Lessons Learned from an Outbreak: 
*E. coli* O157:H7 linked to Romaine Lettuce

National Investigation and Communication Process

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West Coast Regional Meeting  
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Spring 2018 Outbreak of *E. coli* O157:H7 Infections Linked to Romaine Lettuce
Day 1 (April 2): Outbreak Detection

- NJ Department of Health notifies CDC of a cluster of *E. coli* O157 infections in NJ and PA
  - Most ill people reported eating salads from the same restaurant chain

- CDC Foodborne Outbreak Response Team begins coordinating the investigation
Day 4 (April 5): Confirming a Multistate Outbreak

- PulseNet confirms 8 O157:H7 illnesses from 6 states with the same PFGE pattern

- Only common ingredient in the salads from the same chain in NJ and PA appears to be romaine lettuce
  - NJ collects records for romaine lettuce supplied to the restaurants

- NJ releases a media statement about their investigation
Day 9 (April 10): What Did We Know?

- How many illnesses and where?
  - 17 illnesses in 7 states

- Outbreak ongoing?
  - Yes

- What evidence links the food to illness?
  - Epi: Strong signal for salads/leafy greens, strength of romaine signal somewhat unclear
  - Traceback: Ongoing
  - Lab testing: None

- Is public communication needed?
  - Case count increasing rapidly
  - *E. coli* O157:H7 is serious
  - Media aware of NJ illnesses
  - Rumors about restaurant chain involvement
  - **Decision:** Communicate about the multistate investigation
Day 9 (April 10): CDC Investigation Notice

- 17 people infected with the outbreak strain of *E. coli* O157:H7 from 7 states
  - Included infections recently reported by the NJ health department

- “This investigation is ongoing and a specific food item, grocery store, or restaurant chain has not been identified as the source.”
Confirming the Source

- **12/12 (100%)** reported eating romaine lettuce in the week before illness started
  - 8/13 (62%) reported eating salads that contain romaine lettuce at the same restaurant chain in MO, OH, NJ, and PA
  - Other restaurant and grocery store sub-clusters identified in additional states

- Restaurants reported using bagged chopped romaine lettuce to make salads
  - According to records, romaine lettuce was grown in the Yuma, AZ growing region
Day 12 (April 13): What Did We Know?

- **How many illnesses and where?**
  - 35 illnesses in 11 states
  - 22 hospitalized, 3 HUS

- **Outbreak ongoing?**
  - Yes

- **What evidence links the food to illness?**
  - Epi: Pre-chopped romaine
  - Traceback: Pointing to chopped romaine from the Yuma, AZ region
  - Lab testing: None

- **Is public communication needed?**
  - Case count increasing rapidly
  - *E. coli* O157:H7 is serious
  - Romaine lettuce leading hypothesis about the source
  - Traceback to Yuma, AZ growing region, but no farm ID’ed
  - **Decision:** Warn consumers and retailers not to eat or sell romaine lettuce grown in Yuma, AZ region
Day 12 (April 13): CDC Issues Advice to Consumers and Retailers

- Restaurants and retailers should not serve or sell any **chopped romaine lettuce from the Yuma, Arizona growing region**.
- Consumers anywhere in the U.S. who have **store-bought chopped romaine lettuce at home** should not eat it and should throw it away.
- Before purchasing romaine lettuce at a grocery store or eating it at a restaurant, consumers should **confirm with the store or restaurant** that it is not chopped romaine lettuce from the Yuma, Arizona growing region.
Day 15 (April 16): Traceback Update - Not Just Pre-Chopped Romaine?

- State and local health officials in AK identified a cluster of illnesses at a correctional facility
  - Ill people report eating romaine lettuce

- Traceback investigations showed the lettuce was whole heads of romaine from Yuma, AZ region
Day 19 (April 20): What Did We Know?

- How many illnesses and where?
  - 53 illnesses in 16 states
  - 31 hospitalized, 5 HUS

- Outbreak ongoing?
  - Yes

- What evidence links the food to illness?
  - Epi: 95% reporting romaine lettuce
  - Traceback: Chopped and whole head from the Yuma, AZ region
  - Lab testing: None

- Is public communication needed?
  - Case count increasing rapidly
  - *E. coli* O157:H7 is serious
  - Current advice only includes chopped romaine lettuce
  - **Decision:** Warn consumers and retailers not to eat or sell *any* romaine lettuce grown in Yuma, AZ region
Day 19 (April 20): CDC Advice Expands

- Based on new information, CDC expands its warning to consumers to cover all types of romaine lettuce from the Yuma, Arizona growing region.

- Warning now includes whole heads and hearts of romaine lettuce, in addition to chopped romaine and salads and salad mixes containing romaine.
Day 44 (May 16): What Did We Know?

- How many illnesses and where?
  - 172 people infected in 32 states

- Outbreak ongoing?
  - Illnesses still being reported
  - Lettuce past its shelf life

- What evidence links the food to illness?
  - Epi: 91% reporting romaine lettuce
  - Traceback: Chopped and whole head from the Yuma, AZ region
  - Lab testing: None

- Is public communication needed?
  - Last shipments from Yuma were one month ago
  - Lettuce likely past its shelf life, so risk to consumers is lower
  - Decision: Lift consumer warning about romaine lettuce from Yuma
Day 44 (May 16): CDC Lifts Warning about Romaine from Yuma

- Romaine lettuce from the Yuma growing region is past its shelf life and is likely no longer being sold in stores or in restaurants.

