technology: at Zagorsk in

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[173] Milton Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, (Carlisle, PA: Strategic Studies Institute of the Army War College, 2005), 55.

[174] Kupperman and Siegrist, "Strategic Firepower in the Hands of Many?" 48; Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, 55.

[175] Kupperman and Siegrist, "Strategic Firepower in the Hands of Many?" 48.

[176] Richard Crowell, "Likely Threat Pathogens in Biological Terrorism," in *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, ed. Potomac Institute for Policy Studies (Arlington, VA: Oceana, 1999), 127.

[177] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148.

1947 smallpox was grown in chicken egg embryos and relatively low-tech equipment.[178] All that was required (aside from the virus itself and knowledge of the procedure) was a small syringe, wax to seal the hole that would be made in the egg shell, a thermostatic oven or incubator to warm the egg while the virus multiplied, vats, stabilizing materials, and a refrigerator.[179] After three or four days of incubation, the virus could be harvested from the egg membrane, "yielding a liquid suspension so enriched in variola virus that it usually did not require further concentration."[180]

Once a sufficient amount of the virus is on hand, the next step is to prepare it for weaponization. Although many suppose that the details of weaponization are freely available, some have pointed out that:

> Far from the popular concept that "anyone" can develop BW agents in their bathtub, the art of developing BW agents and the munitions to deliver them is a carefully guarded secret. Even decades after the U.S. offensive BW program ended, little is published about how these weapons were developed or employed out of fear that other nations might pick up some tips.[181]

Former Soviet scientists, too, have demonstrated reluctance to discuss the intricate details of weaponization in interviews or publically available materials.[182]

2. Characteristics of the Virus that Make It Suitable for Weaponization

The smallpox virus is not simply cited as a potential weapon of bioterror because of its history as a terrible disease. There are characteristics of the virus that make it more suitable than other viruses to be successfully weaponized and dispersed. When one is choosing a biological weapon, considerations of whether the agent can survive dissemination are paramount. Sunlight, heat, and weather conditions are some of the environmental factors that the agent must be able to withstand. Additionally, the

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[178] Alibek and Handelman, *Biohazard*, 111.

[179] Alibek and Handelman, *Biohazard*, 111; Tucker, *Scourge*, 141.

[180] Tucker, *Scourge*, 141.

[181] Mauroni, *Chemical and Biological Warfare*, 163.

[182] Tucker, "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek," 3.

infectivity of the agent chosen must match the means of dispersal; in the case of smallpox, because the virus is transmitted through inhalation, aerosol delivery is most suitable. In general, it has been assessed that "aerosol release of Variola virus would disseminate widely, given the considerable stability of the orthopoxviruses in aerosol form and the likelihood that the infectious dose is very small."[183] From a terrorist point of view, these are precisely the characteristics that would make an agent favorable.

Studies from 1961, 1974, and 1988 determined that "Variola virus is fairly hardy in the environment if protected from heat and ultraviolet light."[184] If too much heat could render the virus inert, it would not make a successful bioweapon; however, there are laboratory procedures that can be conducted, called lyophilization, that improve tolerance to heat. Scientists expect that these drying techniques could be used with smallpox based upon their knowledge of vaccinia: "Vaccinia virus, a close cousin of variola, is routinely grown in many laboratories, and can be lyophilized to ensure stability to heat. The same techniques could be used with variola."[185]

An additional factor to consider when debating whether smallpox could be weaponized, dispersed, and survive is that it is possible to alter the virus in specific ways to make its survival more likely. Because "the genes of orthopoxviruses are amenable to deletions and additions,"[186] it is possible that different strains could be created with characteristics that are more suitable to surviving these processes. It is likely, though, that only highly-trained scientists would be capable of this type of technical laboratory work.

3. Technological Difficulties and Barriers to Dissemination

Spreading smallpox in such a way that it will remain able to infect those who come into contact with the virus is another hurdle that potential bioweaponeers would have to address. First, the care that was taken in the preceding steps of preparing the

[183] Henderson et al., "Smallpox as a Biological Weapon," 2128.

[184] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148.

[185] Ibid.

[186] Ibid.

smallpox (such as care taken with "the medium chosen for cultivation, length of incubation … temperature, harvesting conditions, and storage"[187]) must have been adequate. Shoddy preparation can lead to dead or degraded virus.[188] Second, the virus must survive dissemination; this can be problematic because "the airborne environment is hostile [to bioaerosols] owing to desiccation, exposure to radiation, oxygen, and pollutants."[189] Third, smallpox is not a natural aerosol; that is:

> It does not travel in the air in nature. The smallpox particle can be found in the skin, in the scabs that fall off a victim, and in most bodily secretions. Patients experience some coughing with smallpox, and a sort of spitting and the clearing of the throat. But when the smallpox falls off the skin or dribbles out of the mouth, there is insufficient energy to create an aerosol. Making an aerosol requires a large amount of energy.[190]

When smallpox is contained in scabs, the particles are too big heavy to float through the air.[191] They usually "fall to the ground within a few meters of [the] object they are released from—the mucous lining of the throat in an individual with smallpox who is coughing, for example."[192] For this reason, in order for smallpox to be disseminated (other than by human to human transmission), it must be either suspended in liquid or dried into a powder. Assuming this has been done, the bioterrorist must then address the means of aerosol dissemination.

Although scenarios often portray this process as a simple spraying of agent from something similar to an agricultural sprayer and resulting in automatic successful infection,[193] others have cautioned that "[a]erosol delivery means is not the 'sure thing' it initially seems. Because these weapons are aerosol plumes, their use is constrained—to a

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[187] Andreas Hensel and Klaus Petzoldt, "Biological and Biochemical Analysis of Bacteria and Viruses," in *Bioaerosols Handbook*, ed. Christopher Cox and Christopher Wathes (New York, NY: Lewis Publishers, 1995), 339.

[188] Ibid.

[189] C.S. Cox, "Stability of Airborne Microbes and Allergens," in *Bioaerosols Handbook*, ed. Christopher Cox and Christopher Wathes (New York, NY: Lewis Publishers, 1995), 77.

[190] Zelicoff and Bellomo, *Microbe*, 108.

[191] Ibid., 108–109.

[192] Ibid.

[193] Kupperman and Siegrist, "Strategic Firepower in the Hands of Many?" 48.

degree often not appreciated by initial analysis—by numerous local topographical and meteorological conditions."[194] In an outdoor release, excessive sun, heat, wind, humidity, or rain could decrease the chances for widespread infection by killing the virus or simply causing the particles to fall out of the air.[195] It has been hypothesized that smallpox virus would survive for less than twenty-four hours if it were delivered through the air. [196] These meteorological constraints would not be difficult to attempt to mitigate, assuming a terrorist was knowledgeable of these factors and that he had an unconstrained timeline for smallpox dispersal that would allow him to wait for ideal environmental conditions.

In spite of these constraints, the characteristics of the virus (such as ideal particle size for airborne particle suspension) are known, and information surrounding dissemination techniques is available. While it is true that the scale and technological development of the Soviet program might be difficult to replicate, such a large-scale program might not be required for a terrorist actor seeking to perpetuate one or several small attacks. It is likely that the general techniques involved in small-scale aerosol delivery are sufficiently available to warrant consideration that knowledgeable terrorists could apply this information to smallpox and attempt this method. For example, it is no secret that scientists have concluded that:

> The key to weaponizing a BW agent is getting the BW agent to cluster in particles of the right size: particles of one to five microns. Less than one micron and the agent does not stay in a person's lungs. More than five microns and it drops to the ground and threatens no one.[197]

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[194] John Bosma, "Bio-Terrorist Attack Pathways and Social/Civil Infrastructure," in *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, ed. Potomac Institute for Policy Studies (Arlington, VA: Oceana, 1999),66; Sidell et al., *Jane's Chem-Bio Handbook*, 165–166.

[195] Hensel and Petzoldt, "Biological and Biochemical Analysis of Bacteria and Viruses," 338.

[196] Centers for Disease Control and Prevention Division of Bioterrorism Preparedness and Response, "Guide F: Environmental Control of Smallpox Virus," *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/files/guide-f.pdf (accessed February 11, 2012).

[197] Mauroni, *Chemical and Biological Warfare*, 162.

Others have observed that any particle size between two and eight microns can behave as an aerosol.[198]

Smallpox does not naturally lend itself to aerosolization because the virus particles tend to be too heavy to travel far beyond the infected; however there are two cases in which smallpox aerosolization is the suspected mode of transmission.[199] Smallpox was transmitted via airborne virus that travelled "a considerable distance" in both a German hospital in 1970 and off the coast of Vozrozhdeniye Island in 1971.[200] These cases, though controversial at the time, "proved that it could be aerosolized."[201] A knowledgeable scientist trained in microbiology would be familiar with the techniques used to disperse particles and to measure their size, thereby being able to assess whether such particles would travel through the air. This knowledge could, in theory, be applied to smallpox.

A terrorist hoping to use some type of aerosol delivery method would most likely need to test this equipment. This has the potential to cause suspicion or capture, which might make a terrorist less likely to prefer aerosol methods; however, it has been shown that a test could be conducted with a less infectious agent, as the goal would be to test the delivery device rather than the success of resulting infections.[202] This decreases the chance that testing the delivery device would lead to discovery of the plot due to the emergence of smallpox resulting from test.

Constraints other than environmental conditions and testing options will arise depending on which method of smallpox dissemination is chosen. It has been published that smallpox could potentially be dispersed in three ways: (1) by infecting an individual

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[198] Zelicoff and Bellomo, *Microbe*, 250.

[199] Ibid., 109.

[200] P.F. Wehrle, J. Posch, K.H. Richter, and D.A. Henderson, "An Airborne Outbreak of Smallpox in a German Hospital and its Significance with Respect to Other Recent Outbreaks in Europe," *Bulletin of the World Health Organization* 43 (1970), 669.

[201] Zelicoff and Bellomo, *Microbe*, 113.

[202] Hinkle, "The Case for a Special Operations Response to Biological Terrorism," 42.

and then engineering his close contact with his targets for infection;[203] (2) by spreading smallpox in a liquid form via bomblets or sprayers;[204] or (3) by spreading dried smallpox particles through the air.[205] There is no consensus on whether all of these methods are likely to be successful, or which is the most likely option for a bioterrorist to choose.

Some believe that "a fear-inducing hoax, or virus sprayed into a building's air circulation system, or the use of nebulizers to infect thousands at a large airport, are all realistic scenarios."[206] It has also been speculated that "[t]errorists could put a solution of smallpox virus into hand-held atomizers, and station volunteers outside of such places as entertainment theme parks, military installations, and critical industries. The virus could be sprayed directly into the faces of persons leaving such facilities, under the guise of marketing a new perfume, etc."[207] In these cases, commercially available products that produce aerosols are said to be suitable. For example, the following products are thought to be sufficient for biological aerosol delivery in general: "truck-mounted sprayers, crop sprayers, 2 gallon garden sprayers, fire extinguishers, [and] cans of underarm deodorant."[208]

Others believe a more complex scenario is preferable, such as one in which a "large aerosol spray from a light airplane, such as a crop duster outfitted to release lyophilized smallpox virus over a public event such as a political rally or sports competition, is technically feasible."[209] Still others claim that a better scenario for transmission would be for a terrorist to infect himself and then spread his disease to

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[203] Henderson et al., "Smallpox as a Biological Weapon," 2129; Enserink, "How Devastating Would a Smallpox Attack Really Be?" 1593; Puskoor and Zubay, "Smallpox," 247.

[204] Tucker, "Biological Weapons in the former Soviet Union: An Interview with Dr. Kenneth Alibek," 3; Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, 57.

[205] Centers for Disease Control and Prevention Division of Bioterrorism Preparedness and Response, "Guide F: Environmental Control of Smallpox Virus," *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/files/guide-f.pdf (accessed February 11, 2012); Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, 56–57.

[206] Lane and Summer, "Smallpox as a Weapon for Bioterrorism,"157; Samuel Bozzette et al., "A Model for a Smallpox Vaccination Policy," *The New England Journal of Medicine* 348, no. 5 (January 30, 2003): 416–425.

[207] Lane and Summer, "Smallpox as a Weapon for Bioterrorism,"158.

[208] Sidell et al., *Jane's Chem-Bio Handbook*, 162–163.

[209] Lane and Summer, "Smallpox as a Weapon for Bioterrorism,"157.

others in a public place. Critics of this method maintain that the "concept of a volunteer suicidal terrorist who walks around a busy mall, or a big city subway, is unrealistic because smallpox renders people so sick that they would be avoided by the general public."[210] It is clear that there are multiple hypotheses for means of dispersal; the capabilities and limitations of each are addressed below.

a. An Infected Terrorist

This dispersal method, more than the others, has been described as suspect due to the incapacitation that the infective terrorist would likely experience due to his own illness and the exceptionally close contact that he would be required to generate in order to spread the virus.[211] The historic record of smallpox transmission does not support scenarios such as a terrorist spreading disease by walking through a shopping mall; in the past, "large outbreaks in schools, for example, were uncommon."[212] Nonetheless, this method is still referred to as being a credible method of starting an outbreak: "Variola virus could hypothetically be used as a weapon … through intentionally infecting one or more persons and encouraging them to circulate among groups of people, thereby exposing these contacts to variola virus infection."[213]

b. Liquid Smallpox in Bomblets or Sprayers

A more plausible, although still difficult, method of dispersing smallpox would be to use the virus in its liquid form and disperse it from an explosive device or sprayer that would create a cloud of virus particles suspended in air. Because the virus establishes itself in human hosts through inhalation, "spray or aerosol may be the likely

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[210] Ibid.

[211] Henderson et al., "Smallpox as a Biological Weapon," 2129; Enserink, "How Devastating Would a Smallpox Attack Really Be?" 1593; Zelicoff and Bellomo, *Microbe*, 105.

[212] Henderson et al., "Smallpox as a Biological Weapon," 2129.

[213] Centers for Disease Control and Prevention Division of Bioterrorism Preparedness and Response, "Guide F: Environmental Control of Smallpox Virus," *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/files/guide-f.pdf (accessed February 11, 2012).

method of introduction."[214] These methods are not fool-proof; although liquid containing smallpox could be sprayed, devices such as garden sprayers "are not efficient in generating a small-particle, highly infectious (toxic) aerosol."[215] Spreading smallpox through a bomb can also provide uncertain results, as the explosion and its heat can harm the virus.[216]

By 1947, the Soviet Union had decided to pursue this dispersal method at its Center of Virology in Zagorsk.[217] They based this choice upon the characteristics of the disease: "it was highly infectious through the air, was rugged enough to survive explosive delivery, and caused a debilitating and demoralizing disease with high mortality."[218] The Soviet scientists always pursued weaponization of smallpox in its liquid form (as opposed to drying the virus into a powder); this was unusual compared to the means they used to weaponize other biological weapons, but the unique properties of smallpox made this difference important.[219] Jonathan Tucker explains the reasons for the Soviet preference for weaponization of smallpox in its liquid form:

> As a rule, Soviet bioweaponeers preferred to manufacture bacterial or viral agents as a dry powder rather than as a wet slurry, because the dried agent had a significantly longer shelf life and could be disseminated more efficiently as an aerosol. This principle did not apply to the smallpox weapon, however, because the liquid smallpox formulation retained its viability for months when deep-frozen and was extremely stable in aerosol form. Moreover, dried smallpox virus posed an extreme hazard of infection to workers during the manufacturing process. For these reasons, the Soviets always produced the virus in liquid form.[220]

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[214] Lane and Summer, "Smallpox as a Weapon for Bioterrorism,"157.

[215] Sidell et al., *Jane's Chem-Bio Handbook*, 161–162.

[216] Ibid.

[217] Tucker, *Scourge*, 140.

[218] Ibid.

[219] Ibid., 141–142.

[220] Ibid.

The Soviet program replicated smallpox virus, stored it in liquid form in refrigerators, and used the liquid form to fill "cluster bomblets and spray tanks."[221] The "small melon-shaped bomblets … were packed into [ballistic missile refrigerated[222]] warheads and aerial bombs"[223] and released at the end of their trajectory with parachutes and altitude sensors that aided in a timely release of the cloud of smallpox virus.[224] Though possible, it is unlikely that warheads with internal cooling mechanisms and intercontinental ballistic missiles would be a delivery method available to many bioterrorists today. Former United States bioweaponeer Dr. William C. Patrick III calls this delivery through aircraft or missiles "not a very viable option today"[225] because he does not "think anyone has the capability."[226]

One reason for this is that there are techniques that are required in order to make the smallpox solution suitable for remaining infective after exploding from its bomblets. After the virus is harvested from the eggs, "the concentrated viral suspension was converted into a finished product by mixing it with a complex formula of chemical additives, including a stabilizer to prolong the viability of the virus in storage and an inert filling agent to facilitate its dispersal as a fine-particle aerosol."[227] Concerns of preserving this mixture until it is ready to be used must also be addressed.[228] Although this process is scientifically complex, it is not overly time-consuming: "The total amount of time required to manufacture weapons-grade smallpox from the initial egg inoculation to the finished product was on the order of one week."[229]

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[221] Tucker, "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek," 3.

[222] Tucker, *Scourge*, 142–143.

[223] Tucker, "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek," 3; Tucker, *Scourge*, 142.

[224] Tucker, *Scourge*, 142–143.

[225] William C. Patrick III, speech at Washington Roundtable on Science and Public Policy, "The Threat of Biological Warfare," (February 13, 2001) http://www.marshall.org/pdf/materials/62.pdf (accessed February 12, 2012).

[226] Ibid.

[227] Tucker, *Scourge*, 142.

[228] Ibid.

[229] Ibid.

A second reason for the belief that this means of aerosol delivery might be beyond the reach of many actors is the highly technical systems that are involved. One who wished to disseminate smallpox in this way would "develop sophisticated small bomblets that employ explosive or gaseous energy to disseminate liquid or dry agents efficiently. These bomblets are usually released from missiles or high-performance aircraft."[230] Barring that, they would have the option of using "a high-performance aircraft with a storage tank attached or a cruise missile that contains its own agent and energy systems."[231] Aircraft and missiles are not readily or easily available for acquisition.

c. Dried Smallpox Spread through the Air

The vaccinated Soviet bioweaponeers determined that drying smallpox for dispersal was too dangerous to pursue.[232] Ken Alibek, noted defector from the Soviet bioweapons proram, has said that he cannot "understand why some people make these scenarios using dry powder smallpox;"[233] the liquid form is sufficiently stable and the dry form is exceptionally dangerous.[234] Nevertheless, drying and disseminating viruses is possible; it is believed that if one "has the capability to produce viruses by means of tissue culture technology, then it would be possible to continue to process the liquid into a dry powder."[235]

The techniques required to complete this process are not negligible: "A dried agent with the desired properties—high agent concentration, small particle size and absence of electrostatic charge—requires serious development with skilled personnel and

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[230] Sidell et al., *Jane's Chem-Bio Handbook*, 161.

[231] Ibid.

[232] Tucker, *Scourge*, 141–142.

[233] Ken Alibek, remarks at the conference "Meeting the Challneges of Bioterrorism: Assessing the Threat and Designing Biodefense Strategies," in Furigen, Switzerland (April 23, 2005), quoted in Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, 57.

[234] Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, 57.

[235] Sidell et al., *Jane's Chem-Bio Handbook*, 159.

sophisticated equipment."[236] There are benefits to this form of dissemination, though, that might be appealing to a terrorist. For example, if a virus were dried correctly, it could "be efficiently disseminated from any number of devices that require only small amounts of energy. The ABC fire extinguisher is a good example of such a system."[237] Purchasing a dispersal machine like a fire extinguisher would likely be more available to a terrorist than the plane or intercontinental ballistic missile (ICBM) that are required for certain types of liquid dissemination.

4. Weaponization Success in the Soviet Union

The Soviet Union is now known to have "developed the largest and most advanced offensive BW program in history."[238] This program included a massive smallpox weaponization program that "far outstripped the efforts of other countries in both scale and sophistication."[239] Ken Alibek is the source of many of the specific details of the smallpox program, as he was responsible for its oversight. He claims that in the 1970s the "Soviet military command issued an order to maintain an annual stockpile of twenty tons"[240] of smallpox so they would not run out. By the 1980s, the Soviets were cultivating "tons of smallpox in [the] secret lab in Zagorsk"[241] and "more than 60 thousand people were engaged in research, testing, production, and equipment design throughout the country."[242] In 1981 and 1987, Gorbachev revealed secret Five Year Plans to Alibek that included development of smallpox weaponization programs.[243] In 1990, Alibek believes that "close to a billion dollars"[244] was spent on biological weapons

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[236] Sidell et al., *Jane's Chem-Bio Handbook*, 162.

[237] Ibid.

[238] Vogel and Ouagrham, "Conversion at Stepnogorsk," 1.

[239] Tucker, *Scourge*, 140.

[240] Alibek and Handelman, *Biohazard*, 112.

[241] Ibid., 19.

[242] Ibid., 43.

[243] Ibid., 111, 117.

