

BIOTERRORISM



WATCH

Preparing for and responding to biological, chemical and nuclear disasters

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Chemical food-borne terrorism poses initial detection problems

Investigators likely will suspect biological etiology

Commonly available chemicals could be used to cause a food-borne disease outbreak that initially might confound investigators looking for a biological etiology, warn epidemiologists at the Centers for Disease Control and Prevention (CDC).

"Chemical agents have been used in the deliberate contamination of food with the intention of causing illness in the past," said **Helen Schurz Rogers**, PhD, research scientist with the CDC's National Center for Environmental Health. "Since the terrorist attacks of 2001, concern has grown about the use of chemical agents in future attacks. Contamination of the nation's food supply is one major area of concern."

Indeed, **Tommy Thomson**, former secretary of Health and Human Services made a point of highlighting the nation's vulnerable food supply when he stepped down from his post last year. "For the life of me, I cannot understand why the terrorists have not attacked our food supply, because it is so easy to do," he said. "We are importing a lot of food from the Middle East, and it would be easy to tamper with that."

In light of such concerns, the CDC recently conducted a training webcast designed to enhance early recognition, reporting, and clinical management of chemical-associated gastrointestinal (GI) food-borne illness. Signs and symptoms of GI illness include nausea, vomiting, abdominal discomfort, and diarrhea. The cause of such illnesses often remain undetermined, and biological agents are much more likely to be suspected than chemicals. No etiologic agent was identified in 62% of the 1,073 food-borne disease outbreaks reported to the CDC in 2003.

"Chemicals are seldom considered early in the differential diagnosis of food-borne GI illness since the majority of these illnesses in which an etiology is identified are caused by biological organisms, such as bacteria, viruses, or parasites," Rogers said on the program.

Moreover, the variety of possible chemicals that can induce GI illness hinders accurate recognition and diagnosis. When chemicals finally are considered, biologic specimens such as urine and blood often have to be re-collected and may not show evidence of the chemical due to the

body's normal elimination mechanisms, she said. "Furthermore, stool samples, which are commonly used for analysis of infectious food-borne illness are often not the ideal specimen to identify chemical etiologies."

Look for rapid onset of illness

Most chemicals tend to produce GI symptoms within a short time frame, fewer than 12 hours, after ingestion. Possible etiologic agents in these short incubation outbreaks include industrial chemicals, drugs, pesticides, and plant toxins. Detection of these agents, however, requires agent-dependent specific biologic specimen collection,

prompt collection methods, and testing techniques that are not routinely included in the investigation of many food-borne outbreaks, Rogers said.

Yet the rapid and accurate identification of a chemical etiology in food-borne illness outbreaks is necessary for many reasons, emphasized **Joshua Schier**, MD, a medical toxicologist in the National Center for Environmental Health.

"Those include proper patient management, risk assessment for long-term adverse health effects, and outbreak control," he said. "In a true chemical terrorism event, this is even more important."

Historically, of course, most chemical-associated food-borne GI illnesses have been unintentional. However, there have been several notable cases of intentional poisoning through food contamination.

For example, an employee at a Michigan supermarket intentionally poisoned 200 pounds of beef with a nicotine-containing insecticide in 2003. He subsequently was arrested but not before the action caused considerable illness and disruption.

Epidemiologists began investigating when 18 people from four families became ill after eating ground beef. Symptoms included nausea, vomiting, and a burning sensation in the mouth.

One patient developed atrial fibrillation, but none had to be hospitalized. Officials recalled approximately 1,700 pounds of ground beef.

Overall, 120 people returned the recalled product, and 36 more people reported being ill. Eventually, it was discovered that the product was contaminated at a single store rather than at the processing plant. The local health department alerted hospital emergency departments and local medical practices. In all, 92 people had an illness consistent with nicotine poisoning after eating the contaminated beef.

Of course, chemical food-borne illness also can occur without the actions of a terrorist. In another case that occurred in July 2004, 10 people reported they became ill at a restaurant. They were not part of a large group that ate together at the restaurant, and local hospitals did not report any rise in community illness, Rogers explained.

