

The State Laboratory of Hygiene's Role in Terrorism Preparedness and Response

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ABSTRACT

In the fall of 2001, the national public health system found itself responding to acts of terrorism. The intentional release of *Bacillus anthracis* spores on the East Coast tested the capacity of all state public health laboratories to respond. The impact on the public health system extended to the Wisconsin State Laboratory of Hygiene (WSLH). Fortunately, participation in the National Laboratory Response Network helped the WSLH meet the challenge of 24 hour/7 days a week coverage, and subsequent federal funding increases have enabled the WSLH to expand its technical capabilities and provide training and outreach to other Wisconsin laboratories to prepare them for their roles in man-made or naturally-occurring public health emergencies.

INTRODUCTION

In October 2001, a man in Palm Beach County, Florida was diagnosed with inhalation anthrax after breathing *Bacillus anthracis* spores contained in an envelope he received through the US Postal Service. This case was important because it was the first instance of bioterrorism-related anthrax in the United States.¹ When additional anthrax-laced envelopes began appearing in other geographical locations, including a US Senate office building, it launched events that challenged the public health system across the nation. An onslaught of more than 728 powder samples were submitted to the Wisconsin State Laboratory of Hygiene (WSLH) for *Bacillus anthracis* testing between October 2001 and May 2002, including more than 230 samples during an 11-day period in mid-October. While this atypical testing volume stretched WSLH resources to a near breaking point, the WSLH was able to respond effectively

because organizational foundations had been laid several years prior.

NATIONAL LABORATORY RESPONSE NETWORK DEVELOPED

In 1999, the Centers for Disease Control and Prevention (CDC), in partnership with the Association of Public Health Laboratories and the Federal Bureau of Investigation, established the National Laboratory Response Network (NLRN).² The network consists of state and federal government laboratories, as well as non-governmental clinical laboratories, organized for the purpose of responding to both terrorism and naturally-occurring public health emergencies. While state public health laboratories are the lead agencies in the NLRN, state food, animal health, chemical, environmental, and radiological laboratories are expected to join the NLRN in the next few years. The NLRN has 4 organizational levels. Level A laboratories, also called sentinel laboratories, will likely provide the earliest detection of an intentional release of a biological agent of terrorism (BT agent); however, their major role is to rule out the presence of a BT agent and/or refer the suspected BT agent on to a Level B laboratory. Level B laboratories, also called confirmatory laboratories, provide confirmatory testing for BT agents in both clinical and environmental specimens. With state-of-the-art molecular methods at their disposal, Level C laboratories have advanced capacity for rapid identification of BT agents. Level D Laboratories (currently federal laboratories) manage the most difficult and dangerous biological agents.³ (Table 1) Taken together, the Level B, C, and D laboratories form a network of microbiology laboratories that can provide confirmatory testing support for both acts of terrorism and naturally-occurring public health concerns. State public health laboratories, such as the WSLH, are the lead confirmatory (Level B/C) laboratories in each state, and they coordinate their respective state's laboratory response to a public health event. The NLRN provides standardized shipping, testing, and interpretation protocols that allow

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Table 1. National Laboratory Response Network: Biological Response³

Level	Wisconsin Participants	Role	Requirements
A	Hospital laboratories, Public health laboratories, Zablocki Veterans Administration Hospital Laboratory	Early detection of intentional releases. Reduce number of false positives. Maximize safety.	Certified biosafety cabinet and other biosafety facilities adequate to rule-out and forward organisms.
B	WSLH, Milwaukee Public Health Department Laboratory, Marshfield Clinical Research Foundation Laboratory (pending)	Agent isolation and diagnostic testing. Minimize false positives. Protect Level C laboratories from overload.	Biosafety Level 3 facilities, and proficiency to perform confirmatory testing and characterize susceptibility.
C	Wisconsin State Laboratory of Hygiene	Rapid detection with probe technology. Molecular typing for comparison. Toxigenicity testing.	Biosafety Level 3 facilities as a minimum, and proficiency sufficient to probe, type, and perform toxigenicity testing. Evaluate reagents and tests to facilitate transfer of technology to Level B laboratories.
D	None in Wisconsin (Federal laboratories)	Detection of genetic recombinants. Banking of isolates.	Biosafety Level 4 biocontainment facilities. Maximum containment facilities with unique expertise and secure banking of biologic agents.

