

## WHAT IS THE WORST CASE RELEASE SCENARIO FOR BOSTON UNIVERSITY'S PROPOSED BSL4 BIOTERRORISM LABORATORY?

### What does Boston University claim?

Boston University's (BU) paid consultant, RWDI West, Inc., wrote a "worst case" release scenario report that claims that no one would get anthrax if the bioterrorism laboratory's containment system fails and releases anthrax into the neighborhood. Based on the report, the National Institutes of Health (NIH) and BU claim that there is no risk from the bioterrorism laboratory.<sup>1</sup>

### What does an independent expert say about the report?

Professor Jeanne Guillemin, Ph.D., reviewed the RWDI West, Inc., report.<sup>2</sup>

Dr. Guillemin wrote, ***"The report contains serious mistakes that lead to the erroneous conclusion that an anthrax spore release caused by a laboratory spill would pose no risk to the public."***

A serious mistake in the RWDI West report is its calculation that a gram of anthrax would contain 400,000 respirable spores, (spores in a size range that someone could inhale into his or her lungs) and that no one would inhale even one spore of anthrax in a laboratory release. The correct number of respirable spores in a gram of anthrax is 40 billion, not four hundred thousand. If RWDI had used the correct number, it would have had to conclude that people would inhale anthrax spores resulting from a laboratory release. Studies of the Sverdlovsk accidental release of anthrax in 1979 show that those who died of anthrax inhaled as few as nine spores.

Other serious mistakes in the RWDI West Report include its failure to consider human dose response to anthrax spores and the dispersal of anthrax spores in an urban environment, and not assessing the release of biological pathogens that are more contagious than anthrax.

Attached is Dr. Guillemin's full review of BU's RWDI West report.

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<sup>1</sup> BU included the report in the Final Environmental Impact Report/Final Project Impact Report (FEIR/FPIR) that it submitted to the state and Boston Redevelopment Authority and in the Draft Environmental Impact Statement (DEIS) that it wrote for NIH. No independent scientific body reviewed the report, but BU and NIH use it to claim that a release of anthrax from the lab would not harm anyone.

<sup>2</sup> Dr. Jeanne Guillemin, a Senior Fellow, MIT Security Studies Program, and Professor of Sociology, Boston College, works in the area of medical anthropology. Her teaching includes a seminar on Risk and Danger. She has more than twenty years of experience in the investigation of biological weapons controversies and has published broadly about them. She is the author of *Anthrax: The Investigation of a Deadly Outbreak* (University of California Press, 1999), the definitive account of the 1992 team research of the largest inhalational anthrax epidemic in recorded history, which in 1979 killed sixty-six people in the Soviet city of Sverdlovsk. Her interviews with the families of victims were the basis for the epidemiological map that proved an anthrax aerosol from a nearby military facility caused the outbreak and her data proved that the incubation period for inhalational anthrax can be as long as six weeks. She is also the author of the forthcoming book, *Biological Weapons; From the Invention of State-sponsored Programs to Contemporary Bioterrorism*. Dr. Guillemin's curriculum vita is available at [http://www2.bc.edu/~guilleje/Homepage\(Frames\).html](http://www2.bc.edu/~guilleje/Homepage(Frames).html). Unlike RWDI West, Inc., which BU paid to write a report, Dr. Jeanne Guillemin is an independent expert. She received no payment or other compensation to review the RWDI West report.

From: Jeanne Guillemin

Date: October 24, 2004

Re: Comments on Final Environmental Impact Report/Anthrax Aerosol Release Models

The report by RWDI West Inc. uses three potential anthrax release scenarios to “provide an estimate of the maximum possible risk of exposure.” The report contains serious mistakes that lead to the erroneous conclusion that an anthrax spore release caused by a laboratory spill would pose no risk to the public.

In its conclusion and in its methodology, the RWDI report also ignores the question of what would happen on a community level after a dangerous release. The 2001 anthrax postal attacks revealed “an unacceptable level of fragility” in public health and hospital response that remains unaddressed (Gursky, Inglesby, and O’Toole 2003: 97). Difficulties (including unpredicted fatalities) in administering the 2003 federal smallpox vaccination campaign pointed to serious shortfalls in defending the public and to increased risks to public health (Hillel, Gould, and Sidel, 2004).

In addition, the report ignores contagious disease outbreaks that could result from BSL-4 accidents. Smallpox and plague outbreaks, widely discussed in the Homeland Security literature, could pose serious threats to the public.