Some of the people who became ill had consumed food, while others only had consumed fountain drinks. Nausea and vomiting were the most common symptoms, and, the average incubation period was 10 minutes.

Two people also developed diarrhea the following day. A health inspection of the restaurant did not indicate any obvious etiologies or health code violations.

"Further investigation, however, found that

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seven out of the 10 cases had consumed fountain drinks," Rogers said. "Ice, water, and carbonated beverages from the fountain machine were collected for testing. Test results indicated that copper was almost seven times higher in the fountain drinks than the acceptable limit for human consumption. This was ultimately determined to be the etiology of the illnesses."

Copper may leach out into the water when acidic solutions enter copper pipes. In a soda machine like those found in fast-food restaurants, carbonation of the water occurs after the water leaves the copper piping. A faulty valve allowed the carbonated water to enter the copper pipe in the restaurant outbreak.

"Most often, the leaching occurs overnight when the dispenser is not operated," Rogers said. "The first users in the morning, typically the restaurant workers, are the ones who become ill — hence copper poisoning has been called the 'restaurant worker syndrome,'" she added.

Neurologic symptoms raise red flag

In general, neurologic symptoms are more indicative of a chemical or biological toxin exposure than a bacterial one. These symptoms may include paresthesias, numbness, weakness in extremities, visual disturbances, or dizziness.

"The presence of symptoms like these can be an important clue that a chemical exposure has occurred," Schier said. "Comments that describe a quality of the food having to do with taste, smell, or visual appearance can be important clues."

Key questions for investigating epidemiologists include: Did the food have an odd taste? Was it metallic, acidic, burning, alcoholic, or bitter? Was there an excessive amount of flavor, such as sweet, salty, or sour? Were there any strange odors associated with the food, such as a chemical or metallic odor? Did the food look different? Was there a strange color or texture? Was it oily or viscous?

"Once a chemical exposure is suspected, it's vitally important to collect proper samples so that the agent can be identified," Rogers said. "This may mean that several types of samples need to be collected initially."

If a chemical food-borne illness is suspected, it is best to collect urine and other appropriate biological specimens as soon as possible — preferably within the first 24 hours, she noted. An early or first vomit sample may sometimes be very helpful in identifying the chemical. Some agents also are identifiable in blood samples.

"It's also important to collect urine samples from nonsymptomatic people who shared in the meal or food item," Rogers said. "The reason for this is that these individuals provide an important control sample that is helpful when evaluating laboratory results. Whenever possible, samples of the implicated food or beverage should also be obtained for analysis."

A vital part of the investigative process in a food-borne outbreak is a standardized food history questionnaire. One of the goals of such a questionnaire is to look for common theme among the ill. Once a food or meal has been implicated, pertinent questions to ask include:

- What were the predominant symptoms?
- What was the latency of illness?
- What food items were available to the patient, which ones were consumed, and how was the food prepared?

For chemical food-borne illnesses, it is helpful to keep in mind the following questions, and then include these in the final questionnaire:

- Were there neurologic symptoms in addition to GI complaints?
- Were there other types of symptoms not commonly associated with food-borne illness, such as sore throat?
- What do the patients think made them ill?

(Editor's note: For a copy of a CDC standardized food questionnaire, go to www.cdc.gov/foodborneoutbreaks/question/standard_questionnaire.doc.) ■

Race between cooperation and nuclear catastrophe

Vulnerable, but attack not inevitable

Though seen by some analysts as inevitable, a terrorist attack with a nuclear weapon may yet be averted if ongoing international efforts are intensified, said **Sam Nunn**, director of the Nuclear Threat Initiative.

As previously reported in *Bioterrorism Watch*, some experts contend that terrorists eventually will detonate a nuclear warhead in the United States, most likely using a small tactical warhead that could be placed inside a vehicle. (See *BW*, July/August 2004, p. 28.)

"Increasingly, we are being warned that an act of nuclear terrorism is inevitable," Nunn said

recently in a speech at the National Press Club in Washington, DC.

"I am not willing to concede that point. I do not think a nuclear explosion on American soil is inevitable, but I think it is possible. We have to do everything we can to prevent it. Unless we greatly elevate our effort and the speed of our response, we could indeed face the kind of disaster that is being predicted. We are in a race between cooperation and catastrophe, and the threat is outrunning our response."

