Chemical Terrorism Preparedness
In the Nation’s State Public Health Laboratories

Since 2003, when the nation’s public health laboratories were first charged to increase laboratory preparedness for chemical terrorism, the Association of Public Health Laboratories (APHL) has been carefully monitoring the progress and activities of its members toward this goal. Data from these assessments have been used to document improvements, highlight gaps and focus attention on the critical challenges that laboratories are confronting as they work to provide more testing capacity to a greater number of public health and safety agencies.

This issue brief presents the results of the third annual Chemical Terrorism Laboratory Preparedness Survey together with background information on chemical terrorism laboratories and their role in the Laboratory Response Network (LRN). Data collected from this survey demonstrate that laboratories have made significant progress toward important preparedness goals. In particular, coordination with other state and federal agencies is high, as is participation in preparedness drills and exercises. However, important gaps persist. Few laboratories are equipped to test for chemical warfare agents, dangerous chemicals such as nerve or choking agents likely to be used in a terrorist attack. Many do not yet have facilities to be able to safely receive samples that contain mixed or unknown hazards — a significant gap in the front lines of terrorism preparedness.

Additionally, adequate capacity to analyze potential chemical warfare agents in environmental samples depends upon integration of the Environmental Protection Agency’s (EPA) network for environmental chemical testing—the eLRN—with the LRN, which provides capability for testing of clinical samples. EPA is working to integrate the two laboratory networks, but it is not clear when this process will be completed.

The Laboratory Response Network
Public health laboratories are the backbone of the nation’s Laboratory Response Network. Founded in 1999 by the Centers for Disease Control and Prevention (CDC), APHL and the Federal Bureau of Investigation (FBI), the LRN is the nation’s chief system for identifying, testing and characterizing potential agents of biological and chemical terrorism. When the LRN was created in 1999, its main objective was to help laboratories prepare for and respond to acts of bioterrorism. In 2003, the LRN charge expanded to include laboratory preparedness for a chemical terrorist attack. Today, the LRN is at the forefront of efforts to identify and respond to all potential terrorist hazards, including biological, chemical and radionuclear agents in clinical samples. To address the growing slate of responsibilities, the LRN has formed partnerships with the Department of Homeland Security (DHS), Environmental Protection Agency, Food and Drug Administration (FDA), United States Department of Agriculture and many other partners.
Chemical LRN
The chemical component of the LRN (chemical LRN) consists of 62 state, territorial and metropolitan public health laboratories. Laboratories are designated Level 1, 2 or 3 based on the laboratory’s capabilities, and these designations in turn define the laboratory’s network participation.

Level 3 Laboratories
All 62 LRN member laboratories have Level 3 characterization and are responsible for Level 3 activities. These include working with hospitals and other first responders in their jurisdiction to maintain competency in clinical specimen collection, storage and shipment; familiarity with chemical agents and their associated health effects; and maintaining an up-to-date coordinated response plan for their respective state.

Level 2 Laboratories
Thirty-seven laboratories are designated as Level 2 laboratories within the LRN. These laboratories are capable of detecting exposure to a limited number of toxic chemicals, such as cyanide or toxic metals, in human specimens such as blood or urine.

Level 1 Laboratories
Ten laboratories in the nation are characterized as Level 1 laboratories within the chemical LRN. These laboratories are capable of detecting an expanded number of chemical agents in human specimens, including all Level 2 laboratory analyses plus analysis for mustard agents, nerve agents and other toxic chemicals that could be used in chemical warfare. These laboratories also are intended to provide the CDC with much-needed surge capacity for handling samples in a chemical event. However, only the first five of the ten designated Level 1 laboratories have been funded to achieve and sustain Level 1 capacity.

Methods
In the fall of 2006, APHL conducted its third annual Chemical Terrorism Laboratory Preparedness Survey.
Chemical Terrorism Preparedness in the Nation’s State Public Health Laboratories

May 2007

of public health laboratories in the 50 states, the District of Columbia (DC) and Puerto Rico. Laboratories were asked to report on their capability and capacity to respond to chemical terrorism as of the most recent Fiscal Year (FY 05: August 31, 2005 - August 30, 2006).

Responses were received from 46 states and DC. Unless otherwise noted, 47 responses were given to each question. For the purposes of this report, the term “states” or “state public health laboratories (SPHLs)” will be used to refer to all respondents, including DC.