Before addressing these problems, I want to offer some background on what we know about anthrax as a disease and about anthrax spores.

#### *About Anthrax*

Anthrax as a disease originated thousands of years ago in grazing animals and only later passed to humans who came in touch with infected livestock carcasses, from butchering or eating infected meat or in industrially processing skins, wool or hair.

The anthrax spore is about one micron in diameter and forms as a protection after the bacterium is exposed to air. Research on anthrax aerosols to attack enemy civilians is fundamental to the history of state biological weapons programs (Guillemin 2005). That history begins with the French in the 1920s, followed by the Japanese Imperial Army in the 1930s. Anthrax spores for use in bombs and spray generators were most extensively developed by the United States from 1943 until it abandoned biological weapons in 1969. From 1975 to 1992, anthrax bacteria were secretly researched and produced by the USSR. A main goal was to increase the virulence of anthrax spores, which could be done by passing the disease through successive animal hosts and also by new methods in biotechnology.

Inhalational anthrax is an extremely rare disease. Most of what we know about it comes from military research, from the 1979 Soviet outbreak in the city of Sverdlovsk, and from the 2001 postal anthrax attacks (WHO 2004: 229-243). The Sverdlovsk outbreak, the largest of its kind in recorded history, was later shown to have resulted from an outdoor spore release from a military facility in the city (Abramova, Yampolskaya, and Walker 1993; Meselson et al. 1994; Guillemin

1999). Sixty-eight people died in the outbreak, from what is estimated as a gram or less of spores disseminated in a plume that blew over a local neighborhood. The released spores killed livestock as far as 30 miles from the source of the emission.

The optimal size of any particulate for inhalation in the human lung is 1-10 microns. Although anthrax spores can clump into larger particle sizes, weapons research showed that spores can easily be separated into the small particle sizes that would increase the chances of infecting the enemy under attack.

A single anthrax spore can cause inhalational anthrax if it is inhaled deep into the lungs and subsequently reaches the lymph nodes. Even small amounts of lethal anthrax spores are dangerous, such as the trace amounts that cross-contaminated letters during the 2001 anthrax attacks.

The early symptoms of anthrax infection are flu-like (not those of the common cold as the RWDI report states on page 2) and can easily lead to misdiagnosis. After symptoms commence, death often occurs within two to three days from massive internal inflammation and hemorrhage (Dixon et al. 1999). Antibiotics can prevent infection in those exposed but once symptoms begin, saving the patient is difficult. An 80-90% fatality rate is associated with inhalational anthrax.

The Sverdlovsk outbreak strongly suggested that, in some cases, the spores can remain dormant even after being inhaled and infection can be delayed as long as six weeks. For this reason, during the 2001 postal attacks, those at high risk of exposure were advised to remain on antibiotics for as long as three months (Jernigan et al. 2002).

The current anthrax vaccine is presumed to be an adequate defense against inhalational anthrax, although, because the disease is so dangerous, the vaccine has never been tested on humans. A large dose of anthrax spores could overwhelm the protection afforded by a vaccine.

Although workplace contamination is not addressed in the RWDI report, the 2001 anthrax postal attacks and indoor simulations showed the ease with which anthrax spores disperse throughout buildings and cause health risks and also the extreme difficulty, time, and expense associated with building decontamination (WHO 2004: 98-108; DRES 2001). The recent report concerning anthrax contamination from Fort Detrick's BSL-3 laboratory also raises concern about leaks from high-containment laboratories (US Army 2004).

Environmental contamination is also not a part of the RWDI report, but any outdoor release brings with it the possibility of soil contamination. Sunshine can eventually degrade anthrax spores but they are otherwise impervious to extremes of heat or cold. They have been known to survive in arid soil for as long as 140 years and to cause repeated animal outbreaks for decades after soil contamination.

### *The RWDI Report on a Potential Anthrax Release*

The central problems in the RWDI report concern:

- 1) the estimated number of spores that could be released
- 2) human dose response to anthrax
- 3) the dispersal of spores in the urban environment.

### **The Estimated Number of Spores Released**

For each of its three scenarios, the RWDI report concludes that the maximum number of spores likely to be inhaled by an individual at ground level in the center of a plume is less than one. “Since the release and inhalation of a partial spore is not feasible, this number may be considered as zero.” A serious mistake, though, appears to have been made in reckoning the number of spores released.