A former U.S. senator, Nunn now leads the NTI's mission to secure nuclear weapons and materials before they fall into the hands of terrorists. "I am not sure we grasp the devastating world-changing kind of impact of a single nuclear explosion.

"If a 10-kiloton nuclear device goes off in midtown Manhattan on a typical working day, it would kill at least a million people. Ten kilotons — a plausible yield for a crude nuclear weapon — has the power of 10 million tons of TNT. To haul that much TNT, you would need a cargo train 100 cars long, but if it were a nuclear bomb it could fit in the back of a truck," he added.

Beyond the immediate deaths and lives that would be shortened by radioactive fallout, the casualty list also would include civil liberties, privacy, and no small portion of the world economy, he noted.

"Are we doing all that we can to prevent a nuclear attack on America?" Nunn asked. "The simple answer is, 'No we're not.' We have, however, taken a number of important steps."

Those include efforts to continue to secure and destroy nuclear materials in the former Soviet Union. In addition, the major industrial powers have agreed to match U.S. funding to reduce nuclear threats and safeguard enriched plutonium in nuclear research facilities.

"There are over 100 of these research facilities in various locations around the globe that have bomb grade material, many of them with almost no security," Nunn warned.

Fortunately, international efforts such as the proliferation security initiative controls are tightening on the movement of nuclear weapons, delivery systems, and related technology, he pointed out.

Russia and the United States also are cooperating in an effort to convert global nuclear reactors to low-enriched uranium fuel rather than the highly enriched, bomb-grade material that still is used at many facilities.

The existing threat, however, is considerable. Nunn presented a chilling scenario for a nuclear terrorist attack that begins with the theft of 50 kilograms of highly enriched uranium from a research facility in Belarus — an independent nation that was formerly part of the Soviet Union.

"The [terrorists] head for a safe house that is equipped with machine tools, chemicals, bomb designs, and a nuclear weapons expert lured away from a former Soviet Union nuclear site," Nunn said. "Everything necessary to turn a terrorist group into a nuclear power."

In the scenario, the bomb is assembled and successfully dispersed through a terrorist network, leaving world governments at a distinct disadvantage. "Frustrated heads of state begin to realize that once the terrorists have the bomb, the chances of finding it are very, very small," he said. "Almost zero. [It's] possible, but we would have to be very, very lucky."

Thus, in Nunn's scenario, though the combined security forces of many governments deploy to guard hundreds of ports, airports, and thousands of miles of coastline around the globe, the bomb moves through a border crossing, undetected by radiation sensors because it is shielded by a thin layer of lead.

"At midday in a city of several million people, the world suffers its first nuclear strike in 60 years," he said. "The day after, what would we wish we had done to prevent it? I believe we would wish we had made it a top priority, a global effort to upgrade the security of all nuclear weapons and weapons usable materials at their source to prevent theft or diversion anywhere in the world."

Cooperation between the United States and Russia is key, particularly in securing tactical, battlefield nuclear weapons in both the United States and Russian arsenals.

"These are small battlefield weapons that are not the subject of any arms control agreement," Nunn explained. "We don't know how many tactical nuclear weapons the Russians have or where they are located. We hope the Russians know. But we do know that they are transportable, mobile; and if one of them got in the hands of terrorists, we would have a different world."

The global cleanup and clampdown has begun in earnest in the wake of 9/11, but much more needs to be done if an attack is to be diverted. "The day after, we [will] wish we would have done all of these things," he added. "My question is, why aren't we doing them now?" ■

History shows smallpox could be contained

Ring approach alternative to mass vaccination

Reviewing two historical smallpox outbreaks, researchers in the United Kingdom say it may be possible to contain transmission of the virus without resorting to mass pre-event immunization. Indeed, unless there is a smallpox outbreak, the individual risks of pre-event smallpox vaccination may outweigh the potential benefits.

The so-called ring containment strategy used to eradicate smallpox in the wild has been criticized as a response to terrorism. Instead, many have argued for mass pre-event vaccination. But the lessons of history suggest that smallpox could indeed be contained even in the event of an intentional release within a susceptible population.

