Division of Consolidated Laboratory Services

Innovation - Public Health - Bioinformatics

DCLS

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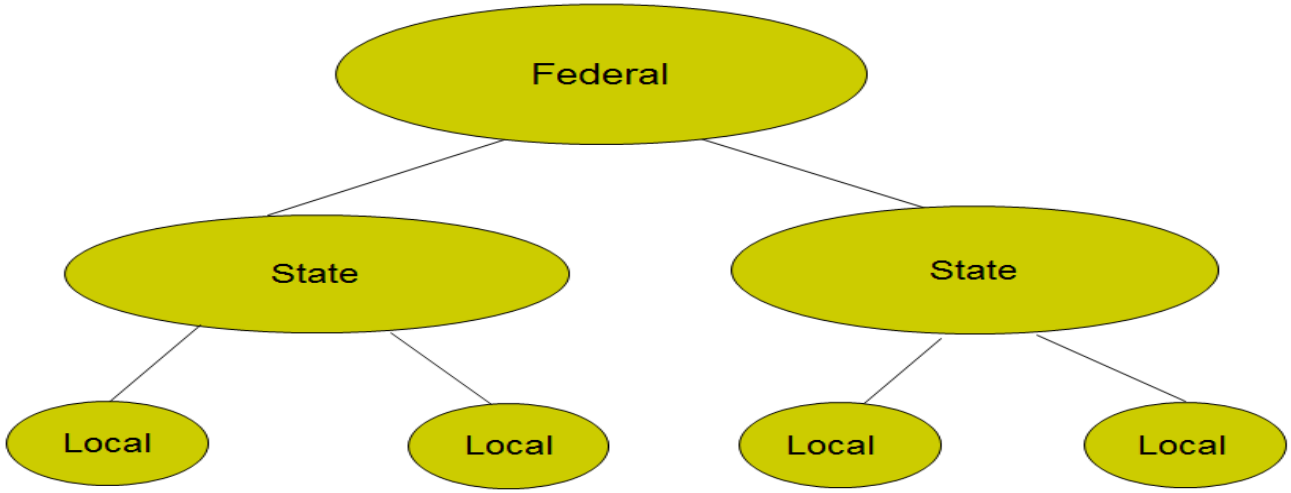
Presentation Overview

- *Overview of DCLS*
- *Laboratory testing services*
  - *Pathogen detection and outbreak tracking*
- *Technology transition - Whole genome sequencing (WGS)*
- *Federal collaborations*
  - *FDA GenomeTrakr*
  - *CDC PulseNet AMD Program*
- *WGS Project Goals*
- *Next Steps*

State Laboratories

- *State laboratories are a critical foundation for the public health delivery system and its infrastructure*
- *All states have laboratories; serve varied purposes*
- *Administrative positioning within government often differs*
  - *Agriculture , Health, Environmental Quality, University, etc.*



Virginia's State Laboratory

Division of Consolidated Laboratory Services (DCLS)

- *Serve as the state's public health, environmental, agriculture and consumer protection laboratory for the Commonwealth of Virginia*
- *Serve hundreds of local, state and federal agencies*
- *Conduct over 7 million tests per year with over 650 different types of analyses*
- *Comprehensive testing services include newborn screening, immunology, molecular biology, drugs of abuse testing, virology, microbiology, mycology, food and water adulteration, biomonitoring, metal and pesticide analyses, radiochemistry, biological and chemical terrorism response, motor fuels and commodities, and organic/inorganic chemical analyses*

Laboratory Mission

DCLS Mission Statement:

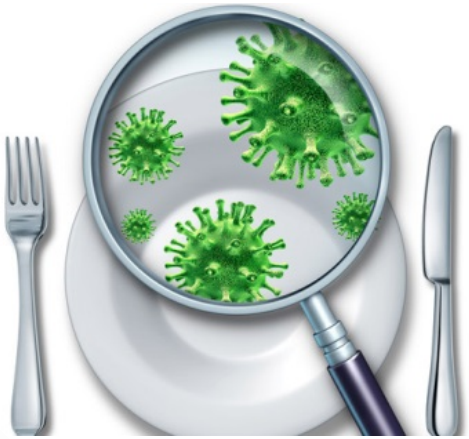
- Dedicated to *ensuring the continuous improvement of laboratory science* and creating a network of laboratories capable of meeting Virginia's current and future health challenges
- *To promote a healthier world through quality laboratory service*

