Multistate Outbreak of *Salmonella* Bovismorbificans Infections Associated with Mediterranean-Style Restaurants — United States, 2011

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Outbreak Detection

3 *Salmonella* Bovismorbificans isolates identified

*Salmonella* case interviews reviewed

PulseNet query requested

PulseNet identified 6 additional cases

CDC Cluster Code (n=9)

27 September

29 September

4 October

5 October

6 October

2011
Salmonellosis

- 40,000 cases and 400 deaths yearly
- Illness onset 12–72 hours after exposure
- Mild to severe gastrointestinal symptoms
- Estimated 29 non-reported cases per 1 reported case
Objectives

1. Identify the vehicle and source of outbreak

2. Identify additional cases to define scope of outbreak

3. Prevent further illness
Case Definition

- Laboratory-confirmed *S. Bovismorbificans* infection
- Indistinguishable pulsed-field gel electrophoresis (PFGE) pattern
- Any U.S. location
- Illness onset during August–December 2011
Case Finding and Interview Methods

- **Case Finding**
  - State reporting
  - Laboratory testing
  - PulseNet monitoring

- **Interviews**
  - Open-ended
  - ‘Shotgun’ questionnaire
  - Targeted questionnaire
Location and Number of Cases (N=23), August–December 2011
## Patient Characteristics (N = 23)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years, median (range)</td>
<td>27 (20–87)</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>13 (57)</td>
</tr>
<tr>
<td>Lived or traveled to DC metropolitan area, n (%)</td>
<td>23 (100)</td>
</tr>
<tr>
<td>Lived outside of Mid-Atlantic region, n (%)</td>
<td>5 (22)</td>
</tr>
<tr>
<td>Hospitalized, n</td>
<td>0</td>
</tr>
<tr>
<td>Deaths, n</td>
<td>0</td>
</tr>
</tbody>
</table>
Cases of *Salmonella* Bovismorbificans by Month of Symptom Onset (N=23)

*One patient was asymptomatic; Culture date shown*
## Restaurant and Food Exposures

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Number reported/interviewed</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commonly reported foods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lettuce</td>
<td>11 / 14</td>
<td>(79)</td>
</tr>
<tr>
<td>Chicken</td>
<td>11 / 15</td>
<td>(73)</td>
</tr>
<tr>
<td>Tomato</td>
<td>11 / 15</td>
<td>(73)</td>
</tr>
<tr>
<td>Cucumber</td>
<td>9 / 11</td>
<td>(82)</td>
</tr>
<tr>
<td>Mediterranean-style foods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hummus</td>
<td>10 / 15</td>
<td>(67)</td>
</tr>
<tr>
<td>Restaurants A, B or C</td>
<td>9 / 13</td>
<td>(69)</td>
</tr>
<tr>
<td>DC metropolitan restaurant</td>
<td>20 / 22</td>
<td>(91)</td>
</tr>
</tbody>
</table>
Location of Implicated Restaurants

Virginia

Maryland

DC

Restaurants A, B and C

= Restaurant
Restaurant Inspections

- Conducted inspections at Restaurants A, B and C

- Collected samples for testing
  - Food
  - Environmental
  - Employee
Indistinguishable PFGE Patterns: New Pattern to PulseNet

Xba1

Bln1
**Foods Tested**

<table>
<thead>
<tr>
<th>Type of Food</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hummus</td>
<td>Salmonella bovismorbificans</td>
</tr>
<tr>
<td>Cucumber sauce</td>
<td>No Salmonella sp isolated</td>
</tr>
<tr>
<td>Mint leaves</td>
<td>No Salmonella sp isolated</td>
</tr>
<tr>
<td>Cumin</td>
<td>No Salmonella sp isolated</td>
</tr>
<tr>
<td>Gyro meat</td>
<td>No Salmonella sp isolated</td>
</tr>
<tr>
<td>Olive</td>
<td>No Salmonella sp isolated</td>
</tr>
<tr>
<td>Olive Oil</td>
<td>No Salmonella sp isolated</td>
</tr>
</tbody>
</table>

**Hummus Sample 1**  
(Restaurant A)

<table>
<thead>
<tr>
<th>Type of Food</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hummus</td>
<td>Salmonella bovismorbificans</td>
</tr>
</tbody>
</table>

**Hummus Samples 2 and 3**  
(Restaurants A and B)  
Samples taken 10 days later

<table>
<thead>
<tr>
<th>Type of Food</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chick peas</td>
<td>No Salmonella sp isolated</td>
</tr>
<tr>
<td>Garlic</td>
<td>No Salmonella sp isolated</td>
</tr>
<tr>
<td>Tahini</td>
<td>No Salmonella sp isolated</td>
</tr>
<tr>
<td>Hummus</td>
<td>Salmonella bovismorbificans</td>
</tr>
<tr>
<td>Hummus</td>
<td>Salmonella bovismorbificans</td>
</tr>
<tr>
<td>Tahini</td>
<td>No Salmonella sp isolated</td>
</tr>
</tbody>
</table>
Testing of Hummus Ingredients

