CHAPTER ADDENDUM 2 (CASE STUDY): FOODBORNE DISEASE OUTBREAK

Source: Adapted from DHEW/CDC training materials as presented in the University of California, Berkeley Infectious Disease Epidemiology course, Spring 1984.

Comment

Foodborne disease outbreak investigations generally involve both a laboratory and an epidemiologic component. The **epidemiologic investigation** determines the number of cases, types and frequency of symptoms, location, date, and time of the suspect meal, on-

set time of symptoms in cases, history of food preparation and handling (including storage conditions), food and biologic samples (when possible), 24-hour food histories for all persons attending the suspect meal, and attack rates by food items eaten and not eaten. By piecing together these bits of information, the epidemiologists can usually determine the agent in question and its ultimate source.

The **laboratory investigation** is necessary to detect the presence of the agent in cases and the environment. The laboratory investigation is also useful in identifying other organisms in the environment that might be present in large enough numbers to suggest inadequacy of general sanitary conditions of food preparation. Laboratory procedures should include aerobic and anaerobic plate counts of samples collected during the epidemiologic investigation, with samples (e.g., stool, saliva, vomit) coming from both cases and foods, as appropriate, depending on the suspected etiologic agent. Culture and other diagnostic procedures aimed at the suspected agent should be pursued.

Background

The local medical center in a rural California county notifies the county health department of a hospitalized case of gastroenteritis. From interviewing this patient, you discover that the case had attended a church supper in Rhynedale, California, seven days earlier. You find out that approximately 50 other individuals had attended this church supper and that several participants had become ill with symptoms similar to those seen in the sentinel case. Your assignment is to investigate this case and determine whether it was the result of food poisoning.

The Locale

Rhynedale is a small, unincorporated town of 581 residents in northern California, not far from Sacramento.

Question 1 Discuss how you might prepare for the field work.

The Church Supper

Between the hours of 6:00 p.m. and 9:30 p.m. on Saturday, July 23, a Rhynedale community church held a pot luck supper in a wooded area near their church. The attending families each brought food from home, which was laid out on tables for all to share. Though many brought similar foods, none of these foods were mixed, and all food remained in its original container. No caterers or other persons were involved in handling the food. The bulk of the food was eaten between 6:30 and 7:30 p.m. All cases that were contacted denied having a diarrheal illness before or during the supper and denied knowledge of the same for others attending the supper.

The Involved Group

Fifty-one people from 16 family groups attended this affair. Thirteen of the families were from the Rhynedale area. One family was from a nearby town. Two families were from out-of-state.

Materials and Methods

You place phone calls to all families who had attended the supper. Family rosters are recorded and, for anyone reporting symptoms, the course and duration of their illness are described by onset, duration, symptoms, and the need for physician care or hospitalization. Food histories are obtained on all supper attendees—whether ill or not—for each item served at the supper. Inquiries are made of pet and other animal contacts, and of prior contacts with persons known to have had diarrheal illnesses.

You request each family to furnish a list of foods they brought to the supper. You also inquire where they purchased these foods, how they were prepared, what foods they took home from the supper, and whether food items were still available for laboratory testing. Visits are made to two families who did not have telephones. (This is a fairly old case study.) Out-of-state parties are not reached, although multiple telephone calls are attempted.

Data

Each study subject is uniquely identified with a record (REC) number. Information on case status and demographic factors appear in Table 14.5. Information on signs, symp-

TABLE 14.5. Case Status and Demographic Data: Foodborne Disease Outbreak Case Study

Variable Names and Descriptions

REC	Record (identification) number
CASE	Case of gastroenteritis (Y/N)
SEX	Gender (M/F)
AGE	Age (in years)

Data

REC	CASE	SEX	AGE	REC	CASE	SEX	AGE
1	Y	M	17	27	N	F	2
2	Y	F	8	28	N	F	15
3	Y	M	37	29	N	M	44
4	Y	F	7	30	N	F	42
5	Y	F	8	31	N	F	17
6	Y	M	26	32	N	F	19
7	Y	F	25	33	N	M	16
8	Y	F	5	34	N	M	3
9	Y	M	14	35	N	F	66
10	Y	M	48	36	N	F	18
11	Y	F	12	37	N	M	39
12	Y	M	10	38	N	F	17
13	Y	M	14	39	N	F	14
14	Y	M	13	40	N	M	46
15	Y	M	28	41	N	F	45
16	Y	F	9	42	N	F	16
17	Y	M	45	43	N	F	11
18	Y	F	35	44	N	M	26
19	Y	F	39	45	N	F	57
20	Y	M	10	46	N	M	60
21	Y	M	11	47	N	F	34
22	Y	M	7	48	N	F	16
23	Y	M	33	49	N	M	18
24	Y	F	41	50	N	F	4
25	Y	M	13	51	N	M	62
26	N	F	52				