Division of Consolidated Laboratory Services
Mission Supportive Activities

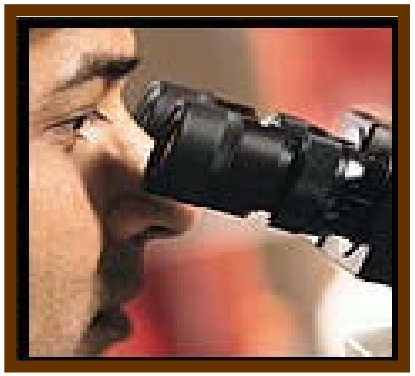
- Evaluation of specialized testing to meet or improve the needs of the Commonwealth
  - Whole genome sequencing
  - High throughput testing, multiplex testing
  - Testing not readily available in Virginia (ie. Ebola)
- Training and Education
  - Internal/external laboratorians
  - Customers, Public, Students, Fellows (internship opportunities)
- Participation in local, state, federal, private and industry partnerships
- Policy Development
- Applied Research
- Emergency, outbreak, surge laboratory testing capacity and support

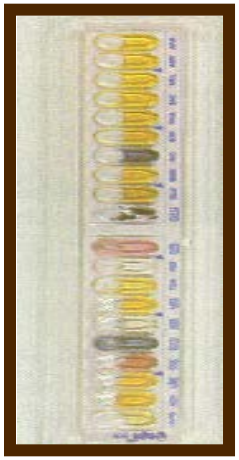
Laboratory Testing Services

Pathogen Detection and Outbreak Tracking



Pathogen Detection
Classical and Advanced Methods





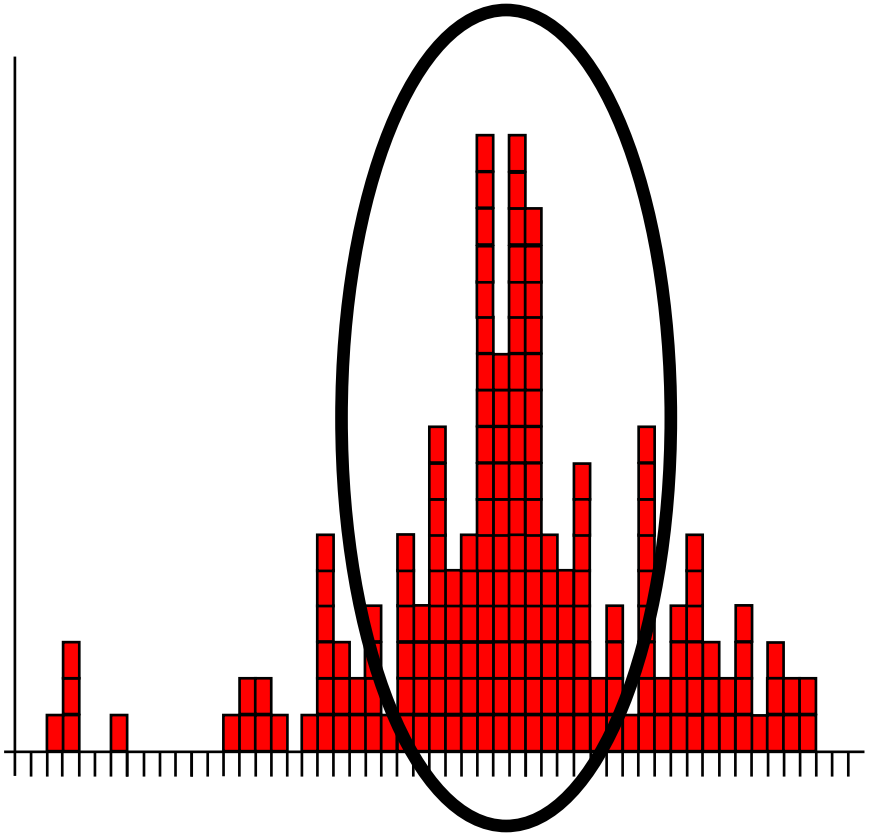
TARGETS:

