Outbreak of *Salmonella* Poona Infections Linked to Cucumbers Imported from Mexico, United States, August 2015—March 2016

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Arizona Infectious Disease Training
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Foodborne Salmonellosis Overview

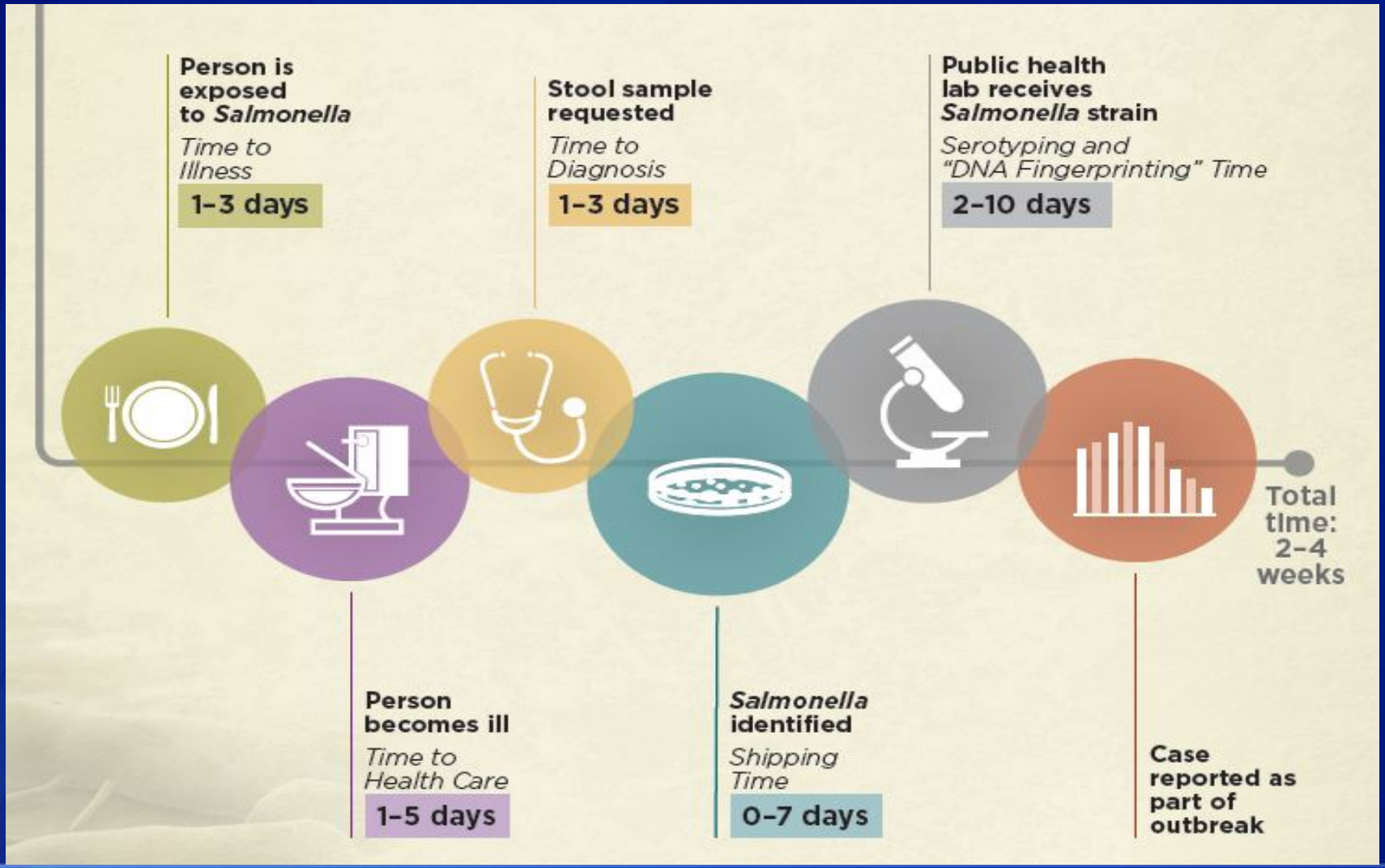
- **1 million illnesses and ~400 deaths annually**
- **Most ill people have diarrhea, fever, and abdominal cramps**
  - Illness usually lasts 4–7 days
  - Most recover without treatment
  - Young children, older adults, immunocompromised people most likely to have severe infections

PulseNet USA

- **National molecular subtyping network for enteric disease surveillance**
- **Molecular subtyping**
  - Pulsed-field gel electrophoresis (PFGE)
  - PFGE pattern = unique molecular fingerprint
  - Isolates with indistinguishable PFGE patterns are more likely to share a common source

PulseNet USA
The National Molecular Subtyping Network for Foodborne Disease Surveillance

Timeline for Reporting Cases of *Salmonella* Infection



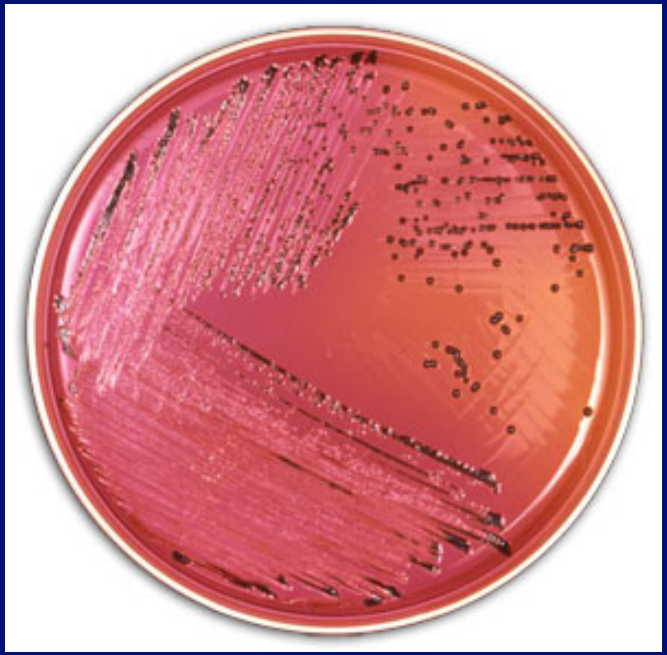
An Outbreak Detected

Day 0 — Case Count: 32

- **August 18, 2015**
  - 32 ill people from 13 states with *Salmonella* Poona with an indistinguishable PFGE pattern
    - Serotype historically linked to cantaloupes, other melons, and turtles

Initial Case Definition

- Illness in a person infected with *Salmonella* Poona PFGE pattern JL6X01.0018
- Isolation date on or after July 3, 2015



Hypothesis Generating Questionnaire

- **Included >300 food, animal, and water exposures**
- **Administered by state and local health departments**
- **Focused questionnaire administered**
  - Compared to FoodNet Population Survey
  - Provides food exposures for healthy people

Hypothesis Generating Questionnaire for _____
Enter Pathogen (e.g., Salmonella Typhimuruim)

PulseNet Cluster Code _____

Form approved
OMB No. 0920-0997
Expires 10/31/2016

Section 1: Interviewer information *(Questions 1-5 to be completed by interviewer prior to questionnaire administration)*

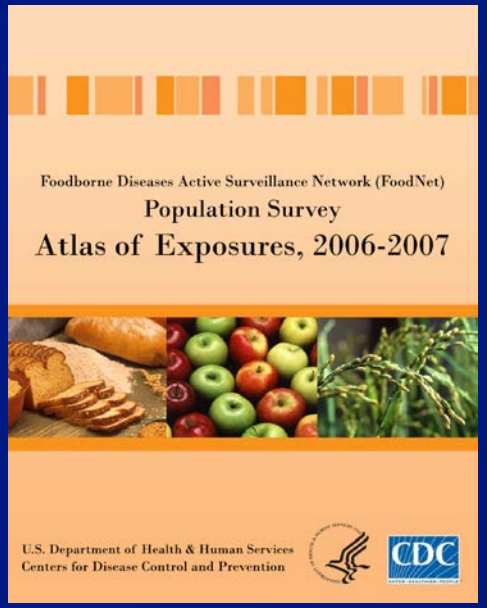
1. PulseNet ID #: _____ 2. State/Local/Other ID #: _____

3. Date of Interview *(must enter MM/DD/YYYY)* _____

4. Interviewer Information Name _____ Contact Phone Number _____
Agency or Organization _____

5. Before this interview how many times has the case been interviewed about their illness? ○ None ○ Once ○ Twice ○ Three Times ○ Other (Specify) _____ ○ Unknown

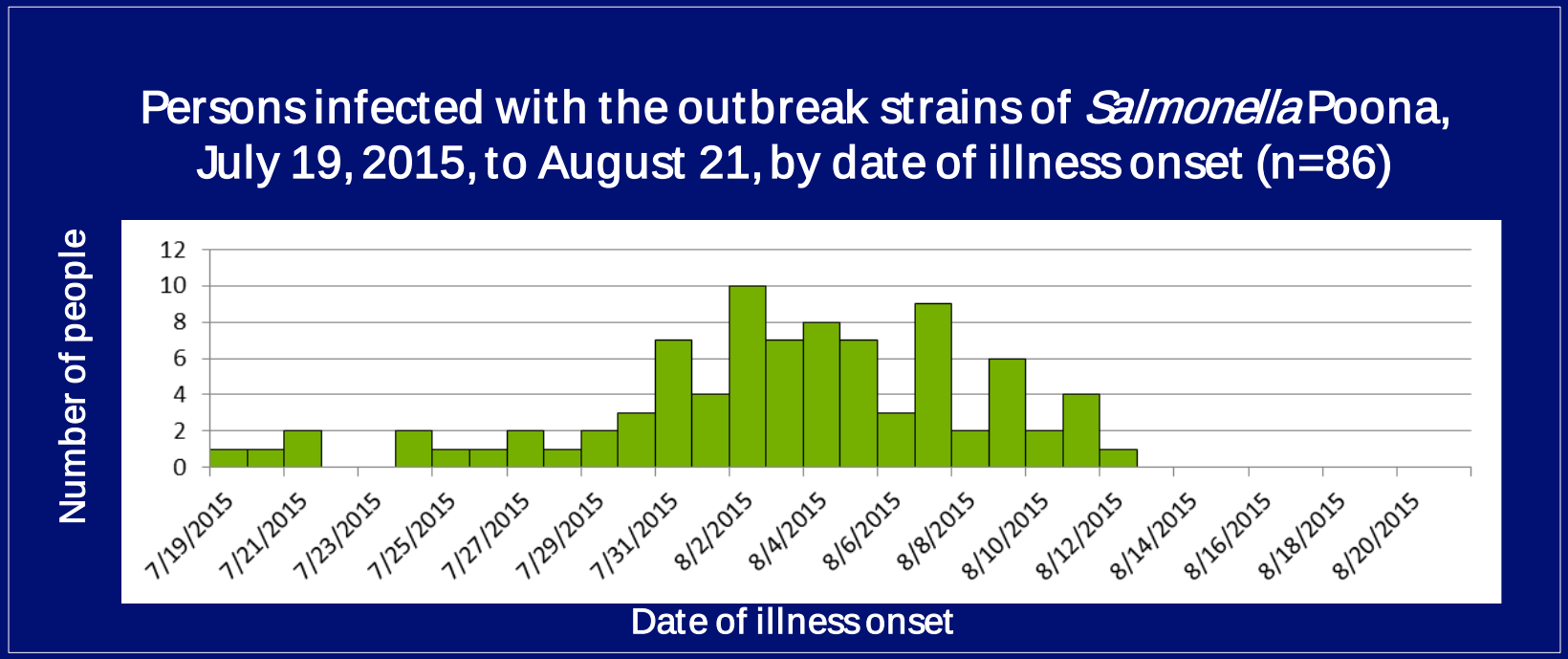
6. Respondent was: ○ Self ○ Parent ○ Spouse ○ Other (Specify) _____



