A Plague on Your City: Observations from TOPOFF

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The United States Congress directed the Department of Justice to conduct an exercise engaging key personnel in the management of mock chemical, biological, or cyberterrorist attacks. The resulting exercise was called “TOPOFF,” named for its engagement of top officials of the United States government. This article offers a number of medical and public health observations and lessons discovered during the bioterrorism component of the exercise. The TOPOFF exercise illuminated problematic issues of leadership and decision-making; the difficulties of prioritization and distribution of scarce resources; the crisis that contagious epidemics would cause in health care facilities; and the critical need to formulate sound principles of disease containment. These lessons should provoke consideration of future directions for bioterrorism planning and preparedness at all levels of government and among the many communities and practitioners with responsibilities for national security and public health.

This article seeks to identify the medical and public health observations and lessons discovered in the biological weapons component (i.e., the Denver component) of the TOPOFF exercise. In describing the response of the medical and public health communities to the simulated bioweapons attack created by TOPOFF, this article is intended to assist in the accomplishment of one of the stated objectives of the exercise: “[to] ensure widespread dissemination and discussion of lessons learned” [1].

The information and statements that follow are derived from the insights and observations of 11 officials who were either participants, controllers, or observers of the Denver exercise. These officials included state and county health department officials, emergency medicine and emergency management professionals, an infection control professional from a participating hospital, and a number of participants and observers from federal health agencies. Most information was obtained through interviews that took place with the understanding that information that was provided for this article would not be attributed to its source. Information and commentary offered at public presentations after the conclusion of the exercise are also included. All persons who were interviewed were asked to review a draft of the article and to make suggestions or corrections. We are grateful to those busy professionals who not only participated in TOPOFF, but also generously offered their time and insights toward the creation of this article.

TOPOFF was widely considered a success: it provided the most comprehensive effort, to date, to test the medical and
public health system and infrastructure that would be called upon in the event of a bioterrorist action. The exercise effectively revealed a number of important vulnerabilities and challenges for the future. Identification of these challenges will be useful for local, state, and federal efforts to counter the threat of biological weapons. Addressing these challenges will also strengthen the ability of public health agencies to perform important routine tasks of medical care and public health.

**BACKGROUND AND CONTEXT OF THE EXERCISE**

Officials were involved in the event as participants, controllers, or observers. Participants were the actual players of the exercise and, in general, operated within the parameters of their usual roles and authorities. Controllers maintained the structure of the exercise, which helped guide the unfolding scenario. Observers were generally agency heads who had policy responsibilities relevant to the events of the exercise. A number of health agencies (including the county health agency, the state health agency, the Centers for Disease Control and Prevention [CDC], the Office of Emergency Preparedness, and elements of the Public Health Service, as well as 3 hospitals in the Denver area [Swedish Medical Center, Medical Center of Aurora, and Denver Health Medical Center]) participated in the exercise. Many persons from these institutions worked around the clock for days in attempts to cope with the unfolding medical and public health crisis depicted in the exercise.

TOPOFF was intended to be “player driven,” which meant that the participants’ decisions and the subsequent consequences were to be the primary drivers in the shaping of the exercise. In practice, the controllers guided a substantial portion of the exercise by giving participants “injects,” which were new information or data delivered verbally or by written memorandum. Participants noted that much of the exercise was, in fact, scripted by the controllers through these injects, which made it unclear whether choices made by decision-makers were influencing unfolding events. One participant said that it appeared preordained that the plague epidemic would spread beyond local control. Other artificialities of the scenario included a greater risk of person-to-person spread than that which has been reported historically and a laboratory diagnostic process that was tested only on paper. None of those who were interviewed believed that these limitations were serious enough to invalidate the major observations and lessons revealed by the exercise.

The scope and complexity of the exercise were such that many of the events that occurred in the exercise could only be “notional” (i.e., they could not be acted out and thus occurred on paper only). Examples of notional events that occurred in the exercise included situations in which “thousands of panicked persons...[were] flooding into emergency departments” and “1 million persons...[were] advised to stay in their homes.” All media communication during the exercise was transmitted through the “Virtual News Network” (VNN). VNN was the virtual news agency that was used in the exercise to interview the exercise participants, to hold press conferences, and to disseminate information (notionally) to the public. No actual news agencies were involved in the exercise, nor was any of the news that was reported on VNN actually disseminated to the public.

