An outbreak of infections with a new *Salmonella* phage type linked to a symptomatic food handler

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Abstract

In December 2001, the South Australian Communicable Disease Control Branch investigated an outbreak of gastrointestinal illness linked to a Korean style restaurant in metropolitan Adelaide. Twenty-eight people were identified as having experienced gastrointestinal symptoms subsequent to dining at the restaurant between 9 and 12 December 2001. A case-control study implicated mango pudding dessert (OR 16.67 95% CI 2.03–177.04) and plain chicken (OR 10.67 95% CI 1.04–264.32). Nineteen cases and one food handler submitted faecal specimens that grew *Salmonella* Typhimurium 64var. Two samples of mango pudding and one sample of pickled Chinese cabbage also grew *Salmonella* Typhimurium 64var. The infected food handler reported an onset of illness 2 days before cases first reported eating at the restaurant. The food handler's only role was to prepare the mango pudding dessert in an area external to the restaurant's kitchen. Illness was strongly associated with consumption of a contaminated mango pudding dessert, with contamination most likely resulting from the symptomatic and culture positive food handler who prepared the dish. This outbreak demonstrates the importance of excluding symptomatic food handlers, and the need for appropriately informing and educating food handlers regarding safe food handling procedures. Restaurants with staff and management from non-English speaking backgrounds should be specifically targeted for education that is both culturally sensitive and language specific. *Commun Dis Intell* 2002;26:562–567.

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Introduction

On 13 December 2001, a public health nurse at the South Australian Communicable Disease Control Branch (CDCB) detected a potential outbreak of acute gastrointestinal illness linked to a Korean restaurant in Adelaide. Three medical notifications had been received over a 2-day period, all of which had implicated the same restaurant (restaurant A) as the possible source of their illness. One case was a confirmed *Salmonella* infection and the remaining 2 cases were notified as cases of suspected food poisoning. Initial inquiries revealed that these cases belonged to two different groups who had dined at the restaurant on consecutive evenings. The restaurant implicated is a licensed 'self serve' restaurant, with facilities available for patrons to cook their own meat and seafood. It is located in metropolitan Adelaide, in an area well known for its range of multicultural restaurants.

An investigation was commenced to confirm the existence of an outbreak and the link to the restaurant to determine the source of the infection and to initiate public health measures to prevent further cases in the community.

Methods

Case series

A case series investigation was commenced and initial cases were defined as any person who was reported to the CDCB with a gastrointestinal illness subsequent to dining at the implicated restaurant. These cases were interviewed using open-ended questionnaires to obtain illness, travel, and seven day food histories to confirm the suspected association with the restaurant and other ill persons. A menu was requested from the restaurant, however, cases were asked for a brief description of menu items and beverages consumed at the restaurant prior to the menu being available.

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Despite requests made to the restaurant, a booking list was not available to assist in the process of identifying more cases. Reports from the restaurant suggested they rely primarily on passing trade and only rarely take telephone bookings. Therefore, in order to identify other patrons of the restaurant that were potentially exposed at the same time, cases were asked for names and contact details of all people with whom they dined.

From the initial case series investigation the hypothesis that illness was associated with the consumption of a food item at restaurant A was established.

Case control study

A case control study was initiated to test the hypothesis that illness was associated with the consumption of a specific food item at restaurant A. For this study, cases were identified from notifications of *Salmonella* infections and suspected food poisoning that were received by the CDCB and that implicated a restaurant as the possible source of their illness. A suspected case was defined as a person who had an onset of diarrhoea (defined as three or more lose bowel motions in a 24-hour period) within 3 days of eating a meal at the restaurant and was reported to the CDCB or to another person who dined at the restaurant. A case was confirmed if they had *Salmonella* Typhimurium phage type 64var (STM 64var) isolated from a stool specimen. Those who did not become ill after eating at the restaurant, as nominated by the cases, were used as unmatched controls.

A structured questionnaire was developed based on the set menu and preliminary findings. Telephone interviews were carried out with cases and controls using the structured questionnaire, and sought to determine the time of onset of symptoms and illness characteristics in cases, consumption of specific menu food items and beverages, as well as their own food handling practices, and cooking methods employed at the restaurant. Data analysis was conducted using Epi Info version 6 software, and both suspected and confirmed cases were included in the analysis.

Environmental investigation

Environmental Health Officers from the local council and the Environmental Health Branch of the Department of Human Services conducted several inspections of the restaurant premises over a number of days. The first inspection was conducted 5 days after cases first reported eating at the restaurant. They assessed the kitchen for appropriate hygiene and sanitation practices. Food handlers were observed for appropriate food handling techniques, and information was sought using a specifically constructed staff questionnaire, regarding recent staff illness and overseas travel. Enquires were also made about the supply of food, including sources of meats, fruits and vegetables, and other packaged foods.

