



An Outbreak of Enteritis During a Pilgrimage to Mecca

Student's Guide

Learning Objectives

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

- Define the term epidemic.
- Create and understand the uses of a case definition.
- Draw an epidemic curve.
- Calculate food-specific attack rates.
- List the steps in investigating an acute outbreak.

This case study is based on an investigation conducted in 1979 by the Kuwaiti epidemiologist assigned to the Kuwaiti medical mission during the pilgrimage to Mecca.

This case study was developed in 1980 by Fred Hoesly and Virgil Peavy. Current version edited by Richard Dicker.



PART I

On the morning of 1-November 1979, during the pilgrimage to Mecca, the epidemiologist assigned to the Kuwaiti medical mission experienced acute onset of abdominal cramps and diarrhea at the holy mosque

before the walk around the Kaaba. He subsequently learned that other members of the mission had developed similar symptoms. When he returned that evening to Muna, he initiated an investigation.

Question 1: What information do you need to decide if this is an epidemic?

The epidemiologist interviewed several ill members of the mission to better characterize the illness. On the basis of these interviews, the epidemiologist quickly prepared a questionnaire and conducted interviews with the 112 members of the Kuwaiti medical mission.

A total of 66 cases of illness were identified; 2 had onset in Kuwait prior to the beginning of the pilgrimage and 64 had onset of symptoms beginning late in the afternoon on 31-October.

Question 2: Is this an epidemic? Explain your answer.

Description of the Pilgrimage

The Kuwaiti medical mission, consisting of 112 members, traveled by automobile from Kuwait to Mecca. On 30-October all members of the mission slept in Muna. At sunrise on 31-October they traveled to Arafat, where at 8:00 a.m. they had tea with or without milk for breakfast. The milk was prepared immediately before consumption by mixing powdered milk with boiled water. The remainder of the day was devoted to religious services. At 2:00 p.m., a lunch was served for all members of the mission who wished to partake. It was a typical Kuwaiti meal consisting of three dishes: rice, meat, and tomato sauce. Most individuals consumed all three dishes. The lunch had been prepared in Muna on 30-

October and transported to Arafat by truck early on 31-October. At sunset on 31-October the mission members returned to Muna.

Clinical Description

The investigator identified a total of 66 cases of gastroenteritis. The onset of all cases was acute, characterized chiefly by diarrhea and abdominal pain. Nausea, vomiting, and blood in the stool occurred infrequently. No case-patient reported fever. All recovered within 12-24 hours. Approximately 20 percent of the ill individuals sought medical advice. The investigator did not obtain any fecal specimens for examination.

Question 3: Develop a preliminary case definition.

Question 4: List the broad categories of diseases that must be considered in the differential diagnosis of an outbreak of gastrointestinal illness.

Question 5: What clinical and epidemiologic information might be helpful in determining the etiologic agent(s)?

Question 6: The Kuwaiti investigators distributed a questionnaire to all members of the mission. What information would you solicit on this questionnaire?

Part II

Investigators determined that of the 64 cases with onset during the pilgrimage, all had eaten lunch in Arafat at 2:00 p.m. on

31-October. Fifteen members of the mission did not eat lunch; none became ill.

Question 7: Calculate the attack rate for those who ate lunch and those who did not. What do you conclude?

Table 1 presents some of the information collected by the investigators. The two members who developed illness prior to 31-

October have been excluded. The 15 members of the mission who did not eat lunch are not included in Table 1.

Question 8: Using appropriate time periods, draw an epidemic curve.

Question 9: Are there any cases for which the time of onset seems inconsistent? How might they be explained?



Table 1 (page 1 of 2). Selected Characteristics of Kuwaiti Medical Mission Members Who Ate Lunch at Arafat, Saudi Arabia, 31-October, 1979