TOPOFF was intended to be a “no notice” drill. Participants were given no formal advanced notice of the nature and timing of the event so as to engender as much verisimilitude as possible. In practical terms, however, it proved difficult to design such a large and sophisticated operation in total secrecy. Some participants in both the federal and state health agencies did have knowledge or a strong suspicion that the exercise would feature a plague outbreak and that it would begin on the day it did, which allowed them to review the medical and public health implications of plague infection in anticipation of the event. However, a number of participants, including participants from the 3 hospitals, did not have advance knowledge of when the exercise was to begin or what weapons agent was to be used; they knew only that a bioterrorism exercise would take place sometime in May.

The exercise began on May 20, 2000, and ended on May 23.

**OVERVIEW OF THE EXERCISE**

*May 17.* An aerosol of plague (*Y. pestis*) bacilli is released covertly at the Denver Performing Arts Center.

*May 20 (day 1 of exercise).* The Colorado Department of Public Health and Environment receives information that increasing numbers of persons began to seek medical attention at Denver area hospitals for cough and fever during the evening of May 19. (For hospital participants, the exercise had begun on the evening of May 19 with the arrival of several sick patients.) By early in the afternoon of May 20, 500 persons with these symptoms have received medical care; 25 of the 500 have died. The Department of Public Health and Environment notifies the CDC of the increased volume of sick patients. Plague is confirmed first by the state laboratory and subsequently, in a patient specimen, by the CDC lab at Ft. Collins, CO (see Appendix, item 2).

A public health emergency is declared by the state health officer. The state health officer places an official request for support from the Department of Health and Human Services’ Office of Emergency Preparedness. The governor’s Emergency Epidemic Response Committee (see Appendix, item 3) assembles to respond to the unfolding crisis. Thirty-one CDC staff are sent to Denver. The CDC is notified by the Denver police and the Federal Bureau of Investigation (FBI) that a dead man...
The government has been found with terrorist literature and paraphernalia in his possession; his cause of death is unknown. Hospitals and clinics in the Denver area, which just a day ago were dealing with what appeared to be an unusual increase in influenza cases, are recalling staffs, implementing emergency plans, and seeking assistance in the determination of treatment protocols and protective measures. By late afternoon, hospital staff are beginning to call in sick, and antibiotics and ventilators are becoming more scarce. Some hospital staff have donated protective respiratory equipment.

The governor issues an executive order that restricts travel (including travel by bus, rail, and air) into or out of 14 Denver metropolitan counties; he also commandeers all antibiotics that can be used to prevent or treat plague [5]. During a VNN press conference, at which a number of agencies are represented, the Denver public is informed that an outbreak of the plague has occurred in the city after a terrorist attack and it is told of the governor's executive order. The public is also told to seek treatment at a medical facility if they are feeling ill or if they have been in contact with a known or suspected case of plague. Those who are healthy are directed to stay in their homes and to avoid public gatherings. The public is told that the disease can spread from person to person only "if you are within 6 feet of someone who is infected and coughing," and they are told that dust masks effectively prevent the spread of disease. Confirmed cases of plague are identified in Colorado locations other than Denver. Patient interviews suggest that most victims were at the Performing Arts Center days earlier. It is announced that the governor is working with the President of the United States to resolve the crisis and that federal resources are being brought in to support the state agencies. By the end of the day, 783 cases of pneumonic plague have occurred; 123 persons have died.

May 21 (day 2 of exercise). VNN reports that a "national crash effort" is under way that aims to move large quantities of antibiotics to the region as the CDC brings in its "national stockpile," but the quantity of available antibiotics is uncertain. The report explains that early administration of antibiotics is effective in the treatment of plague, but that antibiotic treatment must be started within 24 h of the development of symptoms. A few hours later, a VNN story reports that hospitals are running out of antibiotics.

A "push-pack" from the National Pharmaceutical Stockpile (NPS; see Appendix, item 4) arrives in Denver, but there are great difficulties in moving antibiotics from the stockpile delivery point to the persons who need it for treatment and prophylaxis. Out-of-state cases begin to be reported. The CDC notifies bordering states of the epidemic. Cases are reported in England and Japan. Both Japan and the World Health Organization (WHO) request technical assistance from the CDC.

A number of hospitals in Denver are full to capacity, and by the end of the day, they are unable to see or to admit new patients. Thirteen hundred ventilators from the NPS are to be flown to Colorado. The number of bodies in hospital morgues is reported to have reached critical levels. By 5:00 p.m. mountain time, the CDC has performed an epidemiological investigation on 41 cases. The US Surgeon General flies to Colorado to facilitate communications issues. Many states are now requesting components of the NPS from the CDC. By the end of the day, 1871 plague cases have occurred in persons throughout the United States, London, and Tokyo. Of these, 389 persons have died.