The survey was conducted using MRInterview, APHL’s web-based data repository and survey tool. Results were coded for entry into SPSS for Windows Version 15.0. Descriptive statistics were gathered for all variables. Results are reported for the following categories:
• Funding
• Testing Capability and Capacity
• Workforce
• Coordination and Response Planning
• All-Hazards Receipt and Testing.

Funding
State public health laboratories depend almost exclusively on federal funding to carry out activities related to homeland security and preparedness. Although the 44 responding laboratories support many federal agencies, the majority (88%) of federal laboratory chemical preparedness funding comes from one agency — CDC — through its Cooperative Agreement on Public Health Emergency Preparedness. In FY 05, 44 states reported receiving a total of nearly $30 million under the CDC Cooperative Agreement, a slight decrease from amounts reported by the same states last year. Grant amounts ranged from $32,313 to $1,879,564; the mean was $673,811.

In FY 05, 14 state public health laboratories also received some funding from other federal agencies to enhance their support for the respective agencies' mission-specific chemical terrorism preparedness activities, up from 9 states the year before. These funds were provided by the Department of Homeland Security (DHS) and/or the Food & Drug Administration’s Food Emergency Response Network (FERN). These funds were a significant boost for the few states that received them, amounting to an average of 25% of a laboratory’s total funding for laboratory chemical preparedness activities.

Despite the critical role that public health laboratories play in supporting first responders and civil support teams, only 6 state public health laboratories received state funding for chemical preparedness activities, down from 9 states the year before. Among the six states, state funds accounted for between 1% and 73% of state laboratory chemical preparedness funding.

Due to a lack of sustained federal and state funding, in FY 05 most states were still in the process of building essential laboratory capacity for chemical terrorism testing. Overall, states used more than 90%
of their chemical terrorism preparedness funds to recruit and retain appropriately trained laboratory personnel, acquire the needed equipment and make renovations to aging physical plants. The remainder was used for training and to purchase consultant services and supplies. Figure 3 illustrates the allocation of the FY 05 expenditures.

As technology continues to evolve, a significant challenge facing all public health laboratories is the ability to acquire new equipment for detection of chemical terrorism agents. In 2005, only 7 states (15%) reported that they were able to set aside funds for the purchase of new equipment/instrumentation to accommodate changes and upgrades in technology.

Testing of Environmental Samples

In a chemical attack, two different types of tests will likely be needed in order to direct treatment and influence decision making: (1) testing “clinical specimens”, such as blood or urine, to identify the chemical and determine who was exposed and at what concentration; and (2) testing “environmental samples” including air, water, soil, food or packaging to determine the source, route and potential extent of contamination.

Equipment and methods for testing clinical specimens and environmental samples are not easily interchangeable. Although most public health laboratories (87%) now have the ability to test clinical specimens for suspected chemical terrorism agents, their ability to test environmental samples is more limited. Very few public health laboratories are able to test for chemical warfare agents, such as vesicants (2), blood agents (12), choking agents (4), nerve agents (3) or other “incapacitating” agents (1) in environmental samples. Furthermore, their capabilities are still generally determined by their experience monitoring ongoing health threats, such as mercury, lead and polychlorinated biphenyls (PCBs) in the food or water supply.

Despite laboratories’ limited environmental chemical testing capabilities, public health laboratories continue to receive more requests for environmental chemical testing than for clinical chemical testing. Laboratories were asked to test food, letters and packages, mysterious powders, drinking water, medications and supplements, among other things. Requests came from post offices, state and federal law enforcement, first responder and civil defense organizations and even other laboratories.

Many laboratories (33%) reported that they will accept but not analyze environmental samples for chemical terrorism agents. Generally, these laboratories will forward environmental samples that need chemical testing on to an alternative laboratory, such as those under the jurisdiction of EPA, the Department of Defense or a commercial/contract laboratory, for analysis. These alternative laboratories also have varying abilities to conduct environmental tests depending upon their equipment, expertise and facilities. For example, EPA laboratories currently lack the resources to analyze chemical, biological and radiological warfare agents in most environmental samples.

