VIRGINIA
EPIDEMIOLOGY BULLETIN

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April 1998 Volume 98, Number 4

A Statewide Outbreak of *Escherichia coli* O157:H7, Virginia, 1997

Background

On June 16, 1997, the Office of Epidemiology of the Virginia Department of Health (VDH) was informed of five confirmed cases of *Escherichia coli* O157:H7 occurring in two adjacent local health districts. The following day, two more cases were reported from two other health districts. Thirty-two cases of *E. coli* O157:H7 with onsets during June 1997 were eventually reported to VDH, as compared with 11 cases in June 1996. During July and August 1997, cases continued to occur in persons who lived in geographically disparate areas across the Commonwealth, with no obvious common exposures. An investigation was undertaken to determine if: 1) an outbreak was indeed occurring; and 2) a common source could be identified among the ill.

Case Finding

Once it was recognized that there was increased reporting of *E. coli* O157:H7 during the month of June, district health departments were asked to inform local physicians and laboratories of the need for heightened suspicion for infection with *E. coli* O157:H7 in patients presenting with bloody diarrhea. *E. coli* O157:H7 infection was eventually confirmed in 61 patients with onsets of illness between June 1 and August 17, 1997.

Laboratory Methods

Physicians, hospitals and commercial laboratories were asked to send stool specimens or isolates to the state laboratory, the Division of Consolidated Laboratory Services (DCLS). Stool specimens were tested for the presence of *E. coli* O157:H7 using a series of biochemical tests and O157 and H7 antigen-specific agglutination reactions. An ELISA-based detection method was employed to test for the presence of Shiga-like toxins. *E. coli* O157:H7 isolates were further subjected to DNA molecular subtyping by pulsed-field gel electrophoresis (PFGE) in order to identify genetically- related organisms and to determine if there was a common outbreak strain. Isolates received by DCLS by July 8 were forwarded to the Centers for Disease Control and Prevention (CDC) for PFGE analysis; DCLS performed PFGE analysis on all isolates received after that date. Of the 26 isolates sent to CDC for PFGE analysis, 24 revealed the same outbreak strain (two of these 24 isolates showed one-band differences using one or two enzymes but were still considered part of the same outbreak strain). Eventually, 19 more isolates were found to have the same pattern. Thirty isolates that matched the outbreak pattern were also phage typed by CDC; 27 were phage type 32.

Case Definition

A confirmed case-patient was defined as a Virginia resident, or non-resident treated at a Virginia health care facility, who presented with diarrheal illness (three or more loose stools in a 24-hour period) with onset between June 1 and August 17, 1997, and who had a stool culture confirming the presence of *E. coli* O157:H7 with the outbreak strain PFGE pattern.

Case-Control Study

Twenty case-patients were matched with controls by age, gender, and geographic location. Case-patients less than 18 years old were matched with controls who were within three years of age, those 18 to 34 years old were matched within 5 years of age, and those over 34 years old were matched within 10 years of age. To locate geographically-matched controls, investigators dialed the case-patients' area code and first five digits of their telephone numbers, then completed the call using a list of randomly-generated numbers for the last two digits. Although attempts were made to identify three controls for each case-patient, three controls were able to be identified and interviewed for only nine case-patients. Two controls were identified and interviewed for ten case-patients and only one control could be identified and interviewed for one case-patient, for a total of 48 controls.

