

# An Outbreak of *Escherichia coli* O157:Nonmotile Associated with Alfalfa Sprouts — Colorado, July 2003

DD Ferguson, MD,<sup>1</sup> A Cronquist, MPH,<sup>2</sup> J Scheffel, DVM, MPH,<sup>3</sup> A Woo-Ming,<sup>2</sup> K Gershman, MD, MPH,<sup>2</sup> J Knutsen,<sup>2</sup> AK De, PhD<sup>4</sup>

<sup>1</sup>Epidemic Intelligence Service assigned to the Colorado Department of Public Health and Environment, Epidemiology Program Office, Centers for Disease Control and Prevention, Atlanta, GA. <sup>2</sup>Colorado Department of Public Health and Environment, Denver, CO. <sup>3</sup>Minnesota Department of Health, Minneapolis, MN. <sup>4</sup>Division of Applied Public Health Training, Centers for Disease Control and Prevention, Atlanta, GA.

## ABSTRACT

**Background:** *Escherichia coli* O157 is a leading cause of diarrhea, hemorrhagic colitis, and hemolytic uremic syndrome (HUS). In July 2003, the Colorado state health department identified an outbreak of *E. coli* O157: NM (nonmotile) in Colorado based on patients with matching pulsed-field gel electrophoresis (PFGE) isolates. We investigated this outbreak with the objectives of identifying the outbreak cause, implementing control measures and preventing future outbreaks.

**Methods:** We conducted a 1:2 matched (sex, age range) case-control study, using sequential-digit dialing. Case-patients were Colorado residents with a PFGE-matched *E. coli* O157 isolate and illness onset during July 18–30, 2003. We obtained food histories from patients for the week before illness, and from controls for the week before cases' illness peak.

**Results:** Among 13 case-patients, median age was 24 years (range: 19–64); 54% were female; 77% had hemorrhagic colitis; and the median duration was 6 days (range: 2–8). One patient was hospitalized; no deaths or cases of HUS occurred. Only alfalfa sprouts, which 8/13 case-patients recalled consuming, were associated with illness (matched odds ratio: 8.0; 95% confidence interval=1.6–77.3). Colorado case-isolates' PFGE pattern matched that of seven case-isolates from a January 2003 alfalfa sprout-associated *E. coli* O157 outbreak in Minnesota. The same seed distributor was identified in Colorado and Minnesota tracebacks. No implicated Colorado sprouts or seeds were available to test. The Colorado sprouter reported compliance with federal seed decontamination guidelines.

**Conclusions:** Contaminated alfalfa seeds from the same seed distributor probably caused outbreaks of *E. coli* O157 infections in Minnesota and Colorado. PFGE was instrumental in identifying these related outbreaks. Research is needed to improve sprout seed decontamination. Raw alfalfa sprouts should be considered potentially contaminated and avoided by high-risk groups, including the elderly, young children, and immunocompromised persons.

## BACKGROUND

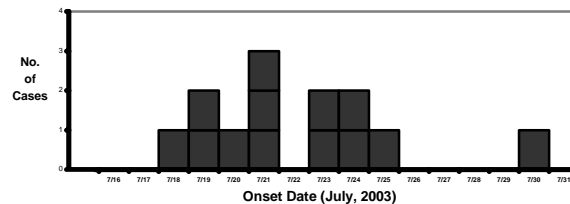
- February 2003, Minnesota (MN) health department implicated alfalfa sprouts as the cause of 7 cases of *E. coli* O157
- July 2003 – Colorado (CO) health department identified 13 cases of *E. coli* O157:NM (nonmotile)
- CO pulsed-field gel electrophoresis (PFGE) pattern matched the MN outbreak strain
- STUDY OBJECTIVES:** Identify outbreak cause, implement control measures, and help prevent future outbreaks

## METHODS

- Case definition – CO resident with onset July 18–30, 2003 – *E. coli* O157 isolate with outbreak PFGE pattern
- 1:2 matched (sex and age range) case-control study
- Sequential digit dialing tied to cases' phone number
- Food histories – Cases: the week before illness onset – Controls: the week before cases' peak illness onset
- PFGE sub-typing using 2 restriction enzymes
- Trace back – CO Consumer Protection Division – Food and Drug Administration (FDA)

## RESULTS

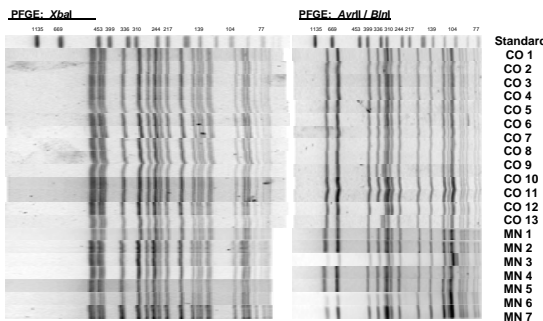
Cases of *E. coli* O157:NM by Onset Date — Colorado, July 2003



Characteristics and Clinical Features of 13 Colorado Case-Patients with *E. coli* O157:NM Infection