[244] Ibid., 43.

development. By the end of the same year, he estimates that the production line for aerosol smallpox "was capable of manufacturing between 80 and 100 tons of smallpox a year."[245]

Although the existence of their program was a closely guarded secret for decades, details have since been revealed that shed light on the biological weaponization process in general, and that of smallpox in particular. When the Soviets began their smallpox program, scientists carefully evaluated which strains of smallpox would be best to use in the biowarfare efforts, choosing strains based upon "best combination of militarily relevant characteristics, including low infectious dose and stability when dispersed as an invisible aerosol cloud."[246] Once they had chosen the particularly virulent India-1967 strain, it was set up for Soviet-style mass-production: thousands of chicken eggs were taken from state-run farms, injected with smallpox, and incubated.[247]

Although the scale and details of the program were unknown to the United States at the time, a hint that a smallpox weaponization program was taking place came from Kazakhstan in 1971. Vozrozhdeniye Island in the Aral Sea was a remote island in Kazakhstan where Soviet scientists are thought to have tested biological weapons from 1952 until 1992.[248] The facilities there were closed in 1992 when Russian President Boris Yeltsin acknowledged his country's prolonged violation of the Biological and Toxin Weapons Convention (BWC), which had been ratified by the Soviet Union in 1975.[249]

One of the indications that the Soviet Union was, in fact, conducting open-air tests with its weaponized smallpox at Vozrozhdeniye Island comes from a study of documents recently translated from Russian describing an unreported outbreak of smallpox in Aralsk, Kazakhstan in 1971. At this time, the disease had not been seen in

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[245] Alibek and Handelman, *Biohazard*, 121–122.

[246] Tucker, *Scourge*, 140.

[247] Ibid., 142.

[248] Jonathan Tucker and Raymond Zilinskas, eds., *The 1971 Smallpox Epidemic in Aralsk, Kazakhstan, and the Soviet Biological Warfare Program*, Center for Nonproliferation Studies Occasional Paper #9 (Monterey, CA: Monterey Institute of International Studies, 2002), 8, 10.

[249] Ibid., 9–10.

the region for nearly three decades, which would have made its appearance immediately suspect in the international community.[250] The outbreak was not reported to the World Health Organization, and there is no evidence that the United States' intelligence community was aware of it or of the associated smallpox weaponization testing program at the time.[251]

Alan Zelicoff, an American medical doctor at Sandia National Laboratories who specializes in biological weapons, has conducted an epidemiological assessment of the outbreak based upon the Soviet reports written in 1971. His assessment of the details of the outbreak led him to conclude that, "there is clear circumstantial evidence that the Soviets not only 'weaponized' smallpox but succeeded in aerosolizing it and, it appears, 'hardening' the virus so that it maintained its infectivity as it traveled downwind over a distance of at least 15 kilometers."[252] Epidemiological and statistical comparison of the Aralsk outbreak to similar outbreaks in Yugoslavia and Pakistan also led Zelicoff to speculate that the Soviets were testing a particularly virulent form of the smallpox virus. He based these conclusions on the statistically significant higher proportions of hemorrhagic smallpox and greater incidence of transmission to those who were previously vaccinated.[253] He says:

> The Soviet scientists managed, even with the limited technology of the time, to isolate a specific strain of smallpox that was not the routine smallpox we're used to seeing in pictures, which typically has a mortality rate of one in three. Instead, the virus seemed to cause hemorrhagic smallpox in unvaccinated individuals. So, the Soviets had selected by far the worst kind of smallpox. In hemorrhagic smallpox… the mortality rate is, for all intents and purposes, 100 percent.[254]

These conclusions support Ken Alibek's claims. Still, some experts accept the Soviet claims about the likely sources of the outbreak, claims that Zelicoff clearly refutes in his report on the epidemic. Notably, D.A. Henderson disagrees with Zelicoff's

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[250] Tucker and Zilinskas, *The 1971 Smallpox Epidemic in Aralsk*, 1.

[251] Ibid., 1, 11.

[252] Ibid., 21.

[253] Ibid., 14–17, 21.

[254] Zelicoff and Bellomo, *Microbe*, 111.

interpretation of what happened at Aralsk—that smallpox was transmitted off the island, to a passenger on a boat—because, he says, "it's not possible to aerosolize smallpox."[255] Most experts, however, have come to be convinced that Aralsk's outbreak is proof that Soviet scientists:

> did something that experts in the United States said could never be done: They *aerosolized* smallpox in such a way that it could drift downwind many miles and still remain viable—that is, capable of causing infection. U.S. experts have long contended that this scenario was simply impossible.[256]

Scholars from the Chemical and Biological Weapons Nonproliferation Program at Monterey Institute of International Studies' Center for Nonproliferation Studies assess that since the terrorist attacks of 2001, "the U.S. government has been increasingly concerned about the possibility that terrorists could gain access to laboratory stocks of *Variola* virus and use it as a mass-casualty weapon. As a result, learning more about the Soviet offensive BW program, especially its efforts to weaponize the smallpox virus, has acquired new urgency."[257] If it is true that the Soviet strain that infected Aralsk is more severe because it causes a greater chance of contracting hemorrhagic smallpox, Zelicoff is correct to point out that, "our complete reliance on a single vaccine (unmodified vaccinia) represents a serious potential vulnerability."[258]

Furthermore, a WHO inventory of the Russian stocks in 1999 revealed that the very strains responsible for this more lethal form of the disease were missing.[259] The Russian government now maintains that these stocks were destroyed. Notably, the same Russian official responsible for this claim—Lev Sandakchiev, the Director General of the smallpox repository in Koltsovo—does not acknowledge that the outbreak at Aralsk ever occurred.[260]

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[255] Zelicoff and Bellomo, *Microbe*, 109.

[256] Ibid., 110–111.

[257] Tucker and Zilinskas, *The 1971 Smallpox Epidemic in Aralsk*, 1.

[258] Ibid., 21.

[259] Zelicoff and Bellomo, *Microbe*, 112.

[260] Ibid., 112–114.

The international community has taken seriously the revelation of the Soviet Union's smallpox weaponization program and its potential impact on the need for smallpox vaccine, until recently thought of as increasingly unnecessary after eradication in 1972. After eradication, the WHO had recommended 200 million doses of smallpox vaccine be kept in its repository; a number that was chosen because that is the amount that was in their frozen storage at the time of the decision.[261] In 1985, this stock was reduced to 5 million doses based on a recommendation from the WHO's smallpox advisory committee and in response to WHO budget concerns.[262] In response to concerns over the Soviet Union's biological weapons program, in 2003 the smallpox advisory committee reversed its decision to lessen the amount of stored smallpox vaccine.[263] The committee determined that the international emergency stockpile should be replenished to its previous level of 200 million doses of vaccine. This was done both because of revelations about the Soviet weaponization program and the fact that it was unknown whether other countries had similar programs.[264] The United States committed 20 million doses to this vaccine storage replenishment cause.[265] Clearly, the weaponization of smallpox was considered possible by top medical and government officials at this time.

5. Reliability of Sources Providing Claims of Success

One of the primary sources for information about the success of smallpox weaponization is Doctor Kenneth Alibek, formerly known as Soviet Colonel Kanatjan Alibekov. He has written a book, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World– Told From the Inside by the Man Who Ran It*, detailing his experiences as a major figure inside the Soviet Union's biological warfare development programs. Eventually he realized that the Americans were most likely not conducting a similar biological warfare program aimed at destroying

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[261] Henderson, *Smallpox: The Death of a Disease*, 255.

[262] Ibid.

[263] Ibid.

[264] Ibid.

[265] Ibid.

the Soviet Union (as he had been told).[266] His disillusionment led him to leave the Soviet program and return to his family's hometown in Kazakhstan. After be learned of the expectation that he would begin a biological warfare program there, he chose to defect to the United States in 1992.[267]

Intelligence and national security officials kept his arrival secret, and repeatedly questioned his shocking claims about the extent of the Soviet biological weapons programs.[268] After his presence was more generally known, smallpox expert D.A. Henderson recalls,

> I had been repeatedly assured that he could not be believed; that he was fabricating information to obtain respect and special favors. Finally I had the opportunity to converse at length with him, to read his book … and to talk with other Russian scientists. Some assertions in the book may be questionable, but Alibekov's detailed descriptions of the programs portray the disturbing reality of a massive and sophisticated biological weapons capacity.[269]

Others, too, were skeptical, believing that intelligence experts were not knowledgeable enough about the scientific aspects of biological weapons engineering to know whether Alibek's claims were credible. For this reason, the CIA asked American biological weapons expert William C. Patrick III to assist with Alibek's debriefing.[270] Patrick had been chief of the Product Development Division of the Agent Development and Engineering Directorate for the Army's Biological Warfare laboratories at Fort Detrick, Maryland in the 1960s and 1970s when the U.S. military had dealt with biological warfare agents.[271] In 2001, Dr. Patrick spoke at the Washington Roundtable on Science and Public Policy. He referred specifically to Alibek's descriptions of the Soviet Union's high production capability, which he says people have asked him if he

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[266] Alibek and Handelman, *Biohazard*, 53, 182, 252; Tucker, "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek," 8.

[267] Ibid.

[268] Henderson, *Smallpox: The Death of a Disease*, 274.

[269] Ibid., 275.

[270] Mauroni, *Chemical and Biological Warfare*, 133.

[271] Ibid.

believes. He stands by Alibek's claims, saying: "The answer is, I do…. I certainly believe these figures to be valid because when you look at their process, it all fitted into a logical sequence."[272]

Some details of Alibek's claims have been confirmed over time. For example, since his book was published, the Russian government has confirmed the existence of the 1971 smallpox outbreak in Aralsk. The deputy minister of health acknowledged in 2005 that, "aerosolized smallpox virus experiments had been conducted during this period on the Aral Sea island."[273]

Other Soviet defectors have made claims similar to Alibek's. Vladimir Pasechnik defected to the United Kindgom in the late 1980s. Pasechnik revealed the truth to the British government about Biopreparat—that it was the Soviet Union's civilian cover agency for what was mainly the militarily controlled "principal government agency for biological weapons research and development."[274] One of the British government officials responsible for debriefing Pasechnik reported that, "[t]he information was stunning; a whole ministry exposed; billions of rubles spent; a complete organization shown to be a front; and there was the clear involvement of Gorbachev."[275] Alibek's information supplemented and did not contradict what Pasechnik had reported.

Although American scientists have by now vetted Alibek's reports, it is important to note that while many consider him credible, his recollections are not universally accepted. Some scientists refute his reports. A Soviet scientist named Sergei Popov (who defected to Britain in 1992) questioned Alibek's re-telling of Popov's experiment to alter Legionnaire's disease. According to Popov, Alibek was wrong on three counts in his book *Biohazard*: he incorrectly described the experiments as using rabbits when they had in fact used guinea pigs; his description of the body being poisoned was inaccurate

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[272] William C. Patrick III, speech at Washington Roundtable on Science and Public Policy, "The Threat of Biological Warfare," (February 13, 2001) http://www.marshall.org/pdf/materials/62.pdf (accessed February 12, 2012).

[273] Henderson, *Smallpox: The Death of a Disease*, 272.

[274] Alibek and Handelman, *Biohazard*, 298–299.

[275] James Adams, *The New Spies: Exploring the Frontiers of Espionage* (London: Hutchinson, 1994), 276.

(as it was the body's reaction to the disease itself that caused the damage); and Alibek's description of the implications of these studies was more benign than was actually the case.[276] Although this example recounts what seem to be errors in relatively insignificant details, it does raise the question of the veracity of the finer details of Alibek's reporting on projects with which he was not intimately involved.

Although Alibek admits that he has no inside information on the state of Russia's biological research programs since 1994,[277] he claims in his 1999 book that he is "convinced that a large portion of the Soviet Union's offensive program remains viable despite Yeltsin's ban on research and testing."[278] He bases this claim in part from scientific research that has been published by his former colleagues, saying that it is similar to or has implications for research that was conducted in the weaponization programs.[279] His unique insider's perspective makes him one of the few qualified to make this assessment.

6. "Brain Drain" from the Former Soviet Union?

There has been speculation that the break-up of the Soviet Union and the rapid down-sizing of its BW programs have left a sizeable number of highly trained scientists unemployed, and knowledgeable enough about biological weapons to make their skills highly desirable to countries or terrorists seeking such a program.[280] D.A. Henderson, a smallpox epidemiology expert and a key figure in the WHO's eradication program, worries that some of the scientists who left the former Soviet Union for other countries:

> Were highly trained professionals, experienced in producing large quantities of virus and knowledgeable of experimental work that had endeavored to combine the smallpox virus with other viruses. It was

[276] Miller, Engelberg, and Broad, *Germs*, 303.

[277] Tucker, "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek," 6.

[278] Alibek and Handelman, *Biohazard*, 263.

[279] Tucker, "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek," 8.

[280] Henderson, *Smallpox: The Death of a Disease*, 275; Frist, *When Every Moment Counts*, 156; Mauroni, *Chemical and Biological Warfare*, 72; Vogel and Ouagrham, "Conversion at Stepnogorsk," 1.

> possible that some of these scientists might have taken samples of the smallpox virus with them. Also troubling was that recruiting teams from some Middle Eastern countries had visited VECTOR and other laboratories, offering generous consulting fees—and finding scientists willing to accept them.[281]

Former Senator Frist describes Russia's biological weapons program as the largest of the "eleven to seventeen countries [that] have biological weapons programs,"[282] and therefore points to the biological weapons programs of the former Soviet Union as a possible source of the spread of biological weapons today.[283] He echoes the commonly cited concern that the failure of the Soviet Union has led to a large number of unemployed scientists who would sell their biological weapons expertise.[284] The former senator concludes that:

> There remains a real concern that all of that expertise and technology could fall into the hands of rogue nations or terrorist organizations. More than seven thousand scientists worked in the bioweapons program during the 1980s. Many of them are now unemployed or working in less lucrative or challenging fields, and there is the very real concern that they could offer to sell their services and their technological know-how to the highest bidder.[285]

These concerns seem valid based upon the terms of the "Joint Statement on Biological Weapons" agreement that Russia signed with the United States and Great Britain in 1992 after Russia's failure to adhere to the terms of the BWC was admitted by President Yeltsin.[286] According to the terms of this agreement, Russia would cut in half

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[281] Henderson, *Smallpox: The Death of a Disease*, 275.

[282] Frist, *When Every Moment Counts*, 156.

[283] Ibid.

[284] Frist, *When Every Moment Counts*, 156; Mauroni, *Chemical and Biological Warfare*, 72; Kathleen Vogel, "Pathogen Proliferation: Threats from the Former Soviet Bioweapons Complex," *Politics and the Life Sciences* 19, no. 1 (March 2000), 6.

[285] Frist, *When Every Moment Counts*, 156.

[286] Vogel, "Pathogen Proliferation," 6.

its biological weapons workforce and would decrease funding for its military biological research weapons programs by 30 percent.[287]

In an attempt to determine whether fear of this "'brain drain' phenomenon"[288] is warranted, RAND Corporation conducted a study in 2005 entitled "Diversion of Nuclear, Biological, and Chemical Weapons Expertise from the Former Soviet Union: Understanding an Evolving Problem." First, the study found that although the number of personnel working with biological weapons was fairly certain in 1991, the numbers in subsequent years are mostly unknown.[289] This highlights the "substantial uncertainties that persist [in]…understanding of the potential problem of weapons complex personnel diverting sensitive information."[290]

In spite of these uncertainties surrounding the number of actors potentially involved, the study found no evidence of actual illegal transfers of knowledge, materials, or weapons.[291] The authors concluded that the:

> Empirical record of illicit knowledge diversion from the FSU [Former Soviet Union] over the past decade suggests that the barriers and disincentives have been much stronger than the incentives. Additionally, U.S. policies may have periodically had significant impacts on the balance between incentives and disincentives to exchange information illicitly.[292]

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[287] "Joint Statement on Biological Weapons by the Governments of the United Kingdom, the United States, and the Russian Federation," (September 14, 1992) http://www.fas.org/nuke/control/bwc/text/joint.htm (accessed February 8, 2012).

[288] John Parachini et al., *Diversion of Nuclear, Biological, and Chemical Weapons Expertise from the Former Soviet Union: Understanding the Evolving Problem* (Santa Monica, CA: RAND Corporation, 2005), 7.

[289] Parachini et al., *Diversion of Nuclear, Biological, and Chemical Weapons Expertise*, 15–17.

[290] Ibid., 15.

[291] Ibid., 31.

[292] Ibid., 6.

Based upon their findings, they predict that this trend of disincentives outweighing incentives to sell Soviet secrets will continue.[293]

Although RAND found no evidence of ill-intentioned scientists, states, or non-state actors attempting to gain dangerous biological weapons materials or knowledge in this way, some sources nonetheless maintain that attempts have been made; however, the lack of evidence "of pathogen diversion by terrorists either through attacks or in collusion with former Soviet BW scientists"[294] is telling.

D. EVIDENCE OF INTENT OR CLAIM TO USE SMALLPOX AS A BIOWEAPON OUTSIDE THE SOVIET UNION

1. Al Qaeda

a. Al Qaeda's Claims and Reasoning

Members of al-Qaeda have developed and published their interpretation of Islamic law in an effort to claim it allows for biological weapons and weapons of mass destruction to be used by Muslims.[295] In September 1999, Sheikh Omar Bakri Mohammed addressed a letter to Osama bin Laden that was published on the Internet.[296] It contained his interpretation of Islamic policy on killing with biological weapons: "Using any biological weapons in self defense is, in Islam, permissible, and I believe that we are currently operating under a defensive jihad. Obviously we regret what could happen to innocent people, but there are always people who are war casualties."[297] According to the Islamic rules (as interpreted by al Qaeda), "[i]f people of authority engaged in jihad determine that the evil of the infidels can be repelled by no other means

[293] Parachini et al., *Diversion of Nuclear, Biological, and Chemical Weapons Expertise*, 39.

[294] Vogel, "Pathogen Proliferation," 8.

[295] David Aaron, *In Their Own Words: Voices of Jihad, Compilation and Commentary* (Santa Monica, CA: RAND Corporation, 2008), 292–297.

[296] Ben Venzke and Aimee Ibrahim, *The al-Qaeda Threat: An Analytical Guide to al-Qaeda's Tactics and Targets* (Alexandria, VA: Tempest Publishing, 2003), 21.

[297] Ibid.

[than weapons of mass destruction], they may be used."[298] This is allowed "even if you kill them without exception,"[299] as a smallpox epidemic would do.

In a 2001 interview, Osama bin Laden claimed, "I wish to declare that if America used chemical or nuclear weapons against us, then we may retort with chemical and nuclear weapons. We have the weapons as a deterrent."[300] In this particular statement he does not mention biological weapons; however, other al Qaeda leadership figures have claimed that al Qaeda "has in its possession… bombs with deadly viruses, which will spread fatal diseases throughout American cities."[301] One is left to wonder which deadly virus they claim to possess, but it is evident that nothing in their stated ideology indicates they would abstain from using those that they could attain.

Osama bin Laden has stated that "it is a 'holy duty' to obtain biological weapons."[302] One of al Qaeda's main spokesmen, Sulaiman Abu Ghaith, reasoned in a 2002 article that they:

> Have the right to kill four million Americans—two million of them children—and to exile twice as many and wound and cripple hundreds of thousands. Furthermore, it is our right to fight them with chemical and biological weapons, so as to afflict them with the fatal maladies that have afflicted the Muslims because of the [Americans'] chemical and biological weapons.[303]

Smallpox is a disease that could kill millions of Americans, but it is unlikely that this rhetoric is any more indicative of intent to pursue such an attack than the Internet requests for prayers to spread "epidemics and scourges"[304] through America.

Al Qaeda leader al-Zawahiri has gone beyond arguing about whether Islamic law allows it, to consider the best way to carry out a biological warfare program.

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[298] Aaron, *In Their Own Words*, 295.

[299] Ibid.

[300] Aaron, *In Their Own Words*, 293.

[301] Ibid.

[302] Venzke and Ibrahim, *The al-Qaeda Threat*, 21.

[303] Ibid., 23.

[304] Ibid., 21.

In a note to Muhammad Atef, he explains that "looking for a specialist is the fastest, safest, and cheapest way [to embark on a biological and chemical weapons program]."[305] This letter seems to conclude with a decision that chemical weapons are a more achievable option for al Qaeda to pursue.[306]

b. Assessments about al Qaeda

According to Gavin Cameron's studies of WMD terrorism, "the evidence clearly shows that al-Qa'eda has simply been trying to develop any type of weapon that might help its cause… [and that] given the difficulty and expense of acquiring and effectively using such weapons, al-Qa'eda may continue to seek WMD, but probably not rely on doing so successfully."[307] Because the World Trade Center attacks demonstrated that an attack that does not involve a biological weapon can cause a large number of casualties, it is not a foregone conclusion that a group such as al Qaeda might choose to pursue smallpox. In fact, its use of conventional weapons in the 2001 attacks, "albeit in an unusual and highly innovative way,"[308] demonstrates that this group may have a preference for conventional versus biological weapons.

In recent years, there has been speculation surrounding this preference as to whether al Qaeda terrorists might seek to use biological weapons against the United States. In 2002, Central Intelligence Agency (CIA) Director George Tenet testified to the U.S. Joint Inquiry Committee that al Qaeda had "attempted to acquire material used in pursuing a chemical, biological, radiological, nuclear (CBRN) capability."[309] Later that year, he reported to the Senate Committee on Armed Services that al Qaeda documents

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[305] Aaron, *In Their Own Words*, 293; Alan Cullison, "Inside Al-Qaeda's Hard Drive," *The Atlantic*, September 2004. http://www.theatlantic.com/magazine/archive/2004/09/inside-al-qaeda-rsquo-s-hard-drive/3428/ (accessed February 3, 2012).

