Foodborne Outbreaks Attributed to Fish — United States, 1998–2012

Jolene H. Nakao, MD MPH
Epidemic Intelligence Service (EIS) Officer
LCDR, US Public Health Service
Division of Foodborne, Waterborne and Environmental Diseases
Centers for Disease Control and Prevention

Conference for Food Protection Workshop
May 3, 2014
Outline

- Introduction to foodborne disease outbreaks and national surveillance
- Fish-attributed outbreaks
Foodborne Illness

- Roughly 1 in 6 Americans, or 48 million people, become ill from foodborne diseases each year
  - 128,000 hospitalized
  - 3,000 die
Foodborne Disease Outbreak Surveillance System
FDOSS

Captures data from investigated foodborne disease outbreaks in the United States

- Provides valuable insights
  - Numbers of illnesses, hospitalizations, deaths
  - Etiologic agents
  - Implicated foods and ingredients
  - Settings of food preparation and consumption
Illnesses associated in time and space: possible outbreak!

Health Department

Investigates outbreak

Data entered into CDC form

CDC

Downloads and verifies data

Data ready for analysis and dissemination

Foodborne Disease Outbreak Surveillance System (FDOSS)
Foodborne Outbreak Online Database (FOOD)

Disclaimer: This site was developed by the Centers for Disease Control and Prevention (CDC) to make Foodborne Disease Outbreak Surveillance System data more available to the public and stakeholders. The FOOD tool is intended to be used for limited and simple descriptive summary of outbreak data. Data obtained from this tool are an extract of reported data and therefore should not be considered completely representative of the findings in investigations of all outbreaks reported. CDC uses more detailed information for its analyses of the causes and risk factors of foodborne disease outbreaks. Please see the FOOD FAQ for more information and limitations of the data. Thank you for your interest in foodborne disease outbreaks.

http://wwwn.cdc.gov/foodborneoutbreaks
To keep in mind…

- Number of reported outbreaks likely underestimates the total number of outbreaks

- An implicated food and etiologic agent are not identified for every outbreak
Foodborne Disease Outbreaks by Food Vehicle Reported, 2008–2012

- No food reported: 57%
- Single food or ingredient: 22%
- All other foods: 21%

All other foods include Complex, Undetermined, and Unclassifiable foods.
Foodborne Disease Outbreaks by Food Vehicle Reported, 2008–2012

- No food reported: 57%
- Single food or ingredient: 22%
- All other foods: 21%

All other foods include Complex, Undetermined, and Unclassifiable foods.
Commodities Implicated in Foodborne Disease Outbreaks, 2008–2012, n=915

- Fish: 14%
- Poultry: 13%
- Beef: 10%
- Leafy: 10%
- Dairy: 9% (2 segments)
- Pork: 9%
- Mollusk: 6%
- Grains-beans: 5%
- Sprout: 2%
- Eggs: 4%
- Vine: 3%
- Other: 5%

“Other” includes crustacean, fungus, game, oil-sugar, and root
Data are preliminary and may change.
Epidemiology of Fish-Attributed Outbreaks in the United States, 1998–2012

- Reviewed data reported to FDOSS for outbreaks attributed to fish
  - Excluded shellfish

- Analyzed
  - Number of outbreaks, illnesses, hospitalizations, deaths
  - State in which outbreak occurred
  - Etiologic agent
  - Implicated fish type
  - Preparation method
Results

- 713 outbreaks
- 4182 illnesses
  - Median 3 illnesses per outbreak (range: 2–425)
- 295 hospitalizations
- 3 deaths
Number of Fish-Associated Outbreaks by Year, United States, 1998–2012

average 65 per year

average 32 per year
Number of Outbreaks by State

Map doesn’t show outbreaks that occurred in Guam (4), Puerto Rico (12), and the District of Columbia (3). Includes 4 multistate outbreaks that are assigned as one outbreak to each state involved.
# Number of Outbreaks by Etiology

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Percent of Outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scombroid toxin</td>
<td>55%</td>
</tr>
<tr>
<td>Ciguatoxin</td>
<td>33%</td>
</tr>
<tr>
<td>Salmonella</td>
<td>2%</td>
</tr>
<tr>
<td>Clostridium botulinum</td>
<td>2%</td>
</tr>
<tr>
<td>Other etiologies (&lt;10 outbreaks each)</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>643</strong></td>
</tr>
</tbody>
</table>

*Among outbreaks with a reported single etiology. 1 outbreak was reported with multiple etiologies, 70 outbreaks with no reported etiology.
Scombroid fish poisoning

- **Caused by:**
  - Elevated histamine levels in fish resulting from improper storage
    - Once histamine is produced, it cannot be eliminated by cooking or freezing
Scombroid fish poisoning

- **Time to symptom onset:** minutes to hours
- **Symptoms/signs:** facial flushing, tingling and swelling, rapid heart beat, wheezing, nausea, vomiting, diarrhea, itchy rash
- **Treatment:** antihistamines and supportive care
Ciguatera fish poisoning

