Foodborne Illness Outbreaks in New York State

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Outline

- Background
  - Foodborne Disease
  - Outbreak Investigation
  - Pulsed Field Gel Electrophoresis (PFGE)
  - Whole Genome Sequencing (WGS)
- Foodborne Disease Surveillance in NYS
- Outbreak Investigation Examples
  - Complaint Driven
  - Laboratory Driven
    - *E.coli* O157:H7 in Ground Beef
    - *Salmonella* in Peanut Butter
    - Listeria monocytogenes
- Questions

CDC Estimates of Foodborne Diseases

- Each year roughly
  - 48 million illnesses
  - 128,000 hospitalizations
  - 3,000 deaths

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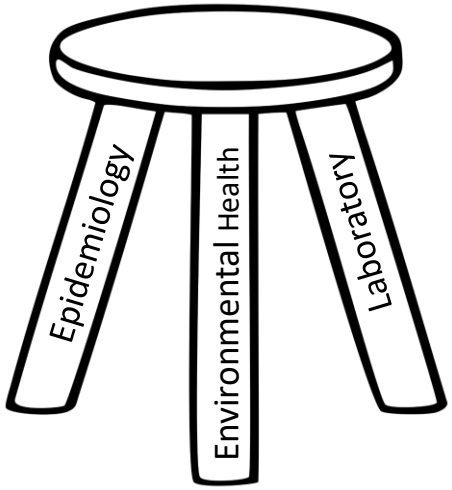
Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson M-A, Roy SL, et al. Foodborne illness acquired in the United States— major pathogens. Emerg Infect Dis. 2011;17:7–15.
Scallan E, Grif n PM, Angulo FJ, Tauxe RV, Hoekstra RM. Foodborne illness acquired in the United States—unspecified agents. Emerg Infect Dis. 2011;17:16–22.

Three-Legged Stool of Investigations

- Environmental Health
  - Visit and conduct evaluation at site
  - Review food prep procedures
  - Conduct staff interviews
  - Collect food & environmental samples
  - Interventions
- Epidemiology
  - Establish case definition
  - Design questionnaire and conduct ill & well interviews
  - Calculate food specific Attack Rate (AR)
  - Epi curves
  - Stool samples
- Laboratory
  - Sample analysis
  - PFGE matching
  - WGS



Communication is Key

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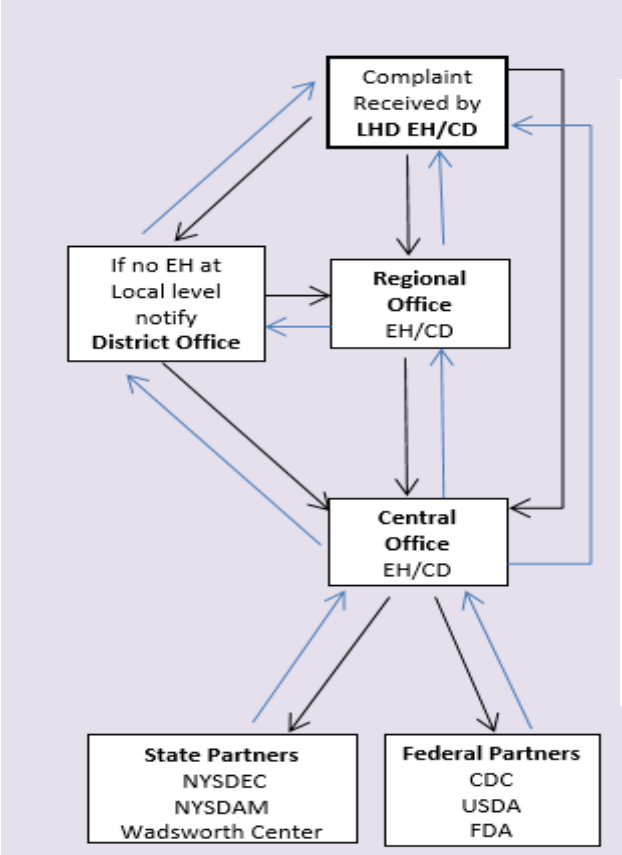
What is an Outbreak?

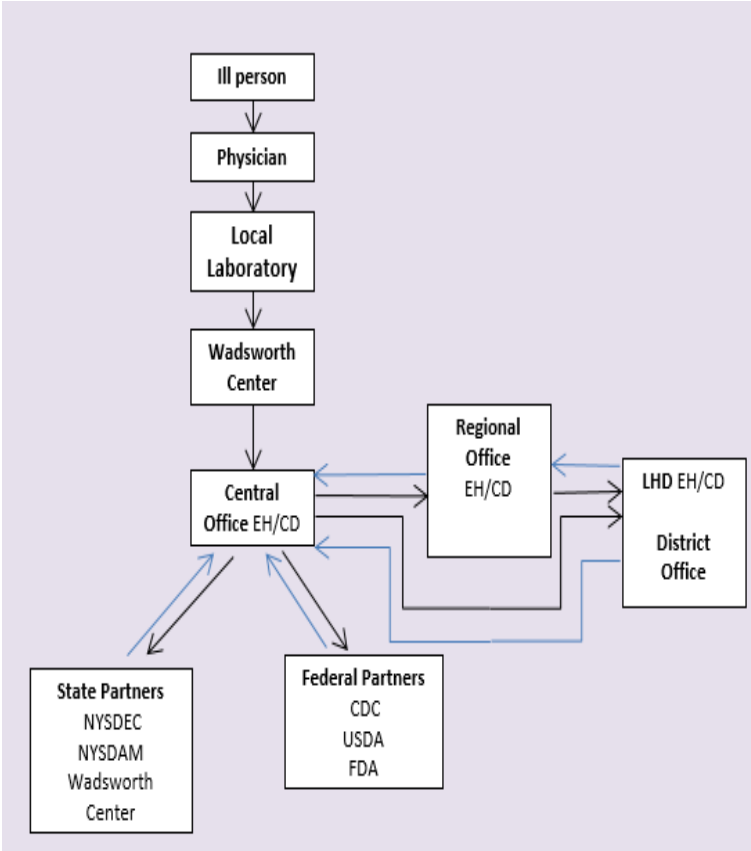
- **A foodborne outbreak is defined as the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food in the United States.**
  - Before 1992, three exceptions existed to this definition; only one case of botulism, marine toxin intoxication, or chemical intoxication was required to constitute an FBDO if the etiology was confirmed. The definition was changed in 1992 to require two or more cases to constitute an outbreak.

Complaint Driven Foodborne Illness Outbreak Communication



- Local Health Department (**LHD**)
- Environmental Health (**EH**)
- Communicable Disease (**CD**)
- New York State Department of Environmental Conservation (**NYSDEC**)
- New York State Department of Agriculture and Markets (**NYSDAM**)
- United States Department of Agriculture (**USDA**)
- Food and Drug Administration (**FDA**)
- Centers for Disease Control and Prevention (**CDC**)

Lab Driven Foodborne Illness Outbreak Communication



What is PFGE?

- Pulsed Field Gel Electrophoresis
- First described in 1984
- A gel electrophoresis technique used to separate very large DNA fragments
- A subtyping method used for surveillance of *Escherichia coli* O157:H7 and other foodborne disease pathogens

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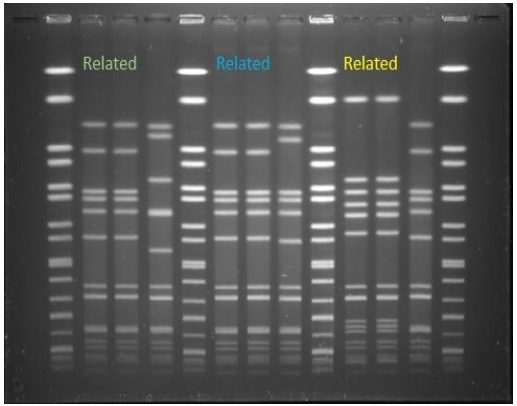
Source: https://www.cdc.gov/pulsenet/anniversary/timeline.html

DNA Fingerprinting by PFGE

- Isolates are obtained from patients, food, etc.
- DNA is isolated
- DNA is cut into fragments with an enzyme
- DNA fragments loaded into a gel matrix and are separated using an electric field



Source: https://www.wadsworth.org/public-health-programs/infectious-diseases/bacteriology/pulse-field-gel-electrophoresis

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Source: Dianna Schoonmaker-Bopp, NYSDOH Wadsworth Center

Whole Genome Sequencing (WGS)

- Laboratory procedure that determines the order of bases or complete DNA sequence in the genome of an organism in one process
  - Uses the genome or genetic material of an organism (i.e., bacteria, virus, human) which is made up of DNA.
  - Each organism has a unique DNA sequence which is composed of bases (i.e., A, T, C, and G).
  - Identifying the sequence of the bases provides you with the unique DNA fingerprint or pattern

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Source: https://www.cdc.gov/pulsenet/pathogens/wgs.html

How Does WGS Work?

