From the lab bench to the Internet: Experience with PulseNet

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What is PulseNet?

- PulseNet is the National molecular subtyping network for foodborne disease surveillance established by the Centers for Disease Control and Prevention in 1996
- Pulsed-field Gel Electrophoresis (PFGE) is used to subtype pathogens
- PFGE images normalized using customized software
- PFGE patterns are electronically submitted to National database located at CDC in Atlanta, GA

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JOURNAL OF CLINICAL MICROBIOLOGY, Dec. 1994, p. 3013–3017
0095-1137/94/$04.00+0

Vol. 32, No. 12

Laboratory Investigation of a Multistate Food-Borne Outbreak of *Escherichia coli* O157:H7 by Using Pulsed-Field Gel Electrophoresis and Phage Typing

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Received 27 July 1994/Returned for modification 6 September 1994/Accepted 19 September 1994

Two hundred thirty-three isolates of *Escherichia coli* O157:H7 were analyzed by both pulsed-field gel electrophoresis (PFGE) and bacteriophage typing. All 26 isolates from persons whose illness was associated with a recent multistate outbreak of *E. coli* O157:H7 infections linked to the consumption of undercooked hamburgers and all 27 isolates from incriminated lots of hamburger meat had the same phage type and the same PFGE pattern. Twenty-five of 74 *E. coli* O157:H7 isolates from Washington State and 10 of 27 isolates from other states obtained during the 6 months before the outbreak had the same phage type as the outbreak strain, but only 1 isolate had the same PFGE pattern. PFGE thus appeared to be a more sensitive method than bacteriophage typing for distinguishing outbreak and non-outbreak-related strains. The PFGE patterns of seven preoutbreak sporadic isolates and five sporadic isolates from the outbreak period differed from that of the outbreak strain by a single band, making it difficult to identify these isolates as outbreak or non-outbreak related. Phage typing and PFGE with additional enzymes were helpful in resolving this problem. While not as sensitive as PFGE, phage typing was helpful in interpreting PFGE data and could have been used as a simple, rapid screen to eliminate the need for performing PFGE on unrelated isolates.

The genesis of PulseNet

- In 1996, 4 public health laboratories in 4 States and an USDA laboratory submitted *E. coli* O157:H7 PFGE patterns to CDC
- In 1997, WASPHL developed 1-day PFGE protocol
- In 1997-98, PulseNet 1-day standardized PFGE protocol
  - Harmonization of CDC and WASPHL