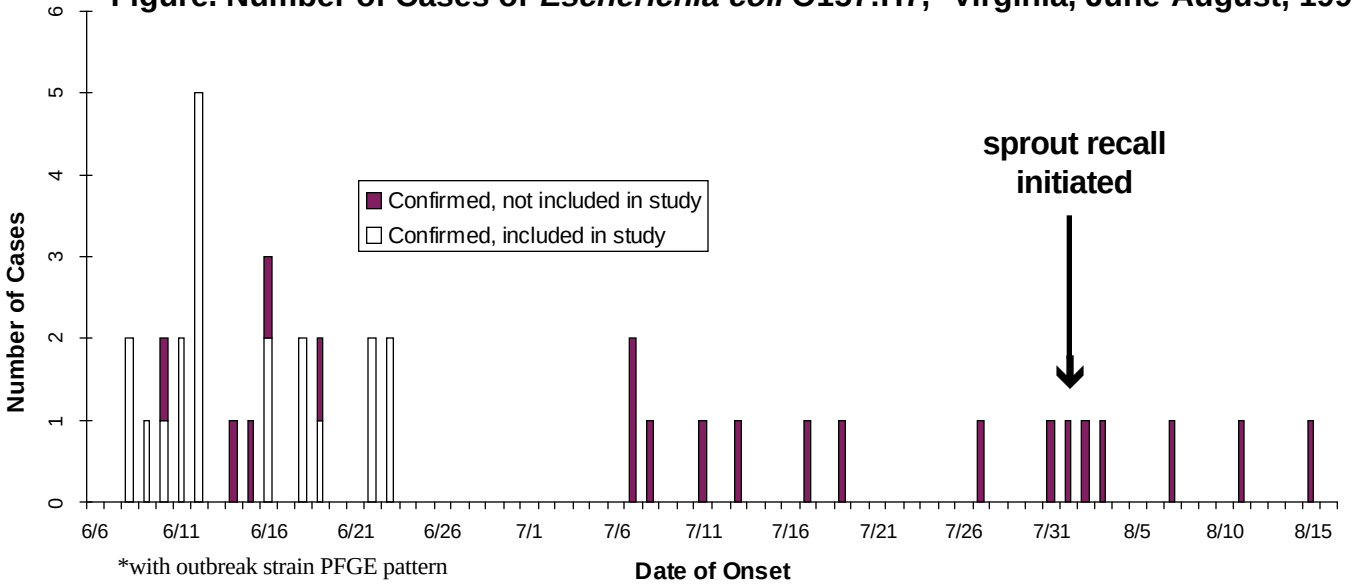
Case-patients and controls were interviewed via telephone by trained interviewers using a standardized questionnaire. Case-patients were asked about exposures during the week prior to their onset of illness. Controls were asked the same questions for the same one week period as the case-patients to whom they were matched. Potential controls were excluded if they reported having had diarrhea within the two months prior to the interview or if they were not living in their current residence during the week prior to their matching case-patients' onset of illness. Participants were questioned about where they purchased meat and produce, and where they went swimming or wading. They were next asked about consumption of 31 food items, including beef, cheese, milk, fresh fruit and vegetables, during the specified week. If a respondent could not remember consuming an item during that week, then he was asked whether that item would have been consumed in a typical week in the month of interest.

Onsets of illness for the 20 case-patients were between June 8 and 23 (Figure). Their median age was 31 years (range 6 to 55 years); 12 (60%) were female (Table). Eighteen (90%) reported bloody diarrhea, and eight (40%) were hospitalized for a median of four

Table. Characteristics of Case-Patients Enrolled in Study (n=20)

	Number (% or range)
Median age in years (range)	31 (6-55)
Female (% of total)	12 (60%)
Symptoms (% of total)	
Diarrhea	20 (100%)
Cramps	20 (100%)
Bloody diarrhea	18 (90%)
Nausea	17 (85%)
Vomiting	13 (65%)
Headache	9 (45%)
Muscle aches	9 (45%)
Chills	8 (40%)
Fever	8 (40%)
Number hospitalized:	8 (40%)
Median days hospitalized (range)	4 (2-7)

Figure. Number of Cases of *Escherichia coli* O157:H7,* Virginia, June-August, 1997



*with outbreak strain PFGE pattern

days (range of two to seven days). No one developed hemolytic uremic syndrome.

Thirteen (68%) of 19 case-patients (one case-patient was unable to answer the question), as compared to 7 (15%) of 48 controls, reported eating alfalfa sprouts during the week prior to case illness onset (matched odds ratio [MOR]=24.6; 95% confidence interval [CI]=4.1–537). (Two case-patients and three controls considered to have been exposed to sprouts reported eating sprouts in a typical week, but could not remember if they had definitely eaten sprouts during the weeks in question. Even if these two case-patients are considered to *have not* eaten sprouts during the selected time period and these three controls are considered to *have* eaten sprouts, the MOR is still statistically significant, though it decreases to 8.9, with a CI=2.1–61.7.) None of the other food items or other exposures was significantly associated with illness.

