ISSUE REPORT

# PUBLIC HEALTH LABORATORIES: Unprepared and Overwhelmed


Trust for America's Health
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**TRUST FOR AMERICA'S HEALTH IS A NON-PROFIT, NON-PARTISAN ORGANIZATION DEDICATED TO SAVING LIVES BY PROTECTING THE HEALTH OF EVERY COMMUNITY AND WORKING TO MAKE DISEASE PREVENTION A NATIONAL PRIORITY.**

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*The opinions expressed in this report are those of the authors and do not necessarily reflect the views of RWJF.*

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# I. Introduction

The United States is fighting the war against terrorism on many fronts both at home and abroad. With the horrific images of the September 11, 2001 attacks etched into our memories, Americans know that we must be prepared to prevent and respond to a growing array of threats.

As a nation, we are now conscious of the potential for nuclear, biological and chemical attacks on our own soil. According to Homeland Security Secretary Tom Ridge, U.S. intelligence services have significant evidence indicating that terrorists already possess chemical and biological weapons. Documents discovered in Afghan caves, videotapes of dogs being gassed at Al Qaeda training camps, and the discovery of chemical-weapons protective gear and Ricin in recent raids on terrorist cells in Europe confirms that terrorism involving chemical or biological weapons is no longer a theory but a threat that now confronts every American. As *Newsweek* reported in February 2003, in an internal intelligence report, a group of CIA analysts predicted that there is only a 6 percent probability that another terrorist attack within the U.S. will never occur.[1]

Traditional warfare planning requires preparing troops with sufficient defense, rescue and medical capabilities. The military works hard to ensure that it has the technology to detect and respond to an attack; the personnel, equipment and facilities to treat casualties; and the communications systems necessary to coordinate responses.

Clearly, the threat of a chemical, biological or radiological attack within U.S borders demands equally strong defenses. Yet, the U.S. public health system, which is an integral part of America's first line of defense, is woefully unprepared to meet this challenge. Thirty years of inadequate training, staffing, equipment, and funding have left our public health system in serious disrepair.[2] Today, analysts believe that America's public health system lacks the capacity to:

- **Rapidly detect a biological attack and its victims;**
- **Accurately identify the toxic substances used in a chemical attack;**
- **Rapidly treat and prevent further spread; and**
- **Communicate the existence of an attack and required actions to necessary responders.**

While recent federal bioterrorism funding has begun to relieve the effect of years of neglect, it has addressed only isolated issues rather than systemic problems. However, a majority of the public health, anti-terrorism measures have focused primarily, if not exclusively, on bioterrorism preparedness. In fact, the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 required that the $1 billion in appropriated funds be used only for bioterrorism, and not chemical terrorism, related activities.[3]

This is startling oversight given the fact that many experts, as outlined in an April 2003 report by the General Accounting Office (GAO), have warned that chemical weapons are much more accessible and likely to be used in the event of an attack.[4]

Moreover, the public health system now faces increased pressure due to dramatic federal and state budgetary shortfalls and the reemergence of infectious diseases such as severe acute respiratory syndrome (SARS). As a result, the lives of countless American families could be in jeopardy.

There is no question that America's public health system requires a systematic and comprehensive upgrading. In a majority of communities, the same resources public health professionals once devoted only to protecting families from infectious and chronic disease are now being called upon to protect Americans from terrorism. As policymakers act on our nation's commitment to combat terrorism, they have a unique opportunity to have homeland security dollars perform "double duty" by expanding the public health system's capacity to protect communities from a full spectrum of modern health threats, including those of terrorism.

This opportunity was highlighted in a January 2003 report by the GAO, which concluded that the U.S. Department of Health and Human Services "must find ways to coordinate programs that dually address critical homeland security priorities and basic public health needs and ensure that the nation's fragile public health infrastructure is strengthened at the federal, state, and local levels."[5]

The purpose of this report is to address the urgent need to upgrade an indispensable component of the public health system and one that is essential to homeland security: **public health laboratories.**

Public health laboratories, together with hospitals and local health departments, are quite literally the "front lines" of America's surveillance of and response to biological, chemical, or radiological attacks. Simultaneously, these laboratories play a critical role in protecting Americans from a wide range of other health threats, including longstanding nemeses (cancer, heart disease), emerging epidemics (West Nile Virus and severe acute respiratory syndrome (SARS), food borne diseases (*e-coli* and salmonella poisoning), and accidents involving hazardous chemicals. If approached strategically, expanding the capacity of public health laboratories could respond to the acute needs of both America's war against terrorism and the continuing battle to protect America's health.

## This report addresses:

**A. The role of public health laboratories and how, together with much of the public health system, these vital facilities have fallen into a state of disrepair;**

**B. A series of assessments on the ability of state public health labs to respond to specific chemical weapon events; and**

**C. Recommendations for improving state public health laboratories so that they can respond effectively to terrorism as well as more conventional threats — from analyzing water contaminants to cancer screening.**

# II. America's Public Health Laboratories

The term "public health laboratories" actually refers to a "loose network of federal, state and local laboratories that work in undefined collaboration with private clinical laboratories."[6] Today, there are approximately 174,000 laboratories operating in the United States; approximately 2,000 of these are public health laboratories, and the remainder are hospital, independent, and physician office laboratories.[7] Together, they are essential to safeguarding our nation's public health.

Recently, public health laboratories have gained increased public attention in light of their crucial new role in responding to the threat of chemical, biological or radiological terrorist attacks.[8] Given that laboratory professionals are not only charged with helping to identify harmful agents, but also with preventing their spread and facilitating rapid treatment, their role is widely recognized as critical if America is to respond effectively to both existing and emergent health threats. In an emergency, rapid identification of unknown substances can mean the difference between life and death as was evident in 2002 when 117 hostages in a Moscow theater died after an unidentified incapacitating gas was pumped into the theater's ventilation system.[9]

Recent guidelines from the Centers for Disease Control and Prevention (CDC) point out that "clinical lab personnel will most likely be the first ones to perform preliminary testing on clinical specimens from patients who may have been intentionally exposed [to biological or chemical terrorism] ... and will play a critical role in facilitating rapid identification of [the hazardous substance]."[10]

Though Americans rely upon the public health laboratories for a wide range of important functions, including disease management, prevention and food safety,[11] there is no seamless, integrated system to ensure that labs are prepared to meet these needs.

## A. CDC Laboratories

CDC operates the world's premier public health laboratories. They are the focal point of federal efforts to combat disease threats. CDC's laboratory remains the lead laboratory in our nation with the capacity to conduct comprehensive testing for the presence of toxic chemicals in the human body.[12] In a domestic emergency, the Federal Bureau of Investigations laboratory at Quantico, Virginia and the Department of Defense facility in Aberdeen, Maryland could potentially be called upon as well.

In addition to operating its laboratory, CDC also provides leadership for public health laboratories throughout the United States and much of the world. The agency provides funding in grants and cooperative agreements; develops and promotes best practices guidelines and new test methodologies; develops and maintains a Web-based information system that links CDC, public health, hospital, and independent laboratories and provides disease surveillance; and is also takes the lead in addressing identified gaps in services. Importantly, CDC also is largely responsible for training state and local public heath officials in the use of new equipment and innovative laboratory techniques.

## B. State Public Health Laboratories

Each of the 50 states (and the five U.S. territories) operates a state public health laboratory (SPHL). Most SPHLs are responsible for providing diagnostic and analytical services for the assessment and surveillance of infectious, communicable, genetic, and chronic diseases. Some SPHLs routinely monitor environmental health concerns, as well.

However, state labs are hardly uniform in their capabilities, functions, or resources.[13] Each state lab was created and operates independently with its state-defined charter. As a result, the capabilities, responsibilities, and practices of the SPHLs vary substantially in many areas that directly impact America's ability to respond to chemical or biological attacks or other public health emergencies, such as food poisoning or toxic substance exposure:

- State health systems individually determine which diseases are tracked by laboratories or clinicians within their states.[14]
- Generally, each SPHL operates under the leadership of the state health officer; however, the nature of the relationship between the health officer and the laboratory director varies by state.
- SPHLs differ widely in their staffing and funding levels.
- Sources of SPHL funds vary significantly, with some states relying upon user test fees for a portion of funding.
- Centralization of laboratory functions varies, with some states utilizing private or regional facilities for certain tests.
- Some SPHLs conduct far broader operations and missions than others, with some SPHLs limited to direct tests of patient specimens, while others conduct activities ranging from general research to environmental monitoring.