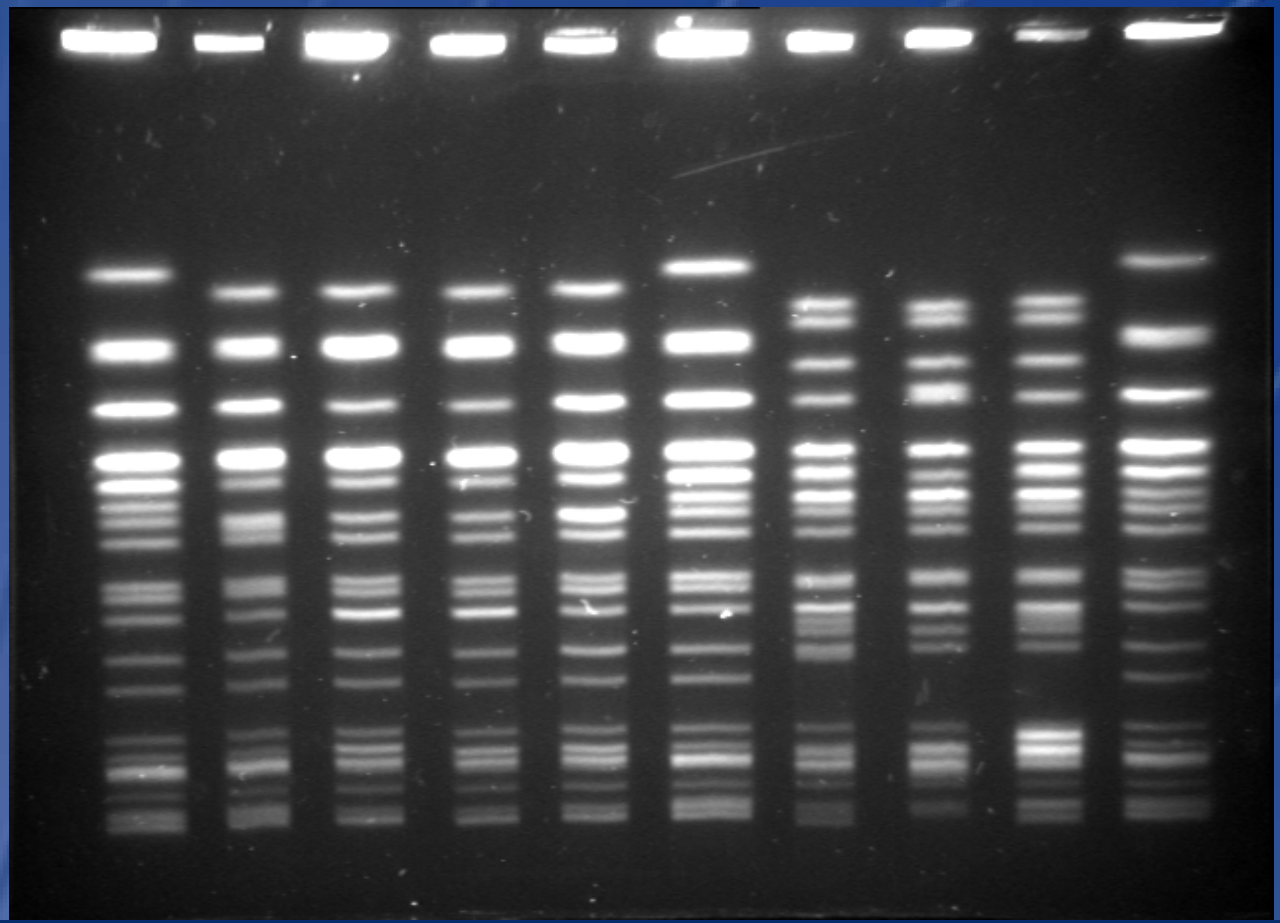
Components of PulseNet

- Laboratory
- Data analysis
- Communication network

Laboratory

- Standardization of rapid one-day (24 hr) PFGE protocol
  - *E. coli* O157:H7, *Salmonella*, *Shigella*, *Listeria monocytogenes*
- Development of new protocols
  - *Campylobacter, Clostridium perfringens, and Vibrio cholerae*
- Certification and proficiency testing
- Training workshops