- DNA Extraction
- DNA Shearing
- DNA Library Formed
- DNA Library Sequenced
- Data Analysis

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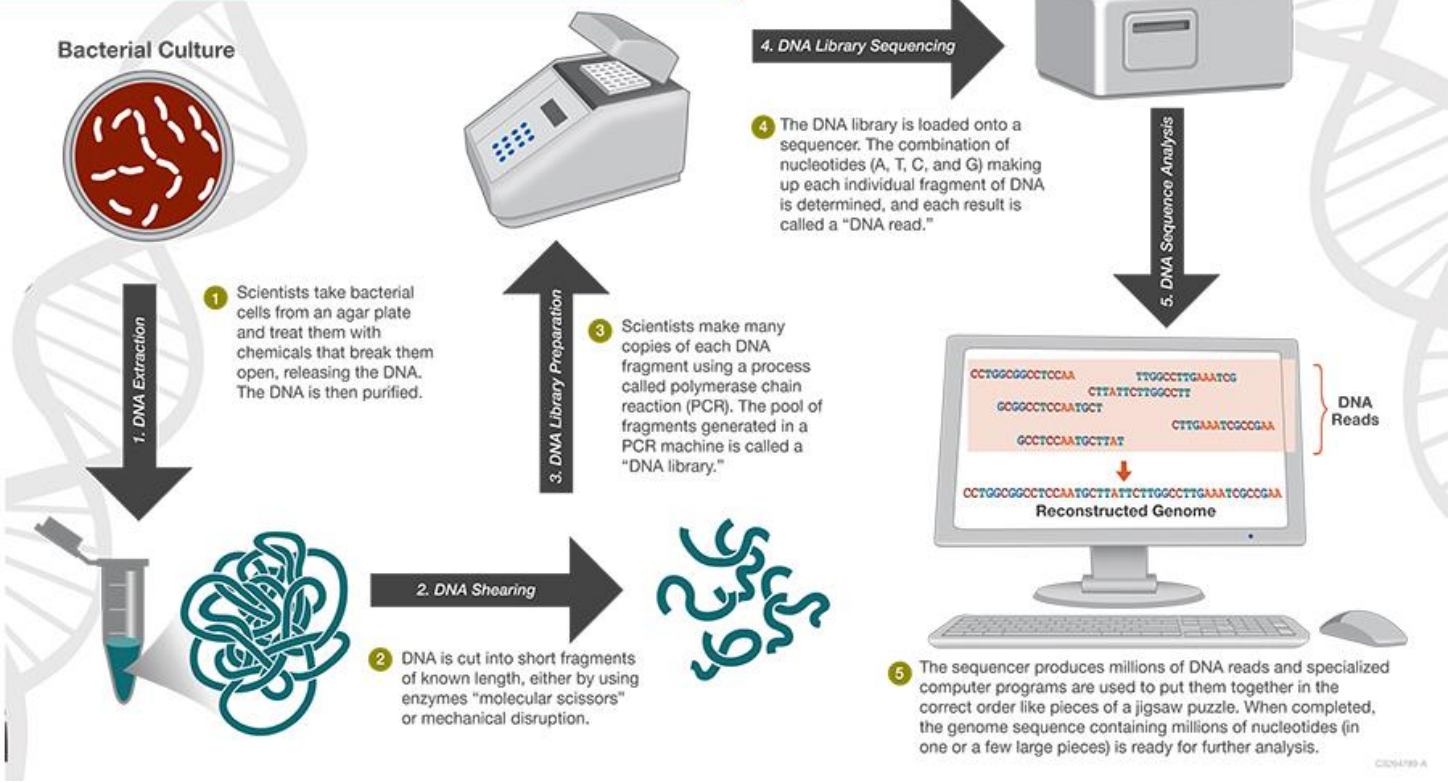
Source: https://www.cdc.gov/pulsenet/pathogens/protocol-images.html#wgs

The Whole Genome Sequencing (WGS) Process

WGS is a laboratory procedure that determines the order of bases in the genome of an organism in one process. WGS provides a very precise DNA fingerprint that can help link cases to one another allowing an outbreak to be detected and solved sooner.



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Source: https://www.cdc.gov/pulsenet/pathogens/protocol-images.html#wgs

Why WGS?

- Provides more detailed and precise data than PFGE
- Provides ability to compare millions of bases rather than minimal number of bands
  - Very helpful when dealing with common PFGE patterns
- With WGS, we can:
  - Detect more clusters
  - Solve more outbreaks
  - Identify new food sources

JOB SECURITY

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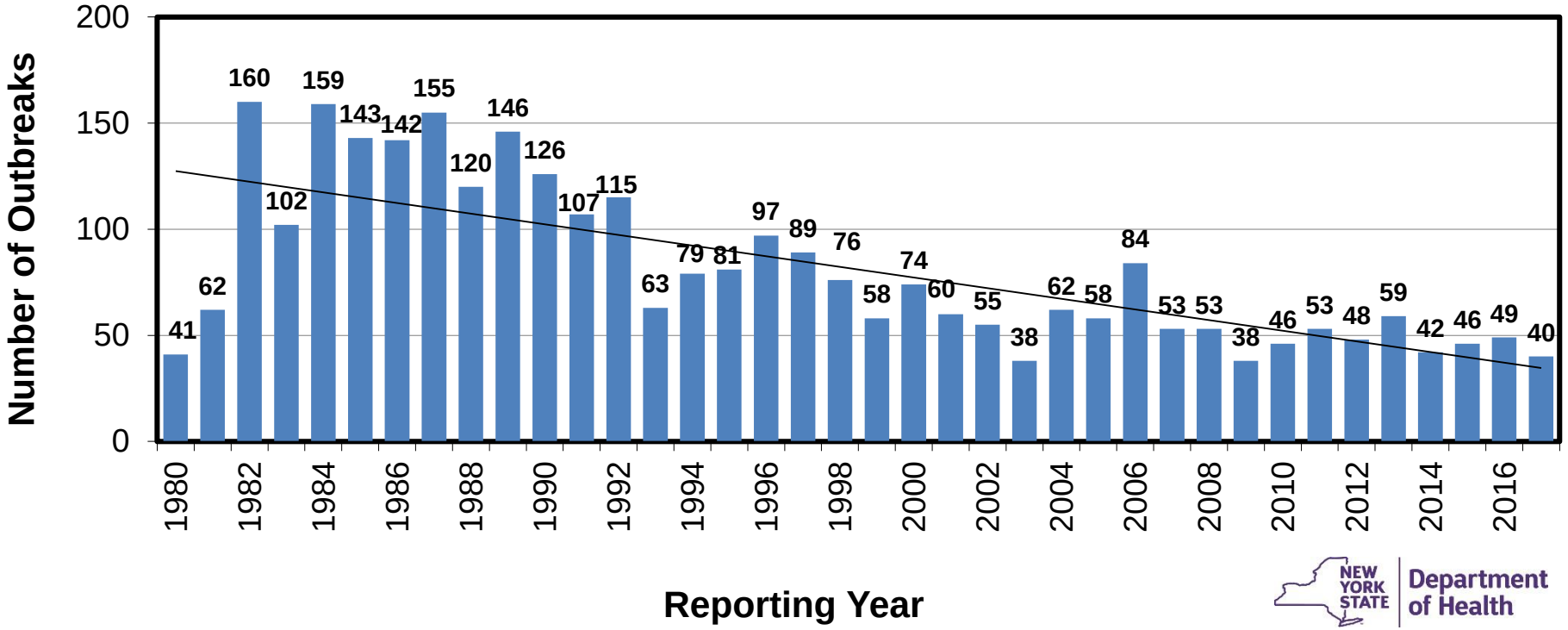
Foodborne Disease Surveillance in New York State: 1980 - 2017