## C. Municipal, County and Private Laboratories

Operating under each state's SPHLs are a wide variety of municipal and county public health agencies that offer laboratory services as well as private laboratories, including those in hospitals and academic centers, many of which devote a portion of their resources to supporting their respective SPHL. It is within this assortment of laboratories that the vast majority of testing for public health occurs in many states. Accordingly, the level of communication and coordination between these laboratories and their SPHL is essential to ensuring the availability, quality, and reporting of tests performed by these facilities.

### A WEAK LINK IN THE CURRENT PUBLIC HEALTH LABORATORY SYSTEM CHAIN

*Many SPHLs rely heavily upon privately run laboratories to supplement and complement their ability to serve communities.*

*Traditionally, the public-private partnerships have provided an efficient means for the public laboratory system to access additional resources. Yet because private laboratories have their own separate missions, they are unable to fulfill the entire wide range of needs to the capacity required of the public system.*

*Generally, private laboratories primarily are focused on individual patient care and treatment. As a result, their equipment, facilities, and workforce are designed to manage a semi-predictable patient load; it is not economical for laboratories to retain the staff necessary to respond to a significant public health emergency. However, additional staffing is precisely what is required in the event of a terrorist incident or major accident.*

*As officials prepare their responses to the very real threat of a terror-related public health emergency, careful consideration must be given to the current system's reliance upon private laboratories.*

# III. TFAH Study of State Laboratories

Trust for America's Health (TFAH) conducted a two-part study to examine the critical role of public health labs in the event of a terrorist chemical attack and to assess risks to the public if these laboratories are not prepared.

This report builds on recent research conducted by the Association of Public Health Laboratories (APHL) and the GAO. The APHL study uncovered alarming shortcomings in the ability of public health labs to respond to a chemical terrorist attack. On a one-to-ten scale measuring preparedness for a chemical incident (with ten being the most-prepared), a November 2002 APHL survey found that 34 of the state labs rate themselves at a 'four' or below while 14 others rated themselves as a 'five' or a 'six.' The survey also determined that only eight laboratories had any chemical terrorism response plan in place. This lack of preparation may be dangerous, especially in light of a March 2003 GAO report that concluded:

> *Chemical facilities may be attractive targets for terrorists intent on causing economic harm and loss of life. Many facilities exist in populated areas where a chemical release could threaten thousands. EPA reports that 123 chemical facilities located throughout the nation have toxic 'worst case' scenarios where more than a million people in the surrounding area could be at risk of exposure to a cloud of toxic gas if a release occurred. To date, no one has comprehensively assessed the security of chemical facilities.*[15]

Though terrorism experts once warned of the use of chemical weapons such as Sarin gas or the nerve agent VX, the difficulty of using these weapons in a civilian environment has led some to rethink their earlier assumptions. According to Department of Health and Human Services Acting Assistant Secretary for Public Health Emergency Preparedness, Jerry Hauer: "Now the greater threats are toxic industrial materials that travel the highways every day." [16]

In light of these estimations, TFAH reviewed what resources or policies are necessary to improve the abilities of laboratories to respond in the event of a chemical attack. This also informs what can and should to be done to revitalize the labs to manage the broader spectrum of public health concerns. A facility's preparedness to respond to chemical terrorism helps illustrate its general preparedness to respond to public health emergencies as a whole.

**Components of the two research efforts included:**

1. Presenting five SPHL directors with a hypothetical chemical weapon scenario to determine (a) how each lab would respond, and (b) if there were shortcomings in their preparedness to respond in the case of such an event; and

2. Selecting three industrial chemicals, which are widely recognized as potential agents of chemical terrorism, to determine how prevalent they are within the United States, and how well prepared SPHLs might be to respond in case of an attack using these agents.

## A. Hypothetical Chemical Terrorist Attack Scenario: Courtside Terror

The deficiencies in the nation's public health laboratory system are not theoretical problems. If left unaddressed they are likely to cost American lives.

The following description of a potential terrorist event highlights America's dependence on public health laboratories. The fact pattern represents a variation on an event that actually occurred, and it is a good approximation of the type of incident that terrorism analysts believe is likely. In this case study, the role of the public health laboratory system is examined, and the practical implications of probable deficiencies in the system when faced with such an episode are described. Other fact patterns likely would highlight other deficiencies in America's public health laboratories.

### 1. Terror at the FleetCenter

In this era of heightened concern, fans entering NBA arenas are subject to random searches with detector wands while handbags are checked and larger bags are banned. Nevertheless, during the third quarter of the Boston Celtics' home game against the Los Angeles Clippers on March 7, 2003, Celtics players suddenly fled their bench, covering their faces with their warm-up jackets and towels. Players and fans seated immediately behind the bench gagged on noxious fumes. Everyone's thoughts turned to terrorism.

The game was delayed only nine minutes. Luckily, no one required medical treatment. Boston police and FleetCenter security ultimately determined the incident was a prank involving mace or pepper spray. Investigators tested the air in the arena before the next night's hockey game and tested for any residue of the substance. They found no harmful material. Nor did investigators find a canister.

One can easily imagine a few twists in the fact pattern.

At a game at a major indoor arena three months later, a crew of terrorists sitting behind the home team's bench spray a noxious chemical. Instead of momentary gagging, players and fans in the immediate vicinity begin choking, having seizures and fainting. Thousands of fans throughout the building begin to suffer. Emergency personnel rush to the scene, discover chaos, and are themselves exposed to toxic fumes. Unaware of the chemical used, they must make immediate response decisions.

At this point, the survival of all those exposed depends upon prompt, proper identification of the hazardous substance.[17] Patients must receive antidotes quickly.[18] However, if the wrong antidote is administered, lives could be lost.[19]

Under ideal circumstances, emergency personnel would immediately call in HAZMAT units based upon the description of the physical state of the victims. Those units would, in turn, be equipped with a combination of detectors capable of generally characterizing the chemical agent. Yet, studies indicate that many emergency response units are significantly concerned that they lack these capabilities.[20] Existing technology and devices used in the field are varied, and there is a lack of uniformity in training for the use of the devices. Moreover, testing of residue of the chemical on environmental samples, such as air, soil, or clothing, is often problematic; in the case of a gas attack, for example, the agent used easily could be dispersed.

As a result, initial identification and diagnosis is likely to rest with the public health laboratories. In any event, whether for confirmation, initial identification, or long-term treatment strategies, laboratory analysis of the chemical elements is crucial.

### 2. Survey Results from SPHLs: Laboratories Ill-Prepared to Respond, a "Train-Wreck in Front of Our Eyes"

Five state public health laboratory directors who currently serve on the APHL board of directors were surveyed about their ability to respond to the scenario described above (See Appendix A). The results of this study are startling: despite the fact that homeland security officials warn that such an event is likely, our laboratories are largely unable to provide the swift, certain analysis necessary to save lives. According to one of the respondents, "should an event such as the scenario above occur today, proper identification of the agent, which drives treatment, containment, and clean-up decisions, will be haphazard and lengthy."

### 3. Lack of Clear Direction and Coordination

According to the SPHL directors surveyed, they have received no clear direction from any federal agency or other authority defining the role and function of any front-line local and state responding agency in the event of a chemical terrorist attack. As one step to try to address this issue, the CDC is currently providing funds to a five states to begin building the capacity to identify chemical agents. Additionally, there has been virtually no assessment of capabilities, and essentially no coordination of possible responders and resources, such as HAZMAT units, public health laboratories, EPA laboratories, and Department of Defense laboratories.

Absent careful coordination, planning, or jurisdictional guidelines, state public health laboratories can develop response plans based only on incomplete information and without a clear sense of their role within the context of the larger emergency response. As a result, they are at serious risk of making quick, but wrong decisions based on limited information or assumptions in the case of an attack.

### 4. First Response: Basing Action on Assumptions

The survey respondents anticipated a reliance on the HAZMAT units as "first responders" to initially manage such a chemical attack. They based their predictions about what would happen on "best guess" assumptions of how emergency responders would handle specific chemical threats. However, there was no clear direction about how HAZMAT units or other first responders would "hand-off" information or samples to the labs. For instance, one director responded that he assumed that:

> *"The HAZMAT unit would make a judgment as to the probable cause and might use some sort of rapid test for tentative verification. They might also collect wipe samples and air samples. They would want to send samples to the public health labs as they do now with suspected bioterrorism samples. However, our chemical capabilities are questionable."*

Another responded that:

> *"The scenario is a likely one and has been played out with biological agents many times. It might be difficult to bring in enough of a chemical agent to overwhelm the entire FleetCenter, but just a couple of isolated areas affected at the same time would cause panic and rioting. HAZMATs and police would be the likely first responders. They may or may not be able to identify the class of compounds, but a good HAZMAT team can collect air samples for laboratory analyses."*

One laboratory director from a state that has only a limited emergency chemical terrorism response plan suggested that prior to a sample "take-in" at the SPHL, all samples would be first triaged (field tested) for radiation, incendiaries, and hazardous chemicals by the FBI or another law enforcement agency.