TABLE 14.6. Signs, Symptoms, Duration of Illness, and Incubation Periods: Foodborne Disease Outbreak Case Study

Variable Names and Descriptions

CRMP	Cramps (Y/N/ · = missing)
DIAR	Diarrhea (Y/N/ · = missing)
BDIAR	Bloody diarrhea (Y/N/ · = missing)
NAUS	Nausea (Y/N/ · = missing)
VOMIT	Vomiting (Y/N/ · = missing)
FEV	Fever (Y/N/ · = missing)
CHIL	Chills (Y/N/ · = missing)
HEAD	Headache (Y/N/ · = missing)
MYAL	Myalgia (Y/N/ · = missing)
DUR	Duration of symptoms (in days)
INC	Incubation (hours between the beginning of supper and first symptoms)

Data

REC	CRAMPS	DIAR	BDIAR	NAUS	VOMIT	FEV	CHIL	HEAD	MYAL	DUR	INC
1	Y	Y	N	Y	Y	Y	N	Y	Y	9	9
2	Y	Y	N	Y	Y	Y	Y	Y	Y	7	15
3	Y	Y	N	N	N	Y	Y	Y	N	3	17
4	Y	Y	·	Y	Y	N	Y	Y	·	7	19
5	Y	Y	N	N	N	Y	N	Y	Y	5	20
6	Y	Y	N	Y	Y	Y	Y	Y	Y	7	23
7	Y	Y	N	Y	N	N	N	Y	·	3	25
8	Y	Y	·	Y	Y	Y	Y	Y	·	7	25
9	Y	Y	N	Y	Y	Y	Y	Y	Y	8	26
10	Y	Y	N	N	N	Y	Y	Y	Y	2	18
11	Y	Y	N	Y	Y	Y	N	Y	Y	7	19
12	Y	Y	·	Y	N	Y	Y	Y	Y	8	32
13	Y	Y	N	N	N	Y	N	Y	Y	6	32
14	Y	Y	N	Y	Y	Y	Y	Y	Y	7	36
15	Y	Y	N	N	N	Y	Y	Y	Y	3	43
16	Y	Y	N	Y	N	Y	Y	Y	Y	6	47
17	Y	Y	N	Y	Y	Y	Y	Y	Y	7	53
18	Y	Y	N	Y	Y	Y	Y	Y	Y	7	62
19	Y	Y	Y	Y	N	Y	Y	N	N	5	76
20	Y	Y	N	N	N	Y	N	Y	Y	4	77
21	Y	Y	N	Y	Y	Y	N	N	Y	7	89
22	Y	Y	·	N	N	Y	N	Y	·	7	97
23	Y	Y	N	Y	Y	Y	N	Y	Y	4	98
24	Y	Y	N	N	N	Y	Y	Y	Y	7	100
25	Y	Y	N	Y	N	Y	Y	Y	Y	8	111

toms, duration of illness, and time of onset relative to the beginning of the church supper appears in Table 14.6. Note that a dot indicates missing data. Information about food items consumed by people attending the church supper appears in Table 14.7.

Question 2 Draw an epidemic curve. Determine the minimum, maximum, and median incubation times.

The median is the data point that is greater than or equal to half the values in the sample. Before calculating the median, data are sorted in ascending order and ranked from 1 to n, where n represents the number of cases. The median value is the value halfway down the rank-ordered list. If n is odd, this corresponds to the value of the observation with rank $(n + 1)/2$. If n is even, this corresponds to the average of values associated with ranks $n/2$ and $(n/2) + 1$.

