“The increasing problem of outbreaks associated with produce”
Produce Outbreaks, United States, 1998–2013

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Acknowledgments

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- US Food & Drug Administration & state counterparts
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  - New York City Department of Health & Mental Hygiene
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Disclaimer: The findings & conclusions in this report are those of the author & do necessarily represent the official position of the Centers for Disease Control & Prevention.
Outbreaks from Unique Sources:
15 New Food Vehicles Identified in US Multistate Outbreaks, 2006-2012

- bagged spinach
- carrot juice
- peanut butter
- broccoli powder on a snack food
- dog food
- pot pies/frozen meals
- canned chili sauce
- hot peppers
- pepper
- raw cookie dough
- hazelnuts
- whole fresh papayas
- pine nuts
- kosher broiled chicken livers
- scraped tuna product

Data Sources: Foodborne Disease Outbreak Surveillance System, CDC Web postings
26 New Food Vehicles Identified in US Multistate Outbreaks, 2006-2015

- Bagged spinach
- Carrot juice
- Peanut butter
- Broccoli powder on a snack food
- Dog food
- Pot pies/frozen meals
- Canned hot dog chili sauce
- Fresh hot chili peppers
- Black pepper
- Tahini sesame paste
- Raw cookie dough
- Fresh papaya
- Frozen mamay fruit pulp
- Bologna
- In-shell hazelnuts

- Pine nuts
- Par-cooked, broiled chicken livers
- Scraped tuna
- Cashew cheese
- Sugar cane juice
- Sprouted chia seeds
- Almond butter
- Caramel apples
- Sprouted nut butters
- Dried mushrooms (in truffle oil puree)
- Wheat flour
Trends of Pathogens Transmitted Commonly Through Food
Foodborne Diseases Active Surveillance Network, 2012-2015

MMWR print publication date: April 15, 2016
(EMBARGOED until April 14, 2016 at 12:00pm)
Crude Pathogen rates per 100,000
FoodNet 1996-2015

Since 1996-1998
↓ E. coli O157
↓ Campylobacter
↓ Listeria
↓ Shigella
↓ Yersinia
± Salmonella
↑ Vibrio

http://www.cdc.gov/foodnet/index.html

- STEC O157
- STEC nonO157
Estimates of Foodborne Illness in the United States, 2011

Top five pathogens causing domestically acquired foodborne illness

Reference: http://wwwnc.cdc.gov/eid/article/17/1/p1-1101_article
Reviewed outbreaks reported to National Outbreak Reporting System (NORS), 1998-2013
- Passive Surveillance
- ≥2 illnesses resulting from the ingestion of food

http://www.cdc.gov/nors/
Outbreaks caused by Norovirus, 1998-2014

* Preliminary analysis

Source: http://wwwn.cdc.gov/foodborneoutbreaks/
Outbreaks caused by Clostridium perfringens, 1998-2014

* Preliminary analysis

Source: http://wwwn.cdc.gov/foodborneoutbreaks/
Outbreaks caused by Staphylococcus aureus, 1998-2014

Source: http://wwwn.cdc.gov/foodborneoutbreaks/

* Preliminary analysis
The Surveillance Pyramid

- Exposure in the general population
- Person becomes ill
- Person seeks care
- Specimen obtained
- Lab test for organism
- Laboratory confirmed case
- Reported to CDC
- Reported to health department
Foodborne Disease Outbreaks, 1973–2014

Data are preliminary & may change.
Average # of produce-associated outbreaks by decade, USA, 1973-97*

* Source: CDC, Friedman CR, 40th Interscience Conference on Antimicrobial Agents & Chemotherapy, Sept 2000. NACMCF, Microbiological safety evaluations and recommendations on fresh produce, Food Control, Volume 10, Issue 2, April 1999, Pages 117–143,
Outbreaks caused by Fresh Produce, 1990-2009

* Preliminary analysis

Source: CSPI Outbreak Alert Database  http://www.cspinet.org/food safety/outbreak/pathogen.php
Increasing proportion of outbreaks with a food reported were caused by raw produce
Number of foodborne disease outbreaks & outbreaks attributed to raw produce

- **Raw produce outbreaks**
- **Total foodborne disease outbreaks**

Year group:
- 1998–2001
- 2002–2005
- 2006–2009
- 2010–2013

- **Number of raw produce outbreaks**
  - 1998–2001: 6000
  - 2002–2005: 5000
  - 2006–2009: 4000
  - 2010–2013: 3000

