

No Fair Warning: An Outbreak Following the 1999 Washington County Fair

Student's Guide

Learning Objectives

After completing this case study, the participant should be able to:

- List the reasons to investigate an outbreak;
- List and discuss each step in the investigation of an outbreak;
- Describe the features of an appropriate case definition; and
- Construct an epidemic curve

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Student Informational Sheet:

This instruction sheet is to be used with the CDC Case “No Fair Warning”

Before coming to class, you are to complete page 2 of this case: Part 1, Question 1 with parts A-D.

PART I

On September 3, 1999, the New York State Department of Health (NYSDOH) received reports of at least 7 children hospitalized with bloody diarrhea in counties near Albany, New York. At least one of the children had developed hemolytic uremic syndrome (HUS), a life-threatening complication, characterized by destruction of blood cells, damage to the lining of blood vessels, and in severe cases, kidney failure.

By the evening of September 3, you have received reports of several hundred cases of individuals with diarrhea in addition to the 7 children hospitalized. This is much higher than expected from previous experience.

Question 1:

- A. What the various categories of diarrhea and what are the possible infectious causes of the type described in this report?
- B. What laboratory tests would be most helpful in this situation?
- C. What are the possible causes of diarrhea in terms of possible exposures and routes of these exposures?
- D. Epidemiology gathers information that may pinpoint the cause, the possible exposure and provide clues to the etiologic agent. Basic to an epidemiologic investigation is gathering information on time, place, and person of individuals experiencing the illness. List a total of 6 questions that you might ask in seeking answers for these epidemiologic parameters.
- E. What is hemolytic uremic syndrome (HUS)?

Question 2: Is this an outbreak?

A stool sample from one child yielded *E. coli* O157:H7.

E. coli O157:H7 has been recognized since the 1980s as an important pathogen that can cause serious illness. Outbreaks have been attributed to ground beef, roast beef, water, juices and cider, unpasteurized milk, and contact with animals. Human infection occurs primarily through ingestion of food or water contaminated with bovine fecal material, but person-to-person transmission also occurs. The organism can survive for extended periods in water, meat stored at subfreezing temperatures, soil, and acidic environments, but can be destroyed by thorough cooking or pasteurization.

Patients infected with *E. coli* O157:H7 typically present with severe abdominal cramps, bloody diarrhea, and low grade fever after a 1- to 8-day incubation period (usually 2-4 days). Children and the elderly are at greatest risk for complications such as hemorrhagic colitis, hemolytic uremic syndrome, and death.

All seven children reported to the NYSDOH had attended the Washington County Fair which had been held from August 23 to 29, 1999. Thousands of people in the region had attended the fair. However, the fair had ended 5 days earlier and would not reopen until August of 2000. Furthermore, the grounds on which the fair is held are used infrequently at other times of the year.

Question 3A: What are the major virulence factor(s) of enterohemorrhagic *E. coli* and how do they relate to the various symptoms observed?

Question 3B: Is this worth investigating? Why or why not? What are some of the other common reasons for conducting a field investigation?

Over the next several days, more and more cases of diarrhea and bloody diarrhea were reported. While the earliest cases were in children, cases occurred among all age groups.

The case-patients did not appear to have any restaurant, food, or home or work water supply in common. However, almost all cases acknowledged attending the Washington County Fair. The investigators, therefore, felt comfortable focusing on the Washington County Fair as the source of the outbreak.

Question 4: What might you use as a case definition? (What is a case definition?)

Question 5: How might you look for additional cases?

Stool samples provided by many ill persons yielded *E. coli* O157:H7. Investigators decided to use the following case definitions:

Confirmed case: self-described diarrhea in a person occurring less than 10 days after having attended the Washington County Fair, and isolation from stool of *E. coli* O157:H7.

Suspected case: self-described diarrhea in a person after having attended the Washington County Fair, without isolation from stool of *E. coli* O157:H7.

Within a couple of weeks, 921 persons had been identified with reported diarrhea after attending the Washington State Fair. Stool cultures from 129 persons yielded *E. coli*

The investigators decided that the next step should be to perform descriptive epidemiology, that is, characterize the cases by person, time, and place.

The median age of cases was 28 years; 58% were female. Among the cases, 65 had been hospitalized. Eleven children had developed hemolytic-uremic syndrome (HUS). Two persons died – a 3-year-old girl with HUS and a 79-year-old man with HUS and thrombotic thrombocytopenic purpura.

For the 761 of the 921 cases with documented dates of onset, those dates are shown in the table below. To characterize the outbreak by time, investigators decided to construct an epidemic curve.
O157:H7.

