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Bioterror

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ACTS OF BIOTERROR have permeated America's post-September 11 consciousness. People no longer rip into their mail: They assess the stack, open envelopes gingerly, then wash their hands if the mail seems crumpled. Television, radio, and web broadcasters, newspapers, and magazines report on bioterror-related incidents, hoaxes, antibiotics, vaccines, DNA sequences, strategies, and policies. Healthy people brood over whether another bioterrorist act is looming; less sanguine types wonder when, not whether, the next attack will occur. It is telling that, as of mid-December 2001, not one of 741 online dictionaries scanned by the OneLook Dictionaries (covering more than four million words) included an entry for bioterror. The word, like the act itself, has arrived full-blown onto the scene.

The weapons that are responsible for the phenomenon of bioterror are distinctive. They exist naturally, unlike nuclear, chemical, and conventional weapons, all of which must be manufactured or synthesized. Bioweapons are alive, which means that they can replicate. And once unleashed, they take on lives of their own. They are capable of mass destruction or of dying out before they do any damage. They pose a danger both to their intended targets and to those who intend to use them.

Bioweapons are insidious, befitting the tastes and styles of rogue states, fanatic groups, and disaffected individuals. They conjure up gruesome images of the suffering, pain, and death associated with the great plagues. Western military establishments pride themselves on the tactical deployment of weapons; the imprecision associated with bioweapons–they disperse and can deteriorate when exposed to air and light; they chance obliteration when delivered as part of an explosive system–makes them unreliable. Bioweapons are not sophisticated, even if the technologies for producing and converting living organisms into weapons are.

Anthrax

Bacillus anthracis, the bioweapon that causes the disease *anthrax*, has had the United States in its thrall for several months. Five people died from inhalation anthrax in 2001. The terrorist(s) sent deadly anthrax spores through the U.S. mail to prominent members of the federal government and the media. But, en route to their targets, the spores infected postal workers and other innocent bystanders. Tens of thousands of exposed individuals received prescriptions for Cipro and other antibiotics (which caused additional illnesses). People were offered a controversial anthrax vaccine on the chance that, post facto, it would gird their bodies against spores that had eluded the antibiotics.

Government and postal buildings were sealed off for weeks and months. "Sleuths" from the FBI, the Center for Disease Control (CDC), and other agencies tried to track down the terrorist(s) through two tell-tale signatures, one in the handwriting on the lethal letters and another in the molecular structures of the spores. Most evidence seemed to point to a disgruntled scientist in the United States, working now or in the past in a bioweapons facility.

Anthrax appears to have been around as long as people have. One scholar suggests that anthrax is the sixth plague, "the sooty morain" in the biblical book of Exodus.[1] The bacteria that cause anthrax flip-flop between an active, infectious form and a spore form that preserves the organisms for years or decades.

Now anthrax is more than a disease. It is a weapon.

bio
From a Greek root for "life"

terror
From a Greek root for "fearing" and "fleeing"

The spores that arrived by mail in autumn 2001 entered their victims' mouths, lungs, and skin, where they encountered conditions that drew them out of their dormant states. Macrophages–the cells that typically clear spores, bacteria, and other foreign substances from the bloodstream and tissues–engulfed the anthrax organisms but then were destroyed by the toxins that the bacteria produced. The accumulating toxins–both those released by the bacteria and those extruded from the dying macrophages–poisoned the victims, shut down their organs, and killed the unluckiest.

Naturally Occurring Anthrax

Cattle, sheep, and other animals have always been susceptible to anthrax. At times, the disease would "jump" into humans–farmers, shepherds, veterinarians, and others working closely with animals and their wool and hides. The cutaneous form of anthrax, the most common, produced dark lesions the color of anthracite coal–hence the name anthrax–on victims' skin. Stomach pains, diarrhea, and vomiting would occur when the spores were swallowed. And those who inhaled the spores almost always died.

When an animal died of anthrax in a pasture, the bacteria in the carcass, deprived of nutrients, would revert to the spore form. Spores left in the grasses would then lie in wait for another victim–the farmer or the next animal grazing on that patch of grass. Other spores embedded in the wool or skins of animals would make their way to the marketplace, where they caused "ragpicker's disease," "wool sorter's disease," and "tanner's disease."

The cutaneous, treatable form of anthrax has long been recognized as an occupational hazard for factory workers. The inhalation form was rare. But in

FBI PHOTO

FBI and Environmental Protection Agency personnel working to identify anthrax-contaminated mail at a containment facility.

