

# Three Outbreaks of Foodborne Disease With Dual Etiology

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THREE CONSECUTIVE outbreaks of foodborne disease in which clostridia and salmonellae were implicated occurred in Seattle, Wash., in December 1965. While salmonellae are well known as a cause of foodborne disease, *Clostridium perfringens* (*welchii*) as a cause is less well known. McClung in England (1) reported four outbreaks of foodborne disease caused by *C. perfringens* first in 1945. However, it was not until 1953 that the role of this organism was generally accepted in England (2). Subsequently, Cockburn in England (3) and Kemp in the United States (4) documented the increased recognition of outbreaks from this cause.

*C. perfringens* and enterococci have been implicated as possible dual etiological agents in two epidemics (5, 6), but the exact etiological role of enterococci was left to conjecture in both episodes. The data to be presented strongly suggest that double infection with *C. perfringens* and *Salmonella typhimurium* occurred in at least some and presumably most persons who attended one of three banquets at a single restaurant. No prior reports of outbreaks from both *C. perfringens* and salmonellae were found.

## Initial Survey

At 11:30 a.m. on December 3, 1965, the division of epidemiology and communicable disease control, Seattle-King County Department of Public Health, was notified that a number of persons who had attended a banquet the evening of December 2, marking the end of a boys' football-league season, had become ill.

Investigation of the restaurant where the banquet had been held began one-half hour after

the first report was received, approximately 18 hours after the food had been served. Numerous deficiencies in the operation of the establishment were noted, particularly with respect to time intervals and temperatures used in cooking and storing food. For example, a whole turkey that had been prepared for serving the preceding evening, but which had not been used, was found stored in a walk-in refrigerator. It was obviously only partially cooked because it had the appearance of rare beef on a cut section. The restaurant operator said that 17 frozen turkeys, each weighing between 20 and 22 pounds, had been obtained November 26.

Apparently the turkeys had not been thawed or had been thawed at room temperature for an indeterminate period of time before being boiled in water for 4 hours. They were left in the cooking water overnight to cool at room temperature. The meat had been served throughout the week preceding the investigation. Specimens of food from the banquet the night before were available, and samples were taken for bacteriological analysis in the health department laboratory. Stool specimens were requested of 10 employees, but only 1 from the

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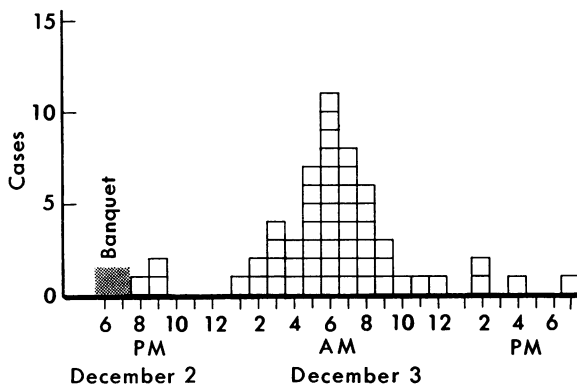
*This study was supported in part by Public Health Service training grant No. T1-A1-206.*

cook who had prepared the turkey was received for examination. The specimen was negative for *Salmonella* and *Shigella*.

The families who attended the banquet were interviewed by telephone the afternoon and evening of December 3 by Jean Spearman, public health nurse, and Herbert W. Anderson, epidemiological assistant, of the health department. Epidemiologic information was obtained from 79 persons; 62 of the 79 reported that they had been ill, which gave an attack rate of 78.5 percent. The character of the illness experienced by the group is shown in table 1, and the epidemic curve in relation to the banquet is charted in figure 1. From these data we determined that the incubation period ranged from 2 to 24 hours, with a median and mode of 12 hours and a mean of 12.3 hours after the suspected meal. Time of onset was not available for 7 of the 62 cases. A detailed account of food items eaten at the banquet was obtained from 73 persons, or all but 6 of 79 known to have attended the banquet. The attack rates for each food item served, for those eating as well as for those not eating a given food item, were determined (table 2). Our analysis pinpointed turkey meat as the probable vehicle of infection and suggested a presumptive epidemiologic diagnosis of *C. perfringens* infection from contaminated turkey meat. Such a diagnosis was supported by reports that the duration of illness was short—usually less than 24 hours. However, many persons were still ill when contacted so data were not collected to corroborate our assumption.