- Chickpeas
- Tahini
- Garlic
- Olive oil
- Lemon juice
- Salt
## Laboratory Results

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental samples</td>
<td></td>
</tr>
<tr>
<td>Employee stool specimens</td>
<td></td>
</tr>
<tr>
<td><strong>Food samples</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Prepared hummus</strong></td>
<td>+</td>
</tr>
<tr>
<td>Hummus ingredients</td>
<td></td>
</tr>
<tr>
<td>Commonly reported foods</td>
<td></td>
</tr>
</tbody>
</table>
Hummus Ingredient Traceback

- Reviewed purchase orders and shipping invoices

2 Virginia Restaurants → Virginia Distributor → Tahini Manufacturer in Lebanon

3 DC Restaurants
S. Bovismorbificans Isolated From Hummus — Actions Taken

- November 2011 — all ingredients used to make hummus were embargoed at Restaurants A, B and C
  - Restricted sale and delivery of hummus
  - Prohibited use of ingredients in other foods (i.e., sauces)

- Embargo ended January 2012
UPDATE (as of May 2012) — FDA Traceback Investigation

- Two tahini recalls in Canada
  - *Salmonella* Cubana (September 2011)
  - *Salmonella* Seftenberg (February 2012)

- Common ingredient in Mediterranean-style foods

- Same tahini brand used in Restaurant A and Virginia restaurants

- May 30, 2012 — FDA implicated tahini as likely source in *S. Bovismorbificans* outbreak
Limitations

- Inconsistent interviewing methodology across jurisdictions
- Patients unable to recall past restaurant and food exposures
- Failed to confirm *Salmonella* contamination in tahini with laboratory evidence
Conclusion

- PulseNet helped identify cases outside of Mid-Atlantic region → Focus on Mediterranean-style restaurants

- Hummus was the likely vehicle of *Salmonella* infections → Tahini was the likely source

- Use of tahini in other foods might explain infections in those not reporting hummus exposure

- Investigating restaurant clusters useful in ingredient-driven outbreaks
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.
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Additional Slides
**Salmonella enterica** serotype Bovismorbificans
*(Salmonella Bovismorbificans)*

- No prior *S.* Bovismorbificans outbreak in the District of Columbia (DC)

- Only 5 documented outbreaks in U.S. since 2001
  - January 2001 – Unknown source and vehicle (Maryland)
  - September 2002 – Homemade cheese (Michigan)
  - April 2004 – Alfalfa sprouts (Multi-state)
  - June 2008 – Pasta salad (Pennsylvania)
  - August 2008 – Striped bass (Virginia)

- No reported deaths associated this serotype
Restaurants A, B and C have the Same Owner
Positive *Salmonella* Cultures
Outbreak Detection

- September 27– 3 *Salmonella* Bovismorbificans isolates matching by PFGE identified at District of Columbia (DC) Public Health Laboratory

- October 4 – PulseNet query identified 6 additional *S. Bovismorbificans* cases in multiple states

- October 6 – CDC assigned a cluster ID to 9 cases; new PFGE pattern to PulseNet
## Salmonella Bovismorbificans Outbreaks (2001-present)

<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>Total Ills</th>
<th>Total Hospitalizations</th>
<th>Total Deaths</th>
<th>Food Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Maryland</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Homemade Cheese</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(unspecified)</td>
</tr>
<tr>
<td>2002</td>
<td>Michigan</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Homemade Cheese</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(unspecified)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Alfalfa sprouts</td>
</tr>
<tr>
<td>2004</td>
<td>Multistate</td>
<td>35</td>
<td>5</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Pennsylvania</td>
<td></td>
<td></td>
<td></td>
<td>Pasta salad</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Striped bass</td>
</tr>
<tr>
<td>2008</td>
<td>Pennsylvania</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>Pasta salad</td>
</tr>
<tr>
<td>2008</td>
<td>Virginia</td>
<td>45</td>
<td>1</td>
<td>0</td>
<td>Striped bass</td>
</tr>
</tbody>
</table>
Cases of *Salmonella* Bovismorbificans by Month of Symptom Onset

- Aug: 0 cases
- Sep: 10 cases
- Oct: 6 cases
- Nov: 4 cases
- Dec: 0 cases
Excited EIS Officer Taking Food Temperature Measurements
The Hummus Mixer
Environmental and Laboratory Testing Results

- All environmental samples were negative for *Salmonella*

- All food handler stool specimens tested negative

- 33 food samples tested
  - Prepared hummus from Restaurants A and B
  - Hummus ingredients from Restaurant A
  - Other commonly-used food items from all 3 restaurants
Tahini Implicated as Source of Contamination for Hummus

- Paste from ground sesame seeds

- Sesame seed composition favorable for *Salmonella*
  - High lipid content
  - Low water permeability

- Protective for survival, not growth

- Resistance to high temperatures
Tahini Implicated as Source of Contamination

- Paste from ground sesame seeds
  - Cleaned and dehulled
  - Roasted (120°C for ≥ 1 hour)
  - Grounded into a paste (130°C)

- Common ingredient in Mediterranean and Middle Eastern foods

- Multi-step production process