1957, five men at the Arms Textile Mill in Manchester, New Hampshire, died of inhalation anthrax, and another five got sick but survived. All ten had handled a single spore-laden lot of goat hair that had been imported from Pakistan.

At the time of the Manchester outbreak, some employees at the factory were participating in a trial of an experimental vaccine for anthrax. The five who died had either received a placebo vaccine or had not been in the study; the five who survived had been in the group that received the anthrax vaccine. The study was halted immediately after the victims died, everyone at the factory was given the anthrax vaccine, and the outbreak ended.

Manchester returned to normal until 1966, when a machine shop worker across the street from the mill died of inhalation anthrax. His shocking death suggested that anthrax spores were floating outside the mill walls and imper-

Timeline: Selected Events in the History of Bioweapons Development and Use

Persian, Greek, and Roman Times

- Soldiers dumped animal cadavers into the reservoirs of their enemies to pollute the water supply.
- Soldiers dipped arrow tips into decomposing corpses to make poison arrows.

Medieval Times

- A Mongol chief catapulted bodies of bubonic plague victims over the walls of a Crimean city.

Questions for Classroom Discussions

- What makes a terrorist? What so alienates people to drive them to extreme behaviors? Consider how both biological (innate) and environmental factors contribute to sociopathic behavior.

- What is the difference between a terrorist and a freedom fighter? Is it possible to obtain international consensus? How likely is it that nations around the world will agree on what constitute valid versus unacceptable ways to protest against a regime?

- Are any forms of violence acceptable? Is violence acceptable when the target is military and when no civilian casualties are incurred? Could nations agree that attacks on civilians are never acceptable? How likely is it that major world powers, particularly those with widely deployed forces, would be amenable to such discussions and to complying with consensus agreements?

- What additional police, military, legal, social, and policy measures should the United States government and other governments take to detect, prevent, and counter terrorism? What might be the accomplishments and drawbacks of each of these proposed actions?

- What systemic changes in global economics, health care, and the distribution of resources and opportunities might be required to rid the world of terrorists?

- The Biological Weapons Convention of 1972 failed to keep signatories from developing weapons because, as one commentator put it, the treaty was "toothless." What forms of inspections and verifications might be included in a future treaty to make the provisions of the treaty enforceable and effective? Consider how inspections are complicated by the need to have samples of a bioweapon not just in facilities that are designed for weapons production but also in facilities designed for developing defenses–vaccines and antidotes–against such weapons.

- During World War II and the Cold War, tens of thousands of people–researchers and others–in many countries participated in the development of bioweapons. What might have motivated these people to engage in this type of work? Consider especially those scientists who were plucked from laboratories where they had been doing basic medical and scientific research. What sorts of moral dilemmas and conflicts might their new assignments–to sicken and kill people rather than to help them–have engendered?

- Bioweapons directed against livestock and plant crops might wreak more havoc with less effort than would weapons against people. Some bioweapons may not even be detectable until long after they are on their way to killing plants and animals. Cleanup costs and effects on the economy could be substantial even if mass human starvation is unlikely. What current agricultural practices in the United States are increasing the vulnerability of crops and animals to bioweapons? (Here you might discuss genetically engineered crops and the loss of biodiversity in both animals and plants, which makes our existing stocks more vulnerable to a carefully engineered bioterror agent.) What changes might be effective in protecting the food supply? (In addition to focusing on diversifying the increasingly homogeneous stocks, you can also discuss how surveillance systems, already intensive and expensive, might need to be even more elaborate and widespread.)

- Is it appropriate for a democracy to engage in secret human experiments on vaccines and drugs that could counter the effects of bioweapons?

- What safeguards must be put in place to protect individual rights while also protecting the public health in times of bioterror threats and attacks?

The Eighteenth Century

- Russian invaders threw bodies of plague victims into Estonian villages.
- Lord Jeffrey Amherst, commander of the British forces during the French and Indian War, gave poxvirus-infected blankets to North American Indians as a "peace offering."

World War I

- German secret agents in the United States inoculated horses and other cavalry animals with pathogens. The animals became sick and died in Europe. None returned at war's end.

The 1930s and 1940s

- Japan developed and produced biological weapons on a massive scale. It built a secret remote establishment in Manchuria during its occupation. This infamous "Unit 731" had the capacity to produce forty million billion pathogenic bacteria in days.

