The Laboratory as a Model Public Health Function

I. Introduction

As early as 1888, only 12 years after Robert Koch proved for the first time that a specific microorganism caused a specific disease, public health laboratories have existed to protect Americans' health. Diphtheria and tuberculosis were among the early challenges for which these laboratories made important and long-standing contributions. Although Rhode Island, Michigan and New York can claim rights to the very first state laboratories, 47 state health departments operated laboratories by 1914. The typical laboratory then performed human diagnostic tests for infectious diseases including diphtheria, typhoid fever, TB, malaria and rabies, as well as bacteriological analyses of water supplies, milk and foods. Many manufactured antitoxins and vaccines, and as many as 20 laboratories conducted research. (Source: Valdiserri, R. O. 1993. Temples of the Future: An Historical Overview of the Laboratory's Role in Public Health Practice. *Annual Review of Public Health*. 14:635-48.)

Over the years, little has changed with respect to states' interest in disease control and prevention. Laboratories have become increasingly essential in the early diagnosis and clinical confirmation of infectious diseases. In the 1990's every state and territory relies on their public health laboratory to perform bacteriology, virology, immunology and environmental microbiology. The vast majority also perform mycology, parasitology, clinical chemistry (including neonatal screening), environmental chemistry and toxicology. Many are involved in applied or basic research. (Source: ASTPHLD. 1993. *Consolidated Annual Report on State and Territorial Public Health Laboratories, Fiscal Year 1991*. Washington, D.C.)

It wasn't until 1946 that the U.S. Public Health Service established the Communicable Disease Center (CDC) from the nucleus of the Office of Malaria Control in War Areas, Atlanta, Georgia, to work with state and local health officials in the fight against malaria, typhus and other communicable diseases. (Souce: CDC Fact Book, 1994).

Public health laboratories are currently defined as a core function of public health. Their mission, which is to promote contributions of laboratories in support of disease prevention and health promotion initiatives, epitomizes the public health mission. ASTPHLD and CDC share these principles; but in so doing today, share the challenge of bridging the "health care" and "health promotion" gap.

Between 1981 and 1991, U.S. health care expenditures increased from $290 billion to over $750 billion per year. During the same time, expenditures for population-based public health initiatives rose at a similar rate from $3.5 billion to $7.6 billion. Using HHS estimates, therefore, public health spending accounts for about 1% of total health care expenditures. (Source: USPHS. 1993. *Health Care Reform and Public Health - A Paper on Population-Based Core Functions*. Washington, D.C.). The state public health laboratory share of the total public health spending is currently estimated at approximately 3-5% based on figures published by the Public Health Foundation between 1989 and 1994. These laboratory estimates include

revenues and expenses from state, local, federal, fees/reimbursements and other sources, and would approach $600 million per year. (Source: Public Health Foundation. 1994. *Measuring State Expenditures for Core Public Health Functions*. Washington, D.C.)

For this modest investment in laboratories, state and federal governments are making an exceptionally cost-effective investment in public health. This represents a form of public health "insurance" with unparalleled public value.

Consider, that without public health laboratories in 1992:

* 8,600 rabid animals would have gone undetected in our communities.

* 4,000,000 babies would not have been tested for treatable but disabling diseases such sickle cell, PKU or serious thyroid deficiencies.

* 4,000,000 individuals would not have been tested for HIV exposure.

* 100,000 women would not have been diagnosed and treated for chlamydia infection.

* 2,500,000 water samples would not have been tested for contamination with human pathogens or toxic substances.

* 50,000 cases of salmonella food poisoning would have gone unconfirmed.

One important function of public health laboratories is to perform tests aimed at preventing diseases. By emphasizing disease prevention testing in communities, the nation's health leadership has access to high quality, accurate, uninterrupted, publicly-accountable health assessment information.

II. Prepared Today For Health Threats Tomorrow

In addition, public health laboratories assume a leadership role in conjunction with medical, environmental, and public health officials in responding to emerging health threats affecting various populations in the United States. Recent examples include such issues as:

* Diagnostic aspects of serious and often deadly emergent health threats like HIV, Hantavirus, drug resistant tuberculosis, Legionnaire's disease, Lyme disease, cryptosporidiosis, cholera, chlamydia and other sexually transmitted diseases, lead poisoning, and others have been managed and coordinated effectively on a national scale.

* Quality standards of clinical and environmental laboratory testing have improved through programs such as personnel training, performance assessment, licensure, certification, research and development.