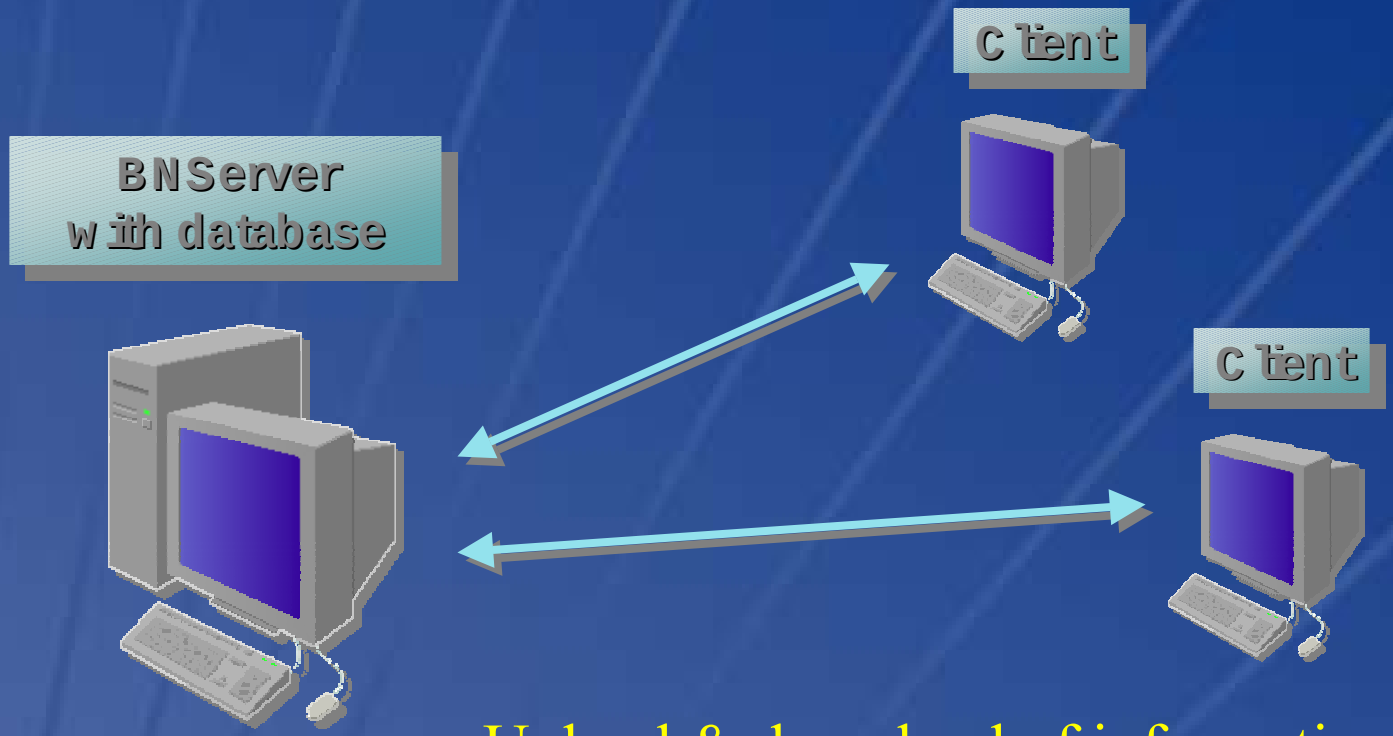
E. coli O157:H7 PFGE gel



Data analysis

- PFGE images analyzed using Molecular Analyst Fingerprinting Plus (Bio-Rad) software
  - Gels normalized using same molecular size standard
- Training workshops
- Certification and proficiency testing
- In 2001, the PulseNet *E. coli* database was converted to a new on-line database system
  - Public health laboratories submit PFGE patterns via the internet
  - *Listeria monocytogenes* and *Salmonella* databases will be on-line by 2002

