Outbreak of *Salmonella* Newport Infections Linked to Cucumbers — United States, 2014

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InFORM
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Foodborne Salmonellosis Epidemiology

- 1 million illnesses
- 20,000 hospitalizations
- 400 deaths

Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson MA, Roy SL, Jones JL, Griffin PM. Foodborne Illness Acquired in the United States – Major Pathogens. Emerg Infect Dis, 2011; 17(1):7-15.
Geographic Distribution of *Salmonella* Newport (PFGE Pattern 61) Cases as of August 19, 2014 (n=85)

- >9 cases:
  - PA (24)
  - OH (4)
  - VA (7)
  - NY (1)

- 4-8 cases:
  - DE (9)
  - MD (15)
  - MA (9)
  - NJ (6)
  - NC (3)
  - SC (3)
  - GA (1)

- 1-3 cases:
  - NH (2)
  - CT (1)

Map colors indicate:
- Light orange: 1-3 cases
- Orange: 4-8 cases
- Dark orange: >9 cases

The map shows the state distribution of cases with varying numbers in each state.
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
Case Definition

- Infection with *Salmonella* Newport PFGE pattern 61
- Illness onset on or after May 20, 2014

Isolation of *Salmonella* on XLD agar. Source: CDC
Hypothesis Generating Questionnaire

- Included >300 food, animal, and water exposures
- Administered by state and local health departments
Supplemental Questionnaire

- Emphasized tomatoes and other produce
- Information on exposures in the 7 days prior to illness onset
Travel Questionnaire

TRAVEL SUPPLEMENTAL QUESTIONNAIRE FOR SALMONELLA NEWPORT (1498MLJJP-1)

Section 1: INTERVIEWER INFORMATION (Questions 1-5 to be completed by interviewer prior to questionnaire administration)
1. Place/ID #: ________________________________
2. State/County/Other ID #: ________________________________
3. Date of Interview: M M D D Y Y Y Y [if unknown, enter 12/31/9999]
4. Interview Information Name: ________________________________
   Agency or Organization: ________________________________
   Contact phone number: ________________________________
5. Before this interview, how many times has the case been interviewed about their illness by a local, state, or federal public health representative? None □ □ □ □ □ □ □ □ □ Once □ □ □ □ □ □ □ □ □ Twice □ □ □ □ □ □ □ □ □ Three times □ □ □ □ □ □ □ □ □ Other (specify # times) □ □ □ □ □ □ □ □ □ Unknown □ □ □ □ □ □ □ □ □
6. Respondent was □ Self □ Parent □ Spouse □ Other (Specify) □ □ □ □ □ □ □ □ □

Section 2: DEMOGRAPHIC DATA: I’d like to begin by asking a few questions about yourself (your child) and your household.
1. Birth month and year: ____________ (If unknown, enter 999999)
2. Sex: □ Male □ Female □ Unknown

Section 3: TRAVEL: Next I have a couple of questions about your travel to Delaware, Maryland, and/or Virginia:

| Did you travel to Virginia? | MAYBE | No | DON'T KNOW |
|----------------------------|-------|----|------------|
| □                          | □     | □  | □          |

1b. If yes, what were the date(s) of travel? __________________________

| Did you travel to Delaware? | MAYBE | No | DON'T KNOW |
|-----------------------------|-------|----|------------|
| □                           | □     | □  | □          |

2b. If yes, what were the date(s) of travel? __________________________

| Did you travel to Maryland? | MAYBE | No | DON'T KNOW |
|-----------------------------|-------|----|------------|
| □                           | □     | □  | □          |

3b. If yes, what were the date(s) of travel? __________________________

| Did you travel to the Delmarva Peninsula (includes VA, MD, and DE)? | MAYBE | No | DON'T KNOW |
|-------------------------------------------------------------------|-------|----|------------|
| □                                                                 | □     | □  | □          |

Please comment specifically on where you traveled (also include mode of transportation - [car, bus, train, air])

Section 4: Restaurant Exposures: I have questions about where you ate in the seven days before you (your child) got sick.

| Did you (your child) eat food from: | MAYBE | No | DON'T KNOW |
|-------------------------------------|-------|----|------------|
| Harpoon Hannah’s (Fenwick Island, DE) | □     | □  | □          |

1a. If yes, please list what you ate there, including breads, drinks, garnishes, appetizers, entrees, desserts.