Five stool specimens from ill persons were submitted to the Seattle-King County health

**Figure 1. Hour of onset of illnesses after last banquet**



department laboratory within 7 days following onset of illness. Paul Bonin, laboratory director, and Evelyn Tronca, microbiologist, supervised the laboratory work. Heat-resistant strains of *C. perfringens* were isolated from three of these specimens. Heat-resistant *C. perfringens* also was cultured from the specimen of turkey meat obtained from the restaurant. These isolates were sent to the laboratory at the Communicable Disease Center, Public Health Service, Atlanta, for typing. All were type A.

Our study of the outbreak after the December 2 banquet revealed a pattern similar to two small outbreaks of foodborne disease from *C. perfringens* investigated earlier in 1965. In one, 27 of 31 persons attending a party in a residence were stricken; in the other, 8 of 11 persons who ate in a restaurant—not the one where the December 2 banquet was served—became ill. Because the collective data seemed sufficient to warrant immediate action to prevent similar episodes, environmental health personnel summarily closed the restaurant involved in our most recent investigation until corrections in its operation seemed assured.

#### Subsequent Investigation

During the initial survey we had learned that the same group who sponsored the banquet on December 2 also had sponsored two other banquets on November 29 and 30. Each of the three banquets was attended by more than 100 persons, or a total of 375, and the same menu had been served. Additional notifications of illness among those who had attended the first

**Table 1. Character of illnesses after December 2 banquet**

Symptoms	Number	Percent
Total ill.....	62	100
Abdominal pain.....	55	89
Diarrhea.....	53	85
Nausea.....	17	27
Headache.....	18	29
Chills.....	7	11
Fever.....	4	6
Vomiting.....	3	5

two banquets, reports of relapses, and additional bacteriological evidence suggested to us that *C. perfringens* was not the only responsible disease agent.

Consequently, we undertook a special canvass of everyone who attended any of the three banquets. A complete list of names of the 375 banquet guests was requested. Detailed information concerning symptoms of illness, time of onset, duration of illness, relapses, and age was obtained by telephone interview, between December 20 and 24, for 345 persons, or more than 90 percent of the names on the list. From our canvass, we learned that the character of the illnesses was similar after each banquet (table 3). The attack rates for 203 parents and 142 children are shown in table 4. The interesting finding was the increased frequency of illness after each succeeding banquet. Figure 2 shows

the day of onset for both primary illnesses and relapses after each of the three banquets. The occurrence of relapses suggested that some etiological agent must be involved along with *C. perfringens*.

An unexpected finding from the bacteriological data collected (table 5) was the recovery of *C. perfringens* from 3 of the 14 stool specimens taken as long as 6 and 7 days after onset. The single isolation of *Salmonella infantis* may be a spurious finding, but the 11 isolations of *S. typhimurium*, all phage type 2b, suggested a common source for these cases. Salmonellae were not recovered from the single turkey specimen submitted for examination, which suggested nonhomogeneous contamination of the 17 turkeys used during this time period by the restaurant; however *C. perfringens* was found in the specimen.

**Table 2. Illness attack rates for 73 persons attending December 2 banquet, by foods served**

Food <sup>1 2</sup>	Eaten			Not eaten			Attributable rate (percent)
	Total	Ill	Percent	Total	Ill	Percent	
Turkey.....	69	56	81	4	0	0	81
Peas.....	53	46	87	20	10	50	37
Turkey dressing.....	57	48	84	16	8	50	34
Mashed potatoes.....	67	53	79	6	3	50	29
Turkey gravy <sup>3</sup> .....	52	43	83	13	7	54	29
Fruit cocktail.....	62	50	81	11	6	54	27
Apple cobbler.....	52	42	81	21	14	67	14
Roll.....	51	41	80	22	15	68	12
Milk.....	21	17	81	52	39	75	6
Coffee.....	37	29	78	36	27	75	3

<sup>1</sup> No food history obtained from 6 persons.