AP Photo/Martin Cleaver

A "No Entry" sign blocks a path leading to a beach on Gruinard Island off the west coast of Scotland, Wednesday, October 24, 2001. The island is where British scientists exploded a series of anthrax bombs during World War II.

iling people in the neighborhood, most of whom would not be protected by a vaccine. The mill was shut down, numerous attempts over a decade were made to clear away the anthrax spores, but when thorough remediation proved impossible after years of trying, the factory was torn down, the wooden structures were burned, and the bricks were buried.[2]

Anthrax as a Weapon

The British government was struggling during those same years to solve a similarly stubborn cleanup problem involving anthrax spores. The contamination had been self-imposed, stemming from bioweapons research during World War II.

Bioweapons researchers had selected Gruinard, a boggy remote Scottish island, for their studies of whether anthrax spores could be made into weapons. In 1941, the island was home to sixty sheep and one shepherd, but in 1942, soldiers, scientists, and engineers reconfigured the island for the "weaponization" experiments.

The first experiment involved a thirty-pound bombshell filled with a suspension of anthrax spores. Fifteen sheep were immobilized in individual wooden crates draped with canvas cloths; only the animals' heads were exposed. The crated sheep were positioned downwind from the blast site. The bomb was detonated, and air sampling devices near each crate collected spores as they floated by. The experiment established that at least some of the anthrax spores could survive the explosion, travel in the wind, and infect and kill the target sheep. The sheep began to die three days after exposure to spores, and only the two farthest from the bomb survived. The experimenters conducted autopsies on the dead sheep to prove that their deaths were caused by anthrax. Then they dumped the carcasses over a cliff.

Testing continued at Gruinard for about a year. All the tests were variations

Some 10,000 people, mostly from around Harbin, Manchuria, died horrible deaths in the experiments.

- German operatives spread non-pathogenic bacteria in the Paris subway in 1933 and tracked their dispersal.
- Nazi scientists carried out small-scale bioweapons experiments in the concentration camps. Hitler is said to have had an aversion to bioweapons and other unconventional weapons because he had been gassed in World War I.
- Soviet secret police were believed to be carrying out bioweapons experiments before World War II.
- The United States and England began biological weapons experiments in 1942 and 1943. No organisms were "weaponized" in the United States before the war ended, but much work was done for defensive purposes.

Taking Sides on Public Health Priorities

The current focus in the United States on bioterrorism and bioweapons could affect the U.S. public health infrastructure in one of two ways. Some believe that new federal monies recently appropriated for research on bioweapon-related infectious diseases, vaccines, antibiotics, diagnostics, and related resources and projects will be a bonanza for public health in general. Others argue that existing public health programs and infrastructure will deteriorate further because funding will be diverted to research on potential threats rather than existing needs.

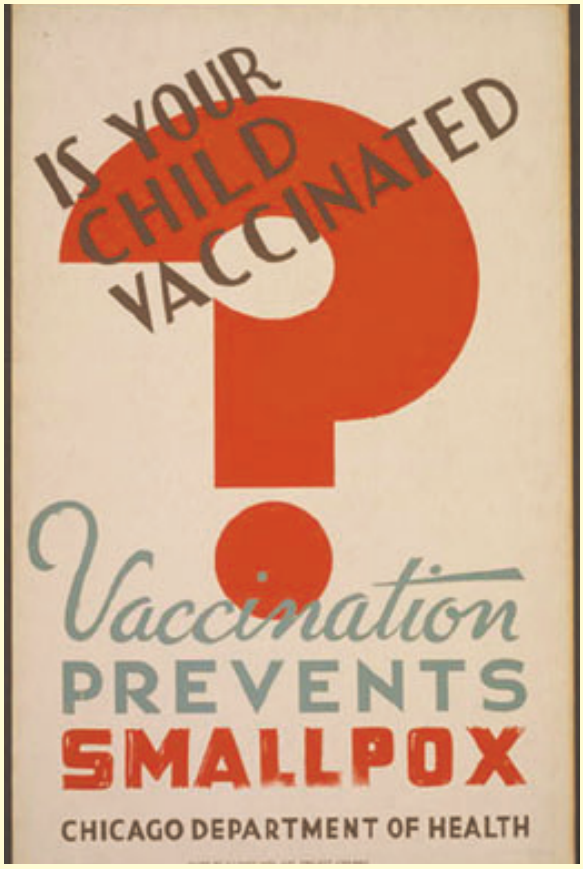
The projects listed below all need more attention from biomedical researchers. Pairs of students should choose one subject (or a public health subject that is of concern in the local community, such as a contaminated drinking water reservoir or an outbreak of food poisoning at a local restaurant). The students should research their subjects, learning about scientific advances and continuing questions and the morbidity and mortality tolls associated with the disease or weapon. In fifteen-minute classroom presentations, each pair of "lobbyists" should present its findings to a panel of students and argue for increased funding for the project.