- **Caused by:** Toxins that accumulate in the flesh of fish, typically large reef-dwelling carnivorous fish found in tropical oceans
- Natural toxins, cannot be reliably eliminated by cooking
Ciguatera fish poisoning

- **Time to symptom onset:** 3 to 30 hours
- **Symptoms/signs:**
  - Gastrointestinal: nausea, vomiting, diarrhea, abdominal pain
  - Neurological: aberrant temperature perception (classically, cold feels hot), numbness and tingling, itching, muscle and joint pains
  - Cardiac: low blood pressure, slow heart rate
- **Treatment:** Supportive care
Preparation Setting

- Restaurant: 54%
- Private home: 33%

- **Scombroid toxin (n=343)**
  - Restaurant: 77%
  - Private home: 9%
  - Other: 14%

- **Ciguatoxin (n=202)**
  - Private home: 76%
  - Restaurant: 15%
  - Other: 9%

*** Of the 685 outbreaks with a reported preparation setting
<table>
<thead>
<tr>
<th>Year</th>
<th>Reporting state</th>
<th>Fish family</th>
<th>Etiologic agent</th>
<th>Number of illnesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Multistate</td>
<td>Tuna</td>
<td>Salmonella Nchanga and Bareilly</td>
<td>425</td>
</tr>
<tr>
<td>2004</td>
<td>Wisconsin</td>
<td>Not specified</td>
<td>Norovirus</td>
<td>380</td>
</tr>
<tr>
<td>2000</td>
<td>New York</td>
<td>Not specified</td>
<td>Salmonella Enteritidis</td>
<td>68</td>
</tr>
<tr>
<td>2004</td>
<td>Virginia</td>
<td>Tuna</td>
<td>Salmonella Weltevreden</td>
<td>63</td>
</tr>
<tr>
<td>1998</td>
<td>Massachusetts</td>
<td>Cod</td>
<td>Not reported</td>
<td>60</td>
</tr>
<tr>
<td>2010</td>
<td>Multistate</td>
<td>Tuna</td>
<td>Salmonella Paratyphi B</td>
<td>51</td>
</tr>
<tr>
<td>1998</td>
<td>Washington</td>
<td>Not specified</td>
<td>Salmonella Typhimurium</td>
<td>50</td>
</tr>
<tr>
<td>1998</td>
<td>Louisiana</td>
<td>Not specified</td>
<td>Shigella sonnei</td>
<td>47</td>
</tr>
<tr>
<td>2008</td>
<td>Virginia</td>
<td>Bass</td>
<td>Salmonella multiple</td>
<td>45</td>
</tr>
</tbody>
</table>
## Ten Largest Outbreaks

<table>
<thead>
<tr>
<th>Year</th>
<th>Reporting state</th>
<th>Fish family</th>
<th>Etiologic agent</th>
<th>Number of illnesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Multistate</td>
<td>Tuna</td>
<td><em>Salmonella Nchanga and Bareilly</em></td>
<td>425</td>
</tr>
<tr>
<td>2004</td>
<td>Wisconsin</td>
<td>Not specified</td>
<td>Norovirus</td>
<td>380</td>
</tr>
<tr>
<td>2000</td>
<td>New York</td>
<td>Not specified</td>
<td><em>Salmonella Enteritidis</em></td>
<td>68</td>
</tr>
<tr>
<td>2004</td>
<td>Virginia</td>
<td>Tuna</td>
<td><em>Salmonella Weltevreden</em></td>
<td>63</td>
</tr>
<tr>
<td>1998</td>
<td>Massachusetts</td>
<td>Cod</td>
<td>Not reported</td>
<td>60</td>
</tr>
<tr>
<td>2010</td>
<td>Multistate</td>
<td>Tuna</td>
<td><em>Salmonella Paratyphi B</em></td>
<td>51</td>
</tr>
<tr>
<td>1998</td>
<td>Washington</td>
<td>Not specified</td>
<td><em>Salmonella Typhimurium</em></td>
<td>50</td>
</tr>
<tr>
<td>1998</td>
<td>Louisiana</td>
<td>Not specified</td>
<td><em>Shigella sonnei</em></td>
<td>47</td>
</tr>
<tr>
<td>2008</td>
<td>Virginia</td>
<td>Bass</td>
<td><em>Salmonella multiple</em></td>
<td>45</td>
</tr>
</tbody>
</table>
Salmonellosis

- **Caused by:** gram-negative bacteria
  - Sources include contaminated water and food

- **Time to symptom onset:** 6 to 72 hours

- **Symptoms/signs:**
  - Fever, abdominal pain, nausea, vomiting, diarrhea,
  - Bloodstream infections

- **Treatment:**
  - Rehydration
  - Antibiotics in certain cases
Largest Fish-Associated Outbreak