May 22 (day 3 of exercise). Hospitals are understaffed and have insufficient antibiotics, ventilators, and beds to meet demand. They cannot manage the influx of sick patients into the hospitals. Medical care is "beginning to shut down" in Denver. A total of 151 patient charts have been reviewed by state and federal health officials who are pursuing the epidemiological investigation. There are difficulties getting antibiotics from the NPS to the facilities that need them. Details of a distribution plan are still not formalized.

Officials from the Department of Public Health and Environment and the CDC have determined that secondary spread of disease appears to be occurring. The population in Denver is encouraged to wear face masks. The CDC advises that Colorado state borders be cordoned off to limit further spread of plague throughout the United States and other countries. Colorado officials express concern about their ability to get food and supplies into the state. The governor's executive order is extended to prohibit travel into or out of the state of Colorado. By noon, there are reports of 3060 US and international patients with pneumonic plague, 795 of whom have died.

May 23 (day 4 of exercise). There are conflicting reports regarding the number of sick persons and dead persons. Some reports show an estimated 3700 cases of pneumonic plague with 950 deaths. Others are reporting >4000 cases and more than 2000 deaths. The rates of cases and deaths are presented in figure 1.

The TOPOFF exercise is terminated.

Figure 1. Conflicting statistics reported on 23 May 2000. Numbers may be as high as >4000 patients infected with plague and >2000 dead persons.
LESSONS FROM THE EXERCISE

Leadership and the Complexity of the Decision-Making Process

Issues surrounding leadership, the role of authorities, and the processes of decision-making were widely considered to be highly problematic and deserving of careful review. Overall, leadership roles and the role of authorities in the crisis were uncertain. When a plague outbreak was suspected, the governor’s Emergency Epidemic Response Committee was convened to provide technical advice to the governor. Because the Colorado governor did not participate in TOPOFF, the role of the expert committee in the exercise de facto changed from providing expert advice to decision-making. By law, in an actual bioterrorist event, this committee would not have had the legal authority to make decisions in the absence of the governor. A number of those involved believed that the absence of the governor or an alternative elected official with legal and moral authority over the crisis had important consequences. To some observers, it appeared that the political ramifications of specific public health measures received less attention from the expert committee than would have occurred if an elected official had been making those decisions. It is probable that a governor would analyze decisions (e.g., how to triage scarce antibiotic resources, whether to impose home curfews, or whether to close city or state borders) in ways that would have differed from the deliberations of a committee of technical advisors.

Although the state public health agency was cited by some of the senior health participants as the agency with the highest authority in the exercise, 2 other participants in the exercise said that it was not clear who was in charge. Another observer said that the FBI was operating under the assumption that the State Attorney General’s office was the organization with highest authority because this is the ranking state office to which the FBI reports in a crisis.

The decision-making process was inhibited by a number of substantial difficulties. The governor’s Emergency Epidemic Response Committee and the larger committee of community-wide decision-makers communicated mostly via conference calls. Almost all observers and participants reported that the process of decision-making by conference call was highly inefficient and led to indecision and significant delays in the taking of action. A series of very large conference calls took place; these included officials from the city and state health departments, hospitals, the CDC, the Federal Emergency Management Agency (FEMA), and many other agencies. At some points, as many as 50–100 persons participated in these calls; many participants had never previously met or worked together. The roles, authorities, and even the identities of those participating in the calls, as well as the leadership of and agendas for the calls, were unclear. Such conference calls occurred throughout the exercise, often with one running into the next.

Some participants attributed these difficulties to the decision-making processes of public health agencies. One observer commented about how “in public health, most decision-making is through democratic processes and consensus building, but for some decisions, this cannot work.” Another advised that “conference calls need to be led, you cannot go around the table and let everyone speak their opinion.” “Decisions made on Saturday were reversed on Sunday morning, then reversed again Sunday afternoon,” commented one individual. “Reversing decisions back and forth is the antithesis of crisis management and efficient decision-making.” Another observer remarked, “The time frame that public health is accustomed to dealing with is not what is needed for bioterrorism. In [this type of crisis], one needs to make decisions quickly. You don’t have the luxury of time to do more research.” One observer remarked, “With thousands standing outside hospitals awaiting prophylaxis, public health officials were citing papers....Some from the CDC, state and local health agencies tried to look at this as a standard epidemiological investigation. In absolutely no way would this [scenario allow] a normal epidemiological investigation.” A health department participant countered that, for the purposes of the exercise, controllers were intentionally limiting the speed of the epidemiological investigation, but he also noted that data collection for such a large-scale outbreak would be a time-limiting step.