Characteristic	No. (%)
Median age (range), years	24 (19 – 64)
Female	7 (54)
<b>Clinical Features</b>	
Abdominal cramps	13 (100)
Diarrhea	12 (92)
Bloody diarrhea	10 (77)
Hospitalized	1 (8)
HUS	0 (0)

Closely-Related PFGE Patterns Among Colorado and Minnesota Case-Isolates Suggest Common Source of Infection



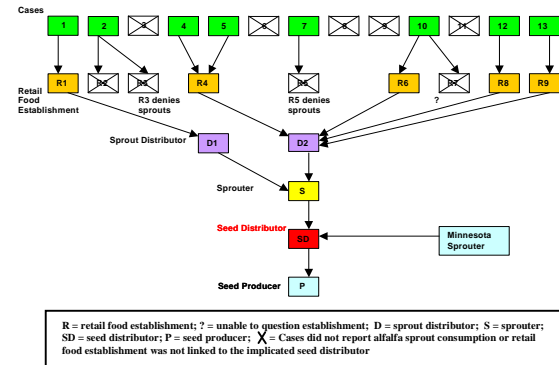
Bivariate Analysis of Selected Food Items from Colorado Investigation of *E. coli* O157:NM Outbreak

Food Item	Cases who ate	Controls who ate	MOR <sup>a</sup>	CI <sup>b</sup>
Alf sprouts	8 / 13	2 / 26	8.0	1.6–77.3
Red grapes	6 / 13	4 / 26	9.0	0.9–374
Carrots	10 / 13	11 / 26	4.0	0.8–20.6
Hamburger	7 / 13	18 / 26	0.4	0.1–2.7

<sup>a</sup> MOR = Mantel-Haenszel matched odd's ratio; <sup>b</sup> CI = Exact 95% confidence interval

- Case-patients were significantly more likely to have eaten alfalfa sprouts than controls
- Using exact multiple logistic regression – only alfalfa sprouts were significant (Conditional Maximum Likelihood Estimate 7.4, CI 1.4–74)

Trace-Back Investigation of Alfalfa Sprouts Associated with Colorado *E. Coli* O157:NM Outbreak



R = retail food establishment; ? = unable to question establishment; D = sprout distributor; S = sprouter; SD = seed distributor; P = seed producer; X = Cases did not report alfalfa sprout consumption or retail food establishment was not linked to the implicated seed distributor

- 8 case-patients (green boxes) ate alfalfa sprouts traced to 5 food establishments (orange boxes) traced to 2 alfalfa sprout distributors (purple boxes) traced to 1 sprouter (yellow box) traced to 1 seed distributor (red box)
- The same seed distributor was implicated in the MN outbreak
- Trace-back did not include the seed producer in Australia – No memorandum of agreement between countries
- No implicated sprouts or seeds available to culture
- The CO sprouter complied with FDA guidelines for seed decontamination

## DISCUSSION

- CO and MN outbreaks of *E. coli* O157 were most likely caused by contaminated alfalfa seeds
  - Distinct outbreaks due to matching *E. coli* O157 strains
  - Only alfalfa sprout consumption was associated with *E. coli* O157 infection in each outbreak
  - Alfalfa sprouts traced back to the same seed distributor and exporter in each outbreak
- FDA guidelines for seed decontamination
  - Calcium hypochlorite (20,000 PPM) solution
  - Soak and agitate seeds for 10 minutes

## BUT

- Guidelines are not enforced<sup>1</sup>
  - MN sprouter did not comply with guidelines
- Guidelines are not completely effective<sup>2,3</sup>
  - CO sprouter reported compliance with guidelines

## LIMITATIONS

- Possible recall bias – Patient interviews closer to exposure
  - Case-patients more motivated to identify cause
  - But, case-patients seemed unaware of risk of produce
- Possible bias in selection of controls
  - 46% response rate among potential controls
- No implicated sprouts or seeds available to culture

## CONCLUSIONS

- Raw alfalfa sprouts should be considered potentially contaminated and potentially harmful
- High-risk persons including the elderly, young children, and immunocompromised persons should avoid raw alfalfa sprouts
- Raw alfalfa sprouts should not be served at nursing homes, hospitals, or child-care facilities
- Consider more stringent regulation of alfalfa sprout production with enforcement of FDA decontamination guidelines
- Additional research in alfalfa seed decontamination is needed

## REFERENCES

- FDA Issues Guidance to Enhance Safety of Sprouts. U.S. Food and Drug Administration. Press release. 25 October 1999. Available at: <http://www.fda.gov/cfsan/press/pr001025.htm>
- Taormina J, Beuchat L. Comparison of Chemical Treatments to Eliminate Enterohemorrhagic *Escherichia coli* O157:H7 on Alfalfa Seeds. J Food Protection 1999;62:318-24.
- Brooks J, Rowe S, Shillam P et al. *Salmonella* Typhimurium Infections Transmitted by Chlorine Pretreated Clover Sprout Seeds. Am J Epidemiol 2001;154:1020-8.