### 5. Sample Testing: Diagnosis Critical

The director of one lab explained that, in the case of a chemical attack, "identifying the group of chemicals and knowing the most prevalent symptoms will direct treatment and control decisions." There are two types of tests that can help make this identification:

a. Testing "environmental" samples, including air, water, soil, food, or clothing. Various agencies, including state public health laboratories, EPA laboratories, or Department of Defense laboratories have various abilities to test these samples depending on their equipment, expertise, and facilities.

b. Testing "clinical" samples taken from humans, such as blood or urine. Public health laboratories are the only group that has this potential capability. Here again, capabilities vary widely depending on the nature of the chemical attack and the equipment, expertise, and facilities of a given lab. However, the CDC does have the ability to test clinical specimens for a number of chemical terrorism agents.

## Table I: Laboratory Capacity to Test for Potential Chemical Agents: Summary of Five State Laboratory Directors' Responses

| Chemical Agents | Lab Capability To Test | | Lab Capability to Send Sample to CDC |
|---|---|---|---|
| | Environmental Sample | Clinical Sample | |
| Biotoxins (e.g. ricin) | 2 of 5 | 2 of 5 | 5 of 5 |
| Blister Agents/ Vesicants (e.g. mustard gas) | 0 of 5 | 0 of 5 | 4 of 5 and 1 possible |
| Blood Agents (e.g. arsine) | 1 of 5 | 1 of 5 | 4 of 5 and 1 possible |
| Caustics (acids) | 2 of 5 | 1 of 5 | 4 of 5 and1 possible |
| Choking/ Lung/ Pulmonary Agents (e.g. chlorine and cyanide) | 3 of 5 | 1 of 5 | 4 of 5 |
| Incapacitating (e.g. phenothiazines) | 0 of 5 | 0 of 5 | 4 of 5 |
| Metals (e.g. arsenic and mercury) | 4 of 5 | 1 of 5 and1 possible and1 limited | 5 of 5 |
| Nerve Agents (e.g. VX, Sarin) | 0 of 5 | 0 of 5 | 4 of 5 |
| Riot Control/ Tear Agents | 1 of 5 | 0 of 5 | 4 of 5 |
| Vomiting (e.g. DM, DA, DC) | 1 possible | 0 of 5 | 4 of 5 |

** Based on survey conducted April 2003. Environmental samples = air, soil, or water. Clinical samples = blood, urine, or saliva.*

**i. Environmental Sample Testing Capabilities**

The state public health laboratories typically have limited ability to test chemical environmental samples. Their capabilities are driven largely by the ability to respond to acknowledged ongoing environmental health risks, such as mercury, lead, and polychlorinated biphenyls (PCBs). For example, according to the TFAH survey, four out of five of the lab directors indicated they have the ability to test environmental samples for many metals (including arsenic, mercury, and lead). Three out of five have the ability to test for certain choking agents.

The laboratories generally lack the ability to test a much wider range of available potentially harmful chemicals: those most likely to be used in a terrorist assault. None of the lab directors indicated that they have the ability to conduct environmental tests for nerve agents (including VX and Sarin), blister agents (including mustard gas), and incapacitating agents (including phenothiazines or anesthetics such as those used in the Moscow theater incident).[21] Two out of five SPHLs surveyed reported the ability to test for biotoxins (including ricin), and two out of five have the ability to test for caustics (including acids). Only one in five of the labs has the ability to test for riot control tear agents and blood agents (including arsine). One SPHL may have a limited ability to test for vomiting agents.

If public health labs do not have the necessary environmental testing capabilities, they send samples to CDC. However, while CDC has the capacity to test clinical specimens for chemical terrorism agents, the agency relies upon EPA to test environmental samples, although EPA has not been given a legal mandate to do so. One of the respondents called this "a glaring problem." Emergency responders or the public health labs may instead hope to use alternative labs such as the facilities under the jurisdiction of EPA or Department of Defense, which may have varying abilities to conduct environmental testing. However, the lack of readily available information as to whether an agency has the capability to test various substances severely impairs the ability of emergency responders to obtain an accurate analysis.

**ii. Clinical or Human Sample Testing Capabilities**

The capabilities of state public health laboratories to test human or clinical samples for chemical agents are minimal at best. Most state labs lack the specialized "biomonitoring" equipment and staff to perform this type of testing. In most cases, the laboratories would need to send samples to the CDC for testing.

According to the TFAH survey, two SPHLs indicated the ability to test clinical samples for biotoxins (including ricin), and only one lab could test for blood agents (including arsine), caustics (including acid), choking or lung agents (including chlorine and cyanide). One lab indicated limited ability to test for lead. None of the SPHLs could test clinical samples for blister agents (including mustard gas), incapacitating agents, nerve agents, riot control tear agents, or vomiting agents.

Additionally, in many states the public health laboratories are focused primarily upon population-based services (i.e. disease surveillance, health education and community health planning), not personal services.[22] As a result, the laboratories are not oriented to examining individuals and conducting clinical testing.

Although four of the directors noted that they had the capability to send chemical samples to CDC in the case of an attack and the CDC reports that a protocols exists for collecting and sending samples for chemical analysis through the Laboratory Response Network (LRN), the February 2003 APHL survey of state laboratory personnel indicated that they did not have protocols for laboratory evaluation of specific chemical threats or even for sending chemical samples. Unlike for incidents of bioterrorism, public health laboratories are not organized in a coordinated network to optimize workflow in the case of a chemical incident. The outcome is that obtaining and transmitting appropriate samples for analysis by the federal laboratory could prove to be much more difficult than anticipated.

### 6. Missing Plans, Protocols, and Surge Capacity

Three of the five directors surveyed said that they did not have a chemical terrorism response plan in place and/or protocols for laboratory evaluation of specific chemical threats and/or for shipping chemical samples. Two responded that they had limited plans in place or had plans developed for industrial spills or radiochemical events, which could potentially be adapted and applied in the case of a chemical terror attack.

The five directors also described a lack of both appropriate standards and analytic methods for examining samples and performance testing programs for these agents.

Additionally, the SPHL directors also expressed concern at their lack of capacity to respond should their lab be inundated with a high number of samples. Each director pointed out that time required to make a positive identification for clinical samples was "days, if at all." Shipping samples to another facility, such as CDC or a Department of Defense facility would only add to the time lag. As one director pointed out, "Given the emergency nature of the event, I would anticipate expedited processing and results in 2 to 3 days *(if we are lucky)*."

If the chemical exposure was more widespread and resulted in the need to conduct testing of individuals on a regional basis, the public health lab system would be quickly overwhelmed due to inadequate staffing. Moreover, coordination with partner laboratories would very likely suffer due to communications deficiencies, since there is a lack of a coordinated communications system between labs to manage chemical threats.

### 7. Risks to Labs' Workforce, Facility Failures

The SPHL directors also voiced concerns about risks to the safety of laboratory personnel and lack of guidance on safe storage and security of chemical agents. APHL's February 2002 study found that there are no comprehensive guidelines available for laboratory workers when handling agents of chemical terrorism. In that study, half of the state laboratories indicated that worker protection equipment is "not very adequate" for chemical toxins, and 75 percent indicated that they could not safely handle samples containing multiple hazards, such as biological and chemical agents.

If laboratory workers are improperly trained or unprepared to handle a certain chemical, they risk exposure themselves, compounding the effects of the attack.[23] Improper handling also could cause a laboratory to become contaminated, shutting it down completely and causing the public to lose the critical services provided by the laboratory for an extended period of time while decontamination takes place.[24]

Emergency workers could also be at-risk under a number of other possible scenarios. For example, if a biological pathogen was placed into the ventilation system following a chemical attack, emergency workers could rapidly spread exposure to the agent in the rush to evacuate the victims of the chemical attack and transport them for treatment.

In addition to its shortcomings in identifying chemicals where exposure is certain to have occurred, the public health laboratory system is largely unprepared to determine whether other individuals with less direct contact with the chemical substance may have been exposed. In this regard, the directors recommend that chemical terrorism practice exercises would be highly useful to inform and improve their preparedness capabilities.

