Centers for Disease Control and Prevention
Case Studies in Applied Epidemiology
No. 055-710

An Outbreak of Gastroenteritis Among Warehouse Workers

Participant's Guide

Learning Objectives

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

- Develop a case definition for an outbreak of gastroenteritis,
- Discuss why an epidemiologic study with a comparison group is useful in the investigation of an outbreak,
- Discuss the types of studies one might conduct in an outbreak setting,
- Calculate appropriate measures of association for the type of study selected,
- Conduct a stratified analysis to address possible confounding.

This case study is loosely based on an investigation in 2003 conducted by Rose Devasia, EIS Officer assigned to the Tennessee State Health Department. The investigation was presented at the Regional EIS Conference in April 2004.

This case study was developed by Richard Dicker in 2005 for the Threat Agent Detection and Response project.

Part I

On Wednesday, August 20, 2003, the local health department received a telephone call from a worker at a warehouse. The caller said that she and several of her workers had been ill with diarrhea and vomiting during the past few days.

The caller mentioned that, on the previous Thursday and Friday, the warehouse had conducted a comprehensive inventory, requiring workers to work long hours. The warehouse had provided dinner on Thursday and lunch on Friday for the workers.

The caller had become ill on Sunday, August 17, and had been sick until today.

The epidemiologist at the health department called the warehouse supervisor to gather additional information.

Question 1: What questions might you ask the warehouse supervisor to further characterize the situation?

Question 2: List the broad categories of diseases that must be considered in the differential diagnosis of an outbreak of gastrointestinal illness.

The health department decided to conduct an epidemiologic study to determine the cause of the outbreak, and to implement appropriate control measures.

Question 3: Would you limit the investigation to the warehouse?

The health department called area hospitals and a sample of physicians, and found no increase in cases of gastroenteritis unrelated to the warehouse. They therefore decided to focus their attention on the warehouse.

The warehouse employs 64 people, including supervisors. All worked on Thursday and Friday and had access to the catered meals. One local catering company catered the Thursday dinner and another, unrelated to the first, catered the Friday lunch. The meals were served at the warehouse in self-serve buffet style. No dishwasher or kitchen is present at the warehouse, so utensils were washed after the meals in the bathroom sinks.

The health department learned that the most prominent symptoms among persons who became ill were diarrhea and cramps, with some fever, and some nausea or vomiting.

The health department's EIS Officer, her colleagues, and her supervisors discussed what type of epidemiologic study to conduct. Some suggested conducting a retrospective cohort study. Others suggested a case-control study.

Question 4: What are the arguments for a retrospective cohort study over a case-control study? What are the arguments for conducting a case-control study over a cohort study?

Question 5: Develop a case definition.

The dinner on Thursday included barbequed pork, barbequed chicken, buns, cole slaw, potato salad, beans, barbeque sauce, peach cobbler for dessert, iced tea, and lemonade. Buckets of ice were also provided. The lunch on Friday consisted of fried catfish, chicken strips, French fries, cole slaw, and hush puppies, and banana pudding for dessert. Condiments included tartar sauce, ketchup, honey-mustard sauce, and hot sauce. Iced tea, lemonade, and ice were also provided.

Question 6a: Review the categories or types of information to include on a questionnaire.
Question 6b: Design your questionnaire.

Investigators defined a case as illness in an employee of the warehouse with onset of gastroenteritis (diarrhea or vomiting or both fever and cramps) between the afternoon of August 14 and August 22.

Investigators were able to interview all 64 employees of the warehouse, either in person or by telephone.

Table 1 provides the clinical information from 10 of the employees.

Table 1: Clinical information from 10 of 64 employees, gastroenteritis outbreak, Warehouse A, August 2003

				First	Date of	Symptoms*						Meets case
ID	Age	Sex	Ill	Symptom	Onset	D	N	V	C	F	B Stool	definition?
1	27	F	Y	Vomiting	8/12	N	Y	Y	N	N	N	_____
2	29	F	Y	Diarrhea	8/16	Y	Y	N	Y	F	N	_____
7	25	M	Y	Diarrhea	8/18	Y	N	N	Y	N	N	_____
17	39	F	Y	Cramps	8/15	N	Y	N	Y	N	N	_____
22	55	M	Y	Other	8/17	Y	N	N	N	N	N	_____
29	43	M	Y	Diarrhea	8/17	Y	Y	N	N	N	N	_____
31	36	M	N									_____
33	43	F	Y	Other	8/16	N	N	N	Y	Y	N	_____
47	39	M	Y	Other	8/18	Y	Y	N	Y	N	N	_____
63	26	F	Y	Other	8/20	N	N	N	N	Y	N	_____

* D=Diarrhea, N=nausea, V=vomiting, C=cramps, F=fever, B Stool= bloody stool

Question 7: Using the data in Table 1 and the case definition used by the investigators, indicate whether each employee met or did not meet the case the case definition.