[306] Alan Cullison, "Inside Al-Qaeda's Hard Drive," *The Atlantic*, September 2004. http://www.theatlantic.com/magazine/archive/2004/09/inside-al-qaeda-rsquo-s-hard-drive/3428/ (accessed February 3, 2012).

[307] Cameron, "Weapons of Mass Destruction Terrorism Research," 78.

[308] Ibid., 79.

[309] Statement of George Tenet, "Written Statement for the Record of the Director of Central Intelligence Before the Joint Inquiry Committee," 17 October 2002. http://www.fas.org/irp/congress/2002_hr/101702tenet.html (accessed February 3, 2012).

revealed that "bin Ladin was pursuing a biological weapons research program."[310] These reports give general information about biological weapons, and mention agents such as anthrax, plague, botulinum, and hepatitis.[311] They do not mention smallpox specifically.

In 2003, a special projects reporter for *The Washington Post* named Barton Gellman wrote an article about al Qaeda's search for biological weapons. In it he cited CIA and White House officials as telling him that, "there was no U.S. intelligence assessment that al-Qaeda was looking for smallpox."[312] When he learned from a separate source that this was not the case, he confronted the officials again and they confirmed that a presentation to "top White House senior officials"[313] did exist; in the brief, read to him by his initial source, al Qaeda was assessed to be "interested in acquiring biological weapons, to include smallpox."[314]

The report of the Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, written in 2005, gives an unclassified summary of the intelligence community's assessment of al Qaeda's likely biological terrorism capabilities, and reports that al Qaeda's biological weapons program was "further along… than pre-war intelligence indicated."[315] The unclassified report makes no mention of smallpox in the two pages devoted to biological terrorism, although al Qaeda in Afghanistan was reported to have a program devoted to an unnamed Agent X.[316] After a close study and cross-referencing of all available related documents, Milton

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310 *The Worldwide Threat to United States Interest: Hearing Before the U.S. Senate Committee on Armed Services*, 107th Cong., 2nd sess. 10 (March 19, 2002) (statement of George Tenet, "Worldwide Threat: Converging Dangers in a Post-9/11 World," Director of Central Intelligence).

311 Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, 29.

312 Barton Gellman, "Revealing a Reporter's Relationship with Secrecy and Sources," *Neiman Reports* 58, no.2 (Summer 2004): 45.

313 Gellman, "Revealing a Reporter's Relationship with Secrecy and Sources," 45.

314 Ibid.

315 The Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, Report to the President of the United States, Official Government Edition, Chapter Three: Case Study: Al-Qa'ida in Afghanistan (March 31, 2005), 269.

316 Ibid., 269–270.

Leitenberg, a specialist in biological warfare and arms control, concludes that Agent X "almost certainly refers to anthrax, with botulinum toxin the most plausible second guess."[317]

In 2005, the Director of the U.S. Defense Intelligence Agency (DIA) reported to Congress his agency's assessment that al Qaeda was interested in biological weapons, but their capability to act on this was not certain.[318] He says, "Because they are easier to employ, we believe terrorists are more likely to use biological agents such as ricin or botulinum toxin or toxic industrial chemicals to cause casualties."[319] The ease of employment argument does not necessarily carry over to smallpox due to the complicated process that must occur before employment (namely, acquisition and weaponization; see abover).

Although al Qaeda has made frequent public mention of its intent to kill and of its considerations regarding the use of biological weapons, there has been no specific mention of smallpox. The group has made public some of its training and ideology surrounding other types of weapons; for example, instructions on use of weapons such as rocket propelled grenades (RPGs) and improvised explosive devices (IEDs) can be found on the Internet alongside how-to guides on more primitive attack methods such as booby traps and using spoiled food or nicotine as a poison.[320] The group does not appear hesitant to reveal what types of weapons it is considering. It is clear that the group is willing to use many means of attack less complex than spreading smallpox, but this does not prove whether or not such an attack is one that they would consider.

In 2005, "al-Qaeda chief propagandist Mustafa Setmariam Nasar, also known as Abu Musab al-Suri, posted a 15-page document entitled 'Biological

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[317] Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat*, 37.

[318] Statement of Vice Admiral Lowell Jacoby to the U.S. Senate Armed Services Committee, "Current and Projected National Security Threats to the United States," March 17, 2005. http://armed-services.senate.gov/statemnt/2005/March/Jacoby%2003-17-05.pdf (accessed February 3, 2012), 3.

[319] Ibid.

[320] Aaron, *In Their Own Words*, 289–292.

Weapons'"[321] that contained lessons on how to turn pneumonic plague into an aerosol weapon.[322] Other publications have discussed biological weapons that are less damaging than WMDs; one training manual's chapter on assassinations with poison intentionally limits the discussion "to poisons that the holy warrior can prepare and use without endangering his health."[323] This suggests that they might believe dangerous biological agents such as smallpox are beyond the means of many of their intended audience. Another example of intent to use biological weapons comes from the United Kingdom, where in 2003 a suspected member of al Qaeda was arrested with materials that authorities assessed could have been used to create ricin or botulinum toxin.[324] These are indications that al Qaeda terrorists are considering biological weapons; however, none of these examples provide evidence of a specific pursuit of smallpox.

Although some have claimed that, "there is evidence that al-Qaeda was experimenting with chemical and biological agents in Afghanistan during the Taliban regime,"[325] others maintain that this is unlikely. These people claim that, "there is no objective evidence that al-Qaeda or any other jihadi group in fact has such weapons."[326] Evidence from 2002 seems to support this claim: "Al Qaeda has expressed interest in using unconventional weapons and has experimented with industrial chemical hazards as terrorist weapons, as evidenced by documents and materials found in Afghanistan by U.S. forces in 2002, but it has not used CB hazards in any terrorist attacks."[327] Clearly there is a lack of consensus on which type of weapons al Qaeda actually possesses as compared to what the organization wishes to possess. It should also be noted that the argument that al Qaeda has not yet used a biological agent in an attack has no bearing on whether this could happen in the future.

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[321] Ibid., 292.

[322] Aaron, *In Their Own Words*, 292; Steve Coll and Susan Glasser, "Terrorists Turn to the Web as Base of Operations," *Washington Post*, August 7, 2005, final edition.

[323] Aaron, *In Their Own Words*, 291; Venzke and Ibrahim, *The al-Qaeda Threat*, 23.

[324] Mauroni, *Chemical and Biological Warfare*, 86.

[325] Aaron, *In Their Own Words*, 292.

[326] Ibid.

[327] Mauroni, *Chemical and Biological Warfare*, 86.

2. Iraq

Iraq signed the BWC in 1972 and ratified it in 1991. In 1995, Saddam Hussein's son-in-law Hussein Kamal defected from Iraq and provided details to the United Nations about Iraq's biological weapons program in the previous decade.[328] The documentation he produced contained information about Iraq's anthrax production and weaponization program, but mentioned nothing about smallpox.[329] Although it was later proven that the anthrax program had ended, alarmists remained convinced that Iraq—as well as other nations—might be secretly pursuing biological warfare in spite of signing the BWC.[330] These suspicions were reinforced by reports from former Soviet scientists that in 1995 Iraq had attempted to buy fermenters and air filtration equipment from Russia that the Russians presumed were to be used for plague production rather than for animal-feed as the Iraqis claimed.[331]

Also in the 1990s, at a time when Iraq had in place a military doctrine to use biological weapons as a state-sanctioned military strategy, the country was found to have research programs in camelpox.[332] Although camelpox is not one of the four members of the *Orthopox* genus that is capable of infecting humans,[333] it is closely related to smallpox genetically; the two viruses share genes that are "greater than 90% identical."[334] This has led to speculation that Iraq was either intending to infect camels, or to conduct research and development with an agent that was similar enough to

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328 Henderson, *Smallpox: The Death of a Disease*, 276; Alibek and Handelman, *Biohazard*, 277.

329 Henderson, *Smallpox: The Death of a Disease*, 276.

330 Ibid.

331 Tucker, "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek," 6; Alibek and Handelman, *Biohazard*, 275.

332 Timothy McCarthy and Jonathan Tucker, "Saddam's Toxic Arsenal: Chemical and Biological Weapons in the Gulf Wars," in *Planning the Unthinkable: How Powers Will Use Nuclear, Biological, and Chemical Weapons*, ed. Peter Lavoy, Scott Sagan, and James Wirtz (Ithaca, NY: Cornell University Press, 2000), 53–56.

333 Henderson and Borio, "Smallpox and Monkeypox," 628.

334 Bernard Moss, "Poxviridae: The Viruses and the Replication," in *Fields Virology*, 5th ed., ed. David Knipe and Peter Howley (Philidelphia, PA: Lippincott, Williams, and Wilkins, 2007), 2906.

smallpox to be useful, but was safer for humans to handle and less likely to reveal the true intent of the program if it were discovered.[335]

Dr. Richard Spertzel, head of the biological weapons inspections for the United Nations Special Commission on Iraq from 1994 to 1998, testified to the House Committee on International Relations in December 2001 that one of the biological agents of concern in Iraq was smallpox.[336] He summarizes his assessment of Iraq's smallpox capability:

> Iraq does not acknowledge any studies on smallpox. However, a smallpox epidemic swept through northern Iraq in the mid 1970s, just two to three years after it embarked on a program to acquire the capability for weapons of mass destruction. It is most unlikely that Iraq would have missed the opportunity to acquire clinical samples for any biological agent that might be of future benefit to the government. Thus it is prudent to make the assumption that Iraq possesses the necessary seed material for smallpox production. It has the necessary facilities, expertise and equipment for such development. A number of other clues strongly suggests that indeed it had an interest if not an active program in such a weapon development.[337]

The National Intelligence Estimate (NIE) provided to Congress in October 2002, titled *Iraq's Continuing Programs for Weapons of Mass Destruction*, details what was believed at the time to be a likely estimate of the regime's biological warfare capabilities. An excerpt from the Key Judgments reads:

> We judge that all key aspects—R&D, production, and weaponization—of Iraq's offensive BW program are active and that most elements are larger and more advanced than they were before the Gulf War. We judge Iraq has some lethal and incapacitating BW agents and is capable of quickly

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[335] Andy Coghlan and Debora Mackenzie, "Fear over Camelpox as Bioweapon," *New Scientist* (April 17, 2002) http://www.newscientist.com/article/dn2173-fear-over-camelpox-as-bioweapon.html (accessed March 1, 2012); Jonathan Tucker, "Breaking the Deadlock Over Destruction of the Smallpox Virus Stocks," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 9, no. 1 (2011): 59.

[336] *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapons*, 107th Cong. 6 (December 5, 2001) (statement of Richard O. Spertzel, Head of Biological Weapons Inspections, United Nations Special Commission on Iraq).

[337] Ibid., 7.

> producing and weaponizing a variety of such agents…. Chances are even that smallpox is part of Iraq's offensive BW program.[338]

In the years since this report was published, it has become accepted that the actual threat posed by Iraq's biological weapons program was much lower than estimated; it was probable that the intelligence community had succumbed to the pressures of interpreting information in the manner that they believed politicians wanted to hear.[339] The assertions made in this NIE were later determined to be based upon unreliable sources and "flimsy intelligence."[340]

In 2003, inspection teams comprised of American scientists known as "Team Pox" searched for three months and were unable to find any "physical or anecdotal evidence to suggest that Iraq was producing smallpox or had stocks of it in its possession."[341] Barton Gellman, a reporter who visited the top ninety suspected weapons site with the inspectors in May 2003, confirmed that no weapons of mass destruction were found.[342]

Based upon the evidence, it is unlikely that Iraq possessed a smallpox weaponization program at the time of the inspections. The report to the House Committee on International Relations, the NIE, and a subsequent article in *The Washington Post* likely provide much of the basis for later reports that Iraq possesses smallpox.[343]

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[338] Director of Central Intelligence, "Iraq's Continuing Programs for Weapons of Mass Destruction: National Intelligence Estimate; Key Judgments" (October 2002), 6–7. http://www.fas.org/irp/cia/product/iraq-wmd-nie.pdf (accessed February 29, 2012).

[339] Joshua Rovner, "Fixing the Facts or Missing the Mark? Intelligence, Policy, and the War in Iraq," Foreign Policy Research Institute E-Notes, October 2011. http://www.fpri.org/enotes/2011/201110.rovner.iraq.html (accessed February 1, 2012), 2–5.

[340] Ibid., 3.

[341] Un-named Military Officer assigned to "Team Pox," quoted in Dafna Linzer, "U.S. Team in Iraq Finds No Smallpox," *The Atlanta Journal-Constitution*, September 19, 2003, A14; Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 156.

[342] Gellman, "Revealing a Reporter's Relationship with Secrecy and Sources," 40.

[343] From 2001: House Committee on International Relations, *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapons*, 6–7. From 2002: Barton Gellman, "Four Nations Thought to Possess Smallpox; Iraq, North Korea Named, Two Officials Say," *Washington Post*, November 5, 2002. Other sources (for example: Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 158) often cite the Gellman article when referring to Iraq and smallpox.

3. Iran

Iran signed the BWC in 1972 and ratified it in 1973. The country claims that it upholds its commitment to this international treaty and therefore does not maintain an offensive biological warfare program; however, some lend more credence to assessments that "[m]ilitary analysts believe its program could still be active…. Iran receives a good deal of support from Russia and China, including production technology and expertise in chemical and biological manufacturing that could be used to create an advanced and self-sufficient military CB warfare capability." [344]

Although such a biological warfare capability has not yet materialized, some claim evidence that Iran is putting the pieces in place to have such a program. In their study of the diversion of biological weapons expertise from the former Soviet Union, the RAND Corporation found that "[i]n the biological sector, there have been several instances in which Iran sought information or materials from Russian biological institutes. In one case, Iranian agents were negotiating a deal with Vector, one of Russia's premier biological research centers that previously performed important weapons research."[345] United States threats to cut financial assistance to Russia prevented that particular deal from being finalized.[346]

Iranian interest in this particular facility could indicate an interest in scientists familiar with smallpox. Vector was more than a premier research center; in 1990 it had been central to the Soviet smallpox weaponization program, with a production capability of 80-100 tons of smallpox each year and a research program focused on genetically altered strains of smallpox.[347]

Iranian interest in recruiting those former Soviet scientists knowledgeable about biological weapons production has been alleged by those involved. Gennady Lepyoshkin, a former Soviet colonel who had run the biological weapons facility at

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[344] Mauroni, *Chemical and Biological Warfare*, 81.

[345] Parachini et al., *Diversion of Nuclear, Biological, and Chemical Weapons Expertise*, 26.

[346] Ibid.

[347] Alibek and Handelman, *Biohazard*, 121–122.

Stepnogorsk, Kazahkstan, reported that Iran had attempted recruitment of the scientists there.[348] In the cases to which he refers, the Soviet scientists turned down the Iranian offers. Whether other offers have been made elsewhere is unknown; Ken Alibek claims to have heard from former colleagues that five scientists involved in biological warfare programs now live and work in Iran.[349]

4. North Korea

North Korea is frequently lumped in with Russia, Iraq, and Iran when smallpox biological weapons capabilities are mentioned.[350] In the House Committee on International Relations report, however, the only mention of North Korea in conjunction with biological weapons is: "It is estimated that at least 20 countries, including … North Korea … either have active research programs or were formerly involved in biological weapons research and production."[351]

Other reports are similarly anecdotal. Ken Alibek alleges that in 1994 the Russian defense ministry sent biological warfare scientists to North Korea, and "the purpose of their visit is still unknown."[352] He has heard from others that several scientists from the Soviet Union's biological weapons program have relocated to North Korea.[353] Lev Sandakchiev, Director of the State Research Center of Virology and Biotechnology (also called Vector), said in 1999 that "he was certain that North Korea, among other countries, was secretly keeping smallpox, and American analysts shared his view."[354] As he was

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[348] Miller, Engelberg, and Broad, *Germs*, 176.

[349] Alibek and Handelman, *Biohazard*, 271.

[350] House Committee on International Relations, *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapons*, 7; Barton Gellman, "Four Nations Thought to Possess Smallpox; Iraq, North Korea Named, Two Officials Say," *Washington Post*, November 5, 2002; Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 158.

[351] House Committee on International Relations, *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapons*, 12.

[352] Tucker, "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek," 5.

[353] Alibek and Handelman, *Biohazard*, 271.

[354] Miller, Engelberg, and Broad, *Germs*, 252.

simply arguing against destruction of the remaining legally stored stocks of the smallpox virus, he did not explain the reasons for his "certainty."

Other reports come from South Korea, and from the United States Forces Korea (USFK) stationed there. USFK's open source collection on North Korea has allowed them to summarize North Korea's relationship to biological weapons as follows:

> Pyongyang has taken advantage of the BWC's verification gap by using its position as a state party to the BWC in order to blanket accusations that it continues to produce and maintain biological weapons. The South Korean Defence Ministry claims that North Korea has possession of several biological agents such as anthrax bacterium, botulinum and smallpox—all of which can be weaponized. However, South Korean and US intelligence assessments about North Korea's BW program remain highly speculative due to the nebulous nature of biological agents and their use.[355]

In addition to these claims that North Korea is in possession of smallpox, South Korean newspapers reported in 2011 that South Korea's defense ministry "estimates that North Korea owns up to 5,000 tons of chemical weapons and is capable of growing anthrax, smallpox and cholera."[356] It is possible that the smallpox claims come from the fact that the North Korean military continues to vaccinate its forces against smallpox.[357] The fact that vaccinations are given does not imply a capability to produce weaponized smallpox; immunity could just as easily be desired as a measure of protection against a suspected attack rather than as an offensive measure.[358]

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[355] United States Forces Korea (USFK) J2 Open Source Intelligence Branch, Joint Intelligence Operations Center Korea, *Korea Open Source Digest* IV, no. 217 (November 12-14, 2011) https://www.opensource.gov/portal/server.pt/gateway/PTARGS_0_0_200_203_121123_43/content/Display/KPP20111114119002#index=21&searchKey=7425905&rpp=10 (accessed February 5, 2012), 66. (*Korea Open Source Digest* is a daily USFK open source product focused on North Korea. It is a collection of media reports, government reports, official press statements, essays, academic journals, nongovernmental organization newsletters, and international organization reports.)

[356] United States Forces Korea (USFK) J2 Open Source Intelligence Branch, Joint Intelligence Operations Center Korea, *Korea Open Source Digest* IV, no. 193 (October 8-10, 2011) https://www.opensource.gov/portal/server.pt/gateway/PTARGS_0_0_200_203_0_43/content/Display/24809407/KPP20111010041001001.pdf (accessed February 5, 2012), 6-6.

[357] Zelicoff and Bellomo, *Microbe*, 114.

[358] Ibid.

E. CONCLUSION

Al Qaeda has demonstrated an interest in biological weapons, and has the ideology that would sanction their use, but there is no evidence that the group is pursuing smallpox specifically. Although it was widely assumed that Iraq had a capable biological weapons program that could include smallpox, inspections revealed no trace of the virus. Iran claims not to have an offensive biological weapons program, yet has allegedly reached out to scientists at former Soviet biological weaponization facilities. There is no evidence that Iran possess the virus or the weaponization programs to spread it, but its interest marks biological weapons—not necessarily smallpox—as a potential future endeavor. Little is known about North Korea's biological warfare programs, but claims have been made that it possesses samples of the virus. As has been demonstrated, there are many resources required and scientific difficulties to overcome before a sample of smallpox virus could be used as a biological weapon.

It is clear that the barriers to terrorist use of smallpox as a biological weapon are significant; in many cases they are likely to be prohibitive. The following chapters will assume, however, that these hurdles are surmountable and that terrorists could, in fact, successfully weaponize smallpox. This assumption allows for consideration of terrorist decision-making. Chapter III will address whether terrorists are likely to choose to use smallpox as a bioweapon over their other options for terrorist actions based upon their rational or irrational considerations. Chapter IV considers the impact that domestic and international law would have as a deterrent to choosing to pursue bioterrorism.

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III. WHAT KINDS OF TERRORISTS MIGHT PURSUE SMALLPOX AS A BIOWEAPON

A. DOES THIS TYPE OF ATTACK MATCH A PARTICULAR IDEOLOGY?

In this chapter, I will examine whether terrorists would be likely to choose to carry out a biological attack using smallpox based upon what might motivate them to pursue it as a bioweapon. As Gavin Cameron points out about weapons of mass destruction in general, both capability and intent of the group or individual conducting the attacks are important to consider.[359] Jessica Stern adds that motivation is a third important factor.[360] Capability, intent, and motivation are equally important to consider when evaluating whether terrorists are willing and able to carry out an attack using smallpox as a weapon.

Chapter II deals with the question of capability. In brief, the debate centers on the characteristics of the smallpox virus. One commonly cited claim is that the nature of the smallpox virus itself makes it unsuitable for use as a biological weapon. As discussed in depth in Chapter II, just to handle the virus, sophisticated laboratory equipment, top security facilities, and highly specific knowledge of microbiology and virology are required. Some say that to turn it into a weapon requires even greater skill and funding than terrorists are likely to possess.[361]

This chapter addresses the questions of motivation and intent. The specific characteristics of the virus may or may not make smallpox an appealing weapon, depending on the goals and intent of the individuals or groups who choose to pursue its use as a weapon. The focus here is on the factors that would likely impact a terrorist's

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[359] Gavin Cameron, "Weapons of Mass Destruction Terrorism Research: Past and Future," in *Research on Terrorism: Trends, Achievements, and Failures* , ed. Andrew Silke (London: Frank Cass, 2004), 74–75.