### WHAT IS BIOMONITORING?

**PERFORMING DOUBLE DUTY: Chemical Agent Identification and Human Exposure Assessment**

*Biomonitoring is the testing of human samples, such as blood or urine, for chemicals in their metabolites. This capability is key to the core functions of an effective public health laboratory. Without biomonitoring, the diagnosis and treatment of chemical exposures can be delayed.*

*Biomonitoring also is an important tool in disease prevention. When combined with disease tracking efforts, biomonitoring enables public health professionals to better understand what, where and when exposures occur, as well as their potential links to environmental factors.*

*Currently,* ***only*** *CDC has the ability to analyze the impact of a broad spectrum of chemicals in clinical samples. As the TFAH study revealed, many state laboratories lack the capacity to test blood or urine for even very common chemicals. This has caused delays, for example, in determining the exposures experienced by the firefighters and other front-line responders during the September 11, 2001 attack on the World Trade Centers in New York (the results of which have yet to be publicly released).*

### 8. The Bad News: It Could Be Much Worse

If the hypothetical scenario had been applied to other states, the results would have been no better and likely could well have been much worse. In most cases, the SPHL director would be required to send a chemical sample to a federal facility and would then need to wait a minimum of 24 hours for results. The time lost would severely impair the ability to treat victims and could cost lives.[25]

As one director remarked, "there are definite problems - safety of laboratory personnel, lack of appropriate standards and analytic methods, lack of proficiency testing programs for these agents, lack of guidance on safe storage and security of agents and/or metabolites." Or, as APHL's Executive Director Scott Becker wrote in a message to public health lab administrators, "we see what I call a 'train wreck,' and it's happening right in front of our eyes."[26]

## B. Assessment of Chemicals in States and Labs' Abilities to Respond: Present Risk, Absent Ability

CDC has identified over 60 toxic substances that could be used as chemical weapons by terrorists. To illustrate the widespread use and availability of these chemicals, TFAH selected three examples that are commonly used in American industry: phosgene, arsine, and cyanide-based compounds. Each of these substances is a potential weapon in the hands of terrorists.[27] Not only are these three chemicals routinely used for industrial purposes, they are readily available as gases. This means that they are particularly difficult for a response team to detect. Further, these gases are extraordinarily toxic and could have delayed impacts on victims if not readily detected.

**In its second study of public health preparedness, TFAH assessed the following data:**

1. General geographic locations where these three chemicals are found in the United States[28]; and

2. The ability of SPHLs to identify human exposure to such chemicals within their facilities.

TFAH conducted a series of interviews with federal and state lab directors and personnel to assess which states have the capabilities to test for various chemical exposures.

As discussed in the preceding section, rapid identification is critical to emergency response-both treatment of victims and containment of exposure. TFAH found that while vast amounts of these chemicals are in use, SPHLs are extremely limited in their ability to identify them. However, these chemicals are as hazardous as they are common. Specifically:

**a. Arsine** is a blood agent. In its pure form, it is a colorless, flammable, highly toxic gas with a garlic or fish-like odor. Inhalation is the most common route of exposure.

The first sign of symptoms after exposure are usually nausea, vomiting, and abdominal pain. Other symptoms may include: headache, malaise, thirst, shivering, dizziness, hypotension, muscle pain and twitches, kidney failure, and dyspnea. These symptoms, along with acute cardiac abnormalities, under heavy exposure can become evident within 30 to 60 minutes and can be fatal. In the case of minimal exposure, less serious symptoms can occur 2 to 24 hours later. Long-term effects, such as peripheral nerve damage may become evident one to two weeks after contact with the agent. Chronic exposure can result in gastrointestinal upset, anemia, and damage to lungs, kidneys, liver, nervous system, heart and other blood-forming organs.[29]

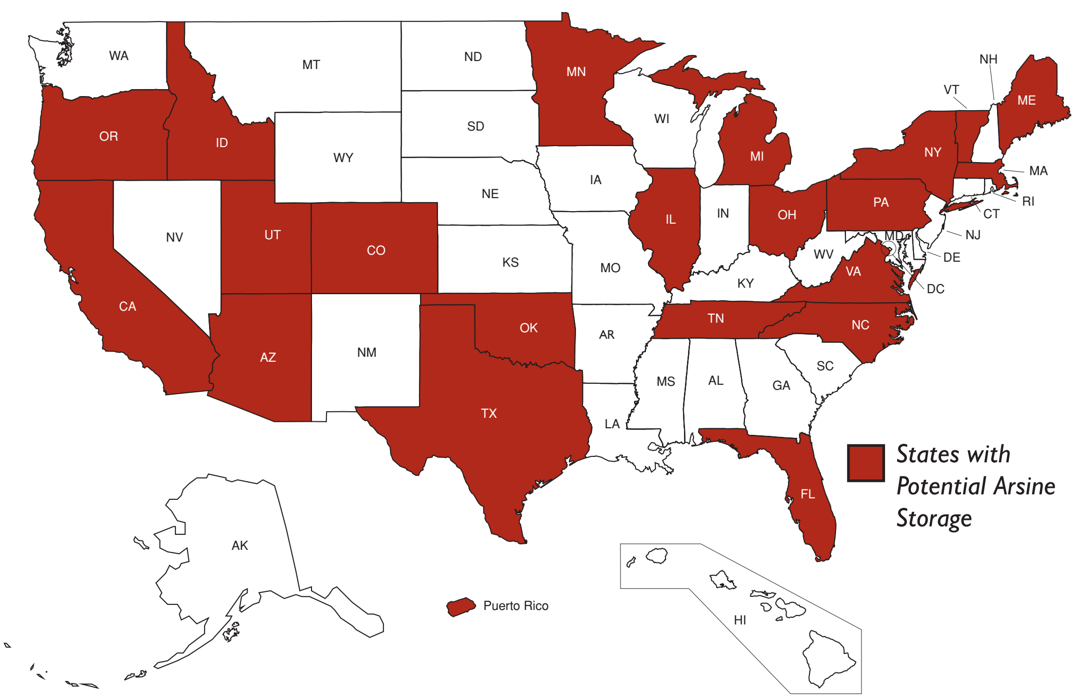
Arsine is commonly used in the semiconductor industry and in the manufacture of crystals for fiber optics and computer chips.

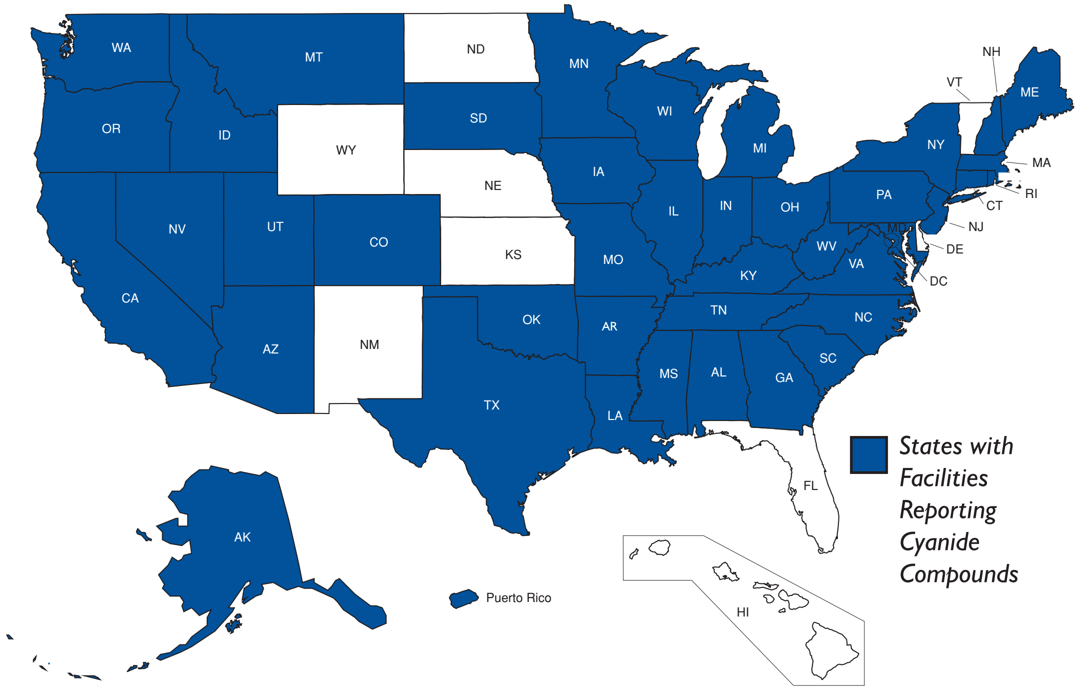
### Arsine in 23 States and 1 U.S. Territory

Arsine is believed to be used in at least 23 states and one U.S. territory, including Arizona, California, Colorado, Florida, Idaho, Illinois, Maine, Massachusetts, Michigan, Minnesota, New Mexico, New York, North Carolina, Oklahoma, Ohio, Oregon, Pennsylvania, Puerto Rico, Rhode Island, Tennessee, Texas, Utah, Vermont, and Virginia. (See Appendix B)

### No U.S. Public Health Laboratories Can Test for Arsine

The CDC and state public health laboratories indicate that they do not currently have the capability to test for arsine in human clinical (blood, urine, or saliva) samples.