- January–July 2012
- *Salmonella* Bareilly and *Salmonella* Nchanga infections
Cases infected with the outbreak strains of *Salmonella Bareilly* or *Salmonella Nchanga*—United States, by state, as of July 25, 2012 (n= 425)
Largest Fish-Associated Outbreak
Nakaochi Scrape

YELLOWFIN TUNA
AAA NAKAOCHI SCRAPE
INDIVIDUALLY VACUUM PACKED
INGREDIENTS FROZEN TUNA AND CARBON MONOXIDE
(TO PROMOTE COLOR RETENTION)
CRYOGENICALLY FROZEN
PRODUCT OF INDIA
(WILD CAUGHT)

NOT FOR RETAIL
NET WT. 22 LBS. (10 KGS.)
[PO # : 117 (IN-NY)]
Public Health Impact

- FDA Office in New Delhi, India
- Hazard Analysis and Critical Control Point (HACCP) Inspection

- Seafood HACCP Deficiencies
  - Controls for histamine
  - Controls for *Clostridium botulinum*
  - Significant sanitation concerns
Public Health Impact

- **Import Alert**
  - April 13, 2012: All fresh and frozen tuna from Company A detained and screened

- **Recalls**
  - April 13, 2012: Company A voluntarily recalled 58,828 lbs of frozen raw tuna scrape
  - May 10, 2012: Company A recalls an undetermined amount of tuna strips yet to enter commerce
### Number of Outbreaks by Fish Family

<table>
<thead>
<tr>
<th>Fish Family</th>
<th>Percent of Outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuna</td>
<td>39%</td>
</tr>
<tr>
<td>Mahi mahi</td>
<td>13%</td>
</tr>
<tr>
<td>Grouper</td>
<td>10%</td>
</tr>
<tr>
<td>Barracuda</td>
<td>6%</td>
</tr>
<tr>
<td>Escolar</td>
<td>6%</td>
</tr>
<tr>
<td>Jack</td>
<td>6%</td>
</tr>
<tr>
<td>Salmon</td>
<td>4%</td>
</tr>
<tr>
<td>Snapper</td>
<td>3%</td>
</tr>
<tr>
<td>Kole</td>
<td>3%</td>
</tr>
<tr>
<td>Marlin</td>
<td>3%</td>
</tr>
<tr>
<td>Other</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>651</strong></td>
</tr>
</tbody>
</table>

**Among outbreaks with a reported fish family. 62 outbreaks with no reported fish family.**
Number of Outbreaks by Fish Family and Etiology, for Six Fish Families Associated with the Largest Number of Outbreaks
Raw or lightly cooked fish was implicated in 48 (10%) of 481 outbreaks with a reported preparation method.

- Tuna (30 of 173 outbreaks) and salmon (6 of 17 outbreaks) were the most common fish types reported consumed raw.
Discussion

- Reported outbreaks attributed to fish declined from 1998–2012
  - Declines were driven by decreases in outbreaks associated with the most common etiologies and fish families reported by a few states

- Fish was consumed raw or undercooked in only a small proportion of outbreaks

- Most outbreaks were caused by scombroid toxin and ciguatoxin, which are not destroyed by cooking
Possible reasons for the decline in the number of outbreaks attributed to fish...

- Hazard Analysis and Critical Control Point (HAACP)
  - HAACP principles mandated for seafood processing by the US Food and Drug Administration (FDA) in 1997 ensure safe and sanitary processing of fish and fishery products
  - FDA provides guidance to industry: “Fish and Fishery Products Hazards and Controls Guidance”
Possible reasons for the decline in the number of outbreaks attributed to fish...

- Guidelines on selection of appropriate harvest locations
  - States issue advisories to commercial and recreational fishermen to avoid reefs known to be toxic
Possible reasons for the decline in the number of outbreaks attributed to fish...

- Reporting
  - The decline may reflect changes in reporting and surveillance by some states
Possible reasons for the decline in the number of outbreaks attributed to fish...

- Public awareness
  - Public health campaigns on safe procurement, storage, and preparation of fish may have prevented illnesses
Possible reasons for the decline in the number of outbreaks attributed to fish...

Other ideas!
Recommendations

- Though reported outbreaks attributed to fish declined, fish continues to be one of the most common foods implicated in outbreaks.
Recommendations

- Control measures targeting the most common etiologies implicated in outbreaks could further reduce outbreaks caused by fish
  - Proper fish storage
  - Selection of appropriate harvest locations
  - Appropriate preparation
Acknowledgments

- State, local, and territorial health departments
- CDC’s National Outbreak Reporting System Team
- CDC’s National Center for Environmental Health
- US Food and Drug Administration
- Florida Fish and Wildlife Conservation Commission
- Steve Otwell, Thomas Swenarton, Wayne Bennett, Gerald L. Hasty, Christie Wilcox
More prevention is possible.

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
E-mail:  cdcinfo@cdc.gov  Web:  http://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.