<sup>2</sup> Tea, Jello, and cranberries eaten by a few people not included.

<sup>3</sup> History for turkey gravy omitted for 8 people.

**Table 3. Character of illnesses after each banquet for 113 persons, compared with 62 in initial survey <sup>1</sup>**

Symptom	November 29		November 30		December 2		December 2 initial survey	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total ill.....	18	100	29	100	66	100	62	100
Abdominal pain.....	13	72	23	79	60	91	55	89
Diarrhea.....	13	72	17	59	58	88	53	85
Headache.....	7	39	10	34	21	32	18	29
Fever.....	2	11	2	7	9	14	4	6
Vomiting.....	5	28	1	3	3	5	3	5

<sup>1</sup> Information not obtainable from 27 persons.

**Table 4. Illness attack rates for parents and children, by date of banquet**

Date of banquet	Parents			Children			Total		
	Number attending	Ill	Percent	Number attending	Ill	Percent	Number attending	Ill	Percent
Total.....	203	80	39	142	60	42	345	140	40
Nov. 29.....	74	12	16	55	17	31	129	29	23
Nov. 30.....	67	23	34	46	17	37	113	40	35
Dec. 2.....	62	45	73	41	26	63	103	71	69

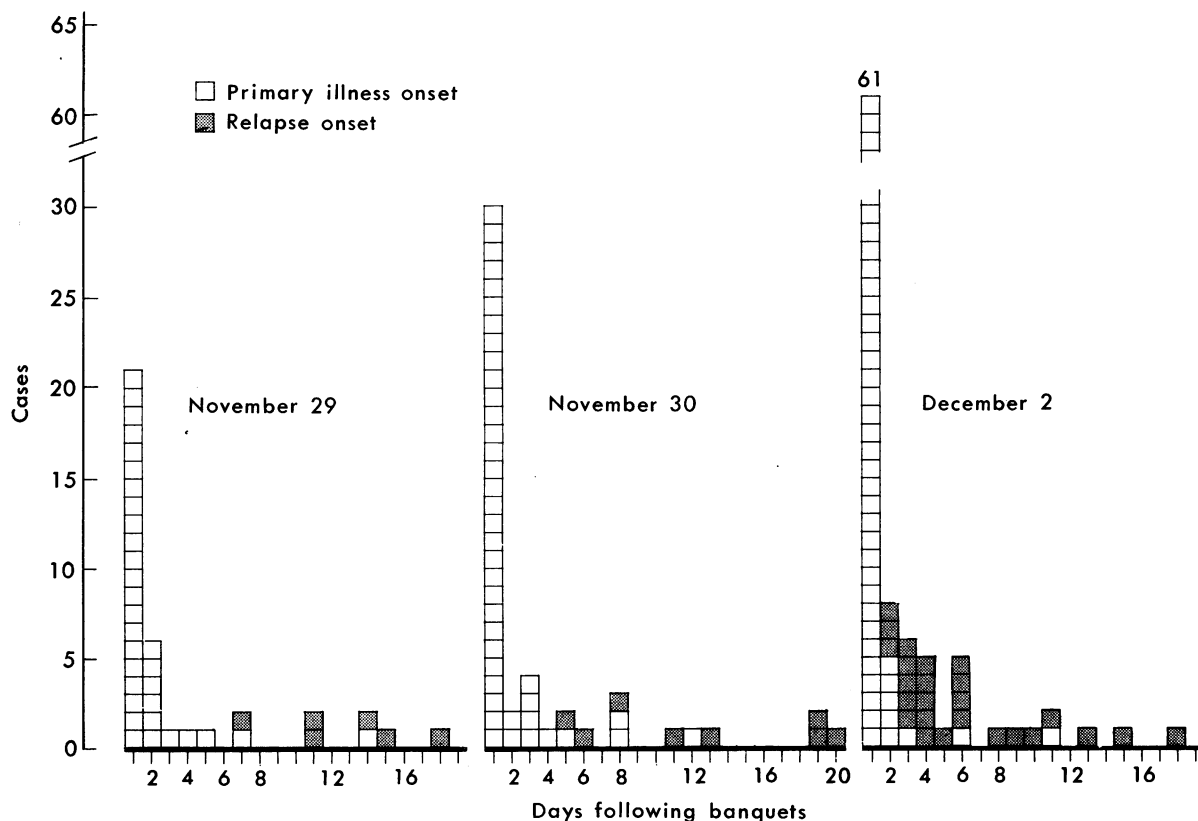
Approximately 506 person-days of illness were experienced by 140 of the 345 persons from whom we obtained information (table 6). This is a conservative estimate since information on illnesses of more than 12 days' duration was not sought, but we know that some illnesses extended beyond 12 days. Abdominal pain and diarrhea were especially persistent symptoms (table 6). Uncomplicated *C. perfringens* infections generally last 12 hours (5). The trend