Targeted surveillance and containment interventions have been successful in the past and should be explored as alternatives to mass vaccination, says lead researcher **Emma Kerrod**, MD, an epidemiologist at the Centre for Emergency Preparedness and Response at the Health Protection Agency in Salisbury, England.

“Containment of an outbreak today, even in a population that is susceptible, would most likely be practicable — assuming good contact tracing, case isolation, and surveillance,” she explains to *Bioterrorism Watch*. “This is a reasonable assumption in any developed country. Mathematical modeling of smallpox outbreaks has done much to support this view, although interventions would ultimately depend on the size of the outbreak.”

Kerrod and colleagues reviewed historical data from smallpox outbreaks in Liverpool in 1902-03 and Edinburgh in 1942.¹ In both outbreaks, extensive contact tracing, quarantine, and staged vaccination campaigns were initiated, and the outbreaks were controlled within 15 months and three months, respectively.

In Edinburgh, the number of fatalities associated with vaccination exceeded number of deaths from the disease. In Liverpool, ambulatory, vaccine-modified cases and misdiagnosis as chickenpox resulted in problems with outbreak control. Active surveillance, vaccination of contacts, and prompt hospital isolation of patients were important aspects of disease control in both outbreaks, the authors said. The relatively slow spread of smallpox, particularly in Liverpool, allowed for effective

implementation of targeted intervention methods.

“The Liverpool outbreak was ultimately contained even though the disease was endemic, social conditions were arguably worse, and disease importations frequent,” Kerrod says. “The outbreak in Edinburgh [1942] lasted only three months before the situation was contained. And this was a situation in which smallpox was not endemic and social conditions were more likely to have been better than in Liverpool. Targeted vaccination was employed in both instances.”

In Edinburgh, 360,000 people were vaccinated after the outbreak, leading to 10 vaccine-related deaths — two more than died of actual smallpox. “[That serves as] a poignant reminder when weighing up the pros and cons of pre-emptive mass vaccination against smallpox when an outbreak is only a possible, not a probable,” she notes.

Analysis of the Edinburgh and Liverpool outbreaks suggests that outbreaks after deliberate release of smallpox virus may “evolve over time,” the study said. Therefore, sufficient opportunity exists for targeted enhanced surveillance measures to be put in place, for additional staff to be mobilized for an effective follow-up, and for a containment strategy to be implemented, it added.

In contrast, mass immunization is problematic because the smallpox vaccine poses a health threat to the millions of people who have atopic dermatitis or are immune-compromised due to HIV infection, chemotherapy, immunity disorders, and transplantations. Kerrod cites another study that suggests a smallpox outbreak could be contained in less than six months by contact tracing and case isolation alone in a population with only 20% immunity.² “Another author suggests that ring vaccination, can be successful in containing a small [e.g., number of index cases] outbreak, if infectious cases are rapidly diagnosed and intervention measures are very effective,” she adds.³ “[Our] argument for targeted vs. mass vaccination echoes the views of many authors.”

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2. Eichner M. Case Isolation and Contact Tracing can prevent the spread of smallpox. *Am J Epidemiol* 2003; 158:118-128.
3. Kretzschmar M, van den Hof S, Wallinga J, et al. Ring vaccination and smallpox control. *Emerg Infect Dis* 2004; 10(5):832-841. Web site: www.cdc.gov/ncidod/EID/vol10no5/03-0419.htm. ■

Postal workers lost trust in fed response to anthrax

Lesson in risk communications from 2001 attacks

With some citing the infamous Tuskegee incident, African-American postal workers exposed in the 2001 anthrax attacks were highly critical of the public health response, according to a recently published study.¹ Researchers recommend that future communications on public health emergencies closely involve people from exposed population groups.

Conducted by investigators at the Rand Corp. in Washington, DC, the study recommended that well-known members of the exposed groups be enlisted to help authorities spread information about the health emergency. The message should be consistent and forthright, even about existing uncertainties. "If those directly affected by a public health emergency don't have confidence in authorities, then it may be hard to get the public to take proper preventive steps," said **Janice C. Blanchard**, a RAND researcher and report lead author. "Our findings underscore the need to develop better ways to deliver direct, consistent, and accurate information to different groups during a health care emergency."