**b. Cyanide-based compounds:** Cyanide is usually joined with other chemicals to form compounds such as hydrogen cyanide, sodium cyanide and potassium cyanide.[30] Exposure to cyanide can be very toxic. At high levels, cyanide harms the brain and heart and can cause coma or death. At lower levels, breathing difficulty, heart pains, vomiting, blood changes, headaches, and enlarged thyroid can occur. If ingested, cyanide can cause deep breathing or shortness of breath, convulsions, loss of consciousness and possibly death. Skin contact can produce irritation and sores. Chronic exposure results primarily in cardiovascular and respiratory effects and possible irritation to skin and eyes.[31]

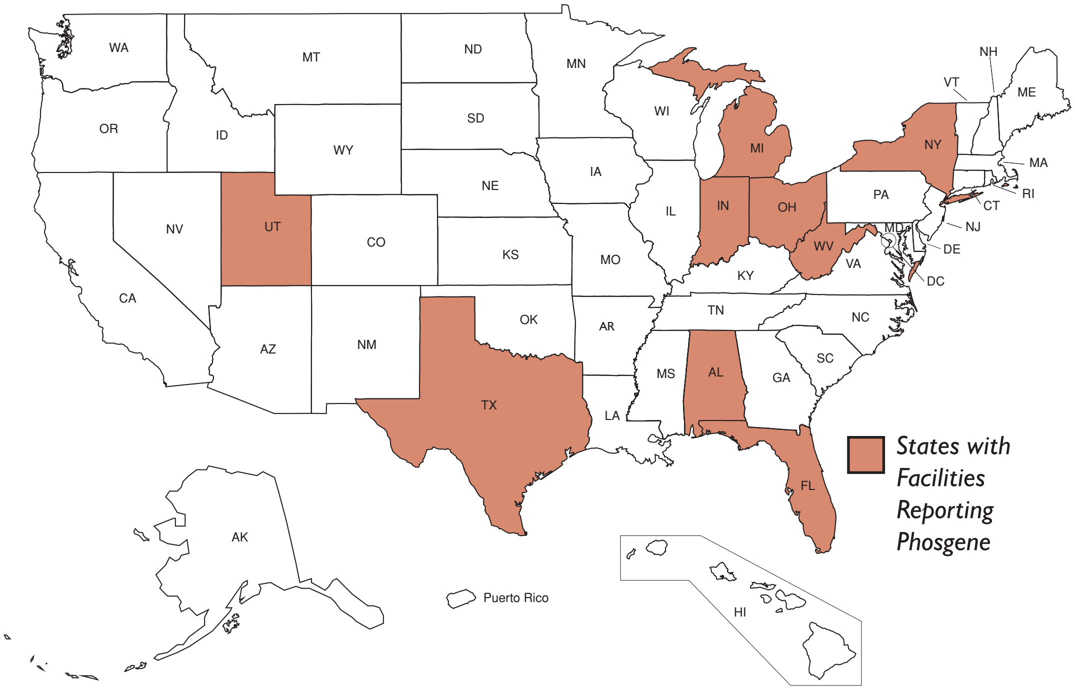
Cyanide usually is used in conjunction with hydrogen in certain industries, such as electroplating, metallurgy, production of chemicals, photographic development, plastics making, ship fumigating, wastewater treatment facilities and in some mining processes.

### Cyanide-Based Compounds in 41 States and 1 U.S. Territory

Cyanide-based compounds are found in 41 states and one U.S. territory, including Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nevada, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Puerto Rico, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, and Wisconsin. (See Appendix B)

### The CDC and At Least One State Can Currently Test for Cyanide-Based Compounds, More Expected by Next Year

The CDC and the Iowa state public health laboratory have the ability to test for cyanide-based compounds in clinical samples. The five SPHLs that have received funding from the CDC to support surge testing of blood, urine, and saliva samples for specific compounds — California, Michigan, New York, New Mexico, and Virginia — are expected to be able to test for cyanide-based compounds next year.




**c. Phosgene** is a choking agent that can damage the respiratory tract, causing extensive fluid build-up in the lungs. In addition, it can cause severe irritation, frostbite and chemical burns when in contact with skin or eyes. It is used commercially in organic synthesis, pesticides and herbicides, pharmaceuticals, dye manufacturing, as a chemical intermediary, and in the welding of metals.[32]

Exposure to phosgene, either by inhalation or direct contact with skin or eyes, has no antidote once exposed. Impact on the body and symptoms can be delayed up to 24 hours after exposure. Common symptoms include: shortness of breath or difficulty breathing, irritation of mucous membranes, coughing, tightness of chest, eye, throat and skin irritation, and chemical burns. The severity of these symptoms will vary depending on the amount and type of exposure. Acute phosgene poisoning may affect the brain, heart and blood due to lack of oxygen from improperly functioning lungs. Symptoms can be treated by moving to fresh air, rest, oxygen therapy, clearing fluid from lungs, washing thoroughly any exposed areas, and washing or rinsing skin or eyes with soap and warm water.[33]

### Phosgene in 11 States

Phosgene is reported in 11 states, including Alabama, Florida, Indiana, Louisiana, Michigan, New Jersey, New York, Ohio, Texas, Utah, and West Virginia. (See Appendix B)

### No U.S. Public Health Laboratories Can Test Phosgene

Currently, the CDC laboratories and state laboratories do not have the capability to test for phosgene in human clinical (e.g. blood, urine, saliva) samples.

This investigation makes evident that chemicals that could potentially be used in a terrorist attack are also in wide use by U.S. industry. Yet, despite their prevalence, our public health laboratory system lacks the capacity to respond rapidly to emergencies involving these agents. Public health labs also have a limited ability to respond to cases of accidental exposure involving these and other similar chemicals when their identity is not known.

## C. Suffering from Neglect and an Urgent Need for Renewal

There is no question that America's public health system "must become an indispensable pillar of our national security framework" or that public health "is a national security issue."[34] There is also broad agreement that the system is not prepared for this role due to years of neglect.[35] On top of that, traditionally, public health laboratories were not designed to have the capacity to respond to the threats of biological, chemical, and nuclear terrorist acts in local communities, which have become a tangible possibility.

In the wake of the September 11, 2001 attacks, Congress moved quickly to pass the "Public Health Security and Bioterrorism Preparedness and Response Act of 2002." The legislation earmarked a record $3 billion for anti-bioterrorism activities. Included in that appropriation was more than $1 billion to upgrade state and local public health capabilities and hospital preparedness.[36] Congress also authorized funding to upgrade the ability of health professionals to recognize and treat diseases caused by bioterrorism and to speed the development of new vaccines, and allocated $147 million in new funds to improving laboratory capacity. Included in this provision was authorization to support the Laboratory Response Network (LRN) to coordinate communications between local, state and federal laboratories.