- *Bacteria*
- *Viruses*
- *Parasites*
- *Toxins*
- *Fungi, yeasts, molds*

Outbreak Tracking and Pathogen Clustering
Traditional Approaches

- Phenotypic Characterization
  - *Biochemical profiles*
  - *Serotyping*
  - *Virulence marker determination*

- Genotypic Characterization
  - *Nucleic acid amplification*
  - *DNA sequencing/Pyrosequencing*
  - *Fingerprinting/Fragment Analysis*
    - *Pulsed-field gel electrophoresis*
    - *MLVA/VNTR*



- Many limitations exist

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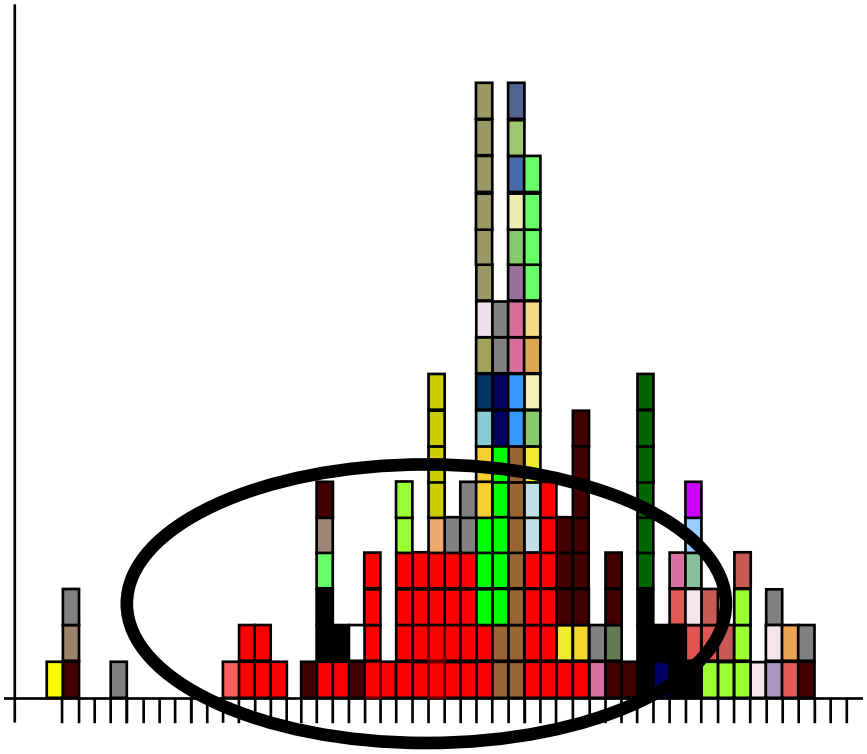