Because the investigators were able to interview all of the employees, they considered their study to be a retrospective cohort study. Table 2 provides clinical information about the 35 employees who met the case definition.

The attack rates by age and sex are shown in Table 3. Figure 1 shows the epidemic curve for the outbreak.

Table 2: Distribution of symptoms among cases (n=35), Warehouse A gastroenteritis outbreak, August 2003

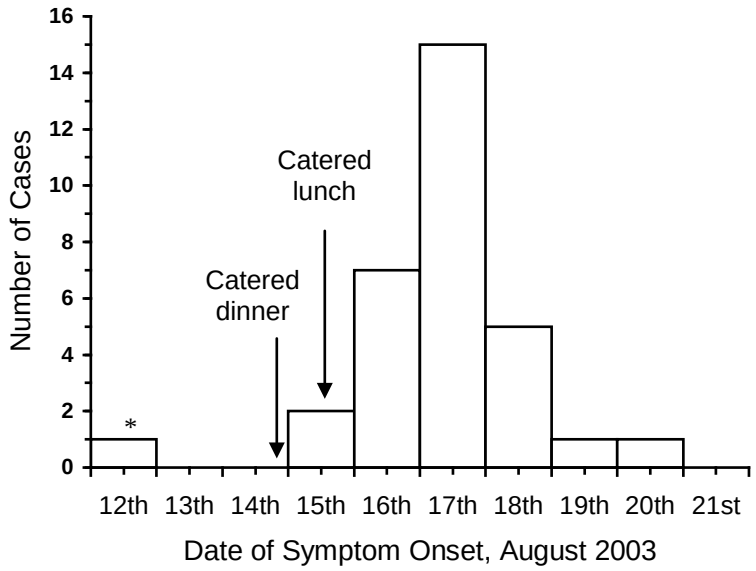
	Number	Percent
Total	35	100%
Diarrhea	33	94%
Cramps	26	74%
Fever	11	31%
Cramps + fever	10	16%
Vomiting	1	3%
Bloody stool	0	0%
Duration of symptoms (median)		82 hours

Table 3: Occurrence of gastroenteritis by age and sex, Warehouse A gastroenteritis outbreak, August 2003

		Number	Number of Cases	Attack Rate (%)
Age	20–29 years	14	8	57.1%
	30–39	26	13	50.0%
	40–49	13	9	69.2%
	50–59	7	5	71.4%
	60–69	0	1	0.0%
	Unknown	0	2	0.0%
Sex	Female	34	18	52.9%
	Male	29	17	58.6%

Question 8: What do you conclude from the age and sex information in Table 2?

Figure 1. Number of cases of gastroenteritis by date of onset, Warehouse A outbreak, August 2003



* Not counted as a case

Question 9: Does this epidemic curve appear to be consistent with a point source outbreak?

The meals and foods eaten most commonly by the cases are shown in Table 4.

Table 4: Meals and foods eaten among cases, Warehouse A gastroenteritis outbreak, August 2003

	Number	Percent
Total	35	100%
Thursday dinner	32	91%
BBQ Sauce (Thurs)	29	83%
Ice (Thurs)	28	80%
Buns (Thurs)	27	77%
Cole slaw (Thurs)	23	66%
Friday lunch	33	94%
Cole slaw (Fri)	31	89%
Catfish (Fri)	30	86%
Ice (Fri)	28	80%
Chicken strips (Fri)	27	77%
Either meal	34	97%
Ice (either meal)	33	94%
Cole slaw (either meal)	31	89%

Question 10: From the information in Table 4, can you implicate a particular food? If yes, which one? If no, what additional information would you like to have?

Part II

Investigators realized that they needed to look at the food consumption information for the entire cohort.

Question 11: What measure of association would you use during the analysis of food consumption and disease status?

Data for the most important foods are shown in Table 5.

