

Developing Laboratory Networks: A Practical Guide and Application

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SYNOPSIS

The role of the public health laboratory (PHL) in support of public health response has expanded beyond testing to include a number of other core functions, such as emergency response, training and outreach, communications, laboratory-based surveillance, and laboratory data management. These functions can only be accomplished by a network that includes public health and other agency laboratories and clinical laboratories. It is a primary responsibility of the PHL to develop and maintain such a network. In this article, we present practical recommendations—based on 17 years of network development experience—for the development of statewide laboratory networks. These recommendations, and examples of current laboratory networks, are provided to facilitate laboratory network development in other states. The development of laboratory networks will enhance each state's public health system and is critical to the development of a robust national Laboratory Response Network.

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The public health laboratory (PHL) is critical to the public health response capability of each state and, by extension, the nation. Traditionally, the PHL has been the sole response laboratory for public health emergencies; however, a new model has emerged, exemplified by the Laboratory Response Network (LRN), a national network of laboratories charged with identifying and characterizing agents of terrorism and other threats to public health.¹

In this new model, the PHL leads a network of clinical and other agency (e.g., food testing, veterinary, and local public health) laboratories to support public health response. The development of a robust national network of laboratories is, however, dependent on the existence of such laboratory networks within each state. The development of these statewide laboratory networks is, in turn, dependent on state-specific leadership and resources. This article describes the process of laboratory network development in Wisconsin and the application of the laboratory network model to specific public health issues.

LABORATORY NETWORK DEVELOPMENT STEPS

Much has been written about the theory of collaboration in network development. Marshall et al. provide an excellent summary in this issue of *Public Health Reports*.² However, laboratory network development in Wisconsin did not follow a theoretical construct or strategically mapped course, but, rather, proceeded in a hopscotch pattern, taking advantage of opportunities as they were presented, adopting a learn-as-you-go attitude, and making corrections as needed. The key steps presented in this article (Figure 1) were identified during laboratory network development in Wisconsin and have been documented retrospectively.³ This information should be applicable to other states, allowing for state-to-state variations in details.

Step 1. Identify a team that will lead the development of the laboratory network

A team of people is optimal for planning, leading, and maintaining the networking effort. Reliance on a single individual leaves the organization vulnerable to retirement, sickness, vacations, and other disruptions and leaves the designated individual without consistently engaged staff with whom to share ideas or tackle problems. Team members should include the following positions: (1) laboratory network coordinator/laboratory outreach coordinator, (2) laboratory training coordinator, (3) technical expert, (4) administrative liaison, (5) clerical staff member, (6) epidemiologist,

Figure 1. Steps to building a statewide laboratory network of public health and private-sector microbiology laboratories

1. Identify a team that will lead the development of the laboratory network.
2. Define the purpose, short-term goals, long-term vision, and potential benefits of the network.
3. Develop a broad proposal for the public health laboratory administration.
4. Plot the course.
5. Identify the potential needs and resources for the development of the laboratory network.
6. Make contact with potential partner laboratories.
7. Select and conduct laboratory network development activities.

and (7) information manager. Descriptions of each of the network development positions are provided in Figure 2.

Step 2. Define the purpose, short-term goals, long-term vision, and potential benefits of the network

The purpose, goals, and vision of the laboratory network must be consistent with the mission, vision, and plans of the PHL. The purpose of the laboratory network should fulfill one or more of five basic functions: (1) emergency response, (2) communications, (3) training, (4) reference testing, and (5) data sharing.

The short-term goals of the network should be realistic, so as not to outpace capabilities and produce early disappointment or failure. These goals should be considered preliminary, however, because they will be adjusted as the network develops and input is received from network partners. It is important that these goals include a measurable outcome, so that clear evidence of success can be documented.

In contrast to the short-term goals, a loftier, long-term vision or “grand dream” that could help others see the potential of the laboratory network also should be defined. This vision ensures that team members and partners will have a parallel, if not identical, view. It also should motivate the team and may help market the network to others.