Table 1. Cases of diarrheal illness by dates of onset, Washington County Fair, NY, 1999

Onset cases Due	#confirmed and suspect cases			Onset Date	#confirmed and suspect		
	Total	Confirmed	Suspect		Total	Confirmed	Suspect
August				September			
20	0	0	0	4	61	9	52
21	0	0	0	5	44	8	36
22	0	0	0	6	36	2	34
23	0	0	0	7	26	0	26
24	2	0	2	8	19	3	16
25	4	0	4	9	8	0	8
26	8	0	8	10	10	1	9
27	13	0	13	11	3	1	2
28	13	3	10	12	8	2	6
29	41	6	35	13	4	2	2
30	84	11	73	14	2	1	1
31	100	24	76	15	0	0	0
September				16	0	0	0
1	118	42	76	17	1	1	0
2	88	30	58	18	0	0	0
3	68	15	53	19	0	0	0
				Total	761	161	600

Question 6: What is an epidemic curve?

An epidemic curve, or epi curve for short, is a two-dimensional graph that provides a simple visual display of an epidemic's magnitude and time course. The epidemic curve has time along the X-axis and number of case along the Y-axis. Because time is continuous, the epidemic curve is drawn as a **histogram** (no gaps between adjacent columns), **not as a bar chart**.

A histogram shows how many people got sick and when they got sick. Each square in the histogram below represents a sick person. What was the day when the most people were sick? This is when the outbreak peaked.

Knowing when an outbreak started, when it ended, and when it peaked helps the disease detective narrow down the kinds of diseases that could have caused the outbreak.

Question 7: Using the graph paper provided, graph the cases by time of onset of illness (include appropriate labels and title). Mark the dates of the fair on the epidemic curve. See attached example at the end of the case.

Question 8: Based on the epidemic curve and what you know about the incubation period, estimate when peak exposure likely occurred. What can you conclude from the epi curve and the likely exposure period?

Question 9: What is the value of an epidemic curve?

The Washington County Fair is the major annual event for this rural area east of the Adirondack Mountains and near the Vermont border. It is New York's largest agricultural fair, where hundreds of farm animals and poultry are exhibited. More than 108,000 total visits were recorded during that week.

Question 10: What hypotheses would you want to evaluate?

Investigators learned that since the fairgrounds operated only 42 days each year, its water supply was not considered a public water system and therefore was not regulated as such by either federal or state law. The fairgrounds were supplied by shallow wells approximately 20 feet deep.

Environmental investigation of the fairgrounds revealed that much of the fair was supplied by chlorinated water. However, in one area of the fairgrounds, a shallow well provided unchlorinated water to several vendors who used the water to make beverages and ice.

Question 11: What epidemiologic approach might you use to evaluate your hypotheses?

Part II

Investigators decided to conduct a case-control study. The case group consisted of residents of Washington County who developed diarrhea after attending the fair and who had stool cultures positive for *E. coli*.

Question 12: Whom might you get for controls?

Controls were residents of Washington County randomly selected from the telephone book who, upon telephone interview, reported that they had attended the fair. They were selected to have a similar age distribution as the cases. The study included 32 cases and 84 controls. All of the cases had attended the fair during its last four days. The following analysis is limited to the 32 cases and 57 controls who attended the fair at least once during its final four days.

Table 2. Exposure to water from Well #6, Washington County Fair outbreak, 1999

		CASES	CONTROLS	
Exposure to Well #6 water	YES	26	9	35
	NO	6	48	54
		32	57	89

Table 3. Exposure to chicken from Vendor A, Washington County Fair outbreak, 1999

		CASES	CONTROLS	
Exposure to Vendor A chicken	YES	14	5	19
	NO	18	52	70
		32	57	89

Question 13: What is the appropriate measure of association for a case-control study? Calculate that measure for the data in Tables 2.

On multivariate analysis, only one factor remained statistically significantly associated with infection – drinking beverages purchased from vendors supplied by water from Well #6.

Table 3. Exposure to chicken from Vendor A, Washington County Fair outbreak, 1999

	CASES with disease	CONTROLS without disease
History of Exposure	a	b
No History of Exposure	c	d

Odds ratio (OR) = $\frac{\text{odds that a case was exposed}}{\text{odds that a control was exposed}}$

Odds ratio (OR) = $\frac{a/c}{b/d} = \frac{a \times d}{b \times c}$

Water OR =
Chicken OR =

Gordis L. Epidemiology, 2nd edition. W.B. Saunders Company. Philadelphia 2000.

Question 14: What control / prevention measures might you suggest?

As part of the environmental investigation, samples of water were tested from Well #6, from the distribution pipe to the vendor area, and from the outlet pipe at the vendor area. Although *E. coli* is infrequently isolated from water supplies, all three sites yielded *E. coli* O157:H7.