As the exercise progressed, many health department officials became exhausted. “Even without the emotion of a real event, a feeling of hopelessness quickly overwhelmed a number of public health officials as well as those participating at medical facilities.” One emergency management official stated, “There were not enough people to manage this event.” Public health resources were clearly limited, despite the fact that the CDC had sent substantial technical expertise and human resources (31 members of the CDC staff) to the exercise on the first day of the event. It is unclear whether the impressively large scale and rapidity of the CDC response accurately reflected the human and technical resources that would be readily available had this truly been a no-notice event. As a point of comparison, the CDC was able to provide far fewer experts for on-site assistance during the 1999 West Nile Virus outbreak in New York City because of resource constraints. During TOPOFF, when cases of plague began to appear elsewhere in the country, it was clear that there were few CDC personnel left in reserve who could readily be deployed outside of the Denver area.

One observer remarked that, “in a real crisis, important decisions could not be made this way,” and he advised that medical and public health become more familiar with the “incident command system.” However, it was unclear whether those incident and disaster-management systems that were in place substantially improved the management of the disaster. Several different emergency operations centers (EOCs) were set up by a variety of state and federal law enforcement and emergency management agencies. The EOCs were intended to help co-

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ordinate management of the crisis, but it was unclear to some observers how a number of distinct EOCs would be able to coordinate management, make decisions, or communicate information to medical and public health stakeholders, such as the hospitals. One public health official noted a widespread lack of familiarity with terms used by the emergency management community: “No one knew what a JIC [Joint Information Center], a JOC [Joint Operations Center], or DMORTs [Disaster Mortuary Assistance Teams] were.”

The flow of information was another major concern of the participants. Several sources of incoming information and data that were made available, by injects, to decision-makers in the exercise would not have been readily available in a real epidemic. For example, it is unlikely that most health departments would have had the information systems in place to be able to say with speed and accuracy how many confirmed or even suspected cases of plague were believed to be present in hospitals or other health care facilities, let alone in Denver. It is also unlikely that health departments would have had the resources to acquire and analyze data rapidly enough to know the rate of secondary transmission or to pinpoint the outbreak’s origin as quickly as was portrayed in the exercise. Without rapid access to this information and other data, decision-makers would have been even more ill positioned to make important decisions, such as how and when to distribute antibiotics, make recommendations for containment measures, or communicate public education messages.

Participating officials who were using 800-MHz radios reported having been able to communicate efficiently, whereas communication by regular phone lines became highly dysfunctional. Hospital officials in particular had great difficulty communicating by phone with the health department or others involved with consequence management. Health department officials were not answering their usual phone lines throughout much of the crisis. They were at other operations centers, were participating in other conference calls, or were managing other aspects of the crisis. One participant said, “People were just not able to find the right persons. A significant amount of time was spent just exchanging phone, beeper, and fax numbers. All of this should be in place before a crisis.”

Therapeutic Priorities and Antibiotic Distribution Mechanisms

Many of those interviewed expressed great concern about the processes needed for prioritizing and distributing antibiotics in the state. Local sources of antibiotics were quickly depleted in the early stages of the epidemic. One observer noted, “The state was very late to take control of medication and disbursement.” Initially, there was no consensus about which groups should be assigned priority to receive antibiotics that were arriving via the NPS.

The governor’s Emergency Epidemic Response Committee eventually decided to offer antibiotic prophylaxis to all Emergency Medical System personnel, police officers, hospital workers, and their respective families. The decision was intended to have 2 consequences: (1) to allow critical responders to remain healthy while they directly managed disaster relief efforts, and (2) to maintain the willingness of critical responders to report to work by ensuring the safety of their families. This decision caused consternation among some participants because it meant that the health department would need to justify the distribution of prophylactic antibiotics to family members of critical personnel at the same time that the city was unable to provide lifesaving antibiotics for some citizens who were already ill.

As the epidemic spread more widely, decisions regarding antibiotic distribution quickly became more complicated. There was disagreement among health experts regarding whether antibiotics should be reserved only for demonstrated contacts of case patients or whether they should be given to the general population. This argument reportedly lasted for many hours. One observer noted, “Some experts only wanted to administer prophylaxis by textbook criteria. In life, you can’t always do this.” Another commented, “In a real scenario, decisions about prophylaxis would be a political decision, not a medical decision.”