The potential benefits of the network for clinical laboratories, the PHL, and the public health system should be described and documented. These should include concrete, measurable outcomes, as well as more abstract, less measurable outcomes (e.g., relationship building). The statement of potential benefits, when combined with the purpose and vision statements, will provide a document that could be useful in marketing

Figure 2. Responsibilities and characteristics of statewide laboratory network development team members

<i>Position</i>	<i>Description</i>
Laboratory network coordinator/ laboratory outreach coordinator	<ul style="list-style-type: none"> • Leads the effort • Communicates with the laboratories • Advocates for the network • Understands the role of the PHL and is: <ul style="list-style-type: none"> — A laboratorian with strong communication and listening skills — Familiar with the diagnostic/clinical laboratory — Open to others' ideas
Laboratory training coordinator	<ul style="list-style-type: none"> • Assesses laboratory training needs • Presents relevant learning opportunities • Arranges meetings, teleconferences, and workshops
Technical expert ^a	<ul style="list-style-type: none"> • Provides technical guidance to laboratories • Acts as faculty for training opportunities • Provides expertise for survey development • Must buy in to the concept of a laboratory network • Must appreciate the role of the clinical laboratories
Administrative liaison	<ul style="list-style-type: none"> • Establishes a direct communication line to the PHL's leadership • Communicates with staff at the PHL to garner support
Clerical staff member	<ul style="list-style-type: none"> • Provides meeting minutes, database and spreadsheet maintenance, and mailings
Epidemiologist ^b	<ul style="list-style-type: none"> • Assists in planning and implementing the collection of laboratory data for surveillance purposes • Advocates for development and use of the laboratory network in epidemiologic studies
Information manager ^b	<ul style="list-style-type: none"> • Advises on systems and capabilities to manage information gathered from laboratories • Provides input on the most effective mechanisms to communicate with laboratory partners and accumulate and share data • Advocates for laboratory network needs

^aRepresentatives in the technical areas of the PHL

^bThis position may be added after the initial planning and may serve as a consultant to the team.

PHL = public health laboratory

the network to other laboratories and budgeting partners.

Step 3. Develop a broad proposal for the PHL administration

The administrative liaison team member should present the documentation previously developed (i.e., purpose, short-term goals, vision, and benefits) to the PHL administration. The presentation should also include a general description of the potential members of the network (e.g., all microbiology laboratories that perform cultures), and an estimate of the costs, potential funding sources, and other support required. After sharing the proposal and garnering support, it will be helpful if a representative of administration informs other PHL staff of network development plans, to facilitate staff acceptance and support.

Step 4. Plot the course

Develop a "road map" based on the purpose and goals already defined for the laboratory network. Development of this road map involves a number of tasks.

Define the membership of the network. A roster of potential member laboratories can be developed using lists from the state's hospital association, its regulatory (e.g., Clinical Laboratory Improvement Amendments) office, team members' laboratory contacts, and/or a national database maintained by the Division of Laboratory Systems at the Centers for Disease Control and Prevention.

Define what will be expected of network laboratories, including the state PHL. A number of expectations of the network laboratories need to be considered. Member laboratories may be expected to provide test result summaries, microbial isolates, completed surveys, and availability of training/meeting facilities. The PHL may contribute such resources as statewide data compilations, training opportunities, meeting/training facilities, and funding support. Request what is needed from member laboratories, but be fully aware that the more that is asked for, the more cautious laboratories may be about your proposal and, thus, the more reluctant they may be to participate. Be mindful of budget and staff

constraints when making commitments and promises for PHL contributions.

Define the structure of the network. The organizational structure of the network should be defined to minimize misunderstandings and miscommunications. The network can be designed to be a voluntary collaboration of equal partners or a voluntary collaboration with the state laboratory at the center. A different model is a formal hierarchical organization with the state laboratory at the top, with laboratory membership and participation defined by contracts or memoranda of agreement. Another task is determining how decisions will be made or priorities will be established. As the network matures, this structure may need to be redefined to reflect changes in the membership or the political environment. Whatever the structure, it is important that laboratories are engaged and feel a sense of ownership and inclusion. One cautionary note: establishing formal agreements could cause delays in network development, as the agreements may require legal review.