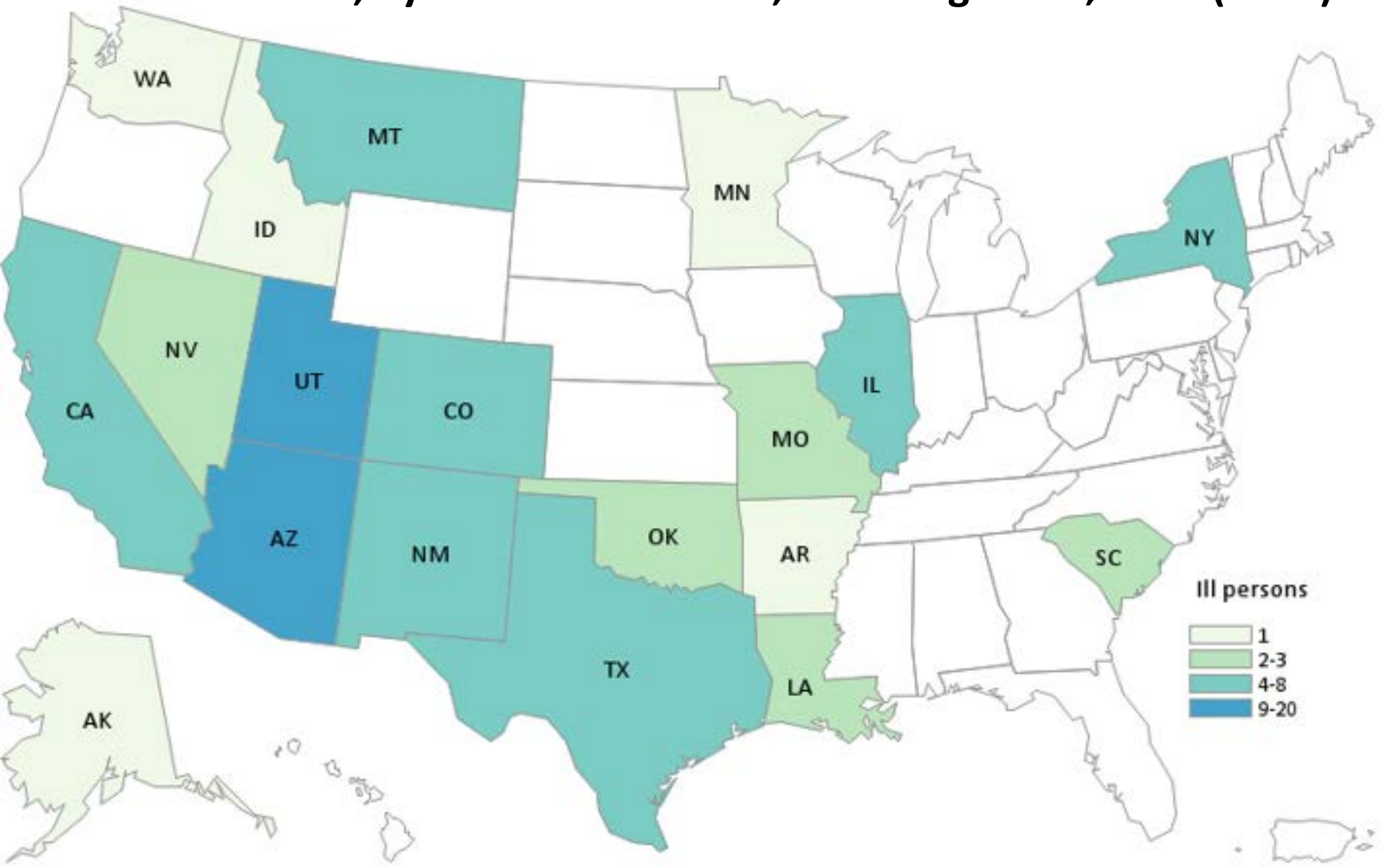
Initial Hypotheses

Day 3 — Case Count: 86

- **August 21, 2015**
  - 86 ill people from 19 states
  - Melons, berries, cucumbers, tomatoes, and lettuce reported



Persons infected with the outbreak strains of *Salmonella* Poona, by state or residence, as of August 21, 2015 (n=86)



Cucumbers Emerge as Suspected Source

Day 6 — Case Count: 145

- **August 26, 2015**
  - 23/27 (85%) reported cucumber consumption
    - Significantly higher than expected in July (55%)
  - Illness sub-clusters identified
    - Common restaurant, event, or grocery store
  - Traceback of sub-clusters initiated

What Is Traceback?

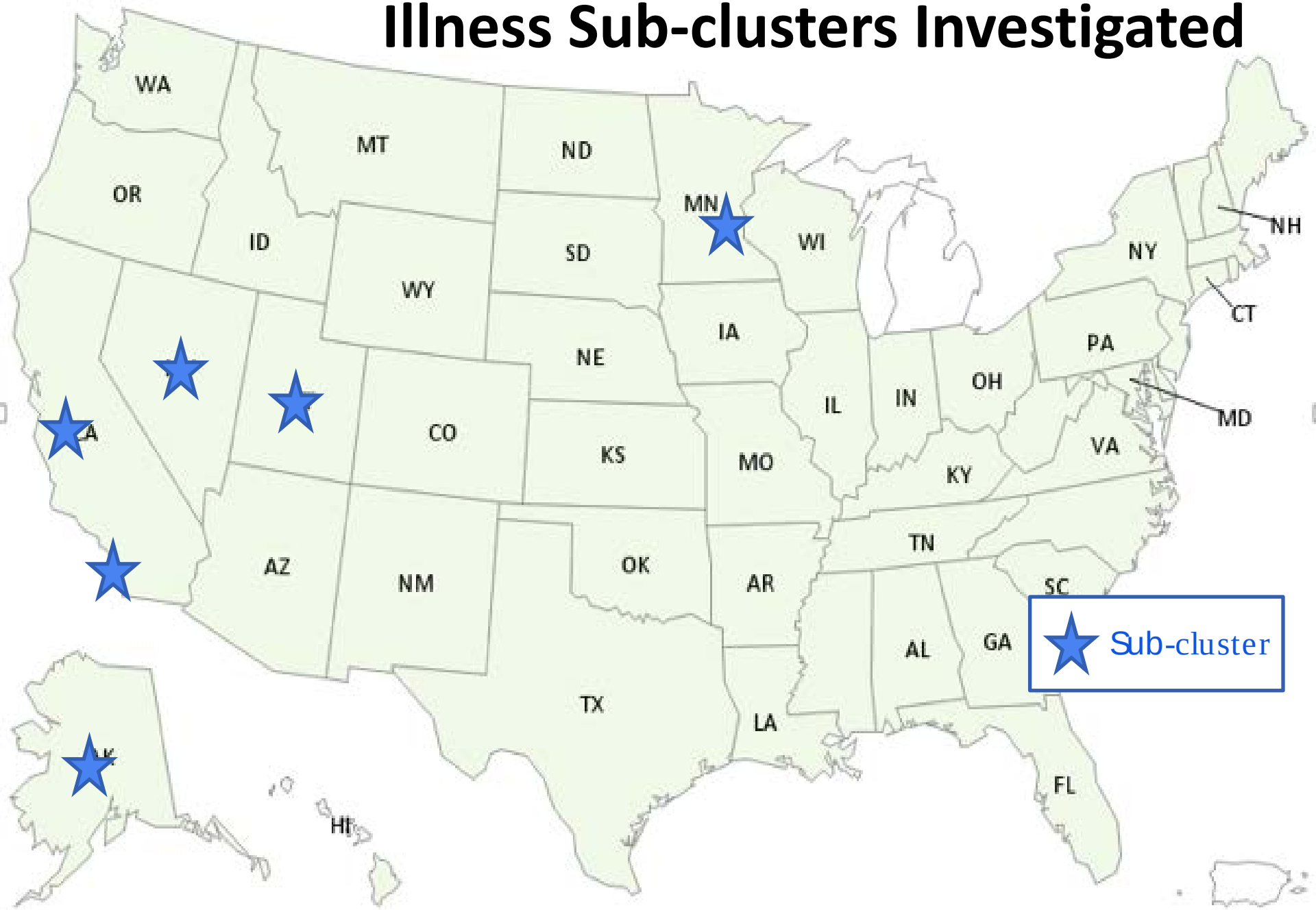
- Using purchase and shipment information
- Identifying a common source of contamination
- Typically performed by state and federal regulatory agencies