Laboratory investigation

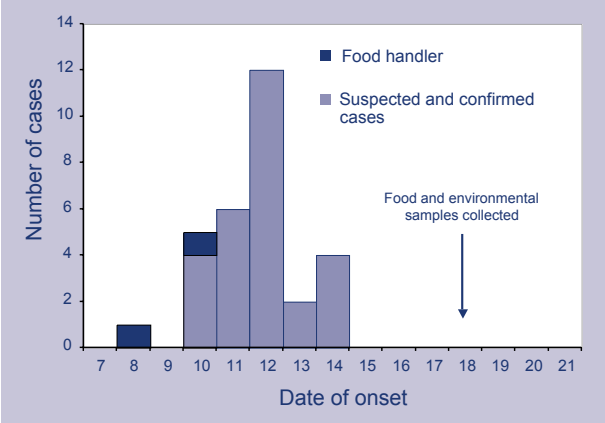
Nineteen cases and one food handler submitted faecal specimens to the Institute of Medical and Veterinary Science (IMVS) for microbiological testing including culture for *Salmonella, Shigella*, and *Campylobacter* species. Samples were also examined for parasites with direct and indirect microscopy. A range of food samples, including raw beef, fish, chicken, pork, mussels, capsicum, tomatoes, mushrooms, sweet and sour cabbage, spiced cucumber, lettuce, pickled Chinese cabbage (Kim Chi), and mango pudding were sent to the Food and Environmental Laboratories located at the IMVS for *Salmonella* culture. Food samples were also examined for total bacterial plate count, as well as for the presence of other specific organisms, namely *Escherichia coli* and faecal (thermotolerant) coliforms. Phage typing of both human and non-human *Salmonella* isolates was performed at the Australian Salmonella Reference Laboratory. Environmental swabs of kitchen and food preparation areas, and gloves used by food handlers were also collected and submitted for microbiological testing. Both food and environmental samples were collected 9 days after the first cases reported eating at the restaurant, with the sampled food items having been freshly prepared ready for serving on that day.

Results

In total, 28 cases were identified from notifications of *Salmonella* infection and suspected food poisoning that fulfilled the initial case definition. They reported eating at the restaurant over a period of 4 days, between 9 and 12 December 2001 (Figure). All reportedly dined in the evening, between 5.30 pm and 11.00 pm, on one of the 4 days. Of the 28 cases, 19 were

confirmed cases, having STM64var detected in a stool specimen. An additional STM 64var positive case linked to the restaurant was identified, however, this case resided interstate and could not be fully interviewed other than to confirm the link to the restaurant.

Figure. Number of cases of gastrointestinal illness categorised by date of onset



The cases belonged to 10 different groups of diners, comprising a total of 37 people. The number of persons in each group ranged from two to seven. The total number of diners at the restaurant over the 4-day period could not be accurately determined from restaurant records, however, it is conservatively estimated that over 240 persons had dined at the restaurant during the specified time period.

The average age of cases, where known, was 33 years (median: 28 years; range 13–63 years; *n=26*) and 57 per cent of cases were female. Eighty-nine per cent consulted a medical practitioner. Symptom prevalence for the 28 cases were: diarrhoea 100 per cent, vomiting 64 per cent, abdominal cramps 100 per cent, nausea 93 per cent, fever 96 per cent, lethargy 100 per cent. No cases reported bloody diarrhoea. The incubation period of each case ranged from approximately 5 hours to 53.5 hours. The average incubation period was 21 hours (median: 18 hours). At the time of interview, 15 cases reported that they were still unwell. Of the 13 whose illness had resolved, duration of illness ranged from 3 days to more than 5 days.

All 28 cases identified in the case series investigation fulfilled either the suspected or confirmed case definition and were enrolled in the case-control study. Nine controls (as nominated by the cases) were enrolled in the study. The average age of the control group was 21 years (median: 28 years; range 3–51 years; *n=9*), and 66 per cent were males. The sex distribution did not differ significantly between the case and control groups (Fisher's exact two tailed test, *p=0.26*), however, the average age of each group was significantly different (*t=1.81 p= 0.03*).

Exposure histories to approximately 50 foods, beverages, and condiments were obtained from the 28 cases and 9 controls. An additional three questions sought information regarding meat, poultry, and seafood that was cooked by the patrons themselves on a barbecue located at each table. Most cases and controls were interviewed as they were notified, with the time between exposure and interview ranging from 7 to 16 days. Several food items had undefined odds ratios, including the pickled Chinese cabbage, the sweet and sour cabbage, turkey, ox liver, and ox tongue. Indeed, many other foods had elevated ORs, including sweet bean curd, fish, squid, and cocktail sausage. However, the association of illness with these foods was not significant as the limits of the 95 per cent confidence interval for each food item included one. Additionally, the number of cases and controls that consumed each of these items were insufficient to explain the distribution of illness.