The US and Canadian military and other authoritative sources commonly calculate that there are around a trillion anthrax spores per gram (Meselson et al. 1994, He and Tebo 1998, Meselson 2002, DRES 2001). In contrast, the RWDI report (p.3) relies on just ten billion spores per gram.

The RWDI report also relies on a reported NIH simulation calculating that 400,000 spores (per ten billion) or 4% would be “respirable”, that is, in the 1-10 micron range. The 4% estimate might be reasonable; but for a gram of anthrax (a trillion spores) 4% would mean 40 billion spores in the respirable range would be released.

This increased amount would likely change the “zero” conclusion about the predictable number of spores inhaled to some whole number.

That said, the attempt to calculate risk in terms of a single individual positioned in the center of an anthrax plume fails to capture the way in which anthrax affects different individuals and also the collective nature of the impact of an anthrax release.

### **Human Dose Response**

The RWDI emphasis on the lone exposed individual ignores the importance of human dose response as it depends on individual susceptibility. We like to average risk assessments, but we must remember that some people are more vulnerable to infectious diseases than other.

For example, in Sverdlovsk, we estimated that the number of inhaled spores per victim was nine and, based on the number of people exposed, around 5000, it was possible to estimate a 2% fatality rate (or, in military terms, attack rate) from the release.

Yet among the victims, older people were more susceptible to inhalational anthrax than younger people or children. No one under age 24 in Sverdlovsk contracted the disease, although many were exposed. Those who contracted inhalational anthrax during the 2001 postal attacks were also in their forties or older. It could be that older people and perhaps those afflicted with respiratory or lung diseases would have increased risks of infection from an anthrax release. For

that reason, beyond even any accurate models RWDI might construct, census data and figures on health and disease are necessary to predict potential harm to the local population.

### **The Dispersal of Anthrax Spores in the Urban Environment**

The RWDI emphasis on a lone exposed individual located at ground level oversimplifies the physical and temporal conditions that affect urban aerosol dispersal. An anthrax aerosol flowing through an urban environment would expose *all those in its path*. That path, if from a single source, would gradually expand, like a cone growing both larger and longer.

Depending on wind velocity and direction and on atmospheric conditions, an anthrax aerosol emission could expose people at a range of altitudes, not only at street level but on different floors in apartment, hospital, office or factory buildings. Even if windows are closed, anthrax spores could penetrate indoors. (Note that in the anthrax postal attacks, spores penetrated the paper of the envelopes in which they were mailed. Such ordinary paper has apertures up to 3 microns in size.)

Population density is, of course, crucial in calculating the risks of exposure. In Sverdlovsk, the neighborhood near the military facility was much less densely populated than more northerly area of the city, where fatalities would have been higher. Within the afflicted neighborhood, the most crowded workplace in the path of the plume, a large ceramics factory employing thousands, lost 19 employees to inhalational anthrax. Equally large industries on either side of the projected plume were unaffected by it.

Although it used models for different weather conditions, the RWDI report could have modeled a potential release in Boston (as opposed to some other metropolis) as a real-time dispersal with impact on communities rather than on a standard individual.

The understanding of the importance of distinct urban characteristics is well represented in US military research on anthrax aerosols. In 1953, the US Army chose three North American cities (Minneapolis, St. Louis, and Winnipeg) for their similarities in population density and climate to Soviet industrial cities targeted for biological attacks (US Army 1954). Since anthrax spores have a tendency to stick to surfaces on impact (like the sides of buildings, trees, or the ground), a city's distinctive topology affects how a plume would spread. Using anthrax simulants, its researchers conducted repeated year-round aerosol release experiments to gauge dispersal in different parts of these cities. Whether a city area was built up or open, had parks, high buildings, highways or waterways made a difference, along with atmospheric conditions, in the plume's potential impact.

Boston is a northeastern port city with predictable prevailing winds and seasonal variations in temperature and daylight hours, which affect the direction and altitude of a potential anthrax plume. The area immediately around the proposed BUMC building has a distinctive topology for which models of aerosol dispersion could be made, in order to estimate the paths of potential anthrax plumes and their impacts on local populations.

## *Contagious Disease Scenarios*

The WHO has recently published guidelines on responses to outbreaks of diseases caused by biological weapons agents (WHO 2004: 53-85). A main point of the WHO guidelines is that a community's existing "well-designed public health and emergency-response system" should be able to handle a medical emergency from any source. On-going community-level disease surveillance should be part of that capability, to identify unusual disease outbreaks as early as possible.