Define the first step for the network. The preliminary short-term goals defined previously will determine what the first step will be. It may be (1) conducting a meeting with all or some laboratory representatives, (2) visiting some of the key laboratories to establish relationships and build a core group, (3) collecting a specific set of data from laboratories, or (4) surveying laboratories to identify their capabilities and needs. Some one-on-one contact, taking the initiative to visit laboratories, can provide a real boost in building relationships and can signal a genuine interest in network laboratories and their opinions. One note of caution, however: actual contact with member laboratories should occur only after a clear statement of purpose and network development plans have been shared.

Step 5. Identify the potential needs and resources for the development of the laboratory network

At this point, one must take stock of what is needed and what is available to take the action that was identified in previous steps. An example of a needs and resources matrix, to be filled out by checking off or placing comments in the appropriate boxes, is provided in Figure 3.

Step 6. Make contact with potential partner laboratories

Decide whether to contact all of the laboratories in the proposed network or a smaller test group, based on the team's perception of the receptiveness of the laboratories. If there is uncertainty, select a test

group to develop the approach plan. When visiting or contacting laboratories, it is important to stress that the visit/contact has no regulatory or inspection connotations.

Step 7. Select and conduct laboratory network development activities

There are a number of potential network development activities for each of the basic network functions: emergency response, communications, training, reference testing, and/or data sharing. The team, perhaps in consultation with laboratory network members, must decide which activities are most appropriate, based on the specific circumstances. Lists of potential activities can be found in Figure 4.

EXAMPLES OF LABORATORY NETWORKS IN WISCONSIN

The development of three very active and dynamic laboratory networks in Wisconsin followed the steps described in this article. Each of the networks followed a different path in its development but benefited from the lessons gleaned during previous network development activities.

Laboratory-based virus surveillance in Wisconsin

The purpose of Wisconsin's laboratory-based virus surveillance⁴ is to monitor the activity of circulating viruses, detect new strains of viruses, and maintain a repository of isolates for future study, with an emphasis on influenza surveillance. Viral surveillance in Wisconsin has evolved since the early 1990s, initially involving telephone calls and fax reports with 10 virology laboratories and gradually incorporating more than 130 sites that perform rapid antigen detection tests.

These laboratories and testing sites provide weekly reports of testing and send selected samples to the Wisconsin State Laboratory of Hygiene (WSLH). The WSLH performs confirmatory and specialized testing of samples, and analyzes and compiles the testing data with added commentary for reports to participants, state epidemiologists, and others. The WSLH also posts reports and graphs of the data on its website and provides information about test limitations, result interpretations, and surveillance activities in annual mailings and audio conferences.

Laboratory-based mycobacteriology surveillance in Wisconsin

The Wisconsin Mycobacteriology Laboratory Network (WMLN)⁵ is a statewide network of Wisconsin laboratories that perform mycobacteriology, including

Figure 3. Potential needs and resources matrix for statewide laboratory network development activities

Network activity	Potential logistical need	Resource availability				
		Not applicable	Available at public health laboratory	Can acquire	Need to address	Possible source
Communications	Group e-mail capability					
	Blast fax capability					
	Laboratory contacts					
Data sharing	Data management staff					
	Information systems support					
	Data receiving					
	Fax					
	Web-based					
Training	Teleconference capability					
	Quiet room					
	Telephone equipment					
	Teleconference service provider					
	Funding					
	Meeting capability					
	Facility					
	Refreshments					
	Audiovisual equipment					
	Materials production					
Communications						
Faculty/presenters						
Funding						
Reference testing	Workshop capability					
	Facility					
	Materials production					
	Faculty					
	Communications					
	Funding					
Reference testing	Refreshments					
	Sample collection supplies					
	Sample transport					
	Courier					
	Fee-exempt testing					