Number of Foodborne Outbreaks, New York State, 1980 – 2017



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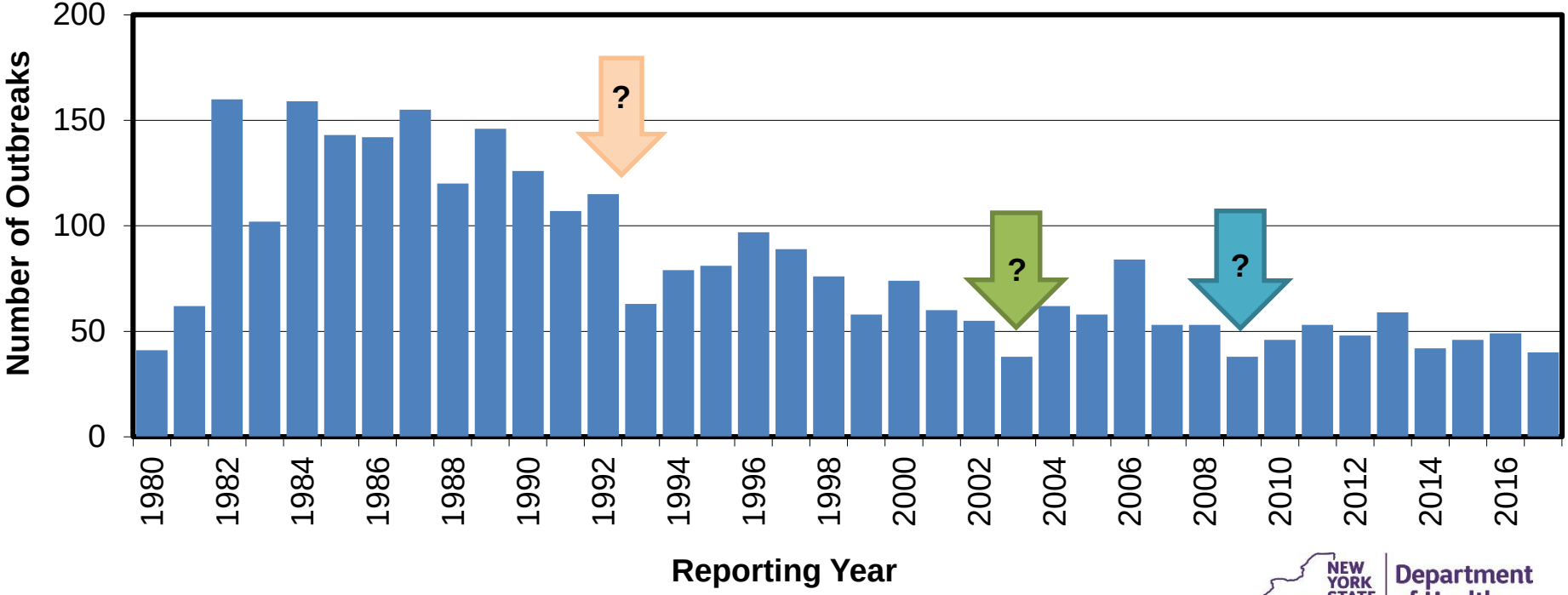
Number of Foodborne Outbreaks, New York State, 1980 – 2017



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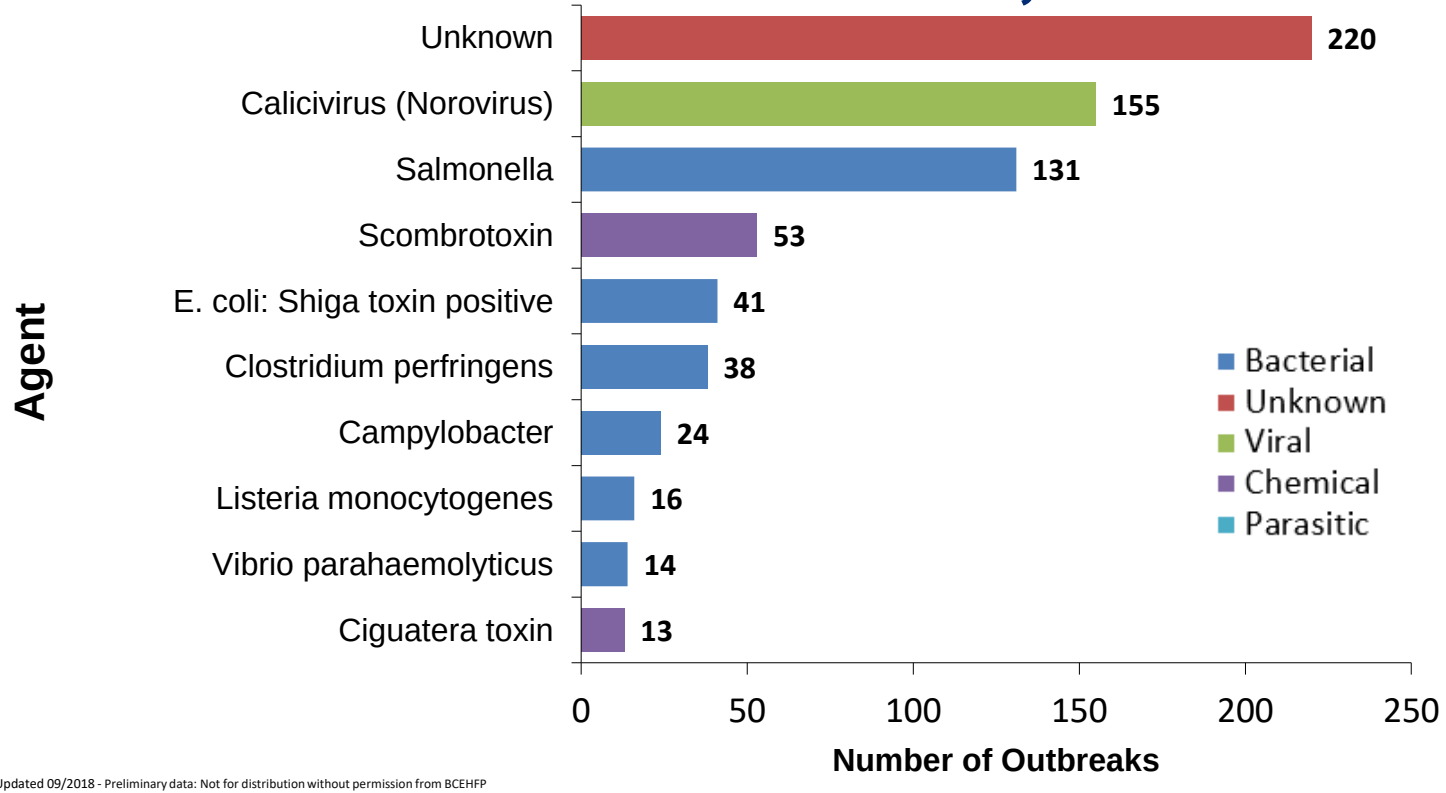
Top 10 Foodborne Outbreaks by Agent, New York State, 2003-2017



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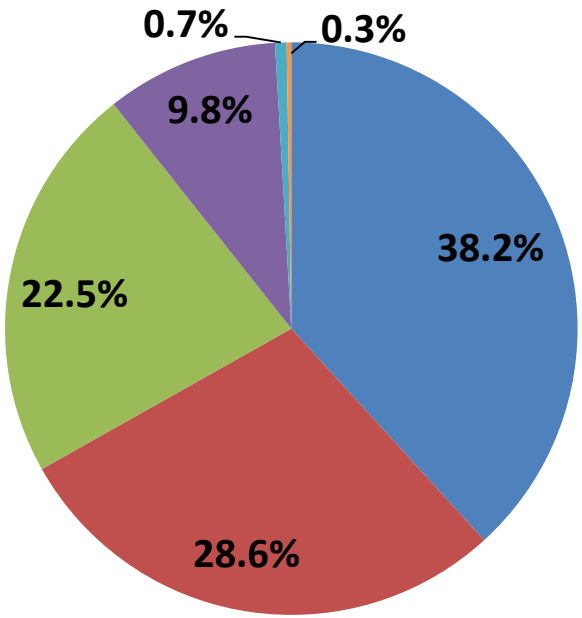
Foodborne Outbreaks by Etiology, New York State, 2003-2017



Number of outbreaks by etiology:

- Bacterial: 294
- Unknown: 220
- Viral: 173
- Chemical: 75
- Parasitic: 5
- Multiple: 2