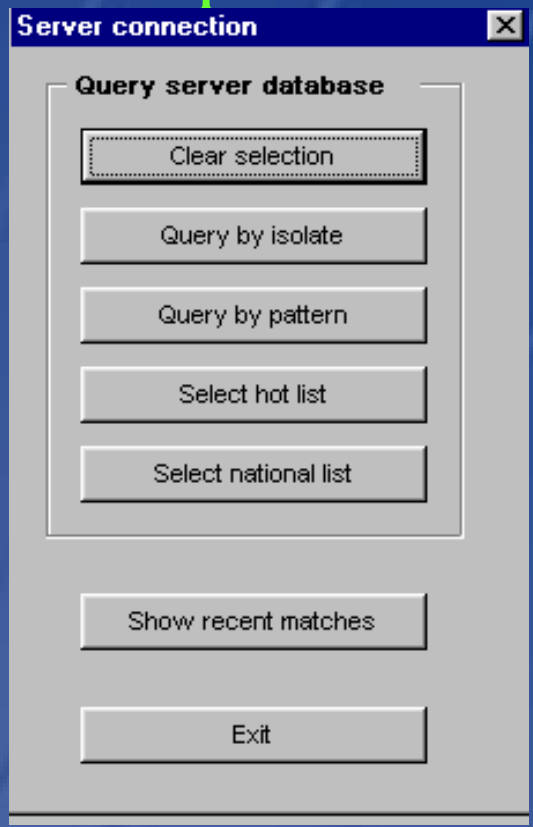
BioNumerics Server



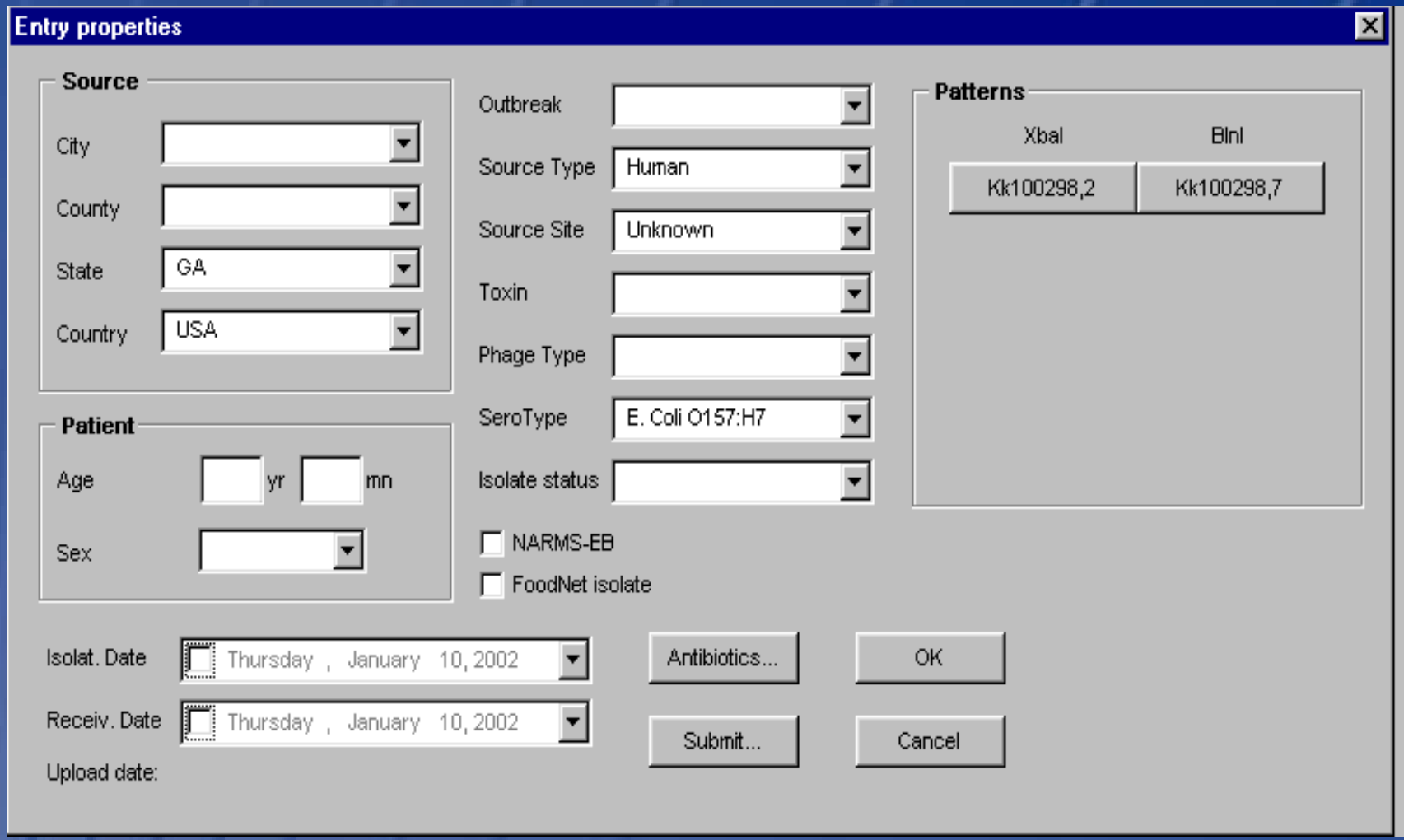
- Upload & download of information
- **Internet based**