On Oct. 15, 2001, a letter containing anthrax was opened by a worker in the office of then-Senate Majority Leader Tom Daschle, triggering a public health emergency. About a month later, 22 cases of anthrax had been identified in the United States and a wide array of people had been exposed in the Washington, DC, area.

While the first concern about exposure occurred in the Hart Senate Office Building, no cases were reported there. Four cases of inhalation anthrax originated at the U.S. Postal Service facility on Brentwood Road in Washington that handled the contaminated letter four days before it was opened. Two of those four people died. Health officials did not focus their attention on the postal center until nine days after the tainted letter was discovered. In total, public health officials advised 2,743 people from the postal facility and 600 from the Hart building to take 60 days of preventive antibiotics.

Blanchard and colleagues evaluated perceptions of workers at the U.S. Postal Service Brentwood Processing and Distribution Center and U.S. Senate employees regarding public health responses to the anthrax mailings of October 2001. Transcripts from

focus groups conducted with Brentwood and U.S. Senate employees were examined, and qualitative analysis identified common factors.

The Brentwood focus groups consisted of 36 participants (97% African American). U.S. Senate focus groups consisted of seven participants (71% White). African American workers at the U.S. Postal Service center in Washington where the tainted letter was processed were the most vocal in their criticism of information provided by authorities, according to the study.

The workers felt they were not treated with respect because they received attention days later than Senate staff.

They also said their view of the effort was influenced by the legacy of the Tuskegee syphilis experiment on black men, according to the study. In the 40-year-long Tuskegee experiment, 399 African American men with syphilis were denied treatment so researchers could document the natural progression of the disease. By the time the study ended in 1972, 128 men had died from syphilis or related complications.

The postal group also included several hearing-impaired workers, who reported that they felt cut off from information because no effort was made to account for their special communication needs. Many people reported that they turned to their personal physicians or local hospitals for counsel during the anthrax crisis, but found the doctors and hospitals had not been given any information. Workers from the U.S. Senate also said they lost confidence in public health officials during the crisis, but reported that their trust was eroded by inconsistent and disorganized messages that were delivered by a variety of health officials.

"We should not wait until a crisis hits before we try to build relationships with different groups," Blanchard said. "We've done this on health issues such as childhood immunizations and breast cancer screenings. We need to do it for bioterrorism, too."

People from both groups said officials from both the Centers for Disease Control and Prevention (CDC) and the District of Columbia Department of Health provided little useful information during the anthrax crisis. In addition, postal workers said information provided by postal managers was incomplete or inadequate. Senate workers reported that they received consistent and helpful information from the Capitol Physician's Office, which is a regular provider of health care to the group. The postal workers reported that their primary source

of information about the anthrax emergency was the news media, which they felt provided accurate information.

The CDC has admitted that many of its assumptions about anthrax were proven wrong in the attacks. One assumption that turned into a fatal error was that postal workers who processed the mail were at risk for cutaneous disease but not inhalational anthrax. (See *Hospital Infection Control*, May 2002, under archives at www.HIConline.com.)

Reference

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Researchers unknowingly used real anthrax in tests

No infections, but a cautionary tale

Like an electrician unknowingly working with hot wires, researchers at a hospital in California found that a benign biological surrogate they were working with actually contained anthrax spores. Consider this cautionary tale from the Centers for Disease Control and Prevention (CDC).¹

On June 9, 2004, the California Department of Health Services (CDHS) was notified of possible inadvertent exposure to *Bacillus anthracis* spores at Children's Hospital Oakland Research Institute (CHORI), where workers were evaluating the immune response of mice to *B. anthracis*.

