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

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Centers for Disease Control and Prevention

Arizona Infectious Disease Training
July 27, 2016
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
Timeline for Reporting Cases of **Salmonella** Infection

- **Person is exposed to Salmonella**
  - Time to Illness: 1–3 days

- **Stool sample requested**
  - Time to Diagnosis: 1–3 days

- **Public health lab receives Salmonella strain**
  - Serotyping and "DNA Fingerprinting" Time: 2–10 days

- **Person becomes ill**
  - Time to Health Care: 1–5 days

- **Salmonella identified**
  - Shipping Time: 0–7 days

- **Case reported as part of outbreak**

Total time: 2–4 weeks
An Outbreak Detected

• 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

Day 0 — Case Count: 32
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
Initial Hypotheses

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

Day 3 — Case Count: 86

Persons infected with the outbreak strains of *Salmonella* Poona, July 19, 2015, to August 21, by date of illness onset (n=86)
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

- **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

Day 6 — Case Count: 145
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

- **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

Day 8 — Case Count: 173
Illness Sub-clusters Investigated
Distribution Routes

Distributor A

Sub-cluster
Distribution Routes

Sub-cluster

Distributor A

Ranch

Sub-cluster

X Distributor A
FDA Traceback Diagram

Point of Sale D  
4 cases

Point of Service B  
2 cases

Point of Service C  
3 cases

Point of Sale D  
4 cases

Point of Sale E  
4 cases

Point of Service F  
3 cases

Distributor A

Distributor B

Distributor D

Distributor E

Distributor F

Distributor G

Distributor H

Distributor I

Distributor J

Distributor K

Implicated Ranch
San Diego, CA
Baja, Mexico

LEGEND:

Traceback verified through actual records

Records not received, but is based on verbal information, screenshots, database spreadsheets, etc.
Public Health Action

- September 4, 2015
  - Distributor A issued recall
  - CDC warns the general public to not eat, sell, or serve imported cucumbers from the Distributor A

Day 16 — Case Count: 305
Laboratory and Regulatory Activities

- **September 10, 2015**
  - Outbreak strain isolated from imported cucumbers from Mexico sold by Distributor A

- **September 14, 2015**
  - FDA actions stopped importation from Mexican ranch (FDA Import Alert)

Day 22 — Case Count: 371

Day 26 — Case Count: 438
End of the Outbreak?

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

Number of People

![Bar Chart showing the number of people infected with the outbreak strains of *Salmonella* Poona from July 3 to September 14, 2015. The chart indicates a decline in infections after a recall event. The CDC logo is present.]
Cases Continue to be Reported

Persons Infected with the Outbreak Strains of *Salmonella* Poona, July 3 – March 15, 2015 (n=907)

End of shelf life
### Pre-recall

<table>
<thead>
<tr>
<th></th>
<th>Pre-Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucumber consumption (# of responses)</td>
<td>65% (138/212)</td>
</tr>
<tr>
<td>Age range (median)</td>
<td>&lt;1–99 (18)</td>
</tr>
<tr>
<td>Female n=893, (%)</td>
<td>426 (55)</td>
</tr>
<tr>
<td>Hospitalized n=661, (%)</td>
<td>117 (20)</td>
</tr>
<tr>
<td>Died n=732, (%)</td>
<td>4 (&lt;1)</td>
</tr>
</tbody>
</table>
### Post-recall

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

<table>
<thead>
<tr>
<th></th>
<th>Pre-Recall</th>
<th>Post-Recall</th>
<th>Expected from FoodNet Population Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucumber Consumption (# of responses)</td>
<td>65%* (138/212)</td>
<td>60%* (77/128)</td>
<td>46.9%</td>
</tr>
</tbody>
</table>

$P < 0.001$
Theories for the Continued Illnesses

- Cross contamination
  - Display bins
  - Reusable plastic containers
  - Grocery bags
- Secondary food vehicles
- Other theories investigated
Theories for the Continued Illnesses

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

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

ATGGTTCCTC = test sequence
ATGGTTCCTC = 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

**SNP** = Single nucleotide Polymorphism

SNP = Single nucleotide Polymorphism
Three Legs of Evidence

Imported Cucumbers Identified as Likely Source

- Epidemiology
- Traceback
- Laboratory
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)

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.
Outbreak Response Timeline

Outbreak Detected (n=18)

Cucumber Hypothesis Generated (n=145)

Distributor A Identified (n=173)

Cucumbers traced back to Distributor A (n=263)

Recall Issued (n=305)

Outbreak Strain Isolated from Cucumber (n=371)

FDA Import Alert (n=438)
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

<table>
<thead>
<tr>
<th>Age range (median), (n=907)</th>
<th>&lt;1–99 (18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, n (%), (n=893)</td>
<td>502 (56)</td>
</tr>
</tbody>
</table>

### Outcomes

<table>
<thead>
<tr>
<th>Hospitalized, n (%), (n=661)</th>
<th>144 (22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died, n (%), (n=732)</td>
<td>6 (&lt;1)</td>
</tr>
</tbody>
</table>
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)
Etymology of ‘Delmarva’

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Ill Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>333</td>
</tr>
<tr>
<td>2003</td>
<td>16</td>
</tr>
<tr>
<td>2005</td>
<td>72</td>
</tr>
<tr>
<td>2006</td>
<td>115</td>
</tr>
<tr>
<td>2007</td>
<td>65</td>
</tr>
<tr>
<td>2009</td>
<td>69</td>
</tr>
<tr>
<td>2010</td>
<td>123</td>
</tr>
<tr>
<td>2011</td>
<td>118</td>
</tr>
</tbody>
</table>

- 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)

- **20-29 cases**
  - OH (6)
  - PA (61)
  - DE (21)
  - CT (13)
- **1-9 cases**
  - NY (24)
  - FL (1)
  - AL (1)
  - CA (1)
  - CO (1)
- **>30 cases**
  - MD (55)
  - MA (18)
  - NJ (18)
  - DE (21)
  - RI (1)
  - VT (3)
  - DC (1)

The map shows the distribution of infections across the United States, with states colored according to the number of cases.
## Final Exposure Data, May 20–September 30, 2014

<table>
<thead>
<tr>
<th>Food Item</th>
<th>n</th>
<th>Ill Persons</th>
<th>FoodNet Population Survey</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucumber</td>
<td>79</td>
<td>49 (62%)</td>
<td>47%</td>
<td>0.005</td>
</tr>
<tr>
<td>Tomato (any)</td>
<td>127</td>
<td>88 (69%)</td>
<td>68%</td>
<td>0.412</td>
</tr>
<tr>
<td>Leafy Greens</td>
<td>88</td>
<td>64 (72%)</td>
<td>86%</td>
<td>0.999</td>
</tr>
</tbody>
</table>
Sub-cluster Traceback of Cucumbers

Different Distribution Chain

Restaurant (NY)
Restaurant (DE)
Restaurant (MD)
Restaurant (MD)
Restaurant (MD)
Restaurant (MD)
Restaurant (MD)
Care Facility (MD)
Day Camp (MD)

8 of 9 sub-clusters

Single Major Distributor

Broker
Broker
Broker

Single Family Owned Farm
MD Eastern Shore,
Delmarva Peninsula
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
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Enteric Disease Laboratory Branch
Thank you

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E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.