The logistics of the distribution of antibiotics from the NPS was another process that raised concern. Local antibiotic supplies in Denver had been depleted early in the crisis. Material from the NPS was requested quickly during the outbreak, and its delivery was approved by the Surgeon General and the director of the CDC. The delivery of components of the NPS to Denver was largely notional, but material that resembled components of the stockpile was flown to an airport in Denver. Stockpile material delivered to the airport for the purposes of the drill was at one point being unbundled by a single individual who “had to count individual pills and put them into plastic baggies.” Before she could even begin, there was a 6-h delay during which terrible (notional) traffic was negotiated “in order to get the plastic baggies from Safeway.”

In addition to deciding to deliver antibiotics to hospitals, the governor’s Emergency Epidemic Response Committee decided to distribute prophylactic antibiotics through central antibiotic distribution facilities that were termed “points of distribution” (PODs). Although the governor’s Emergency Epidemic Response Committee decided to open multiple PODs, only a sample POD was exercised during TOPOFF. One observer remarked, “They could take care of only 140 people/h at the mass antibiotic prophylaxis [POD] center. For a city of 1 million, that’s pitiful.” Other concerns regarding the POD included the following: “No written guidelines were given out with the dispensed antibiotics . . . Directions were too difficult to understand” and “Persons were allowed to take their antibiotics from a box, with little oversight regarding how much each took.” Another commented, “What we needed from CDC was people
to help us treat and give out antibiotics, not epidemiologists.”

As part of the exercise, 50 trainees from the Bureau of Alcohol, Tobacco and Firearms had been instructed to cause as much unrest as possible at the POD. The unrest was largely notional, but one observer concluded that, in a real epidemic, each POD would “require several hundred people to staff it and provide security.” No such staffing plan existed for the POD.

It also became clear that if decision-makers required that receipt of antibiotic prophylaxis be linked to specific exposure criteria, there would be no reliable way to determine whether individuals had actually met those criteria; decision-makers would have to accept individuals at their word. It was not clear what people would be willing to say or do to obtain antibiotics for themselves or for their families.

At the time of termination of the exercise, at least 11 states were reporting cases of pneumonic plague, and some were demanding that they be given antibiotics from the NPS. When other states began to report cases, Denver was told by the Department of Health and Human Services authorities that no further antibiotic push-packs would be available and that it would need to go to “vendor-managed inventory” (VMI; see Appendix, item 5). How rapidly the VMI system would have delivered the large quantities of antibiotics that Denver was seeking was not clear and was not tested.

The Crises at Health Care Facilities

The large numbers of ill persons seeking medical care was one of the most serious challenges identified by the exercise, according to one senior health department official. Even at the outset of the epidemic, hospitals were quickly seeing far more cases than they could handle. Notional patient visits to the emergency department at one hospital were double and then triple the normal volumes. Within the short time frame of the exercise, they quickly escalated to 10 times the usual caseload.

It is important to emphasize that most of the events that occurred in health care facilities were notional. Participating hospital officials were given “injests” to relay the events of the unfolding exercise, such as what the caseload or body count had risen to and how many persons outside of the hospitals were (notionally) demanding antibiotics. Only a moderate number of patient-actors actually participated in the exercise at hospitals. Despite this, one of the major hospitals had to drop out of the exercise prematurely because it had so many actual patients that needed treatment that it could not spare the resources to participate even in the notional, “on-paper” elements of the exercise.

One public health participant noted that it appeared that the hospitals that participated in the exercise “were beyond capacity in less than 24 hours of the epidemic.” A recently closed 200-bed hospital was (notionally) reopened, but was quickly filled until it could no longer admit additional patients. One participating hospital was unable to dispose of the bodies that accumulated in the emergency department and wards. By the end of the exercise, one hospital had (notionally) seen an incredible 3878 persons since the beginning of the exercise only a few days earlier. Of these, some 3200 were “worried well”—persons who did not truly have pneumonic plague but were worried that they might have the disease or be developing it. TOPOFF did not address how health care facilities would distinguish between the uninfected “worried well,” those with incubating or early symptoms of plague, and those with other illnesses.

Antibiotic supplies were a serious problem for the hospitals. When their own stocks were exhausted early in the exercise, hospitals called the state to request additional supplies. One participant said that the state replied that, in essence, hospitals were on their own regarding antibiotics. Hospitals attempted to contact area pharmacies, but found that no antibiotics were available. One hospital official noted that “medical and public health workers and first responders need to feel safe and need to have their families feel safe or they won’t show up.” But hospitals could not offer prophylactic antibiotics to all of their own staff, let alone their patients.