the information created by NLRN members to be more consistent, reliable, and timely. This network, in turn, enables public health officials, who are responsible for determining the level of public health risk and overseeing response, to more rapidly compare test results from events occurring in multiple locations across the United States. In Wisconsin, Peter Shult, PhD, WSLH Communicable Diseases Division Director, is the state's Laboratory Response Network Director.

ASSESSING PUBLIC HEALTH LABORATORY READINESS TO RESPOND

In May 2000, the Department of Justice conducted a 3-day, \$3 million bioterrorism simulation in Denver. While called a success, "...the chaos the exercise engendered revealed that the systems and resources now in place would be hard-pressed to successfully manage a bioweapons attack."⁴ Lack of training and inadequate planning were identified as 2 challenges for national and state partners. First responders, including emergency room physicians, needed to understand the symptoms of the most likely agents to be used in a biological event and how to properly handle sample collection and testing. Local and state laboratories needed to understand their roles and responsibilities with respect to sample evaluation, handling, transporting, testing, and reporting. As the lead NLRN laboratory for Wisconsin, the WSLH is charged with the responsibility of assuring that laboratory-related deficiencies are eliminated in this state.

FEDERAL FUNDS HELP TO PREPARE WISCONSIN LABORATORIES

Since 1999, federal funds have been awarded annually to the Wisconsin Department of Health and Family Services, Division of Public Health, for terrorism preparedness and response. Some of these dollars have been distributed to the WSLH to meet key national objectives, such as: 1) ensuring that all laboratories in the state are able to test for, and recognize, priority-threat agents; 2) building a multi-tiered laboratory response system; 3) developing standard operating protocols for shipping, packaging, and testing suspect samples; 4) developing standard operating protocols for communication among NLRN laboratories before, during, and after an event; 5) developing and delivering laboratory training programs based on an assessment of clinical laboratory testing capabilities; and 6) ensuring that laboratory emergency response plans are compatible with local, state, and national plans.⁵

Building on the partnership models of Wisconsin's Virus and Tuberculosis Testing Laboratory Networks, WSLH Laboratory Network Coordinator Carol Kirk has identified key contacts in each of the 124 hospital laboratories and 8 local public health laboratories in Wisconsin. Over the past 3 years, Kirk and other WSLH staff have presented many on-site or teleconference training sessions to Level A laboratory staff. In addition, City of Milwaukee Health Department Laboratory Director Steve Gradus, Zablocki Veterans Administration Hospital Microbiology Laboratory

Supervisor Thomas Wisniewski and Marshfield Clinic Research Foundation Director Kurt Reed, MD, have also conducted training sessions for laboratory professionals. Level A laboratories now have access to the WSLH response team on a 24 hour/7 days a week basis and they have been provided with written protocols to assist them in carrying out their roles in a biological emergency. All clinical laboratories are linked to the WSLH via a laboratory electronic emergency notification system. Finally, regular training events are designed to keep staff abreast of technological and scientific information related to emerging public health issues.

ENHANCED LABORATORY CAPACITY IN WISCONSIN

For nearly a decade, the Communicable Diseases Division of the WSLH has faced a declining clinical workload. Because less than 30% of the WSLH's operating revenues are from state tax dollars, the decline in program revenue workload has limited the WSLH's ability to carry out some public health activities, including broad application of new protocols and technologies. Support from the federal bioterrorism preparedness grant, however, has allowed the WSLH to expand technological capabilities that can be applied not only in a biological terrorism event, but also during other public health emergencies. This concept of dual-use has been essential in rebuilding the public health system across our nation.