PulseNet "Client" BioNumerics software

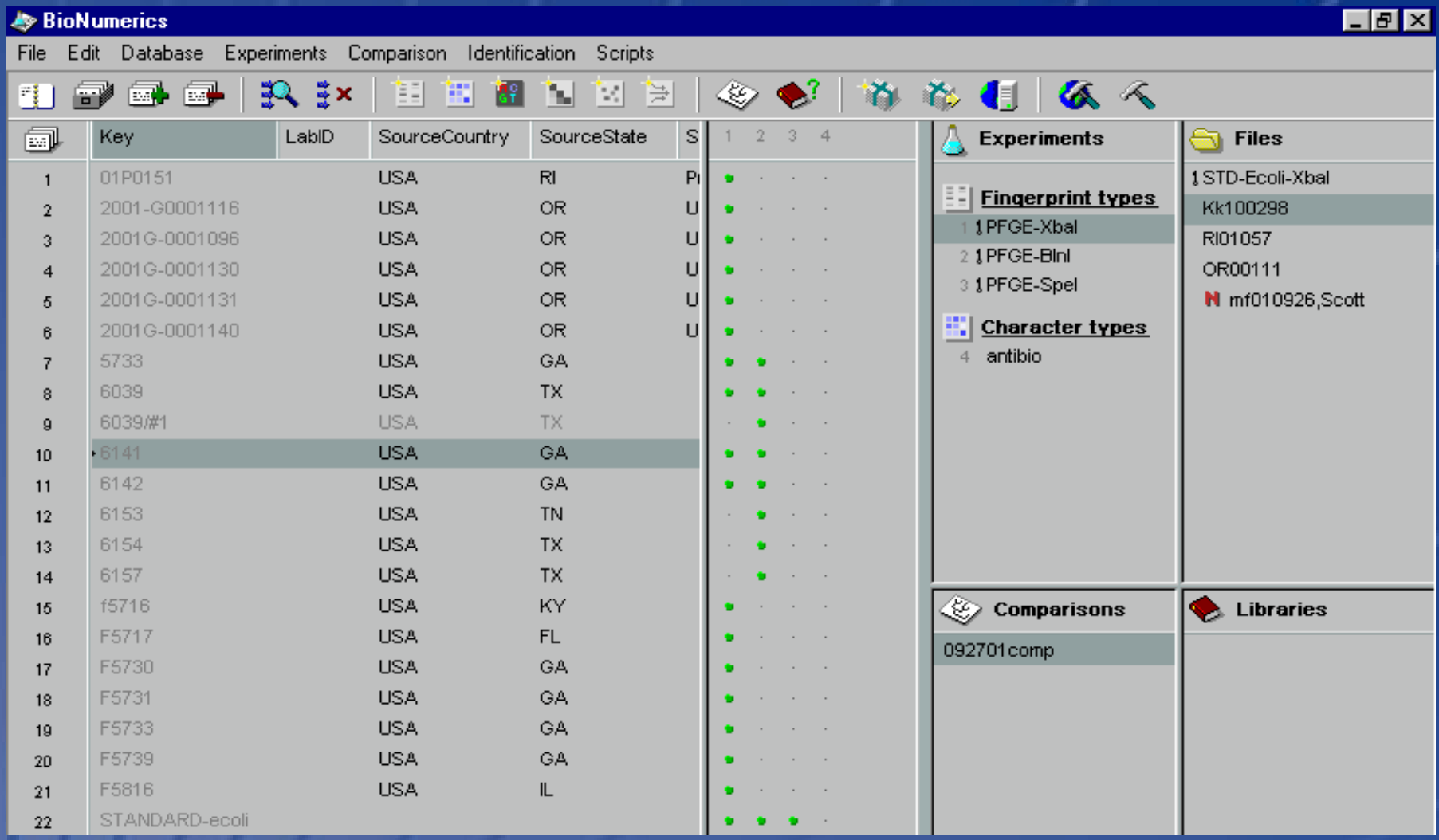
- On-line system allows public health labs to actively submit and view PFGE patterns from the National database.