tuberculosis (TB), testing. The WMLN was established after a 1998 task force of Wisconsin health-care and laboratory professionals from both the public and private sectors developed recommendations for improvements in TB laboratory testing in Wisconsin. The most significant recommendation of the task force was to develop a statewide TB laboratory network, with the primary objective of assuring consistent, high-quality testing by diagnostic laboratories. The WMLN provides (1) a means for ongoing assessment of TB laboratory practices and capacity in Wisconsin, (2) a means to evaluate and implement testing algorithms on a statewide basis, (3) a conduit to relay technical and result-reporting information to Wisconsin laboratories, (4) a mechanism to provide laboratory-based surveillance, and (5) a mechanism to save and characterize

all *Mycobacterium tuberculosis* (*M. tuberculosis*) isolates in a central repository at the WSLH.

Wisconsin Clinical Laboratory Network

The WSLH led the development of and coordinates the Wisconsin Clinical Laboratory Network (WCLN),⁶ a dynamic and highly functional network of the state’s clinical laboratories. The purpose of the WCLN is to provide support for clinical laboratories to ensure timely and effective laboratory response to public health needs, including emergency preparedness, disease surveillance, laboratory diagnostics, training and education, and communications.

The WCLN was originally developed following the model of the LRN as a communications network to provide information and inform clinical laboratories

of emergency response needs. With the input of laboratories and a clinical laboratory technical advisory group, this network has evolved to address training needs, communications, and public health surveil-

lance, in addition to emergency preparedness. Most WCLN laboratories are active participants in laboratory-based influenza surveillance and foodborne outbreak detection.

Figure 4. Potential statewide laboratory network activities

<i>Function</i>	<i>Activity</i>
Communications	<ul style="list-style-type: none"> • What is the purpose of your communications network? <ul style="list-style-type: none"> — Emergency notifications — Training opportunity announcements — Laboratory updates — Information exchange among laboratories • What will be the format of your communications? <ul style="list-style-type: none"> — List server — Periodic newsletter — E-mail — Fax • What resources will be required to maintain the communications network?
Training	<ul style="list-style-type: none"> • Have you verified the need for the training? • Have you assessed the interest in attending the program? • What is the best format for this training? <ul style="list-style-type: none"> — Audio conference or Web conference — Hands-on workshop — Series of in-person presentations • Is this training available elsewhere? • Who will be the faculty for this program? • Where will the program be held? • Where will you find the materials to use? • What funding is necessary or available? • Will there be a registration fee? • How will the program be advertised?
Reference testing	<ul style="list-style-type: none"> • For which agents will testing be provided? • What testing capability and capacity is available at your laboratory? • Has the need for this testing, either by public health or clinical laboratories, been verified? • What are the requirements for sample submission? • Will there be a fee for the testing? • Will fee-exempt specimen collection supplies and transport be provided? • Will results be reported and, if so, when, to whom, and by what method? • Will there be additional data-management requirements?
Data sharing	<ul style="list-style-type: none"> • What information is needed? <ul style="list-style-type: none"> — Laboratory contact — Laboratory capabilities — Laboratory training needs — Laboratory test data for surveillance • How frequently do you need to collect the data? • What is the best data collection mechanism? <ul style="list-style-type: none"> — Fax — Paper — Web-based survey • Who will analyze the data? • Will you share summary data with the laboratories?
Emergency response	<ul style="list-style-type: none"> • Identify sentinel laboratories. • Identify two points of contact within each laboratory and their preferred means of communication. <ul style="list-style-type: none"> — Who will maintain the contact list? — Do you have blast fax capability? • Define the laboratory emergency response protocol. • How will you distribute the emergency response protocol to laboratories?

ISSUES IN LABORATORY NETWORK DEVELOPMENT AND MAINTENANCE

The development of these networks has taken years of effort and substantial financial commitment. Maintenance of the laboratory networks likely will be even more costly. Even after the initial development, continuing effort is required to sustain the network and deal with the issues that could interfere with its growth and development. During the 17 years of network development in Wisconsin, we have identified a number of critical issues to be addressed, including funding, staff turnover, training needs, complacency, flexibility, and changing technology. Unfortunately, we currently don't have all of the answers in addressing these issues.