Under the supervision of David Warshauer, PhD, WSLH Bacteriology Section Chief, 6 WSLH microbiologists have been trained, thus far, to perform real-time polymerase chain reaction (PCR) procedures for the highest-threat agents, using equipment acquired with CDC funds. This cutting-edge technology serves a dual purpose in that the personnel, equipment, and methods can be applied to other public health threats, such as West Nile Virus, Severe Acute Respiratory Syndrome, and, most recently, monkeypox. Pulsed Field Gel Electrophoresis (PFGE) equipment and procedures have been available since the late 1990s and have been used primarily for epidemiological tracking of foodborne and other outbreaks of public health importance. This technology, combined with the WSLH's participation in the national PulseNet PFGE data and image library, allows public health epidemiologists to genetically fingerprint clinical isolates as a means of determining whether bacteria isolated from 1 geographic outbreak location are related to those from a different location or event.

HEALTH ALERT NETWORK

In addition to the federal funds state public health lab-

oratories received to develop enhanced testing capabilities and improve coordination among laboratories, the public health system also received funding to build an integrated public health communication system called the Health Alert Network (HAN). The goals of the Wisconsin HAN are "to foster high-speed and dedicated internet connections for our local public health agencies; to create a secure web site and emergency messaging system for communications among health agencies for bioterrorism and all other public health threats; and to establish a distance learning capability to foster greater public health organizational capacity and public health professional development."⁶

The system will also provide direct electronic linkages to state agency response partners. Based on a national system architecture, the Wisconsin HAN is already providing alert messaging and other mechanisms to allow public health systems partners to gather and share information. HAN Principal Investigator Larry Hanrahan, PhD, notes that the HAN will "...one day soon provide a dynamic, real-time, 'weather channel' view of the health status of Wisconsin's communities and relay this view to other state and federal partners."⁷ The WSLH is participating in development of the HAN by extracting data from WSLH laboratory information systems and assembling the data in standard formats so that public health officials may more easily query the data as part of their surveillance and epidemiology functions. Clinicians interested in accessing the HAN can apply for privileges by logging on to www.han.wisc.edu.

CHEMICAL TERRORISM ADDRESSED

Nationally, while public health laboratories have focused on enhancing laboratory capability and capacity to address acts of biological terrorism, coordinated efforts to prepare for chemical terrorism had not received an equivalent level of funding or attention. A study completed by the Association of Public Health Laboratories (APHL) in early 2003 reported that "...three-quarters of the nation's state labs are unable to safely accept samples suspected of containing multiple hazards, such as toxic chemicals and infectious organisms. Only eight states reported having a chemical terrorism response plan."⁸ In January 2003, WSLH Director Ronald Laessig, PhD, in his capacity as chair of APHL's Environmental Health Committee, facilitated a meeting of all state public health laboratory directors and other key federal partners. The purpose of this meeting, co-hosted by the CDC, was to develop a list of actions needed for developing laboratory capacity to respond to a chemical event. Subsequent to that

meeting, the CDC indicated that federal grant dollars, originally allocated exclusively to bioterrorism, could be spent on building laboratory capacity to respond to chemical terrorism and that future federal grant funds would be earmarked to build chemical laboratory capacity. Nationally, state public health laboratories will aspire to 1 of 3 levels of chemical response capacity established by CDC. The WSLH intends to achieve a Level 2 status within the next 12 months. At Level 2, the WSLH will be expected to use Biosafety Level 2 practices, meet security standards as set forth in the Select Agents Rule, enhance Internet connectivity for rapid communication and data transfer between NLRN laboratories and public health professionals, purchase equipment, and hire and train staff to competently analyze Level 2 chemical agents or their metabolites in human specimens.⁹