- **Number of foodborne disease outbreaks**
  - 1998–2001: 5000
  - 2002–2005: 4000
  - 2006–2009: 3000
  - 2010–2013: 2000

- **Percentage decrease**
  - Raw produce outbreaks: 17%
  - Total foodborne disease outbreaks: 39%
Methods

- Reviewed outbreaks reported to National Outbreak Reporting System (NORS), 1998-2013
  - Passive Surveillance
  - ≥2 illnesses resulting from the ingestion of raw produce
    - Only included outbreaks associated with raw produce
  - Analysis
    - Number of outbreaks, illnesses, outcomes
    - Etiologic agents
    - Types of produce

http://www.cdc.gov/nors/
Food categories used for analysis of outbreak data

- All Foods
  - Aquatic Animals
    - Shellfish
    - Fish
    - Other aquatic animals
  - Land Animals
    - Dairy
    - Eggs
    - Meat-Poultry
    - Game
  - Plants
    - Oils-sugars
    - Produce
  - Other
    - Grains-beans
    - Nuts-seeds

- Mollusks
  - Bivalve
  - Non-bivalve

- Crustaceans
  - Mollusks

- Meat
  - Beef
  - Pork
  - Other meat (mutton, chevon, lamb, etc.)
  - Other poultry

- Poultry
  - Chicken
  - Turkey

- Vegetables
  - Fungi
  - Root-underground
    - Bulbs
    - Sprouts
    - Roots
    - Other
  - Seeded vegetables
    - Solanaceous
    - Vine-grown
    - Legumes
    - Other
  - Vegetable row crops
    - Stems
    - Leafy
    - Flowers
    - Other

- Plants
  - Nuts-seeds
    - Grains
    - Beans

- Fruits
  - Sub-tropical
  - Tropical
  - Small
  - Stones
  - Pomes
  - Melons

http://www.cdc.gov/foodsafety/ifsac/index.html
Outbreaks associated with raw produce, 1998-2013

17,374 foodborne outbreaks

9,422 (54%) with food reported

972 (10%) consumption of raw produce

- 34,674 illnesses
- 2,315 hospitalizations
- 72 deaths
Outbreaks not categorized further (n=345)

- **Not categorized**
  - Salad
    - 226 outbreaks
  - Mexican-style dips/salsas
    - 62 outbreaks
  - Mixed vegetables
    - 57 outbreaks
Types of produce implicated in outbreaks (n=612 with single produce category)

Single produce category

- Vegetable row crops: 38%
- Fruits: 35%
- Seeded vegetables: 11%
- Sprouts: 7%
- Fungi: 4%
- Root/underground: 3%
- Herbs: 2%
Outbreaks associated with vegetable row crops (n=235)

- **Leafy**: 98%
- **Stem**: 1%
- **Flowering**: 1%
Types of leafy vegetables implicated in outbreaks (n=78)

Lettuce
- Romaine 26%
- Leaf 19%
- Iceberg 18%
- Mesclun 5%

Other leafy vegetables
- Cabbage 12%
- Spinach 6%
- Scallions 5%
- Kale 3%
- Arugula 1%
Outbreaks associated with fruits (n=216)

Further categorized (110)

- Melons 38%
- Small 27%
- Pome 14%
- Sub-tropical 12%
- Tropical 7%
- Stone 2%

‘Mixed fruit’, ‘Fruit salad’, ‘Fruit’ (106)
Outbreaks associated with seeded vegetables (n=66)

- **Seeded vegetables**
  - Solanaceous
    - 47 (85%)
  - Vine-grown
    - 7 (13%)
  - Legumes
    - 1 (2%)
  - Tomatoes
    - 42 outbreaks
  - Peppers
    - 3 outbreaks
  - Multiple
    - 2 outbreaks
3 pathogens caused 85% of outbreaks associated with produce

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Number outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norovirus</td>
<td>418 (54%)</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>167 (21%)</td>
</tr>
<tr>
<td>Newport</td>
<td>31 (19%)</td>
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<tr>
<td>Enteritidis</td>
<td>22 (14%)</td>
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<tr>
<td>Typhimurium</td>
<td>18 (11%)</td>
</tr>
<tr>
<td>Shiga toxin-producing <em>E. coli</em></td>
<td>74 (10%)</td>
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</tbody>
</table>
### Most common pathogen-food pairs causing outbreaks

