An outbreak of *Salmonella* Typhimurium phage type 64 gastroenteritis linked to catered luncheons in Adelaide, South Australia, June 2005

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Abstract

Salmonella sp. **are important causes of foodborne illness, with restaurants and catered functions being commonly reported settings for outbreaks. In June 2005 an investigation commenced following reports of gastrointestinal illness in attendees at luncheons catered by an Adelaide café, as well as persons eating at the café itself. The investigation sought to determine the existence of an outbreak, identify a source and method of transmission and implement public health measures to prevent further cases. Lists of luncheon attendees were obtained from function organisers. A retrospective cohort study was commenced using a structured questionnaire developed from the café's menu listings. A suspected case was defined as a person developing two or more gastrointestinal symptoms after attending a luncheon catered by the café. A case series investigation was used for café diners. Of the 102 respondents, 61 (60%) met the case definition with 32 subsequently confirmed as *Salmonella* Typhimurium phage type 64 (STM 64) infections. Of the 61 cases, 59 (96%) reported eating a bread roll. STM 64 was detected in raw defrosted chicken recovered from the café's kitchen. This suggested cross-contamination from the chicken to one or more ingredients common to the bread rolls was the route of infection. To prevent further cases, perishable goods were discarded, the café was closed, the premises cleaned, then restrictions were placed on the types of foods served. This investigation's findings highlight the importance of safe food handling and hand hygiene in commercial food preparation.** ***Commun Dis Intell*** **2006;30:443–448.**

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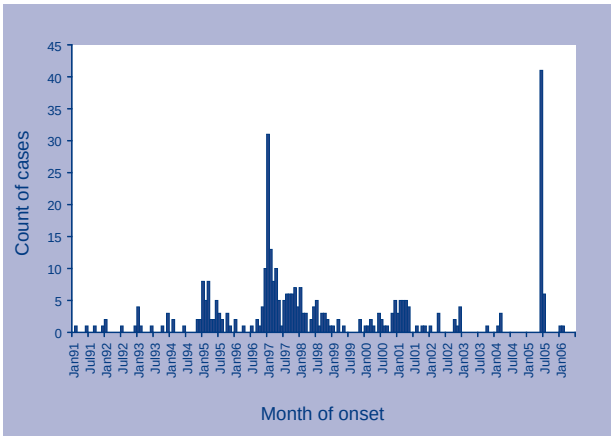
Introduction

Since the commencement of national surveillance, *Salmonella* Typhimurium phage type 64 (STM64) has been present in South Australia at a low endemic level (Figure 1). South Australia and other states began to show increased notifications of this phage type during the mid-1990s with annual reporting in Australia peaking at 374 cases in 1997.[1] Notifications exceeding 50 cases per year continued in some states until 2002 but since that time this phage type has largely disappeared from most jurisdictions, with the exception of South Australia.

Salmonellae are a frequent cause of foodborne illness, with restaurants and catered functions often reported as the settings for outbreaks.[2] The few

Figure 1. Number of notified cases of *Salmonella* Typhimurium phage type 64, South Australia, 1 January 1991 to 30 June 2006, by month of onset



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reports of outbreaks of STM64 infections in Australia include an investigation in 1997 linked to a restaurant in South Australia[3] where 16 of 19 symptomatic diners were diagnosed with STM64 infection. A number of food items, including chicken, tested positive for STM64. The investigation concluded that fried ice-cream was the cause of the illness, with the chicken the likely source of the contaminant. In the same year a joint study involving the Victorian Department of Human Services and the South Australian Health Commission[4] was also undertaken using hypothesis generating questionnaires. The descriptive epidemiology and subsequent case control analysis revealed no food items with a significant odds ratio.

The most recent outbreak was reported on 30 June 2005 when the Communicable Disease Control Branch (CDCB) in Adelaide was advised by a senior hospital clinician that a number of staff members who had attended a lunchtime meeting on 27 June had developed a gastrointestinal illness. Food for the meeting had been prepared by an Adelaide café. The following day further reports were received from local government and a university, advising of illness in members of the public, staff and students who had eaten at the café or attended other luncheons catered for by the same café. Additional cases were also reported via routine notification and when interviewed were found to have eaten at the implicated café.

