Two Successive Outbreaks of *Clostridium Perfringens* at a State Correctional Institution

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Abstract: An outbreak of acute gastrointestinal illness of short duration involving 100 inmates at a correctional institution followed a similar outbreak among the same population by eight days. *Clostridium perfringens* was the specific etiology in both outbreaks; the vehicle was roast beef in the first outbreak, ham in the second. Direct observation of food handling practices revealed that the meats were not cooled quickly enough following cooking; not reheated adequately prior to serving, and; held at improper temperatures prior to serving. (*Am J Public Health* 1985; 75:287–288.)

Introduction

On March 19, 1984, the Palm Beach (Florida) County Health Department was notified of an outbreak of gastrointestinal illness among inmates at a state correctional institution in that jurisdiction. Investigation revealed 74 out of 276 inmates to be ill. Epidemiologic analysis implicated roast beef served at the lunch meal on the previous day as the source of the illness, whose mean incubation was 10½ hours. Bacteriological analysis of stool specimens from ill inmates implicated *Clostridium perfringens* as the specific etiology. Initial investigation of the kitchen which prepared the roast beef, and of the food preparing practices of the kitchen staff, did not reveal significant faulty practices which would have accounted for the outbreak.

Eight days later, on March 27, the Health Department was again notified of a similar outbreak of gastrointestinal illness among the same inmate population. This raised two important questions: 1) Why did two similar outbreaks occur at the same institution within an eight-day period?; and 2) Why was only the inmate population selectively affected in both outbreaks when institutional staff and tuberculosis patients at the attached TB hospital were unaffected even though one kitchen at the institution routinely prepared identical meals for all three groups?

Investigation of Second Outbreak

One hundred cases of gastrointestinal illness in inmates were identified in the second outbreak.* The frequency of various symptoms are indicated in Table 1. The predominant symptoms were abdominal cramping and diarrhea. Illness was generally mild and lasted less than 24 hours in almost all cases.

TABLE 1—Frequency of Symptoms: *C. perfringens* Food Poisoning Outbreak at a State Correctional Institution in Florida

Symptom	# Cases	% Cases with Symptom
Abdominal Cramps	95	95
Diarrhea	88	88
Nausea	53	53
Vomiting	25	25
Chills	17	17
Fever	8	8

The epidemic curve (Figure 1) strongly suggests a common source. Epidemiologic analysis of food histories obtained from interviews with cases and inmate controls implicated a ham which was served for lunch approximately eight to 16 hours prior to the height of the second outbreak as the vehicle for the outbreak (Table 2).

C. perfringens spore counts with active cases ranged from 4.0×10^6 to 1.2×10^9 per gram, whereas counts with control specimens were less than 4.0×10^4 per gram.** Representative isolates from the outbreak specimens were identified as *C. perfringens* by the official AOAC (Association of Official Analytical Chemists) method[1] and were shown to be enterotoxigenic by an enzyme-linked immunosorbance assay and predominantly of one biotype. All specimens were negative for Salmonella and Shigella. Food specimens were not available for analysis.

All groups receive the same food, which is prepared in large quantity in the hospital kitchen and then divided up and transported to separate cafeteria-type units for serving each of the groups separately. The hospital facilities and equipment for food preparation, storage, transport, and holding prior to serving were found to be completely adequate for all groups.

A major problem was the storage of food following cooking. Food was stored in large walk-in coolers which could not have maintained large portions of food at or below 45°F because of the insulating effects of a large volume of food and insufficient air movement even though the temperature in the cooler was <45°F. Meat present in the cooler at the time of the inspection was found to have an internal temperature of 85°F although it had been placed in the cooler nearly five hours previously. Presumably, the organism initiated growth following cooking and reached a population level before serving sufficient to cause food poisoning.

The other critical deficiency explains why only the inmates became ill. Meat was observed being "reheated" on overcrowded steam tables with pans of food stacked three layers high, a process which could not possibly have resulted in the desired internal temperature of 165°F. This was

*A case was defined as a person who developed diarrhea or abdominal cramping some time between 2:00 pm on March 26 and 9:00 am the following day.

**Stool specimens from seven cases and 10 normal controls were diluted 1:10 in peptone dilution water, heated for 20 minutes at 75°C, and tested for viable *C. perfringens* spores by plating on trypticase soy sheep blood agar.