The lack of funding to support laboratory testing of environmental samples for chemical terrorism agents means that there also have been no funds to
support the development of standards and procedures to ensure accurate, consistent and reliable test results across laboratories, or to train laboratory workers in safe methods for testing of chemical warfare agents. In the absence of standards, public health laboratories have adapted methods from traditional toxicology screening, clinical specimen analysis, academic, vendor and other testing protocols to test environmental samples suspected of containing chemical terrorism agents. In 2006, APHL began working with the EPA to fill this gap by developing an environmental arm of the LRN (eLRN), which will include equipment standards, testing protocols and training modules for laboratory workers.

Radiochemical Testing Capability
The National Commission on Terrorist Attacks Against the United States (9/11 Commission) concluded that detonation of a Radiologic Dispersion Device (“dirty bomb”) is one of the most likely terrorism scenarios. However, the ability to monitor the effects of a large radiation exposure incident or to investigate radiation sickness remains a challenge.

While most states report that they have the equipment needed to detect (85%) and analyze (72%) radiochemicals and radiological contaminants in samples, much of this capability appears to be driven by emergency response planning and exercises associated with nuclear power plants or drinking water testing. In fact, 30% of public health laboratories currently do not accept environmental samples for radiochemical analysis at all and only 25% currently accept non-blood clinical specimens. Of the 47 respondents, only 3 state public health laboratories now routinely perform any clinical monitoring for radiologicals.

Despite their currently limited capabilities for radiochemical testing, laboratory directors know that the identification, analysis and characterization of radiological contaminants is key to a comprehensive response to a radiologic event. Sixty-six percent reported they would be willing to undergo rigorous certification procedures to become approved under the Clinical Laboratory Improvement Amendments for emergency testing and monitoring of population

Figure 4  Laboratory Chemical Terrorism Environmental Testing Certification
exposure to radiochemicals. Given clear warning by the 9/11 Commission and other terrorism experts, resources are needed for laboratories nationwide to upgrade their radiologic testing capabilities to meet those certification requirements.

**Workforce Challenges**

An aging public sector workforce and a shrinking pool of job-seekers interested in government service, coupled with a general shortage of laboratory professionals, are critical challenges to the recruitment of highly skilled public health laboratory personnel. In 2005, the majority of laboratories (55%) employed just 1-2 doctoral and/or masters level chemical terrorism scientists.

Two thirds of state public health laboratories reported difficulty in recruiting (66%) and hiring (64%) laboratory workers, an increase over the previous year. Vacancies were particularly acute for
senior laboratory personnel: twenty six laboratories (55%) reported vacancies for at least 1 laboratorian and often 2 or 3, in chemical terrorism/radiochemical terrorism-related positions. Among the barriers to recruitment and hiring, laboratories cited as problematic the inability to offer competitive salaries to laboratory personnel, difficulty finding qualified candidates, lengthy state approval processes and hiring freezes. Laboratories also face challenges in retaining qualified personnel in the face of intense demand by clinical and other private sector laboratories. These human resource challenges are likely to intensify as demands on public health laboratory capacity and technical competence grow.

**Coordination and Response Planning**

State public health laboratories universally have established working relationships with many important preparedness partners in order to provide coordinated support for detecting and responding to chemical terrorism events. These include first responders such as members of Hazardous Material teams and the Army National Guard Weapons of Mass Destruction Civil Support Teams (WMD-CST); local, state and federal law enforcement; the military; and clinical, veterinary, agricultural and other laboratories. Joint activities include written emergency response plans; cooperation in chemical terrorism preparedness exercises and drills; and consultation and confirmatory testing on samples.

**All-Hazards Receipt and Testing**

As a measure of protection for staff and facility operations, most laboratories (85%) currently require that unknown samples be screened in the field by law enforcement or first responders for potential hazards, such as chemical, radiological and explosives, before being delivered to the laboratory. However, suspicious samples often are delivered without this prescreening, and in an emergency situation, the transportation time needed to take a sample to and from a first responder unit for prescreening could be very costly. In response, 27 laboratories (57%) have created a dedicated triage area in or near their building where unknown materials can safely be received and screened before being taken inside the laboratory. An additional 11 laboratories (23%) are planning to develop All-Hazards Receipt (AHR) Facilities. However, with the capacity for all-hazards receipt comes the need for highly specialized design specifications, screening protocols and staff training. Twenty states (43%) reported a shortage of funds to implement or fully support all-hazards receipt facilities in their laboratories. In addition, many states are awaiting soon-to-be-released federal guidance on facility specifications and triage protocol before designing or upgrading their AHR facilities.