The panel members should then evaluate each proposal and create a priority list for funding that reflects the persuasiveness of the lobbyists' arguments. The panel should then defend its list to the lobbyists.

The whole class should then brainstorm about additional health research that should be considered in a future list.

The class can also reflect on the original issue of public health, focusing on how it might be possible to direct the new bioterror research to shore up rather than to further compromise the public health infrastructure in the country. Keep in mind in this discussion that public health focuses on the health of populations, not on individuals. This discussion should consider relevant statistics. For example, during the two-week period in October 2001, during which five Americans died of anthrax, some 470,000 people around the world died of other infectious diseases.

Finally, the class should compose a letter to senators, representatives, and other national policymakers, describing the class's conclusions about what public health efforts belong at the top of the national priority list.



Projects

- Research on the bacteria that cause anthrax, the virus that causes AIDS, or the parasites that cause malaria
- Development of a vaccine for anthrax, AIDS, or malaria
- Development of new therapies for anthrax, AIDS, or malaria
- Public education programs about antibiotic use, safe sex practices, or water purification
- Development of remediation methods for anthrax spores

The Cold War

- The United States developed bioweapons for assassinations. Patrice Lumumba and Fidel Castro were discussed as possible targets.
- The Soviets mass produced many weapons through their secret Biopreparat program. They also developed new methods for storing and rapidly loading bacteria and viruses into warheads.
- From 1949 to 1969, the United States conducted secret open-air tests over U.S. cities with bacteria thought to be harmless. They were studying dispersal patterns.

on the original theme. Some assessed fixed bombs, others evaluated the efficacy of bullets loaded with spores; two were trials of bombs dropped from airplanes. The bullets were powerful enough to penetrate armor plating, then spewed out anthrax spores and killed sheep on the other side. They were deemed promising anti-tank weapons, both because they could kill soldiers inside the tanks and because they would permanently decommission the spore-splattered vehicles. One airborne bomb killed target sheep, but the other did not; it sank into a peat bog and only later exploded, releasing all of its spores into the ground.

Spores from the bombs, bullets, and carcasses left Gruinard completely contaminated. Scientists returned there every year for twenty-five years, sampling the soil and checking for active spores. But the spore counts never changed, and the virulence of the spores never diminished. Eventually, the British Chemical Defense Establishment spent eight years–1979 to 1986–charting areas of contamination, working out remediation procedures, and treating and retreating the land with formaldehyde and other chemical sporicides. Finally, in 1987, after half a century of contamination, Gruinard was declared inhabitable when forty ewes that had grazed on the island for six months returned to the mainland "in excellent health," showing no signs of disease.[3]

"Weaponized" Anthrax Outbreak

The Gruinard experiments answered two key questions about anthrax: the spores could survive the blast of a bomb, and they could serve as killer weapons. Another question of interest to weapons developers was whether novel and more dangerous forms of the lethal organisms could be produced. This question was answered many times over by Soviet scientists who, despite signing the Biological Weapons Convention of 1972 (see Timeline), pressed forward with the development and production of massive numbers, kinds, and quantities of bioweapons. Their secret work continued into the 1990s.

The Soviet program–Biopreparat–employed some 50,000 scientists, technicians, and others working in secret cities, labs, and test sites throughout the Soviet Union. The researchers produced new organisms in profusion, including 2,000 different strains of anthrax. The U.S. government became aware of Biopreparat only in the early 1990s, and the U.S. public learned about the program some years later.

Even a 1979 outbreak of anthrax in the Soviet Union did not trigger suspicions or an awareness of the ongoing bioweapons research. At least sixty people in the town of Sverdlovsk died of anthrax infections within days of one another. The official story at the time was that the outbreak occurred when people ate batches of meat from infected sheep. The true, though perhaps not the complete, story surfaced nineteen years after the outbreak. Spores were accidentally released from a Biopreparat facility in the town. The organisms were especially lethal, having been made resistant to all available vaccines and antibiotics. One estimate was that as many as 1,000 people actually died in that outbreak. Like the proverbial successful operation that, nevertheless, kills the patient, the (unintended) anthrax experiment brutally killed untargeted individuals, successfully demonstrating that novel, lethal superbugs could be made.