Total Number of Outbreaks: 769

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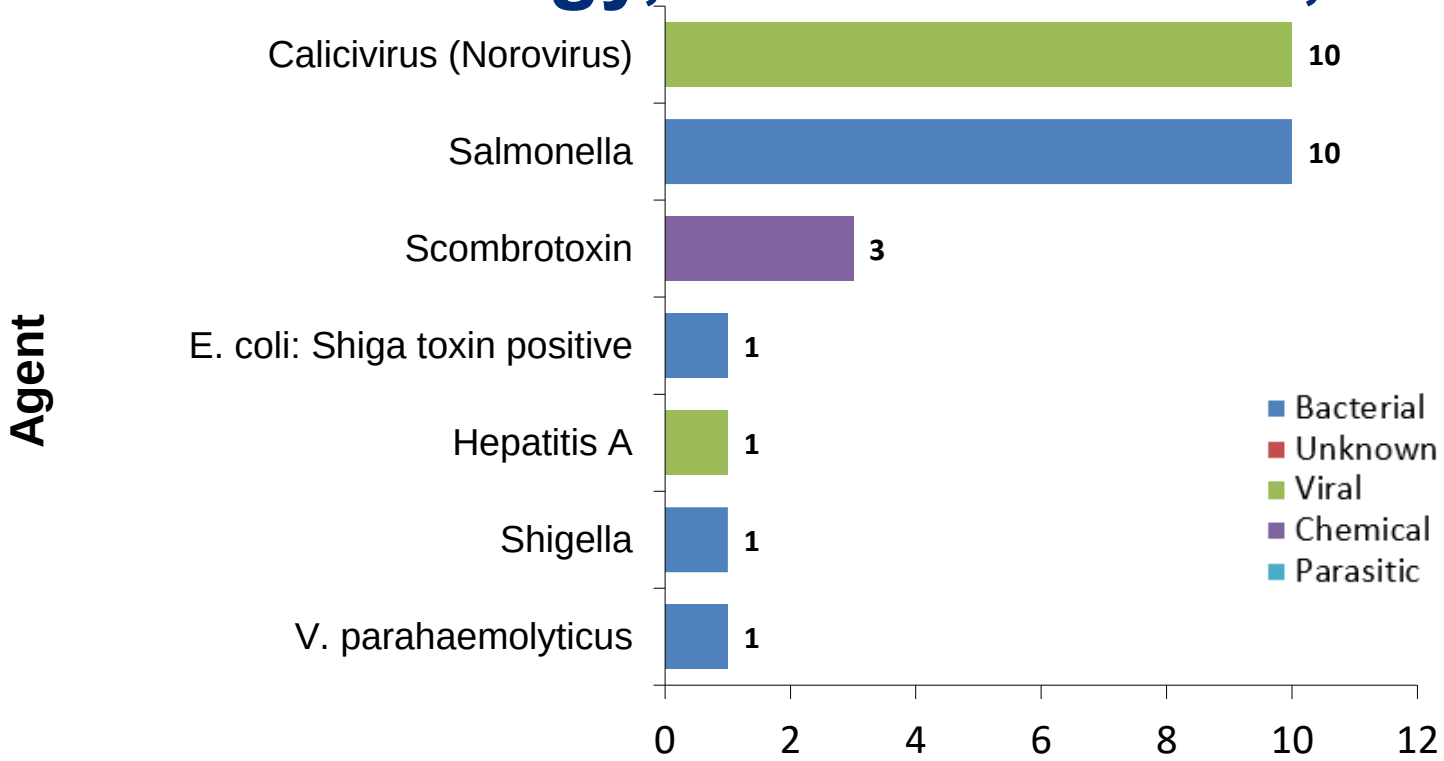
Number of Foodborne Outbreaks with Known Etiology, New York State, 2017



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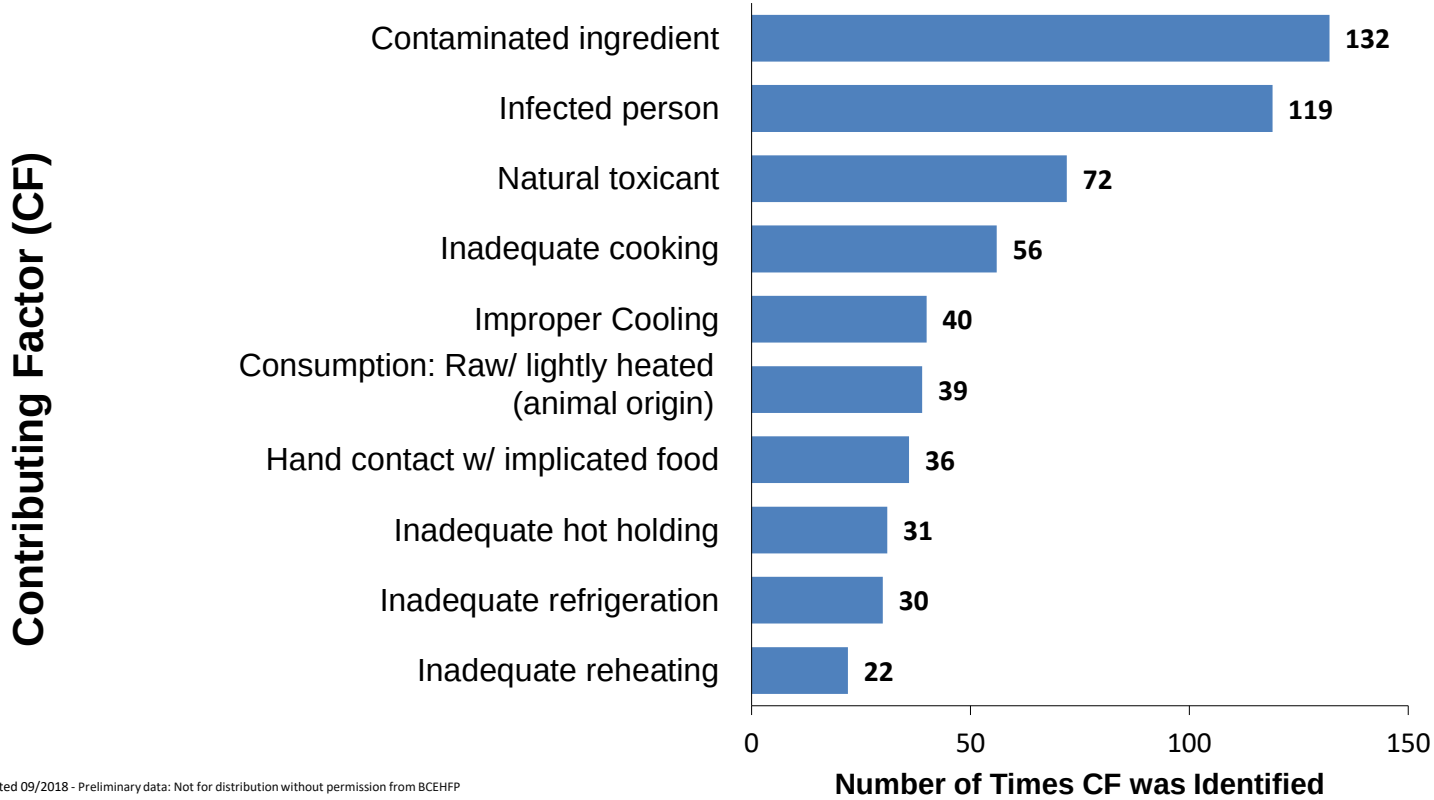
Top 10 Contributing Factors Identified in Foodborne Outbreaks, New York State, 2003-2017