[360] Jessica Stern, *The Ultimate Terrorists* (Cambridge, MA: Harvard University Press, 1999), 70; Jessica Stern, "Terrorist Motivations and Unconventional Weapons," 203.

[361] U.S. Library of Congress, CRS, *Smallpox: Technical Background on the Disease and its Potential Role in Terrorism*, by Frank Gottron, CRS Report RS21288 (Washington, D.C.: Office of Congressional Information and Publishing, January 10, 2003), 5.

decision to pursue or avoid smallpox as a bioweapon. In this chapter, the analysis follows an assumption that terrorists would be capable of overcoming the technological difficulties and costs associated with virus acquisition, laboratory requirements, weaponization, and safe handling. An assumption that these processes could be mastered by a terrorist organization allows this chapter to focus on whether the use of smallpox as a bioweapon is likely given the motivations of terrorists who would potentially choose to use it.

Two sets of data validate narrowing the investigation based upon this assumption. First, evidence from the Soviet Union proves that clandestine weaponization is possible. Although significant resources were devoted to this state-directed project that might not be available to terrorist actors today, the Soviet case demonstrates that the likelihood of determined actors pursuing smallpox weaponization deserves consideration.[362] Some of the factors that might influence a terrorist's calculus of whether smallpox will be his bioweapon of choice are: the virus is likely to be difficult to obtain;[363] smallpox is challenging to work with safely;[364] and there is a vaccine available for unvaccinated victims and many others are at least partially immune, which would lessen the effectiveness of an attack.[365]

Second, smallpox virus can be genetically engineered based on the scientific research that has been carried out and publicized since its eradication. Because the process of synthesizing smallpox virus DNA is thought to be technologically feasible, from the terrorist point of view, the problem of initially acquiring the smallpox virus could be significantly altered, as he might have the option to create the smallpox virus synthetically in a laboratory (rather than relying on finding or stealing historically stored

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[362] House Committee on International Relations, *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapons*, 8; Falkenrath, Newman, and Thayer, *America's Achilles' Heel*, 45, 203.

[363] Tara O'Toole, "Smallpox: An Attack Scenario," *Emerging Infectious Diseases* 5, no. 4 (July–August 1999): 540.

[364] Falkenrath, Newman, and Thayer, *America's Achilles' Heel*, 94–95.

[365] Henderson, "The Looming Threat of Bioterrorism," 1281.

samples).[366] Synthetic engineering of viruses, however, is a complex procedure, so direct acquisition would be preferable if it were possible.

The chapter now turns to the debate about the novelty of contemporary terrorists' motivations and the factors that influence their decisions surrounding types of weapons used. There is division in the field of terrorism scholarship over whether terrorist decision-making is rational or irrational. While some claim that ideology leads to irrational decision-making, others believe that even ideologically motivated terrorists take into account factors such as the terrorist organization's survival and reputation, as well as the ease of means used to achieve its ends. The following sections describe the ideological frameworks that might influence terrorists' goals and choice of methods. Rational considerations such as organizational and individual survival and the comparative ease of conventional over biological weapons are shown to be motivators that would likely lead a terrorist to choose a means of terrorism other than a smallpox attack.

1. "New" Terrorism

The current terrorism literature is divided over whether the last decade or two has shown development of a new kind of terrorist motivation that is significantly different from the world's historical experiences with terrorism. Involvement of extreme religious motivation, level of lethality of attacks, and desire that greater results be realized from the terrorist acts are characteristics that some believe imply that terrorism today is different from in the past. These are precisely the characteristics that many suppose would describe a group with a propensity to use WMDs, arguably making these weapons a more real threat today.[367]

Terrorism scholars who are proponents of the idea that there is a "new terrorism" claim that "new motivations and different capabilities"[368] exemplify a break from the

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[366] Tucker, "The Smallpox Destruction Debate," 6–15.

[367] Walter Laqueur, "Postmodern Terrorism," *Foreign Affairs* 75 no. 5 (September—October 1996): 27–34.

[368] Bruce Hoffman, "Terrorism Trends and Prospects," in *Countering the New Terrorism*, ed. Ian Lesser (Santa Monica, CA: RAND, 1999), 10.

world's past experiences with terrorism in a way that is newly and uniquely dangerous to Western society today.[369] According to these scholars, this "new" terrorism:

> Pursues broad, ideological/religious goals so utopian as to be unattainable in the real world. With God on their side or at least with an unshakable faith in some vision of the future behind them, these zealots kill in pursuit of their millenarian vision, restrained only by the means at their disposal.[370]

These types of terrorists are "thought to be more inclined to use highly lethal methods in order to destroy an impure world and bring about the apocalypse."[371] Although Martha Crenshaw is not a proponent of this idea that today's terrorism is fundamentally different from the past, she accurately summarizes "new" terrorism's purported distinction from "old" terrorism, saying that "new" terrorism:

> Is motivated by religious belief and is more fanatical, deadly, and pervasive than the older and more instrumental forms of terrorism the world had grown accustomed to…. [It] is thought to differ from the 'old' terrorism in terms of goals, methods, and organization.[372]

The proponents of "new" terrorism have studied the motivation behind recent acts of terrorism and have observed that terrorist actors are increasingly drawn to create events that are highly symbolic and dramatic.[373] Ideological motivations could provide the basis for such a large and dramatic attack. Terrorists motivated by religion might display their "dedication to a provocative and shocking form of violence" by causing sensational damage.[374] Because of their belief that their actions have divine backing,

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[369] Hoffman, "Terrorism Trends and Prospects," 7–38.

[370] Thomas Mockaitis, *The "New" Terrorism: Myths and Reality* (Westport, CT: Praeger Security International, 2007), 8.

[371] Martha Crenshaw, "The Psychology of Terrorism: An Agenda for the 21st Century," *Political Psychology* 21, no. 2 (2000), 411.

[372] Ibid.

[373] Mark Juergensmeyer, *Terror in the Mind of God: The Global Rise of Religious Violence* (Berkeley, CA: California University Press, 2000), 121–141, 220.

[374] Martha Crenshaw, "An Organizational Approach to the Analysis of Political Terrorism," in *Orbis* 29 no. 3 (Fall 1985), 466; Martha Crenshaw, "'New' vs. 'Old' Terrorism: A Critical Appraisal," in *Jihadi Terrorism and the Radicalisation Challenge in Europe*, ed. Rik Coolsaet (Hampshire, England: Ashgate Publishing, 2008), 25–36; Laqueur, "Postmodern Terrorism," 30–36.

these types of terrorists "seem far less likely to worry about the consequences of their actions and far more willing to engage in mass killing"[375] than the more traditional types of terrorists who are concerned with gaining support for their cause. The use of weaponized smallpox would necessitate such a disregard for consequences. Its high fatality rate would put smallpox in the category of an attack that is sensational, dramatic, and lethal, and in line with the "indiscriminate killing"[376] that terrorism scholar Walter Laqueur claims is the current trend in terrorist tactics.

One explanation for this motivation in terrorists driven by religious fervor is their tendency to believe that their cause is part of a divine war. Portraying "the dichotomous image of the conflict [as]… 'amplified' into an image of military war," provides terrorists with a clear enemy.[377] Because this enemy acts against God's will, the violence is justified. In a cosmic struggle, there is no room for compromise; this belief in the absolute rightness of their actions provides these terrorists with a moral sanction.[378]

For example, religiously motivated terrorists could construe a deadly transmissible disease such as smallpox as a plague on non-believers or enemies of God's plan. If a terrorist believes that his actions are justified by God, it is possible that he would consider a large-scale attack. Two examples illustrate this belief. First, Shoko Asahara, the leader of Aum Shinrikyo, explained to his followers that the conflict between good and evil warranted the use of any kind of weapon to bring about the Armageddon that God had revealed to him.[379] Second, al Qaeda has reasoned that God allows the use of biological weapons against non-believers when conducting a defensive jihad.[380] Smallpox would certainly qualify as a weapon that would further both groups' aims in this regard.

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[375] Mockaitis, *The "New" Terrorism*, 8.

[376] Laqueur, "Postmodern Terrorism," 25.

[377] Donatella Della Porta, "Introduction: On Individual Motivations in Underground Political Organizations," in *Social Movements and Violence: Participation in Underground Organizations*, ed. Donatella Della Porta (JAI Press, 1992), 21.

[378] Juergensmeyer, *Terror in the Mind of God*, 219–221.

[379] Jessica Stern, "Terrorist Motivation and Unconventional Weapons," 211, 214.

[380] Ibid.

If, as these proponents of "new" terrorism claim, terrorists today require a large, dramatic, symbolic attack, then this type of terrorist could find value in resorting to WMDs. If mass casualty is not a goal that is aligned with terrorists' desired outcome, however, terrorist actors would not be likely to prefer smallpox. In making an argument against the likelihood of terrorists choosing to use nuclear weapons, Brian Jenkins has claimed that terrorists might not be inclined toward huge numbers of casualties, saying: "Terrorists want a lot of people watching and a lot of people listening and not a lot of people dead."[381] Until the terrorist attacks of 2001, many terrorism scholars agreed with Jenkins' conclusion that "killing a lot of people has seldom been a terrorist objective…. Terrorists operate on the principle of the minimum force necessary. They find it unnecessary to kill many, as long as killing a few suffices for their purposes."[382] Other scholars, however, have determined through a more recent historical review of instances of terrorism that "the argument that terrorists want publicity is clearly no longer the sole motivation for many groups and the concept that such organizations do not want a lot of people dead is also questionable."[383] If the latter scholars are correct, the motivation to use smallpox as a weapon could be considered plausible.

Terrorism scholars who have examined historical trends of terrorism do not all agree with this assessment that terrorist ideology today is identified by propensity to create larger and deadlier attacks. They maintain that the term "new terrorism" misleads us to believe that terrorist methods today are increasingly focused on killing in large numbers purely because of religious convictions of the attackers, when, in fact, this is not the case.[384] Martha Crenshaw and others have demonstrated that claims of an entirely "new" form of terrorism that is more deadly than in the past should be generally considered an erroneous and unfounded interpretation of the recent examples of terrorist history.[385] As Crenshaw points out, a historical analysis of instances of terrorism reveals

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[381] Brian Jenkins, "Will Terrorists Go Nuclear?" RAND Paper Series, no. P-5541 (Santa Monica, CA: RAND Corporation, 1975), 5.

[382] Cameron, "Weapons of Mass Destruction Terrorism Research," 75.

[383] Ibid., 78.

[384] Crenshaw, "'New' vs. 'Old' Terrorism," 25–31.

[385] Crenshaw, "The Psychology of Terrorism," 411–418.

that "religious terrorists have not been quick to resort to weapons of mass destruction,"[386] and furthermore, the "data on which the association between religion and mass casualties is based are incomplete."[387] Crenshaw finds an "absence of empirical evidence for many claims about a 'new' terrorism, particularly in the likelihood of the use of weapons of mass destruction."[388] The "new" label is misleading because "levels of selectivity [in choice of targets] and restraint vary across groups and across time, but not according to a religious–secular or past–present divide."[389] David Rapoport agrees that a historical overview of terrorist actions does not bear out that religious conviction is a motivator for large-scale violence.[390] Although this does not rule out the possibility of those with religious conviction ever killing in large numbers in the future, it is unlikely that religious or moral motivations alone indicate a preference to choose smallpox as a bioterror weapon.

2. Compared to Suicide Terrorism

Extreme ideology or conviction would likely also motivate a terrorist who attempted to use his body as a means of transmitting smallpox. Studies conducted on the "modern phenomenon"[391] of suicide terrorism have concluded that "religious fanaticism is neither a necessary nor a sufficient factor in suicide terrorist attacks."[392] Therefore, the previous debate surrounding religious conviction as an insufficient potential motivation for pursuing this type of biological warfare attack is strengthened. Religion by itself is not likely to convince a terrorist to conduct a smallpox attack on others or to accept the fact that he will die in the process of unleashing such a disease. In fact, even though there might exist "the microsociety of a terrorist group…that provides the social milieu

386 Crenshaw, "'New' vs. 'Old' Terrorism," 31.

387 Ibid., 36.

388 Crenshaw, "The Psychology of Terrorism," 415.

389 Crenshaw, "'New' vs. 'Old' Terrorism," 31.

390 Cameron, "Weapons of Mass Destruction Terrorism Research," 76.

391 Ariel Merari, "Psychological Aspects of Suicide Terrorism," in *Psychology of Terrorism*, ed. Bruce Bongar, Lisa Brown, Larry Beutler, James Breckenridge, and Phillip Zimbardo (Oxford: Oxford University Press, 2007): 102.

392 Ibid., 106.

amenable to generating self-sacrificial suicide … the great majority of terrorist groups, regardless of their structure, have not resorted to suicide attacks."[393]

In spite of these assessments, many cases of suicide terrorism have occurred. Suicide terrorism scholar Robert Pape has catalogued eighteen campaigns (consisting of multiple attacks each) from 1980 to 2003.[394] In the majority of these attacks, death of the suicide terrorist occurs through vehicle bombs, belt bombs, or similar explosive means.[395] It is clear that those who are strongly committed to their cause sometimes come to believe that their death, though violent, can help to achieve a goal.[396] Even those willing to kill themselves for a cause, however, might not choose to do so using smallpox. The likelihood of suffering a slow, painful death—compared to death that comes quickly from something like an explosion—could be a factor that makes suicide-by-smallpox less appealing than more traditional means of suicide terrorism.

Additionally, as there is no way of knowing in advance whether a case of smallpox will be fatal, an informed terrorist might consider the fact that blindness and/or disfiguration—rather than death—could be the result of his actions. Suicide terrorists who would consider killing themselves through an explosion or similar means might be less willing to suffer the symptoms that sickness from smallpox would bring. For these reasons, even a terrorist who otherwise possesses the conviction to die for a cause might not be willing to attempt to do so via smallpox.

If he was willing, however, as Chapter II notes, it is generally held to be scientifically improbable that a smallpox epidemic could be started in a manner similar to a suicide mission. One member of the Centers for Disease Control's team who studies

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[393] Merari, "Psychological Aspects of Suicide Terrorism," 108.

[394] Robert Pape, *Dying to Win: The Strategic Logic of Suicide Terrorism* (New York, NY: Random House, 2005), 253–263.

[395] Ibid.

[396] Ami Pedahzur, *Suicide Terrorism* (Cambridge, UK: Polity Press, 2005), 126–134.

smallpox outbreak models has called such as scenario "absolutely preposterous."[397] A terrorist who believes these assessments would likely be deterred from using this method due to its low chance of success.

3. Rational Considerations as Possible Deterrents

A terrorist who makes decisions rationally must consider the impact that his goals and methods will have on his individual survival, and that of his organization. He must also weigh the impact of a decision to violate the potential taboo against killing with biological weapons. Additionally, conventional weapons have advantages over a smallpox weapon that might be more appealing to terrorist actors.

In making this decision between biological and conventional weapons, the terrorist would likely consider the advantages brought by each. Conventional weapons are generally cheaper and easier to obtain and use than biological weapons.[398] Unlike biological weapons, conventional weapons will not infect those who are exposed to them.[399] Conventional weapons can be, however, sometimes dangerous to those who work on them. For example, a bomb-maker faces significant risk of explosion while constructing his weapon.

Even if a terrorist did choose to pursue biological weapons instead of conventional ones, there are biological agents that are easier to obtain, produce, and control than smallpox. Anthrax is one example of a biological agent that can be found in nature, that is relatively easily reproduced in large quantities in a short amount of time, and that does not spread uncontrollably from person to person.[400] These factors demonstrate that within the range of possible agents for use in biological terrorism, there are less complex agents available to choose than smallpox. Groups committed to a biological attack, therefore, are more likely to use agents other than smallpox.

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[397] Enserink, "How Devastating Would a Smallpox Attack Really Be?" 1593.

[398] Falkenrath, Newman, and Thayer, *America's Achilles' Heel*, 100–115.

[399] Ibid.

[400] Chris Holmes, *Spores, Plagues and History: The Story of Anthrax* (Dallas, TX: Durban House Publishing, 2003), 138; Jeanne Guillemin, *Anthrax: The Investigation of a Deadly Outbreak* (Berkeley, CA: University of California Press, 1999), 4–5.

Most groups, however, will probably still choose to use conventional over biological options. Another advantage of conventional weapons is that they have shown demonstrable historical successes when compared to biological weapons.[401] There are fewer historical instances of successful biological attacks than conventional weapon attacks that potential terrorists can look to for planning guidance.[402] Some scholars have used case studies to conclude that terrorists tend to prefer weapons that work as expected vice those that could produce unknown results.[403] Bruce Hoffman has concluded that:

> The operational conservatism inherent in the terrorists' organizational imperative to succeed… [will keep them from] embark[ing] on grandiose operations involving weapons of mass destruction (WMD) that carry with them the potential to kill on a much larger scale…. [W]ithout exception the terrorists' weapons have remained exclusively conventional… and have mostly conformed to long-established patterns of previous terrorist operations.[404]

The risks from conventional weapons are likely preferable to most terrorists, as they are more predictably assessed than the risks associated with contagious and transmissible viruses. These criteria would likely tip the scales in favor of terrorists choosing to use conventional weapons such as guns and bombs over the more complicated alternative of weaponizing a transmissible deadly disease.

Not all terrorist groups, however, have considered these to be adequate deterrents from pursuing unconventional weapons. Aum Shinrikyo attempted ten chemical attacks and ten biological attacks between 1990 and 1995.[405] Clearly, what some have perceived as advantages to conventional weapons did not deter them from pursuing biological weapons such as botulinum toxin, anthrax, Q fever, and chemical weapons such as sarin

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[401] Falkenrath, Newman, and Thayer, *America's Achilles' Heel*, 100–115.

[402] Ibid., 45.

[403] Jonathan B. Tucker, *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons* (Cambridge, MA: MIT Press, 2000), 266–267; Jessica Stern, "Terrorist Motivations and Unconventional Weapons," 204.

[404] Hoffman, "Terrorism Trends and Prospects," 36.

[405] David Kaplan, "Aum Shinrikyo (1995)," in *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, ed. Jonathan Tucker (Cambridge, MA: MIT Press, 2000), 207.

gas, VX gas, and hydrogen cyanide.[406] The case of Aum Shinrikyo may not be an exemplar of the norm; Jessica Stern points out through her rational actor model of terrorist motivation for using unconventional weapons that "terrorists who hope to influence policy (rather than to destroy the government outright or kill for its own sake) are unlikely to resort to mass destruction."[407] As long as terrorists believe that their long-term goals can be met by means other than spreading a deadly transmissible disease, they might choose not to follow Aum Shinrikyo's example. Furthermore, although the cult had intended to kill thousands of people through biological attacks, the fact that their attempts proved unsuccessful could inform future terrorist decision-making.[408] Aum Shinrikyo's demonstrated failures with chemical and biological attacks could make CBW less attractive, as terrorists are unlikely to attempt to duplicate methods that have proven unsuccessful in the past.

Ehud Sprinzak claims that "the flourishing mystique of chemical and biological weapons suggests that angry and alienated groups are likely to manipulate them for conventional political purposes."[409] Despite this conclusion, Sprinzak would likely agree that smallpox as a weapon would not be one that falls within this category because the "growing interest in…biological weapons" that he has studied was primarily related to "small-scale tactical attacks."[410] An attack using smallpox, even among a partially vaccinated population, would spread the disease and would not be considered small-scale.

Other considerations that are likely terrorist concerns are factors such as organization survival and loss of support for the group after a smallpox attack. Would the use of smallpox hurt a terrorist organization? If so, what might explain or justify the use of this exceptionally deadly bioterror weapon?

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[406] Kaplan, "Aum Shinrikyo," 213–214.

[407] Jessica Stern, "Terrorist Motivations and Unconventional Weapons," in *Planning the Unthinkable: How Powers Will Use Nuclear, Biological, and Chemical Weapons* , ed. Peter Lavoy, Scott Sagan, and James Wirtz (Ithaca, NY: Cornell University Press, 2000), 211.

[408] Stern, "Terrorist Motivations and Unconventional Weapons," 208.

[409] Ehud Sprinzak, "The Great Superterrorism Scare," *Foreign Policy* 112, (Fall 1998), 118.

[410] Sprinzak, "The Great Superterrorism Scare," 118.

a. Impact on Organization

Martha Crenshaw's analysis of terrorist organizations has demonstrated that "acts of terrorism may be motivated by the imperative of organizational survival" and that it is important to both the leaders and members within the organization that the group survives.[411] A terrorist using a communicable disease such as smallpox as a bioweapon would have to consider both surviving the infection that has been set loose as well as surviving the reprisals and retaliation that are likely to come from conducting such a serious attack.[412] Biological weapons, more than conventional weapons, pose the risk of injury or death to greater numbers of the terrorist's own group or supporters.[413] While a conventional attack is likely limited to impacting a particular location, a smallpox attack would cause infections that would spread unpredictably. This makes a conventional attack (or a biological or chemical attack that could be contained to a local area) one that could potentially produce less harsh reprisals than a high-impact biological attack such as smallpox. The perception that a conventional attack might bring about less severe retaliation could impact a terrorist's decision not to use a biological weapon such as smallpox.