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Vegetable Row Crops</th>
<th>Fruits</th>
<th>Seeded Vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norovirus</td>
<td>119</td>
<td>93</td>
<td>15</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>9</td>
<td>51</td>
<td>36</td>
</tr>
<tr>
<td>Shiga toxin-producing <em>E. coli</em></td>
<td>41</td>
<td>13</td>
<td>2</td>
</tr>
</tbody>
</table>
Role of ill food handlers

- ~$\frac{1}{4}$ of outbreak reports implicated an ill food handler

- By produce category:
  - 30% of outbreaks associated with vegetable crops
  - 23% of outbreaks associated with fruits
  - 3% of outbreaks associated with seeded vegetables

- 78% of norovirus outbreak reports
Limitations

- Not all foodborne disease outbreaks are detected, investigated, & reported
- Data did not always clearly indicate if produce was consumed raw
- Processing & packaging data was limited
- Sources of food implicated & points of contamination was incomplete
Conclusions: Role of produce in foodborne illness, 1998–2008

Estimated annual foodborne illnesses attributed to produce, by pathogen type, USA, 1998–2008*

N = 4,924,877

Conclusions

- 1973-2000, there was a continuous increase in the # of fresh produce associated outbreaks.

- 1998–2013, total produce outbreaks decreased. Proportion of outbreaks attributed to raw produce increased.

- Many types of raw produce cause outbreaks, although leafy vegetables & fruits most common
Many studies of “sporadic” illness do NOT associate fruit & vegetable items with illness

<table>
<thead>
<tr>
<th>Food</th>
<th>Agent</th>
<th>Study*</th>
</tr>
</thead>
<tbody>
<tr>
<td>‡ Risk: Berries, Carrots, strawberries, apples, pears, raw vegetables</td>
<td>Campylobacter</td>
<td>Adak, Cowden et al. 1995</td>
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<td></td>
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<td>Kapperud, Espeland et al. 2003</td>
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<td>Neimann, Engberg et al. 2003</td>
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<td>Friedman, Hoekstra et al. 2004</td>
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<td></td>
<td></td>
<td>Schonberg-Norio, Takkinen et al. 2004</td>
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<tr>
<td></td>
<td></td>
<td>Wingstrand, Neimann et al. 2006</td>
</tr>
<tr>
<td>‡ Risk: Fruit &amp; vegetables</td>
<td>Salmonella</td>
<td>Gillespie, O'Brien et al. 2005</td>
</tr>
<tr>
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<td></td>
<td>Doorduyn, Van Den Brandhof et al. 2006</td>
</tr>
<tr>
<td>‡ Risk: Fruit &amp; vegetables</td>
<td>E coli O157:H7</td>
<td>Kassenborg, Hedberg et al. 2004</td>
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<td>Voetsch, Kennedy et al. 2007</td>
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<tr>
<td></td>
<td></td>
<td>Rivas, Sosa-Estani et al. 2008</td>
</tr>
<tr>
<td>‡ Risk: Fruit &amp; vegetables</td>
<td>Cryptosporidium</td>
<td>Robertson, Sinclair et al. 2002</td>
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<tr>
<td></td>
<td></td>
<td>Khalakdina, Vugia et al. 2003</td>
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<td></td>
<td></td>
<td>Roy, DeLong et al. 2004</td>
</tr>
<tr>
<td>‡ Risk: melons at commercial establishment</td>
<td>Listeria</td>
<td>Varma, Samuel et al. 2007</td>
</tr>
</tbody>
</table>
The Last Word

- The vast majority of meals are safe
  - these estimates do not provide information on the risk of illness per serving

- Fruits & vegetables are an essential part of a healthy diet
  - they are linked to a reduced risk of heart attack, stroke, & cancer

These attribution estimates are important because they can help regulatory agencies & industry to target prevention efforts that will improve the safety of the foods that we need & that we love to eat

Source: Christopher R. Braden, M.D., National Center for Emerging & Zoonotic Infectious Diseases
January 30, 2013
Foodborne Outbreak Online Database Tool

http://wwwn.cdc.gov/foodborneoutbreaks/
Thank you

For more information please contact Centers for Disease Control & Prevention
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Visit: www.cdc.gov | Contact CDC at: 1-800-CDC-INFO or www.cdc.gov/info