ID #	Age	Sex	Onset of Illness		Foods			Symptoms*						
			Date	Hour	Rice	Meat	TS*	D	C	BS	N	V	F	
31	36	M	31-Oct	5 p.m.	Y	Y	Y	D	C	BS				
77	28	M	31-Oct	5 p.m.	Y	Y		D	C					
81	33	M	31-Oct	10 p.m.	Y	Y	Y	D	C					
86	29	M	31-Oct	10 p.m.	Y	Y	Y	D	C					
15	38	M	31-Oct	10 p.m.		Y		D		BS	N			
17	48	M	31-Oct	10 p.m.	Y	Y		D	C					
18	35	M	31-Oct	10 p.m.	Y	Y	Y	D	C					
35	30	M	31-Oct	11 p.m.	Y	Y	Y	D	C					
88	27	M	31-Oct	11 p.m.	Y	Y	Y	D	C					
76	29	M	31-Oct	11 p.m.	Y	Y	Y	D	C	BS				
71	50	M	1-Nov	12 MN	Y	Y	Y	D						
1	39	F	1-Nov	1 a.m.	Y	Y	Y	D	C				V	
27	36	M	1-Nov	1 a.m.	Y	Y	Y	D	C		N			
28	44	M	1-Nov	1 a.m.	Y	Y	Y	D	C					
29	48	M	1-Nov	1 a.m.	Y	Y	Y	D	C	BS				
30	35	M	1-Nov	2 a.m.	Y	Y	Y	D	C					
50	29	M	1-Nov	2 a.m.	Y	Y	Y	D	C					
59	51	M	1-Nov	2 a.m.	Y	Y	Y	D	C					
67	40	M	1-Nov	2 a.m.	Y	Y		D						
72	58	M	1-Nov	2 a.m.	Y	Y	Y	D	C					
73	28	M	1-Nov	3 a.m.	Y	Y	Y	D	C					
60	31	M	1-Nov	3 a.m.	Y	Y	Y	D	C					
61	38	M	1-Nov	3 a.m.	Y	Y	Y	D		BS				
51	32	M	1-Nov	3 a.m.	Y	Y	Y	D	C				V	
52	37	M	1-Nov	3 a.m.	Y	Y		D						
58	30	M	1-Nov	3 a.m.	Y	Y	Y	D	C					
22	35	M	1-Nov	3 a.m.	Y	Y	Y	D	C					
25	30	M	1-Nov	3 a.m.	Y	Y		D	C					
32	50	M	1-Nov	3 a.m.	Y	Y	Y	D	C					
38	26	M	1-Nov	3 a.m.	Y	Y	Y	D	C					
79	29	M	1-Nov	3 a.m.	Y	Y	Y	D	C					
80	28	M	1-Nov	3 a.m.	Y	Y	Y	D	C					
37	30	M	1-Nov	4 a.m.	Y	Y	Y	D						
65	34	M	1-Nov	4 a.m.	Y	Y		D		BS				
66	45	M	1-Nov	4 a.m.	Y	Y		D	C					
87	41	M	1-Nov	4 a.m.	Y	Y	Y	D	C					
89	43	M	1-Nov	4 a.m.	Y	Y	Y	D	C					
90	43	M	1-Nov	4 a.m.	Y	Y	Y	D	C					
91	38	M	1-Nov	4 a.m.	Y	Y	Y	D	C					
92	37	M	1-Nov	4 a.m.	Y	Y	Y	D	C					
70	31	M	1-Nov	5 a.m.	Y	Y	Y	D	C					
2	34	F	1-Nov	5 a.m.	Y	Y	Y	D	C					
21	38	M	1-Nov	5 a.m.	Y	Y	Y	D	C					
40	38	M	1-Nov	5 a.m.	Y	Y	Y	D						
78	27	M	1-Nov	5 a.m.	Y	Y	Y	D	C					
82	39	M	1-Nov	5 a.m.	Y	Y	Y	D	C					
83	40	M	1-Nov	5 a.m.	Y	Y	Y	D	C					

* TS = Tomato sauce; D = diarrhea, C = cramps, BS = blood in stool, N = nausea, V = vomiting, F = fever

Table 1 (page 2 of 2). Selected Characteristics of Kuwaiti Medical Mission Members Who Ate Lunch at Arafat, Saudi Arabia, 31-October, 1979

ID #	Age	Sex	Onset of Illness		Foods			Symptoms*						
			Date	Hour	Rice	Meat	TS*	D	C	BS	N	V	F	
84	34	M	1-Nov	5 a.m.	Y	Y		D	C					
14	52	M	1-Nov	6 a.m.	Y	Y	Y	D						
16	40	M	1-Nov	6 a.m.	Y	Y	Y	D		BS				
93	30	M	1-Nov	6 a.m.	Y	Y	Y	D	C					
94	39	M	1-Nov	6 a.m.	Y	Y	Y	D	C					
33	55	M	1-Nov	7 a.m.	Y	Y	Y	D	C					
34	28	M	1-Nov	7 a.m.	Y	Y	Y	D	C					
85	38	M	1-Nov	7 a.m.	Y	Y		D	C					
43	38	M	1-Nov	9 a.m.	Y	Y		D	C					
69	30	M	1-Nov	9 a.m.	Y	Y	Y	D	C					
4	30	F	1-Nov	10 a.m.	Y			D	C					
5	45	F	1-Nov	10 a.m.		Y			C					
3	29	F	1-Nov	1 p.m.	Y	Y		D	C					
12	22	F	1-Nov	2 p.m.	Y	Y	Y		C					
74	44	M	1-Nov	2 p.m.	Y	Y	Y	D						
75	45	M	1-Nov	5 p.m.	Y	Y	Y	D		BS				
95	40	M	1-Nov	11 p.m.	Y	Y	Y	D	C					
6	38	F	WELL		Y	Y								
7	52	F	WELL		Y	Y	Y							
8	35	F	WELL		Y		Y							
9	27	F	WELL		Y	Y	Y							
10	40	F	WELL		Y	Y	Y							
11	40	F	WELL		Y	Y	Y							
13	50	M	WELL		Y	Y	Y							
19	38	M	WELL		Y	Y	Y							
20	38	M	WELL		Y	Y	Y							
23	29	M	WELL		Y	Y	Y							
24	27	M	WELL		Y	Y	Y							
26	47	M	WELL		Y	Y	Y							
36	60	M	WELL		Y									
39	27	M	WELL		Y	Y	Y							
41	30	M	WELL		Y	Y	Y							
42	38	M	WELL		Y	Y	Y							
44	50	M	WELL		Y	Y	Y							
45	27	M	WELL		Y	Y	Y							
46	31	M	WELL		Y	Y	Y							
47	46	M	WELL		Y	Y	Y							
48	38	M	WELL		Y	Y								
49	36	M	WELL		Y		Y							
53	36	M	WELL		Y	Y	Y							
54	27	M	WELL		Y	Y	Y							
55	40	M	WELL		Y	Y	Y							
56	30	M	WELL		Y	Y	Y							
57	25	M	WELL		Y	Y	Y							
62	50	M	WELL		Y									
63	44	M	WELL		Y									
64	47	M	WELL		Y		Y							
68	31	M	WELL		Y	Y	Y							