Releasing a deadly disease such as smallpox could alienate the terrorist organization from the society among which it was living, assuming the source of the attack was attributed correctly. Because releasing smallpox has no guarantee that an attack against outsiders would not also spread to cause infection among local supporters, it is unlikely that the terrorist organization would perceive such a lethal and uncontrolled event as one that would not have potential to harm its cause. By potentially killing (rather than protecting or coexisting with) their supporters, the terrorists would likely lose their support and the appearance of legitimacy if it was known that they were the perpetrators. Because smallpox is no longer present in nature, terrorist release would be implicated in a smallpox epidemic today. Depending on how well the terrorist

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411 Crenshaw, "An Organizational Approach to the Analysis of Political Terrorism," 473–474.

412 Laqueur, "Postmodern Terrorism," 31.

413 Ibid.

organization's goals and methods are known to its supporters, suspicions of the outbreak's origin may or may not be aroused in the terrorist group's community.

b. Belief in a Moral Sanction

Martha Crenshaw has observed that although attention and recognition of terrorist acts is important to the actors, "media attention must be gratifying to the terrorist…. [T]errorist strategies are adapted to acquiring maximum publicity in terms of timing and choice of appropriate targets of violence."[414] Neither the immediate nor the international communities are likely to view any attack using such a disease as being an "appropriate target" of violence. Bioterrorism expert Leonard Cole describes the repulsion for using biological agents as weapons as a "deeply imbedded human inclination: we are attuned to fighting *against* germs, not *with* them. To disturb this primal formula is to invite psychological dissonance."[415] Because of this, "people find efforts purposely to infect others repugnant."[416] A smallpox attack would almost certainly be universally decried as an abhorrent tactic, therefore earning little support for the terrorist organization's aims.

If terrorists themselves do not believe that it is wrong to use biological agents in terrorism, they may be deterred because they expect that their audience or supporters would have moral objections to spreading lethal contagious disease. Terrorism expert Jessica Stern claims that "many terrorists will shy away using these [WMD] weapons because they, or their constituents, consider them morally abhorrent."[417] As an illustration, she hypothesizes that the Irish Republican Army would "probably be less effective in fundraising operations on Boston Common if it employed

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414 Crenshaw, "An Organizational Approach to the Analysis of Political Terrorism," 478.

415 Leonard A. Cole, *The Eleventh Plague: The Politics of Biological and Chemical Warfare* (New York, W.H. Freeman and Company, 1996), 220.

416 Ibid., 221.

417 Jessica Stern, *The Ultimate Terrorists* (Cambridge, MA: Harvard University Press, 1999), 69.

bubonic plague as a weapon."[418] Such moral implications, if present in a terrorist actor, could influence a decision to use conventional instead of biological weapons.[419]

Not all terrorist groups, however, are affected by such moral norms; Aum Shinrikyo's use of nerve gas in an attack in the Japanese subway system in 1995 shows that moral considerations are not always adequate deterrents.[420] Nuclear terrorism expert S. Paul Kapur has concluded that Aum Shinrikyo's negative goals made the group unsusceptible to this type of deterrent, as they "did not value the well-being of any particular population or territory."[421] Such moral disengagement is likely required for any terrorist group considering the use of WMDs.[422]

Al Qaeda, too, has implied recognition of these moral norms. Their statements on the topic of using WMD show realization that their use is somewhat exceptional, and therefore requires addition explanations and justification. In order to maintain their legitimacy, the organization's leaders have attempted to explain how the group is not, in fact, violating the taboo against killing with biological weapons because their actions are justifiable. By including reasoning such as "it is our right to fight them with chemical and biological weapons, so as to afflict them with the fatal maladies that have afflicted the Muslims because of the [Americans'] chemical and biological weapons,"[423] al Qaeda is acknowledging the exceptional nature of the use of chemical and biological agents in war.

B. CONCLUSION

Given the considerations of a smallpox attack's likely impact on the terrorist organization and the advantages that conventional weapons offer over biological ones, it seems probable that a terrorist actor or group would not choose smallpox as a bioweapon

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[418] Stern, *The Ultimate Terrorists*, 185.

[419] Cole, *The Eleventh Plague*, 213–226.

[420] Ibid., 221.

[421] Kapur, "Deterring Nuclear Terrorists," 122.

[422] Stern, *The Ultimate Terrorists*, 80.

[423] Venzke and Ibrahim, *The al-Qaeda Threat*, 23.

of choice. Those motivated by religious ideology are not likely to want to take advantage of the exceptionally lethal and transmissible nature of smallpox based upon either religious or moral imperatives or because they are seeking exceptionally deadly or sensational means of attack. Claims that these terrorists' motivations are part of new and more lethal form of terrorism are exaggerated or misinterpreted. Those terrorists who take into account rational decision-making factors are likely to be dissuaded from choosing to conduct a smallpox attack. It is probable that motives such as group preservation and preferences for conventional weapons would deter these terrorists from choosing smallpox over other weapons. Given these considerations, it is unlikely that a terrorist actor or group would make the decision to pursue smallpox weaponization as a candidate for a bioterrorist attack.

Chapter IV will continue the assumption that terrorists are capable of weaponizing smallpox and additionally will assume that the rational considerations just discussed in this chapter have not deterred a terrorist from pursuing smallpox. This allows Chapter IV to address the impact that domestic and international laws and consequence mitigation measures might have on this decision.

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IV. CURRENT POLICIES AND REPORTS

I will next examine the factors likely to affect the response of the U.S. government if a biological attack were to occur, and whether the knowledge of forthcoming retaliation would be likely to deter terrorist actors from pursuing or using smallpox as a weapon of bioterror. In addition to this aspect of deterrence, I will also consider the potential for deterrence by denial. Government action in advance of an attack aimed at mitigating the consequences of smallpox bioterrorism could influence terrorists not to use smallpox because of the lessened chance that their objectives would be met.

A. POLICIES, LAWS, AND TREATIES AGAINST BIOWARFARE

Three major international documents address the issue of biological warfare: the Geneva Protocol, the Biological Weapons Convention, and United Nations Security Council Resolution 1540. Domestic laws supplement their provisions with specific regulations intended to make United States citizens safe from bioterrorism and to create a legal regime that balances this security with the need to protect legitimate scientific research and to protect the civil liberties of those involved. In spite of the intent of this legislation, it is unlikely that the provisions of either the international or domestic laws are strong enough to enable prevention or to deter a terrorist actor intent on committing a smallpox attack.

1. Geneva Protocol

In 1925, the Geneva Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare was signed. Previous treaties had prohibited the use of many forms of poison gases and

liquids in war, but had not banned biological warfare.[424] The 1925 Protocol aimed to re-affirm and formalize the earlier treaties' universal condemnation and, additionally, "to extend this prohibition to the use of bacteriological methods of warfare."[425] Biological warfare was now forbidden, but cessation of research and weaponization was not called for. Countries continued to develop and study both chemical and biological warfare agents during and after World War II.[426]

By the 1960s, the domestic and international political climate had changed. The United States had been accused of using biological weapons during both the Korean War and the Cold War.[427] Critics of germ warfare had begun to criticize publically the government's secret biological research programs.[428] Government officials had begun to question whether biological warfare was necessary in light of the deterrent factor provided by the nation's nuclear weapons.[429] Great Britain summarized the concerns surrounding the indiscriminate and unpredictable nature of biological weapons in a proposal to limit practices related to biological warfare that was presented to the United Nations in July 1969.[430]

In response to these concerns and the growing lack of acceptance of biological warfare as legitimate or necessary, President Nixon announced in November 1969 that the United States would "renounce the use of lethal biological agents and weapons, and all other methods of biological warfare. The U.S. will confine its biological research to

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[424] The Hague Declaration Concerning Asphyxiating Gases (signed in 1899) and the Hague Convention Respecting the Laws and Customs of War on Land (signed in 1907) were pre-World War I measures to address the use of these poison agents in warfare. The 1925 Protocol was seen as a necessary improvement in response to the chemical warfare that took place during World War I. [Mauroni, *Chemical and Biological Warfare*, 5–11.]

[425] Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare, signed at Geneva, June 17, 1925.

[426] Mauroni, *Chemical and Biological Warfare*, 11–14.

[427] George Christopher, Theodore Cieslak, Julie Pavlin, and Edward Eitzen, "Biological Warfare: A Historical Perspective," in *Biological Weapons: Limiting the Threat*, ed. Joshua Lederberg (Cambridge, MA: MIT Press, 1999), 25–26.

[428] Mauroni, *Chemical and Biological Warfare*, 18.

[429] Judith Miller, Stephen Engelberg, and William Broad, *Germs: Biological Weapons and America's Secret War* (New York: Simon & Schuster, 2001), 61–62.

[430] Christopher, Cieslak, Pavlin, and Eitzen, "Biological Warfare," 27; Mauroni, *Chemical and Biological Warfare*, 19.

defensive measures."[431] This was the first step in extending the belief that biowarfare was no longer acceptable into government policy. However, nothing about an announcement from the American president prevented other countries, especially the Soviet Union, from continuing research and development in their own offensive biological weapon programs. Although it was not brought to light until years later, it is believed that during this time the Soviet Union was capable at its peak of producing one hundred metric tons per year of smallpox virus.[432] It would take more than a good-faith declaration from the Americans to stop such a robust Soviet program.

2. Biological Weapons Convention

The next step to changing biological weapons policy came in 1972, when the United States signed The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, which is more commonly referred to as the Biological Weapons Convention (BWC). The States Parties and Signatories believed that it was in the best interests of the international community to update and supplement the 1925 Geneva Protocol with more specific regulations.

When the BWC was ratified in 1975, each State Party agreed "never in any circumstance to develop, produce, stockpile, or otherwise acquire or retain: … Microbial or other biological agents … of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes."[433] Countries could still conduct research for defensive purposes, as long as it did not involve research on biological

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[431] Speech given by President Richard Nixon (November 25, 1969; Fort Detrick, MD), quoted in Judith Miller, Stephen Engelberg, and William Broad, *Germs: Biological Weapons and America's Secret War* (New York: Simon & Schuster, 2001), 63.

[432] Miller, Engelberg, and Broad, *Germs*, 254; Alibek and Handelman, *Biohazard*, 121–122.

[433] United Nations, "The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction," 10 April 1972, United Nations *Treaty Series: Treaties and International Agreements Registered or Filed or Recorded with the Secretariat of the United Nations* 1015 (New York: United Nations, 1984), 166.

weapon delivery systems, which was explicitly banned.[434] The terms of the convention were intentionally left vague enough to remain relevant through future scientific advances;[435] however, this left room for interpretation. For example, in the late 1990s, the Central Intelligence Agency and the Pentagon were both studying biological weapons, causing government lawyers to debate whether studying a weapon for defensive purposes was a violation of the 1972 BWC.[436]

After the World Trade Center attacks in 2001, the international nature and exceptionally lethal potential of terrorism was evident. This brought to light the need to take greater measures to ensure that non-state actors would not acquire nuclear, biological, and chemical weapons.[437] In addition, limitations of the BWC had surfaced since its ratification: evaluating state parties' compliance had proven difficult, information sharing between parties surrounding the effectiveness of their national legislation was lacking, and national laws were not all implemented using the definitions agreed upon in the text of the BWC.[438]

3. UN Security Council Resolution 1540

As a result, in April 2004, the United Nations Security Council unanimously adopted Resolution 1540, which made two important points clear: (1) that "all States shall refrain from providing any form of support to non-State actors that attempt to develop, acquire, manufacture, possess, transport, transfer or use"[439] biological weapons or delivery devices; and (2) that:

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[434] Angela Woodward, "The Biological Weapons Convention and UNSCR 1540," in *Global Non-Proliferation and Counter-Terrorism: The Impact of UNSCR* 1540, ed. Olivia Bosch, Peter van Ham, and Jeffery Almond (Washington, D.C.: Brookings Institution Press, 2005), 98.

[435] Ibid.

[436] Miller, Engelberg, and Broad, *Germs*, 288.

[437] Mauroni, *Chemical and Biological Warfare*, 24–27.

[438] Woodward, "The Biological Weapons Convention and UNSCR 1540," 105–106.

439 U.N. Security Council, 4956th Meeting, Resolution 1540 (2004), (S/RES/1540), 28 April 2004. http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N04/328/43/PDF/N0432843.pdf?OpenElement (accessed August 15, 2011), 2.

> All States, in accordance with their national procedures, shall adopt and enforce appropriate effective laws which prohibit any non-State actor to [perform the above actions,] in particular for terrorist purposes, as well as to engage in any of the foregoing activities, participate in them as an accomplice, assist or finance them.[440]

Because of the nature of Security Council resolutions, these provisions legally bind all states to adhere to these prohibitions.[441] Not to fulfill its obligations would put a signatory in violation of international law.[442]

Therefore, a state that assisted non-state actors in any form of research or development relating to smallpox would be acting in contravention to Resolution 1540 and, therefore, Chapter VII of the United Nations (UN) Charter. Such a state "could face a bevy of different actions by other nations, including such things as sanctions,… loss of good will and international capital, etc."[443] Although peaceful resolution of violations is the Security Council's first resort, Article 39 of the UN Charter could be invoked under certain circumstances to allow for the use of force to resolve a violation.[444]

Although no evidence has come to light in the international community that any state is in violation of Resolution 1540, the threat that a terrorist actor could research and develop a smallpox weapon is real. As Chapter III makes clear, evidence from the Soviet Union proves that clandestine weaponization of the smallpox virus is possible, and that secret state sponsorship of biological weapons research has been a reality in the past. However, significant resources were devoted to the Soviet Union's biological weapons research and development projects that might not be available to terrorist actors today.[445]

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[440] U.N. Security Council, 4956th Meeting, Resolution 1540 (2004), (S/RES/1540), 28 April 2004. http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N04/328/43/PDF/N0432843.pdf?OpenElement (accessed August 15, 2011), 2–3.

[441] Woodward, "The Biological Weapons Convention and UNSCR 1540," 97.

[442] Beckman, *Comparative Legal Approaches*, 155.

[443] Ibid., 154–155.

[444] Ibid., 156.

[445] House Committee on International Relations, *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox, and Other Bioterrorist Weapons*, 8; Falkenrath, Newman, and Thayer, *America's Achilles' Heel*, 45, 203.

Although Resolution 1540 could be a significant factor in deterring a state from funding terrorist smallpox weapons, it is possible that terrorists could fund and conduct the required operations without state backing. Scientific advances have made it likely that the smallpox virus can be genetically engineered, based on the scientific research that has been carried out and publicized since its eradication.[446] Many legitimate laboratories conduct research on genetic engineering and DNA synthesis, and the same techniques could be applied to smallpox in laboratories that already exist. Because the process of synthesizing smallpox virus DNA is thought to be technologically feasible,[447] laws preventing a state from transferring smallpox to a non-state actor are rendered less important. However, laws preventing the state from supporting and funding biological programs that could be used for terrorist purposes remain relevant.

Although DNA synthesis may be able to be used to synthesize the smallpox virus for nefarious purposes, it can also be conducted legitimately. The World Health Organization sanctioned such legitimate research in 1990.[448] In the following years, a debate was periodically raised over whether to destroy the two remaining legal stores of smallpox virus.[449] One reason for the virus' stay of destruction was that synthesis of its DNA was incomplete: a fact that anti-destructionists claimed would leave the scientific community unable to adequately protect the public in the event of a smallpox outbreak.[450] Clearly, research into DNA synthesis cannot be banned on the chance that a

[446] Lane and Summer, "Smallpox as a Weapon for Bioterrorism," 148.

[447] Jonathan B. Tucker, "The Smallpox Destruction Debate: Could a Grand Bargain Settle the Issue?" *Arms Control Today* (March 2009): 6–15.

[448] Jonathan Tucker, "Preventing the Misuse of Biology: Lessons from the Oversight of Smallpox Virus Research," *International Security* 31, no.2 (Fall 2006): 128.

[449] Tucker, "Preventing the Misuse of Biology," 129; D.A. Henderson and Frank Fenner, "Recent Events and Observations Pertaining to Smallpox Virus Destruction in 2002," *Clinical Infectious Diseases* 33, no. 7 (October 1, 2001): 1057–1059; Jonathan Tucker, "Breaking the Deadlock Over Destruction of the Smallpox Virus," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 9, no. 1 (2011): 63–66; J. Michael Lane, "Remaining Questions about Clinical Variola Major," *Emerging Infectious Diseases* 17, no.4 (April 2011): 676–679.

[450] Committee on the Assessment of Future Scientific Needs for Live Variola Virus, Board on Global Health, Institute of Medicine, *Assessment of Future Scientific Needs for Live Variola Virus* (Washington, DC: National Academy Press, 1999), 2–3.

terrorist might use it to conduct biological terrorism; however this makes the issues of protection and punishment more difficult from the point of view of the legal and judicial systems.

Resolution 1540 was an important addition to the international legal regime for another reason. For the first time, international law surrounding bioterrorism required more than a state's pledge to uphold the terms of the treaty to which it was party. By signing Resolution 1540, states agreed to augment their domestic legal systems with laws of their own that were in accordance with the terms set forth by the Security Council. In effect, this shifted the matter of international bioterrorism from an international political matter to a domestic legislative concern.

The 1540 Committee periodically reports to the Security Council on compliance with Resolution 1540. The most recent report indicates an "upward trend in the progress made by States in implementing measures to prevent non-State actors from acquiring… biological weapons and their means of delivery."[451] As of 2011, "112 States have a national legal framework prohibiting the manufacture or production of biological weapons."[452] Ninety states have implemented legislation addressing the issue of biological weapons delivery and more than 100 currently have laws forbidding acting as an accomplice in many of the aspects of biological warfare.[453] Fifty-seven states have enforcement measures in place that regulate licensing "for materials related to biological weapons as permitted activities for academic, commercial, industrial or public health purposes" and forty-seven have similar laws regarding genetic engineering of biological weapons.[454] All of these numbers reflect improvement from previous reports. The

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[451] Security Council Committee established pursuant to Security Council Resolution 1540 (2004), *Report of the Committee established pursuant to Security Council Resolution 1540 (2004)*, S/2011/579, (September 14, 2011), 2. http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N11/530/08/PDF/N1153008.pdf?OpenElement (accessed March 19, 2012).

[452] Ibid.

[453] Committee on the Assessment of Future Scientific Needs for Live Variola Virus, Board on Global Health, Institute of Medicine, *Assessment of Future Scientific Needs for Live Variola Virus* (Washington, DC: National Academy Press, 1999), 12.

[454] Ibid., 15.

Committee noted, however, that additional efforts were required to strengthen the area of enforcement of prohibitions surrounding non-State actors and biological weapons.[455]

4. Domestic Legislation

Domestic legislation in the U.S. had attempted to address different issues related to bioterrorism prior to the signing of Resolution 1540 in 2004. In response to the 1972 BWC, Congress passed the Biological Weapons Antiterrorism Act of 1989.[456] This law attempted to define for the U.S. legal system the use of biological agents[457] for the purpose of a weapon, and to make such actions illegal.[458] Scientists provided input into the drafting of this legislation so that its final form would be less likely to cause confusion over whether legitimate scientific pursuits had been made illegal and so that legitimate laboratory practices would not be unintentionally affected.[459] The legislation leaves to the government the crucial role of proving that a person charged with violating this law had not intended to use the biological agent for a legitimate purpose; the burden of proof does not lie with the accused to prove his or her innocent scientific intentions.[460]

This legislation was proven insufficient in 1995 when an American member of a white supremacist group named Larry Wayne Harris successfully ordered vials of bubonic plague through the mail.[461] When law enforcement officials were contacted based on suspicions surrounding his order, their investigation uncovered that he was insufficiently trained in the scientific practices required to handle the plague bacteria that

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[455] Ibid., 11.

[456] Gerald Epstein, "Law Enforcement and the Prevention of Bioterrorism: Its Impact on the U.S. Research Community," in *Global Non-Proliferation and Counter-Terrorism: The Impact of UNSCR* 1540, ed. Olivia Bosch, Peter van Ham, and Jeffery Almond (Washington, D.C.: Brookings Institution Press, 2005), 169.

[457] The term "biological agent" is defined in *U.S. Code* 18, section 175. Use of the term throughout this paper refers to that definition.

[458] *Biological Weapons Antiterrorism Act of 1989*, Public Law 101-298, codified as *U.S. Code* 18, sections 175–178.

[459] Epstein, "Law Enforcement and the Prevention of Bioterrorism," 169–170.

[460] Ibid., 170.

[461] Jessica Stern, "Larry Wayne Harris (1998)," in *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, ed. Jonathan Tucker (Cambridge, MA: MIT Press, 2000), 227–246; Epstein, "Law Enforcement and the Prevention of Bioterrorism," 170.

he had been storing in his car.[462] In spite of the fact that he was not a microbiologist (as he claimed) and he did not have adequate laboratory facilities to handle the plague safely, law enforcement officials were unable to convict him of violating the Biological Weapons Antiterrorism Act of 1989 because there was no proof of his intent to use the bubonic plaque as a weapon.[463] His claim of needing the plague for his protection could not be disproven by the FBI; therefore, the only charge brought against him was mail fraud.[464]

Partly in response to the gaps in the law brought to light by the Larry Wayne Harris case, the Antiterrorism and Effective Death Penalty Act was passed in 1996.[465] It included more specific regulation about transferring and possessing certain biological agents because Congress had realized that "the transfer and possession of potentially hazardous biological agents should be regulated to protect public health and safety."[466] The law mandated that within 120 days the Secretary of Health and Human Services must oversee:[467]

> (1) the establishment and enforcement of safety procedures for the transfer of [listed] biological agents,… including measures to ensure: (a) proper training and appropriate skills to handle such agents; and (b) proper laboratory facilities…; and (2) safeguards to prevent access to such agents for use in domestic or international terrorism or for any other criminal purpose.[468]

By amending the existing bioterrorism legislation, Congress had recognized that current laws were insufficient to allow the judicial system to adequately address the cases being brought forth by law enforcement officials. In response to this law, by 1997 a

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462 Epstein, "Law Enforcement and the Prevention of Bioterrorism," 171.