Pulse-field gel electrophoresis was done on the human and environmental isolates of O157. The Well # 6 *E. coli* pattern was indistinguishable from the patients' pattern. Investigators looked for sources that might have contaminated the well. They identified two areas of concern – a nearby cattle barn with a manure storage area, and a dormitory which housed approximately 80 people who cared for farm animals during the fair. The dorm had bathroom facilities and shower drains that connected to a septic tank and then to a seepage pit. The seepage pit was only 36 feet from Well #6.

A thunderstorm had drenched the fairgrounds on the afternoon of Thursday, August 26. Three weeks after the fair ended, red fluorescent dye was flushed down a hole in the manure storage area but was never detected in water pumped from Well #6. Green fluorescent dye was flushed down a toilet in the dormitory. Within hours, green dye was detected in the septic tank, the seepage pit, and Well #6 water. Investigators speculated that, given the muddy conditions following the heavy rains on Thursday, cattle manure on boots or clothing of the workers who slept in the dormitory could have washed down the floor shower or sink drains and entered Well #6. However, they could not rule out Well 6 was contaminated directly by the nearby manure storage site – while the fluorescent dye test did not demonstrate a connection during dry weather, the groundwater table may have been higher and more easily contaminated following the heavy rains.

Question 15: Who needs to know? Why? How might you communicate these findings?

Conclusion

This was one of the largest outbreaks of *E. coli* O157:H7 in U.S. history. Based on extrapolations from a household survey of Washington County residents, perhaps up to 5,000 fair attendees may have become ill. The source was an unchlorinated shallow well that was not regulated as a public water supply.

To prevent similar outbreaks from occurring in the future, New York State issued summary orders to prohibit the use of untreated water at certain agricultural fairs and to require daily testing and disinfection of water supplies during public events. However, infrequently used water supplies continue to be unregulated in many other states.

References

Washington County Fair Outbreak

- CDC. Outbreak of *Escherichia coli* O157:H7 and *Campylobacter* among attendees of the Washington County Fair – New York, 1999. *MMWR* 1999;48(36):803-804.
- Ackelsberg J, Wallace B, Limberger R, et al. A large waterborne outbreak of *Escherichia coli* O157:H7 and *Campylobacter jejuni* gastroenteritis at a county fair. Submitted.

Outbreak Investigation, General

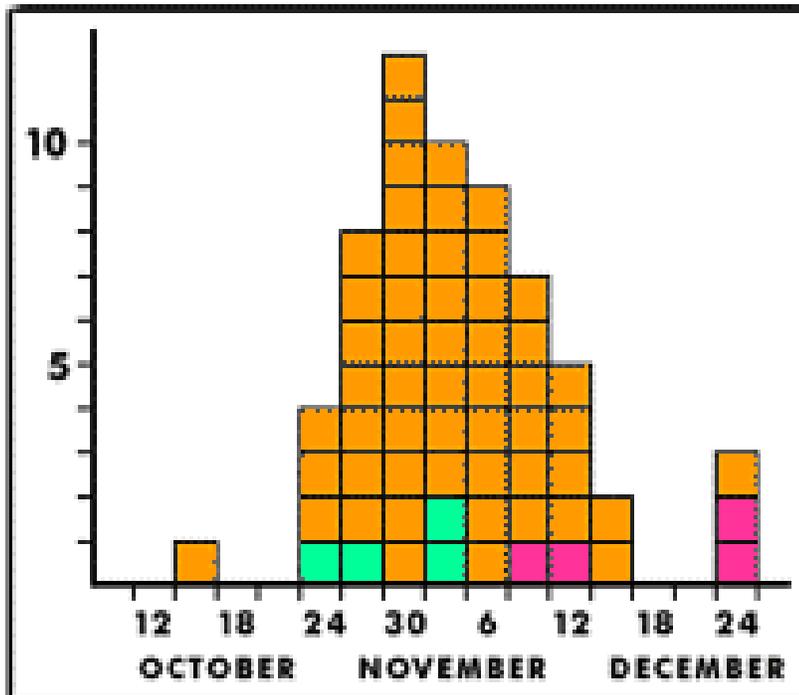
- CDC. *Principles of Epidemiology, 2nd edition*. Atlanta: Centers for Disease Control and Prevention, 1992.
- Gregg MB. Conducting a Field Investigation. In: Gregg MB, ed., *Field Epidemiology, 2nd edition*. New York: Oxford University Press, 2002.

E. coli

- Web site: <http://www.cfsan.fda.gov/~mow/intro.html>
- Web site: http://www.cdc.gov/ncidod/dbmd/diseaseinfo/escherichiacoli_g.htm

Example of an epidemic curve or histogram:

Histogram: <http://www.cdc.gov/gcc/exhibit/virtualtour/field2.htm>



- CASE**
- FOOD HANDLER CASE**
- SECONDARY CASE**