Distributor A Identified

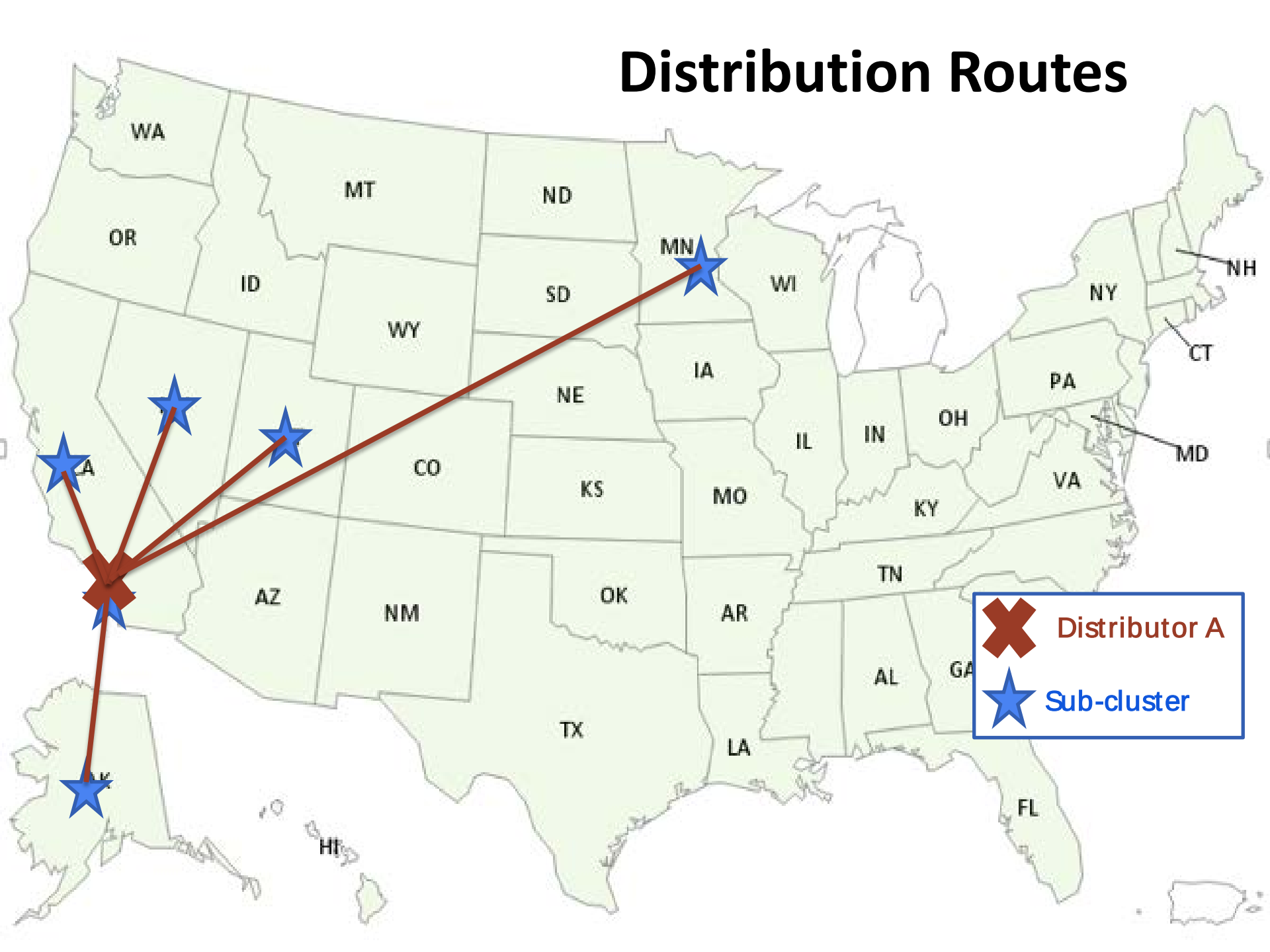
Day 8 — Case Count: 173

- **August 28, 2015**
  - Distributor A supplied common retail locations with cucumbers sourced from Mexico
  - Increased product testing at United States-Mexico border initiated
  - Cucumbers collected

Illness Sub-clusters Investigated



Distribution Routes



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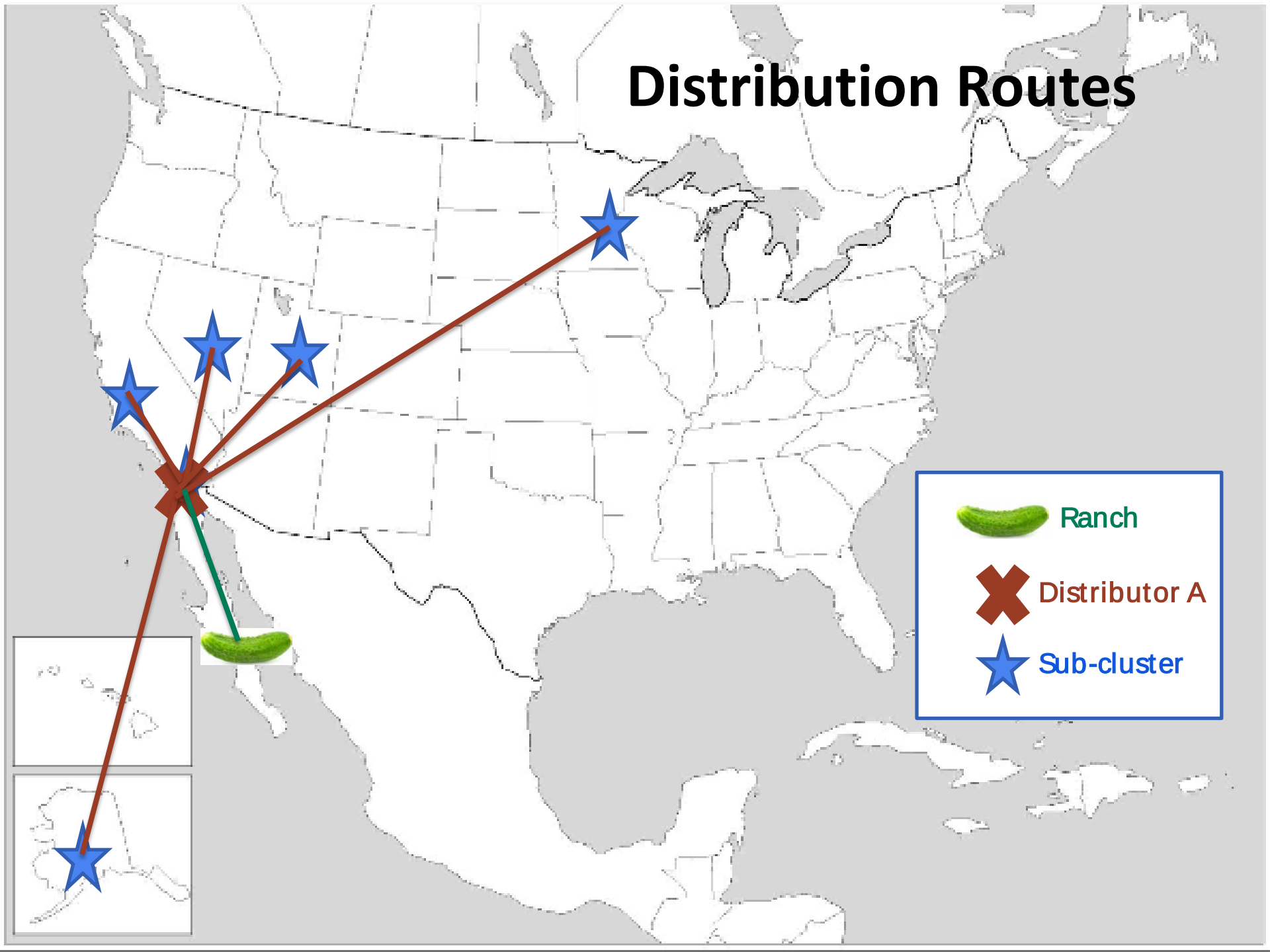


