CATERING ON THE MOVE - INVESTIGATING A TYPICAL OUTBREAK OF GASTROENTERITIS

Mark Veitch[1], *Catherine Ferreira*[2], *Kylie Densten*[1], *Selena Heaton*[1] *and Julia Griffith*[1].

Abstract

An outbreak of diarrhoea affected at least 33 of the 58 persons who attended a baptism luncheon. Our investigation included site inspections, microbiological tests and food questionnaires. *Clostridium perfringens* intoxication probably caused the outbreak, the result of inadequate refrigeration of meat cooked the day before the gathering. To avoid this hazard, mobile or home caterers must have adequate facilities for refrigeration and transport of food. Established guidelines must be followed.

Introduction

Gastroenteritis may come to the attention of public health practitioners as isolated cases of food poisoning, as clusters of cases related to gatherings, and community-wide outbreaks. The public health response will depend on the clinical and public health importance of the incident or outbreak. Factors that influence this response include the number of cases, the seriousness of the illness, the setting of the outbreak, the implications of the outbreak for food safety and the food industry, and whether the outbreak continues or has ceased.

Action may range from an inspection of an implicated premise to an extensive microbiological and epidemiological investigation. Resources to undertake such investigations are limited. As days after an outbreak elapse, the quality of microbiological and epidemiological information decays. How much does an extensive investigation add to the information derived from incisive questions asked early in the outbreak? Does it alter the response to an outbreak? Does such information provide useful data that contribute to understanding, controlling and preventing epidemic and endemic enteric illness in the community?

The outbreak

Three days after a baptism celebration, the organiser of the gathering reported to his local council cases of gastroenteritis among attendees. The council environmental health officer contacted the Regional Public Health Unit and the Infectious Diseases Unit of Health and Community Services (now the Department of Human Services), Victoria.

Fifty-eight family members and friends had attended the luncheon in a suburban Melbourne hall. A friend of the host had prepared the food, which included meats cooked on a spit, vegetables and cakes. The following night, a substantial proportion of attendees developed diarrhoea. In conjunction with local and regional health authorities, we undertook an investigation of the outbreak.

Methods

Local environmental health officers investigated the preparation of the food. We obtained details about the food served, and interviewed attendees or their parents to establish details of illness and the foods they had consumed. We analysed data with Epi Info version 6.01 and calculated relative risks of illness for specific foods.

We sought specimens of leftover food, and faeces from those who were ill, and examined these for foodborne enteric pathogens by culture and *C. perfringens* enterotoxin by reverse passive latex agglutination[1,2]. We examined both food and faeces for *Salmonella* spp., *Staphylococcus aureus*, enteropathogenic *Escherichia coli*, *Bacillus cereus* and *C. perfringens*; and faeces for *Shigella* spp., *Aeromonas* spp., *Campylobacter* spp., *Listeria monocytogenes*, *Vibrio* spp. and *C. perfringens* enterotoxin.

Our case definition was 'a person who attended the gathering at the hall and who reported developing diarrhoea during the following four days'.

Results

Food eaten at the gathering was prepared by a person who formerly ran a catering business but who at the time of the outbreak only catered for friends, and functions at a sporting club. His operation was not registered as a food premise with the local council.

The caterer bought snack-foods, meat (pork and beef in approximately three-kilogram portions), fruit and cheesecake three days before the function. The meat and fruit were stored in a domestic refrigerator, and the cheesecake in a freezer at his home. He stated that on the afternoon before the function, he had thoroughly cooked the meat for about four and a half hours on a gas spit oven in his carport. He did not impale the meat, but instead had turned it by hand from time to time. He had wrapped the cooked meat in foil, let it cool in the carport for one and a half to two hours, and then returned it to the refrigerator. The next morning he had

1. Microbiological Diagnostic Unit, Department of Microbiology, University of Melbourne, Parkville, Victoria, 3052.
2. Infectious Diseases Unit, Department of Human Services, Victoria.