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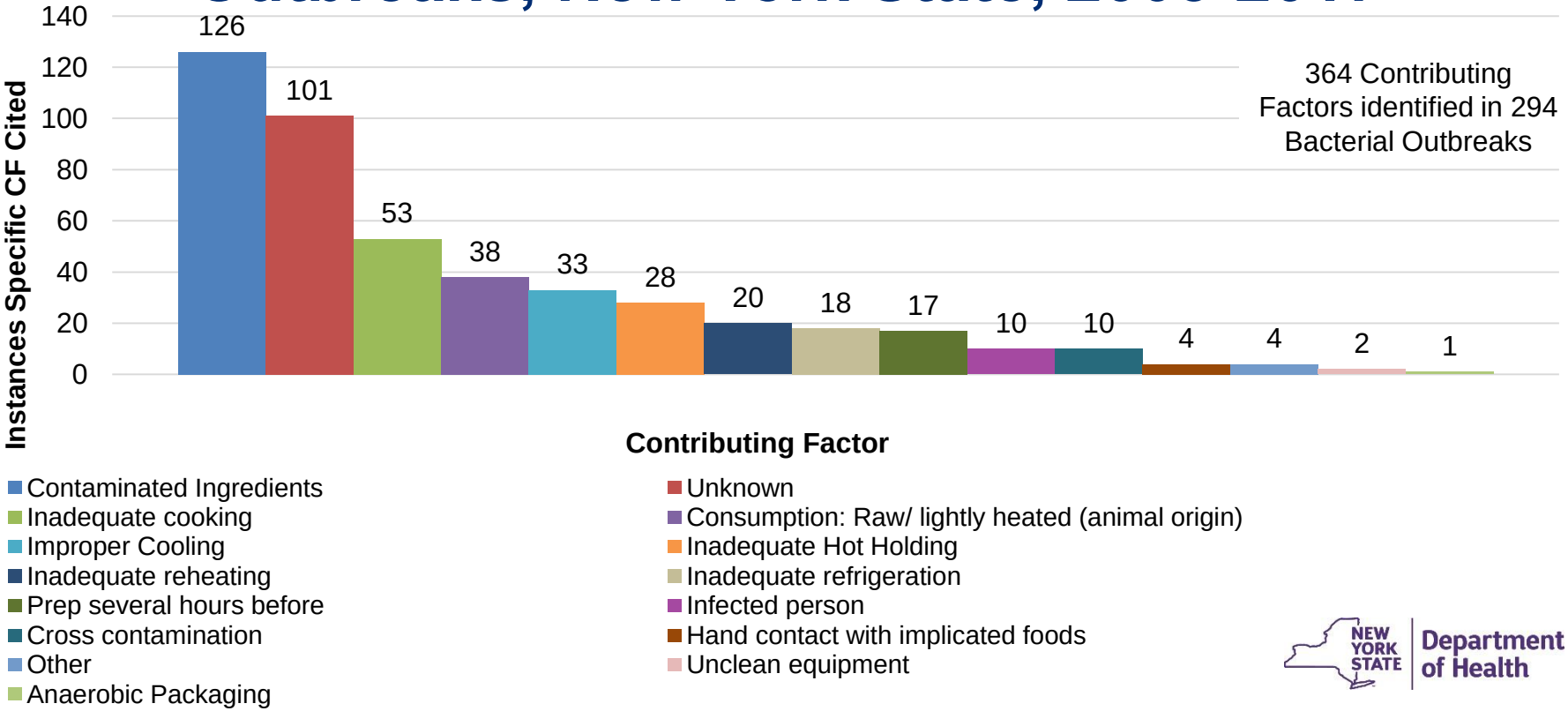
Specific Contributing Factors Identified in Bacterial Outbreaks, New York State, 2003-2017



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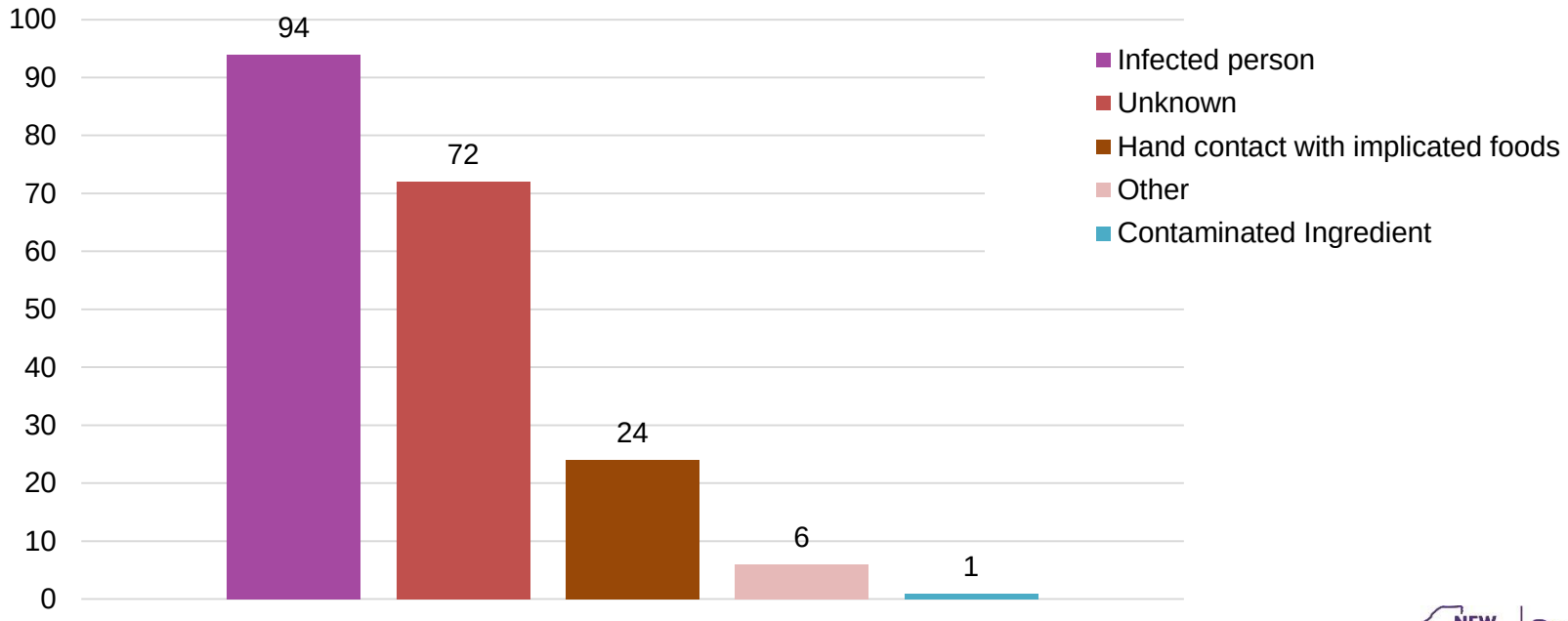
Specific Contributing Factors Identified in Viral Outbreaks, New York State, 2003-2017



103 Contributing Factors identified in 173 Viral Outbreaks

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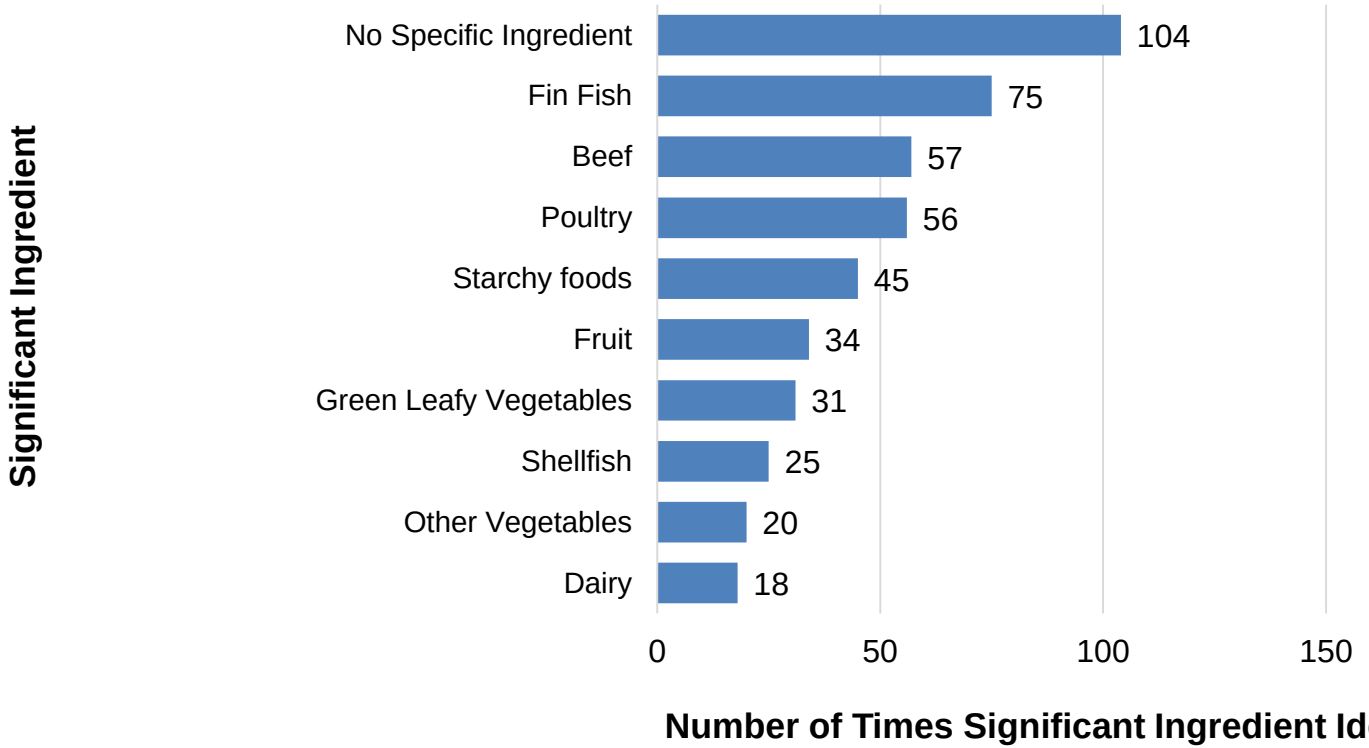
Top 10 Significant Ingredients Identified in Foodborne Outbreaks, New York State, 2003-2017