However, despite these efforts the fundamental problem of preparedness remains largely unaddressed. As U.S. Senate Majority Leader Bill Frist (R-Tenn.), the lead sponsor of the bioterrorism bill, recently acknowledged, the new law is not nearly enough:

> *Over the past two decades, the [nation's public health infrastructure] has greatly deteriorated. A lack of focus, funding, and national attention have combined to reduce the physical structures (such as laboratories) and workforce capabilities necessary to collect and analyze data, conduct epidemiology and disease surveillance, communicate effectively, and implement interventions to respond to threats to the health of our entire country.*[37]

Dr. Julie Gerberding, the CDC's director, agrees, and adds that despite recent infusions of federal funds, "public health is the first service to experience declines... when there are difficult budget times at the state, (county and municipal) level."[38]

SPHLs have been particularly hard hit. According to a hallmark 1988 report issued by the Institute of Medicine (IOM), by 1984, only an average of three percent of state health expenditures are directed to fund laboratory services.[39] Since then, little has changed, according to the IOM's 2002 report *The Future of the Public's Health in the 21st Century*.[40] As outlined below, serious deficiencies are now readily apparent in the three key components that define an effective SPHL: (1) an adequate number of qualified staff; (2) proficient, secure facilities and equipment; and (3) a strong, integrated communications system.[41]

### 1. Inadequate Training and Staffing

SPHLs lack sufficient training opportunities and adequate staff. For example, 18 percent of jobs in the nation's public health labs are currently unfilled, and the salaries they offer suggest there is little hope of filling them.[42] In addition:

- Over 75 percent of SPHLs report a shortage of PhD-level molecular scientists currently on staff, and half had no PhD-level experts in the SPHL. Only nine SPHLs had more than one.[43]

- Many have insufficient staff to perform basic testing for bioterrorism.[44]
- Half of SPHLs have no full-time information technology staff to develop and maintain lab information systems, and two-thirds report shortages in administrative staff to handle times of significant demand for services.[45]

Today, SPHLs are not adequately designed or prepared to meet the range of responsibilities they are asked to perform, even in times of normal demand. As one GAO report released just after the September 11, 2001 terrorist attacks starkly concluded: "reductions in public health laboratory staffing and training have affected the ability of state and local authorities to identify biological agents."[46] A later GAO Report issued in January 2003 added that: "increasing staffing of public health departments and laboratories is a top priority for enhancing preparedness in many areas. Officials told [GAO] that they did not have enough trained epidemiologists, laboratory technicians, and other professionals to respond to the anthrax incidents while meeting normal day-to-day responsibilities, such as preventing the transmission of sexually transmitted diseases."[47]

The administrators of SPHLs agree with the GAO's findings; in one survey, almost two-thirds of SPHLs officials indicated that staff vacancies had negatively affected the ability to perform capably, and more than a quarter reported that it had "greatly or significantly" impacted their ability to perform in a competent fashion.[48] As a result of understaffing, two-thirds of SPHLs reported that they lacked the ability to respond to surge in service demands that accompanied the anthrax events of October 2001.[49]

### 2. Obsolete Facilities and Equipment

Prior to September 11, 2001, the physical plant and equipment of public health labs were almost uniformly sub-standard. Targeted funding has improved or will improve many capabilities; however, as the recent APHL survey revealed, there remains a great need for basic upgrades and modernization within facilities and additional equipment to permit testing:

- Almost every SPHL has serious, basic physical plant defects.[50]
- Regional and local labs are among the worst; even major metropolitan areas such as Los Angeles must make do with 1960s-era labs.[51]
- According to the APHL study, a large percentage of SPHLs need an upgrade to one or more of the following physical structures: storage facilities, freezers, biohazard disposal facilities, dedicated power systems, redundant fan systems, and air handling systems.
- Close to 100 percent reported a need to upgrade the basic mail and specimen-receiving areas.[52]

Although some post-September 11, 2001 improvements have been made, SPHLs still lack the equipment, technology, and processes to test for many elements likely to be used in terrorist attacks. For example, although CDC has developed a rapid toxic screen to test for 150 chemical weapons agents, only five states have been provided with testing capability.

Additionally, according to the APHL survey, laboratory professionals are not trained to handle potential chemical terrorism agents and facilities lack sufficient protective equipment. The survey also found that nearly three-quarters of the laboratories reported inadequate air handling systems, threatening lab workers and other building tenants with exposure to toxic elements and the labs to contamination.

Given the other shortcomings described, it's not surprising that the APHL survey also found that three-quarters of SPHLs reported a need for security upgrades, including locks, electronic tracking of entries and video surveillance.

### 3. Antiquated Communications

Public health labs lack communication systems capable of facilitating rapid response to emergencies. The APHL survey found that less than half of responding laboratories had rapid communications capabilities, including blast-fax or even e-mail. Approximately half the survey respondents indicated that they did not have full time Information Technology staff dedicated to developing and maintaining the lab information systems. Additionally, a quarter of the state public health labs stated that they did not have integrated data management systems, and ten of those that did have them reported that these systems were over seven years old. In the event of an emergency, these limited or outdated communications systems severely impairs the ability of the labs to share vital information in a real-time manner.

The shortcomings of the communications capabilities within the larger public health community further diminishes the abilities of the labs to perform in a rapid response mode. A recent Institute of Medicine report revealed that during the anthrax events in 2001, "only half of the nation's [public] health departments had full-time Internet connectivity." In fact, as many as 20 percent of state, local and territorial health agencies lacked e-mail and were unable to receive any electronic updates regarding the anthrax events."[53]

# IV. Conclusion

With biological or chemical terrorism within our borders considered almost inevitable, public health professionals have joined the members of our armed services on the front lines of national security. However, America's public health system is not up to the job. As former Senate Armed Services Committee Chairman Sam Nunn recently stated, an attack on our public health is the threat "we are least prepared to handle today."[54] TFAH's study of chemical capabilities at the state public health labs supports this statement.

There has been a flurry of activity to address this risk. A billion dollars a year in federal funding over the past two years has addressed some specific problems: the stockpiling of various vaccines and other medicines, training for certain events, and providing SPHLs with the means to test for certain antibodies. Some individual laboratories have been earmarked for upgrades or replacement, and some communications systems have been improved.

However, it would be a serious mistake to believe that these efforts have done more than patch a few leaky holes in the public health care system. Moreover, even with new federal expenditures, overall public health funding is declining due in part to massive budget deficits at every level of government.

To play an effective role in America's war on terrorism, our public health system needs more money, better communications, additional personnel, improved training, modernized facilities, and the direction and coordination only national leadership can provide.

In addition to helping protect Americans from the effect of biological and chemical attacks, investing in public health yields an added bonus: it will help our nation prevent and respond to chronic and infectious diseases, more effectively detect and treat foodborne diseases, monitor and prevent environmentally caused diseases, and meet other public health challenges, which now claim the lives of millions of Americans per year. An effective public health defense may be the antidote to escalating health care costs by more efficiently reducing and preventing illness. Now is the time to ensure our homeland security investment is strategic and creates a defense that protects us from all health threats.

# V. Recommendations:

## FORTIFY AND ENSURE LABORATORY CAPABILITIES IN ALL STATES

To restore their effectiveness, all state public health laboratories must have minimum capacities to respond, 24 hours a day/7 days a week, to the full spectrum of public health emergencies, including terrorism, without compromising critical and routine investigations, such as testing drinking water or food supplies. A federal agency such as the Department of Homeland Security must step into the leadership void to ensure that the different local, state, and federal groups that may be called upon during a terrorist attack are coordinated and cooperative in their activities.

As a first step, by 2004, CDC, in collaboration with the Association of Public Health Laboratories, must develop minimum requirements and standards for state laboratories to ensure basic protections for all citizens. These should include the following:

- **Improved Facilities:** By the end of 2004, every state should have at minimum testing capabilities for priority biological and chemical agents.

- **Improved Communications:** To ensure effective coordination and rapidly identify suspect infections, all state public health laboratories must establish an effective communications network incorporating clinical laboratories, hospitals and private labs that evaluate patients directly.

- **Bolstered Workforce:** Each state laboratory should have PhD-level microbiologists and PhD-level chemists to ensure effective biological, chemical and environmental testing capacity.

- **Bolstered and Stable Funding:** To be prepared for future emergencies, and ensure basic standards laboratories must have a strong and reliable funding base. States must provide a minimum 40 percent of laboratory budgets to ensure proper capacity.

### Preparedness Needed for Chemical Terrorism

States have been able to quickly advance bioterrorism preparedness because of development efforts in the 1990s. A similar federal commitment is needed now to develop the nation's response strategy for a potential chemical weapon and/or radiological attack. This requires:

- **National Coverage.** For three years, beginning in FY 2004, the federal budget must include $200 million to enhance federal and state public health laboratories capabilities, including upgrading facilities and equipment and bolstering the workforce. This funding is essential if they are to have the ability to conduct clinical testing for potential dangerous chemicals, such as ricin, cyanide, nerve agents and pesticide exposures. After this period, laboratories should be sustained at a level of approximately $100 million per year for rebuilding.

- **CDC Sets Mandatory Standards and Training.** CDC must have the authority to ensure capacity, collaboration and consistent methodology for clinical testing for chemical exposures. The National Center for Environmental Health should be supported to advance methodologies, develop training systems and establish performance measures for state laboratories. The Department of Homeland Security must partner with CDC and EPA to prioritize chemical agents for environmental and clinical laboratory methodologies.