Information fields



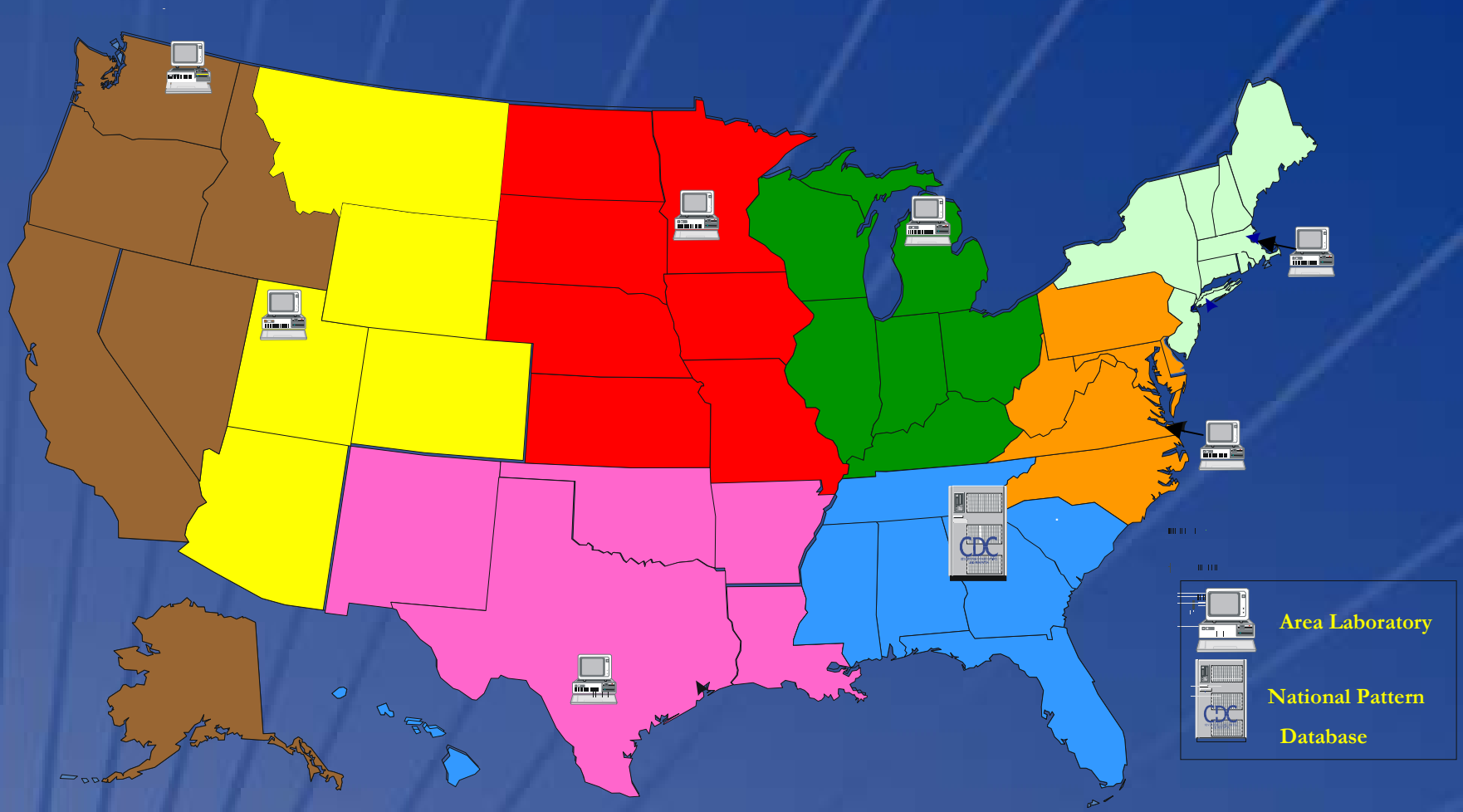
Additional lab data



Communication network

- Listserv postings
  - Cluster detection
  - Outbreak investigations
  - Technical support
- "PulseNet News" Newsletter
  - Quarterly publication
- Annual meeting
  - April 8-10, 2002