Table 5: Foods consumed at Thursday dinner and Friday lunch by illness status, Warehouse A gastroenteritis outbreak, August 2003

	Ate Food				Did Not Eat Food				Measure of Association
Food	Ill	Well	Total	Attack Rate	Ill	Well	Total	Attack Rate	
Thursday	32	27	59	54.2%	3	1	4	75.0%	0.72
BBQ Sauce	29	22	51	_____	6	6	12	_____	_____
Ice	28	26	54	_____	7	2	11	_____	_____
Buns	27	24	51	_____	8	4	12	_____	_____
Cole slaw	23	19	42	_____	12	9	21	_____	_____
Friday	33	19	52	63.5%	2	9	11	18.2%	3.49
Cole slaw	31	7	38	_____	4	21	35	_____	_____
Catfish	30	17	47	_____	5	11	16	_____	_____
Ice	28	18	46	_____	7	10	17	_____	_____
Chicken strips	27	19	46	_____	8	9	17	_____	_____
Any ice	33	27	60	_____	2	1	3	_____	_____
Any cole slaw	31	7	38	_____	4	21	35	_____	_____

Question 12: Using the data in Table 5, calculate food-specific attack rates for those who did and did not eat each food. Calculate the appropriate measure of association.

One of the members of the investigative team expressed concern that cole slaw was served at both meals, and perhaps employees did not remember correctly at which meal they ate the cole slaw.

Question 13 What besides a true association could account for cole slaw's apparent association with illness?

Investigators identified two foods with risk ratios above 2.0. They wondered if one or both could have been responsible for the outbreak, or if one is confounding the other.

Question 14 How would you disentangle the effects of the two foods, and determine whether one or both foods were associated with illness in this outbreak?

Thirty-four employees ate both cole slaw and catfish at the Friday lunch, including 28 of the cases.

Question 15 Set up and perform an analysis to disentangle the effects of cole slaw and catfish.

Question 16 What do you conclude about the two foods now?

Part III — Conclusion

Inspectors from the health department visited the restaurant that catered the Friday lunch. The restaurant had prepared 800 servings of cole slaw on August 15. Fewer than 50 servings were delivered to the warehouse. As noted earlier, no other gastrointestinal illness in the community had been reported to the health department or to the restaurant, and no illness was reported among restaurant employees. No cole slaw was available for testing.

Eighteen stool cultures were collected from warehouse employees. All 18 tested negative at the state laboratory for *Salmonella*, *E. coli* O157:H7, *Campylobacter*, and *Clostridium perfringens*.

In 1982 Kaplan and colleagues proposed criteria for considering an outbreak to be caused by norovirus (1):

- Stool cultures negative for routine bacterial pathogens
- Median incubation period of 24–48 hours (if known)
- Median or mean duration of illness of 12–60 hours
- Vomiting in ≥ 50% of patients (alternatively, vomiting more common than fever (2))

In 1999, Dalton and colleagues proposed criteria for suspecting enterotoxigenic *E. coli* (ETEC) as the cause of an outbreak of gastroenteritis (3)

- Stool cultures negative for routine bacterial pathogens
- Median incubation period of 24–48 hours (if known)
- Median or mean duration of illness greater than 60 hours (if known)
- Diarrhea / vomiting ratio ≥ 2.5

Enterotoxigenic *E. coli* (ETEC) is a frequent cause of diarrhea among U.S. travelers to other countries such as Mexico. An increasing number of outbreaks in the U.S. have been attributed to ETEC. ETEC cannot be identified by conventional laboratory methods. However, ETEC can be identified by PCR that detects the gene for enterotoxin production, followed by serotyping.

Sweeps of the 18 stool cultures were sent to CDC for additional testing. Twelve of the 18 tested positive for ETEC-producing heat-stabile enterotoxin. Serotyping identified the bacterium as *E. coli* O169:H41, which has been identified in 10 (63%) of 16 ETEC outbreaks between 1996 and 2003.

Unfortunately, the health department was unable to obtain a stool specimen from the warehouse employee who had traveled to Mexico and developed gastroenteritis on August 12, nor were they able to determine whether any of the food preparers at the restaurant may have been infected.

References

1. Kaplan JE, Feldman R, Campbell DS, Lookabaugh C, Gary GW. The frequency of a Norwalk-like pattern of illness in outbreaks of acute gastroenteritis. Am J Public Health 1982;72:1329–32.

2. Hedberg CW, Osterholm MT. Outbreaks of food-borne and waterborne viral gastroenteritis. Clin Microbiol Rev 1993;6:199-210.

3. Dalton CB, Mintz ED, Wells JG, Bopp CA, Tauxe RV. Outbreaks of enterotoxigenic *Escherichia coli* infection in American adults: a clinical and epidemiologic profile. Epidemiol Infect 1999:123:9-16.