1b. What date did you dine at this establishment? ____________

1c. Did you make any substitutions or deletions to the items you ordered? If yes, please list changes here

1d. How many others did you dine with at this restaurant? ________ people

1e. Was anyone else whom you dined with also sick? □ Yes □ No □ Unknown

1f. If yes, how many are ill

1g. If yes, what foods did you eat in common?
Foodborne Diseases Active Surveillance Network (FoodNet)
Population Survey
Atlas of Exposures, 2006-2007

U.S. Department of Health & Human Services
Centers for Disease Control and Prevention

CDC
### Tomato Exposure Data as of August 27, 2014 (n=13)

- 9 (69%) reported tomatoes on the supplemental questionnaire
  - Not significant when compared to 68% ($p=0.593$)

| Type of Tomato | n (%) |
|----------------|-------|
| Red Round      | 4 (31%) |
| Vine Ripe     | 3 (23%) |
| Cherry         | 1 (8%)  |
| Grape          | 1 (8%)  |
| Roma           | 1 (8%)  |
| Other          | 1 (8%)  |
| Unknown        | 1 (8%)  |
Cucumber Exposure Data as of September 3, 2014 (n=32)

| Ill Persons | FoodNet Population Survey | p-value |
|-------------|---------------------------|---------|
| Cucumber    | 21 (66%)                  | 47%     | 0.026   |
Industry Consultation

- 3 independent produce industry experts
- Provided information regarding:
  - Crop production
  - Distribution practices
  - Plausibility of cucumbers as a vehicle
Investigating Sub-clusters

- **Sub-cluster definition**
  - 2 or more unrelated ill persons
  - Eating at the same restaurant or event, or shopping at the same store

- **Importance of sub-clusters**
  - Suggest that the contaminated food item was served or sold there
  - Traceback of suspected food items may be facilitated by onsite records
Illness Sub-clusters (n=12)

| Sub-cluster State | Type of Establishment | # of Ill Persons | Traceback Performed |
|-------------------|-----------------------|------------------|---------------------|
| Connecticut       | Restaurant            | 2                | Partial             |
| Delaware          | Restaurant            | 6                | Yes                 |
| Maryland          | Restaurant            | 4                | Yes                 |
| Maryland          | Restaurant            | 4                | Yes                 |
| Maryland          | Restaurant            | 3                | Yes                 |
| Maryland          | Restaurant            | 2                | No                  |
| Maryland          | Restaurant            | 2                | Yes                 |
| Maryland          | Restaurant            | 2                | Yes                 |
| Maryland          | Care Facility         | 2                | Yes                 |
| Maryland          | Day Camp              | 4                | Yes                 |
| New York          | Restaurant            | 4                | Yes                 |
| Pennsylvania      | Funeral               | 3                | No                  |
## Illness Sub-clusters (n=12)

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|-------------------|-----------------------|------------------|---------------------|
| Connecticut       | Restaurant            | 2                | Partial             |
| Delaware          | Restaurant            | 6                | Yes                 |
| Maryland          | Restaurant            | 4                | Yes                 |
| Maryland          | Restaurant            | 4                | Yes                 |
| Maryland          | Restaurant            | 3                | Yes                 |
| Maryland          | Restaurant            | 2                | No                  |
| Maryland          | Restaurant            | 2                | Yes                 |
| Maryland          | Restaurant            | 2                | Yes                 |
| Maryland          | Care Facility         | 2                | Yes                 |
| Maryland          | Day Camp              | 4                | Yes                 |
| New York          | Restaurant            | 4                | Yes                 |
| Pennsylvania      | Funeral               | 3                | No                  |
Sub-cluster Traceback of Cucumbers

8 of 9 sub-clusters

Different Distribution Chain

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

Single Major Distributor

Broker
Broker
Broker

Single Family Owned Farm
MD Eastern Shore, Delmarva Peninsula
Salmonella Newport (PFGE Pattern 61) Infections by Date of Illness Onset, May 20–September 30, 2014 (n=275)
Number of Persons Infected with *Salmonella* Newport (PFGE Pattern 61) by State, 2014 (n=275)