Battling Anthrax

Anthrax is a harsh disease. Three strategies exist for combating it, at least in theory: prevent anthrax with a vaccine; treat anthrax with antibiotics, antitoxins, and other targeted "magic bullets" that inhibit the actions of the organism or its toxins; and destroy the spores in the environment with sporicidal chemicals. In practice, none of these is simple or sure. Anthrax has been such a rare disease that health experts responding to the current crisis had little or no past clinical experience to turn to, and neither they nor the environmental remediators had any sure tools at the ready.

Vaccines

A vaccine was offered to (and eventually taken by some) postal workers and employees on Capitol Hill who had been exposed to the anthrax spores. No one actually knew whether a vaccine would have any protective value so long after exposure: The standard use of vaccines is to protect against future exposures, not past ones. But the reasoning after the attack was that the vaccine might provide some protection in case any long-lasting spores had survived the sixty-day bombardment with Cipro.

The day that the vaccine was made available, the *New York Times* quoted a Capitol Hill employee: "The military can get it. Why can't we …?" In contrast, postal workers were feeling exploited, like "guinea pigs being experimented upon [with] an unsafe vaccine."[4]

The word "experimental" had been tossed around carelessly by the federal spokespersons announcing the availability of the vaccine and probably raised more red flags than anything else. Scandalous experiments done in the past by federal scientists–among the most infamous were the "experiments" in Tuskegee, Alabama, in which poor black men with syphilis were simply left untreated for decades, long after antibiotics became available–has made government experiments seem suspicious, whether or not they are. The spokespersons' statements about the vaccine were both confused and confusing.

The 1960s

- The United States "weaponized" anthrax and other agents in 1966.
- The United States released harmless germs in the New York City subway to simulate a biological attack and to assess defensive measures.
- The United States stopped experiments with infectious agents in 1969.

The 1970s

- The Biological Weapons Convention was signed by 144 nations in 1972. The treaty lacked rules for verification and enforcement.

Smallpox Doomsday Scenario

Smallpox has been one of the greatest scourges in the history of humanity. In the twentieth century alone, it killed more people–500 million–than did all the wars of the century–320 million.† Smallpox would be far more dangerous as a bioweapon than anthrax because it is highly contagious.

Poxviruses spread rapidly from person to person. They produce no disease signs for more than a week as they circulate in the victim's body, entering cells and then replicating. Lesions eventually appear on the skin; soon bleeding pustules cover the body with a raw rash that weeps viruses. Standard symptoms develop (fevers, headaches, muscle pains, back pain, vomiting), the immune system is overwhelmed, and death results.

People who have not been vaccinated have a one-in-three chance of dying from the disease. Those who survive may be scarred and disfigured for life. The Plains Indians had a descriptive name for smallpox–rotting face.

A massive and aggressive international public health campaign eradicated smallpox from the world two decades ago. The last natural case of smallpox was recorded in 1977. Years later, officials in the United States and Russia publicly agreed to keep small samples of poxvirus for possible future studies. One sample was stored in the United States at the CDC; the other was placed in a laboratory in Moscow. Both were kept under top security. Smallpox was considered a threat of the past.

Today, concern is high that terrorists–individuals, fanatical groups, or countries–at some point may have acquired smallpox virus samples and turned them into weapons. The virus is robust and might, like anthrax spores, withstand an explosive blast of a small bomb and survive in the air for some time. The last smallpox vaccinations, which provide protection for about a decade, were given in the United States in 1972 and elsewhere in 1980. Thus, few people are likely to still be immune. The U.S. government recently ordered 300 million doses of the smallpox vaccine, enough for everyone in the country.

The smallpox vaccine, like all other vaccines, is not a sure thing, and it comes with costs. Some individuals who were vaccinated decades ago are thought to have developed symptoms of smallpox, and some may even have died after receiving the vaccine. (The records from that time are vague and incomplete.) People with depressed immune systems due to HIV/AIDS, cancer chemotherapy, or advanced age, among other conditions, are at high risk from the side effects of any vaccine. Persons with eczema are also discouraged from taking the smallpox vaccine.

During a "normal" smallpox outbreak, quarantine would be a key component of the public health response. The first diseased person would be separated physically from others, and those who had been exposed to that person would be vaccinated. But a well-designed terror attack would infect tens, hundreds, or thousands of people at once, making quarantine impossible and vaccination worthless.

Classroom Research and Writing Assignment

Assume you are a federal official. You have been alerted to the possible threat of a bioterror attack that will use smallpox. The vaccine is available. How will you decide whether to immunize everyone in the United States? Consider the following questions as you decide and explain your reasoning.