A number of other serious problems were catalogued. “There were not enough places to put sick people, triage people, put dead bodies.” Hospitals were competing for ventilators. It was not clear which health care workers should be wearing personal protective equipment or what form of protection was appropriate. Security at health care facilities would have played a major role in the crisis, but for understandable practical reasons, most security issues were treated entirely notional during the exercise. The concept of a “security lockdown” was discussed, wherein all entrances to the hospital would be locked and guarded to keep out people. One hospital official expressed serious doubts that such control would ever really be possible in her hospital, which was not designed to accomplish this. Similarly, concern was expressed regarding how hospitals would have controlled the massive crowds that were notionally outside their doors, or if they would have been able to enforce an order forbidding contagious patients to leave. Another topic that wasn’t directly addressed in the exercise is how decision-makers would know a hospital had been overwhelmed, given the absence of historical precedence or systems to make such a judgment.

The Need to Develop Principles of Disease Containment

Perhaps the issues that provoked the greatest concerns and uncertainties with regard to TOPOFF were the series of containment measures that were undertaken to control the spread of the epidemic. One observer said, “Containing the epidemic did not receive high enough priority. No amount of incoming federal resources could stop the epidemic without a priority on containment.” Another commented, “Hospitals were the
squeaky wheel, and so we were preoccupied with reinforcing [efforts to treat] the mass of sick people.” Even at the end of the exercise, there was still disagreement amongst decision-makers regarding what portion of resources should be dedicated to controlling the outbreak and what portion of resources should be dedicated to providing care for the sick and dying.

Early in the crisis, antibiotic prophylaxis and isolation of individual patients in hospitals were the primary epidemic containment measures. Less than 1 full day into the exercise, the epidemic was rapidly spreading—long before health authorities had sufficient time to characterize the common source of the outbreak, the rate of secondary transmission, the response to antibiotics, or the results of other containment measures. The unfolding situation precipitated a series of increasingly stringent containment measures. By the end of the first day, the Emergency Epidemic Response Committee issued a travel advisory that restricted travel in 16 Denver metropolitan counties. However, as one person noted, “the public was not [heeding] the voluntary travel advisory.” Some people, in fact, were reported to have been racing out of the state. As part of the travel advisory, persons were advised to stay home unless they were close contacts of persons with diagnosed plague or were feeling sick; in the case of the latter, they were directed to seek medical care. As one observer noted, “They told 1 million people to stay in their homes. How would we have enforced this?” When asked what would be possible if the situation actually required it, the police and National Guard admitted to the Emergency Epidemic Response Committee that they would be unable to keep people at home. Another participant commented that, by the end of the exercise, “people had been asked to stay in their homes for 72 hours….How were they supposed to get food or medicine?”

Throughout the unfolding epidemic, the determination of what information the public should be given and how quickly they should be given it was an important and difficult issue. “Should we tell people there is a terrorist link? Should we tell them that people are sick?” One suggestion that was considered was announcing to the public that this was like “The 1918 influenza epidemic.” It was clear that the public message itself would affect the capacity to control the epidemic, in that worried or panicked people may not seek the care they needed or, alternatively, might dangerously crowd health care facilities.

Balancing the rights of the uninfected with the rights of the infected was considered a critical issue. One observer commented that a citizen might be expected to respond to the series of advisories by saying, “You’ve told me I should just stay in my home, now you have an obligation to give me antibiotics.” But there were not enough antibiotics to do this. The public had also been told that “dust masks might keep the disease from spreading.” However, as with antibiotic distribution, there was no easy way to distribute masks to the population.

When health officials were informed (by inject) on May 22 (5 days after the release of plague) that there were now >3000 persons with pneumonic plague, “it was not clear who they [the victims] were, where they lived, where they were exposed, how many of them were secondary cases.” Contact-tracing was not part of the exercise. One public official emphasized that contact-tracing would have been critical in a real epidemic, a key mechanism in defining the scope of the outbreak and designing a containment strategy. He noted that this type of outbreak would necessitate large-scale contact-tracing, which would require significant human resources, such as public health officials and epidemiologists.

The governor’s Emergency Epidemic Response Committee, in consultation with the CDC, discussed issuing an executive order that would close the Colorado state borders and the Denver International Airport. Not all committee members agreed that the borders should or could be closed. A number of senior observers said that recommendations for quarantine were made without sufficient consideration of the wide variety of ramifications. “With borders closed, how were we planning to feed 4 million people?….Many of the control measures ordered were delusional.” One containment measure that was considered was the segregation of contacts at some locations, although this idea did not move forward out of committee. Another idea that was considered, but never publicly stated, was to have healthy persons go to areas termed “holding tanks”; when the 7-day incubation period of pneumonic plague had passed, persons would then be allowed to leave the state. Although, at the termination of the exercise, the Emergency Epidemic Response Committee had not officially reached a final decision regarding whether the state borders should be closed or how these measures would be enforced, it is notable that some senior TOPOFF participants stated that the decision to close state borders had been made.