TABLE 14.7. Food Histories: Foodborne Disease Outbreak Case Study

Variable Names and Descriptions

SHRIMP	Shrimp salad (Y/N/ · = missing)
OLIVE	Olives (Y/N/ · = missing)
FRCHICK	Fried chicken (Y/N/ · = missing)
BBQCHICK	Barbecued chicken (Y/N/ · = missing)
BEANS	Beans (Y/N/ · = missing)
POTSAL	Potato salad (Y/N/ · = missing)
GJEL	Green Jell-O (Y/N/ · = missing)
RJEL	Red Jell-O (Y/N/ · = missing)
MAC	Macaroni salad (Y/N/ · = missing)
RBEER	Root beer (Y/N/ · = missing)
ROLL	Rolls (Y/N/ · = missing)
BUTTER	Butter (Y/N/ · = missing)
DEVEGG	Deviled eggs (Y/N/ · = missing)
POTCHIP	Potato Chips (Y/N/ · = missing)
PICK	Pickle (Y/N/ · = missing)
SCP	Strawberry cream pie (Y/N/ · = missing)
NCP	Neapolitan cream pie (Y/N/ · = missing)
CAKE	Cake (Y/N/ · = missing)
TOM	Tomato (Y/N/ · = missing)

Data, Part I (Shrimp Salad, Olives, Fried Chicken, Barbeque Chicken, Beans, Potato Salad, Green Jell-O, Red Jell-O, Macaroni Salad)

REC	CASE	SHRIMP	OLIVE	FRCHICK	BBQCHICK	BEANS	POTSAL	GJEL	RJEL	MAC
1	Y	N	Y	Y	Y	N	Y	Y	Y	N
2	Y	N	N	Y	·	N	N	Y	N	Y
3	Y	N	N	Y	Y	N	Y	·	N	N
4	Y	·	Y	Y	Y	N	Y	Y	Y	N
5	Y	N	Y	Y	·	Y	N	·	Y	Y
6	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
7	Y	·	Y	·	Y	·	Y	Y	N	N
8	Y	N	Y	Y	Y	Y	Y	N	Y	N
9	Y	N	Y	Y	Y	Y	Y	N	Y	N
10	Y	Y	Y	Y	N	N	Y	·	N	·
11	Y	Y	Y	Y	N	Y	Y	Y	N	N
12	Y	Y	Y	Y	N	Y	Y	N	Y	Y
13	Y	N	N	N	Y	N	N	N	N	N
14	Y	N	Y	Y	Y	N	Y	N	·	N
15	Y	Y	Y	Y	Y	Y	N	·	·	·
16	Y	N	N	Y	Y	N	N	·	N	Y
17	Y	N	Y	·	Y	Y	Y	·	N	Y
18	Y	Y	Y	Y	·	N	N	N	Y	N
19	Y	Y	N	Y	N	Y	Y	N	Y	N
20	Y	N	Y	Y	N	N	Y	N	·	Y
21	Y	N	·	·	Y	Y	N	Y	Y	N
22	Y	N	Y	·	Y	N	Y	N	Y	N
23	Y	Y	Y	Y	Y	Y	N	Y	·	Y
24	Y	N	Y	·	Y	Y	Y	Y	N	Y
25	Y	N	Y	Y	N	N	Y	N	Y	N
26	N	Y	N	N	N	Y	Y	·	N	Y
27	N	N	N	Y	N	N	Y	N	Y	·
28	N	N	Y	Y	N	·	Y	Y	·	Y
29	N	N	N	Y	N	Y	Y	Y	N	N
30	N	N	Y	Y	N	N	N	Y	N	Y

TABLE 14.7. *(Continued)*

Data, Part I (Shrimp Salad, Olives, Fried Chicken, Barbeque Chicken, Beans, Potato Salad, Green Jell-O, Red Jell-O, Macaroni Salad)

REC	CASE	SHRIMP	OLIVE	FRCHICK	BBQCHICK	BEANS	POTSAL	GJEL	RJEL	MAC
31	N	N	N	Y	N	Y	Y	.	N	Y
32	N	Y	Y	Y	N	N	Y	N	Y	N
33	N	N	N	Y	N	N	Y	N	Y	Y
34	N	.	N	N	N	Y	Y	N	Y	Y
35	N	.	N	N	N	Y	Y	N	Y	Y
36	N	N	Y	Y	N	N	Y	.	.	Y
37	N	N	N	Y	N	N	Y	N	Y	N
38	N	N	N	Y	N	N	Y	.	.	N
39	N	N	N	Y	N	Y	Y	N	Y	N
40	N	N	N	Y	N	Y	Y	.	.	Y
41	N	N	N	Y	N	Y	N	N	Y	Y
42	N	N	Y	Y	N	Y	Y	Y	N	N
43	N	N	Y	Y	.	N	Y	Y	.	N
44	N	N	Y	Y	N	Y	Y	Y	N	Y
45	N	N	Y	Y	N	N	N	Y	.	N
46	N	N	N	Y	N	Y	Y	.	N	Y
47	N	N	Y	Y	N	Y	N	.	.	N
48	N	N	Y	Y	N	Y	N	Y	.	N
49	N	Y	Y	Y	N	.	Y	N	Y	Y
50	N	N	Y	Y	N	Y	Y	.	.	Y
51	N	Y	Y	Y	.	N	N	Y	.	Y