FDA Traceback Diagram

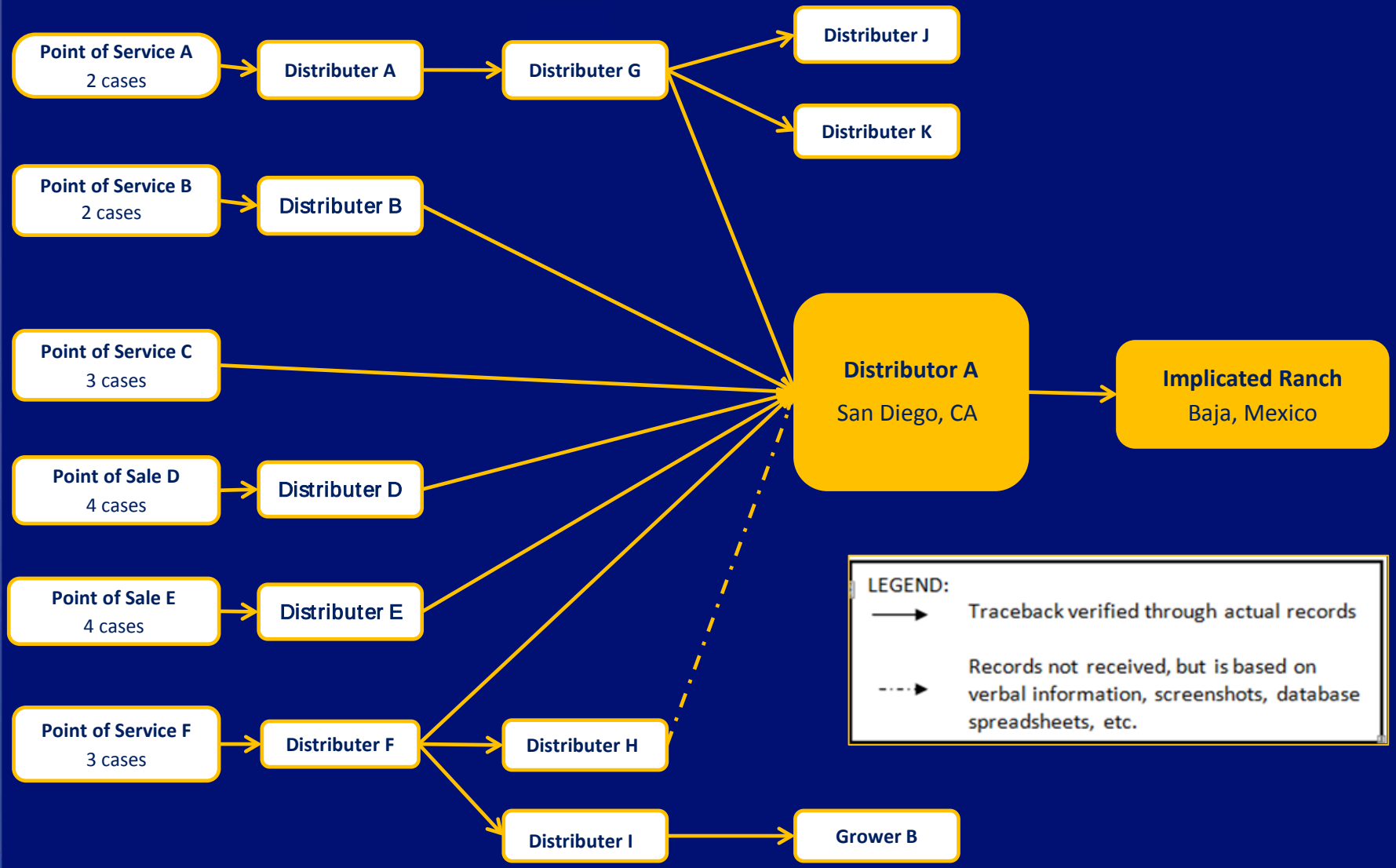


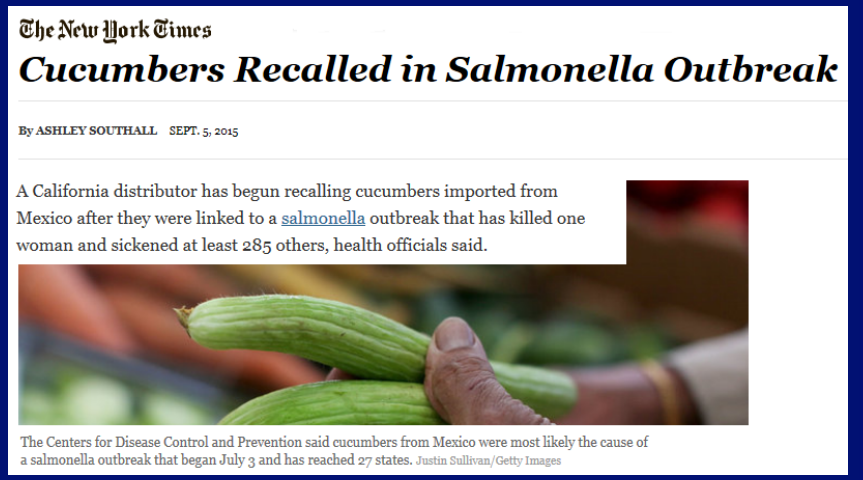
Diagram credit: FDA CORE Response Team 1

Public Health Action

- **September 4, 2015**

Day 16 — Case Count: 305

  - Distributor A issued recall
  - CDC warns the general public to not eat, sell, or serve imported cucumbers from the Distributor A



Laboratory and Regulatory Activities

- **September 10, 2015**

Day 22 — Case Count: 371

  - Outbreak strain isolated from imported cucumbers from Mexico sold by Distributor A

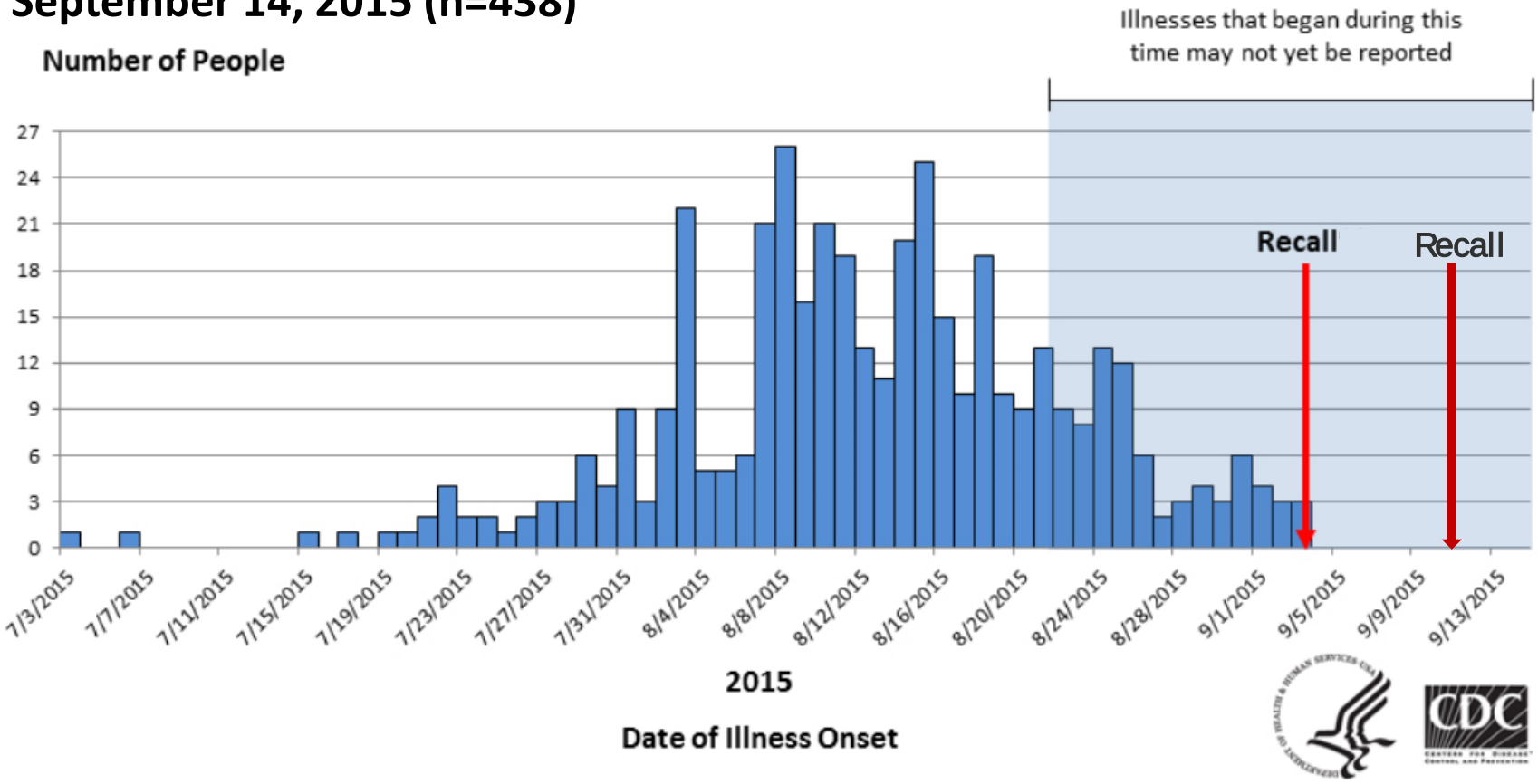
- **September 14, 2015**

Day 26 — Case Count: 438

  - FDA actions stopped importation from Mexican ranch (FDA Import Alert)

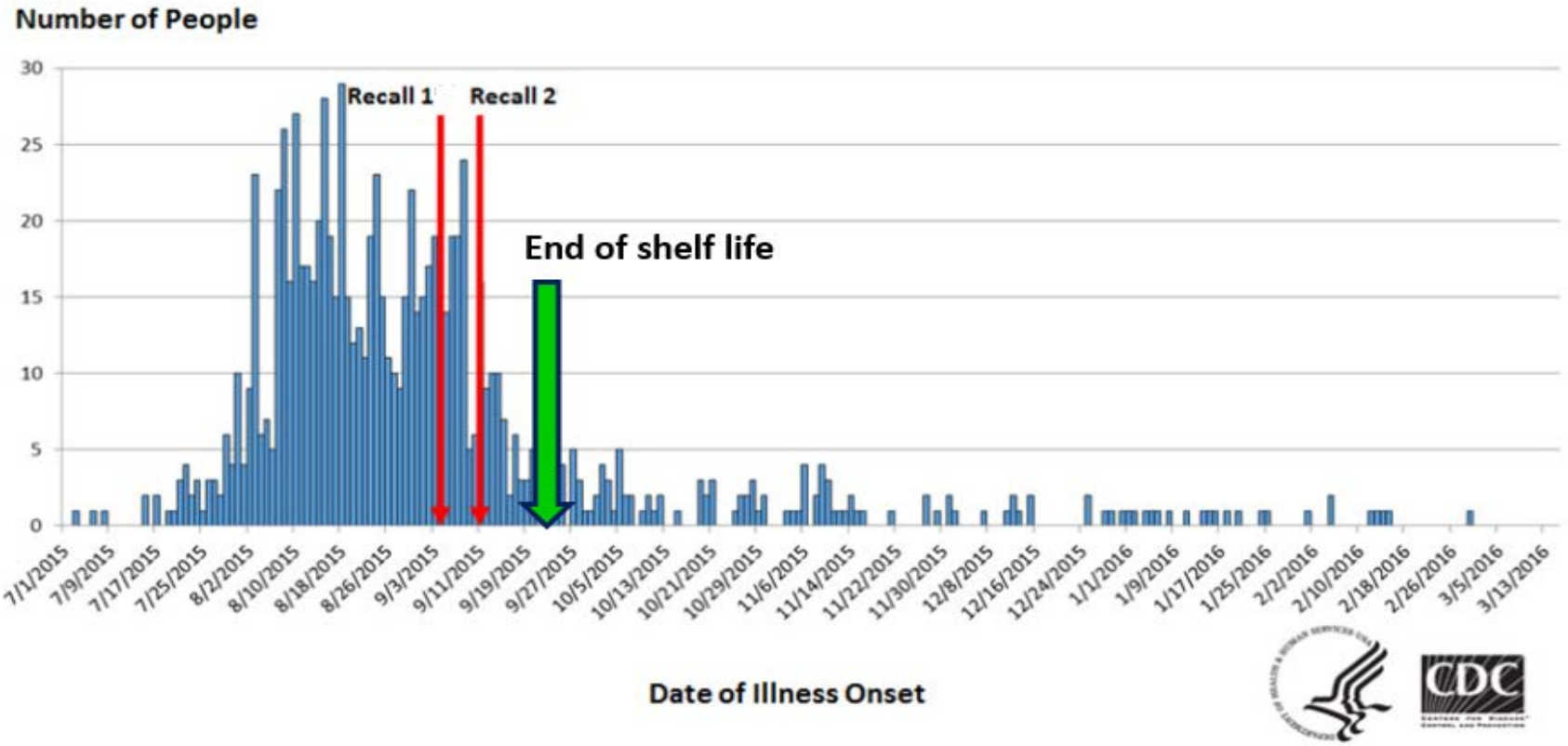
End of the Outbreak?