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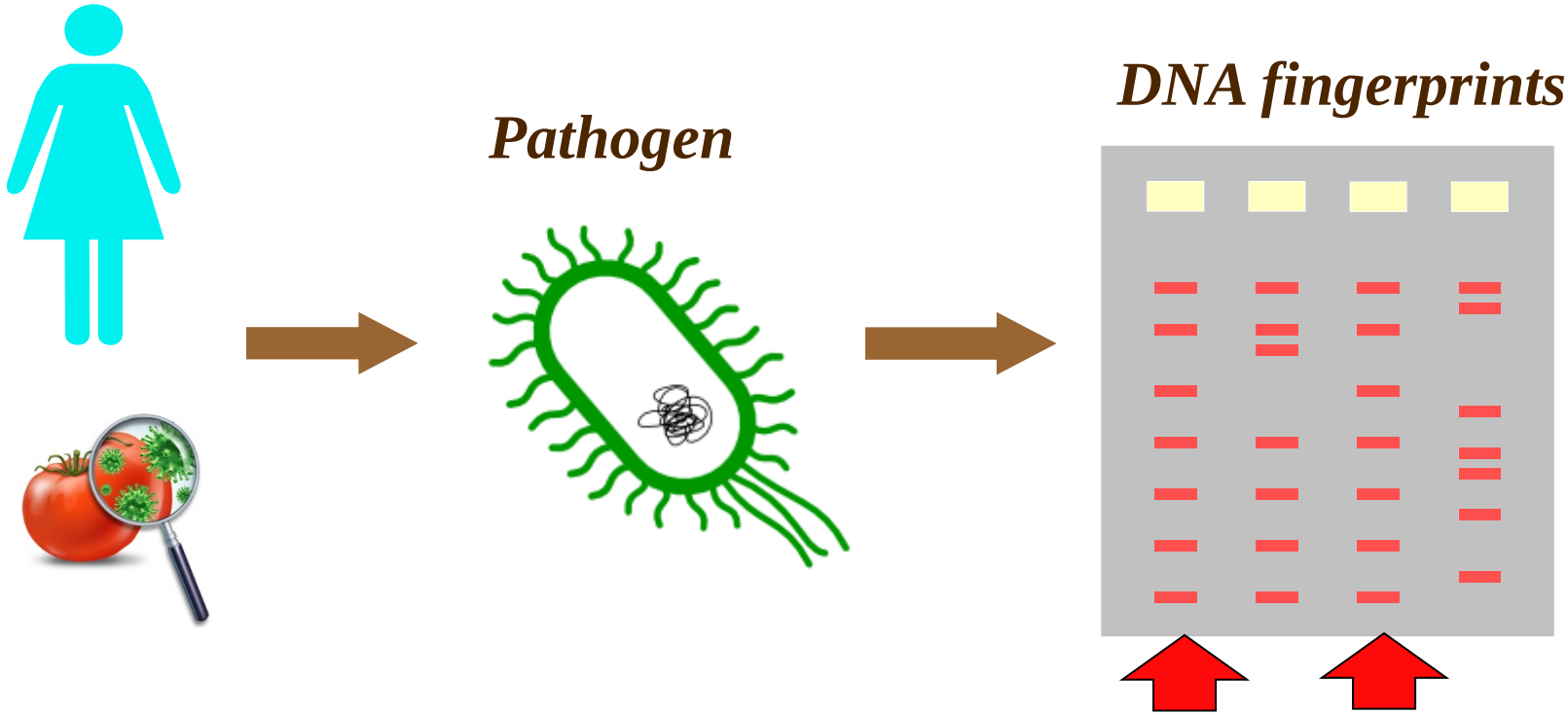