- What would you need to know before making a decision?
- What special considerations should you think about for people who are old, have weakened immune systems, and are suffering from other diseases, all of whom might react adversely to the vaccine?
- How much confidence would you want to have that a smallpox bioterror threat was credible before you advocated inoculating all Americans?
- How large a profit, if any, should vaccine manufacturers be allowed to make during this emergency?
- If you decide that vaccination is reasonable, would you make vaccination mandatory or voluntary?

One useful resource for this project is Richard Preston's 2000 New Yorker article, "The Demon in the Freezer," reprinted in *The Best American Science and Nature Writing 2000,* David Quammen, ed. (Boston: Houghton Mifflin Company, 2000).

† Laurie Garrett, *Betrayal of Trust: The Collapse of Global Public Health* (New York: Hyperion, 2000), 488.

The 1980s

- The Kremlin's immense and highly compartmentalized biological weapons capability was the first to surpass the Imperial Japanese efforts of the 1930s.*
- Iraq, North Korea, and other countries made significant investments in bioweapons. Iraq, in particular, built up huge bioweapons stores. It purchased anthrax over the counter from the American Type Culture Collection in the United States. It bought thirty-nine tons of bacterial growth medium from a British supplier. The Iraqi stockpile, which includes anthrax and might include smallpox, is well-documented and considered to be a genuine threat.
- The apartheid South African regime used bioweapons against both foreign and domestic enemies. It worked on weapons targeted at people of color: One effort was to find a virus that would sterilize black women.

The vaccine had been tested in clinical trials decades earlier and licensed by the FDA in 1970. But the trials were limited, and the vaccine's efficacy remains uncertain because anthrax is so rare. The trials involved several hundred workers at the Ames Textile Mill and two other mills where cutaneous anthrax was known to be an occasional but persisting problem. Anecdotal information from a few accidental exposures also had suggested that the vaccine was effective.

Wariness about the vaccine was compounded by recent branding of the vaccine as "controversial." In 1988, the Department of Defense learned that Iraq had probably "weaponized" anthrax. Vaccination was ordered for about 150,000 soldiers who served in the 1991 Gulf War. The vaccine was later considered by some to have contributed to Gulf War Syndrome, which afflicted hundreds of veterans. In 1998, the Department of Defense ordered the vaccination of all active and reserve forces, but within a year, several hundred troops–concerned about the quality of the vaccine and being used as guinea pigs–refused the order. Many were discharged and a few faced courts-martial. The Pentagon eventually suspended the vaccination order while maintaining that the anthrax threat was real.

The soldiers' concerns about the quality of the vaccine were valid. In 1998, the FDA shut down the one production plant–BioPort–that was producing the vaccine, when inspectors found both safety and production violations.

When the need arose in 2001 to stop a possible outbreak of anthrax, this vaccine was the one offered to the exposed individuals as "experimental." Use of the vaccine in the current crisis was indeed experimental, but the vaccine itself was not. The vaccine had never previously been paired with the particular "weaponized" spores that came through the mail. And vaccination post-facto rather than before exposure was both a novel and untested strategy.

Therapies

Cipro was distributed in October and November to all exposed employees of the post office and Capitol Hill who wanted it. But by December, health officials reported that many people had not completed the full course of the antibiotic. Some experienced unpleasant side effects and gave up on the drug; others felt healthy and concluded that they probably had not actually been exposed to the spores.

That so many simply stopped taking the drug showed that the health establishment had done a poor job explaining the possible benefits and risks of taking the medicine. Antibiotics kill bacteria, but the killing takes time. When people stop taking antibiotics prematurely, the remaining bacteria grow and replicate. These resilient bacteria are drug-resistant, and a subsequent infection requires a new or stronger antibiotic. Only time will tell whether Cipro-resistant anthrax strains arose during this period.

Remediation

The cleanup work at Manchester and Gruinard demonstrated how durable and treacherous the anthrax spores truly are. Cleanup crews at the postal facilities and on Capitol Hill encountered comparable difficulties. Federal and public health officials face the daunting responsibility of declaring the buildings safe for reoccupation after the completion of the work. And, again, only time will tell if they were cautious enough.

Anthrax Availability

Samples of anthrax bacteria are easily obtained and found in laboratories around the world. The now famous "Ames strain" and other versions of the bacteria have been used by veterinary and agricultural laboratories for basic and applied research purposes–for learning about the structure and the properties of the organisms and for making vaccines and antidotes.

The weapons-grade bacterial strains–"weaponized anthrax"–are not in this category. Strategies for making killer anthrax are neither generally known nor shared. And the strains are not for sale or commercially available. But any experienced bacteriologist might find ways to produce new and lethal strains, know how to guard against becoming infected, and then grow a supply of the bacteria. No watchdog agency or authority is in a position to automatically know when "weaponized" anthrax has been produced.