Persons Infected with the Outbreak Strains of *Salmonella* Poona, July 3 – September 14, 2015 (n=438)



Cases Continue to be Reported

Persons Infected with the Outbreak Strains of *Salmonella* Poona, July 3 – March15, 2015 (n=907)



Pre-recall

	Pre-Recall
Cucumber consumption (# of responses)	65% (138/212)
Age range (median)	<1–99 (18)
Female n=893, (%)	426 (55)
Hospitalized n=661, (%)	117 (20)
Died n=732, (%)	4 (<1)

Post-recall

	Pre-Recall	Post-Recall
Cucumber consumption (# of responses)	65% (138/212)	60% (77/128)
Age range (median)	<1–99 (18)	<1–92 (30)
Female n=893, (%)	426 (55)	76 (62)
Hospitalized n=661, (%)	117 (20)	27 (32)
Died n=732, (%)	4 (<1)	2 (3)

Cucumber Consumption

	Pre-Recall	Post-Recall	Expected from FoodNet Population Survey
Cucumber Consumption (# of responses)	65%* (138/212)	60%* (77/128)	46.9%

P<0.001

Theories for the Continued Illnesses

- **Cross contamination**
  - Display bins
  - Reusable plastic containers
  - Grocery bags
- **Secondary food vehicles**
- **Other theories investigated**

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No other explanation identified

Whole Genome Sequencing (WGS)

- Clinical isolates as well as isolates recovered from cucumbers analyzed
- WGS provided higher resolution compared to PFGE
- Isolates from past outbreaks sequenced for comparison

WGS Methodology

- **Determines the complete DNA sequence of an organism's genome at a single time**
- **Single Nucleotide Polymorphism (SNP) Analysis**
  - Evolutionally informative differences
    - Confer the most recent likely ancestor

ATGTT**C**CTC = test sequence
ATGTT**G**CTC = reference sequence

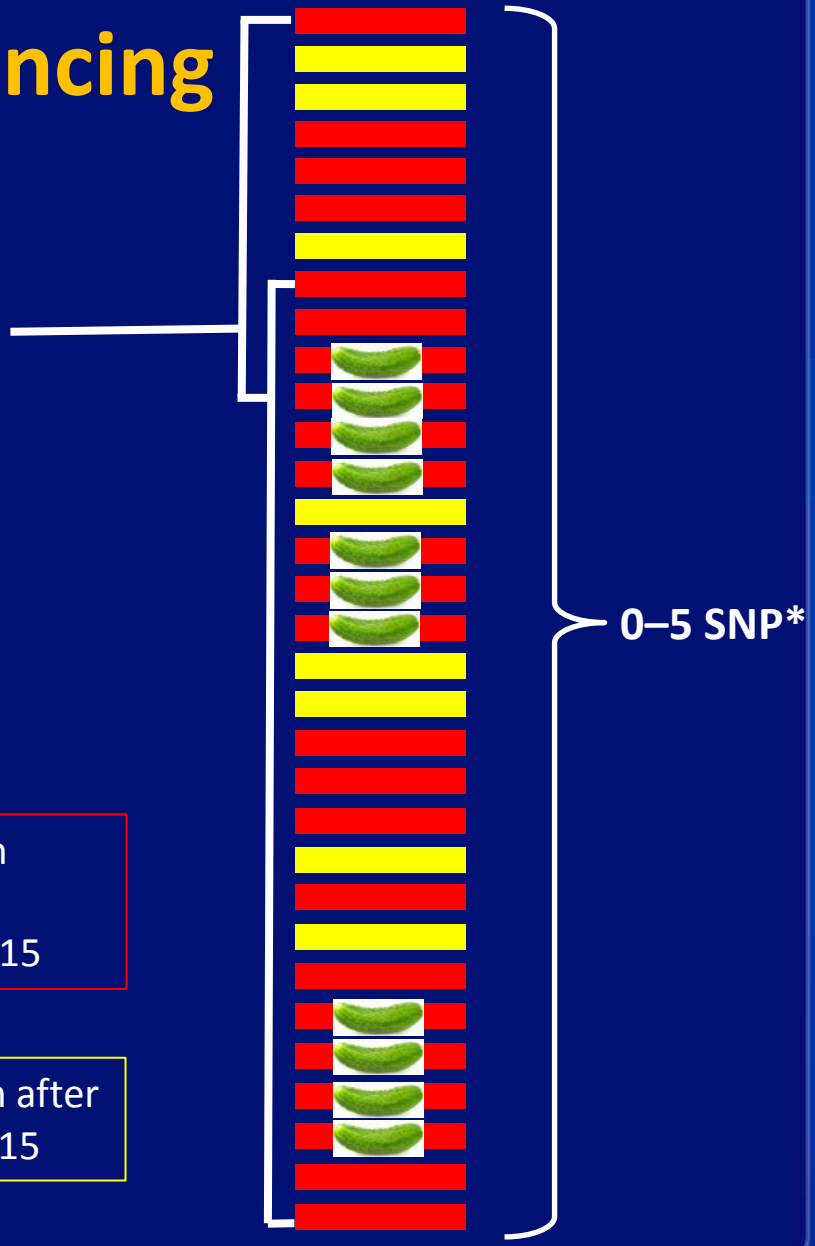
Whole Genome Sequencing Results

- Late onset isolates highly related to pre-recall isolates
- WGS results support epidemiological and traceback evidence of common source for illnesses