* TS = Tomato sauce; D = diarrhea, C = cramps, BS = blood in stool, N = nausea, V = vomiting, F = fever

Question 10: Modify the graph you have drawn (Question 8) to illustrate the distribution of incubation periods.

Question 11: Determine or calculate the minimum, maximum, mean, median, mode, range, and standard deviation of the incubation periods.

Question 12a: Calculate the frequency of each clinical symptom among the cases.

Question 12b: How does the information on the symptoms and incubation periods help you to narrow the differential diagnosis? (You may refer to the attached *Abbreviated Compendium of Acute Foodborne Gastrointestinal Diseases*).

Question 13a: Using the food consumption histories in Table 1, calculate attack rates and attack rate ratios (risk ratios) for each food.

Question 13b: Do these calculations help you to determine which food(s) served at the lunch may have been responsible for the outbreak?

Question 14: Outline further investigations that should be pursued. List one or more factors that could have led to the contamination of the implicated food.

Part III

The lunch that was served in Arafat at 2:00 p.m. on 31-October was prepared at 10:00 p.m. the night before in Muna. It consisted of boiled rice, chunks of lamb fried in oil, and tomato sauce prepared from fresh tomatoes which were sectioned and stewed.

The cooked rice was placed in two large pots and the lamb was divided evenly on top. The tomato sauce was kept in a third pot.

These pots were covered with metal tops and placed in an open spot among some rocks near the kitchen and allowed to stand overnight. They were presumably not touched by anyone during this period. Early in the morning on 31-October, the pots were transported by truck from Muna to Arafat where they stood in the truck until 2:00 p.m.

The temperature in Arafat at noon that day was 35°C. The food was not refrigerated from the time of preparation to the time of consumption.

Cooks and all other individuals who helped in preparing the meal were intensively interviewed regarding any illness present before or at the time of preparation. All individuals interviewed denied having any illness and knew of no illness among any other members of the group responsible for meal preparation. No specimens were obtained from any of the cooks for laboratory examination.

The following is quoted verbatim from the report prepared by the epidemiologist who investigated the outbreak:

“This clinical picture probably suggests an infection by *Clostridium perfringens*. This organism could be detected in the food elements consumed as well as in the patient's stool. However, no laboratory diagnostic procedures were possible in the outbreak site. All the investigations conducted were based entirely on epidemiologic grounds.

“The incubation period as well as other

data extrapolated from epidemiological analysis suggests that *Clostridium perfringens* is the causative agent. This organism is widely distributed in nature especially in soil and dust. So there is ample opportunity for contamination of the food. If cooked meat is allowed to cool slowly under suitable anaerobic conditions, spores which might have survived cooking or have subsequently come from dust may germinate and within a few hours produce large numbers of vegetative bacilli. In fact, the pilgrimage camp in Muna lacks sanitary cooking facilities. The food is usually prepared in a dusty place open to the blowing winds creating an ideal situation for *Clostridium perfringens* contamination.

“The type of the organism, the type of food dish it usually contaminates, its mode of spread and the differences in the attack rates for those who consumed meat and those who did not points to the meat as the probable source of infection in this outbreak.

“Conclusion: The acute illness of enteritis in Arafat affected many persons in an epidemic form. It was a common-source outbreak, the source being the meat consumed at the Arafat lunch. The incubation period was about 13 hours. The illness was characterized by colicky abdominal pain and diarrhea with no elevation of temperature. The responsible agent for this outbreak is most probably *Clostridium perfringens*.

“The lunch at Arafat should have been prepared in the same day of consumption, or kept refrigerated if it had to be prepared the day before. Although kitchens could not be fully equipped to fulfill the essential safety measures in a place like Muna, they should be supplied by essential measures to protect food from contamination. The remaining food in

Arafat should have been condemned after the investigation, but none remained at that time.”

The epidemiological investigations carried out in this epidemic could explore the nature of this epidemic and answer most of the questions raised. The laboratory investigation, although helpful to detect the

causative organisms, should not replace the more efficient epidemiological methods in the exploration of such epidemics. The lack of the necessary laboratory facilities to detect the causative organisms in foodborne outbreaks should not discourage the investigative epidemiologist and make him doubtful and lose confidence in his epidemiological tools.

Question 15: In the context of this outbreak, what control measures would you recommend?

Question 16: Was it important to work up this outbreak?