Massachusetts Department of Public Health

State Laboratory Institute

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Foodborne Illness

by Harvey George

Complaints alleging foodborne illness are referred to the Department of Public Health Foodborne Illness Investigations Committee. This Committee is comprised of representatives from the Bureaus of Laboratory Science, Communicable Disease Control and Food and Drug. The State Laboratory supports foodborne illness investigations and safeguards the public from foodborne illness by

1. analyzing implicated foods for the presence of harmful bacteria or extraneous substances.

2. monitoring milk, frozen deserts and shellfish to assure freedom from harmful bacteria and compliance with safety standards.

The Laboratory routinely identifies pathogenic organisms from both clinical specimens and suspect foods. Bacterial organisms that are often implicated in foodborne disease include *Bacillus cereus, Campylobacter spp., Clostridium spp., Escherichia coli* O157:H7, fecal coliforms, *Listeria spp., Salmonella spp., Shigella spp., Staphylococcus aureus, Vibrio spp.,* and *Yersinia spp*.

Historically, methods that have been used to subtype bacteria, e.g., *Salmonella enteritidis*, include serotyping, bacteriophage typing, antimicrobial susceptibility testing, plasmid profile analysis (including restriction digest analysis of plasmid DNA), and multilocus enzyme electrophoresis. Although each of these methods has demonstrated utility in specific circumstances, none has shown adequate sensitivity or ease of inter-laboratory transferability to be useful in all outbreak investigations. The application of pulsed-field gel electrophoresis (PFGE) as a standard tool for genomic characterization has imparted a much higher level of precision to epidemiologic investigations. New instrumentation and software has improved the efficiency and standardization of PFGE analysis, which has led to more routine use in public health laboratories.

The CDC has designated the Massachusetts State Laboratory Institute as a regional laboratory for *E. coli* O157:H7 genotyping. As such, our responsibilities include PFGE analysis of the various strains of this bacterium in the Northeast region, maintenance of a strain library and support of the national PulseNet database.

PFGE analysis is used for foodborne related outbreak investigations caused by *Salmonella spp., Listeria monocytogenes, Shigella sonnei, Escherichia coli* O157:H7 and other enteric pathogens. Results of one of these investigations, involving a foodborne outbreak at a suburban restaurant, established that it was the same clonal strain of *Salmonella javiana* that was recovered from food, foodhandlers and patrons.

Paralytic Shellfish Poisoning

by Julianne Nassif

The State Laboratory Institute will soon begin its annual 'seafood monitoring' program for the marine biotoxins, which are usually found as contaminants in mussels and clams and are associated with paralytic shellfish poisoning (PSP). Biotoxins are naturally occurring chemical compounds produced by some marine phytoplankton and released into the surrounding water. Molluscan filter-feeding shellfish, such as mussels and clams, may accumulate high levels of these toxins in their tissues, because large volumes of water pass through their systems during feeding.

An acute human illness, PSP, can result from consumption of the contaminated shellfish, which contain a suite of potent neurotoxins known collectively as saxitoxins. Saxitoxin and the related alkaloid toxins associated with PSP are produced in local water by the marine dinoflagellate *Alexandrium tamerense*. The toxins are thermally stable and therefore not destroyed by cooking or freezing.

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Grants, Projects & Publications

Rapid Pulsed-Field Gel Electrophoresis Facilitating the Identification of Two Simultaneous, Multi-state *E. coli* O157: H7 Outbreaks[1]