Methods

Epidemiological investigation

The investigators sought to confirm the existence of an outbreak linked to the café, prevent further cases and to determine the source and method of transmission of the infection. The café owner provided details of catered events for the period 23 June to 4 July including contact details for organisers, number of attendees, menus and descriptions of food served. Luncheon organisers were contacted and asked to supply contact details for attendees. A retrospective cohort study was commenced using a food and illness questionnaire specific to the catered luncheons. This was administered via telephone, direct post or email. People who reported becoming ill after eating at the café itself (community cases) were not included in the cohort study because of their potentially different food exposures. Community case details were collected using standard hypothesis generating food and illness questionnaires. Descriptive analysis of the community case series was performed using Microsoft Excel.

Cohort study questionnaires were entered into Epi Info Version 6 before transfer to Microsoft Excel for descriptive analysis. Stata Version 8.2 was used for the analytical epidemiology. Univariate analysis involved the calculation of relative risks, in conjunction with a two-tailed Fischer's exact test and 95 per cent confidence intervals (CI).

A case was defined as either a person diagnosed with STM64 or a person developing two or more gastrointestinal symptoms after eating at the café or eating at luncheons, held between 27 and 30 June, where food had been supplied by the café.

Environmental health investigation

Café investigation

The first of several inspections of the café was conducted by Environmental Health Officers from the local City Council and the Environmental Health Branch of the Department of Health on 1 July 2005. The kitchen was assessed for appropriate hygiene and sanitation standards, cooking practices were observed and enquiries were made about the supply and storage of foods. A number of food samples and environmental swabs were taken. To conclude the investigation, experimental bread rolls were prepared for microbiological testing to confirm that the clean-up and disposal of foods by the café was effective in eliminating *Salmonella* from bread products.

It was found that the descriptions of bread rolls provided at the catered functions did not accurately match what some attendees had reported eating. This occurred because café staff would use different combinations of ingredients in order to provide greater variety at catered events. As a result meals eaten by community cases were examined in considerable detail as it was felt that food ordered from a set menu would be more true to description. A chicken caesar roll was identified and environmental health staff thoroughly investigated its preparation to identify ingredients that may have been contaminated or steps in the process where cross-contamination could have occurred.

Chicken wholesaler and chicken producer

The South Australian Department of Primary Industries and Resources (PIRSA) provided assistance to determine the source of chicken used in the café and to help organise the collection of any further microbiological evidence.

Laboratory investigations

Phage typing of both human and non-human *Salmonella* isolates was performed by the Australian Salmonella Reference Centre at the Institute of Medical and Veterinary Science (IMVS). In addition, a range of food and environmental samples were also submitted for testing to the Food and Environmental Laboratory at the IMVS for standard

plate counts and *Salmonella* culturing in addition to examination for organisms such as *Escherichia coli* and *Bacillus cereus*. A number of experimental bread rolls with assorted fillings were also made up and submitted for testing.

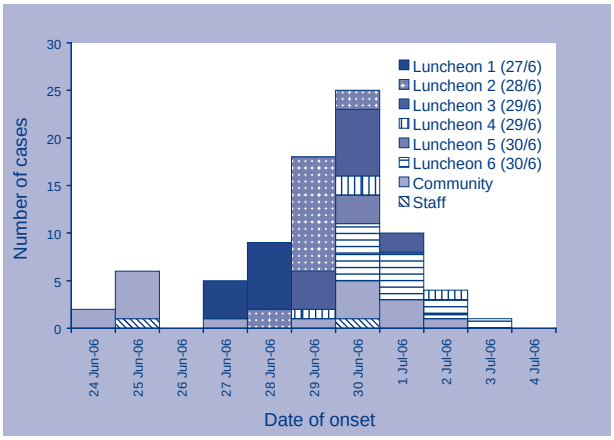
Results

The investigation comprised a cohort study of attendees at functions catered by the café and investigation of people who had eaten at the café (community cases), including ill staff members.