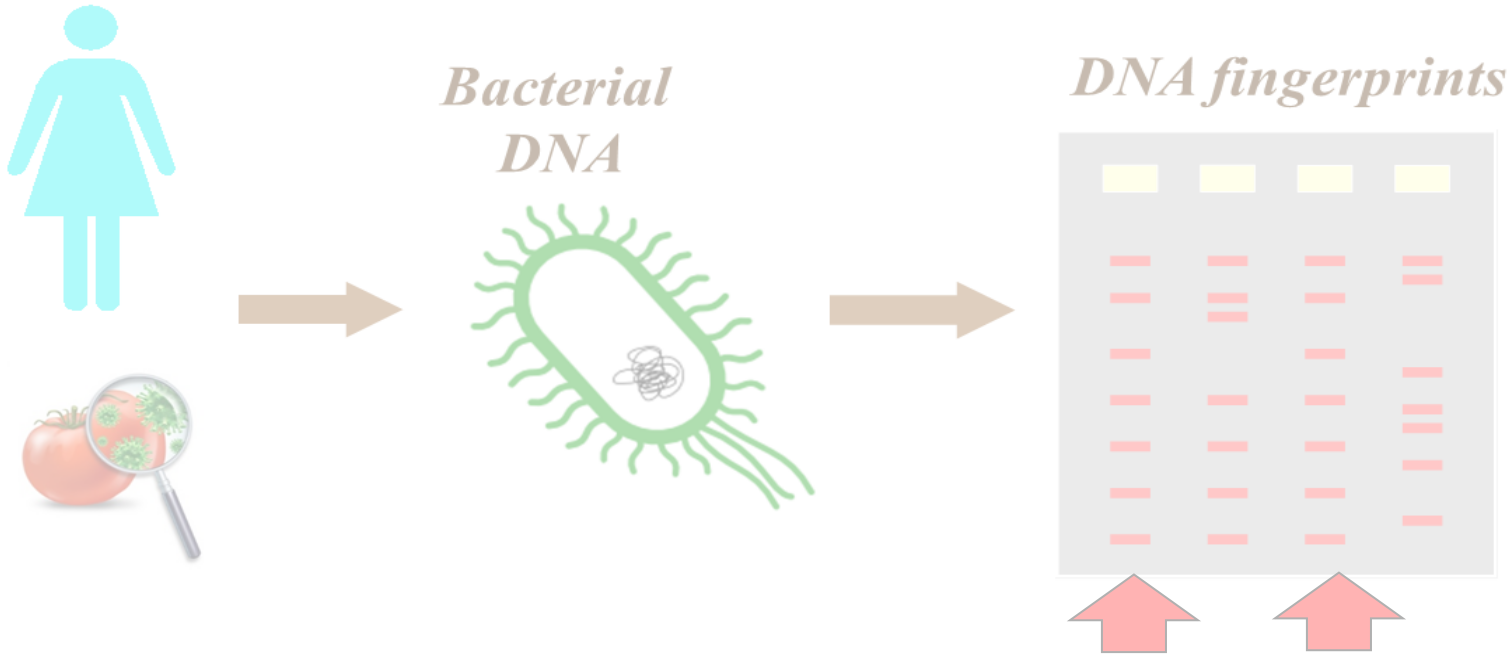
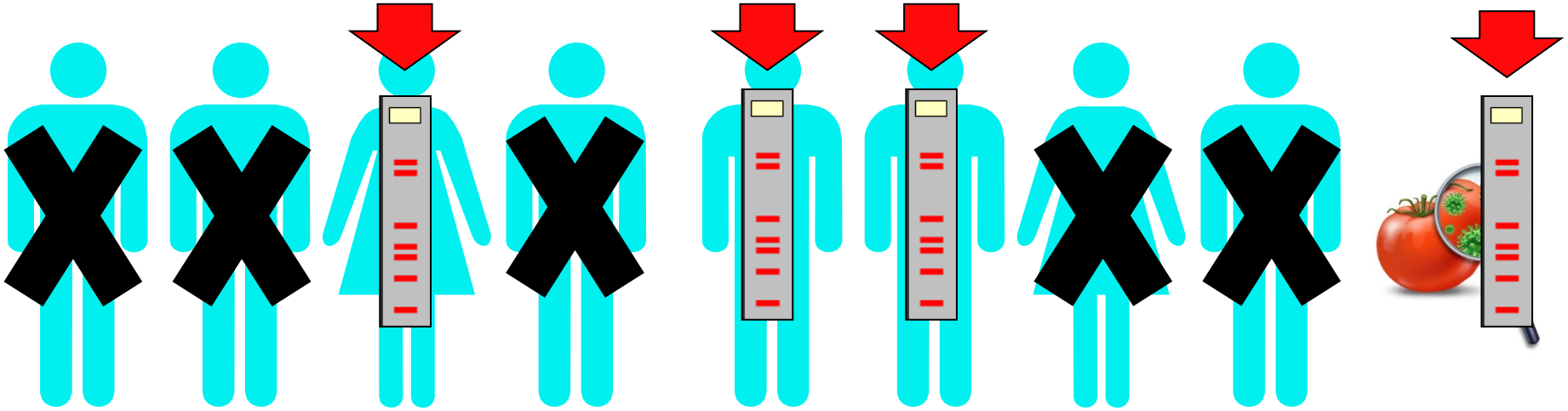
Foodborne Pathogen Tracking - DCLS