Some time into the exercise, (notional) civil unrest broke out. People had not been allowed to shop. Stores were closed. Food supplies ran out because no trucks were being let into the state. Rioting began to occur. Gridlock occurred around the city, including around health care facilities. The use of snowplows was proposed as a way of clearing the road of cars. Given the constraints of the exercise, it was not possible to gauge the true extent of social disorder that a bioterrorist attack might evoke, but most observers and participants agreed that serious civil disruption would be a genuine risk in such a crisis. The wide spectrum of disease containment measures that were considered or implemented illustrated the uncertainty surrounding what measures would, in fact, be feasible and effective. One senior health participant said that sufficient legal powers seemed to exist to carry out the decisions that were being made, and noted that legal authorities were not the problem. The critical issue was having access to the necessary scientific, tech-
nical, practical, and political expertise, and having sufficient reliable and timely information available (e.g., the number and location of sick persons, etc.) to make sound decisions about how to contain the epidemic.

Comments offered by one senior health participant summarized the implications and lessons of disease containment:

Many previous bioterrorism exercises dealt with non-contagious diseases. It is just beginning to dawn on us how dramatically different this was as the exercise ended. It terminated arbitrarily and many issues were left unresolved. It is not clear what would have happened if it had gone on....There were ominous signs at the end of the exercise. Disease had already spread to other states and counties. Competition between cities for the NPS has already broken out. It had all of the [characteristics] of an epidemic out of control.

CONCLUSIONS

TOPOFF revealed many valuable lessons about how the United States might deal with future epidemics—whether deliberate or naturally occurring—and by this standard alone the exercise was a significant success. Perhaps the most striking observation overall is the recognition that the systems and resources now in place would be hard-pressed to successfully manage a bioweapons attack like that simulated in TOPOFF. The exercise was also instructive in illuminating problematic issues of leadership and decision-making, the difficulties of prioritization and distribution of scarce resources, the crisis that contagious epidemics would cause in health care facilities, and the critical need to formulate sound principles of disease containment. From these lessons, a number of recommendations can be advanced.

Political leadership will be essential to manage the consequences of a serious epidemic after a bioterrorist event. In this type of crisis, efficient decision-making would be paramount, and would require not only strong and clear leadership but, also, the sustained counsel of a multidisciplinary body of experts, such as was represented by the Colorado Emergency Epidemic Response Committee. Without political leadership, many highly consequential decisions would lack the moral and legal authority to be enacted. Without the advice of expert counsel, the same decisions are liable to lack the technical and practical expertise needed to control and end the epidemic.

Decision-making in such a crisis would also require information sources, conduits, and analytical capacities that do not now exist within the current medical and public health infrastructure. Information systems that would be vital to decision-making include systems that deliver real-time data that show the number and location of persons with the specific illness in the affected area; systems that allow for rapid collection and analysis of patient epidemiological information, to determine source(s) of exposure to an agent; and systems that allow decision-makers to communicate efficiently with hospitals and the public health community. There is no doubt that such capabilities could be designed to significantly augment routine organizational purposes, such as monitoring of natural disease outbreaks; however, resources will be needed to construct and implement such systems.

Clear principles are needed that allow decision-makers to assign priorities for the use of scarce resources and to implement such decisions during an unfolding epidemic crisis. A well-designed and well-managed NPS is important, but equally critical is the local capability to efficiently and rapidly distribute antibiotics and other needed resources (e.g., simple face masks) to where they are needed. In addition to ensuring that health care facilities are properly supplied, antibiotic distribution plans should be able to support additional centers of antibiotic distribution, thereby drawing crowds away from besieged hospitals and ensuring the ability to reach all segments of the population. These principles and planning efforts should be a priority in bioterrorism planning efforts and should be funded accordingly.

TOPOFF also made it clear that public health human resources now in place would not be sufficient to meet the great surges in demand that would occur during an epidemic. Public health participants in the exercise should be praised for their sustained efforts and dedication throughout the exercise, but no level of engagement and dedication could take the place of the critically needed public health infrastructure and resources. Local and state public health agencies would need to rapidly increase the number of people available to perform a wide variety of essential functions. In an epidemic crisis, public health would need to undertake surveillance for new or as-yet-undetected cases; epidemiological investigation; facilitation of laboratory diagnosis; dispensation of medical and public health recommendations; distribution of scarce resources; and communication with the public, hospitals, other local and federal health agencies, and the broad panoply of other local and federal emergency management and law enforcement agencies. Few public health agencies now have a plan to address surge capacity needs; they will need resources to create plans that address this issue.