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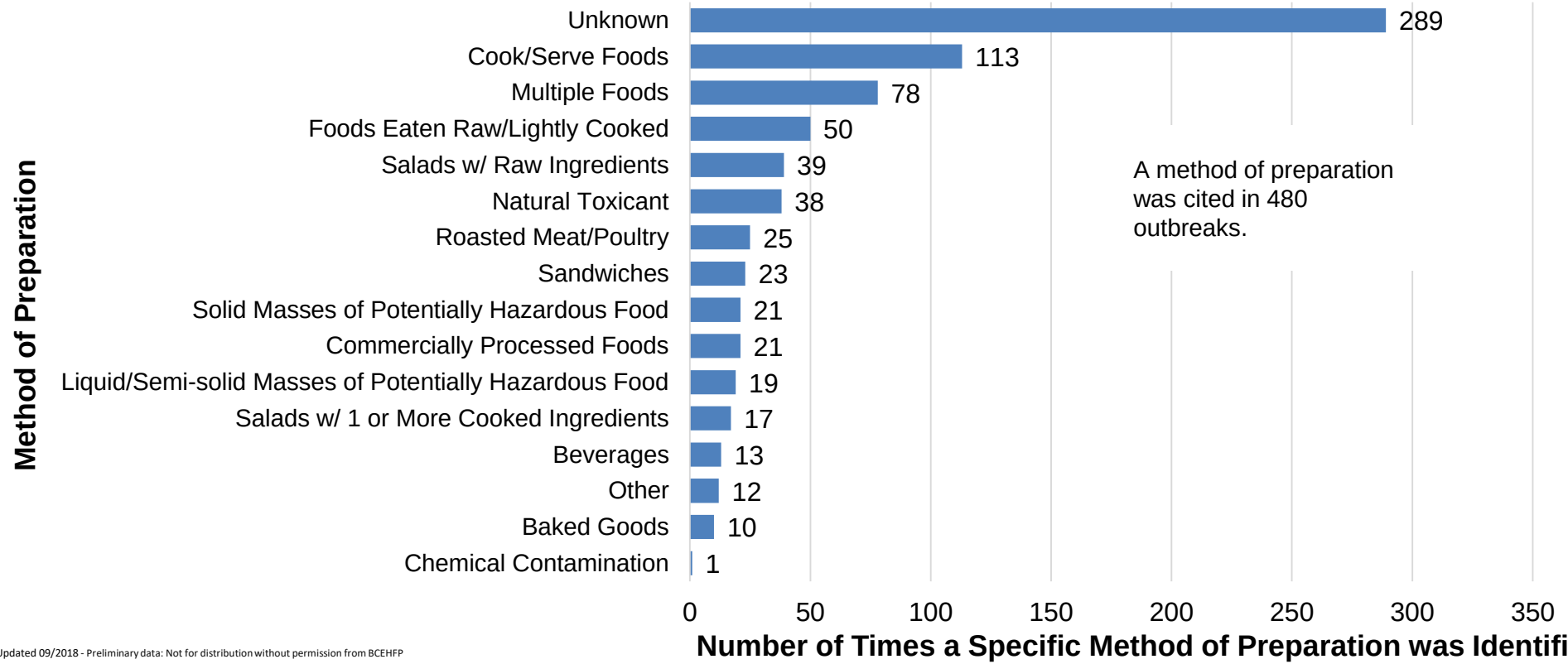
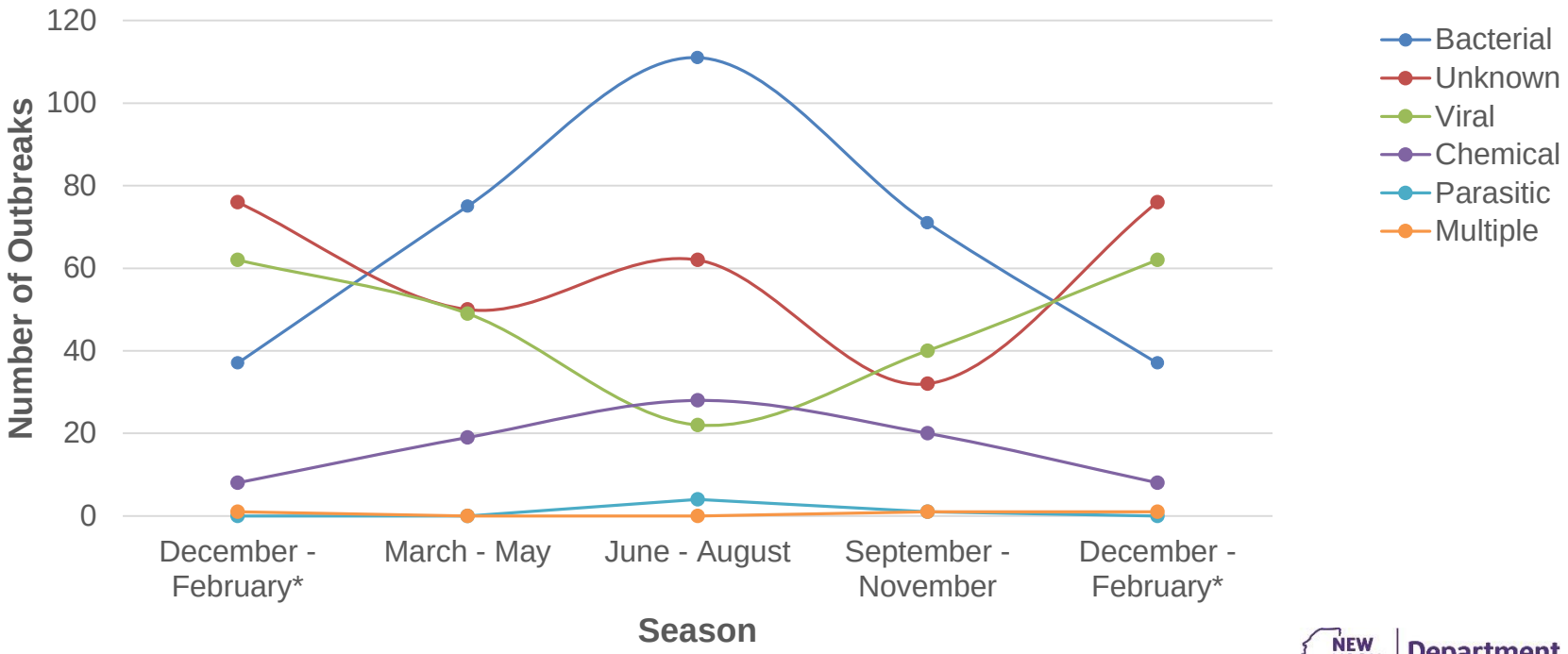
Method of Preparation Identified in Foodborne Outbreaks, New York State, 2003 - 2017



Total Number of Foodborne Outbreaks by Season for All Etiologies, New York State, 2003- 2017



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* December – February contain duplicate information to visually represent trend.