The National PulseNet Network - 2002



PulseNet North

Partnership with Canada has been particularly rewarding

PulseNet has revolutionized foodborne disease surveillance

- Real-time laboratory data available to epidemiologists
  - Cluster detection
  - Outbreak investigation
  - Scope of outbreak
  - Identification of source of outbreak
  - Effectiveness of prevention measures

PulseNet at Work

- Hudson beef outbreak, 1997
  - CO SPHL and USDA-FSIS performed PFGE typing of clinical and hamburger isolates
  - Patterns transmitted electronically to CDC
  - Found to be indistinguishable from each other within minutes of receiving the hamburger pattern
  - Determined that the scope of the outbreak was limited within 48 hours

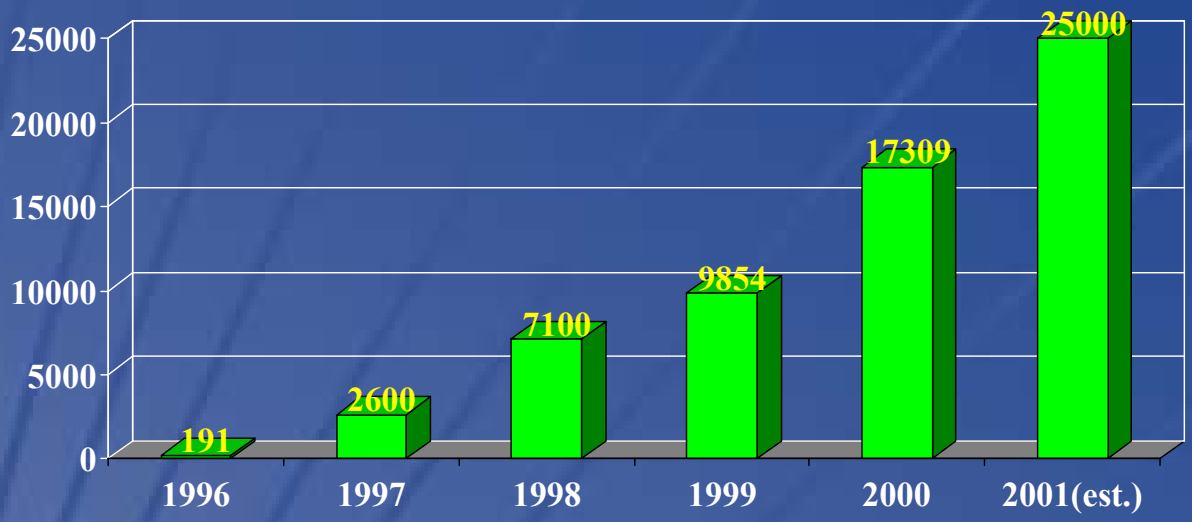
PulseNet Activity, 1996-2001

	1996	2000	2001
No. of pathogens	1	4	7
No. of U.S. participating laboratories	10	50	64

E. coli O157:H7, Salmonella, Listeria, Shigella

Campylobacter, Clostridium perfringens, Vibrio cholerae

PFGE patterns submitted to PulseNet Databases



PulseNet Activity 2001: *E. coli* O157:H7

TIFF files received	**704**
No. labs submitting TIFF	**44**
PFGE patterns received	**3788**
Clusters/outbreaks investigated	**44**
No. of laboratories certified	**25**
No. of laboratories on-line	**19**

Expanding the Net: Beyond Foodborne Pathogens

- 2000
  - Division of Bacterial and Mycotic Diseases / MSPB
    - *N. meningtidis* and *B. pertussis*
  - Division of Health Quality Promotion
    - MRSA
  - Division of Viral and Rickettsial Diseases
    - Calicinet

2001

  - Division of Bacterial and Mycotic Diseases / RDB
    - S. *pneumoniae*
    - *Legionella sp.*

CPHL will coordinate the establishment of PulseNet Europe in 2002


PulseNet
The National Molecular Subtyping Network
for Foodborne Disease Surveillance