PFGE "Strain" Characterization



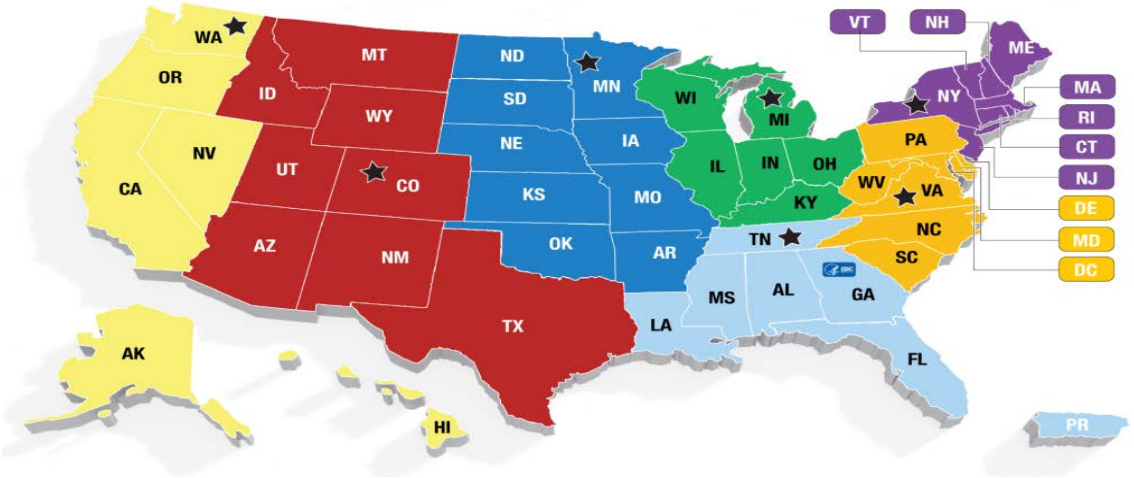
Allows for the "fingerprinting and comparison" of pathogens to predict when an OUTBREAK may be occurring


Bacterial DNA
DNA fingerprints



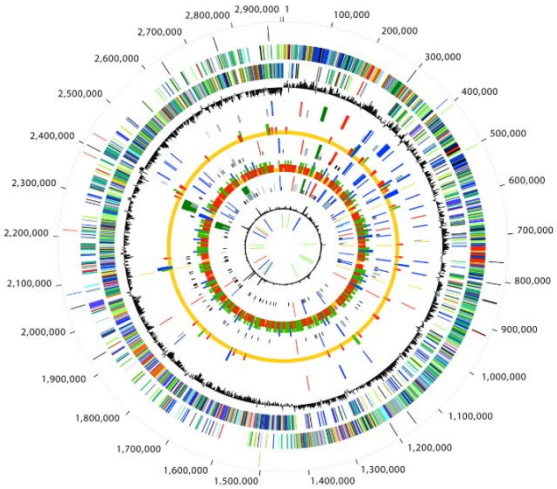
CDC PulseNet Program
State-Federal Collaboration

- National molecular subtyping network for foodborne disease surveillance
  - > 80 public health and regulatory laboratories
  - Virginia/DCLS serves as the Mid-Atlantic Regional Laboratory
- Standardized subtyping of foodborne bacteria using PFGE
  - Data shared electronically – CDC maintains National Database
  - Transitioning from PFGE to WGS