463 Ibid.

464 Jessica Stern, "Dreaded Risks and the Control of Biological Weapons," *International Security* 27, no. 3 (Winter 2002–2003): 108.

465 Epstein, "Law Enforcement and the Prevention of Bioterrorism," 171.

466 *Antiterrorism and Effective Death Penalty Act of 1996*, Public Law 104-132, 104th Cong., 2d sess. (January 3, 1996), section 511(a)(3).

467 Ibid., section 511(f)(2).

468 Ibid., section 511(e).

system was in place that required shipping and receiving facilities that handled the listed biological agents to register with the federal government before the transfer of any of the agents could take place.[469]

In spite of this additional regulation, the laws concerning possession of these agents remained unchanged; the system enacted in 1997 required the facilities to register the transfer of agents, but registration for the personnel who used them was still not required.[470] Partly in response to the fact that in spite of the new legislation a person could still only be charged with violation if it could be proven that he or she intended to use the biological agents as a weapon, President Clinton proposed legislation entitled the 21st Century Law Enforcement and Public Safety Act in 1999.[471] The president's proposed legislation was written with the intent to:

> Keep dangerous biological agents and toxins out of the wrong hands by: barring unauthorized possession and transfer of harmful biological agents; holding accountable persons who knowingly disregard public health and safety when handling deadly toxins; making it a crime to perpetrate a hoax involving biological agents; and prohibiting violent felons and fugitives from possessing dangerous biological agents.[472]

Congressional hearings devoted to the issues raised in this bill pointed out the negative implications of President Clinton's proposed measures, citing the careful balance that is required between safety and over-regulation.[473]

The American Society for Microbiology, a large and well-respected professional science organization, testified to Congress that regulations of the type that President Clinton detailed could "pose a threat to biomedical or other life sciences research and

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[469] Epstein, "Law Enforcement and the Prevention of Bioterrorism," 171.

[470] Ibid., 172.

[471] Ibid., 173.

[472] "The 21st Century Crime Bill," William J. Clinton Presidential Library, Bruce Reed Collection, http://www.clintonlibrary.gov/assets/DigitalLibrary/BruceReed/Crime/86/C%20647420-21st-century-crime-bill.pdf (accessed September 10, 2011).

[473] House Committee on Commerce, *The Threat of Bioterrorism in America: Assessing the Adequacy of the Federal Law Relating to Dangerous Biological Agents: Hearing before the Subcommittee on Oversight and Investigations,* 106th Cong., 1st sess., May 20, 1999, 51.

clinical diagnostic activities that are essential for public health."[474] Mr. Ronald Atlas, Co-chair of the Task Force on Biological Weapons Control, testified to the same Committee that the "unintended consequences [of the proposed legislation] could stifle the free exchange of microbial cultures among members of the scientific community and could even drive some microbiologists away from important areas of research."[475] It was his professional opinion that such regulation aimed at the prevention of bioterrorism, "instead of enhancing global security, could prove detrimental to that goal if scientists can no longer obtain authenticated cultures. A key point is that natural infectious diseases are a greater threat than bioterrorism."[476] Because agreement could not be reached within the legislative branch about how to phrase the proposed legislation to take these concerns into account, thereby balancing the need for security with the need for allowing legitimate scientific pursuits, the 21st Century Law Enforcement and Public Safety Act was never passed.[477]

The need to re-address the issue of bioterrorism law was made clear in 2001 after two highly visible incidents showed that terrorism was a threat to the American public: the World Trade Center attacks and the following week's anthrax mailings. In October 2001, the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act, also known as the USA PATRIOT Act, was signed.[478] This legislation addresses the issue of possessing biological agents in a way that previous legislation had not: "Whoever knowingly possesses any biological agent… of a type or in a quantity that… is not reasonably justified by a prophylactic, protective, bona fide research, or other peaceful purpose, shall be fined, … imprisoned not more than ten years, or both."[479] For the first time, possession was addressed in the domestic legal framework.

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[474] House Committee on Commerce, *The Threat of Bioterrorism in America*, 51.

[475] Ibid.

[476] Ibid.

[477] Epstein, "Law Enforcement and the Prevention of Bioterrorism," 173.

[478] *Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001*, Public Law 107-56, 107th Cong., 1st sess. (October 26, 2001).

[479] Ibid., section 817(1)(c).

A second important section of the USA PATRIOT Act defines special categories of "restricted persons"[480] for whom it is illegal to possess or transfer any of the select biological agents, even for reasons that are otherwise lawful.[481] The categories of restricted persons were taken from the U.S. Code that lists the categories of persons who are banned from purchasing firearms and ammunition.[482] Several examples of the categories the USA PATRIOT Act uses to define restricted persons include any individual who:

> Has been convicted in any court of a crime punishable by imprisonment for a term exceeding one year;…is an unlawful user of any controlled substance; … has been committed to any mental institution;…is an alien (other than an alien lawfully admitted for permanent residence) who is a national of a country as to which the Secretary of State… has made a determination… that such a country has repeatedly provided support for acts of international terrorism.[483]

At the same time that some were raising concerns over whether this aspect of the legislation went too far in the name of security, "approximately sixty percent of [homeland security poll] respondents thought it was necessary to sacrifice certain civil liberties to combat terrorism."[484]

In light of these regulations, there is concern surrounding balancing protection from potential future terrorist acts with protection of basic constitutional freedoms. For example, the fact that employers would be made to "inquire about, or even to investigate the mental health and medical history of their employees"[485] caused some to fear that civil liberties were being eroded. Faculty at the Massachusetts Institute of Technology (MIT) expressed concern that regulations not be extended to foreign nationals because

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480 *Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001*, section 817(2).

481 Ibid.

482 Epstein, "Law Enforcement and the Prevention of Bioterrorism," 174.

483 *Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001*, section 817 (2).

484 James Beckman, *Comparative Legal Approaches to Homeland Security and Anti-Terrorism* (Hampshire, England: Ashgate Publishing Limited, 2007), 27.

485 Epstein, "Law Enforcement and the Prevention of Bioterrorism," 175.

such restrictions would violate the institution's principles, as well as potentially causing the school to re-evaluate whether research into agents covered under these laws was worth pursuing.[486] It was the finding of an MIT faculty committee appointed to study the issue of regulating scientific research that "the well-being of our nation will ultimately be damaged if education, science, and technology suffer as a result of any practices that indiscriminately discourage or limit the open exchange of ideas."[487]

At the same time that MIT was debating the impact of the law on scientific pursuits, the University of Connecticut was experiencing the impact first-hand. In 2002, the USA PATRIOT Act was used for the first time as a basis for charges surrounding bioterrorism. A Czech-born graduate student from the University of Connecticut named Tomas Foral was charged with possessing anthrax that was not being used for legitimate research. What his lawyers describe as a miscommunication within the laboratory about where to store which test tubes when cleaning and organizing laboratory freezers resulted in formal charges against Foral, which could have resulted in a trial and ten years in prison.[488] Because his research was unrelated to the anthrax vials that he relocated, his case was determined not to meet the PATRIOT Act's exemption for bona fide scientific pursuits.[489] This case highlights the "treacherous legal landscape"[490] that now surrounds scientific research because of the newly enacted domestic legislation.

In light of the new legal landscape formed by the bioterrorism portion of the PATRIOT Act and in response to the charges against the student described above, other

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[486] Epstein, "Law Enforcement and the Prevention of Bioterrorism," 179.

[487] Ad Hoc Committee on Access to and Disclosure of Scientific Information, Massachusetts Institute of Technology, "In the Public Interest: Report of the Ad Hoc Committee on Access to and Disclosure of Scientific Information," June 12, 2002. http://web.mit.edu/faculty/reports/pdf/publicinterest.pdf (accessed August 3, 2011).

[488] Because Foral cooperated with the FBI, he was not prosecuted. He did, however, have to complete community service requirements. [Gerald Epstein, "Law Enforcement and the Prevention of Bioterrorism: Its Impact on the U.S. Research Community," in *Global Non-Proliferation and Counter-Terrorism: The Impact of UNSCR* 1540, ed. Olivia Bosch, Peter van Ham, and Jeffery Almond (Washington, D.C.: Brookings Institution Press, 2005), 181.]

[489] David Malakoff, "Student Charged with Possessing Anthrax," *Science* 297, August 2, 2002, 751; Jessica Snyder Sachs, "Will Terror Laws Give Science a Chill?" *Popular Science* 262 no. 4 (April 2003): 30.

[490] Malakoff, "Student Charged with Possessing Anthrax," 751.

scholarly institutions have expressed concern over whether they will be able to continue research into the biological agents regulated by legislation.[491] Because of the potential for run-ins with the law and the necessity of demonstrating legitimate research if questioned, it is possible that scientific institutions would have cause to re-evaluate whether the costs of conducting research into the regulated biological agents is now too high to merit the gains. Cessation of legitimate research was not the intent of the legislation, and the consequences of abandoning the pursuit of knowledge could be grave.[492] Although scientists recognize the need for safe practices and regulations to enforce them, some have said that they "are concerned that recently enacted measures may go too far and hinder research."[493]

Conversely, others predict that the USA PATRIOT Act's greater regulation will not cause the detrimental effects to scientific research or to the academic institutions as claimed above. The President of the American Biological Safety Association believes that research will actually be enhanced. She predicts that "[w]hen the bioterrorism dollars start flowing, those institutes that are compliant with this new law are going to be able to expand their programs tremendously, and those that don't have programs will want to start them."[494] She also points out that the scientific community is familiar with operating within government regulations, such as the Occupational Safety and Health Administration laws, of which a violation can bring about similar fines and prison sentences as the USA PARTIOT Act.[495]

These issues came to light in the recent debate surrounding whether scientists should be prevented from publishing their research on genetically altered H5N1 avian flu virus. Their alterations made the virus deadlier and more transmissible between ferrets, and some scientists expressed concern that publishing the details of their methods could

[491] Sachs, "Will Terror Laws Give Science a Chill?" 30.

[492] Ibid.

[493] Epstein, "Law Enforcement and the Prevention of Bioterrorism," 179.

[494] Sachs, "Will Terror Laws Give Science a Chill?" 30.

[495] Ibid.

unnecessarily inform one who wished to alter the disease to spread among humans.[496] The National Science Advisory Board for Biosecurity (NSSAB)—a federal committee designed to oversee biological research that could impact national security—recommended that certain details not be published.[497] Scientists objected not only to the act of censorship, but also to the fact that withholding details of the research from legitimate scientists prevents others from conducting research to protect the public.[498] In this case, the scientists and the NSSAB reached an agreement: the research would be published, but in a modified form to mitigate the risk of misuse, and a system would be set up to securely share the redacted information with legitimate researchers.[499]

In addition to the impact of the legislation on science and research, one must also consider its ability to enable law enforcement officials to protect public safety in a manner that will allow their investigations to be upheld within the judicial system. Although the Tomas Foral case reads to some like a case of overzealous agents from the Federal Bureau of Investigation (FBI) on an anti-science crusade, it must be considered that the mandate of law enforcement is to protect the public by enforcing the legislation that Congress has enacted. The FBI began its investigation of Foral only after an anonymous tip received by local police (in conjunction with an anthrax death sixty miles away) led them to his laboratory, where he was found to possess frozen stores of anthrax. There was sufficient cause to open an investigation. This case exemplifies the need to carefully write the laws in order to allow for a balance between constraining scientists and protecting the public.

Although one method that enforcers of the law have determined would help with this protection is "placing those who are allowed access [to certain biological agents]

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[496] Fergus Walsh, "When Should Science Be Censored?" *BBC News: Health* (December 20, 2011) http://www.bbc.co.uk/news/health-16275946 (accessed March 19, 2012); Denis Grady and William Broad, "Journals Asked to Cut Details of Flu Studies," *New york times* (December 21, 2011); Doreen Carvajal, "Scientist in Bird Flu Study Says He is Not Convinced Censorship is a Safeguard," *New york times*, December 22, 2011.

[497] Ibid.

[498] Ibid.

[499] Martin Enserink, "Grudgingly, Virologists Agree to Redact Details in Sensitive Flu Papers," *Science Insider* (December 20, 2011) http://news.sciencemag.org/scienceinsider/2011/12/grudgingly-virologists-agree-to.html (accessed March 19, 2012).

under greater scrutiny,"[500] this might not be in the interest of the balance mentioned above. The advance investigation of scientific personnel who seek to work with the regulated agents raises additional issues pertaining to Constitutional rights.

In an attempt to address this, and thereby strengthen the domestic biological terrorism legal regime, Congress passed the Public Health Security and Bioterrorism Preparedness and Response Act of 2002. This law requires greater oversight of the registration that is required in order to lawfully possess or transfer select biological agents.[501] It makes the Secretary of Health and Human Services and the Attorney General responsible for verifying that such registrants have "a legitimate need to handle or use such agents"[502] and also includes provisions to protect against the undue disclosure of information from the registration databases.[503] Criminal penalties apply for transferring biological agents to unregistered persons and for possessing an agent without being registered.[504]

Although these measures will likely hinder terrorists in their pursuit of biological agents that can be a danger to society, it remains possible that either a lawfully registered person could commit illegal actions with a regulated biological agent or that a terrorist could falsely obtain a legitimate registration. Because of this, other safeguards must be in place. There must also be a place within the legal framework that allows for investigations into suspicious laboratories.

Because legitimate laboratories need not be exceptionally and obviously different from laboratories used for terrorist purposes, it is difficult to determine when research that could lead to an attack might be being conducted. This raises the critical tension between bona fide scientific pursuits and illegal practices; there is a fine line between the two when it comes to determining whether an investigation can be conducted into the

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[500] Epstein, "Law Enforcement and the Prevention of Bioterrorism," 178.

[501] Ibid.

[502] *Public Health Security and Bioterrorism Preparedness and Response Act*, Public Law 107-188, 107th Cong., 2nd sess. (June 12, 2002), section 201(a).

[503] Ibid.

[504] Ibid.

intent of the research and use of the equipment contained in a potentially suspect laboratory. In spite of this difficulty, and the fact that it could leave room for planning a terrorist attack, current domestic legislation is written so that a crime must be committed or justification must be had in order to conduct an investigation. These factors make prevention of bioterrorism difficult in spite of the laws that are in place.

In order to avoid the perceived censorship that additional regulation could bring, many scientists and academic institutions have taken voluntary precautions to consider whether their research—if published—could be applied for terrorist purposes.[505] Gerald Esptein points out:

> Measures to foster a community sense of responsibility and accountability in biological research would have the greatest payoff: an ethic that encourages informal review and discussion of proposed activities, that heightens an obligation to question activities of other researchers that may seem inappropriate…and that engages in a continuing dialogue with members of the national security community.[506]

Additional self-regulation comes both from the inherent concern for safety practices within the scientific community and the incentives to avoid the constraints related to formal legal regulation. Laboratory guidelines for the safe handling of harmful biological agents and internal requirements for safety measures are ways that the scientific community has voluntarily chosen to strengthen its own safety procedures without legal regulation. Kathleen Vogel has studied these regulatory practices in the former Soviet biological research facilities (including the facility that houses smallpox). She has found that:

> All research work involving dangerous pathogens must be conducted in paired team operations, with no fewer than two persons. Work in the evening and night, as well as on days off and holidays, is possible only with the written permission of the institution director, and two persons are

[505] Jessica Stern, "Dreaded Risks and the Control of Biological Weapons," *International Security* 27, no. 3 (Winter 2002–2003): 120–121.

[506] Gerald Epstein, "Better Rules for Biotech Research," *Issues in Science and Technology* 21, no. 1 (Fall 2003), 7.

> present. Also, transfer of pathogen cultures in containers from one section to another is only by persons cleared to work with dangerous pathogens, and with an escort.[507]

In both the Russian and American maximum containment laboratories, biocontainment practices for dealing with high-risk pathogens like smallpox provide safety and decrease the risk of unauthorized access. Some of these practices include: access restrictions (both through physical guards and identity verification procedures), contained workspaces, and rigorous training standards and safety protocols.[508] These standards significantly limit access to smallpox to a limited number of qualified scientists.

The domestic and international laws and treaties alone are not likely to be sufficient deterrents to bioterrorists; however, having them in place remains important. By creating the expectation that smallpox bioterrorism will not be tolerated, these treaties and laws strengthen norms against bioterror and empower law enforcement officials to address security threats. Because these measures are not wholly adequate in deterring non-state actors, however, other means of deterrence can be used as supplements. One way to approach this is to convince the would-be biological terrorists that the cost associated with the retribution or retaliation that would occur is greater than the potential aims to be achieved by launching an attack using smallpox. Another way is to enact measures that have a deterrent effect by way of denying the terrorist organization its supporters or the benefits it aims to achieve. The following sections will discuss these measures in greater detail.

B. DETERRENCE BY RETRIBUTION OR PUNISHMENT

Some have argued that international agreement to treat possession of smallpox as a crime against humanity would be an effective deterrent. D.A. Henderson, one of the world's leading experts on smallpox epidemiology, claims that an effective policy would be "for the World Health Assembly and United Nations General Assembly to take the

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[507] Vogel, "Pathogen Proliferation," 12–13.

[508] Vogel, "Pathogen Proliferation," 12–13; James Le Duc et al., "Framework for Leadership and Training of Biosafety Level 4 Laboratory Workers," *Emerging Infectious Diseases* 14, no. 11 (November 2008): 1685–1686.

formal position that after the designated date of smallpox destruction, any scientist or any country found to possess smallpox virus would be deemed guilty of a crime against humanity."[509] This gesture would set the bar high enough that the international community would have a means of response; international courts would have a legal basis for action, and this fact could have the added benefit of deterrence.

A similar strategy, indirect deterrence, focuses on deterring supporters of terrorism—either states or individuals—from providing assistance rather than deterring the actual terrorists themselves.[510] In the case of smallpox bioterrorism, this could be applied by making it known that supporters of any aspects of acquisition, production, or weaponization would be held liable by the international community.

While terrorism and deterrence scholars agree that such deterrence by punishment or indirect deterrence of terrorism supporters are valid policy options for deterring states, some question the utility of such strategies in deterring non-state actors.[511] Non-state actors may not be as likely to be deterred by retaliation as states, and in any case it can be difficult to retaliate against groups that are not tied to a specific territory or who do not have anything that can be held at risk.[512] For this reason, an increased focus on deterrence by denial strategies is evident in deterrence studies today.[513]

C. DETERRENCE BY DENIAL

Recent deterrence literature has examined the changes in strategy that are required to deal with the asymmetric threats posed by non-state actors.[514] One strategy that has

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[509] Henderson, *Smallpox: The Death of a Disease*, 263.

[510] Jeffrey Knopf, "The Fourth Wave in Deterrence Research," *Contemporary Security Policy* 31, no. 1 (April 2010), 11; Alex Wilner, "Deterring the Undeterrable: Coercion, Denial, and Delegitimization in Counterterrorism," *The Journal of Strategic Studies* 34, no. 1 (February 2011), 19–20.

[511] Knopf, "The Fourth Wave in Deterrence Research," 5–6, 11; Wilner, "Deterring the Undeterrable," 14–15.

[512] Knopf, "The Fourth Wave in Deterrence Research," 9–10.

[513] Ibid.

[514] Ibid., 1–8.

been identified is "increasing the probability that individual attacks will fail."[515] Called deterrence by denial, this involves convincing the would-be terrorists that their attacks will likely be unsuccessful.[516]

In order to make this strategy applicable to smallpox, it could be useful to publicize the futility of the effort. For example, if the significant number of hurdles to be overcome are known to terrorists, they might consider their efforts potentially wasted due to the unlikely chance of being able to successfully complete all the prerequisite steps to an attack.[517] This strategy, however, requires publication of an accurate threat assessment in order to act as an effective deterrent.

Additionally, if terrorists are aware that their attack is not guaranteed to spread smallpox uncontrollably or, alternatively, that it could spread to their own constituents, they might be deterred from using smallpox. Promoting and publicizing norms against the use of biological weapons could also increase the chances that constituencies terrorists claim to represent might be expected to condemn the use of smallpox. Called deterrence by delegitimization or by counter-narrative, this approach seeks to "use information and discourse to convince… [a terrorist group] that WMD terrorism will cause a backlash from within its intended support base."[518]

Another means of deterrence that is thought to be a valuable counterterrorist strategy is deterrence by mitigation.[519] By denying "the immediate consequences terrorists anticipate and desire," the thought is that terrorists might reconsider their methods.[520] In an attempt to achieve this, authorities have implemented consequence mitigation and prevention measures such as improving public health capabilities and

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[515] Ibid., 12.

[516] Wilner, "Deterring the Undeterrable," 21–24; Knopf, "The Fourth Wave in Deterrence Research," 12–14.