Data, Part II (Root Beer, Rolls, Butter, Deviled Eggs, Potato Chips, Pickles, Strawberry Cream Pie, Neapolitan Cream Pie Cake, Tomato)

REC	CASE	RBEER	ROLL	BUTTER	DEVEGG	POTCHIP	PICK	SCP	NCP	CAKE	TOM
1	Y	Y	N	N	.	Y	N	N	N	N	N
2	Y	Y	.	N	N	N	N	Y	N	N	N
3	Y	Y	N	N	Y	Y	Y	N	.	N	Y
4	Y	Y	N	N	Y	Y	N	N	.	N	N
5	Y	Y	N	N	Y	Y	N	N	Y	N	Y
6	Y	Y	N	N	N	Y	Y	Y	N	Y	Y
7	Y	Y	N	N	Y	Y	.	.	.	.	.
8	Y	Y	N	N	Y	Y	N	N	N	N	N
9	Y	Y	N	N	Y	Y	N	N	N	N	N
10	Y	Y	.	.	.	Y	Y	N	N	.	N
11	Y	Y	N	N	Y	Y	N	Y	N	N	N
12	Y	Y	N	N	Y	N	Y	N	N	.	N
13	Y	N	N	N	N	N	N	N	N	N	N
14	Y	Y	N	N	N	Y	Y	N	N	N	N
15	Y	Y	N	N	Y	Y	Y	Y	N	N	.
16	Y	Y	Y	Y	N	N	Y	Y	N	N	N
17	Y	Y	Y	Y	N	N	Y	Y	N	N	N
18	Y	Y	N	N	Y	Y	Y	Y	N	N	N
19	Y	Y	N	N	N	Y	N	N	N	N	N
20	Y	Y	N	N	Y	Y	N	N	N	N	N
21	Y	N	.	.	N	Y	Y	Y	N	.	Y
22	Y	Y	N	N	N	Y	Y	Y	N	N	N
23	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N
24	Y	Y	Y	Y	N	Y	N	N	N	.	N
25	Y	Y	N	N	N	Y	N	N	N	N	Y

(continued)

TABLE 14.7. *(Continued)*

Data, Part II (Root Beer, Rolls, Butter, Deviled Eggs, Potato Chips, Pickles, Strawberry Cream Pie, Neapolitan Cream Pie Cake, Tomato)

REC	CASE	RBEER	ROLL	BUTTER	DEVEGG	POTCHIP	PICK	SCP	NCP	CAKE	TOM
26	N	Y	N	N	N	·	N	N	N	N	Y
27	N	Y	N	N	N	Y	N	N	N	N	Y
28	N	Y	Y	Y	Y	Y	N	N	N	Y	Y
29	N	Y	N	N	·	Y	Y	N	N	N	N
30	N	Y	Y	Y	N	Y	Y	N	N	N	Y
31	N	Y	N	N	N	Y	Y	N	N	Y	Y
32	N	Y	Y	Y	N	Y	N	Y	N	N	N
33	N	Y	N	N	N	Y	N	N	N	N	N
34	N	Y	N	N	N	Y	N	N	N	N	Y
35	N	Y	N	N	N	Y	N	N	N	N	Y
36	N	·	Y	·	N	Y	N	·	·	N	Y
37	N	Y	N	N	N	Y	N	N	N	·	Y
38	N	Y	N	N	Y	Y	N	N	N	·	N
39	N	N	Y	Y	N	N	N	·	N	N	Y
40	N	Y	Y	Y	N	N	N	N	Y	N	Y
41	N	Y	Y	Y	N	N	Y	N	N	N	N
42	N	Y	N	N	N	N	N	N	N	N	N
43	N	Y	Y	Y	·	Y	N	N	N	N	N
44	N	Y	N	N	Y	N	Y	N	N	Y	N
45	N	Y	Y	Y	Y	N	N	N	Y	N	Y
46	N	Y	Y	Y	Y	N	Y	N	·	N	Y
47	N	Y	N	N	Y	N	Y	Y	N	N	N
48	N	Y	N	N	N	N	N	N	N	N	Y
49	N	Y	Y	·	N	N	N	Y	N	N	Y
50	N	Y	N	·	N	Y	Y	·	·	Y	N
51	N	N	Y	Y	Y	Y	Y	N	N	·	Y

Question 3 Determine the frequency of symptoms by filling in Table 14.8. Exclude people with missing values from numerators and denominators of the frequency calculation in question.