- **Conduct Chemical Exercises.** Key federal agencies including DHS, EPA and CDC must collaborate to develop a joint training exercise with states and first responders to prepare for chemical attacks. The scenario should be similar to the hypothetical stadium attack outlined in this report, where individuals were exposed to unknown gaseous substances.

- **Ensure Double Duty.** To maximize their value, biomonitoring measures should be fully integrated into the nationwide health tracking network to strengthen public health investigations of chronic disease and environmental risks. For example, federal preparedness investment should allow laboratory equipment and training to be used for routine human testing for potential environmental contaminants.


## PUBLIC HEALTH LABORATORIES: UNPREPARED AND OVERWHELMED



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# Appendix A:

## Survey Distributed to Five State Public Health Laboratory Directors:

1. What is the procedure your state follows for identifying a chemical substance in the above situation?

2. Does your SPHL have the capability to do the identification itself (for all or most chemicals, including nerve agents, incapacitating agents, vesicants, blood agents, certain industrial chemicals, and choking agents), or must it send a sample to a federal or state lab? Please respond by marking the table below:

**LABORATORY CAPACITY TO TEST FOR POTENTIAL CHEMICAL AGENTS:**

| Chemical Agents | Lab Capability To Test | | Lab Capability to Send Sample to CDC |
|---|---|---|---|
| | Environmental Sample | Clinical Sample | |
| Biotoxins (e.g. ricin) | | | |
| Blister Agents/ Vesicants (e.g. mustard gas) | | | |
| Blood Agents (e.g. arsine) | | | |
| Caustics (acids) | | | |
| Choking/ Lung/ Pulmonary Agents (e.g. chlorine and cyanide) | | | |
| Incapacitating (e.g. phenothiazines) | | | |
| Metals (e.g. arsenic and mercury) | | | |
| Nerve Agents (e.g. VX, Sarin) | | | |
| Riot Control/Tear Agents | | | |
| Vomiting (e.g. DM, DA, DC) | | | |

3. What is the likely timeframe for making a positive identification for clinical samples? And for environmental samples?

4. Do you have a chemical terrorism response plan in place and/or protocols for laboratory evaluation of specific chemical threats and/or for shipping of chemical samples? Do you foresee problems?

5. Would your workers have safety problems in handling chemical samples or biological samples containing a chemical agent?

6. In the event that a combination of biological, chemical or radiological agents are included in the same attack, would you be able to make proper identification of samples? Would you be able to handle samples safely?

7. If you were provided hundreds of samples at once, what is your surge capacity? How would timing be affected?

# Appendix B:

## States with Supplies of Potential Chemical Weapons and Public Health Laboratories Capability to test Clinical Samples for Exposure

| STATES | Phosgene | | Arsine | | Cyanide Based Compounds | |
|---|---|---|---|---|---|---|
| | Present in State | Capability to Test | Present in State | Capability to Test | Present in State | Capability to Test |
| Alabama | ✓ | | | | ✓ | |
| Alaska | | | | | ✓ | |
| Arizona | | | ✓ | | ✓ | |
| Arkansas | | | | | ✓ | |
| California | | | ✓ | | ✓ | ✓* |
| Colorado | | | ✓ | | ✓ | |
| Connecticut | | | | | ✓ | |
| Delaware | | | | | | |
| Florida | ✓ | | ✓ | | | |
| Georgia | | | | | ✓ | ✓ |
| Hawaii | | | | | | |
| Idaho | | | ✓ | | ✓ | |
| Illinois | | | ✓ | | ✓ | |
| Indiana | | | | | ✓ | |
| Iowa | | | | | ✓ | ✓ |
| Kansas | | | | | | |
| Kentucky | | | | | ✓ | |
| Louisiana | ✓ | | | | ✓ | |
| Maine | | | ✓ | | ✓ | |
| Maryland | | | | | ✓ | |
| Massachusetts | | | ✓ | | ✓ | |
| Michigan | ✓ | | ✓ | | ✓ | ✓* |
| Minnesota | | | ✓ | | ✓ | |
| Mississippi | | | | | ✓ | |
| Missouri | | | | | ✓ | |
| Montana | | | | | ✓ | |
| Nebraska | | | | | | |
| Nevada | | | | | ✓ | |
| New Hampshire | | | | | ✓ | |
| New Jersey | ✓ | | | | ✓ | |
| New Mexico | | | ✓ | | | ✓* |
| New York | ✓ | | ✓ | | ✓ | ✓* |
| North Carolina | | | ✓ | | ✓ | |
| North Dakota | | | | | | |
| Ohio | ✓ | | ✓ | | ✓ | |
| Oklahoma | | | ✓ | | ✓ | |
| Oregon | | | ✓ | | ✓ | |
| Pennsylvania | | | ✓ | | ✓ | |
| Puerto Rico | | | ✓ | | ✓ | |
| Rhode Island | | | ✓ | | ✓ | |
| South Carolina | | | | | ✓ | |
| South Dakota | | | | | ✓ | |
| Tennessee | | | ✓ | | ✓ | |
| Texas | ✓ | | ✓ | | ✓ | |
| Utah | ✓ | | ✓ | | ✓ | |
| Vermont | | | ✓ | | | |
| Virginia | | | ✓ | | ✓ | ✓* |
| Washington | | | | | ✓ | |
| Washington, DC | | | | | | |
| West Virginia | ✓ | | | | ✓ | |
| Wisconsin | | | | | ✓ | |
| Wyoming | | | | | | |

*Ability to test for these chemicals anticipated in one year

# Endnotes


1 Klaidman, D. and Thomas, E. "Anatomy of a Threat," Newsweek. 24 February 2003.

2 Some of these reports include: The Future of the Public's Health in the 21st Century. Washington, DC: Institute of Medicine. 2002; Public Health Infrastructure. Atlanta, GA: Centers for Disease Control and Prevention. 2001; Major Management Challenges and Program Risks: Department of Health and Human Services. Washington, DC: U.S. General Accounting Office. 2003.

3 White House Press Release. "President Signs Public Health Security and Bioterrorism Bill." Washington, DC: The White House. 2002.

4 Homeland Security: Voluntary Initiatives Are Under Way at Chemical Facilities but the Extent of Security Preparedness is Unknown. Washington, DC: U.S. General Accounting Office. 2003.

5 Major Management Challenges and Program Risks: Department of Health and Human Services. Washington, DC: U.S. General Accounting Office. 2003.

6 Skeels, M. "Public Health Labs in a Changing Landscape," American Society of Microbiology News, 2003:479-483.

7 OSCAR database: Online Survey and Certification Reporting System [Electronic database]. Baltimore, MD: Centers for Medicare & Medicaid Services. 2002.

8 During the anthrax attacks in 2001, over 70,000 samples were tested in laboratories across the country. Major Management Challenges and Program Risks: Department of Health and Human Services. Washington, DC: U.S. General Accounting Office. 2003.

9 On October 23, 2002, in the middle of an evening performance, Chechen rebels equipped with firearms and explosives seized the Moscow music theater and took 800 patrons inside hostage. The militants threatened to kill everyone inside unless Russia granted independence to Chechnya. Over the next few days, negotiations with Russian authorities stalled, and the rebels declared that they would execute each hostage, one by one. Just before dawn on October 26, Russian special police units pumped an incapacitating gas into the theater. Every rebel was killed, and the majority of opera patrons were freed. However, the gas caused many casualties among the hostages; 117 opera patrons died from the effects and many more suffered serious reactions. Russian authorities refused to disclose the identity of the gas, even to treating physicians, according to chief Moscow doctor Andrei Seltsovsky, hindering treatment.

10 Szabo, J. "Is Your Laboratory Prepared for a Bioterrorism Attack?," Medical Laboratory Observer 2002: 12(33):10.

11 Core Functions and Capabilities of State Public Health Laboratories: A White Paper for Use in Understanding the Role and Value of Public Health Laboratories in Protecting our Nation's Health. Washington, DC: Association of Public Health Laboratories. 2002. Along with emergency response, public health laboratories are an integral and necessary part of a wide range of public health efforts, including:

(1) disease prevention, control, and surveillance; (2) integrated data management; (3) reference and specialized testing; (4) environmental health and protection; (5) food safety; (6) laboratory improvement/regulation; (7) policy development; (8) public health related research; (9) training and education; and (10) partnerships and communication.