- Advice to consumers:
  - See a clinician if you have symptoms of an *E. coli* infection
Day 88: Outbreak Declared Over

- Outbreak declared over on June 28, 2018
  - 21 day maximum shelf life for romaine
  - 2-4 week reporting delay in PulseNet

- 210 ill people from 36 states
  - 48% hospitalized; 27 people developed HUS; 5 deaths
Whole Genome Sequencing Results

- Illnesses in the outbreak caused by STEC O157 were all closely related genetically
  - Multiple PFGE patterns found to be closely related
  - Two primary sub-clades of even more closely related isolates

- Water isolates collected from an irrigation canal in the Yuma growing region closely related to clinical isolates

- WGS also showed that this strain had been seen previously
  - Illness clusters in CO (2017) and ME (2018), possibly leafy greens
  - 2017 outbreak in CA linked to a recreational water source with migratory geese
  - Other sporadic isolates from 2017 and 2018
Illnesses by WGS Clade: Multistate Outbreak of E. coli O157:H7 Infections Linked to Romaine Lettuce

*** Data are preliminary and subject to change – As of 07/23/2018***
Evidence Linking Illnesses with Romaine Lettuce from the Yuma Growing Region

- **Epidemiologic evidence:**
  - High percentage of ill people reported eating romaine lettuce (87% or 145/166 interviewed)
  - More than 12 illness sub-clusters identified. Multiple ill people reported eating a salad at a restaurant or other venue; romaine lettuce was the only common ingredient identified

- **Traceback evidence:**
  - FDA traced romaine lettuce to many farms in Yuma growing region

- **Laboratory evidence:**
  - Outbreak strain identified in irrigation canal water samples taken from Yuma growing region
  - Whole genome sequencing showed that bacteria from ill people and from canal water were closely related genetically
Outbreak Challenges

- **Challenges collecting epidemiologic data and microbiologic testing**
  - People who eat lettuce eat it often, and many have multiple exposures
  - Many people don’t remember what type of lettuce eaten
  - Short shelf life limits ability to test leftover product

- **Challenges interpreting traceback data**
  - Romaine from multiple farms/ranches/lots comingled at processing
  - Common identifiers not always used to track through production/distribution

- **Challenges communicating clearly**
  - Labels on romaine lettuce do not typically list growing region
  - Sometimes conflicting advice from various outlets and agencies
  - Collateral damage to romaine producers outside of the Yuma growing region
Outbreak Successes

- **Successes in collecting epidemiologic data**
  - Rapidly identified and investigated illness sub-clusters to help confirm the outbreak vehicle

- **Successes in microbiologic testing**
  - Demonstrated value of WGS in investigation

- **Successes in communications**
  - Issued public warning within 8 days of identifying the multistate outbreak
  - Worked closely with New Jersey officials to provide unified message early in investigation
Outbreak Conclusions

- Largest multistate outbreak of *E. coli* O157:H7 infections in over a decade

- Providing clear messaging was challenging; however, we needed to provide rapid advice to the public
  - Outbreak grew quickly and was severe

- Moving forward, how might we do things differently if this happens again?
Questions?

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For more information, contact CDC  
1-800-CDC-INFO (232-4636)  

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.
Extra Slides
## Updated Quantitative Sample Results Total Numbers

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<th>Total Number of EA Samples</th>
<th>Total Number of STEC Samples</th>
<th>Total Number Samples Matching Outbreak Strain</th>
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<th>STECs from Sample Locations</th>
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<tr>
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<td>Irrigation Canal - Yuma Valley 4</td>
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<tr>
<td></td>
<td>Dry Bed of Gila River 1</td>
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<td>CAFO (including Fence Perimeter &amp; Pens) 4</td>
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<td></td>
<td>CA Imperial Spruce Main Delivery 49/50 #1 and #2 Sediment – Imperial Valley 2</td>
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<td>Imperial Valley Site 2 2</td>
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Water tested from 14 locations including discharge, reservoir, and canal water

Sample types included: large volume ultrafiltration (UF; 30-100L), small volume grab (250ml), sediment, and surface swabs

Fecal indicator testing
• Standard methods for *E. coli* and enterococci measured as Most Probable Number/100ml)

DNA amplification and detection with *E. coli* O157:H7 virulence and serotype-specific targets

Culture enrichment, colony isolation
• Fingerprinting by pulsed field electrophoresis (PFGE), whole genome sequencing (WGS)
Environmental Assessment Water Sampling Results: June 2018

- *E. coli* 0157:H7 isolated from large volume (UF) water samples only
  - 3/14 sites positive - all 3 taken from canal (UF; 53 liter): ~1 mile upstream, next to, and 1 mile downstream of cattle feedlot

- Generic *E. coli* results in 3 positive samples: 4, 84, and 84 MPN/100 ml
  - All within acceptable standard range (<126 MPN/100 mL)

- PFGE/WGS matches outbreak strain from ill people
- Complex outbreak with pervasive contamination
- Wide-ranging analysis including sampling
- No smoking gun
- Canal water positive for outbreak strain in multiple locations
- Further research and analysis is needed