Question 4 Calculate the food-specific attack rates (cumulative incidences) and relative risks (cumulative incidence ratios) associated with each food item. Attack rates are calculated as follows:

$$\text{Attack rate}_{exposed} = \frac{\text{no. of people who ate food and became ill}}{\text{total no. of people who ate food}} \tag{14.1}$$

$$\text{Attack rate}_{unexposed} = \frac{\text{no. of people who did not eat food and became ill}}{\text{total no. of people who did not eat food}} \tag{14.2}$$

The relative risk (RR) is

$$RR = \frac{\text{Attack rate}_{exposed}}{\text{Attack rate}_{unexposed}} \tag{14.3}$$

Write your answers in Table 14.9. Based on your calculations, what is the most likely source of exposure to the pathogen?

TABLE 14.8. Frequency of Symptoms: Foodborne Disease Outbreak Case Study

Symptom	Number Reporting Symptom	Number of Cases Responding to Question	Percentage
Cramps			
Diarrhea			
Bloody diarrhea			
Nausea			
Vomiting			
Fever			
Chills			
Headache			
Myalgia			

Question 5 Use the Abbreviated Compendium of Acute Foodborne Gastrointestinal Diseases that appears as Table 14.10 to create a list of the most likely agent. Base this list on the typical signs, incubation period, and most likely food source of the pathogen.

TABLE 14.9. Attack Rates and Relative Risks: Foodborne Disease Outbreak Case Study

Food Exposure	Attack Rate in Consumers	Attack Rate in Nonconsumers	Relative Risk
Shrimp salad	8/12 (66.7%)	15/35 (42.9%)	1.56
Olives			
Fried chicken			
Barbecued chicken			
Beans			
Potato salad			
Green Jell-O			
Red Jell-O			
Macaroni salad			
Root beer			
Rolls			
Butter			
Deviled eggs			
Potato chips			
Pickle			
Strawberry cream pie			
Neopolitan cream pie			
Cake			
Tomato			

TABLE 14.10. An Abbreviated Compendium of Acute Foodborne Gastrointestinal Diseases

Agent	Incubation Period Usual (and Range)	Symptoms[a] (Partial List)	Pathophysiology	Characteristic Foods	Specimens
I. Diseases Typified by Vomiting After a Short Incubation Period with Little or No Fever					
A. *Staphyloccocus aureus*	2–4 hours (1–6 hours)	N, C, V; D, F may be present	Preformed enterotoxin	Sliced/chopped ham and meats, custards, cream fillings	*Food:* enterotoxin assay (FDA), culture for quantitation and phage typing of staph, gram stain *Handlers*: culture nares, skin, skin lesions, and phage type staph *Cases:* culture stool and vomitus, phage type staph
B. *Bacillus cereus*	2–4 hours (1–6 hours)	N, V, D	? Preformed enterotoxin	Fried rice	*Food:* culture for quantitation *Cases:* stool culture
C. Heavy metals 1. Cadmium 2. Copper 3. Tin 4. Zinc	5–15 minutes (1–60 minutes)	N, V, C, D		Foods and beverages prepared/stored/cooked in containers coated/lined/ contaminated with offending metal	Toxicologic analysis of food container, vomitus, stomach contents, urine, blood, feces
II. Diseases Typified by Diarrhea After a Moderate to Long Incubation Period, Often with Fever					
A. *Clostridium perfringens*	12 hours (8–16 hours)	C, D (V, F rare)	Enterotoxin formed *in vivo*	Meat, poultry	*Food:* enterotoxin assay done as research procedure by FDA, culture for quantitation and serotyping *Cases:* culture feces for quantitation and serotyping of *C. perfringens;* test for enterotoxin in stool *Cases:* culture feces for quantitation and serotyping of *C. perfringens*