Scientific activities related to the development of anthrax strains and antidotes are soon likely to come under greater government scrutiny as a result of the recent uses of the organism for bioterrorism. So are the people who carry out these activities. This surely will interfere with the traditional modus operandi of U.S. scientists–free inquiry. The flourishing private biotechnology industry will likely balk or back away from needed research if surveillance becomes too restrictive. One model for how the private and public sectors might work cooperatively to meet the needs of both sides is the one that is in place in the nuclear power industry: A federal agency–the Nuclear Regulatory Commission–establishes standards and keeps an eye on the industry.

Safeguarding the Public Health

Responses to the recent anthrax incidents have involved private physicians and the public health establishment, law enforcement agents, and federal officials and policymakers. The reactions of some

The 1990s

- The West became aware of the Iraqi stockpiles.
- The West learned of Biopreparat from former Soviet workers who defected.
- In Japan, the Aum Shinrikyo cult released sarin gas in the Tokyo subway in 1995, killing twelve, after its failed use of anthrax at other sites.
- Bioweapons were considered by Western experts, for the first time, to be real rather than potential national security threats.

2001

- Anthrax is used for the first time as a bioweapon directed at human beings in the United States.

* *See the book on the subject by the head of the Soviet operation, who became a defector. Ken Alibek,* Biohazard *(New York: Random House, 1999).*

Classroom Assignment

Have each student choose one item on the timeline for further research or select another area of bioweapons development that is not on the list. (Public libraries now have many books on biowarfare, bioweapons, anthrax, smallpox, and plague.) Students should consider the information on the timeline only as a starting point and should investigate these and other questions:

- What specific weapons were used?
- What was the point of the experiments?
- What were the populations that were targeted?
- How successful were the efforts?
- What issues did the research raise and address?
- What were the legacies of the program or the attack?

Students should present their findings to the class. Students may add relevant information to the timeline to expand, amplify, and enrich its contents.

doctors, nurses, and other health providers have been lifesaving for a few individuals. But many responses have been awkward, misguided, and incorrect.

The first reaction to an enigmatic illness–whether a bioterror attack or a naturally occurring epidemic–must be the identification of the problem. The "index" or "sentinel" case, the very first, is typically the hardest to identify. No one expected anthrax at the time that the first person became sick. And because anthrax is such a rare disease, few doctors in the United States were familiar with its symptoms. D. A. Henderson, who is now in charge of the Homeland Defense office's health task force, was prescient when he commented at an international conference in 1998 that

> No emergency room physicians or infectious disease specialists have ever seen a case of inhalation anthrax; medical laboratories have virtually no experience in diagnosis. Thus it is probable that a delay of at least three to five days would elapse before [it is possible to make] a definitive diagnosis.[5]

The speed with which medical experts can jump on an outbreak or epidemic reflects both readiness and lucky breaks or, as Pasteur noted in the late nineteenth century, "chance favors the mind that is prepared." The detective-style work by epidemiologists includes identifying the nature of the infection and then determining what are appropriate treatments, how widespread the outbreak is, where it arose, and whether it is an act of nature or of a terrorist.

Epidemiology is a component of public health, and preparedness is a public health function. But public health has not received funding priority in the United States for many years. (The U.S. medical establishment has, instead, focused more on individual fitness and health.) Stockpiles of vaccines have dried up as infectious diseases have been perceived, erroneously, to be receding problems. Research into new forms of antibiotics has not been vigorous or encouraged, even though increasing numbers of infectious organisms have become drug-resistant. The managed care system has pushed the privatization of health-care resources, as well as the centralization and compartmentalization of medical care and expertise. Wide-ranging expertise and readiness are no longer common at most local hospitals and clinics: Blood and tissue samples must be sent to distant labs for analyses, doctors scramble for information and treatment ideas, and meanwhile the patients wait and grow sicker.

The awkward response to the anthrax outbreak showed that the infrastructure of public health needs shoring up.

Public Health Concerns versus Individual Liberties

Public health and legal experts are now working with policymakers to consider ways to balance safeguarding the public health with safeguarding individual rights.

Even in a system of popular self-government like that of the United States, people accept that individual liberties may at times be curtailed in the event of a crisis that threatens public health. What government interventions will be appropriate in times of bioterror threats and events? What restrictions to the activities and movements of individuals exposed to bioweapons might be justified? How should medical records–generally considered private–be treated at such times?