As might be expected, the primary issue is, and likely will continue to be, funding. Costs must be covered for meetings, mailings, staffing, training activities, reference testing, and data management. Emergency preparedness funding may have covered initial laboratory network activities, but that funding is likely to diminish. Under these circumstances, it is important to confirm the commitment of the PHL and the public health department to develop and maintain the network and identify other resources that could be used to support it.

Beyond funding, staff turnover at both the PHL and the clinical laboratories will have a significant impact on sustainability. The primary issue that will need to be addressed is how the laboratory network coordinator, other members of the laboratory network development team within the PHL, or new clinical laboratory contacts committed to the network will be identified and replaced in the event of resignation or retirement. Moreover, this turnover will no doubt affect the personal relationships that have been built and that create the sense of connection between the clinical laboratories and the PHL. These relationships will take considerable time and effort to rebuild.

Training needs are an increasingly important issue in any laboratory network. The PHL and network members must decide who has the primary responsibility to continue to address those needs for all clinical laboratories within the network. If the PHL accepts this responsibility, the questions will be, "How can it best assist laboratories with their training needs?" and "How can this effort be sustained?" Challenges will include making available national resources, knowing that many laboratories cannot afford to access them, or helping laboratories maintain proficiency in procedures or agents that are rarely encountered (e.g., agents of bioterrorism). In addition, the PHL must consider its own training needs related to laboratory outreach, in

addition to training needs related to technical skills and knowledge.

Over time, as a laboratory network matures, another challenge will be to keep laboratories engaged in the network and stave off or overcome the complacency that is almost certain to occur. Clinical laboratories and PHLs—and, more specifically, their representatives and staff—will need to remain engaged in the network, active in network activities, and responsive to network and/or public health needs. Ensuring this engagement while maintaining the balance between network needs and individual laboratory responsibilities and activities will be a difficult but necessary task. Moreover, the network will need to retain sufficient flexibility to ensure it can meet the everyday needs of the network members and public health, respond to public health emergencies, and adapt to the changing purpose of the network.

Finally, changing technology in clinical laboratories and PHLs—and even in nontraditional testing sites or the home—will impact the character and role of laboratory networks and PHL-based surveillance. The advent of commercially available rapid tests for influenza and other agents has allowed widespread testing at both traditional clinical laboratories and more nontraditional sites, including physician offices and long-term care facilities. It is critically important that states be capable of identifying this expanding universe of testing sites to communicate with them for surveillance and emergency response purposes. These and other changes in technology will also affect training and communication needs and audiences. If it is the responsibility of PHLs to identify these testing sites and provide them with similar resources and support provided to traditional laboratories to address these needs, even more funding and resources will need to be secured.

Despite the differences among them, all PHLs share a variety of roles and responsibilities, which are called the Core Functions and Capabilities of State Public Health Laboratories (hereafter, Core Functions).⁷ Among the Core Functions that relate directly to networks with clinical laboratories are those involving emergencies, outreach, reference testing, surveillance, laboratory data, and training. Clearly, this is an evolution beyond the concept of the PHL as only a testing facility.

In fact, the most fundamental role of PHLs, as with all laboratories, is to provide laboratory test data. These data can be acquired through on-site testing at the PHL or through the collection of test data and/or samples from other laboratories. It is in the collection of data and samples from various testing sites that laboratory

networks provide concrete benefits to everyday public health. These data clearly need to be maintained.

CONCLUSIONS

The challenges facing the development and maintenance of laboratory networks, now and in the future, are many. However, the rewards provided by a functioning laboratory network are at least as numerous. In Wisconsin, we have noted increased involvement of testing sites in influenza surveillance and increased submission of isolates to monitor for foodborne disease outbreaks. Less quantifiable, but just as important (to us), are the anecdotes we have heard from laboratories that they are now more closely connected to public health and to the state laboratory. Meeting these challenges will result in visible and substantial improvements in our public health systems, at both the state and national levels.

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