Cucumber isolate

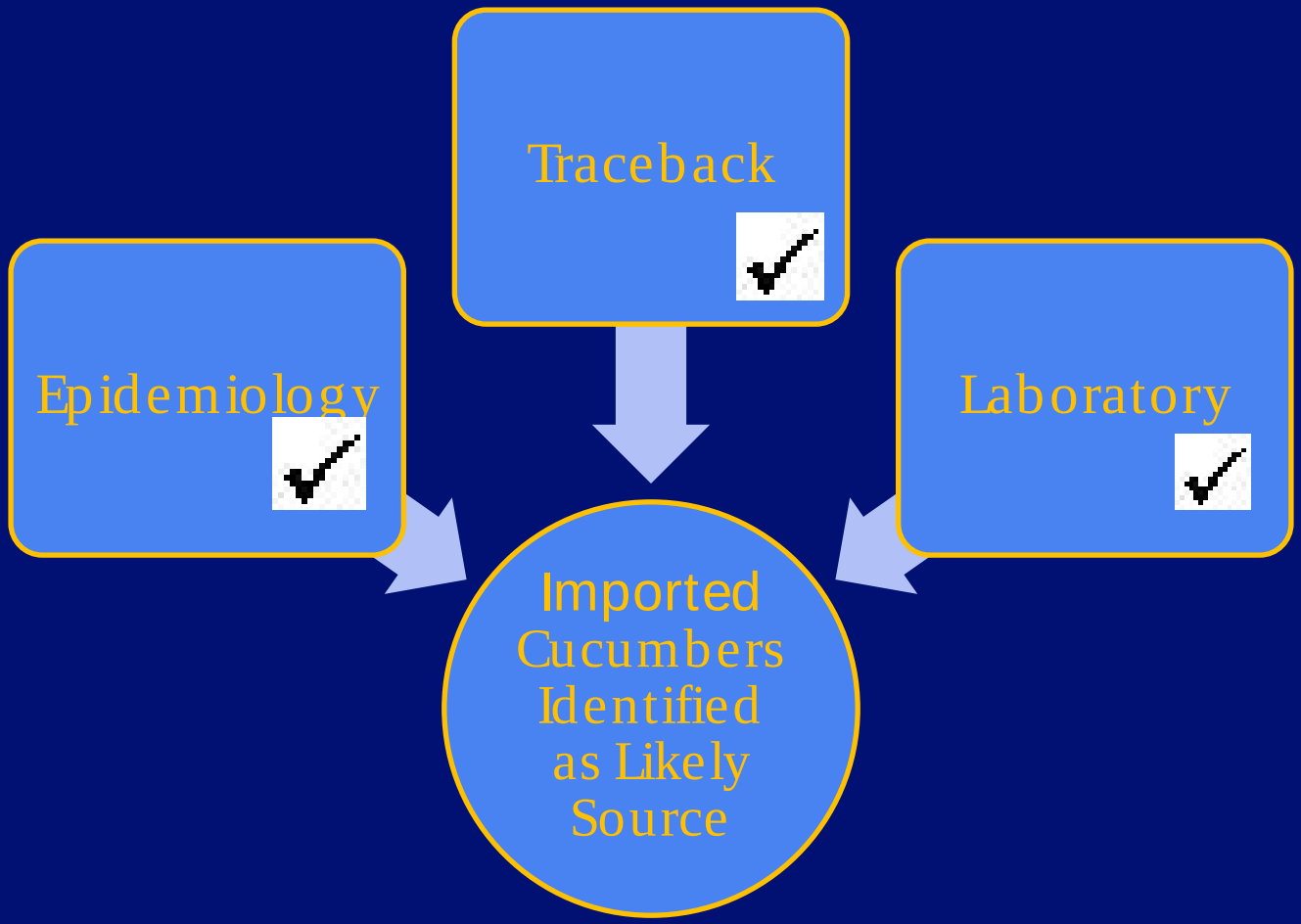
Isolation before 9/24/2015

Isolation after 9/24/2015



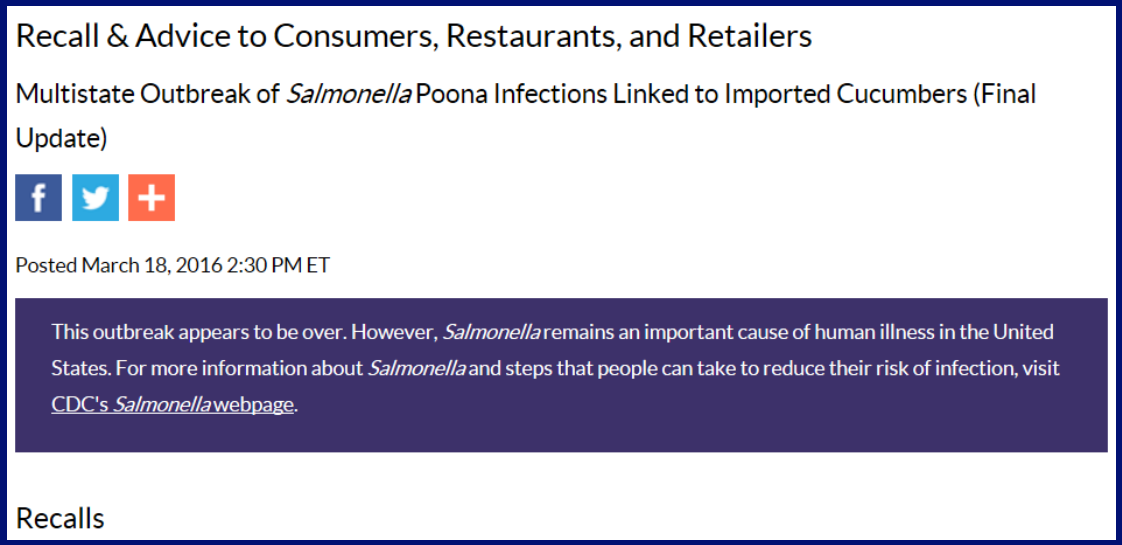
SNP = Single nucleotide Polymorphism

Three Legs of Evidence



Preventing Further Illnesses

- **Possible ongoing cross contamination**
  - Advice to consumers
    - Throw away recalled product
    - Wash and sanitize refrigerator
    - Wash reusable grocery bags



Recall & Advice to Consumers, Restaurants, and Retailers

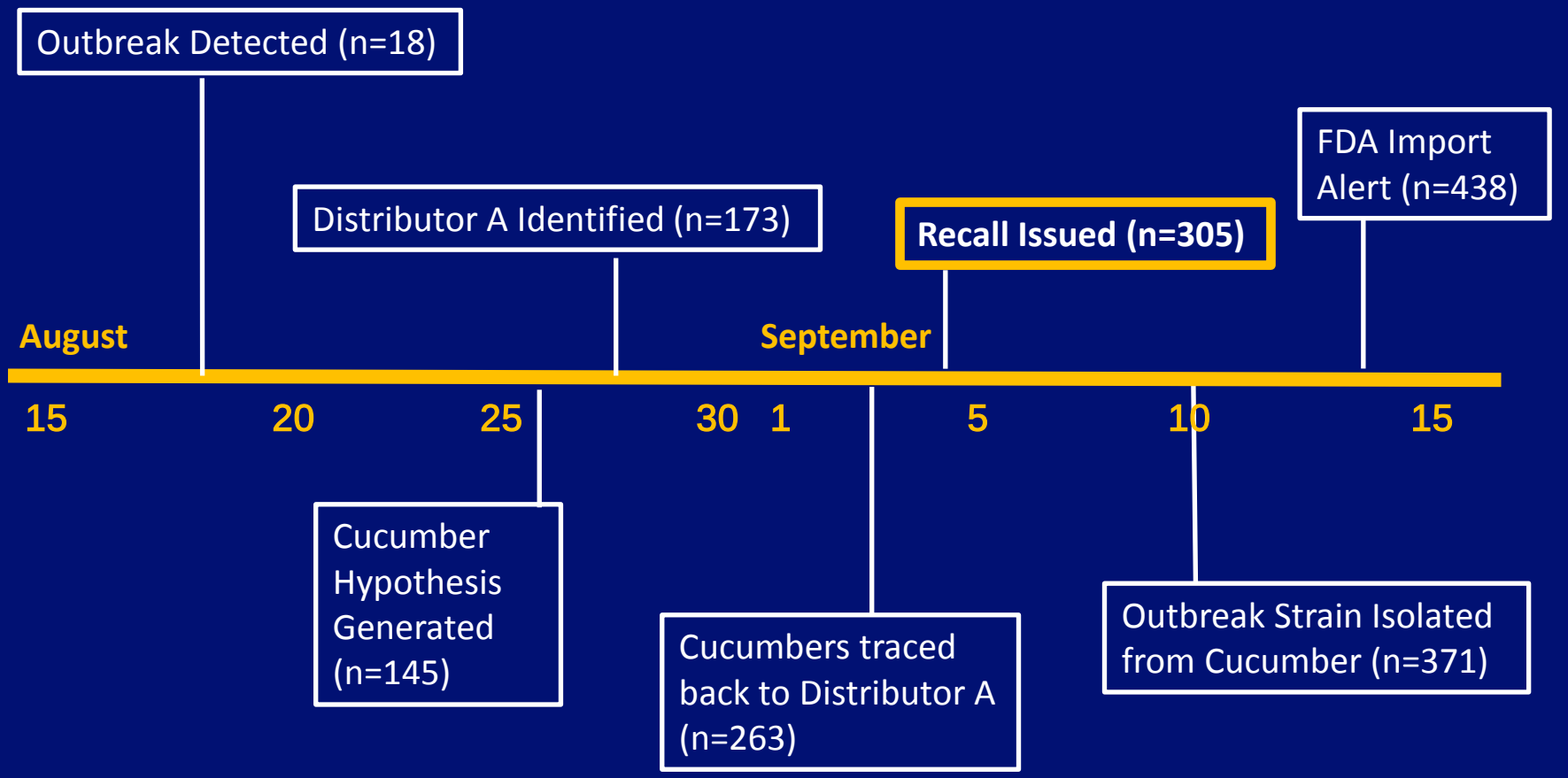
Multistate Outbreak of *Salmonella* Poona Infections Linked to Imported Cucumbers (Final Update)

Posted March 18, 2016 2:30 PM ET

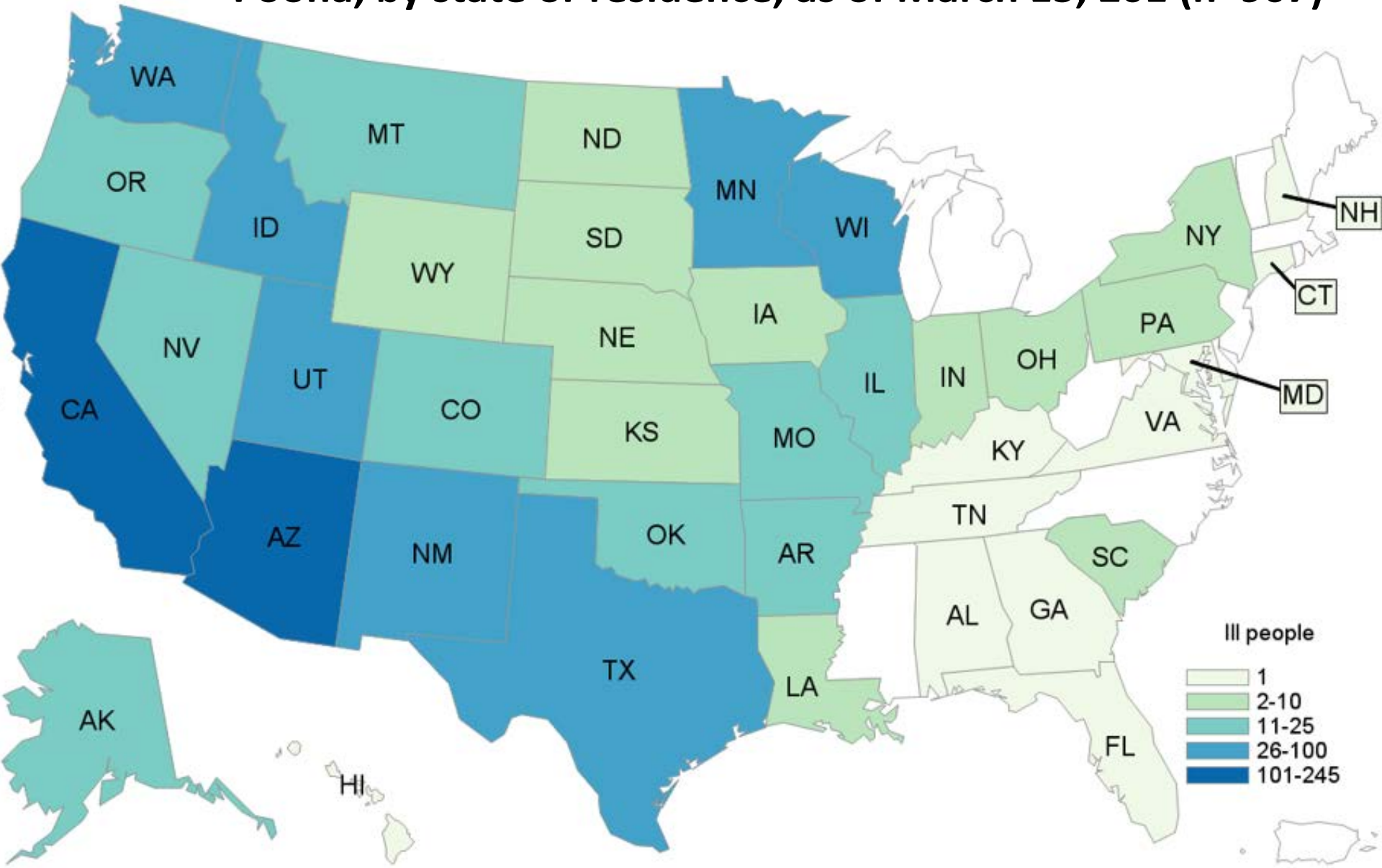
This outbreak appears to be over. However, *Salmonella* remains an important cause of human illness in the United States. For more information about *Salmonella* and steps that people can take to reduce their risk of infection, visit CDC's *Salmonella* webpage.