of the data in table 6 therefore corroborates our inference that some cases were most likely single infections from *C. perfringens*, while others were double infections from *C. perfringens* and salmonellae.

**Severity of Illness**

No special attempt was made to gauge the severity of the illness. A 14-year-old boy was hospitalized for 3 days with high fever and

**Figure 2. Day of onset of primary illnesses and relapses after three successive banquets**



**Table 5. Bacteriological data on 14 stool specimens <sup>1</sup>**

Age of patient (years)	Date of banquet	Date of onset	Days from onset to culture	Culture finding	
				<i>C. perfringens</i>	<i>Salmonella</i>
9	Nov. 29	Nov. 30	11	( <sup>2</sup> )	+ <sup>3</sup>
48	Nov. 30	Dec. 1	7	+	+
10	do	Dec. 2	31	( <sup>2</sup> )	+
51	Dec. 2	do	1	+	-
14	do	Dec. 3	6	+	+
15	do	do	3	-	+
9	do	do	3	-	+
43	do	Dec. 5	5	-	+
33	do	Dec. 3	5	+	+
14	do	do	11	-	+
52	do	do	12	-	+
35	do	do	7	+	-
14	do	do	14	( <sup>2</sup> )	+
38	do	do	40	( <sup>2</sup> )	+

<sup>1</sup> Includes 5 specimens collected during initial survey.

<sup>2</sup> Not examined.

<sup>3</sup> *Salmonella infantis*; remainder, *Salmonella typhimurium*.

required replacement of intravenous fluid. A 15-year-old boy underwent a laparotomy for suspected appendicitis, which was not present at surgery. The discharge diagnosis was mesenteric adenitis. *S. typhimurium* was isolated from stools of both boys. Many people lost time from their regular pursuits. More were doubtless not at their best for several days, though not completely incapacitated. We estimated that each person was ill between 3 and 4 days (506 person-days of illness divided by 140 ill persons = 3.62 days).

### Discussion

All the epidemiologic evidence from our investigation indicated the likelihood of contaminated turkey meat. Table 4 and figure 2 clearly show an increasing frequency of illness with each succeeding banquet. Knowing the inadequate manner in which a single lot of turkeys was prepared and stored before serving, one can readily postulate the increasing growth of bacteria as time progressed. No attempt was made in this investigation to relate the amount of turkey ingested to the risk of illness, but it seems reasonable that a relationship would be found.