Epidemiological investigation – cohort study

A total of 119 persons were identified as probable attendees at one of six catered luncheons. Following questionnaire administration (either via direct interview, email or regular post) 102 responses were received (86%) from 49 female and 53 male respondents. The average age of respondents (n=99) was 38 years (range 21–63 years). Included among the 102 respondents to the questionnaire were 61 cases of gastroenteritis, providing an overall attack rate of 60 per cent. Among these cases 32 persons were confirmed as STM64 positive. Dates of onset for cases ranged from 26 June to 3 July. The epidemic curve (Figure 2) shows the distribution of cases by specific function in addition to community cases and staff.

Figure 2. Epidemic curve showing community and cohort (catered lunch) identified cases, by date of onset and individual luncheon



Symptoms included diarrhoea (97%), abdominal pain (97%), fever (92%), chills (90%), headache (49%), vomiting (48%), myalgia (20%) and nausea (8%). Four cases reported bloody diarrhoea. Where data were complete (n=55) incubation periods ranged from 2 hours to 81 hours, with a mean of approximately 20.5 hours (median: 16 hours). At the time that questionnaires were completed 64 per cent of cases (n=39) reported still being unwell. For the 19 cases with resolved symptoms, the median self-reported duration of illness was four days (range 2–10 days). Four cases provided no details on resolution of their symptoms.

A variety of food platters in different combinations were served at the six luncheons. Bread rolls (with assorted fillings) and fruit platters were common to all six functions. Cheeses, hot finger foods and Mediterranean style platters were also supplied by the café to some of the luncheons. Analysis of these foods showed 79 per cent of respondents (n=81) reported eating a bread roll (see Table). Fifty-nine of these persons became ill, giving a food-specific attack rate for bread rolls of 73 per cent. Eating a bread roll with any meat or fish filling showed a low but significant association with becoming ill (RR 1.75, 95% CI 1.09, 2.81 p=<0.01). Ham (RR 1.63, 95% CI 1.15, 2.30 p=0.01), smoked salmon (RR 1.57 95% CI 1.19, 2.07 p=0.02) and tuna filled rolls (RR 1.57, 95% CI 1.17, 2.11 p=0.04) all showed a low but statistically significant association with their consumption and illness. For other foods served at the luncheons no association with illness was shown.

Community cases

The median age of community cases was 25 years (range 18–59 years) and included 13 females and six males. Fourteen of the 19 community cases were positive for STM64. This included two staff members, neither of whom was involved in food preparation while they were ill. Dates of onset ranged from 24 June to 1 July, with symptom prevalence for those supplying illness details being: diarrhoea (100%), abdominal pain (94%), fever (82%), vomiting (71%), nausea (53%) and bloody diarrhoea (12%). The median incubation period was 16 hours (range 4–36 hours). At the time food history questionnaires were completed, 10 cases reported resolution of symptoms, with the duration of illness between 6–14 days.

Environmental findings

Café investigation

Prior to the arrival of investigators the café kitchen had been cleaned and all previously prepared food items and most other perishable goods had been discarded. As a consequence of this, investigators were restricted in their ability to hypothesise and test potential means of cross contamination. During the initial inspection on 1 July enquiries were made about catering arrangements and supply of food, including sources of chicken, perishable goods such as fruit and vegetables and other packaged foods used by the café. General hygiene and food handling practices were considered to be good. Remaining food items regarded as being potentially hazardous

Table 1. Food specific attack rates and relative risks for function attendees who reported eating and not eating selected food items