Recalls

Outbreak Response Timeline



Persons infected with the outbreak strains of *Salmonella* Poona, by state or residence, as of March 15, 201 (n=907)



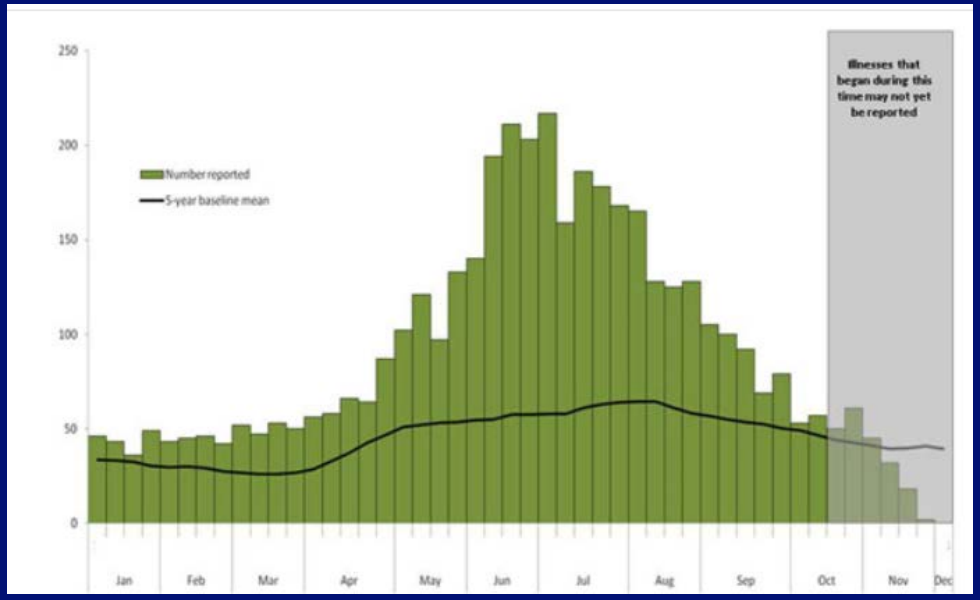
Outbreak Demographics and Outcomes

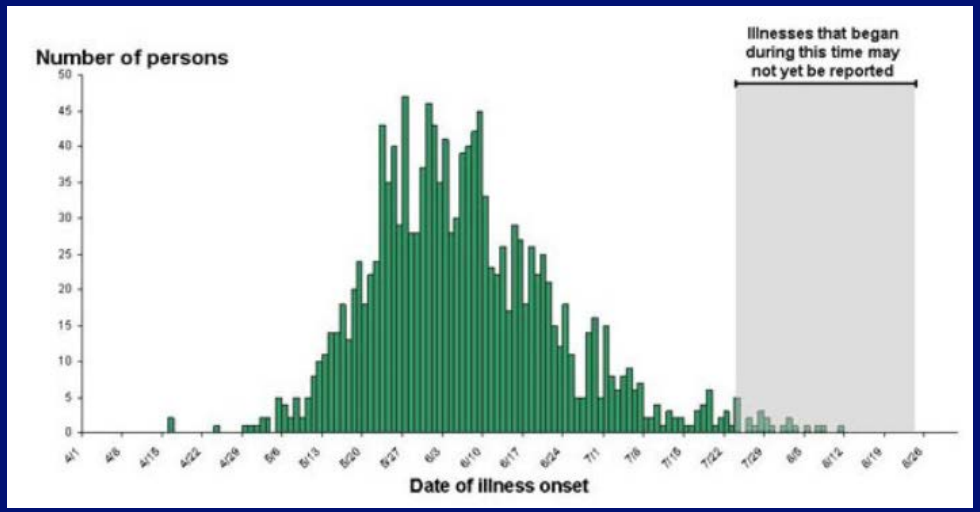
Demographics	
Age range (median), (n=907)	<1–99 (18)
Female, n (%), (n=893)	502 (56)

Outcomes	
Hospitalized, n (%), (n=661)	144 (22)
Died, n (%), (n=732)	6 (<1)

Largest Outbreaks

- **2010 — Shell Eggs**
  - 3578 illnesses
  - *Salmonella* Enteritidis
- **2008 — Multiple Raw Produce Items**
  - 1442 illnesses
  - *Salmonella* Saintpaul





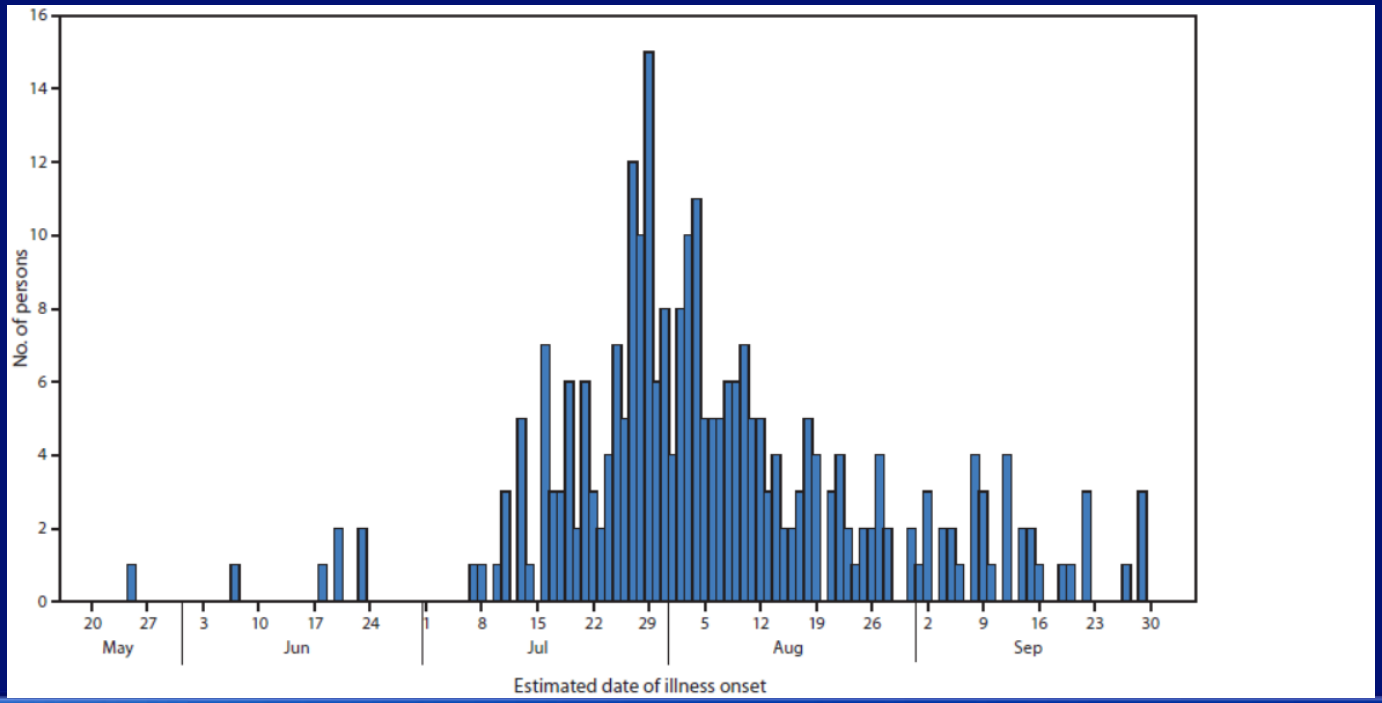
Conclusions

- **Third largest outbreak of *Salmonella* infections in the United States**
- **Short time to recall: 16 days**
  - Sold at multiple points of sale without any brand identification
  - Poor recall with salad items
- **Collaboration between local, state, and federal partners**

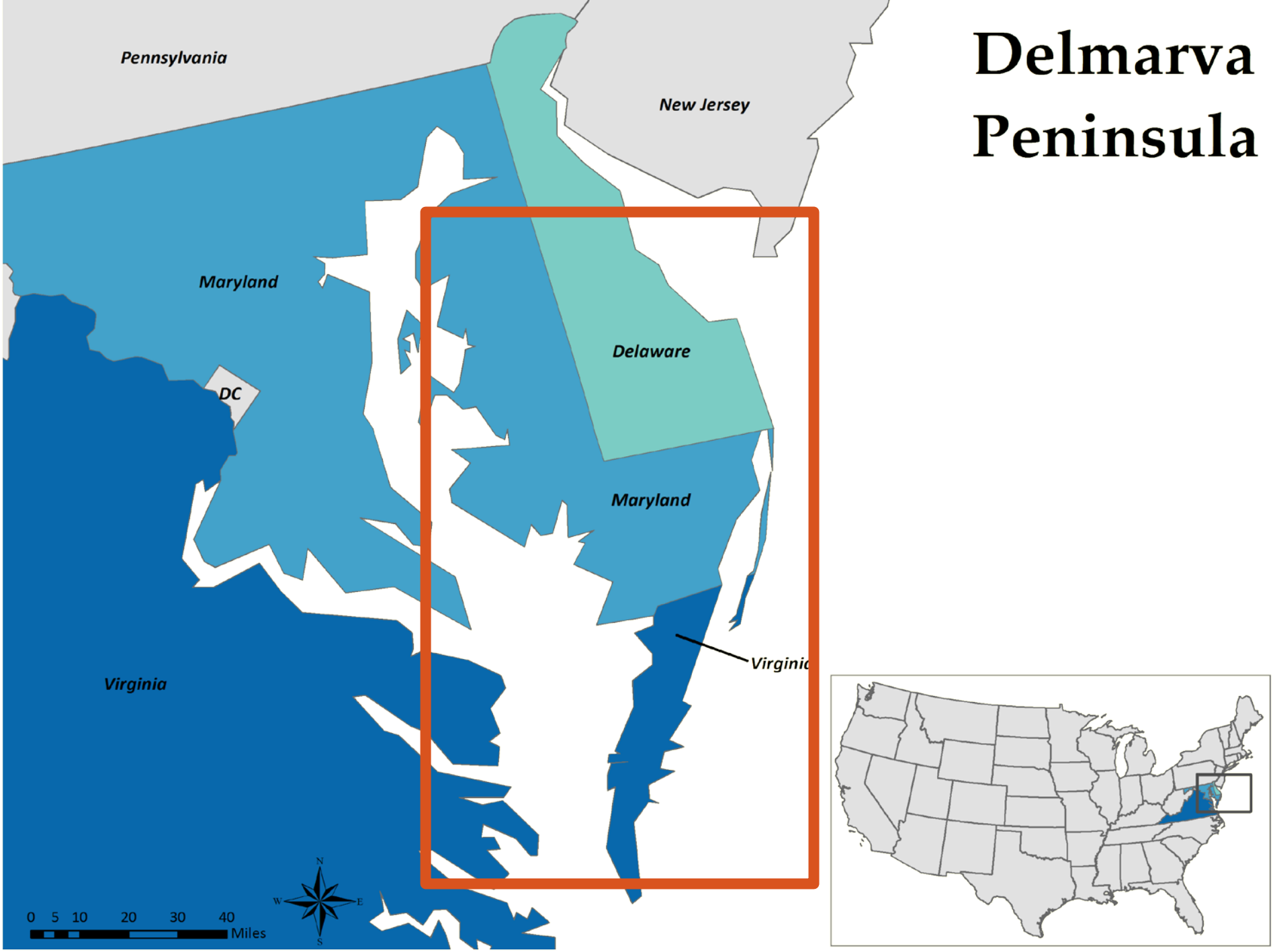
Not the First Time for Cucumbers

- *Salmonella* Saintpaul – 2010
- *Salmonella Newport - 2014*

Persons Infected with the Outbreak Strains of *Salmonella* Poona, July 3 – September 14, 2015 (n=438)