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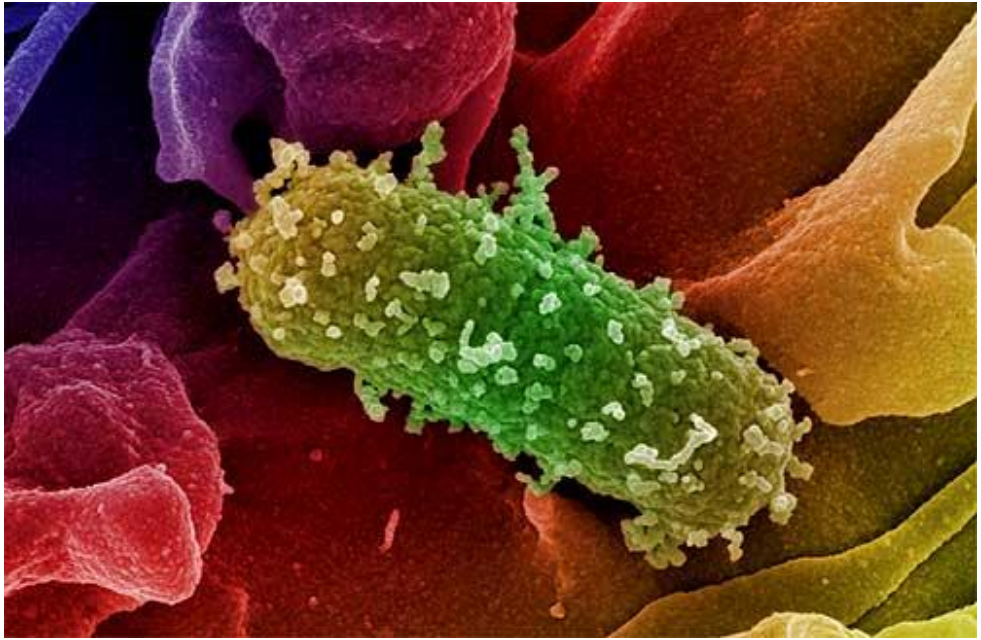
Outbreak Investigation Examples

Local Outbreak

Local Outbreak

- 15 people ill, 33 attended, 32 consumed food
- Christening Party
- Store Bought & Home Prepared Food
- 3 Day Food History
- Developed and Implemented Questionnaire
- Developed a Case Definition
- Onset: 23-49 hours, Duration 19-48 hours
- Sx: N, V, D, Cramps, F, Chills

E. Coli O157:H7



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Source: https://www.marlerblog.com/case-news/what-is-e-coli-o157h7/

STEC O157

- First recognized as a public health threat in the early 90's - associated with hamburger served at a fast food chain

- Extremely adaptable to harsh and acidic conditions
- Most common serogroup related to outbreaks of bloody diarrhea and Hemolytic Uremic Syndrome (HUS)
- Estimated to cause over 63,000 illnesses a year in the US
- Incubation period 2 to 10 days (med. 3-4)

Source: https://www.facebook.com/jackinthebox.wabash/photos/a.156856441007781/406682592691830/?type=1&theater

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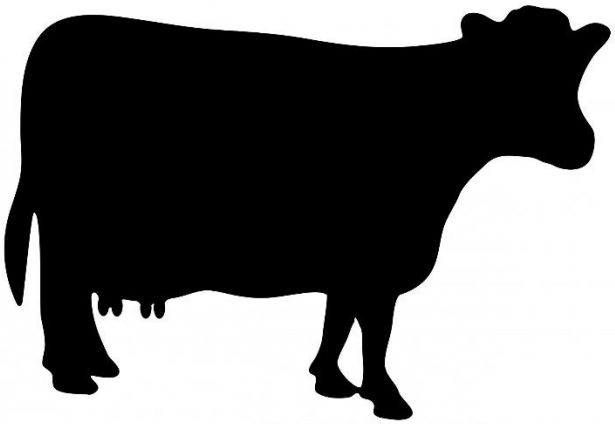
Ground Beef Outbreak



- September-October 2007
- 13 people ill across New York State

Symptoms:

- vomiting
- diarrhea
- cramps
- fever
- one case of HUS

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Source: https://www.publicdomainpictures.net/en/view-image.php?image=43998&picture=cow-silhouette-clipart

Ground Beef Outbreak

- Early on, nationally 12 cases, 5 States, source unidentified
- Later, NYS identified 2 cases from neighboring counties within NYS, positive for *E.coli*, both had ground beef exposure
- Raw frozen patties from same box were submitted for testing from each case
  - One case matched outbreak pattern, and raw patties from opened box
  - Other case matched burgers from their opened box, but did not match outbreak pattern
  - USDA Action = Not Yet!

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- NYSDOH and NYSDAM searched for unopened boxes
- NYSDOH and NYSDAM issued a joint consumer advisory based on opened package positives
- Wadsworth confirmed E.coli from patties of an unopened box
- USDA posted a Recall Notice after Consumer Advisory issued

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Source: http://www.toppsmeat.com/

Topps-Summary

- NYS 13 Cases
  - 12/13 recalled consuming ground beef
  - 10/12 recalled consuming Topps brand
  - HUS (1), Hospitalized (10)
- 40 Cases in 8 States
- Recall of 21.7 million pounds of ground beef
  - Traced back to a Canadian firm that provided beef trim to Topps

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Source: https://www.cdc.gov/ecoli/2007/ground-beef-patties-10-26-2007.html

2005 Outbreak

- 3 persons ate burgers at the same house
- Patties were purchased frozen in a box
- All three cases confirmed with *E.coli* O157:H7
- NYSDAM & USDA notified of investigation
- Leftover burgers sent to Wadsworth Lab for testing and were a match to the case
- Unopened box yielded positive patties

USDA Recall

abc NEWS November 6, 2005 | Get Your Local News an

U.S.

All Sections

ABC News Home > U.S.

Pennsylvania company recalls 94,400 lbs of beef

REUTERS

Nov 1, 2005 — WASHINGTON (Reuters) - Quaker Maid Meats Inc. on Tuesday said it would voluntarily recall 94,400 pounds of frozen ground beef panties that may be contaminated with E. coli.

Salmonella Example

Salmonella

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Source: https://abcnews.go.com/Health/90-people-26-states-infected-salmonella-cdc/story?id=56712700

Salmonella Background

- Causes diarrhea illness in humans and multiplies in the intestines of those it infects
  - Symptoms:
    - diarrhea
    - fever
    - abdominal cramping
    - appear within 12-72 hours of infection
  - Duration: 4-7 days

Multi-State *Salmonella* Outbreak

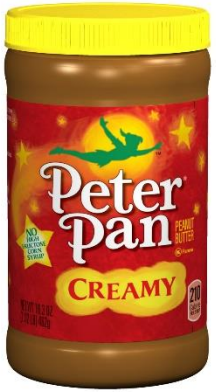
- November 2006
  - CDC and State Health Departments identified a substantial increase in *Salmonella* serotype Tennessee
    - usually 1-5 cases/ month
    - October 2006; 30 cases of *S.* Tennessee

- November - December 2006
  - Several states began investigating the increased incidence
  - 3 uncommon PFGE patterns among cases
    - possible common source

Source?

- No commonalties among cases
  - Geographically dispersed
  - No common foods identified
- January 2007 : Cases re-interviewed with a standard food consumption survey (200 items)
  - 48% consumed turkey
  - 85% consumed peanut butter
    - Higher proportions than expected when compared to food consumption from the FoodNet population survey

Peanut Butter



- February 2007 Case Control Study
  - Turkey no longer significant
  - Cases more likely to consume PB
    - 81% versus 65%
    - especially Peter Pan and Great Value
    - 67% versus 13%
- February 14, 2007
  - FDA consumer advisory
  - ConAgra Recall
    - All Peter Pan
    - Great Value made in the same plant beginning with product code 2111

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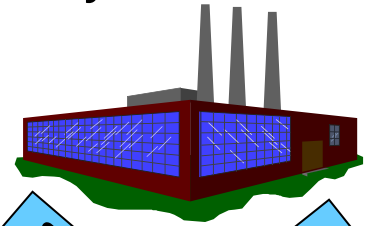
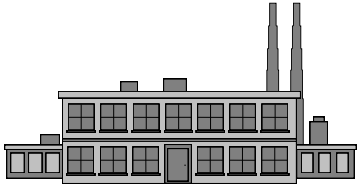
Source: https://www.walmart.com/ip/Peter-Pan-Creamy-Peanut-Butter-16-3-oz/13448726
http://www.glasgowdailytimes.com/news/local_news/peter-pan-set-for-comeback/article_c8b1d67c-de3e-58d2-adce-63ec6cbea43f.html

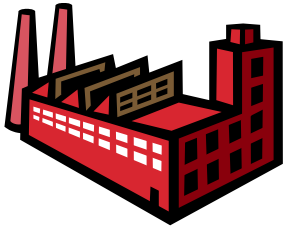
Decoding the Codes

Affected Plant
Sylvester, GA

Other Plants
Throughout U.S.