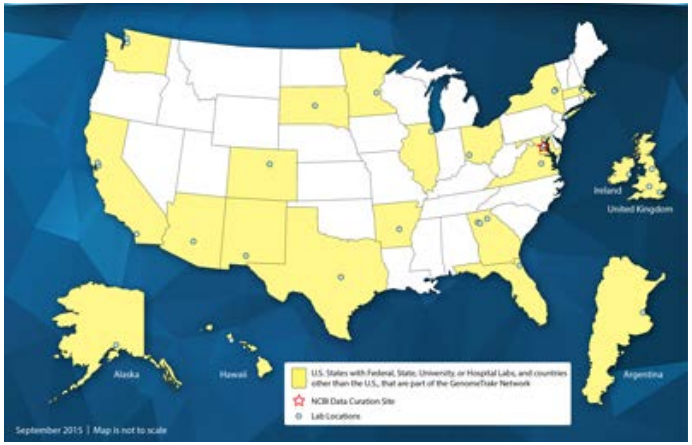
Whole Genome Sequencing (WGS)
Advantages over PFGE

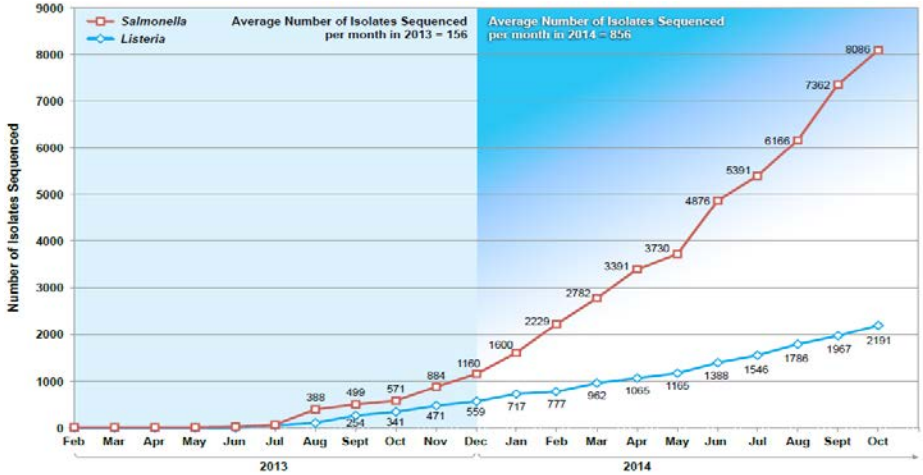
- More efficient outbreak detection, investigation and control
  - Greater level discrimination; Highly clonal strains (ie. SE)
  - Detect relatedness earlier; TAT of 2-4 days
  - Less subjective; improved networking and data sharing
- Applicable to direct specimen testing (ie. CIDT)
- All information obtained by traditional methods is contained within sequencing data
  - Serotype, Virulence Genes
  - Antibiotic resistance genes and genetic elements
- Public Health Applicability
  - Tuberculosis, Newborn Screening, Influenza, Antibiotic resistance, etc.



DCLS - WGS Collaborations
FDA GenomeTrakr Program

- National WGS network
  - Initial state participants included NY, FL, AZ, WA, MN, VA, MD; continues to expand (industry/international)
- Sequenced more than 32,000 isolates; adding over 1,000 isolates/month
- Data publically available through NCBI





Whole Genome Sequencing
DCLS Activities and Current Status

- Isolates sequenced to date:

Program	Circa	Isolates Sequenced	Data Shared
GenomeTrakr	**2013**	**645**	**~0.5 TB**
PulseNet	**2014**	**396**	**~0.3 TB**

- Perform real-time WGS for all CDC PulseNet foodborne pathogens and in support of FDA surveillance projects
- WGS of clinical isolates in support of outbreak investigations at the request of CDC/FDA
- All data analysis performed outside of DCLS

Public Health Impact of WGS in Virginia

Recent Recalls

Recall -- Firm Press Release

Recall -- Firm Press Release

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FDA posts press releases and other notices of recalls and market withdrawals from the firms involved as a service to consumers, the media, and other interested parties. FDA does not endorse either the product or the company.