But how should gaps in the system be identified? The WHO strongly advises the use of scenarios involving different agents to pinpoint problems:

The level of threat that exists is also a function of the potential vulnerability of the community concerned. Vulnerability analysis will identify potential scenarios as well as weaknesses in the system...and will determine the current ability to manage the emergency. (2004:58)

Regarding biological weapons, even when public health systems are effective, there are limits to medical interventions to protect against select agents. Although we want to believe in "magic bullet" defenses, none exist that would protect the public without risk. The possible short-term and long-term effects of the anthrax vaccine have been an on-going source of controversy in the US military (Sidel, Nass and Ensign, 1998; Guillemin 2000, 2003a; Institute of Medicine 2002). The 2003 smallpox vaccination campaign faltered quickly after five first responders over age fifty died from heart problems aggravated by the vaccine. Nor should individuals with skin diseases, compromised immune systems, or other medical vulnerabilities be vaccinated against smallpox. The biodefense initiative aims to invent better protections, but in the meanwhile an exposed public has to be vigilant about risks and hazards.

### **Contagion Scenarios and Smallpox**

Worst-case scenarios involving highly contagious disease outbreaks from select agents, (such as those for smallpox, pneumonic plague, tularemia or one of the hemorrhagic fevers, such as Ebola virus) would necessarily reveal complexities that can be avoided in models of a single-point source anthrax emission. Unlike scenarios for inhalational anthrax, which is not transmitted human-to-human, a contagion scenario requires calculation of how a disease is introduced into and can proliferate in a community and possibly beyond, and what public health measures are either in place to contain the epidemic or are insufficient or lacking.

In the simplest scenario, a single index case contacts and infects others who in turn pass on the disease. How many people an individual is likely to infect is called the contagion rate, which can vary by the virulence of the disease and the relative immunity or susceptibility of those exposed. If contagion began with an aerosol release, the number of vectors could be multiplied with catastrophic consequences. Modern travel has also accounted for the rapid spread of dangerous infectious diseases like AIDS, smallpox, and SARS.

Smallpox, highly communicable and, with anthrax, a disease of great national security concern, is the most likely candidate for a worst-case contagious disease scenario. Officially eradicated from the world in 1981, long after it was a serious threat in North America, smallpox causes fear because of reduced immunity in the general population. Those under twenty-five are unlikely to be vaccinated and older people who are vaccinated may have only residual immunity or none at all. Only two reserves of smallpox strains now exist, at two WHO reference laboratories, one at the Centers for Disease Control and Prevention (CDC) in Atlanta and the other at Vektor, the Russian research center in Novosibirsk. Intermittent research that exposes animals, including primates, to smallpox aerosols is currently conducted at the CDC. Concerns have been raised about security at the Vektor facility. In the run-up to the 2003 invasion of Iraq, rumors that Saddam Hussein might attack the US with smallpox were rampant and affected public opinion about a vaccination campaign (Blendon et al. 2002).

The World Health Organization summary of its eradication campaign includes descriptions of the laboratory accidents that caused outbreaks in the United Kingdom in 1966, 1973, and 1978 (WHO 1988:1095-1101). Following early misdiagnoses, all were contained by public health intervention. The earliest and latest epidemics were apparently caused by insufficient ventilation precautions between a Birmingham medical school laboratory and the floor above it. The 1973 outbreak was started at the London School of Hygiene and Tropical Medicine when a laboratory assistant, vaccinated as a child and again in 1972, nevertheless contracted smallpox after briefly visiting the poxvirus laboratory. Safety measures are more stringent today but, should smallpox return, its consequences could be not only national but international.

Experts concerned with bioterrorist attacks have differed with each other about a likely contagion rate, should a smallpox outbreak occur in the United States. Authors of the well-known table-top exercise “Dark Winter,” relying on information from the 1972 smallpox outbreak in Yugoslavia, postulated a 1:12 rate of transmission (O’Toole, Mair, and Inglesby 2002). They also conjectured 3000 initial cases, an especially virulent smallpox strain, and a shortage of smallpox vaccine, which in the exercise led to an international pandemic in a matter of weeks.