[517] Examples of these challenges include the fact that smallpox acquisition or synthesis is difficult and producing and weaponizing smallpox is dangerous. See Chapter II.

[518] Knopf, "The Fourth Wave in Deterrence Research,"25; Wilner, "Deterring the Undeterrable," 26–28.

[519] Wilner, "Deterring the Undeterrable," 23.

[520] Ibid.

taking measures to reduce the severity or effects of an attack.[521] These are considered valuable strategies because of the two-fold benefit they provide.[522] In addition to the deterrence effect, these measures also increase preparation and response capability.

Government offices are aware of these benefits of the consequence management strategy for biosecurity.[523] In 2009, the Obama Administration summarized that it intended to build capacity in this area of mitigating the consequences of bioterror attacks through the following measures:

> Ensure that decision makers have the information and communication tools they need to manage disease outbreaks by linking healthcare providers, hospitals, and public health agencies. A well-planned, well-rehearsed, and rapidly executed epidemic response can dramatically diminish the consequences of biological attacks.[524]

This strategy, more than deterrence through a legal regime, is the main strategy of biosecurity today.[525] It can be applied to smallpox bioterrorism by publicizing the facts that the U.S. is prepared to respond to and to contain an outbreak.[526] Again, this strategy can only be successful when accurate portrayals of the threat from smallpox and the country's ability to respond effectively are spread.

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[521] U.S. Library of Congress, CRS, *An Overview of the U.S. Public Health System in the Context of Bioterrorism*, by Holly Harvey and Sarah Lister, CRS Report RL31719 (Washington, D.C.: Office of Congressional Information and Publishing, February 11, 2004), 3–5; Barry Kellman, "Bioviolence: A Growing Threat," *The Futurist* (May–June 2008): 30.

[522] Barry Kellman, "Bioviolence: A Growing Threat," *The Futurist* (May–June 2008): 30.

[523] Department of Health and Human Services and the Centers for Disease Control and Prevention, *Public Health's Infrastructure: A Status Report Prepared for the Appropriations Committee of the United States Senate* (Atlanta, GA: CDC, 2000), ii.

[524] President Barak Obama, quoted in Tara O'Toole and Thomas Inglesby, "Biosecurity Memos to the Obama Administration," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 7, no. 1 (2009): 25.

[525] The Bipartisan WMD Terrorism Research Center, *Bio-Response Report Card: 21st Century Biological Threats, October 2011* (Washington, D.C.: WMD Center, 2011), 59.

[526] Centers for Disease Control and Prevention, Division of Bioterrorism Preparedness and Response, *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/ (accessed February 11, 2012); Centers for Disease Control and Prevention, Division of Bioterrorism Preparedness and Response. "Smallpox Fact Sheet: Vaccine Overview," http://emergency.cdc.gov/agent/smallpox/vaccination/facts.asp (accessed March 1, 2012).

D. CONCLUSION

Initially conceived along the lines of an arms control regime and gradually appended and updated with more domestic laws throughout the years, the current legal regime remains insufficient to address the threat posed by bioterrorism. Neither international nor domestic laws are ideally suited to address the complexities brought about by the dual-use of many aspects of modern science. The cases brought forth under the current laws show that common scientific research is being mistaken for illegal practices; clearly American domestic law requires improvement. Improvement, not simply the addition of more laws, is required in order to further protection against today's scientific terrorist threats such as the threat posed by smallpox as a bioweapon.

A terrorist is unlikely to be swayed by the fact that his actions are in violation of the domestic or international law, because by the fact of being a terrorist he has forgone his identity as a law-abiding citizen. Threat of a fine no greater than $2,000,000 and a 25-years-to-life prison sentence for possessing or using the smallpox virus[527] is not likely to be an effective deterrent for a terrorist who is already willing to risk his life by working to weaponize a deadly virus. Therefore, it is likely that the laws in place are most beneficial for the framework they provide for guiding law enforcement and judicial policies, rather than for their deterrent effect on individual actors.

Laws, however, are not the only tools available. This requirement for improvement has been addressed partially through voluntary self-regulation measures, imposed by the concerned scientists and academics who work closest with the laboratory environment. Improving biosecurity is accomplished by focusing on other means of deterrence: deterring supporters, denying terrorist aims, and preparing for the consequence of an attack so that bioterrorists are less able to achieve their goals.

The following chapter will review the preceding conclusions and provide an overall evaluation of the threat the United States is likely to face from a bioterrorist attack using smallpox.

[527] U.S. Code, Title 18, Part 1, Chapter 10, Section 175(c), "Variola Virus."

V. CONCLUSION

The commonly supposed level of threat that smallpox poses as an agent of bioterror is likely higher than the actual threat. A careful study of the factors that indicate whether terrorists will likely use *Variola* as a weapon reveals that there are probably not groups or individuals who possess the necessary combination of resources, capabilities, motivations, and intentions to make smallpox a realistically impending threat. If such a bioterrorist considered pursuing smallpox weaponization in spite of those improbabilities, there remains the possibility that the biosecurity measures that are in place in the U.S. today would deter him from proceeding with a smallpox attack because of a belief that the severity of his attack would be mitigated.

Chapter I introduced the gap in the risk assessment of a smallpox attack and the impact that government preparedness exercises, the debate over vaccination, and media coverage of the topic of smallpox have on the perception of the threat of attack. Exaggerations, generalizations, and misperceptions cause a belief that the level of risk is higher than it actually is. Although smallpox's release into the world today would have terrible consequences, this does not elevate the actual level of risk.

Chapter II demonstrated that acquiring, synthesizing, reproducing, weaponizing, and disseminating smallpox are challenging both in the resources and in the scientific expertise that are required. Although the characteristics of the disease make it suitable to consider as a bioweapon, those challenges are significant enough to be considered prohibitive barriers for many potential bioterrorists. The case of the Soviet Union is unique in the level of state support that was devoted to the program and to maintaining its secrecy. Furthermore, an analysis of presence of suspected smallpox weaponization programs shows that no state or non-state actors can be said—with certainty—to possess the virus or programs to weaponize it.

Chapter III revealed that religious ideology is not a likely motivation for the use of smallpox. The exceptionally lethal and transmissible nature of smallpox would probably cause rational decision-makers to prefer other weapons due to considerations

such as organizational survival. These terrorists are not likely to resort to an attack with consequences as severe, as widespread, and as uncontrollable as unleashing a smallpox epidemic would be. Rational actors are also likely to conclude that conventional weapons (and even biological weapons other than smallpox) are easier and safer to use and deploy, and are more likely to be successful than smallpox.

Chapter IV demonstrated that current domestic and international policies, laws, and treaties are most likely insufficient deterrents to individual terrorists considering bioterror in general. However, UN Security Council Resolution 1540 does create the international expectation that bioterrorism should be addressed by domestic legislation. Furthermore, states are likely to be deterred from supporting smallpox bioterrorism due to the international disdain that would result if the support were discovered. Because violation of Resolution 1540 also violates Chapter VII of the UN Charter, states that value their international standing are unlikely to contribute to smallpox weaponization programs.

Compared to other potential bioweapons, smallpox's status as an eradicated disease with only two internationally recognized locations for its storage should make it easier to distinguish nefarious from legitimate research and to apply criminal charges only when appropriate. The current legal regime alone, though, is unlikely to be successful as a deterrent to bioterrorism. Although there have been improvements to domestic and international laws, deterrence through punishment is less likely to be effective than deterrence by denial. Laws that enhance biosecurity through consequence mitigation and prevention are measures that are are more likely to prevent a terrorist attack using smallpox.

It is evident that the public is aware of the potential danger presented by a smallpox outbreak; however, based upon the study of terrorist motivation, decision-making, capabilities, and factors of deterrence, this concern is greater than is warranted. The threat from terrorist actors pursuing smallpox as a weapon of bioterrorism is one that the United States is unlikely to face.

A. HOW CAN THE THREAT BE BETTER ASSESSED?

1. Recognize that Medical Expertise does not Equal Terrorism Expertise

The risk from an epidemic of smallpox itself and from the likelihood of terrorists attempting to start such an epidemic are two entirely different calculations. The threat picture is often muddled when scientists—recognized experts in epidemiology or virology—combine their assessment of the medical aspects of an epidemic and the resultant public health issues (which they are qualified to give) with a prediction of the likelihood that terrorists will choose this method of attack (which is often based upon speculation).

For example, the authors of "Smallpox as a Biological Weapon: Medical and Public Health Management" include some of the world's experts on smallpox, among other public health, emergency management, and communicable disease professionals. Their conclusions within their respective fields of expertise, published in the *Journal of the American Medical Association*, are undoubtedly well-founded. When they stray into the realm of predictions of terrorism, exemplified by conclusions such as "the threat of an aerosol release of smallpox is real and the potential for catastrophic scenario is great,"[528] their legitimacy and credibility in the world of science are projected into the field of terrorism. This undoubtedly contributes to acceptance of their predictions of impending bioterror attacks. It is important to realize that one's status as an expert in the medical aspects of smallpox does not automatically correlate to being an expert in the field of terrorist activities.

2. Recognize that Protections are in Place

Since 2001, the United States has spent approximately $60 billion on biodefense.[529] Funding has been applied directly toward preparation for a smallpox attack. The Centers for Disease Control and Prevention have devoted time, attention, and

[528] Henderson et al., "Smallpox as a Biological Weapon," 2136.

[529] Leonard Cole, "Bioterrorism: Still a Threat to the United States," *Combating Terrorism Center Sentinel* 5, no. 1 (January 2012): 9.

resources to develop a detailed a Smallpox Response Plan that would lessen the severity of a smallpox outbreak, in the unlikely event that an attack is carried out.[530] Enough smallpox vaccine is stored in the national stockpile to vaccinate every person in the United States.[531] Additional preparedness measures include education of medical professionals and first responders, stocking vaccinia immune globulin, and immunizing hospital workers.[532] Even though smallpox could spread before it was identified, ring vaccination and/or mass vaccination strategies could contain an outbreak.[533] These factors demonstrate that in the (unlikely) event that a terrorist did succeed in conducting a smallpox attack, measures are in place to mitigate the attack's severity and the virus' spread. Though an attack could have awful consequences for those infected, there are adequate measures in place to implement response and recovery efforts on a national scale.

B. POLICY RECOMMENDATIONS

In light of these assessments, there is room for improvement in the manner in which smallpox bioterrorism is addressed. Rather than projecting an inflated sense of the likelihood that terrorists will conduct an attack with smallpox, government officials, academics, and the media should endeavor to emphasize the challenges that have been identified in the previous chapters. By publicizing the message that acquiring, producing, weaponizing, and disseminating smallpox are realistically quite difficult—rather than sending the opposite message by repeating the inflated threat assessment that these processes are simple—terrorists might be less inclined to choose this tactic.

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[530] Centers for Disease Control and Prevention, Division of Bioterrorism Preparedness and Response, *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/ (accessed February 11, 2012).

[531] Centers for Disease Control and Prevention, Division of Bioterrorism Preparedness and Response. "Smallpox Fact Sheet: Vaccine Overview," http://emergency.cdc.gov/agent/smallpox/vaccination/facts.asp (accessed March 1, 2012).

[532] Hugh Pennington, "Public Health Reviews: Smallpox and Bioterrorism," *Bulletin of the World Health Organization* 81, no.10 (October 2003), 764. http://www.scielosp.org/scielo.php?script=sci_arttext&pid=S0042-96862003001000014&lng=en&nrm=iso&tlng=en (accessed March 1, 2012).

[533] Edward Kaplan, "Preventing Second-Generation Infections in a Smallpox Bioterror Attack," *Epidemiology* 15, no. 3 (May 2004): 268–269.

Al Qaeda letters have identified that these types of emphases do impact their choice of tactics. In a letter from Ayman al-Zawahiri to Muhammad Atef dated April 15, 1999, Zawahiri wrote that despite the "extreme danger" posed by biological and chemical weapons, "we only became aware of them when the enemy drew our attention to them by repeatedly expressing concerns that they can be produced simply with easily available materials."[534] By making a concerted effort in government and media references to emphasize and disseminate the true nature of challenges related to smallpox terrorism, it is possible that future potential terrorists would receive the message that smallpox would be neither easy to acquire nor simple to use in a terrorist attack.

Increasing awareness of the actual threat assessment of smallpox bioterrorism can help to counteract the tendency to assume that because smallpox is a terrible scourge it follows that terrorists are likely to use it in an attack. If future government exercises, academic reviews of whether to destroy the remaining stocks of the virus, and public health and vaccination policy debates send a uniformly accurate message of the actual threat posed by smallpox as a weapon of bioterror, it would greatly benefit bioterrorism preparedness efforts and it would contribute to establishing a more accurate level of public concern for the disease.

Communication at all levels of the public health infrastructure is necessary to create a community of support for spreading an accurate threat assessment. Agencies specializing in public health, infectious diseases, biosecurity, and emergency management are best suited to play a lead role in organizing and implementing the publication of correct threat information from medical and biosecurity points of view; however, their initiatives cannot stand alone. Their efforts must be supported on a national scale and must be informed by accurate representation of the terrorism threat.

[534] Alan Cullison, "Inside Al-Qaeda's Hard Drive," *The Atlantic*, September 2004. http://www.theatlantic.com/magazine/archive/2004/09/inside-al-qaeda-rsquo-s-hard-drive/3428/ (accessed February 3, 2012).

Local, state, and federal integration is required in order to widely and effectively disseminate a message that counteracts scare tactics and inflated or inaccurate threat assessments. Framing the threat posed by smallpox bioterrorism accurately is a key policy goal that should be implemented now in order to spread a better understanding of the factors that inform the question “should we be concerned?”

LIST OF REFERENCES

Aaron, David. *In Their Own Words: Voices of Jihad, Compilation and Commentary*. Santa Monica, CA: RAND, 2008.

Adams, James. *The New Spies: Exploring the Frontiers of Espionage*. London: Hutchinson, 1994.

Ad Hoc Committee on Access to and Disclosure of Scientific Information, Massachusetts Institute of Technology. "In the Public Interest: Report of the Ad Hoc Committee on Access to and Disclosure of Scientific Information," June 12, 2002. http://web.mit.edu/faculty/reports/pdf/publicinterest.pdf (accessed August 3, 2011).

Alibek, Ken, and Stephen Handelman. *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World –Told From the Inside by the Man Who Ran It*. New York: Random House, 1999.

Baker, James. *In The Common Defense: National Security Law for Perilous Times*. Cambridge, NY: Cambridge University Press, 2007.

Beckman, James. *Comparative Legal Approaches to Homeland Security and Anti-Terrorism*. Hampshire, England: Ashgate Publishing Limited, 2007.

Blendon, Robert, John Benson, Catherine DesRoches, and Melissa Hermann, "Survey Project on Americans' Response to Biological Terrorism: Study 3: Public Attitudes About the Threat of a Smallpox Attack" (Harvard School of Public Health, June 5, 2002). http://www.hsph.harvard.edu/research/horp/project-on-the-public-and-biosecurity/ (accessed May 17, 2011).

Bloche, M. Gregg. "Rogue Science." *Georgetown Law Journal* 91, no.6 (August 2003): 1257–1275.

Bosma, John. "Bio-Terrorist Attack Pathways and Social/Civil Infrastructure." In *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, edited by Potomac Institute for Policy Studies, 59–68. Arlington, VA: Oceana, 1999.

Bozzette, Samuel, Rob Boer, Vibha Bhatnagar, Jennifer Browner, E.B. Keller, S.C. Morton, and M.A. Stoto. "A Model for a Smallpox Vaccination Policy." *The New England Journal of Medicine* 348, no. 5 (January 30, 2003): 416–425.

Cameron, Gavin. "Weapons of Mass Destruction Terrorism Research: Past and Future." In *Research on Terrorism: Trends, Achievements, and Failures*, edited by Andrew Silke, 72–90. London: Frank Cass, 2004.

Center for Biosecurity of the University of Pittsburgh Medical Center, "Atlantic Storm Exercise Materials: Assumptions; Method of Attack," http://www.atlantic-storm.org/materials.html (accessed January 27, 2012).

———. "Atlantic Storm Exercise Materials: Assumptions; Smallpox Epidemiology," http://www.atlantic-storm.org/materials.html (accessed January 27, 2012).

———. "Atlantic Storm Exercise Materials: Briefings; Intelligence Brief," http://www.atlantic-storm.org/flash/pdf/brief_0910.pdf (accessed January 27, 2012).

———. "Atlantic Storm Interactive," http://www.atlantic-storm.org/flash/index.html (accessed January 27, 2012).

Centers for Disease Control and Prevention, Division of Bioterrorism Preparedness and Response. "Guide F: Environmental Control of Smallpox Virus." *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/files/guide-f.pdf (accessed February 11, 2012).

———. "Smallpox Fact Sheet: Smallpox Disease Overview." http://www.bt.cdc.gov/agent/smallpox/overview/disease-facts.asp (accessed February 10, 2012).

———. "Smallpox Fact Sheet: Vaccine Overview." http://emergency.cdc.gov/agent/smallpox/response-plan/ (accessed March 1, 2012).

———. *Smallpox Response Plan and Guidelines* (March 20, 2003) http://emergency.cdc.gov/agent/smallpox/response-plan/ (accessed February 11, 2012).

———. "What We Learn About Smallpox from Movies: Fact of Fiction." http://www.bt.cdc.gov/agent/smallpox/disease/movies.asp (accessed February 17, 2012).

Centers for Disease Control and Prevention, Special Pathogens Branch. "Glossary of Terms." http://www.cdc.gov/ncidod/dvrd/spb/mnpages/glossary.htm (accessed February 11, 2012).

Christopher, George, Theodore Cieslak, Julie Pavlin, and Edward Eitzen. "Biological Warfare: A Historical Perspective." In *Biological Weapons: Limiting the Threat*, edited by Joshua Lederberg, 17–35. Cambridge, MA: MIT Press, 1999.

Clunan, Anne. "Identifying Biological Agents, Characterizing Events, and Attributing Blame." In *Terrorism, War, or Disease: Unraveling the Use of Biological Weapons*, edited by Anne Clunan, Peter Lavoy, and Susan Martin, 1–20. Stanford, CA: Stanford University Press, 2008.

Crenshaw, Martha. "An Organizational Approach to the Analysis of Political Terrorism." *Orbis* 29 no. 3 (Fall 1985): 465–489.

———. "The Psychology of Terrorism: An Agenda for the 21st Century." *Political Psychology* 21, no. 2 (2000): 405–420.

———. "'New' vs. 'Old' Terrorism: A Critical Appraisal." In *Jihadi Terrorism and the Radicalisation Challenge in Europe*, edited by Rik Coolsaet, 25–36. Hampshire, England: Ashgate Publishing, 2008.

Crowell, Richard. "Likely Threat Pathogens in Biological Terrorism." In *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, edited by Potomac Institute for Policy Studies, 127–148. Arlington, VA: Oceana, 1999.

Coghlan, Andy and Debora Mackenzie. "Fear over Camelpox as Bioweapon," *New Scientist* (April 17, 2002) http://www.newscientist.com/article/dn2173-fear-over-camelpox-as-bioweapon.html (accessed March 1, 2012).

Cole, Leonard. *The Eleventh Plague: The Politics of Biological and Chemical Warfare*. New York: W.H. Freeman and Company, 1996.

———. "Bioterrorism: Still a Threat to the United States." *Combating Terrorism Center Sentinel* 5, no. 1 (January 2012): 8–12.

Committee on the Assessment of Future Scientific Needs for Live Variola Virus, Board on Global Health, Institute of Medicine. *Assessment of Future Scientific Needs for Live Variola Virus*. Washington, DC: National Academy Press, 1999.

Cox, C. S. "Stability of Airborne Microbes and Allergens." In *Bioaerosols Handbook*, edited by Christopher Cox and Christopher Wathes, 77–99. New York, NY: Lewis Publishers, 1995.

Cullison, Alan. "Inside Al-Qaeda's Hard Drive." *The Atlantic*. September 2004. http://www.theatlantic.com/magazine/archive/2004/09/inside-al-qaeda-rsquo-s-hard-drive/3428/ (accessed February 3, 2012).

Della Porta, Donatella. "Introduction: On Individual Motivations in Underground Political Organizations." In *Social Movements and Violence: Participation in Underground Organizations*, edited by Donatella Della Porta, 3–27. JAI Press, 1992.

Department of Health and Human Services and the Centers for Disease Control and Prevention. *Public Health's Infrastructure: A Status Report Prepared for the Appropriations Committee of the United States Senate*. Atlanta, GA: CDC, 2000.

Director of Central Intelligence. "Iraq's Continuing Programs for Weapons of Mass Destruction: National Intelligence Estimate; Key Judgments" (October 2002). http://www.fas.org/irp/cia/product/iraq-wmd-nie.pdf (accessed February 29, 2012).

Donahue, Mick. "Terrorist Organizations and the Potential Use of Biological Weapons." In *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, edited by Potomac Institute for Policy Studies, 21–34. Arlington, VA: Oceana, 1999.

Enserink, Martin. "How Devastating Would a Smallpox Attack Really Be?" *Science* 296, no. 5573 (May 31, 2002): 1592–1595.

———. "Grudgingly, Virologists Agree to Redact Details in Sensitive Flu Papers." *Science Insider* (December 20, 2011) http://news.sciencemag.org/scienceinsider/2011/12/grudgingly-virologists-agree-to.html (accessed March 19, 2012).