(UPDATE) EXPANDED - Roos Foods Voluntarily Recalls Variety of Cheeses (listed below) Due to Possible Health Risk

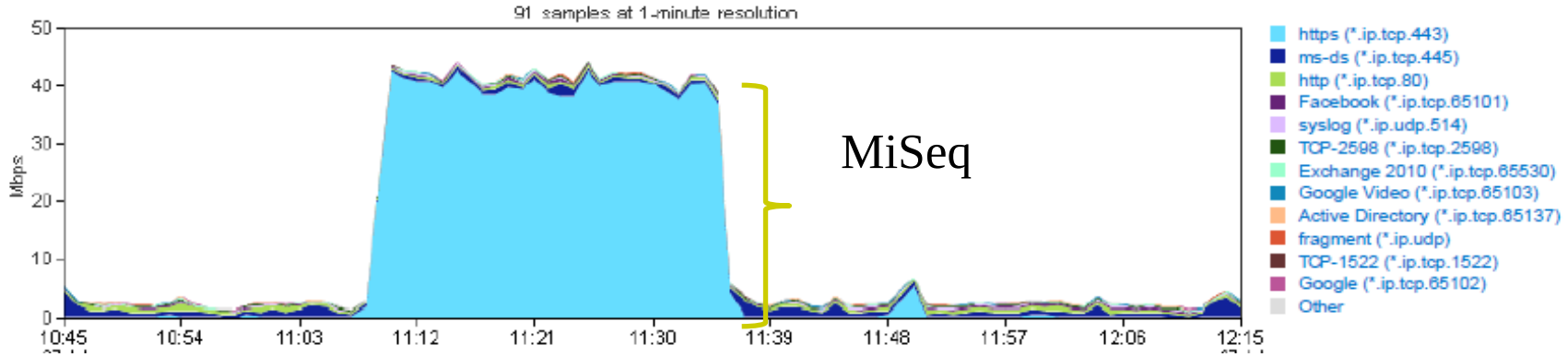
DCLS Project Goals

- Develop capacity for WGS data analysis (in house) to expand public health initiatives for VA
  - TB, Newborn Screening, Influenza, etc.
  - Virulence factor/resistance marker tracking
- Establish a state-based analytical pipeline for WGS to interface with federal pipelines (short-term) and local hospital partners (long-term)
- Strengthen and standardize bioinformatics capability and infrastructure at DCLS

Summary

Ongoing Activities and Next Steps

1. Enhance DCLS bioinformatics IT capacity
   - Current lab network bandwidth is 45 Mbps; WGS raw data files are ~10 Gb
   - Streaming can cause major strain on the overall building



2. Identifying new strategies for data storage and software analysis
3. Expand lab capability and capacity – equipment, facility, staffing
4. Expand Bioinformatics partnerships and collaborations

Questions??

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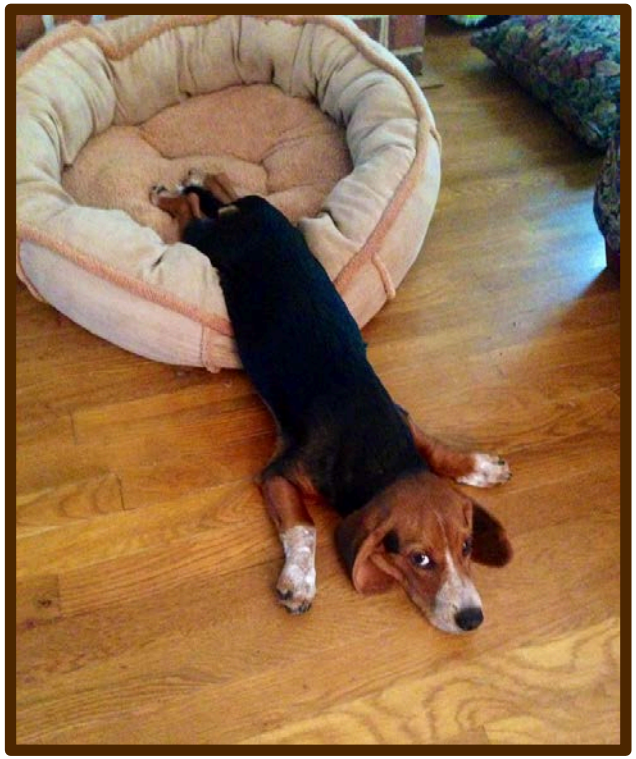

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