Delmarva Peninsula



Etymology of ‘Delmarva’

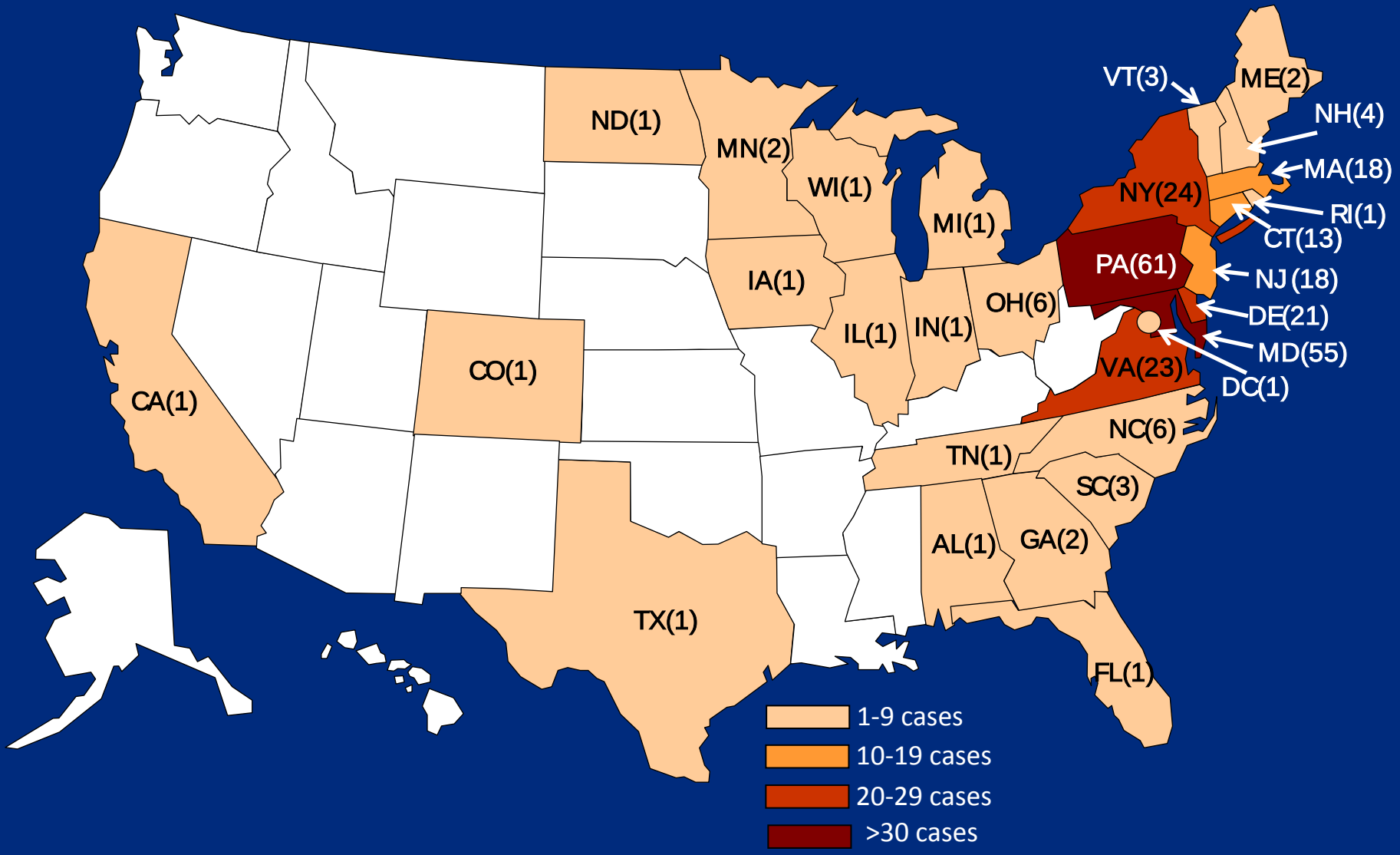
DEL MAR VA

Previous Outbreaks of *Salmonella* Newport Infections (PFGE Pattern 61) from the Delmarva Peninsula

Year	Number of Ill Persons
2002	333
2003	16
2005	72
2006	115
2007	65
2009	69
2010	123
2011	118

- Red round tomatoes
- VA Eastern Shore of the Delmarva Peninsula

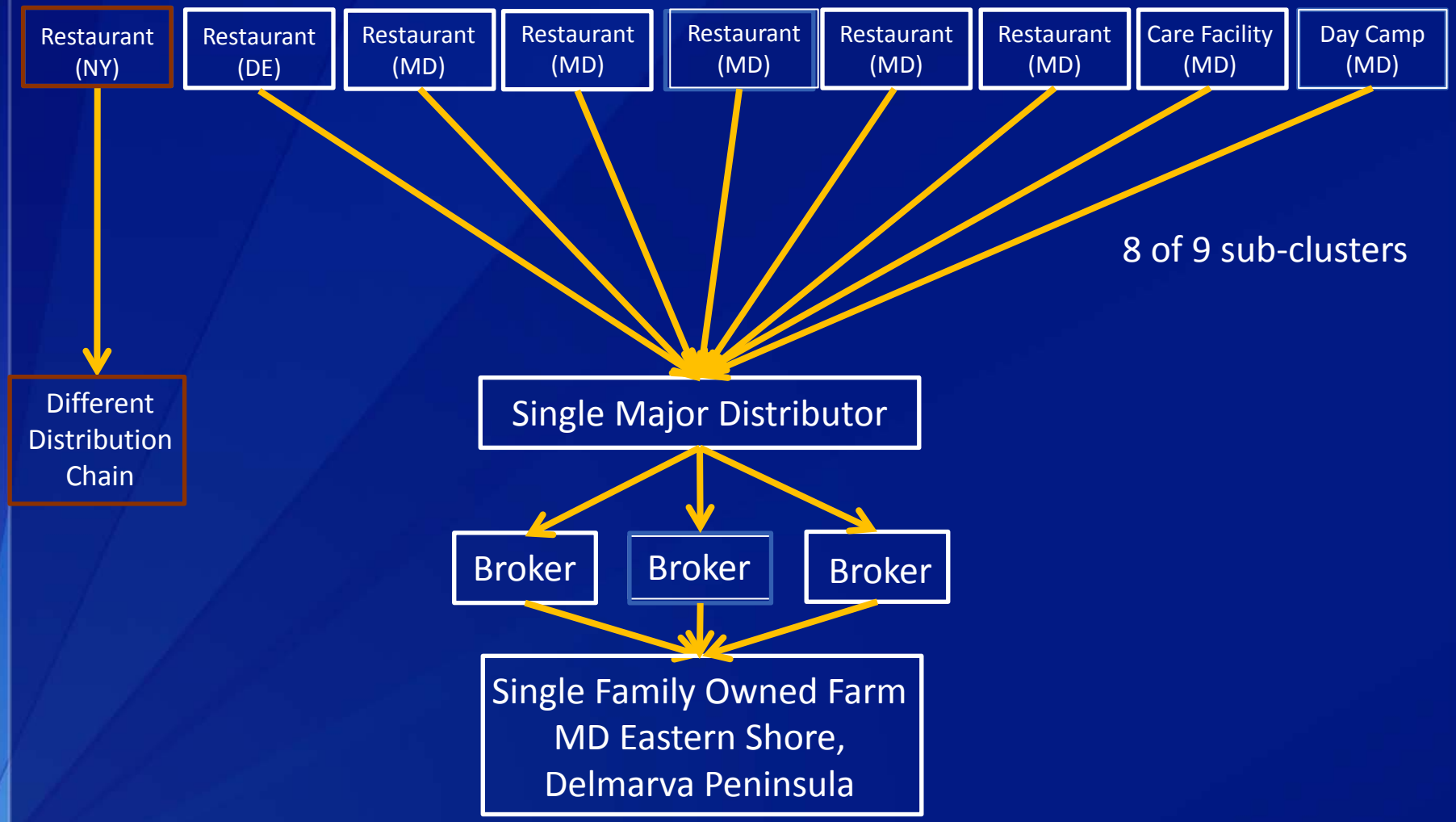
Number of Persons Infected with *Salmonella* Newport (PFGE Pattern 61) by State, 2014 (n=275)



Final Exposure Data, May 20–September 30, 2014

Food Item	n	Ill Persons	FoodNet Population Survey	*p*-value
Cucumber	79	49 (62%)	47%	0.005
Tomato (any)	127	88 (69%)	68%	0.412
Leafy Greens	88	64 (72%)	86%	0.999

Sub-cluster Traceback of Cucumbers



Investigation Summary

- **First outbreak of *Salmonella* Newport PFGE pattern 61 from the Delmarva Peninsula not linked to red round tomatoes**
- **Cucumbers were a major source of illness**
  - Only item consumed by ill persons greater than expected
  - Traceback of the MD and DE sub-clusters led to a single farm
- **WGS**
  - Supported traceback findings
  - Demonstrated genetic relatedness between isolates

Cucumber Challenges

- **Common, but stealthy ingredient**
- **Distribution routes**
  - Domestic and international
- **Fertilizers, irrigation – sources of contamination**
- **Problems with cleaning and processing**

What's Next

- **Continued development of WGS**
- **Continued collaboration between local, state, federal partners**

Acknowledgements

State and local Health Departments & Public Health Laboratories

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FDA Core Response Team 1

FDA Latin America Office

Investigative Team

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- Jessie Marus
- Chandler Church
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- DFWED
- Enteric Disease Laboratory Branch

Thank you

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