Food item	Persons who ate item			Persons who did not eat item			Relative risk	95% C.I.	*p* value
	Number ill	Total number	Attack rate (%)	Number ill	Total number	Attack rate (%)			
Any filled roll	59	81	73	0	11	–	–	–	–
Any meat filled roll	43	58	74	11	15	73	1.75	1.09, 2.81	<0.01
Chicken roll	18	23	78	28	52	54	1.45	1.04, 2.02	0.07
Ham roll	18	21	86	20	38	53	1.63	1.15, 2.30	0.01
Bacon roll	5	6	83	33	54	61	1.36	0.90, 2.07	0.40
Bacon & egg roll*	5	5	100	29	51	57	1.76	1.38, 2.23	–
Salami roll	6	8	75	33	53	62	1.20	0.76, 1.89	0.70
Beef roll	4	5	80	34	55	62	1.29	0.80, 2.10	0.64
Turkey roll*	4	4	100	41	68	60	1.66	1.37, 2.01	–
Smoked salmon roll	15	17	88	36	64	56	1.57	1.19, 2.07	0.02
Tuna roll	11	12	92	28	68	41	1.57	1.17, 2.11	0.04
Any vegetable filled roll	9	17	53	30	42	71	0.74	0.45, 1.21	0.23
Salad roll	6	9	67	33	49	67	0.99	0.60, 1.63	1.00
Roasted vegetable roll	7	16	44	41	61	67	0.65	0.36, 1.17	0.15
Mediterranean vegetable roll	2	4	50	34	64	53	0.79	0.29, 2.16	0.63
Egg roll*	5	5	100	35	57	61	1.62	1.33, 2.00	–

* *P* value not reported due to small numbers of subjects reporting these exposures.

were shown to be under temperature control following testing. The storage of raw food was closely examined, in particular the separation of chicken from other raw or ready to eat foods in the cold room. There were no identified safety issues with raw chicken, and all other foods were adequately covered and protected from contamination in the cold room, freezers and dry storage.

Hand washing and toilet facilities were clean and appropriately fitted. Previous routine inspections by local government had not identified any other concerns relating to kitchen hygiene, sanitation or food handling practices. Cleaning and sanitising of utensils, equipment and work surfaces was very good. The kitchen used colour coded cutting boards with staff displaying a good understanding of washing and sanitising practices.

Staff demonstrating preparation of chicken for cooking were seen to handle raw chicken meat immediately prior to seasoning it with pinches of salt and pepper kept in takeaway containers on the preparation bench. The same salt and pepper was then used for seasoning bread rolls as well as being used as an ingredient in guacamole. The guacamole was stored in plastic containers that sat on a kitchen bench during roll preparation and peak trading. The same knife used to spread guacamole onto bread rolls was also reported by the café as being used to spread butter onto hamburger buns, with hamburgers being identified as a food item eaten by a number of the community cases. It was also found that some of the bread rolls served at the luncheons did not match the descriptions of what was supplied for that particular event.

Laboratory findings

STM64 positive faecal specimens were obtained from 32 cohort and 14 community cases. STM64 was also cultured from a 25 g sample of raw defrosted chicken tenderloin obtained at the time of the first kitchen inspection. *Campylobacter jejuni* was also present in this specimen and in a faecal specimen provided by a staff member with a dual infection. An experimental bread roll filled with turkey, lettuce, cucumber, cheese, sprouts, cranberry sauce and dressing was positive for STM64. All other food and environmental samples were negative for STM64, although low levels of *Bacillus cereus* and *E. coli* were detected in samples of fried rice and cooked beef.

Chicken wholesaler and chicken producer

As the chicken meat sample was positive for STM64 the decision was made to undertake a trace back of chicken to identify contamination along the food chain. An Adelaide poultry wholesaler supplied the café with fresh chicken which was ordered as required. The wholesaler reported supplying the café with breast fillets while the café stated they received both breast and thigh fillets (tenderloins). The chicken was usually purchased in 5 kg lots, separated at the café and then frozen. It would then be removed from the freezer and allowed to thaw in a cool room prior to cooking. The local wholesaler sourced their chicken from an interstate processing facility. At the request of PIRSA the processor undertook a review of quality assurance data with no evidence of this phage type being found in the plant. PIRSA then sought assistance from the interstate producer to undertake drag swabbing of sheds from the farm where the chickens were raised.