Table. Foods eaten by persons who attended the baptism luncheon

Food	Attack rate in persons who ate item (%)	Attack rate in persons who did not eat food (%)	Relative risk (95% confidence limits)
Snack foods	21 / 33 (64)	11 / 14 (79)	0.8 (0.6-1.2)
Beef	32 / 45 (71)	1 / 6 (17)	4.3 (0.7-25.8)
Pork	30 / 38 (79)	2 / 12 (17)	4.7 (1.3-17.0)
Gravy	29 / 42 (69)	4 / 9 (44)	1.6 (0.7-3.3)
Potatoes	33 / 49 (67)	0 / 2 (0)	undefined
Carrots	32 / 46 (70)	1 / 5 (20)	3.5 (0.6-20.3)
Peas	31 / 47 (66)	2 / 4 (50)	1.3 (0.5-3.6)
Cheesecake	19 / 30 (63)	14 / 21 (67)	1.0 (0.6-1.4)
Fruit salad	17 / 22 (77)	16 / 29 (55)	1.4 (0.9-2.1)
Whipped cream	15 / 19 (79)	18 / 32 (56)	1.4 (1.0-2.1)

transported the meat in an unrefrigerated foam container to the hall, about one hour's drive away. The meat was then refrigerated for about an hour before being carved. The cut meat lay unrefrigerated for about two hours before being served from 12.30 pm. The caterer prepared the rest of the food in the hall on the morning of the function.

The kitchen in the hall was clean, and contained a sink, hot water, ample preparation and storage space, and a refrigerator that maintained a temperature below 1°C two hours after being turned on.

We interviewed 51 (88%) attendees, comprising persons from 20 households. Thirty-three persons with diarrhoea met the case definition. These comprised 18 females and 15 males, range 1 to 78 years with a median age of 35 years. The incubation period was in the range 7 to 24 hours, median 14 hours. Eighty-eight percent (29 / 33) of cases were ill for 48 hours or less.

Common symptoms included abdominal cramps or aches (28 / 33, 85%) and nausea (17 / 33, 52%). Four persons (12%) had vomited. Five persons (15%) had bloody diarrhoea. There was no significant difference in the mean duration of illness in cases who reported bloody diarrhoea (41 hours) compared with those with non-bloody diarrhoea (36.4 hours, p=0.68).

The table describes the attack rate and relative risk associated with the consumption of various foods. Data from some attendees were incomplete.

Forty-six of 51 attendees ate some meat and most of these (37 / 46) ate both beef and pork. Because few people ate only one meat, we could not distinguish statistically the effect of eating either meat. None of the five persons who did not eat meat became ill. There appeared to be an increased risk associated with eating carrots, but since most of those who consumed carrots also ate meat, the effects could not be distinguished.

We collected six faecal specimens from cases, and isolated *C. perfringens* from five (heavy or moderate growth from four, light growth from one). *C. perfringens* enterotoxin was detected by latex agglutination in three of these five samples and in the sample from which *C. perfringens* was not isolated. *C. perfringens*, but not enterotoxin, was detected in faeces from the caterer who had had diarrhoea late in the evening after the function.

We tested one sample of beef and gravy and detected 3.1 coliform organisms / g, 1.6×10^3 colony forming units (CFU) *Bacillus cereus* / g, and 7.4×10^3 CFU *C. perfringens* / g.

Discussion

C. perfringens is the second-most common cause of outbreaks of food poisoning (after *Salmonella*) reported to the national outbreak surveillance scheme in England and Wales[3]. Its relative importance as a cause of Australian outbreaks is unknown. *C. perfringens* is common in the natural environment. It also appears in faeces of persons who showed no clinical signs[4]. Type A enterotoxin-producing strains cause diarrhoea after an incubation period of 8 to 24 hours[5]. *C. perfringens* as a cause of illness is suggested when more than 10^6 *C. perfringens* organisms / g are found in faeces, together with more than 10^5 organisms / g in food, with supporting clinical and epidemiologic evidence[6].

We performed semi-quantitative culture of *C. perfringens* in faeces, and detected only 7.4×10^3 organisms / g in the one available sample of meat served at the gathering. However, the following evidence suggests that this outbreak was caused by enterotoxin-producing *C. perfringens* acquired from meat at the gathering:

- the illness (acute self-limiting diarrhoea after a median incubation period of 14 hours) was compatible with *C. perfringens* intoxication[5];
- the flaw in food handling (slow cooling and inadequate refrigeration of cooked meat) is a recognised cause of *C. perfringens* food poisoning[6]. Cooked fresh vegetables are a less likely vehicle for this pathogen;
- eating pork and beef at the gathering were each associated with a four-fold increased risk of illness;
- *C. perfringens* and enterotoxin were isolated from the faeces of three of six cases;

- no other bacterial pathogens were identified in the faeces of cases;
- *C. perfringens* was isolated from meat (beef) served at the function.