* Communicable disease information is transmitted rapidly to local, state and national health decision-makers through an adaptable, enhanced electronic communications and surveillance network. Utilization of this health status information allows health leaders to respond to early warnings of possible epidemics.

* Special populations, such as the indigent and underserved, have been afforded access to health services otherwise unavailable in the private sector.

* Through prevention-oriented testing and screening, state public health laboratories effectively reduce the our nation's financial burden associated with disease by a) ensuring early detection and treatment; b) recommending counseling aimed at preventing disease transmission; c) educating the public about health threats; d) monitoring the quality of testing.

III. A Cost-Effective Public Function

The cost savings of public laboratories is analogous to the cost savings associated with effective immunization programs -- where immunization programs are shown to save $10 for every $1 spent, public health laboratory testing represents the basis for determining which diseases require population-based health interventions. A few examples include:

* **Newborn Screening:** The U.S. government has determined that for every $1 spent in screening newborn babies for metabolic disorders, nearly $9 in medical treatment costs are avoided. Since 4 million babies are screened each year, that results in a savings of $36 million per year.

* **Chlamydia:** In 1991, 9% (108,000) of chlamydia tests conducted in state public health laboratories showed positive results. Undetected, untreated patients can develop medical complications such as pelvic inflammatory disease, costing an estimated $4,300 to treat. The cost savings associated with this testing ranges from $100-400 million per year.

* **HIV/AIDS:** State laboratories conduct over 4 million HIV tests annually, at a cost of about $10/test. With nearly 90,000 cases of AIDS reported in 1993 (based on new CDC case definition), the importance of high risk individuals knowing and understanding their HIV status is prerequisite to effective HIV control. The U.S. Department of Health and Human Services estimates the lifetime medical costs (excluding lost productivity) for each AIDS case to be $100,000. If 10% of new HIV infections could be avoided by preventing exposure, the cost savings would approach $1 billion per year.

* **Rabies:** Public health laboratories perform about 80,000 rabies tests annually in the U.S., most following contact between a suspected rabid animal and a human. In 1992 these tests confirmed 8,589 rabid animals. Thus, by ruling out rabies using a $50 laboratory test, over 71,000 individuals avoided the $1,500-4,000 cost for human rabies prophylaxis. This translates into savings of over $100 million annually.

* **Cryptosporidium:** Over 2.5 million water samples are tested in public health laboratories annually for bacterial and other contamination. A 1992 water-borne epidemic (cryptosporidium protozoan) in Milwaukee resulted in 400,000 individuals suffering some ill-effects, and about 50 dying. Effective water testing and treatment can prevent this type of event.

* **Lead Poisoning:** Studies indicate that 17% of preschool children have blood lead levels exceeding 10-15 micrograms/dL. Estimates suggest that for every 10 micrograms/dL of blood lead poisoning, children lose 4-5 IQ points. Blood lead testing (screening) of children affords an opportunity to remediate children's environment to reduce their exposure and improve their cognitive ability.

* **Cancer Prevention:** Public health laboratories test water, soil, and air for known cancer-causing agents including pesticides, radiation, asbestos, and many others. In the U.S., cancer is attributed to 22% of all deaths, and is, economically, the most important health problem. Assessing the environment for agents which are known to cause cancer or reproductive disease is perhaps the most important prevention function of public health laboratories. By identifying carcinogens in the environment, public health laboratories help reduce the incidence of cancer in our communities.

IV. Laboratories As A Model Public Health Function

One very useful and effective method for characterizing public health functions was reported by the Institute of Medicine in 1988. Using this method, each public health function is classified into one of three broad categories: a) assessment, b) policy development, or c) assurance. Adapting this system for public health laboratories, one can demonstrate the laboratories' comprehensive role with respect to each function.

Assessment: Public health laboratories analyze human and environmental specimens of profound public health interest, and initiate investigations into remarkable findings. This surveillance role is distinct from most non-government laboratory providers whose missions are for-profit, are outside the public health infrastructure, and lack accountability for prevention-oriented, population-based health management.

Policy Development: Public health laboratory personnel possess unique qualifications to advise policy makers on technologic advances or limitations in implementing new policy. Effective implementation of new public health policy may be contingent on available technologies, especially their speed, accuracy, reliability, and cost.