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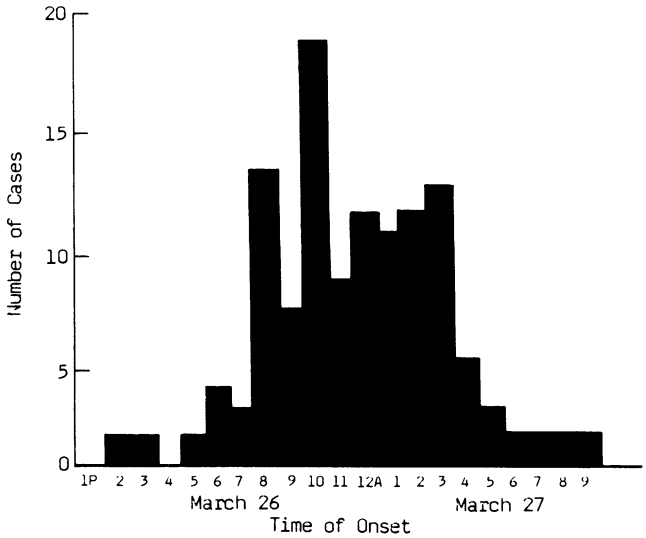

FIGURE 1—Time of Illness Onset: *C. perfringens* Food Poisoning Outbreak in a State Correctional Institution in Florida

confirmed by measured internal temperatures of 120°F, an ideal temperature for growth of *C. perfringens* (optimum 113-119°F). Such a practice would have permitted continued growth of the organism. This "reheating" practice was used routinely for food going to the inmates' cafeteria and, as a consequence, the *C. perfringens* bacteria were not killed. Food served to employees and TB patients was reheated properly in convection ovens before serving and did not cause illness.

A final problem contributing to the outbreaks was holding of foods in the inmates' cafeteria prior to serving at a temperature of 120°F, a temperature conducive to rapid proliferation of *C. perfringens*. A proper holding temperature of 140°F would have prevented any further growth of the organism and probably would have reduced or eliminated those organisms already present.

Discussion

Clostridium perfringens food poisoning has remained the third leading cause of reported foodborne disease in the United States for the past several years. In 1981, 1,162 cases and 28 outbreaks were reported, representing 13.4 per cent of all reported cases of foodborne disease for which a specific etiology was confirmed[2] and from 1972-77, it accounted for 11.2 per cent of cases.[3]

An important contributing factor in the frequency of *C. perfringens* food poisoning is its ubiquitous nature as part of the normal intestinal flora of many animals.[3] The only way to prevent foodborne disease from this organism is through proper food hygiene. Adequate cooking alone will not prevent disease because the spores are resistant to heat. Following cooking, unless the food is immediately eaten or

TABLE 2—Epidemiologic Analysis of Association between Illness and Consumption of Ham

	Ill	Not Ill	Total
Ate Ham	91	10	101
Did not eat Ham	9	30	39
Total	100	40	140

Chi Square = 61.9. P < .0005.

quickly cooled to a temperature of <45°F, the organism will have the opportunity to multiply and produce toxin.[5,6] The food may then be served cold, but if served hot it should be reheated to a temperature of at least 165°F,[6] which will prevent growth of and kill any microorganisms (other than spores), and also destroy *C. perfringens* toxin which is already present.[5-8]

In both outbreaks reported here: 1) food was not cooled adequately following initial cooking (thus allowing heat-resistant spores of *C. perfringens* to germinate and grow); 2) the reheating process was entirely inadequate (for food going to the inmates' cafeteria only), thus permitting the vegetative cells of the organism to survive (the foods should have been reheated to 165°F); and 3) the holding process in the inmates' cafeteria also took place at inadequately hot temperatures which provided an additional opportunity for the bacteria to proliferate rapidly prior to serving. Thus there were repeated opportunities for *C. perfringens* bacteria to survive and proliferate under such conditions. If any of these mistakes had not been made—particularly the critical reheating step—the outbreaks would not have occurred. Furthermore, if the investigators of the first outbreak had thoroughly observed the food handling practices of the kitchen and cafeteria staff rather than relying on interview histories, the problem probably would have been discovered earlier and the second outbreak prevented.

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