Prior to the national mandate to build state public health laboratory capabilities to respond to an act of chemical terrorism, the WSLH assigned Chemist Supervisor David Degenhardt to be the WSLH Chemical Terrorism Preparedness Laboratory Coordinator. Under Degenhardt's leadership, the WSLH has completed an assessment of WSLH internal capabilities, developed a checklist of priority chemical threat agents, drafted a chemical response plan, and begun the process of building relationships with potential local, state, and national partners. In addition, the WSLH Chemical Terrorism Response Team is working with Wisconsin Emergency Management and regional Hazardous Materials (HazMat) teams to develop sample collection kits, write sample collection and transportation protocols, and provide training and education to response partners. The WSLH provided technical assistance in the selection of equipment that can be used by first responders in the field for rapid chemical identification and in the laboratory for confirmatory analysis. The efforts of the WSLH Chemical Terrorism Response Team follow the model of the WSLH Biological Terrorism Response Team that took the lead in developing a response partnership with regional HazMat teams and other first responders in late 2001.

ROLE OF CLINICIANS

Dr Donald A. Henderson, Director of the Office of Public Health Preparedness in the US Department of Health and Human Services, testified before the Senate Foreign Relations Committee on September 5, 2001 concerning the impact of bioterrorism on the American health care system. He said,

"If we do nothing more than strengthen the public health and medical care systems, we can significantly decrease the suffering and death that would follow a bioweapons attack. By being able to mitigate the consequences of such an attack, we can make ourselves less attractive targets to would-be perpetrators. And more importantly, we could improve the everyday functioning of the health care and the public health system for the general good."¹⁰

Preventing terrorist events is difficult; reducing the impact of a terrorist event is possible if systems can respond quickly and in a coordinated manner. In the early phases of an event, it is not always clear that an attack has occurred or that a health impact is naturally occurring or man-made. Either event is likely to be detected initially in local communities, including hospital emergency rooms or doctors' offices. A well-informed medical community with knowledge of possible agents and their symptoms, and effective communication systems between clinicians and public health officials are essential. The WSLH is committed to developing and sustaining partnerships with physicians and the laboratory community that supports them, so that together we can effectively respond to all emergencies that affect the health of the citizens of Wisconsin.

LOOKING AHEAD

In 1988, the Institute of Medicine reported that the public health system had "lost sight of its public health goals and...allowed the system of public health activities to fall into disarray."¹¹ In 2002, the Institute of Medicine took another look at the public health system and found that, despite progress in some areas, the public health system is still not prepared to deal effectively with the challenges of the 21st century. The recent report characterizes the public health laboratory system as "antiquated," calling upon the federal Department of Health and Human Services to provide for a strong, sustainable state-of-the-art public health laboratory system by:

- "evaluating the status of the public health laboratory system, including assessment of the impact of recently awarded grant funds that were provided to enhance disease surveillance and laboratory capacity,
- identifying funding shortfalls and allocating adequate funds to address them,
- developing a base funding level that will maintain the laboratory systems at a level capable of rapid deployment of new technologies."¹²

In Wisconsin, federal funds are being leveraged to enhance statewide laboratory capacity. In the coming year, the WSLH will acquire instrumentation and expertise to achieve Level 2 status with respect to chemical terrorism preparedness. Laboratory leaders will participate on state and national committees to assure coordination, including working with the CDC National Center for Environmental Health as it plans the development of self-contained, modular facilities for screening unknown environmental or clinical specimens. Further development of the Wisconsin Laboratory Response Network will occur by using distance learning technologies to reach more partners in real-time, by strengthening state and regional planning, by bringing hospital laboratory personnel together with regional public health consortium leaders, and by developing cooperative agreements with other state laboratories such as those at the Diagnostic Veterinary Laboratory and the Department of Agriculture, Trade, and Consumer Protection. The ultimate goal is the development of a seamless system of laboratory capabilities in Wisconsin that will enable public health system partners to address more effectively naturally occurring or man-made threats to the health of our population.

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