Sprout Traceback

Once alfalfa sprouts were identified as the likely source of the outbreak, a traceback was undertaken. Without informing case-patients of the results of analyses implicating alfalfa sprouts, investigators contacted them to further inquire about where they might have eaten fresh produce. Case-patients were probed on alfalfa sprouts as well as other vegetables. If case-patients reported eating alfalfa sprouts at home, they were then asked where and when the alfalfa sprouts had been purchased. If they reported eating them at a restaurant, they were asked for the name and location of the restaurant, as well as for the date(s) of consumption. Investigators visited the identified restaurants and grocery stores to determine from which grower or intermediate distributor they had received their alfalfa sprouts.

Of the 13 case-patients who reported eating alfalfa sprouts, only one had purchased them at a grocery store; the other 12 had eaten them at 11 restaurants. The source of the sprouts for the grocery store and for the restaurants was a grower in southeastern Virginia. This sprouting company ("Company A") received its seeds from the same distributor that had been implicated in a concurrent *E. coli* O157:H7 outbreak in Michigan. Clinical isolates from Michigan and Virginia had indistinguishable PFGE patterns. Further traceback activities revealed a common seed lot, produced in Idaho. No other states had received seeds from the implicated lot. Company A ceased using seeds from this lot, returned the remaining seeds to the distributor, and issued a voluntary recall on August 1 for any product still on the market.

Discussion

This investigation, in conjunction with a concurrent outbreak and investigation in Michigan, represented the first reported outbreaks of *E. coli* O157:H7 infection associated with the consumption of alfalfa sprouts. Outbreaks of *Salmonella*, a bacteria with similar modes of transmission, have previously been traced to alfalfa sprouts,[1,2] so it was feasible for alfalfa sprouts to be a vehicle of transmission for *E. coli* O157:H7.

Some case-patients repeatedly denied sprout consumption within the seven days prior to their onset of illness, despite further questioning after the case-control study was completed. People are not always aware of eating sprouts, as they are often part of the ingredients of a sandwich ordered at a restaurant and may go unrecognized during both consumption and later dietary recall. As a result, the exact mode of transmission may never be known for some case-patients, although person-to-person transmission may have occurred in some instances. Additionally, certain strains of *E. coli* O157:H7 including our outbreak strain are considered "endemic," and so will occasionally be identified on routine molecular subtyping; this could explain the non-sprout associated case-patients in our study.

Prevention of future similar outbreaks will involve developing and implementing effective methods of decontamination of alfalfa sprouts or seeds. Current treatments, such as soaking seeds in water with chlorine concentrations of 2000 ppm, have been shown to leave viable *Salmonella* on the seeds—*Salmonella* that may increase up to 10,000-fold during the sprouting process.[3] As with all fresh produce, comsumers should thoroughly rinse alfalfa sprouts before eating; however, the effectiveness of rinsing to reduce contamination is unknown. In addition, CDC recommends that persons at higher risk for severe complications of *E. coli* O157:H7 or *Salmonella* infection, such as infants and young children, the elderly, pregnant women, or immunocompromised persons, can reduce their risk by not eating raw alfalfa sprouts.[4]

Finally, the Michigan and Virginia *E. coli* O157:H7 outbreaks demonstrate the value of molecular subtyping in the investigation of foodborne outbreaks. In both states, PFGE analysis helped investigators ascertain that an increase in the number of reported cases of *E. coli* O157:H7 infection was likely due to a common-source outbreak rather than an increase in sporadic cases. In addition, molecular subtyping of isolates from both states demonstrated that these outbreaks were linked by a common strain, corroborating the epidemiologic and traceback findings.

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Acknowledgements

Elizabeth Petrilack MPH, Mary Winnett MD, MPH, Medical College of Virginia, Richmond; Lisa Baker RN, Elizabeth Barrett DMD, MSPH, Faye Bates RN, Cindy Chaos MPH, Lori Chabassol, Shirley Coleman RN, Patricia Culhane-Gizzi RN, Catherine Cummins REHS, Barbara Dell'aria RN, Kathryn Driscoll RN, Andrea Ewing-Thomas RN, Renee Field RN, Robert Hackler, Pamela Hankison RN, Suzanne Jenkins VMD, MPH, Jack Kress, Mary Jean Linn MURP, Jim Martin PhD, Michael McMahan, Dena McWilliams MPH, Grayson Miller, Jr. MD, John Monroe MBA, Jane Moore RN, MHSA, Ann Patch RN, Linda Rose RN, Betty Rouse, John Rullan MD, MPH, Sylvia Ryder RN, Susan Scott RN, Nancy Timmons RN, Janis Travers RN, Linda Vasquez RN, MSN, Pamela Warner, Suzanne Willis MSW, Rosemary Wlaschin RN, Diane Woolard PhD, MPH, Patricia Young RN, Phyllis Young RN, Virginia Department of Health; Richard Alley, Bernadette Cunanan RN, Arlington Health District; Happy Calloway RN, Crystal Groth RN, MSN, Christopher Melchert RS, Fairfax Health District; Sydney Borkey MURP, Edward Payne, Patricia Plander RN, Richmond City Health District; Judith Carroll, Sarah Henderson, Mary Mismas, Daksha Patel MT, James Pearson DrPh, David Peery, Denise Toney PhD, Division of Consolidated Laboratory Services, Commonwealth of Virginia; Frederick Barham III, John Beers, Ryan Davis, Laurianne Richards, Douglas Saunders, Virginia Department of Agriculture and Consumer Services; Tim Barrett PhD, Henry Rolka PhD, CDC.