- **20-29 cases**: PA (61), NY (24), ME (2), GA (2), IL (1), IN (1)
- **10-19 cases**: CT (13), RI (1), NJ (18), DE (21), MD (55), VA (23)
- **1-9 cases**: NY (24), MA (18), NC (6), SC (3), AL (1), GA (2), CO (1), CA (1), TX (1), WI (1), IA (1), IN (1), OH (6), MI (1), MD (55), MA (18), NY (24), VA (23), PA (61), DE (21), RI (1), CT (13), MD (55), VA (23), MA (18), NY (24), PA (61), ME (2), GA (2), IL (1), IN (1)
- **>30 cases**: DC (1), VA (23), PA (61), NC (6), SC (3), AL (1), GA (2), CO (1), CA (1), TX (1), WI (1), IA (1), IN (1), OH (6), MI (1), MD (55), MA (18), NY (24), VA (23), PA (61), ME (2), GA (2), IL (1), IN (1)
### Ill Person Demographic and Clinical Data (n=275)

| Description                  | Value                  |
|------------------------------|------------------------|
| Median age in years (range)  | 42 (<1 to 90)          |
| Female (%)                   | 66%                    |
| Hospitalizations (%)         | 34%                    |
| Deaths (n)                   | 1                      |
## 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   |
Final Exposure Data, May 20–September 30, 2014

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|------------------|----|-------------|---------------------------|---------|
| Cucumber         | 79 | 49 (62%)    | 47%                       | 0.005   |
| Tomato (any)     | 127| 88 (69%)    | 68%                       | 0.412   |
| Leafy Greens     | 88 | 64 (72%)    | 86%                       | 0.999   |
Dendrogram of Isolates with Whole Genome Sequencing (WGS) Performed

- Performed on 58 (PFGE pattern 61) clinical isolates
- Revealed 2 groups of highly related isolates

- Primary Group
- Secondary Group

MD and DE sub-clusters

NY sub-cluster

* ≤ 10 SNPs
Investigation Summary

- First outbreak of *Salmonella* Newport PFGE pattern 61 from the Delmarva Peninsula not linked to red round tomatoes
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 more often by ill persons than healthy persons
  - Traceback of the MD and DE sub-clusters led to a single farm
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
**Acknowledgements**

- **CDC**
  - Outbreak Response and Prevention Branch
  - Enteric Diseases Laboratory Branch

- **Food and Drug Administration**
  - CORE Response Team 1
  - Baltimore District Office
  - New York District Office

- **Departments of Agriculture**
  - Maryland Department of Agriculture
  - New York State Department of Agriculture and Markets

- **State Health Departments**
  - Maryland Department of Health and Mental Hygiene
  - New York State Department of Health
  - Delaware Department of Health and Social Services
  - Virginia Department of Health
  - Minnesota Department of Health
  - Connecticut Department of Public Health
  - Ohio Department of Health
Thank you!

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone: 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
Visit: www.cdc.gov | Contact CDC at: 1-800-CDC-INFO or www.cdc.gov/info

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.
PulseNet Data Analysis: Searching for Clusters

- CDC monitors the database for similar PFGE patterns
- Patterns visually compared
- PulseNet team notifies epidemiologists
- Outbreak investigation begins

Cluster of indistinguishable patterns
Salmonella Newport Infections by Upload Date, May 20–October 31, 2014 (n=275)
Salmonella Newport Infections by Illness Onset Date and Upload Date, May 20–October 31, 2014 (n=275)
Expected Cases of *Salmonella* Newport Pattern 61 by Month*

*Compilation of background data from 1998 to 2014*
Number of Persons Infected with *Salmonella* Newport (PFGE Pattern 61) by State, August 20–September 30, 2014 (n=57)

- **>4 cases**
  - NY (5)
  - PA (9)
- **3-4 cases**
  - CO (1)
  - GA (2)
  - IA (1)
  - IL (1)
  - ME (1)
  - MN (1)
  - ND (1)
  - NH (1)
  - NJ (3)
  - RI (1)
  - TN (1)
  - VA (7)
- **1-2 cases**
  - AL (1)
  - CT (4)
  - DE (3)
  - MD (6)
  - MA (6)
  - ME (1)
  - MN (1)
  - ND (1)
  - NH (1)
  - NJ (3)
  - RI (1)
  - TN (1)
  - VA (7)
  - VT (1)
  - WI (1)
### Final Exposure Data, May 20–September 30, 2014

| Item                      | Ill Persons | Percent of Ill Persons | National FoodNet Population Survey | p-value |
|---------------------------|-------------|------------------------|-----------------------------------|---------|
| Cucumber                  | 49/79       | 62%                    | 47%                               | 0.005   |
| Tomato (any)              | 88/127      | 69%                    | 68%                               | 0.412   |
| Red Round                 | 27/101      | 27%                    | N/A                               |         |
| Cherry                    | 19/101      | 19%                    | N/A                               |         |
| Vine Ripe                 | 12/101      | 12%                    | N/A                               |         |
| Roma                      | 9/101       | 9%                     | N/A                               |         |
| Grape                     | 8/101       | 8%                     | N/A                               |         |
| Leafy Greens (any)        | 64/88       | 72%                    | 86%                               | 0.999   |
| Iceberg                   | 33/81       | 41%                    | 46%                               | 0.856   |
| Romaine                   | 28/78       | 36%                    | 47%                               | 0.982   |
| Spinach                   | 20/87       | 23%                    | 23%                               | 0.543   |
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