During an epidemic of contagious disease, hospitals could quickly face unprecedented challenges. They might need to care for overwhelming numbers of patients; manage shortages of personnel, medicines, and equipment; and provide the security needed for crowd control, for the provision of safety for health care workers and patients, and even, perhaps, for the enforcement of mandatory isolation of contagious patients. To deal with such a crisis, hospitals would need to communicate with and receive support from a wide variety of organizations, including other hospitals and local, state, and federal health of-
ficials, as well as emergency management and public safety agencies. The capacity for efficient communication throughout the health care system during a crisis should be built now.

There is an urgent need to formulate clear, scientifically and politically sound principles for the containment of highly contagious disease outbreaks in large urban communities. Decisions regarding patient isolation and regarding travel advisories, home curfews, the closure of airports and highways, and attempts to “quarantine” cities and states must be balanced against the practical feasibility of such measures and their implications for civil liberties. Multidisciplinary expertise should now be convened to craft such principles and guidelines.

TOPOFF was expensive, particularly when one accounts for the indirect costs of time and effort put forth by the medical, public health, public safety, emergency management, and other communities involved in the planning and execution of the exercise. It is hoped that careful consideration will be given to the objectives and processes of future exercises. How can exercises be performed with maximum cost-efficiency? What are the best mechanisms to exercise the medical and public health infrastructure and to engage the medical and public health community? How should the lessons be used to inform and propel ongoing preparedness efforts? How can systems be designed to better respond to the bioweapons threat and simultaneously serve routine medical and public health functions? It would be a significant loss if the lessons learned by the health community in Denver were not used as a platform to further improve the medical and public health infrastructure that is needed to respond to epidemics, regardless of whether the occur after an act of bioterrorism or a natural event.

The capacities and responsibilities that would be demanded from the medical and public health communities in the event of a bioweapons attack are not commensurate with the resources now available. The lessons of TOPOFF should provoke consideration of future directions for bioterrorism planning and preparedness at all levels of government and among the many communities and practitioners with responsibilities for national security and public health.

APPENDIX

1. The 1996 Defense Against Weapons of Mass Destruction Act, commonly referred to as the “Nunn-Lugar-Domenici Act,” designates the Department of Defense as “the lead agency to enhance domestic preparedness for responding to and managing the consequences of terrorists’ use of [weapons of mass destruction].” In fiscal year 1997, the Department of Defense received $36 million, whereby it initiated the Domestic Preparedness Program to enhance existing first-responder training in dealing with terrorist incidents involving radiological, nuclear, chemical, and biological weapons. The program is intended to train fire department, law enforcement, hazardous materials, and emergency medical personnel in the 120 largest cities in the United States. The relevant personnel undergo 1 week of training, which is composed of 6 separate courses [3, 4].

2. Laboratory diagnostic procedures were not actually tested. In the exercise, controllers presented a laboratory technician with a copy of a textbook picture of a Gram stain. The picture showed plague bacilli but was of poor quality; the technician believed that the picture presented gram-positive rods, consistent with anthrax. The state laboratory had initially been told of this finding, the controllers quickly corrected the story, and notified the state laboratory that the Gram stain in fact showed gram-negative bacilli. The state laboratory then performed (notionally) a direct fluorescent antibody test on the specimen, which led to a diagnosis of plague. Later, the specimen was sent for repeat testing to the CDC (Fort Collins, CO), where it was also (notionally) diagnosed as plague.

3. In March of 2000, Colorado House Bill 00-1077 was passed. One participant said that the bill accomplished 3 significant goals. First, it established an “Emergency Epidemic Response Committee” that would provide expert advice to the governor in a time of epidemic crisis and that would do so with legal immunity. Second, it protected hospitals from legal recourse if their actions were in keeping with the executive orders of the governor. Third, it called for the adoption of standards for health care facilities to respond to this type of epidemic crisis.

4. NPS is a national repository of pharmaceuticals and medical material being developed and maintained by the CDC. It is bundled into “push-packs” that can be deployed by commercial cargo to the scene of a biological or chemical weapons attack within 12 h of request by a state. Material in these packages consists of antibiotics, iv supplies, ventilators, bandages and dressings, and vaccine supplies.

5. Vendor managed inventory (VMI) is the second component of the NPS. Antibiotics from this component are intended to be shipped from pharmaceutical manufacturers to the site of an epidemic after an act of bioterrorism; it ships within 24–36 h of a request. This part of the NPS program is still in development.

References