**Conclusion**

Fast, accurate laboratory analysis to confirm or rule out the presence of potential chemical terrorism agents is vital in providing a comprehensive response to emergencies. Many federal and state agencies, including the United States Postal Service, the FBI, local law enforcement, the FDA, departments of agriculture and environmental health and municipal water suppliers, among others — all rely on state public health laboratories to identify and characterize potentially dangerous chemical agents in human tissue and/or environmental media. With continued funding from CDC, state public health laboratories have been able to enhance their chemical testing capacity to support preparedness efforts. They have also assumed greater responsibility for a high level of coordination and planning with external agencies. However, significant gaps in chemical terrorism preparedness remain. Insufficient capacity to test for chemical warfare agents; spotty environmental and radiological testing capabilities; laboratory workforce shortages and a lack of standards and protocols for safely testing chemical terrorist agents...
across the LRN all create vulnerabilities not only during terrorist events but also during other potential widespread chemical emergencies.

The Association of Public Health Laboratories is helping to address some of these gaps through collaborations with the CDC, DHS and EPA. Through these partnerships, APHL is helping provide safe and secure facilities for screening unknown samples, assisting with instrumentation purchases, training laboratorians, and developing and disseminating standardized protocols and procedures for handling and testing mixed or unknown hazards. In addition, APHL and EPA are bringing environmental health laboratories from across the nation together with state public health laboratories.

However, as expectations and responsibilities of the chemical Laboratory Response Network continue to grow, financial and logistical support from federal and state agencies that rely on the laboratory network need to keep pace. Sustained support for all laboratory chemical preparedness activities is essential to bring laboratory capacity up to the levels needed to rapidly identify and contain potential chemical threats to public safety.

Table 1 Laboratory Communication/ Collaborations with Other Agencies

<table>
<thead>
<tr>
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<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Military</td>
<td>29 (62%)</td>
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<tr>
<td>National Guard/CST</td>
<td>47 (100%)</td>
<td></td>
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<tr>
<td>HazMat</td>
<td>47 (100%)</td>
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<tr>
<td>State/Local Law Enforcement</td>
<td>45 (96%)</td>
<td></td>
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<tr>
<td>FBI/WMD Coordinator</td>
<td>47 (100%)</td>
<td></td>
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<tr>
<td>Local Public Health Lab</td>
<td>39 (83%)</td>
<td></td>
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<tr>
<td>Vet Lab</td>
<td>36 (77%)</td>
<td></td>
</tr>
<tr>
<td>Ag Lab</td>
<td>39 (83%)</td>
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<tr>
<td>Food Lab</td>
<td>38 (81%)</td>
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<tr>
<td>University Lab</td>
<td>37 (79%)</td>
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<tr>
<td>Local Hospitals/ Sentinel Labs</td>
<td>47 (100%)</td>
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Table 2 Methods of Collaborating with External Agencies

<table>
<thead>
<tr>
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<th>Yes</th>
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<tbody>
<tr>
<td>Written emergency plan in place</td>
<td>32 (68%)</td>
<td>15 (32%)</td>
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<tr>
<td>Collaborate on selection and validation of field instruments</td>
<td>20 (43%)</td>
<td>27 (57%)</td>
</tr>
<tr>
<td>Cooperate in exercise and drills</td>
<td>47 (100%)</td>
<td>0</td>
</tr>
<tr>
<td>Provide advice on sample collection/shipping</td>
<td>45 (96%)</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>Perform confirmatory testing on screened samples</td>
<td>45 (96%)</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>Provide other consultation</td>
<td>45 (96%)</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>Provide training to first responders</td>
<td>31 (66%)</td>
<td>16 (34%)</td>
</tr>
<tr>
<td>Provide funding</td>
<td>15 (32%)</td>
<td>32 (68%)</td>
</tr>
<tr>
<td>Other*</td>
<td>8 (17%)</td>
<td>39 (83%)</td>
</tr>
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</table>

1U.S. Territories include Puerto Rico, Mariana Islands, Guam, American Samoa and the U.S. Virgin Islands.
3Ibid
4Ready, Set, Respond…
5Urine, fecal and/or nasal smear