The consumption of 'plain' chicken was significantly associated with illness (crude OR 10.67 95% CI 1.04–264.32). Only 16 cases however, reported eating this dish. Two other chicken dishes, chili chicken and chili chicken wings, were not associated with illness. The consumption of any one of the three chicken dishes was not statistically significant (crude OR 6.67 95% CI 0.86–59.48). Eating undercooked meat or seafood, or using the same utensils (such as chopsticks or tongs) for cooking and then eating meats cooked on the barbeque, were not associated with illness.

Mango pudding was significantly associated with illness with a crude OR of 16.67 (95% CI 2.03–177.04) (Table). Twenty-five cases reported consuming between one and eight servings of the pudding. Three out of the 9 controls also reported eating the mango pudding dessert.

Table. Odds ratios and consumption distribution among cases and controls for some food items (*Cases=28 Controls=9*)

	Foods eaten		Foods not eaten			
	Cases	Controls	Cases	Controls	OR	95% CI
Plain chicken	16	1	12	8	10.67	1.04–264.32
Any chicken dish	25	5	3	4	6.67	0.86–59.48
Lamb	11	2	17	7	2.26	0.32–19.65
Kangaroo	5	1	23	8	1.74	0.14–46.36
Pickled chinese cabbage	8	0	20	9	?	?
Mango pudding	25	3	3	6	16.67	2.03–177.04
Sweet bean curd	13	1	15	8	6.93	0.68–171.14

Environmental findings

All foods at the restaurant were served in a buffet style where patrons 'served themselves'. There were several buffets with sections for hot dishes, salads and desserts. Raw meat and seafood were also selected from the buffet and cooked by patrons at small gas barbecues located on each table. Approximately one barbecue was available to every two patrons. All food items, apart from the mango pudding dessert, were prepared in the restaurant kitchen, including sauces and marinades.

Further investigation of the mango pudding dessert identified that it was the only food item not prepared in the kitchen. It was prepared in an area at the back of the restaurant where a small bench space and sink were available. The utensils used in its preparation were dedicated to this task. It was made fresh daily in individual servings. Ingredients included a dry crystal (gelatine) mixture, boiling water, and sliced fresh mangoes (layered on top). The freshly prepared dessert was placed directly into refrigeration until required by the customers.

Inspection of the kitchen and self-serve areas revealed major inadequacies. The general condition of the kitchen with respect to maintenance and upkeep was poor. The kitchen was inadequately cleaned, and there was no sanitation step for bench tops or items that did not go in the dishwasher. There were no dedicated hand washing facilities. Raw meats and vegetables were prepared in the same bench space due to the small size of the kitchen. However, their preparation appeared suitably separated, with vegetables being prepared prior to meats, and chopping boards and utensils dedicated to each.

Two food handlers reported gastrointestinal illness in the week prior to the restaurant inspection. The first food handler reported an onset of illness the day before cases first dined at the restaurant (8 December). She continued to work until her symptoms resolved 6 days later. The primary role of this food handler was to prepare the mango pudding dessert and to work in the front area of the restaurant. She was not involved in the preparation of any other food items. A stool specimen submitted by this food handler 2 weeks after the onset of her illness was positive for STM 64var. The second food handler reported an onset of illness on 10 December. He continued to work for 3 days while symptomatic. He was not involved in the preparation of foods, but worked mainly in the self-serve area of the restaurant, topping up empty food containers. He did not submit a stool specimen for testing. Both food handlers reported symptoms of diarrhoea, abdominal pains and fever. Neither reported recent overseas travel.

Laboratory findings

Salmonella Typhimurium 64var was detected in 25 gm samples of both the mango pudding and the pickled Chinese cabbage. Two samples of the mango pudding had 46 and 110 colony-forming units (cfu) of *Salmonella* per gram,

respectively. The single sample of the pickled Chinese cabbage had less than 3 cfu per gram, which is at the limit of detection for *Salmonella*. Both of these food samples were of very poor microbiological quality, indicated by large numbers of coliforms (both thermo tolerant and faecal) and *Escherichia coli* organisms detected in the samples. The pH of both the mango pudding and the pickled Chinese cabbage was quite acidic, approximately 4.5 for each sample.