12 The CDC lab is exceeded in capabilities only by the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID). USAMRIID and CDC labs are classified as a Level D, state health laboratories are Level B/C, and hospital and independent laboratories are designated as Level A laboratories.

13 Witt-Kushner, J., Astles, J., et al. "Core Functions and Capabilities of State Public Health Laboratories: A Report of the Association of Public Health Laboratories," Morbidity and Mortality Weekly Report. 2002: 37(51):S1.

14 Roush, S., Birkhead, G., Koo, G., Cobb, A. and Fleming, D. "Mandatory Reporting of Diseases and Conditions by Health Care Professionals and Laboratories," Journal of the American Medical Association. 1999: 282:164-170.

15 Homeland Security: Voluntary Initiatives Are Under Way at Chemical Facilities but the Extent of Security Preparedness is Unknown. Washington, DC: U.S. General Accounting Office. 2003.

16 Connolly C. "'Dream Team' of Scientists Prepares for the Worst." Washington Post. 5 March 2003: A19.

17 Health and Medical Services Support Plan for the Federal Response to Acts of Chemical/Biological(C/B) Terrorism. Washington, DC: U.S. Department of Health and Human Services. 1996.

18 Sidell, F.R., Takafuji, E.T., and Franz, D.R., eds. Medical Aspects of Chemical and Biological Warfare. Falls Church, VA: Office of the Surgeon General. 1998. and

Brennan, R.J., Waeckerle, J.F., Sharp, T.W., and Lillibridge, S.R. "Chemical Warfare Agents: Emergency Public Health Issues," Annals of Emergency Medicine 1999: 34:201.

19 Smithson, A.E., and Levy, L-A. Ataxia: The Chemical and Biological Terrorism Threat and the US Response. The Henry L. Stimson Center. Washington, DC: 2002: Report No. 35: 224.

20 Ibid: 210. Moreover, even when first responders are equipped with detection devices and properly trained as to their use, the devices "often provide false positive results and false negative results and cannot be relied upon to provide accurate testing at this time." Testimony of Mary J.R. Gilchrist, President of the Association of Public Health Laboratories, to the United States Senate Appropriations Subcommittee on Labor, Health, Human Services and Education 23 October 2001.

21 See endnote #9 regarding Moscow music theater incident.

22 For example, Minnesota has a population-based focus, whereas Tennessee has a personal health care focus. Available: http://aspe.hhs.gov/health/reports/phlabs/part2a.htm [accessed 11 April 2003].

23 In the 1995 terrorist attack on a Tokyo subway, nearly half of the police, paramedics, and hospital personnel were poisoned by touching victims and their contaminated clothing. Okumura, T., Takasu, N., Ishimatsu, S., et al. "Report on 640 Victims of the Tokyo Subway Sarin Attack," Annals of Emergency Medicine. 1996: 28:129-135.

24 During the anthrax crisis, inexperienced technicians in the New York City public health laboratory failed to turn on an exhaust fan while testing anthrax samples and accidentally contaminated the laboratory. Eban, K. "Waiting for Bioterror: Is our Public Health System Ready?" The Nation. 9 December 2002: 11.

25 For example, during the anthrax threats and other criminal investigations, delays in getting samples to the CDC labs for testing has resulted in treatment delays for citizens exposed to biotoxins.

26 Becker, S. "Executive Director's Note." The Association of Public Health Labortories Minute. March-April 2003: 3.

27 Each is typically included in lists of potential chemical weapon agents by government agencies including the CDC and Agency for Toxic Substances and Disease Registry, which is part of the U.S. Department of Health and Human Services.

28 TFAH found that two of the best sources for determining this information were the Toxics Release Inventory (TRI) and the National Emissions Trends (NET) databases managed by the EPA. The most recent available data from TRI was 2000 and from NET was 1999. TRI catalogs information on toxic chemical releases and other waste management activities by major industrial facilities. The NET database contains emissions levels from industrial and other facilities across the country. Using these databases TFAH was able to approximate where in the United States these chemicals arsine are being used, produced or distributed.

Currently, there is limited public information on the use, release and production of the chemical arsine. In order to distinguish potential locations throughout the country, TFAH identified the industrial sectors that heavily rely upon this chemical, as based on industry reports, experts, and the Agency for Toxic Substances and Disease Registry. By using these criteria, TFAH reviewed computer chip semiconductor and semiconductor fabrication plants, where other toxic chemicals have been reported.

29 Division of Specialized Information Services. ChemIDplus Chemical Search Input Page: Arsine. Washington, DC: National Library of Medicine. Available: http://chem.sis.nlm.nih.gov/chemidplus/ [Accessed 14 April 2003].

30 Division of Specialized Information Services. ChemIDplus Chemical Search Input Page: Cyanide Compounds. Washington, DC: National Library of Medicine. Available: http://chem.sis.nlm.nih.gov/chemidplus/ [Accessed 14 April 2003].

31 Ibid.

32 Division of Specialized Information Services. ChemID*plus* Chemical Search Input Page: Phosgene. Washington, DC: National Library of Medicine. Available: http://chem.sis.nlm.nih.gov/chemidplus/ [accessed 14 April 2003].

33 Ibid.

34 Nunn, S. "The Future of Public Health Preparedness: Nuclear, Chemical and Biological Attacks," Journal of Law, Medicine & Ethics. 2002: 3(30).

35 A bipartisan report recently issued by the Council on Foreign Relations warned that America remains dangerously unprepared for a terrorist attack, with its emergency responders untrained and its public health systems depleted.

36 White House Press Release. "President Signs Public Health Security and Bioterrorism Bill." Washington, DC: The White House. 2002.

[37] Frist, B. "Public Health and National Security: The Critical Role of Increased Federal Support," Health Affairs. 2002: 21(6):117-130.

[38] See, also, Nunn, S. "The Future of Public Health Preparedness: Nuclear, Chemical and Biological Attacks." Journal of Law, Medicine & Ethics. 2002: 3(30).

[39] The Future of Public Health in the 21st Century. Washington, DC: Institute of Medicine. 1988: 181.

[40] The Future of Public Health in the 21st Century. Washington, DC: Institute of Medicine. 2002.

[41] Public Health Laboratory Issues in Brief: Bioterrorism Capacity. Washington, DC: Association of Public Health Laboratories. 2002.

[42] Eban, K. "Waiting for Bioterror: Is our Public Health System Ready?" The Nation. 9 December 2002: 11.

[43] Public Health Laboratory Issues in Brief: Bioterrorism Capacity. Washington, DC: Association of Public Health Laboratories. 2002.

[44] Many SPHLs have only one laboratorian trained to perform certain tests and some have no laboratorians trained to perform certain tests. Public Health Laboratory Issues in Brief: Bioterrorism Capacity. Washington, DC: Association of Public Health Laboratories. 2002.

[45] Public Health Laboratory Issues in Brief: Bioterrorism Capacity. Washington, DC: Association of Public Health Laboratories. 2002.

[46] Bioterrorism: Federal Research and Preparedness Activities. Washington, DC: U.S. General Accounting Office. 2001.

[47] Major Risk Report. Washington, DC: U.S. General Accounting Office. 2003.

[48] Emerging Infectious Diseases, Consensus on Need Laboratory Capacity Could Strengthen Surveillance. Washington, DC: U.S. General Accounting Office. 1999.

[49] For example, in Arkansas, normal "overload" levels for the SPHL are 15-20 samples at the same time; during the anthrax scare, the SPHL was flooded with more than 900 samples at once. Yee, D. "State Not Ready for Bioterror, but Report Tells of Plans, Needs," Arkansas Democrat-Gazette. 4 May 2002: A1.

[50] For example, in the Arizona SPHL, pipes in the building often burst and cause flooding. Graham, J. "Money Woes Plague Nation's Health Labs," Chicago Tribune. 23 November 2001: 3.

In Iowa, until the APHL study highlighted the problem and prompted new federal funs, the SPHL was housed in a building that was converted from a tuberculosis hospital in 1904 and which contained storage of small samples of non-active anthrax. ———. 2002. Hygienics laboratory gets $1 million for bioterrorism. Associated Press State & Local Wire. 29 Jan.

[51] While CDC money has been earmarked for replacement of the lab, groundbreaking is still months away. For now, said Dr. Jonathan Fielding, the county's public health director, the lab in Los Angeles is "woefully inadequate and inefficient," he said. "We can't even get pieces of equipment that we need up to it, because the elevator won't accommodate them." Daunt, T. and Fox, S. "Anti-Terror Readiness Still Lacking," The Los Angeles Times. 23 February 2003: 1 Metro section.

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