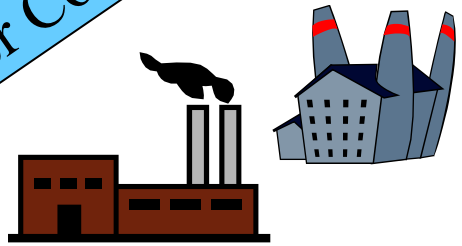




All Peter Pan (2111 Code)

2111 Code

Other Codes



Source: https://www.walmart.com

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Lab Analysis Results

- Late February, 2007
  - 13 States and FDA
    - ~34 jars positive with matching patterns
    - 2 environmental samples positive

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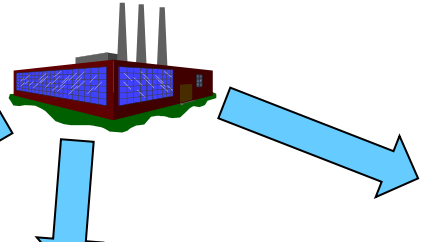
Source: https://www.foodsafetynews.com/2015/05/conagra-pleads-guilty-to-misdemeanor-agrees-to-pay-11-2-million-for-peter-pan-outbreak/

More Recalls

- March, 2007
  - Recall Expanded
    - Back to October, 2004
    - Include dessert toppings made with PB from plant



Source: https://www.walmart.com

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What We Know Now

- This was the first reported outbreak of a foodborne illness caused by peanut butter consumption in the United States.
- As of March 7th at 12 PM EST
  - 425 cases
  - 44 states
  - 48 cases in New York State

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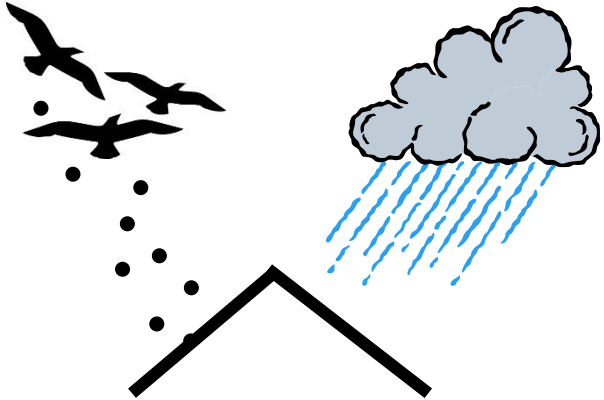
Source: https://www.cdc.gov/salmonella/2007/peanut-butter-3-7-2007.html

Possible Source



- Leaky Roofs and Building Structures
  - More emphasis placed on external and internal building structures during routine inspections

Sources: https://qz.com/752139/food-safety/
https://www.nytimes.com/2015/05/21/us/georgia-conagra-fined-11-2-million-for-salmonella-tainted-peanut-butter.html?_r=0

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Listeria monocytogenes
Example #1

First Notification

USDA

… No hot dog consumption was reported among the cases

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Source: http://www.clker.com/cliparts/g/K/W/w/f/1/hot-dog-hi.png

Epi Data

- 3 NYS Cases
  - 2/3 NYC
- 3/3 Female
- 3/3 Hospitalized
- 3/3 Consumed Soft Cheeses

Exposure Data

Establishments									
	A	B	C	D	E	F	G	H	I
Case 1	X	X	X	X					
Case 2	X		X		X	X			
Case 3							X	X	X

Exposure Data

	Establishments								
	A	B	C	D	E	F	G	H	I
Case 1	X	X	X	X					
Case 2	X		X		X	X			
Case 3							X	X	X

Establishments A, C, D and H carried cheese from a VT Establishment.

Data Changes

- Focus on a VT establishment
  - Was that the source?
  - What do we do next?
- Environmental Investigation/Sampling
  - NYS requested sampling from 4-5 retail locations
  - Requested invoices from 4-5 retail locations
  - Other states VT & CT had some sampling results
    - CT reported leftover positive cheese sample that was collected from a patient's home
    - This sample was a soft cheese from a NY creamery and purchased from an Establishment in NY

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Exposure Data

Establishments										
	A	B	C	D	E	F	G	H	I	J
Case 1	X	X	X	X						
Case 2	X		X		X	X				X
Case 3							X	X	X	

- It was later discovered that Case 2 consumed cheese from Establishment J.
- Establishment J received cheese from same NY Creamery traced back from the CT case

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Environmental Follow-up

- Focus now on a NY Creamery
  - NYSDAM Division of Milk Control and Dairy Services collected samples from three intact wheels of cheese from the NY Creamery
  - The outbreak strain of *Listeria* was identified in samples taken from the three wheels of cheese

National Summary

- 8 people infected with the outbreak strain of Listeria were reported from 4 states.
- WGS performed on clinical isolates from all eight ill people showed that the isolates were closely related genetically.
  - This close genetic relationship provided additional evidence that people in this outbreak became ill from a common source.

What Next?

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Source: https://www.redbubble.com/people/jnasty/works/14308873-happy-hot-dog?p=womens-relaxed-fit

Recall

- On March 7, 2017 NY Creamery issued a Recall
- Soft raw milk cheeses from the NY Creamery were distributed nationwide.
- Establishment no longer in business.

Listeria monocytogenes
Example #2

The Investigation Begins…

- Local NYS *Listeria* Cluster
  - 2 *Listeria* cases from same county
  - 2/2 male
  - Age: both in their 70's
  - Onset 10 days apart
  - PFGE match to each other and to nationwide cases
  - WGS – Both cases 0-1 allele different, and far from other PFGE matching cases

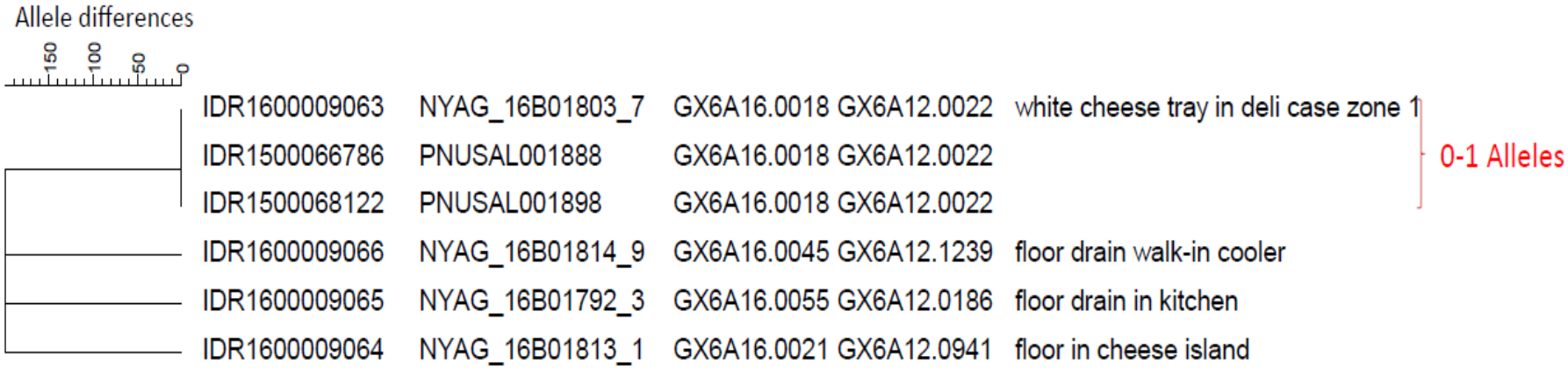
Identifying Commonalities

- Review of the 2 NYS cases indicated they shopped at the same location of a grocery store chain
  - Both purchases Brand X cheese
- Grocery Store had a shopper card program
  - Shopper card releases obtained
    - Both shopped in deli area and produce area
    - Did not shop on same day
    - Purchased from same deli department within 3 days of each other

Environmental Sampling

- NYSDAM conducted environmental sampling at the grocery store
  - 11/20 Environmental Samples from deli were positive for *Listeria*
  - 8/11 samples were a PFGE match to the outbreak strain
  - 3 different PFGE patterns identified
- WGS conducted by Wadsworth Center
  - Cheese tray was closely related

Environmental Sampling



Source: New York State Department of Health Wadsworth Center

Actions Taken

- Grocery Store
  - Voluntarily cleaned
  - Hired a consultant to conduct testing

Acknowledgements

- CDC EHS-Net
- USDA , CDC, FDA
- CT, VT, FL Department of Health Staff
- Local Health Departments
- NYCDOHMH staff
- NYSDOH staff
- NYSDAM staff
- New York Integrated Food Safety Center of Excellence

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Questions?

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