Control measures

Public health measures were instituted at the restaurant to eliminate the source and potential spread of infection, and to prevent any further outbreaks of foodborne illness. Initial control measures included advising sick food handlers to exclude themselves from work until 48 hours after the resolution of symptoms, and disposing of food items not subject to further cooking after preparation, such as salads, fruits, vegetables, sauces and desserts. The restaurant was closed to allow for food contact surfaces, food containers, and self-serve areas to be thoroughly cleaned and sanitised. Food handlers were advised to use a hand cream effective against *Salmonella* before starting work and after using the toilet. For the purpose of long-term prevention, recommendations were made regarding the ongoing use of sanitising practices, installation of dedicated hand washing facilities, and improvement in the general repair and condition of the kitchen area. Restaurant staff members were educated about appropriate food handling practices and other food safety issues by local council environmental health officers.

Discussion

The findings of this investigation show a clear association between the consumption of mango pudding and STM 64var infection. Epidemiological and microbiological evidence support this conclusion. Descriptive evidence shows a culture positive and symptomatic food handler to be a likely source of the contamination. This evidence includes the dedicated preparation of the implicated dish by this particular food handler, and onset of illness just prior to the commencement of this outbreak. Moreover, the infected food handler had freshly prepared the mango pudding on the day of sampling, and this was several days after the last cases reported eating at the restaurant.

Food handler contamination via direct hand contact is further suggested by the considerable handling of the mangoes in the preparation of the dessert. It has been demonstrated that salmonellae can survive on the fingertips for at least 3 hours,[1] and outbreaks of *Salmonella* associated with infected food handlers contaminating food items (not subject to further cooking) via direct hand contact have been documented.[2,3] The fact that no dedicated hand washing facilities were available at the restaurant questions the personal hygiene practices of the implicated food handler. A recent survey of Australian food premises indicated that adequate facilities influenced the likelihood of good staff practice in regard to personal hygiene, with just under one in five (17%) Australian businesses lacking adequate hand washing facilities.[4]

Our results question the role of symptom-free non-typhoidal *Salmonella* excreting food handlers in foodborne disease outbreaks. In this outbreak, no further cases were notified subsequent to the resolution of the food handler's symptoms. This is despite evidence that the organism continued to be excreted without symptoms by the food handler for several weeks. This could suggest that the amount of bacteria carried in the convalescent stages of illness is insufficient to transmit illness and that simple food hygiene will sufficiently reduce any risk that exists. Equally, irrespective of the number of organisms contained in the faeces, hands may be more easily contaminated in the acute phase of illness because stools are loose and more frequent. Regardless, this demonstrates the importance of good hygiene practice and excluding food handlers who are actually ill.

This report documents the epidemiological, environmental, and microbiological features of an outbreak of a previously unrecognised *Salmonella* Typhiumurim phage type. The phage type pattern of the *Salmonella* isolated in this outbreak did not conform to that of other known phage types. Despite this, its phage pattern was similar to that of phage type 64, having only one additional phage susceptibility. Thus, the Australian Salmonella Reference Laboratory termed the phage pattern of this isolate 64 'variant' or 'variety', reflecting its similarity to phage type 64 in phage pattern only.

The original source of this new phage type of *Salmonella* Typhimurium can only be surmised.

The emergence of new types of foodborne pathogens, including new types of *Salmonellae*, has been facilitated by changes in these pathogens over time, as well as increasingly centralised and concentrated food production, globalisation of the food supply, and increases in the populations at risk. It is possible that STM 64var was imported from overseas, or is the result of genetic variation or changes in the *Salmonella* Typhimurium organism. It is a continuing challenge to identify these new pathogens as they emerge, understand how they contaminate food and cause illness and define and implement best prevention strategies.

This outbreak demonstrates one way in which food premises can facilitate the spread of foodborne disease. It highlights the importance of appropriately informing and educating owners of food premises and their workers regarding safe food handling procedures, sanitation and hygiene. Changes to the South Australian Food Act will see the Food Safety Standards in the Australia New Zealand Food Standards code adopted into the legislation. These standards contain requirements relating to food safety practices, premises and equipment. More specifically, they address the responsibilities of food handlers and food premises with regards to illness and personal hygiene. A recent survey was conducted by the Food Standards Australia New Zealand (formerly Australian New Zealand Food Authority) to evaluate the impact of these changes.[4] It indicated that between 10 and 20 per cent of Australian food businesses did not know correct food handling practices, and had poor practices and knowledge of washing and sanitising procedures. Personal hygiene and approaches to staff illness were areas identified as of most concern, with over half of the businesses saying it would be acceptable for a staff member with diarrhoea to undertake food handling tasks. While legislation plays an important role in preventing the spread of potential foodborne pathogens, it is necessary that these regulations are properly interpreted and understood by those to whom they apply. This is particularly important for those food premises that have staff and management who are culturally and linguistically diverse. In light of this particular outbreak, the local council for the area in which the restaurant is located, has proactively contacted all Asian and multicultural restaurants in their district regarding safe food practices, and will continue educating these establishments about food hygiene on a regular basis.

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