The attack rate and relative risk associated with eating pork indicate that pork was probably a vehicle of infection. However, there was no leftover pork available for analysis. The presence of *C. perfringens* in the sample of beef may reflect contamination of the beef, cross contamination from pork, or both.

B. cereus was also recovered from the single food sample, but food poisoning caused by this organism is usually associated with detection of more than 10^5 *B. cereus* organisms per gram of food[6]. The clinical syndrome was consistent with the diarrhoeal form of *B. cereus* intoxication, but we did not detect the pathogen in faeces from cases[5].

Bloody diarrhoea is not a feature of *C. perfringens* intoxication, nor is it a feature of illness due to any of the common agents of gastroenteritis with short incubation periods[7]. These observations may have been misinterpretations by respondents or perhaps been due to blood from another source, such as haemorrhoids.

Two of the five persons who reported bloody stools provided specimens. Neither specimen was macroscopically bloody. *C. perfringens*, but no other enteric pathogen, was isolated from the faeces of both cases.

The costs and disabilities of enteric illness to affected persons and their families can be considerable, and include medical care and loss of work, education and leisure. Further costs fall upon operators implicated in outbreaks and include recall of food products, testing and destruction of food, insurance and advertising, loss of sales and legal costs[8]. Such events readily damage reputations. The operator involved in this outbreak abandoned catering altogether after this outbreak. The use of public health resources to systematically collect, collate, analyse and disseminate knowledge gained by investigations of outbreaks may prevent illness, similar outbreaks, and the costs associated with these events.

How did the various aspects of this investigation contribute to the public health outcome of this outbreak?

The key circumstantial features of this outbreak (diarrhoea after an incubation period of less than 24 hours, and leaving cooked meat unrefrigerated) suggested the possibility of *C. perfringens* intoxication.

Microbiological examination of faeces provided supportive evidence and excluded other common bacterial causes of food poisoning. Specimens from acute cases, and secondary cases, are crucial to this component of the investigation. Late collection of faeces may add expense rather than information, as the likelihood of isolating an outbreak-associated pathogen diminishes with time after illness.

Viruses spread person to person directly or through fomites (which may include prepared food) must always be considered when diarrhoea and vomiting occur one to two days after a gathering[9]. Secondary cases among persons not exposed to the original gathering are an important (almost diagnostic) clue. In this setting, virological examination of stools of acutely ill cases is particularly important.

Epidemiologic methods are often used to determine possible sources of infection. For one or two isolated cases of gastroenteritis, foods consumed in the 72 hours before illness are usually considered. When cases are apparently related to an event, the investigation usually concentrates on the food served at the main gathering, although other related functions should also be considered. In this outbreak, data from questionnaires supported the information obtained from early interviews and inspections, and from microbiological investigations.

Investigations of large gatherings are time consuming (and therefore expensive), and are subject to logistic and other difficulties. Data collection may be incomplete and biased towards affected persons, and food recall may be inaccurate unless the investigation is undertaken swiftly. Results may be inconclusive. However, in many outbreaks of gastroenteritis, the symptoms often do not point to a particular pathogen, faults in food handling may not be evident (or may be numerous!), and microbiological tests may be unhelpful. Food recall histories may be particularly useful in this setting.

In practice, the usefulness of an epidemiological analysis of food histories cannot be anticipated, and therefore this component of the investigation should be considered (and usually undertaken) as soon as possible after an outbreak is reported.

Furthermore, epidemiological analyses of food recall histories may play a key role in investigations of widely dispersed outbreaks of enteric illness - clusters which may only be identified by analysis of patterns in surveillance data. Low level microbiological contamination of foods, a relatively low attack rate, and unanticipated pathogens, make investigation of these clusters difficult[10]. In this setting, epidemiological analysis of food recall histories of cases may help identify the causative vehicle.

We propose that this particular outbreak was caused by *C. perfringens* intoxication resulting from slow cooling and inadequate refrigeration of cooked meat by a mobile or home caterer. Recently published guidelines draw attention to this particular hazard, and ways of avoiding it by ensuring cooked meat is rapidly cooled to less than 5^oC and kept adequately refrigerated until just before serving[11,12].

As national surveillance for outbreaks of enteric illness is implemented, investigating authorities should consider how they may most efficiently and accurately investigate outbreaks, both for surveillance purposes and to facilitate an appropriate response.

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