The epidemic curve (fig. 1) is typical of *C. perfringens* infection; otherwise, our initial survey might have taken a different direction. If infective doses of salmonellae had been ingested at the banquet, a curve reflecting a com-

posite onset of the two diseases, which normally peak at 10 hours for *C. perfringens* and 18 hours for salmonellae, would result. One likely explanation for the nonappearance of the two peaks is that *C. perfringens* infection, producing as it does acute, severe diarrhea, exerted a dampening effect by washing out and reducing salmonellae so that the alimentary dose was lower than that ingested. An alternate explanation is that the ingested dose was small, thus lengthening the incubation interval. Either explanation accounts for the delayed onset of illness in some persons and the relapse in others, both unusual in uncomplicated outbreaks of *C. perfringens*.

While salmonellae can be recovered from the stool for weeks or sometimes even months after infection, we have supposed that *C. perfringens* was rapidly excreted and usually have not attempted stool culturing after the second day of illness. The successful isolation of *C. perfringens* from stools as late as 6 and 7 days after onset is a finding of some pragmatic value.

### Summary

In December 1965, three consecutive outbreaks of foodborne-disease were traced to three banquets held at a single restaurant in Seattle, Wash. The investigation of these outbreaks was conducted in two phases. The outbreak

Table 6. Persistence of symptoms in 113 persons <sup>1</sup>

Date of banquet and symptoms of illness	Day following banquet											
	1	2	3	4	5	6	7	8	9	10	11	12
Nov. 29, total ill.....	18	19	11	9	6	5	5	3	3	3	3	2
Abdominal pain.....	13	13	7	6	4	2	4	3	3	3	3	2
Diarrhea.....	13	13	8	5	5	2	4	3	2	2	2	1
Headache.....	7	9	8	8	5	5	5	2	2	1	3	1
Fever.....	2	4	3	2	2	1					1	
Vomiting.....	5	3					1					
Nov. 30, total ill.....	29	25	22	17	15	11	15	14	11	11	12	7
Abdominal pain.....	23	21	21	16	15	11	15	14	11	10	7	7
Diarrhea.....	17	14	9	5	4	3	7	7	7	6	3	3
Headache.....	10	8	7	5	5	4	5	5	4	4	2	2
Fever.....	2	2	2	2	3	1	1	1	1			
Vomiting.....	1	1	2	2	2	1	1					
Dec. 2, total ill.....	66	46	40	33	31	30	27	18	13	10	10	8
Abdominal pain.....	60	39	33	30	30	29	23	15	13	9	10	6
Diarrhea.....	58	30	27	23	18	20	17	9	4	4	3	3
Headache.....	21	18	18	13	11	12	10	8	7	4	4	3
Fever.....	9	8	9	9	7	7	5	4	1	2	1	1
Vomiting.....	3	3	2	1	1	2	2	3	2	1		

<sup>1</sup> Information not obtainable from 27 persons.

after the last banquet was investigated first; then 3 weeks later the outbreaks after all three banquets were investigated.

Information was obtainable, by telephone interview, from 345 of the 375 persons attending the banquets. The attack rate after the three banquets combined was approximately 40 percent; 140 persons were ill. Illness frequency increased after each successive banquet. The attack rate after the first banquet was 23 percent and after the third banquet, 69 percent. Two persons were hospitalized with severe illness. An estimated 506 person-days of illness, or between 3 and 4 days for each person, resulted from the epidemic.

Both *Clostridium perfringens* and *Salmonella typhimurium* were implicated as agents of infection in the three outbreaks. The vehicle of infection was inadequately cooked and stored turkey meat. Several unique epidemiologic features ascribed to both dual etiology and temporal sequence of exposure were noted. The mean incubation period was intermediate between that typical of infection with either agent alone. The distribution pattern for duration of illness was dissimilar to that usual with infection from either agent separately. Symptoms

of abdominal pain, diarrhea, and headache were particularly persistent.

All five isolates of *C. perfringens* were heat-resistant, type A organisms. Eleven of twelve salmonellae isolates were *S. typhimurium*, phage type 2b. Double infection was confirmed bacteriologically in three patients. *C. perfringens* was isolated 6 days after the onset of illness in one instance and 7 days after in another.

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