Others have argued that a ratio of 1:2-3 is more in line with past epidemics (Meltzer et al. 2001; Ganl and Leach 2003). Historically, the mortality rate associated with smallpox also varies, from 12% to 30% of those who contract it. Those most at risk for secondary infection and death would be small children and pregnant women, along with those with suppressed immune systems, malnourished, elderly, or sick with other diseases.

### **Public Trust and Communication Failures**

Experts agree that the successful containment of a contagious disease from any source depends on the public’s trust, cooperation and understanding of risks (Levy and Sidel 2003).

Transparency is vital. To protect themselves, people need information about the nature of the disease threat, the kinds of protective interventions that are available, and how to access those interventions. Any disease outbreak model for Boston should reckon beforehand the main obstacles to trust and communication and therefore increase the vulnerability of communities.

Two such obstacles are predictable: 1) existing social barriers; and 2) secrecy surrounding biodefense research.

Social barriers to communication based on differences in education, ethnicity, race and language can hinder diagnoses and increase the dangers of any outbreak. Boston's population is both diverse and, in many instances, segregated. To what extent would this hinder communication in an unusual disease outbreak?

When a biological weapons agent is involved, services can break down along existing racial divides even when government agencies are technically prepared for an emergency. During the 2001 anthrax postal attacks in Washington, DC, the 97% African-American postal workers where two of the contaminated letters were processed were only belatedly warned of their risks and given antibiotics, while the government early on distributed antibiotics to other, mainly white employees.

State secrecy regarding dangerous epidemics has been a repeated source of danger to the public (Guillemin 2003b). We saw this most recently with China's reluctance to admit to the SARS epidemic. In 1972, Iraq kept silent about the smallpox epidemic in Baghdad that later spread to Yugoslavia and in the early 1990s India denied epidemics of plague affecting its cities.

The 1979 Sverdlovsk anthrax outbreak was an extreme instance of state secrecy; the Soviet military never admitted its responsibility for the aerosol release and the affected community remained ignorant of the source and nature of the disease. By the time antibiotics and treatment were available, nearly half the victims had died or were beyond help.

Defense research on weapons seeks innovative advantages in anticipation of what an enemy might acquire and strives to keep these innovations secret. We should expect that is no less true for biological weapons than for other weapons, even though offensive development is banned by international treaty. For example, in early 2001, the US secret development of a vaccine-resistant anthrax strain was leaked to the press (Miller, Engelberg, and Broad 2001: 231). Critics pointed out that such weapons development is forbidden by the 1972 Biological Weapons Convention and, moreover, that it dangerously stimulates less powerful nations to emulate American flaunting of the treaty (Wright 2002: 15-16). The line between offensive and defensive research, though, has been historically difficult for military and intelligence agencies to draw.

Most microbiologists working in this country have not had their work classified or restricted as "sensitive." Open review and publication in medical research have led to altruistic advances for the general benefit of humanity. Yet there are pressures now on scientists funded to do secret biodefense research in the name of US national security, like physicists who work on nuclear weapons programs. In reaction, a recent National Research Council commission report urges scientists become vigilant about the risks of research on select agents and recommends against secrecy: "Given the increased investments in biodefense research in the United States, it is imperative that the United States conduct its legitimate defensive activities in an open and transparent manner." (NRC 2003:9)

The secrecy around biodefense research that could erode the altruistic goals of medical research could also pose a risk to local vulnerable communities if they are kept in the dark about potential disease threats.

### *Recommendations*

Models for assessing the health risks of a BSL-4 laboratory to Boston and surrounding communities should be more complex and various and meet the WHO guideline for identifying community vulnerability and gaps in public health response systems.

Scenarios for anthrax and other aerosols should take into account the demography of communities that could be affected, as well as the particular atmospheric, weather, and topological characteristics of Boston and its suburbs.

Scenarios for contagion should involve two sources: a) outdoor aerosol release; and b) a BSL-4 employee or visitor to the building as an index case.

Around 40 select agents are commonly listed as dangerous to humans (WHO 2004: 230-231). Many more exist which affect animals and crops. Those in charge of modeling scenarios should consult with Boston University Medical Center and NIAID about the agents likely to be researched in the proposed BSL-4 laboratory.

For transparency on a local level, to protect the public in the Boston area, BUMC should immediately agree to an independent oversight committee to consult on risk assessment for the BSL-4 laboratory, including disease outbreak scenarios, and on future plans for biodefense research. The members of this committee should not be affiliated with Boston University or NIH. The committee should include knowledgeable scientists and Boston community residents most likely to be affected by the laboratory.

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