Hospital researchers had injected 10 mice with a suspension believed to contain nonviable vegetative cells of *B. anthracis* Ames strain. The suspension was centrifuged and drawn into syringes on an open bench in the laboratory. The mice were injected in a separate animal-handling facility at CHORI. By May 30, all of the injected animals had unexpectedly died. The carcasses were removed from the cages, placed into a plastic biohazard bag, and frozen. The bedding was discarded as standard animal waste. The cages were sanitized

CE/CME questions

1. Chemicals seldom are considered early in the differential diagnosis of food-borne gastrointestinal illness since the majority of these illnesses in which an etiology is identified are caused by biological organisms, such as:
A. bacteria
B. viruses
C. parasites
D. all of the above
2. According to Sam Nunn, if a nuclear bomb is successfully assembled and dispersed through a terrorist network world governments would still be at a distinct advantage because radioactive materials are so easy to detect.
A. true
B. false
3. Reviewing historical smallpox outbreaks, researchers in the UK say it may be possible to contain transmission of the virus without:
A. using any smallpox vaccine
B. use of protective gear
C. designating smallpox hospitals
D. mass pre-event immunization
4. During the 2001 anthrax attacks, African American postal workers said their view of the public health response was influenced by the legacy of the Tuskegee experiment on black men. What disease was left untreated in that infamous study?
A. HIV
B. syphilis
C. hepatitis
D. tuberculosis

Answer Key: 1. D; 2. B; 3. D; 4. B

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in an automated washer.

A sample of the original suspension was cultured and grew nonhemolytic gram-positive rods consistent with *B. anthracis*. Because staff believed they were working with inactive organisms, they had performed these activities on an open bench, and appropriate personal protective equipment (PPE) was not used consistently until after the deaths of a second group of mice.

Twelve people were involved in either the lab or its animal-handling facilities. Three had direct contact with the bacterial suspensions, cultures, or infected animals. Although at low risk for inhalation of *B. anthracis* spores, to further reduce their risk, the three workers with direct contact were recommended for post-exposure chemoprophylaxis for prevention of inhalational anthrax (i.e., either ciprofloxacin 500 mg or doxycycline 100 mg, orally twice daily for 60 days). The nine people who worked in the lab or animal-handling facility but who did not have direct contact were offered the same chemoprophylaxis regimen. Eight of the 12 potentially exposed people opted to take chemoprophylaxis, including the three for whom the regimen was recommended. None of the potentially exposed people had symptoms consistent with anthrax.

"The findings in this investigation indicate that workers in a research laboratory unknowingly received and used a suspension from a contract laboratory that likely contained viable *B. anthracis* organisms," the CDC concluded. "... CDC continues to work with state agencies and other federal agencies to investigate processing procedures at the contractor facility to determine why the suspension contained viable *B. anthracis* organisms."

One theory is that the heat-killing procedures used by the contractor might have been lethal to vegetative cells, but anthrax spores survived. Regardless, inactivated suspensions of *B. anthracis* should be cultured both at the preparing lab before shipment and at the research lab several days before use to ensure sterility, the CDC added. Such procedures would increase the probability of detecting even a small number of viable *B. anthracis* spores. CHORI staff did not perform sterility testing on the suspension received in March 2004.

Because inhalation of viable *B. anthracis* spores can result in fatal infection, the CDC recommends lab personnel who routinely perform activities with clinical materials and diagnostic quantities of infectious cultures implement biosafety Level 2 (BSL-2) practices. These practices include use of appropriate PPE (e.g., gloves, gowns, or lab coats)

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After reading each issue of *Bioterrorism Watch*, the infection control professional will be able to do the following:

- identify the particular clinical, legal or educational issue related to bioterrorism;
- describe how the issue affects health care providers, hospitals, or the health care industry in general;
- cite solutions to the problems associated with bioterrorism, based on guidelines from the federal Centers for Disease Control and Prevention or other authorities, and/or based on independent recommendations from clinicians and bioterrorism experts. ■

and a safety cabinet for procedures with the potential to expel infectious aerosols (e.g., centrifuging or ejection of pipette tips). Face protection (e.g., goggles, faceshield, or splatter guard) should be used against anticipated splashes or sprays when potentially infectious materials require handling outside of the cabinet.

"Research laboratory workers should assume that all inactivated *B. anthracis* suspension materials are infectious until inactivation is adequately confirmed," the CDC stressed.

Reference

1. Centers for Disease Control and Prevention. Inadvertent laboratory exposure to *Bacillus anthracis* — California, 2004. *MMWR* 2005; 54(12):301-304. ■