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Section F: Case Examples

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Field Assessment of Microbial Load in Swine Waste

- Swine CAFO

Photo by Friends of Family Farmers via flickr.com. Creative Commons BY-ND.
Swine CAFO Housing Conditions
Swine CAFO Effluent Sampling
Levels of Microorganisms in Swine Lagoon Waste

- Levels of microorganisms in swine lagoon waste

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fecal coliforms</td>
<td>$8.8 \times 10^6$ per liter</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>$1.0 \times 10^7$ per liter</td>
</tr>
<tr>
<td><em>Enterococci</em></td>
<td>$5.2 \times 10^6$ per liter</td>
</tr>
</tbody>
</table>

- A lagoon can hold up to 100 million liters of effluent ...

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fecal coliforms</td>
<td>$2.2 \times 10^{14}$ per $10^8$ liters</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>$2.5 \times 10^{14}$ per $10^8$ liters</td>
</tr>
<tr>
<td><em>Enterococci</em></td>
<td>$1.3 \times 10^{14}$ per $10^8$ liters</td>
</tr>
</tbody>
</table>
## Antibiotic-Resistant *Enterococci*: Swine Lagoon Waste

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Resistance Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythromycin</td>
<td>69%</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>85%</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>0%</td>
</tr>
</tbody>
</table>

- Approved for non-therapeutic use in swine
- Never approved for use in swine in the U.S.
2006 Multi-State Spinach *E. coli* O157: H7 Outbreak

Swine photo by Yu vis flickr.com; Creative Commons BY-ND-SA. Spinach photo by Gaetan Lee vis flickr.com; Creative Commons BY. Cow photo by Dennis Marciniak via flickr.com; Creative Commons BY-NC-SA.
Lettuce and Spinach

- 21 *E. coli* outbreaks since 1995
  - At least 1,000 reported illnesses and 7 deaths

- Fresh or fresh-cut lettuce or spinach implicated as outbreak vehicle

- Eight outbreaks traced back to produce from Salinas, California

E. coli Outbreaks

- Lettuce from all three outbreaks came from California’s Salinas Valley
  - July 2002—Washington dance camp
    ▶ 50 dance campers sickened, several hospitalized, one with life-long kidney damage
    ▶ “Pre-washed” lettuce
  - September 2003—California restaurant
    ▶ 40 patrons ill
    ▶ Salads prepared with bagged, “pre-washed” lettuce
  - October 2003—California retirement center
    ▶ 13 residents sickened, two died
    ▶ “Pre-washed” spinach
2006 Spinach *E. coli* Outbreak Timeline

- September 5, 2006: cluster of five *E. coli* O157:H7 cases
  - Livestock at Manitowoc county fair suspected

- September 7: report of five adults with hemolytic uremic syndrome (HUS) who had undergone plasma exchange
  - *E. coli* O157:H7 confirmed in three patients

- September 8: Wisconsin State Laboratory of Hygiene (WSLH) post PFGE pattern of eight isolates on PulseNet
  - Seven had indistinguishable patterns, one a small variation

Source: Wisconsin State Laboratory of Hygiene (WSLH).
2006 Spinach *E. coli* Outbreak Timeline

- September 7-9: 12 more *E. coli* O:157:H7 samples received at WSLH

- September 11: DPH questionnaires indicate a high percentage of females and a link with spinach consumption

- September 12: Oregon investigation suggests six patients with *E. coli* O157:H7 linked to spinach

- September 14: CDC confirms 50 cases in eight states
  - Wisconsin, New Mexico, Utah, Oregon
  - One death—77-year-old Wisconsin woman

- September 14: conference call with CDC, state HDs, and FDA
  - FDA issues advisory for consumers not to eat bagged spinach

Source: Wisconsin State Laboratory of Hygiene (WSLH).
2006 Spinach *E. coli* Outbreak Timeline

- September 15: National Selection Foods of San Juan Bautista, California, recalls all products containing spinach (use-by dates from August 17 to October 1)

- September 19: New Mexico confirms *E. coli* from patient’s open bag of spinach
  - Identical PFGE pattern to outbreak strain
  - Other states later identify outbreak strain in bags of spinach
    - Thirteen bags from eight states, including two from Wisconsin

- September 20: 2-year-old Utah boy dies

- October 5: elderly Nebraska woman dies

Source: Wisconsin State Laboratory of Hygiene (WSLH).
2006 Spinach *E. coli* Outbreak: Statistics

- 205 cases
  - 26 states
  - 1 Canadian province

- Approximately 50 percent hospitalized (104)

- Hemolytic uremic syndrome (HUS) \( (n = 31; 17 \text{ percent}) \)
  - Higher than usual
    - 39 percent of children
    - 10 percent of adults

- Three deaths
Reporting Timeline

Best = 6 days
Worst = 23 days

Source: Wisconsin State Laboratory of Hygiene.
Spinach Outbreak Strain

- *E. coli* O157:H7 identified as EXHX01.0124 strain
  - Accounts for less than 1 percent of strains reported each year
  - Produces only Type 2 shiga toxin
    - Usually more virulent than strains that produce only Type 1 or both toxins
What Was the Source?

- Extensive environmental sampling
  - Water
  - Processing plant
  - Cattle feces
  - Wild pig feces
2006 Dole *E. coli* Outbreak

- *E. coli* O157:H7
  - Isolated from 13 packages of Dole spinach
  - “DNA fingerprints” of all 13 match the outbreak strain of ill people
  - Same strain found on one of four farms that supplied spinach to a single manufacturing facility on a particular day—cow feces, water source, and wild pig gut
FDA Definition of *Adulterated*, 2005

- FDA cited research linking some or all of the outbreaks to sewage exposure, animal waste, and other contaminated water sources.


“In light of continuing outbreaks associated with fresh and fresh-cut lettuce and other leafy greens, particularly from California, we are issuing this second letter to reiterate our concerns and to strongly encourage firms in your industry to review their current operations (2005)”
2006 Taco Bell and Taco John’s *E. coli* Outbreaks

- At least 150 sickened in seven states
  - Dozens hospitalized
  - Several HUS cases

- Two outbreaks separated by a few weeks

- Different suppliers and growers

- Lettuce grown in California
How Do We Prevent Future Outbreaks

- Preventive measures
  - At the field
    - Irrigation water
    - Proximity to cattle, pig, and other animal ranches
    - Farm worker access to portable toilets and hand washing facilities
  - At the processing plant
    - Decontamination steps
  - Distribution
    - Maintaining appropriate temperatures
  - Consumer education