D. Shea, J. Fontana, A. Goddard, J. Peppe, J. Isadore, B. Matyas, P. Neves and H. George

Twelve clinical isolates of *Escherichia coli (E. coli)* O157: H7 were received during the week of June 1, 1998 at the Massachusetts State Laboratory Institute. The isolate identifications were confirmed, based on biochemical results, and analyzed by Pulsed-Field Gel Electrophoresis (PFGE). Separation of DNA fragments, following treatment with Xba I enzyme, was done on a CHEF Mapper XA System using a 24-hour protocol (U.S.CDC and WDPH). Two patterns, which differed by two-bands, were identified among the 12 isolates. Epidemiological investigation identified a concurrent rise in *E. coli* O157: H7 cases in neighboring states. Using the CDC's PulseNet database, the PFGE patterns from *E. coli* O157: H7 isolates in MA were matched against those from neighboring states and found to be indistinguishable from either one or the other of the two patterns identified in MA. Epidemiological follow-up implicated ground beef as a common food exposure source in MA and NH cases. PFGE patterns of *E. coli* O157: H7, recovered from left-over ground beef samples provided by two MA patients and ground beef samples obtained at two NH grocery stores, were indistinguishable from one of the two PFGE patterns found from clinical isolates. Further investigation showed that cases in MA and NH purchased ground beef from two different grocery store chains that had a common beef distributor. The second PFGE pattern type found in MA was indistinguishable from a strain that the CT Public Health Laboratory recovered from cases during this same time period. Extensive epidemiological investigation was unable to identify a common source of infection for these cases. The use of a 24-hour protocol and the PulseNet database facilitated prompt identification of two simultaneous multi-state outbreaks, encompassing several states and over 40 confirmed cases of *E. coli* O157: H7. In the case of the MA-NH outbreak, PFGE analysis supported the epidemiological data, which linked ground beef and cases. Rapid identification of a putative common source exposure to *E. coli* O157: H7 via hamburger permitted a voluntary recall of the implicated ground beef, possibly preventing further illness.

[1] Presented at the General Meeting of the American Society for Microbiology, May 30-June 3, 1999.

Paralytic Shellfish Poisoning

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PSP symptoms develop quickly, usually within 30 minutes of ingestion of toxins. Initial symptoms include tingling, numbness or burning of the lips, tongue, gums and face, followed by progressive paralysis of the extremities. In severe cases, death due to respiratory paralysis may occur. There are no known antidotes for the toxins; therefore medical treatment of PSP affected individuals consists of evacuation of stomach contents to prevent further absorption of the toxins, artificial respiration to facilitate breathing, and other symptomatic treatment.

Given the prevalence of PSP contaminated shellfish in the late spring and summer and the severity of the acute human illness associated with ingestion, the monitoring and protection of the food supply is an important public health concern. Massachusetts has an extremely effective two-tiered monitoring program. The Massachusetts Division of Marine Fisheries collects mollusks for analysis from shellfish beds from April through October. Beds containing toxic shellfish are closed until toxicity has waned. Additionally, the Department of Public Health collects and analyzes market samples originating from areas of historic PSP activity such as Massachusetts, Maine and Canada.

Monitoring of shellfish beds and market samples requires a rapid assay, which can detect toxicity within a few hours of receipt in the laboratory. These samples are tested by mouse bioassay. Acidified aqueous extracts of shellfish tissue are injected intra-peritoneally into CD-1 female white mice of a specified weight range. The mice are observed for the characteristic neurological symptoms associated with PSP including death by respiratory failure. The concentration of toxin present in shellfish is calculated based upon the death time of the mouse. This is the quickest reliable assay currently available for monitoring purposes and serves an important role in assuring the safety of the public food supply.

The State Laboratory also analyzes samples by gradient elution high-pressure liquid chromatography (HPLC) with post-column derivitization and fluorescence detection. The major advantages of this technique over the bioassay are that it does not require the use of laboratory animals, it is more specific, and it provides data for individual toxins, rather than the cumulative toxicity measured in the bioassay. However, the relatively long time to obtain analytical results makes it impractical for routine safety monitoring. The HPLC analysis is an important research and epidemiological tool to understand dinoflagellate bloom dynamics and associated toxicity. Further research is needed to develop a rapid in-vitro assay that can accurately determine risk of human toxicity to PSP.

Program Reports — Training Initiatives Strengthen Public Health Strategies

by G. Greer, S. Escott, J. Sullivan, S. Ratelle, M. Stowell

Recognizing that today's public health challenges and advanced laboratory technologies rely on highly trained and skilled personnel, the State Laboratory Institute (SLI) complements its core functions of clinical and environmental testing and surveillance with a strong commitment to continuing education and training. The Institute brings together a cross-section of public and private sector professionals from a variety of laboratory disciplines. This is accomplished by several programs, co-located at SLI, working together to develop training programs and products that are created in response to public health strategies, needs assessments, emerging and re-emerging communicable diseases, new technologies and regulatory changes. SLI training offers attendees the opportunity to interact with peers on the local, state, regional, national and international levels.

