What is PulseNet?

- National network of public health and federal food regulatory labs
- Routinely perform standardized DNA “fingerprinting” of foodborne bacteria
- Method is called pulsed field gel electrophoresis (PFGE)
- Share DNA “fingerprints” electronically in real time via the Internet
- National database of DNA “fingerprints” at CDC that participants can access
History of PulseNet

- Initiated in response to 1993 Western States *E. coli* O157:H7 outbreak.
- Network started in 1996 with ten state public health labs.
- SHL joined network in 1998.
- The Network has 87 participating labs, including all 50 state public health labs, 7 FDA labs and 1 USDA lab.
83 member countries from 7 national and regional PulseNet networks

- PulseNet Canada
- PulseNet USA
- PulseNet Latin America & Caribbean
- PulseNet Europe
- PulseNet Africa
- PulseNet Middle East
- PulseNet Asia Pacific

PulseNet International

The International Molecular Subtyping Network for Foodborne Disease Surveillance

December 2011
PFGE Is Like Sorting Socks

• Easy to tell socks apart if different colors, designs, or patterns
• Can tell pathogens apart if different species and serotypes
• What if socks are all white gym socks and pathogens all same serotype?
Steps Prior to PFGE

- Properly collect patient stool samples and send with completed test request forms
- Submit samples to lab
- Laboratory isolates bacterial pathogen(s)
- Pathogens are identified with stains, biochemical tests, and serotyping
- PFGE performed on foodborne pathogens
  - *Salmonella*, *Shigella*, toxigenic *E.coli*, *Listeria monocytogenes*, and others
PFGE Process

...cells are lysed...

...releasing DNA
PFGE Process

DNA is cut into fragments using special restriction enzymes.

DNA loaded into gel. An electric current is applied to the gel causing the negative-charged DNA fragments to run toward the positive charge. DNA fragments separated by size through the process called electrophoresis.
DNA Fingerprinting
Pathogens to Patterns

PulseNet database is comprised of “patterns” obtained from a laboratory test
PFGE Process – End Result

- Pattern of fragments is called the DNA fingerprint
- A computer generated image is created
- Each lane or column is a DNA fingerprint of one isolate from one sample
Pulsed-Field Gel Electrophoresis
Stool and Milk Isolates

All isolates demonstrated identical DNA patterns!
SHL’s Role in PulseNet

- Obtain all *E. coli* O157:H7, *Listeria*, *Salmonella*, and *Shigella* isolates for serotyping and DNA “fingerprinting”.
- Use CDC standardized PFGE protocols for “fingerprinting” the isolates.
- Keep a local database for the state’s own “fingerprint” patterns.
- Submit all patterns to a national database accessed by all labs in the network.
- If cluster detected, submit cluster and pattern information to the network’s national Web Board.
- Communicate with IDPH
Importance of food and water samples

• Food and water samples containing the same pathogen as the patient samples and the same PFGE patterns can confirm and support the epidemiological evidence in food borne disease and outbreak investigations.
Statewide – Outbreak Investigation Tool

- Early warning system
- Differentiate outbreak cases from sporadic
- Cluster detection tool (NOT outbreak detection system)
- Can help identify outbreak vehicle
- PulseNet serves this function in all states
Nationally – Link Sporadic Cases to Outbreaks

- Single cases from different states help identify outbreak
- PulseNet very successful
- Annually, 1200 clusters identified by state/local health agencies
- Annually, 10-15 multistate or national outbreaks identified
- Strengthen evidence for product recall
Notable Natl Outbreaks Identified by PulseNet

- Spinach *E.coli* 0157:H7
- Peanut Butter *Salmonella* Tennessee
- Sprouts *E.coli* 026
- Hazelnut *E.coli* O157:H7
- Cantelophe *Listeria monocytogenes*
Nationwide Peanut Butter Salmonella Outbreak

- First recognized by PulseNet in July 2006 – slowly growing outbreak
- Epi data implicated certain brands of peanut butter

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5621a1.htm
Nationwide Peanut Butter Salmonella Outbreak

- FDA issues national alert and company shuts down plant
- SHL 1st state lab to isolate S. Tennessee from an opened jar of implicated PB
- Over 600 cases from 47 states

[Link to CDC report](http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5621a1.htm)
Iowa S.Tennessee PFGE

STD patient peanut butter STD
Listeria Cantelope Outbreak

- Deadliest foodborne outbreak in US in nearly 90 years with 29 deaths
- Number of deaths would have been much higher if it wasn’t for Pulsenet
- Outbreak detected, source identified and national warning issued IN DAYS (10 days!).
- Sept 2011 outbreak linked to a single canteloupe farm in Colorado
Isolates Reported to PulseNet USA, 1996-2011

- Human
- Food/Animal/Environment

2012: over 60,000 isolates
In Summary

- Ultimate goal: prevent foodborne illness and outbreaks (HACCP, good manufacturing practices, safety inspections)
- Complexity of food production, distribution, preparation, impossible to completely eliminate
- **PulseNet**: best tool for detecting unrecognized problems in our food safety system