Enserink, Martin and Jocelyn Kaiser. "Has Biodefense Gove Overboard?" *Science* 307, no. 5714 (March 4, 2005): 1396–1398.

Enserink, Martin and Richard Stone. "Dead Virus Walking." *Science* 295, no. 5562 (March 15, 2002): 2001–2005.

Epstein, Gerald. "Better Rules for Biotech Research." *Issues in Science and Technology* 21, no. 1 (Fall 2003): 6–7.

———. "Law Enforcement and the Prevention of Bioterrorism: Its Impact on the U.S. Research Community." In *Global Non-Proliferation and Counter-Terrorism: The Impact of UNSCR 1540*, edited by Olivia Bosch, Peter van Ham, and Jeffery Almond, 168–188. Washington, D.C.: Brookings Institution Press, 2005.

Epstein, Joshua, Derek Cummings, Shubba Chakravarty, Ramesh Singha, and Donald Burke. *Toward a Containment Strategy for Smallpox Bioterror: An Individual-Based Computational Approach*. Washington, D.C.: Brookings Institution Press, 2004.

Falkenrath, Richard A., Robert D. Newman, and Bradley A. Thayer. *America's Achilles'Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack.* Cambridge, MA: MIT Press, 1998.

Frist, Bill. *When Every Moment Counts: What You Need to Know about Bioterrorism from the Senate's Only Doctor*. Lantham, MD: Rowman & Littlefield Publishers, Inc., 2002.

Fong, I.W., and Kenneth Alibek, eds. *Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century*. New York: Springer, 2005.

Gellman, Barton. "Revealing a Reporter's Relationship with Secrecy and Sources." *Neiman Reports* 58, no. 2 (Summer 2004): 40–45.

Guillemin, Jeanne. *Anthrax: The Investigation of a Deadly Outbreak.* Berkeley, CA: University of California Press, 1999.

Harder, Ben. "The Vaccinia Dilemma," *Science News* 163, no. 14 (April 5, 2003): 218–220.

Hays, J.N. *Epidemics and Pandemics: Their Impacts on Human History*. Santa Barbara, CA: ABC-CLIO, 2005.

Henderson, D. A. "The Looming Threat of Bioterrorism." *Science* 283, no. 5406 (February 26, 1999): 1279–1282.

Henderson, D.A. and Luciana Borio. "Smallpox and Monkeypox." In *Tropical Infectious Diseases: Principles, Pathogens, and Practice*, 2nd ed., edited by Richard Guerrant, David Walker, and Peter Weller, 621–636. Philadelphia, PA: Elsevier, 2006.

Henderson, D.A. and Frank Fenner. "Recent Events and Observations Pertaining to Smallpox Virus Destruction in 2002." *Clinical Infectious Diseases* 33, no. 7 (October 1, 2001): 1057–1059.

Henderson, D.A., Thomas Inglesby, John Bartlett, Michael Ascher, Edward Eitzen, Peter Jahrling, Jerome Hauer, Marcelle Layton, Joseph McDade, Michael Osterholm, Tara O'Toole, Gerald Parker, Trish Perl, Philip Russell, and Kevin Tonat. "Smallpox as a Biological Weapon: Medical and Public Health Management." *JAMA* 281, no. 22 (June 9, 1999): 2127–2137.

Hensel, Andreas and Klaus Petzoldt. "Biological and Biochemical Analysis of Bacteria and Viruses." In *Bioaerosols Handbook*, edited by Christopher Cox and Christopher Wathes, 335–360. New York, NY: Lewis Publishers, 1995.

Hinkle, Peter. "The Case for a Special Operations Response to Biological Terrorism." In *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, edited by Potomac Institute for Policy Studies, 35–46. Arlington, VA: Oceana, 1999.

Hoffman, Bruce. "Terrorism Trends and Prospects." In *Countering the New Terrorism*, edited by Ian Lesser, 7–38. Santa Monica,

Holmes, Chris. *Spores, Plagues and History: The Story of Anthrax.* Dallas, TX: Durban House Publishing, 2003.

Hopkins, Donald. *The Greatest Killer: Smallpox in History.* Chicago, IL: Chicago University Press, 2002.

Jacoby, Lowell. Statement to the U.S. Senate Armed Services Committee. "Current and Projected National Security Threats to the United States," March 17, 2005. http://armed-services.senate.gov/statemnt/2005/March/Jacoby%2003-17-05.pdf (accessed February 3, 2012).

Jahrling, Peter. "Medical Countermeasures Against the Re-emergence of Smallpox Virus." In *Biological Threats and Terrorism: Assessing the Science and Response Capabilities*, edited by Stacey Knobler, Adel Mahmoud, and Leslie Pray, 51–54. Washington, D.C.: National Academy Press, 2002.

Jenkins, Brian. "Will Terrorists Go Nuclear?" RAND Paper Series, no. P-5541. Santa Monica, CA: RAND Corporation, 1975.

Johns Hopkins Center for Civilian Biodefense. "Dark Winter Exercise Script: Final Script."http://www.upmcbiosecurity.org/website/events/2001_darkwinter/dark_winter.pdf (accessed January 27, 2012).

"Joint Statement on Biological Weapons by the Governments of the United Kingdom, the United States, and the Russian Federation." (September 14, 1992) http://www.fas.org/nuke/control/bwc/text/joint.htm (accessed February 8, 2012).

Juergensmeyer, Mark. *Terror in the Mind of God: The Global Rise of Religious Violence* Berkeley, CA: California University Press, 2000.

Kaplan, David. "Aum Shinrikyo (1995)." In *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, edited by Jonathan Tucker, 207–226. Cambridge, MA: MIT Press, 2000.

Kaplan, Edward. "Preventing Second-Generation Infections in a Smallpox Bioterror Attack." *Epidemiology* 15, no. 3 (May 2004): 264–270.

Kapur, S. Paul. "Deterring Nuclear Terrorists." In *Complex Deterrence: Strategy in the Global Age*, edited by T.V. Paul, Patrick Morgan, and James Wirtz, 109–129. Chicago, IL: University of Chicago Press, 2009.

Kellman, Barry. "Bioviolence: A Growing Threat." *The Futurist* (May–June 2008): 26–30.

Knopf, Jeffrey. "The Fourth Wave in Deterrence Research." *Contemporary Security Policy* 31, no. 1 (April 2010): 1–33.

Kupperman, Robert and David Siegrist. "Strategic Firepower in the Hands of Many?" In *Countering Biological Terrorism in the U.S.: An Understanding of Issues and Status*, edited by Potomac Institute for Policy Studies, 47–52. Arlington, VA: Oceana, 1999.

Lane, J. Michael. "Remaining Questions about Clinical Variola Major." *Emerging Infectious Diseases* 17, no.4 (April 2011): 676–680.

Lane, J. Michael and Joel Goldstein. "Evaluation of 21st-Century Risks of Smallpox Vaccination and Policy Options." *Annals of Internal Medicine* 138, no. 6 (March 18, 2003): 488–493.

Lane, J. Michael and Lila Summer. "Smallpox as a Weapon for Bioterrorism." In *Bioterrorism and Infectious Agents: A NewDilemma for the 21st Century*, edited by I.W. Fong and Kenneth Alibek, 147–167. New York: Springer, 2005.

Laqueur, Walter. "Postmodern Terrorism." *Foreign Affairs* 75 no. 5 (September—October 1996): 24–36.

Le Duc, James, Kevin Anderson, Marshall Bloom, James Estep, Heinz Feldmann, Joan Geisbert, Thomas Geisbert, Lisa Hensley, Michael Holbrook, Peter Jahrling, Thomas Ksiazek, George Korch, Jean Patterson, John Skvorak, and Hana Weingartl. "Framework for Leadership and Training of Biosafety Level 4 Laboratory Workers." *Emerging Infectious Diseases* 14, no. 11 (November 2008): 1685–1688.

Leitenberg, Milton. *Assessing the Biological Weapons and Bioterrorism Threat*. Carlisle, PA: Strategic Studies Institute of the Army War College, 2005.

Mack, Thomas. "Smallpox in Europe, 1950-1971." *Journal of Infectious Diseases* 125 no. 2 (February 1972): 161–169.

Malakoff, David. "Student Charged with Possessing Anthrax." *Science* 297, no. 5582 (August 2, 2002): 751–752.

Mauroni, Al. *Chemical and Biological Warfare*. 2nd ed. Santa Barbara, CA: ABC-CLIO, Inc., 2007.

McCarthy, Timothy and Jonathan Tucker. "Saddam's Toxic Arsenal: Chemical and Biological Weapons in the Gulf Wars." In *Planning the Unthinkable: How Powers Will Use Nuclear, Biological, and Chemical Weapons*, edited by Peter Lavoy, Scott Sagan, and James Wirtz, 47–78. Ithaca, NY: Cornell University Press, 2000.

McEleney, Brenda J. "Smallpox: A Primer." In *The Gathering Biological Warfare Storm*, edited by Jim A. Davis and Barry R. Schneider, 141–159. Maxwell Airforce Base, Alabama: USAF Counterproliferation Center, 2002.

Merari, Ariel. "Psychological Aspects of Suicide Terrorism." In *Psychology of Terrorism*, edited by Bruce Bongar, Lisa Brown, Larry Beutler, James Breckenridge, and Phillip Zimbardo, 101–115. Oxford: Oxford University Press, 2007.

Merkle, Peter B. "Smallpox and Public Health: A Reality Check." *Science* 298, no. 5591 (October 4, 2002): 57.

Miller, Judith, Stephen Engelberg, and William Broad. *Germs: Biological Weapons and America's Secret War*. New York: Simon & Schuster, 2001.

Mockaitis, Thomas. *The "New" Terrorism: Myths and Reality*. Westport, CT: Praeger Security International, 2007.

Moodie, Michael. "The Soviet Union, Russia, and the Biological and Toxin Weapons Convention." *Nonproliferation Review* 8, no. 1 (Spring 2001): 59–69.

Moore, John Norton. *National Security Law*. Edited by Robert Turner. Durham, NC: Carolina Academic Press, 2005.

Moss, Bernard. "Poxviridae: The Viruses and the Replication." In *Fields Virology*, 5th ed., edited by David Knipe and Peter Howley, 2906–2946. Philidelphia, PA: Lippincott, Williams, and Wilkins, 2007.

O'Toole, Tara. "Smallpox: An Attack Scenario." *Emerging Infectious Diseases* 5, no. 4 (July–August 1999): 540–546.

O'Toole, Tara, Michael Mair, and Thomas Inglesby. "Shining Light on 'Dark Winter.'" *Clinical Infectious Diseases* 34, no.7 (April 1, 2002): 972–983.

O'Toole, Tara and Thomas Inglesby. "Biosecurity Memos to the Obama Administration." *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 7, no. 1 (2009): 25–28.

Patrick III, William C. Speech at Washington Roundtable on Science and Public Policy. "The Threat of Biological Warfare." (February 13, 2001) http://www.marshall.org/pdf/materials/62.pdf (accessed February 12, 2012).

Parachini, John, David Mosher, John Baker, Keith Crane, Michael Chase, and Michael Daugherty. *Diversion of Nuclear, Biological, and Chemical Weapons Expertise from the Former Soviet Union: Understanding the Evolving Problem.* Santa Monica, CA: RAND Corporation, 2005.

Pedahzur, Ami. *Suicide Terrorism*. Cambridge, UK: Polity Press, 2005.

Pennington, Hugh. "Public Health Reviews: Smallpox and Bioterrorism," *Bulletin of the World Health Organization* 81, no.10 (October 2003): 762–767. http://www.scielosp.org/scielo.php?script=sci_arttext&pid=S0042-96862003001000014&lng=en&nrm=iso&tlng=en (accessed March 1, 2012).

Preston, Richard. *The Demon in the Freezer: A True Story*. New York: Random House, 2002.

Puskoor, Rohit and Geoffrey Zubay. "Smallpox." In *Agents of Bioterrorism: Pathogens and their Weaponization*, edited by Geoffrey Zubay, 229–251. New York, NY: Columbia University Press, 2005.

Rabodzey, Aleksander. "Biosecurity Implications of the Synthesis of Pathogenic Viruses." *Politics and the Life Sciences* 22, no. 2 (September 2003): 44–49.

Sachs, Jessica Snyder . "Will Terror Laws Give Science a Chill?" *Popular Science* 262 no. 4, (April 2003): 30.

Scardaville, Michael. "Public Health and National Security Planning: The Case for Voluntary Smallpox Vaccination," *The Heritage Foundation Backgrounder*, no. 1616 (December 6, 2002).

Schneider, Barry R., and Jim A. Davis, eds. *The Gathering Biological Warfare Storm*. 2nd ed. Maxwell Air Force Base, Alabama: USAF Counterproliferation Center, 2002.

Scott, Susan and Christopher Duncan, eds. *Human Demography and Disease.* Cambridge, UK: Cambridge University Press, 1998.

Security Council Committee established pursuant to Security Council Resolution 1540 (2004). *Report of the Committee established pursuant to Security Council Resolution 1540 (2004)*, S/2011/579, (September 14, 2011). http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N11/530/08/PDF/N1153008.pdf?OpenElement (accessed March 19, 2012).

Selgelid, Michael. "A Tale of Two Studies: Ethics, Bioterrorism, and the Censorship of Science." *Hastings Center Report* 37 no. 3 (May–June 2007): 35–43.

Shapira, Shmuel, Jeffrey Hammond, and Leonard Cole, eds. *Essentials of Terror Medicine*. New York, NY: Springer, 2009.

Sherman, Irwin. *Twelve Diseases That Changed Our World*. Washington, D.C.: American Society of Microbiology Press, 2007.

Sidell, Frederick, William Patrick III, Thomas Dashiell, Ken Alibek, and Scott Layne. *Jane's Chem-Bio Handbook*. 2nd ed. Alexandria, VA: Jane's Information Group, 2002.

Smith, Bradley, Thomas Inglesby, Esther Brimmer, Luciana Borio, Crystal Franco, Gigi Kwik Gronvall, Bradley Kramer, Beth Maldin, Jennifer Nuzzo, Ari Schuler, Scott Stern, Donald Henderson, Randall Larsen, Daniel Hamilton, and Tara O'Toole. "After Action Report: Navigating the Storm; Report and Recommendations from the *Atlantic Storm* Exercise." *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 3, no. 3 (2005): 256–267.

Sprinzak, Ehud. "The Great Superterrorism Scare." *Foreign Policy* 112 (Fall 1998): 110–124.

Stern, Jessica. *The Ultimate Terrorists.* Cambridge, MA: Harvard University Press, 1999.

———. "Larry Wayne Harris (1998)." In *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, edited by Jonathan Tucker, 227–246. Cambridge, MA: MIT Press, 2000.

———. "Terrorist Motivations and Unconventional Weapons." In *Planning the Unthinkable: How Powers Will Use Nuclear, Biological, and Chemical Weapons*, edited by Peter Lavoy, Scott Sagan, and James Wirtz, 202–229. Ithaca, NY: Cornell University Press, 2000.

———. "Dreaded Risks and the Control of Biological Weapons." *International Security* 27, no. 3 (Winter 2002–2003): 89–123.

Tenet, George. Statement to the U.S. Senate Committee on Armed Services. "Worldwide Threat: Converging Dangers in a Post-9/11 World." *The Worldwide Threat to United States Interest*, 107th Cong., 2nd sess., March 19, 2002.

———. "Written Statement for the Record of the Director of Central Intelligence Before the Joint Inquiry Committee," 17 October 2002. http://www.fas.org/irp/congress/2002_hr/101702tenet.html (accessed February 3, 2012).

"The 21st Century Crime Bill." William J. Clinton Presidential Library, Bruce Reed Collection. http://www.clintonlibrary.gov/assets/DigitalLibrary/BruceReed/Crime/86/C%20647420-21st-century-crime-bill.pdf (accessed September 10, 2011).

The Bipartisan WMD Terrorism Research Center. *Bio-Response Report Card: 21st Century Biological Threats, October 2011*. Washington, D.C.: WMD Center, 2011.

Tucker, Jonathan B. "Biological Weapons in the Former Soviet Union: An Interview with Dr. Kenneth Alibek." *The Nonproliferation Review* 6 (Spring/Summer 1999): 1–10.

———. *Scourge: The Once and Future Threat of Smallpox*. New York: Atlantic Monthly Press, 2001.

———. "Preventing the Misuse of Biology: Lessons from the Oversight of Smallpox Virus Research." *International Security* 31, no.2 (Fall 2006): 116–150.

———. “Multilateral Approaches to the Investigation and Attribution of Biological Weapons Use.” In *Terrorism, War, or Disease: Unraveling the Use of Biological Weapons*, edited by Anne Clunan, Peter Lavoy, and Susan Martin, 267–292. Stanford, CA: Stanford University Press, 2008.

———. “The Smallpox Destruction Debate: Could a Grand Bargain Settle the Issue?” *Arms Control Today* (March 2009): 6–15.

———. “Breaking the Deadlock Over Destruction of the Smallpox Virus Stocks.” *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 9, no. 1 (2011): 55–67.

Tucker, Jonathan B., ed. *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*. Cambridge, MA: MIT Press, 2000.

Tucker, Jonathan B. and Raymond A. Zilinskas, eds. *The 1971 Smallpox Epidemic in Aralsk, Kazakhstan, and the Soviet Biological Warfare Program.* Center for Nonproliferation Studies Occasional Paper #9. Monterey, CA: Monterey Institute of International Studies, 2002.

United Nations. “The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction.” 10 April 1972.

———. *Treaty Series: Treaties and International Agreements Registered or Filed or Recorded with the Secretariat of the United Nations* 1015. New York: United Nations (1984).

U.N. Security Council. 4956th Meeting. *Resolution 1540 (2004)*. (S/RES/1540), 28 April 2004. http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N04/328/43/PDF/N0432843.pdf? OpenElement (accessed August 15, 2011).

U.S. Congress. House . Committee on Commerce. *The Threat of Bioterrorism in America: Assessing the Adequacy of the Federal Law Relating to Dangerous Biological Agents: Hearing before the Subcommittee on Oversight and Investigations*, 106th Cong., 1st sess., May 20, 1999.

———. House. Committee on International Relations. *Russia, Iraq, and Other Potential Sources of Anthrax, Smallpox and Other Bioterrorist Weapons: Hearing Before the Committee on International Relations*, 107th Cong., 1st sess., December 5, 2001.

United States Forces Korea (USFK) J2 Open Source Intelligence Branch, Joint Intelligence Operations Center Korea. *Korea Open Source Digest* IV, no. 193. (October 8–10, 2011) https://www.opensource.gov/portal/server.pt/gateway/PTARGS_0_0_200_203_0_43/content/Display/24809407/KPP20111010041001001.pdf (accessed February 5, 2012).

———. *Korea Open Source Digest* IV, no. 217. (November 12–14, 2011) https://www.opensource.gov/portal/server.pt/gateway/PTARGS_0_0_200_203_121123_43/content/Display/KPP20111114119002#index=21&searchKey=7425905&rpp=10 (accessed February 5, 2012).

U.S. Library of Congress. Congressional Research Service. *Smallpox: Technical Background on the Disease and its Potential Role in Terrorism*, by Frank Gottron. CRS Report RS21288. Washington, D.C.: Office of Congressional Information and Publishing, January 10, 2003.

———. Congressional Research Service. *An Overview of the U.S. Public Health System in the Context of Bioterrorism*, by Holly Harvey and Sarah Lister. CRS Report RL31719. Washington, D.C.: Office of Congressional Information and Publishing, February 11, 2004.

Venzke, Ben and Aimee Ibrahim. *The al-Qaeda Threat: An Analytical Guide to al-Qaeda's Tactics and Targets*. Alexandria, VA: Tempest Publishing, 2003.

Vogel, Kathleen. "Pathogen Proliferation: Threats from the Former Soviet Bioweapons Complex." *Politics and the Life Sciences* 19, no. 1 (March 2000): 3–16.

Vogel, Kathleen and Sonia Ben Ouagrham. "Conversion at Stepnogorsk: What the Future Holds for Former Bioweapons Facilities," *Peace Studies Program Occasional Paper #28*. Ithaca, NY: Cornell University, 2003.

Wehrle, P.F., J. Posch, K.H. Richter, and D.A. Henderson. "An Airborne Outbreak of Smallpox in a German Hospital and its Significance with Respect to Other Recent Outbreaks in Europe." *Bulletin of the World Health Organization* 43 (1970): 669–679.

Weiss, Martin, Peter Weiss, Glenn Mathisen, and Phyllis Guze, "Rethinking Smallpox," *Clinical Infectious Diseases* 39, no. 11 (December 1, 2004): 1668–1673.

Wilner, Alex. "Deterring the Undeterrable: Coercion, Denial, and Delegitimization in Counterterrorism." *The Journal of Strategic Studies* 34, no. 1 (February 2011): 3–37.

Woodward, Angela. "The Biological Weapons Convention and UNSCR 1540." In *Global Non-Proliferation and Counter-Terrorism: The Impact of UNSCR 1540*, edited by Olivia Bosch, Peter van Ham, and Jeffery Almond, 96–112. Washington, D.C.: Brookings Institution Press, 2005.

World Health Organization. *Laboratory Biosafety Manual*. 3rd ed. Geneva: World Health Organization, 2004. http://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf (accessed February 11, 2012).

Zelicoff, Alan and Michael Bellomo. *Microbe: Are We Ready For The Next Plague?* New York, NY: AMACOM, 2005.

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