The Office of Employee Development and Training provides a variety of resources and training for Institute staff, including 1) staff development courses, such as essential skills programs and technical writing; 2) computer training skills, including word processing, database, presentation, and spreadsheet programs from the basics to advanced level hands-on workshops and 3) supervisory and management training. On-site training laboratories facilitate easy access to these courses.

The Massachusetts Public Health Laboratory Training Office provides technical and safety training for SLI staff, as well as community outreach services such as public health laboratory tours, speaking engagements and mentoring programs. Each summer, the SLI participates in the Brandeis Summer Odyssey program by hosting international students who are pursuing careers in medicine & science. The students are able to "touch the future" by spending time with public health laboratory specialists and epidemiologists. Wet workshops, such as Anaerobic Bacteriology, Mycology, Syphilis Serology, Wet Mounts, and Stained Smears are held in the Institute's Training Laboratory, which accommodates 20 students for hands-on bench training. An ongoing Public Health Teleconference Series has been widely attended by laboratory and allied health professionals from throughout Massachusetts and the Northeast region.

SLI additionally hosts two national training programs' regional offices, which work closely with the Laboratory Training Office. The STD/HIV Prevention Training Center of New England is one of ten regional sites of a national network funded by the Centers for Disease Control (CDC). It provides STD intensive clinical courses and wet-lab courses, such as Wet Mounts and Stained Smears.

The Northeast Office of the National Laboratory Training Network (NLTN), sponsored by the Association of Public Health Laboratories (APHL) and CDC, is one of 7 regional offices. It works closely with the public health laboratories in the Northeast regional states and with professional organizations. In 1998, 36 programs were delivered to approximately 1,060 attendees. Topics vary widely, but often focus on public health issues, such as food safety and microbiology, emerging and re-emerging infectious diseases, and quality assurance and regulatory issues. Training interventions include the traditional seminars, as well as wet workshops, video- and teleconferences, roundtables and computer based instruction. An on-line, interactive training seminar on Shiga-toxin producing *E. coli* was recently co-developed by SLI, the NLTN, and the Northeast Association for Clinical Microbiology and Infectious Diseases (NACMID). The office also maintains a lending library, which includes videos, books, slides, CDs and facilitator training manuals.

National and international training have been a priority for SLI as well. A one week hands-on Advanced Level Mycobacteriology Workshop has been offered for three years. Fifty-three senior level mycobacteriologists have attended this program, collectively representing laboratories that process approximately a half-million specimens a year. The course provided not only technical skills and knowledge, but gave attendees the unique opportunity to share information and common concerns among peers across the country.

Through the Association of Public Health Laboratories (APHL), the SLI has hosted two Emerging Infectious Diseases (EID) fellows who have worked in the area of respiratory pathogens, concentrating on molecular methods such as pulsed-field gel electrophoreses. The current EID fellow is completing a study on the recovery and genetic diversity of *Bordetella holmesii*. SLI also recently hosted three laboratory managers from Kuwait, who studied here for one month under a WHO/PAHO fellowship program through APHL. They were able to gain new knowledge and skills in the areas of quality assurance and management and new methods for microbiology and newborn screening.

SLI's access to specialized equipment, experts in the field, and governmental and public health laboratories make it an ideal setting to offer courses otherwise unavailable. By participating in educational projects at the local, state, regional, national and international levels, lines of communication necessary for all those interested in public health are opened. Networking and training are essential to the continual development of the nation's public health system.

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for the electronic version of this newsletter and other information about the State Laboratory Institute: www.state.ma.us/dph/bls.

Laboratory Training Activities

Public Health Teleconference Series, State Laboratory Institute, Boston, MA: Influenza - Preparing for the Pandemic? October 19; *Chlamydia trachomatis* - With an Eye on Amplification, November 16. Fee $25 per site per program. Call (800) 536-NLTN or (617) 983-6285.

Response to Bioterrorism - Role of the Clinical Laboratory, State Laboratory Institute, Boston. MA: September 9, a seminar with speakers from CDC, the FBI, and the Medical and Public Health Communities. Call (800) 536-NLTN or (617) 983-6285.

State Laboratory Training Coordinator, *Garry R. Greer, BS, (617) 983-6608, E-mail: garry.greer@state.ma.us.*
For a list of NLTN courses in your area sign on to the Web at http://www.cdc.gov/phppo/dls/nltn.htm.

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