Quality Assurance: The public health laboratory role in quality assurance ranges from managing or participating in clinical and environmental laboratory

improvement and regulation, to directly providing clinical laboratory tests (services) supporting public programs for the indigent, uninsured, or other special populations.

"CHART A"

Public Health Laboratory Function	Examples/Comments
ASSESSMENT:	
Monitoring Disease Patterns in Communities	Supporting investigations of public health threats such as childhood lead poisoning, HIV transmission, Hantavirus, or tuberculosis
Protecting Safety of Food, Dairy, and Agricultural Products	Checking for Salmonella food poisoning, E. coli or pesticide contamination
Screening Newborn Babies for Disease	Sickle cell disease, thyroid deficiencies, and PKU testing in 4,000,000 babies each year
Diagnosing and Controlling Infectious Disease	Detecting and reporting sexually transmitted diseases such as HIV, syphilis, chlamydia; testing for Legionnaires' disease, hepatitis
Ensuring Safe Drinking Water, and Other Environmental Factors	Test toxic or microbial contaminants in drinking water, soil, air. Examples are lead, cryptosporidium, PCB's, asbestos, petroleum, radioactivity
Offering "Reference" Testing to Support Hospitals, Clinics, etc.	Public health laboratories provide testing expertise for unusual or unconfirmed results generated in hospitals or clinics.
Supporting "Special" Populations	Public health laboratories are able to provide clinical laboratory tests for individuals or groups who are underserved.

"Chart B"

Public Health Laboratory Function	Examples/Comments
QUALITY ASSURANCE	
Training and Education	Providing and participating in training, especially relating to evolving analytic technologies.
Monitoring Quality of Laboratories	Offering laboratory improvement programs which physicians' offices, clinical, water testing, or other laboratories may enroll and be evaluated.
Scientific Expertise, Testimony	Advising state and federal legislators, prepare written recommendations, and participate on public health and/or scientific committees.
Public-Private Outreach	Participating scientific forums with private-sector leaders in order to develop solutions to critical health issues.
Disaster Preparedness	Agreements between laboratories can assure continuing services in emergencies. Many laboratories have contingencies to ensure services in case of floods or earthquakes.

"Chart C"

Public Health Laboratory Function	Examples/Comments
POLICY DEVELOPMENT	
Developing Laboratory Practice Standards	Recommending changes or improvements in analytic or quality assurance practices. Recent examples involve HIV diagnostic criteria, sample collection procedures for lead poisoning in children, and protocols for TB testing clinics.
Year 2000 Health Planning	Strategic planning to define and address laboratory aspects of state and national health objectives for the year 2000.
Research and Development	Evaluating new analytic technologies before use in public health settings; recommending development of new methods or instruments

V. The Challenge to State and Federal Leadership

Any laboratory supporting the public health mission of disease prevention or health promotion is a public health laboratory. This would include all CDC laboratories, many more HHS, EPA or other federal laboratories, and any state, county or city laboratory which provides clinical or environmental laboratory services. Recent changes in the U.S. health system would suggest that private laboratories and even our homes are becoming sites to conduct disease monitoring or prevention practices. Technologic advances will assure this trend continues.

Public health laboratories have been a showcase of leadership and innovation in public health practice. Coordination of state and federal public health laboratories has been and continues to be prerequisite to public health's continued success in building safer communities for our infants, children, teens, adults and maturer populations. But the stability of this system is threatened by changing economic, social and political environments.

Public health laboratories have a direct impact on every American, everyday. Their personnel maintain an on-going preparedness, capable of immediate response to emergent health threats. By focussing on preventing disease, these laboratories help save lives, eliminate suffering, and reduce medical costs associated with preventable sickness or death. They represent a model public health function -- one which cross-cuts multiple boundaries by performing assessment, policy development and assurance.

ASTPHLD and CDC have this opportunity to assess their effectiveness in accomplishing their missions. Is our partnership, communication and coordination strong? Are we assessing and reporting the cost-benefit of our functions? Are we promoting effective management, leadership and decision-making for a healthier national health system?

"In preparing for the 21st century, we must renew and strongly support those activities and policies enacted at the beginning of the 20th century that have provided us with an expectation for a current standard of healthy living, an improved environment, and extended longevity. The gate-keepers of healthy communities are the dedicated professionals of a well-supported public health system." (Source: ASTPHLD. 1993. *Task Force Report on The Public Health Laboratory -- A Critical National Resource*. Washington, D.C.)

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