Anthrax is not a contagious disease, not passed from person to person. But other potential bioweapons, such as smallpox, are highly contagious and lethal (see Smallpox Doomsday Scenario, p. 86). If, for example, a single case of smallpox is confirmed, could authorities restrict travel, impose quarantines, and commandeer medical resources? How might such strictures be imposed to maximize the public's protection but maintain individual rights?

An even thornier problem arises if an outbreak is not confirmed but only suspected. The proper handling of such

a situation early on is crucial in shaping the course of the epidemic. Who should have the authority to deprive individuals of basic freedoms at those times? What liberties can be suspended in such times of uncertainty? Would people object to the loss of certain basic freedoms if they clearly understood the associated benefits? These freedoms and benefits include

- Freedom from search and seizure–curtailed in order to identify who is infected.
- Freedom from bodily intrusion–limited in order to force noncompliant individuals to accept therapies.
- Freedom of movement–regulated in order to quarantine individuals who might rapidly spread the infection.
- Freedom of association–restricted to limit interactions between infected and noninfected individuals.
- Freedom of speech–limited to stop transmission among individuals in close proximity.

Appropriate Medical Responses to Bioterrorism

Health professionals are now considering what frameworks would be best for the management of future bioterror events. One approach is triage, a familiar principle in combat medicine: Those who are severely injured and can be saved are treated first, those who can survive with delayed treatment are cared for second, and those who will likely die, even if treated, are given only comfort measures.

Triage might be effective for a limited attack, especially one in which the agent–like anthrax–is not infectious. But, for a widespread bioterror attack with a highly infectious agent–like smallpox–other factors may kick in. How might an outbreak best be handled so that the health of emergency medical professionals will not be unduly compromised? What ancillary facilities–schools, pharmacies, public buildings, private homes–could be used instead of hospitals for treating victims? Should hospitals be off-limits at such times to protect sick and vulnerable individuals who were already in the hospital at the time of the attack? What occupancy limits should hospitals honor to keep from overcrowding?

People who might be involved in future responses to bioterrorism need training now. Medical and nursing teams typically practice for unusual but expected situations, such as the birth of septuplets. The time has come for bioterror rehearsals as well.

The Bioterror Threat

The anthrax events have done great physical damage to a small number of individuals since last autumn. The events have done great psychological damage to many more. Bioweapons were once the stuff of science fiction and fiction; today they are realities of contemporary life.

Reasonable people are at a loss to understand the sort of mind that chooses to harm and kill innocent people through pain, disease, and poisoning. Or, as thriller author Tom Clancy commented in a December 2001 interview about bioterrorism, "The difference between fiction and reality is that fiction makes sense."[6]

Bioweapons are the first weapons to merit their own term for terror–bioterror. No one speaks of "chemoterror" or "nucleoterror" or "conventioterror." Perhaps the coinage of a new term reflects the special, shocking quality of bioterror–that its perpetrators have chosen to use life to snuff out life.

On the Web

In addition to the books and journals cited in the notes to this article, the following websites are useful to those interested in the subject of bioterror.

- **American Medical Association**
  www.ama-assn.org/ama/pub/category/6206.html
- **Centers for Disease Control**
  www.bt.cdc.gov
- **Johns Hopkins University Center for Civilian Biodefense Strategies**
  www.hopkins-biodefense.org
- **National Library of Medicine**: search any subject related to bioterror and diseases: www.ncbi.nlm.nih.gov/entrez/query.fcgi
- **University of California at Los Angeles**
  www.ph.ucla.edu/epi/bioter/bioterrorism.html
- **World Health Organization**
  www.who.int/home-page

Notes

1. Jeanne Guillemin, *Anthrax: The Investigation of a Deadly Outbreak* (Berkeley: University of California Press, 1999), 2.
2. Pam Belluck, "Anthrax Outbreak of '57 Felled a Mill but Yielded Answers," *New York Times* (October 27, 2001): B8.
3. Ed Regis, *The Biology of Doom* (New York: Henry Holt and Company, 1999), 27-32; R.J. Manchee and W.D.P. Stewart, "The Decontamination of Gruinard Island," *Chemistry in Britain* (July 1988): 690-691.
4. Sheryl Gay Stolberg and David E. Rosenbaum, "U.S. Will Offer Anthrax Shots for Thousands," *New York Times* (December 19, 2001): A1.
5. Laurie Garrett, *Betrayal of Trust: The Collapse of Global Public Health* (New York: Hyperion, 2000), 505.
6. Ann Reilly Dowd, "It's a Dangerous World, Babe," *Washingtonian* (December 2001): 39.

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