Food Safety and Farms: How can farms and public health keep your food safe?

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What is Food Safety?

- Prevent food contamination and illness
- Respond to illness from food
Why is food safety important to me?

Just about everyone gets sick from food several times in their life. One person in six gets sick every year.

Getting sick costs approx. $1,600 for a working adult. Up to $77,000,000,000 ($77 billion) are lost from US economy every year.

3,000 people die every year from foodborne illnesses. Death rates are much higher in < 22 year olds and > 65 year olds.
If food safety is so important why is it still a problem?

Salmonella

Toxin-producing *E. coli* (*E. coli* O157:H7)

Norovirus
Farm to fork: The whole food system

Fresh-cut lettuce distribution chain

[Images showing the process from farm to consumer]
Fresh fruits and vegetables are a big challenge for food safety: Animals on produce farms

Jay et al. 2007
Fresh fruits and vegetables are a big challenge for food safety: Water quality
Fresh fruits and vegetables are a big challenge for food safety: “Treated and untreated soil amendments”
Activity 1: Can you tell which of these foods is contaminated?
Consumers can’t prevent food contamination, so what can you do?
Wash your fruits and vegetables.

This does not always work, but it is better than not doing it.

Credit: Prof. Gad Frankel and colleagues, Imperial College of London.
Activity 2: Outbreak!

The Case

The New Hampshire State Department of Health is reporting a surge in gastrointestinal illness cases this week. Since August 28th, 39 people have been admitted to hospitals across the state for nausea, vomiting, and diarrhea. The only thing they seem to have in common is that all victims were in Swansville, NH from August 24-26. We are reasonably sure that the infection occurred in Swansville during this time period.
You are a Microbiologist at a hospital in Swansville, NH. You took cultures from the 3 patients that came to your hospital with symptoms. The cultures contained Salmonella bacteria. You think it may be a foodborne illness, but you don’t know which food. What should your next step be?
The outbreak is national, can you solve it first?

Nation-wide Cases of *Salmonella* SaintPaul
What did the people eat?

• This is a list of the foods your patients ate from **Aug 24-26**: Apple, salsa, potatoes, eggs, chicken, beef, pork, salads, rice, bananas, spinach, pasta, fish, cereal, peanut butter sandwich, cheese, yogurt, almonds, oranges, chips, tacos, corn, beans, tomatoes, cucumbers, celery, pizza
Foods eaten that are known to have *Salmonella* problems

Which food made people sick?

- Phone surveys of the sick and random control groups
  - Who ate the food and got sick?
  - Who ate the food and didn’t get sick?
  - Who didn’t eat the food and got sick?
  - Who didn’t eat the food and didn’t get sick?
## Attack table and risk

<table>
<thead>
<tr>
<th>Food</th>
<th>Ate the Food</th>
<th>Did Not Eat the Food</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Well</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>Eggs</td>
<td>79</td>
<td>64</td>
</tr>
<tr>
<td>Chicken</td>
<td>52</td>
<td>18%</td>
</tr>
<tr>
<td>Pork</td>
<td>82</td>
<td>40%</td>
</tr>
<tr>
<td>Tomatoes (salsa, salad, tacos, and fresh)</td>
<td>77</td>
<td>49</td>
</tr>
<tr>
<td>Peppers (salsa, salad)</td>
<td>124</td>
<td>66%</td>
</tr>
<tr>
<td>Peanut butter</td>
<td>96</td>
<td>12</td>
</tr>
<tr>
<td>Spinach</td>
<td>40</td>
<td>36</td>
</tr>
</tbody>
</table>

\[
\text{Attack rate (ate the food)} = \left( \frac{\text{Ate the food and ill}}{\text{Total who ate the food}} \right) \times 100
\]

\[
\text{Attack rate (did not eat the food)} = \left( \frac{\text{Did not eat the food and ill}}{\text{Total who did not eat the food}} \right) \times 100
\]
Epidemic curve
But which food is it really?

• With your attack table you should have an idea of which foods are causing the illness.
• The next thing microbiologists do is DNA fingerprinting to link the bacteria to one food.
How DNA fingerprints are generated...

Restriction enzyme “X” cuts a specific DNA sequence:

Salmonella Enteriditis

Salmonella Saintpaul
Matching fingerprints

• Receive the DNA fingerprint from the patients with *Salmonella* Saintpaul.
• Match this pattern to the reference sheet to determine which food carried the *Salmonella*.
• With the information from the DNA fingerprinting and attack table, figure out the cause before time runs out.

![Pattern 1 from Cilantro]
DNA Fingerprinting: What real data look like...
This is based on real events!

- 1443 people reported ill with *Salmonella Saintpaul* in July and August, 2008.
- First tomatoes were thought to be the culprit, then peppers were finally discovered to be the problem.
- But where did the peppers get contaminated?
  - Not in the home.
  - Not in the store.
  - Not on the truck or in the warehouse.
  - They must have been contaminated on the farm.
Activity 3: Contamination on Farms

- **Still draft** Diorama image, some contamination maps.

Simulated abundance of *Salmonella* after deposition by wild animals
How did that happen?
Food Safety on fruit and vegetable farms is about environmental quality

Wildlife intrusion and/or runoff

Irrigation or Flooding

Runoff

Overland Vehicles: Wind, wildlife, transportation

Wildlife intrusion
Figuring out how contamination happened?

• Sample water, soils, poop and veggies from the farm

• What is the pattern of the contamination in the field?
  – Make a map of where bacteria are on the farm.

• Are the bacteria that made people sick still there?
  – Match DNA fingerprints from environmental sources, patients and food.
The outbreak vs the investigation of the outbreak

Outbreak investigators have to work backwards from illness in the home to the cause.

Causes are often not conclusively identified because it can be 1 to 2 months before outbreak investigators even visit a grower.