Cases of Selected Notifiable Diseases Reported in Virginia*

Disease	Total Cases Reported, March 1998						Total Cases Reported Statewide, January through March		
	State	Regions							
		NW	N	SW	C	E	This Year	Last Year	5 Yr Avg
AIDS	128	11	22	5	25	65	227	291	337
Campylobacteriosis	38	15	4	9	5	5	102	50	87
Giardiasis	19	1	6	3	1	8	65	77	59
Gonorrhea	759	50	77	160	196	276	1827	2282	2436
Hepatitis A	35	4	22	3	2	4	60	39	39
Hepatitis B	15	2	5	0	1	7	25	16	27
Hepatitis NANB	0	0	0	0	0	0	1	4	6
HIV Infection	129	2	27	3	22	75	249	253	199
Influenza	10	0	0	6	0	4	722	422	595
Legionellosis	0	0	0	0	0	0	3	1	2
Lyme Disease	1	1	0	0	0	0	1	0	4
Measles	2	0	2	0	0	0	2	0	0
Meningitis, Aseptic	9	2	2	3	0	2	24	30	36
Meningitis, Bacterial†	8	2	0	1	0	5	16	16	20
Meningococcal Infections	6	3	1	0	1	1	14	14	16
Mumps	0	0	0	0	0	0	2	1	6
Pertussis	0	0	0	0	0	0	0	14	6
Rabies in Animals	68	26	17	5	11	9	151	141	98
Rocky Mountain Spotted Fever	0	0	0	0	0	0	0	0	0
Rubella	0	0	0	0	0	0	0	0	0
Salmonellosis	47	2	14	11	14	6	129	131	169
Shigellosis	12	2	7	0	1	2	29	103	88
Syphilis, Early‡	29	0	1	7	7	14	125	197	288
Tuberculosis	19	4	9	2	2	2	53	85	70

Localities Reporting Animal Rabies This Month: Accomack 3 raccoons; Amelia 1 raccoon; Amherst 3 raccoons; Augusta 1 horse; Bath 1 cow; Brunswick 1 raccoon; Buckingham 1 skunk; Caroline 1 raccoon, 1 skunk; Charles City 1 raccoon; Culpeper 1 raccoon; Fairfax 1 fox, 6 raccoons, 1 skunk; Franklin County 1 skunk; Fredericksburg 1 raccoon; Greensville 1 raccoon; Hanover 2 skunks; King and Queen 2 raccoons; Loudoun 5 raccoons, 3 skunks; Louisa 1 raccoon, 1 skunk; Mecklenburg 1 skunk; Nelson 5 raccoons, 2 skunks; Newport News 1 raccoon; Orange 1 raccoon; Page 1 raccoon, 2 skunks; Prince George 1 raccoon; Prince William 1 raccoon; Richmond City 2 raccoons; Rockbridge 1 raccoon; Shenandoah 1 skunk; Spotsylvania 1 cow, 1 skunk; Stafford 1 raccoon, 1 skunk; Virginia Beach 2 raccoons; Wythe 1 raccoon; York 1 raccoon.

Occupational Illnesses: Asbestosis 32; Carpal Tunnel Syndrome 52; Hearing Loss 9; Lead Poisoning 2; Mesothelioma 4; Pneumoconiosis 12.

*Data for 1998 are provisional. †Other than meningococcal. ‡Includes primary, secondary, and early latent.

Published monthly by the
VIRGINIA DEPARTMENT OF HEALTH
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