Public health action

Public health action was taken to eliminate potential sources of infection and to reduce potential transmission of foodborne pathogens. Before inspection of the café by health department and local government investigators the café was cleaned with any remaining prepared food items and most perishable goods being discarded. The café voluntarily decided to close for additional cleaning and did not trade over the weekend. Restrictions were then placed on the types of food served. No sandwich items were permitted to be made and rolls for upcoming catered functions were brought in ready-made from an independent supplier. Only hot meals such as pasta dishes, schnitzels and fish and chips, in addition to plain salads, were to be prepared and served on the premises. Staff members were instructed on safe food handling practices and other issues relating to food safety by environmental health officers. In order to recommence catering and sandwich making the café was required to make up an assortment of menu-listed bread rolls for additional laboratory testing. Following the positive laboratory finding in the initial batch of experimental rolls the café was required to submit another two batches of rolls for testing. After both batches had tested negative for *Salmonella,* the café was permitted to recommence catering and making sandwiches and rolls. Traceback of chicken to suppliers, processors and farms was instituted, with the aim of identifying a primary source of contamination.

Discussion

The high food-specific attack rate associated with eating bread rolls, food items common to all functions, coupled with the low relative risks for individual roll types, suggests contamination of an ingredient common to many of the rolls served at both the luncheons and the café itself. The STM64 infections were likely acquired from eating bread rolls cross-contaminated from raw chicken, possibly via black pepper or guacamole.

Although the exact mechanism of cross-contamination in this outbreak may only be surmised, environmental health staff did identify a possible mechanism whereby *Salmonella* on raw chicken could have cross-contaminated a ready-to-eat food, reinforcing the need for restaurants and caterers to both comprehend and to comply with the requirements of the Australia New Zealand Food Standards Code.[5]

Although salmonellae will not grow in food with low water activity (a_w), they are able to survive for long periods in low a_w foods such as black pepper, gelatine and chocolate.[6] While the link between guacamole and chicken is less direct than that of the pepper it remains plausible. Guacamole could certainly act as a growth medium and sat in tubs on the kitchen bench at an ambient temperature during roll preparation and peak trading. This may have assisted the growth of any *Salmonella* added to the guacamole via contaminated black pepper.

A similar mechanism could explain detection of STM64 in the test bread roll. While enumeration of the salmonellae was not reported the numbers of organisms in the 25 g sample was thought to have been low, as following detection of the organism the remainder of the roll was divided and its individual ingredients tested separately, with no *Salmonella* detected.

The rapid onset of symptoms and duration of illness is suggestive of the ingestion of large numbers of *Salmonella*. This could not be confirmed as, with the exception of the positive chicken sample recovered from the cafe freezer, most perishable ingredients used in the rolls had been discarded prior to investigators inspecting the café. Furthermore, no specimens were recovered from any of the luncheons. Investigators did not collect data on number of bread rolls consumed by cases and thus no proxy measure of dose based on a relationship between incubation period and number of bread rolls eaten could be calculated.

Limitations

The respondent's memory and reporting of exposures may potentially lead to non-differential misclassification in this study. This issue is further clouded by the generic descriptions of bread rolls not matching what had been served at the luncheons. This could not be controlled in the cohort study and made it difficult to ascribe any epidemiological association

with contamination of a specific bread roll or bread roll component. However, if an ingredient common to many of the bread rolls had been contaminated as suggested, such bias would have had little effect on the conclusion of the investigation, apart from generating relative risks for individual rolls that are closer to the null than the actual effect.

This study has highlighted the importance of understanding and adhering to good food handling techniques in commercial kitchen and catering settings. Although the exact mechanism of contamination remains unknown our findings would indicate a breakdown in safe food handling and preparation as the likely cause. It was unfortunate that samples from the implicated farms where not obtained. The involvement of interstate health authorities may have helped in this matter.

Acknowledgements

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