ATGTTCCCTC = test sequence
ATGTTGGCTC = reference sequence
| Exposure                        | California N=564 | Colorado N=904 | Connecticut N=915 | Georgia N=931 | Maryland N=929 | Minnesota N=928 | New Mexico N=904 | New York N=933 | Oregon N=888 | Tennessee N=923 | Total N=8,829 |
|--------------------------------|------------------|----------------|-------------------|--------------|---------------|----------------|------------------|---------------|-------------|----------------|--------------|
| Cucumbers                      | 230 40.8         | 422 46.7       | 524 57.3          | 361 42.0     | 459 49.4       | 469 51.9         | 440 47.2         | 416 45.1     | 4,149       |                | 8,291 46.9   |
| Broccoli                       | 388 65.2         | 501 55.4       | 511 55.8          | 470 50.5     | 534 57.5       | 414 44.6         | 460 50.0          | 515 57.3     | 4,708       |                | 53.3         |
| Cauliflower                    | 123 21.8         | 196 21.8       | 180 19.7          | 176 18.9     | 172 18.5       | 236 25.4         | 232 25.7          | 207 22.2     | 1,989       |                | 22.5         |
| Green bell peppers            | 219 38.8         | 412 45.6       | 428 46.8          | 406 43.6     | 414 44.6       | 424 46.9         | 406 43.5          | 402 43.6     | 3,817       |                | 43.2         |
| Red bell peppers              | 220 39.0         | 341 37.7       | 353 38.6          | 104 20.8     | 278 29.9       | 242 26.1         | 243 28.9          | 261 28.0     | 2,603       |                | 29.5         |
| Asparagus                      | 174 30.9         | 238 26.3       | 209 22.8          | 147 15.8     | 224 24.1       | 168 18.3          | 165 18.3          | 178 19.1     | 1,850       |                | 21.0         |
| Fresh corn                     | 210 37.2         | 362 40.0       | 330 38.1          | 397 42.6     | 405 43.6       | 397 42.8          | 406 43.5          | 358 38.4     | 3,688       |                | 41.5         |
| Snow peas (eaten in the pod)   | 90 16.0          | 148 16.4       | 104 11.4          | 84  9.0      | 119 12.8       | 102 11.0          | 101 10.8          | 128 14.3     | 1,084       |                | 12.3         |
| Fresh beans                    | 201 35.6         | 246 27.2       | 298 32.6          | 203 31.5     | 268 28.8       | 223 24.0          | 270 29.9          | 246 26.4     | 2,569       |                | 29.1         |
| Brussel sprouts                | 57 10.1          | 64  7.1        | 74  8.1           | 56  6.0      | 62  6.7        | 45  4.8           | 60  6.0           | 57  6.1      | 589  6.7    |                |              |
| Eggplant                       | 73 12.9          | 51  5.6        | 131 14.3          | 44  4.7      | 69  7.4        | 31  3.3           | 49  5.4           | 76  8.1      | 616  7.0    |                |              |
| Zucchini or other soft squash  | 222 39.4         | 287 31.7       | 301 32.9          | 277 29.8     | 244 26.3       | 160 17.2          | 383 40.2          | 238 24.4     | 2,651       |                | 30.0         |
| Any hard squash (pumpkin, acorn, etc) | 54 9.6   | 83 9.2        | 101 11.0          | 48 5.2       | 47 5.1         | 111 12.0         | 73  8.1           | 92  9.9      | 724  8.2    |                |              |
| White or yellow onions         | 393 69.7         | 666 72.8       | 662 72.3          | 650 69.8     | 616 66.3       | 637 68.6          | 709 78.4          | 645 66.1     | 656 71.1    |                | 71.3         |
Investigation Timeline 2014

Aug 2014

- PulseNet detects the cluster

Aug 19
- First multi-state conference call

Aug 22
- Distributed supplemental questionnaire

Late Aug
- Cucumbers become of interest
- Multiple sub-clusters identified

Sep 2014

- Industry Consultation

Mid to Late Sept
- Traceback Completed

Late Oct
- Farm Visit

Nov 2014
Salmonella Newport Infections by Illness Onset Date and Upload Date, May 20–October 31, 2014 (n=275)