B. *Salmonella* (nontyphoid)	12–36 hours (6–72 hours)	D, C, F, V, H septicemia or enteric fever	Tissue invasion	Poultry, eggs, meat, raw milk (cross-contamination important)	*Food:* culture with serotyping *Cases:* stool culture with serotyping *Handlers*: stool culture with serotyping as a secondary consideration
C. *Vibrio parahaemolyticus*	12 hours (2–48 hours)	C, D N, V, F, H, B	Tissue invasion, ?enterotoxin	Seafood	*Food:* culture on TCBS. serotype, Kanagawa test *Cases:* stool cultures on TCBS, serotype, Kanagawa test
D. *Escherichia coli* enterotoxigenic	16–48 hours	D, C	enterotoxin	Uncooked vegetables, salads, water, cheese	*Food:* culture and serotype *Cases:* stool cultures; serotype and enterotoxin production, invasiveness assay
Escherichia coli enteroinvasive	16–48 hours	C, D, F, H	Tissue invasion	Same	*Cases:* stool cultures; serotype and enterotoxin production. Look for common serotype in food and cases not found in controls; DNA probes
Escherichia coli enterohemorrhagic (*E. coli* O157.H7 and others)	48–96 hours	B, C, D, H; F infrequent	Cytotoxin	Beef, raw milk, water	Stool cultures on MacConkey's sorbitol; serotype
E. *Bacillus cereus*	8–16 hours	C, D	? Enterotoxin	Custards, cereals, puddings, sauces, meat loaf	*Food:* culture *Cases:* stool cultures
F. *Shigella*	24–48 hours	C, F, D, B, H, N, V	Tissue invasion	Foods contaminated by infected foodhandler; usually not foodborne	*Food:* culture and serotype *Cases:* stool culture and serotype *Handlers*: stool culture and serotype

(continued)

TABLE 14.10. ***(Continued).***

Agent	Incubation Period Usual (and Range)	Symptoms[a] (Partial List)	Pathophysiology	Characteristic Foods	Specimens
G. *Yersinia enterocolitica*	3–5 days (usual) range unclear	F, D, C, V, H	Tissue invasion, ? enterotoxin	Pork products and foods contaminated by infected human or animal	*Food:* culture *Cases:* stool, blood cultures, serology *Handlers*: stool cultures
H. *Vibrio cholerae* O-1	24–72 hours	D, V	Enterotoxin formed *in vivo*	Shellfish, water or foods contaminated by infected person or obtained from contaminated environmental source	*Food:* culture on TCBS, serotype *Cases:* stool cultures on TCBS, serotype Send all isolates to CDC for confirmation and toxin assay
I. *Vibrio cholerae* non O-1	16–72 hours	D, V	Enterotoxin formed *in vivo* ? Tissue invasion	Shellfish	*Food:* culture on TCBS, serotype *Cases:* stool cultures on TCBS, serotype
J. *Campylobacter jejuni*	3–5 days	C, D, B, F	Unknown	Raw milk, poultry, water	*Food:* culture on selective media (5%O_2, 42°C) *Cases:* culture on selective media (5%O_2, 42°C), serology
K. Parvovirus-like agents (Norwalk, Hawaii, Colorado, cockle agents)	16–48 hours	N, V, C, D	Unknown	Shellfish, water	Stool for immune electron microscopy and serology by special arrangement
L. Rotavirus	16–48 hours	N, V, C, D	Unknown	Foodborne transmission not well documented	*Cases:* stool examination by EM or ELISA; serology

			III. Botulism		
Clostridium botulinum	12–72 hours	V, D, descending paralysis	Preformed toxin	Improperly canned or similarly preserved foods	*Food:* toxin assay *Cases:* serum and feces for toxin assay by CDC or State Lab; stool culture for *C. botulinum*
			IV. Diseases Most Readily Diagnosed from the History of Eating a Particular Type of Food		
A. Poisonous mushrooms	Variable	Variable		Wild mushrooms	*Food:* speciation by mycetologist.
B. Other poisonous plants	Variable	Variable		Wild plant	*Cases:* vomitus, blood, urine *Food:* speciation by botanist; feces may sometimes be helpful in confirmation
C. Scombroid fish poisoning		N, C, D, H, flushing, urticaria	Histamine	Mishandled fish (i.e., tuna)	*Food:* Histamine levels
Ciguatera poisoning		D, N, V, paresthesias, reversal of temperature sensation	Ciguatoxin	Large ocean fish (i.e., barracuda, snapper)	*Food:* Stick test for ciguatoxin (not widely available)
D. Other poisonous food sources	Variable	Variable	Variable		

Source: Centers for Disease Control, Epidemic Intelligence Service, Summer 1992.

[a]*Abbreviations:* B = bloody stools, C = cramps, D = diarrhea, F = fever, H = headache, N = nausea, V = vomiting.

Question 6 What are the mechanisms by which such vehicles usually become contaminated with the pathogen you suspect caused this outbreak?

Question 7 What measures are possible to prevent such contamination?

Question 8 What can be done to prevent illness if foods do become contaminated?