

Salmonellosis outbreak linked to the consumption of fried ice-cream

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Background

On 8 April 2011, the Communicable Disease Prevention and Control Unit (CDPCU) of the Victorian Department of Health was advised that three adolescents from the same family had been admitted to a metropolitan hospital for treatment of dehydration secondary to diarrhoea. Other symptoms included fever and vomiting. Initial enquires suggested that the adolescents may have become infected after eating fried eggs for breakfast at their aunt's home over three consecutive days, or dinner at a Chinese restaurant. Six days later two more notifications of salmonellosis were received by CDPCU; both cases had eaten at the same Chinese restaurant. Also on this day, the Department was notified that *Salmonella* spp. was isolated from two of the original adolescent's faecal specimens.

An investigation was initiated to characterise the outbreak, identify the source and possible cause of the infection and to prevent ongoing transmission of the infection.

Methods

A retrospective cohort study was conducted using the booking list of patrons to the Chinese restaurant. A standard CDPCU questionnaire for gastrointestinal illness, tailored to include food and drink from the restaurant menu, was used to collect data through telephone interviews. A confirmed case was defined as a patron who had eaten at the restaurant between five and 11 April, who reported diarrhoea and one or more of the following symptoms: vomiting, fever, nausea, lethargy, abdominal pain and/or headache, and had a laboratory confirmed infection with *Salmonella* Typhimurium phage type 170. A probable case included the definition of a confirmed case but without the laboratory confirmed infection. Active case finding through the surveillance system for notified cases of salmonellosis living within a 20km radius from the restaurant was also conducted. A possible case had laboratory confirmed *Salmonella* spp. and resided within the 20km distance from the restaurant.

The local government environmental health officers inspected the restaurant and the aunt's kitchen, taking egg samples from both venues, as well as frozen ice-cream balls from the restaurant. These were submitted for microbiological investigation to the Microbiological Diagnostic Unit (MDU).

Data were entered into Excel and analysed with Stata version 9. Where several food items were statistically associated with salmonellosis, stratified analyses were used to adjust for potential confounding.

Results

Epidemiologic investigation

Of the 307 patrons recorded in the restaurant booking list over the seven day period in question, 91 telephone contact numbers were available. Of these, 68 patrons were able to be contacted and subsequently interviewed by telephone (22 per cent of the cohort).

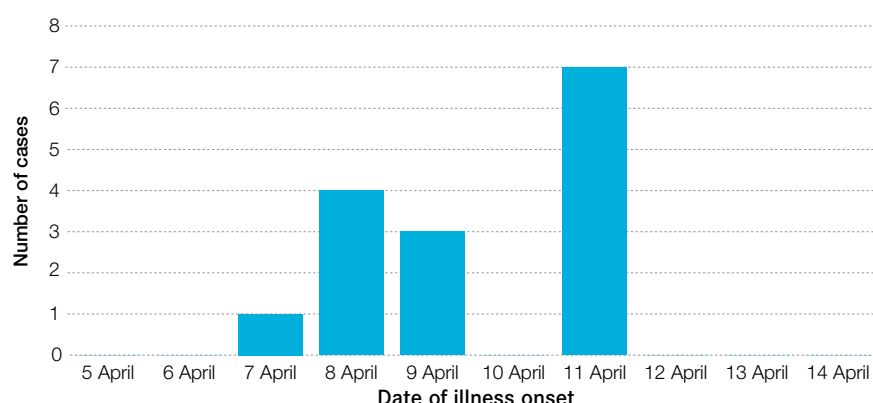
Nine people notified to CDPCU with *Salmonella* Typhimurium 170 had eaten at the restaurant between the

7th and 10th of April (Figure 1). Three of these cases were identified during active case finding through routine surveillance systems. An additional six probable cases were reported during interviews with the confirmed cases; they became ill after eating at the restaurant with friends or family but faecal specimens had not been collected. Food histories and time of illness onset were not available for three of these individuals. In total, diet histories were available for 82 patrons of the restaurant sourced via the booking list and active case finding.

Five further possible cases were identified during active case finding. *Salmonella* Typhimurium 170 was isolated from faecal specimens of four of the cases; however, none reported eating at the restaurant. *Salmonella* Newport was cultured from the fifth case. These cases were therefore excluded from the cohort investigation.

All 15 confirmed and probable cases reported fever and diarrhoea, while 80 per cent reported abdominal pain and 73 per cent reported vomiting. Time

Figure 1: Epidemic curve by date of illness onset, outbreak investigation, April 2011



of symptom onset was reported by all confirmed cases; incubation periods ranged from six to 14 hours (median 11 hours). Six confirmed cases were hospitalised.

Table one shows the risk associated with consuming various foods at the restaurant. Of the 33 food and drink items consumed by patrons, six had significantly elevated risk ratios. All cases interviewed had consumed fried ice-cream giving an attack rate of 100 per cent for this item. Patrons that did not eat the fried ice-cream reported no disease. Relative

risks (RR) were also elevated for consumption of abalone, noodle with crab, fried rice noodles, Singapore noodles, and lychees with ice-cream.

Stratified analysis showed that the effects of eating abalone, noodles with crab, fried rice noodles, Singapore fried noodles and lychees with ice-cream were confounded by the effect of consuming fried ice-cream. There were no patrons who had eaten any of these food items (excluding the fried ice-cream) and become unwell.

Environmental investigation

The proprietors of the restaurant were instructed to clean and sanitise all kitchen surfaces using the Department of Health's *Guidelines for the investigation of gastroenteritis*,¹ to keep food safety records up to date and accessible and to rectify various items not functioning. Staff's hand-washing techniques were found to be inadequate and advice on the correct techniques was provided.

Laboratory investigations

Aunt's house

Salmonella Infantis was isolated from the external surface of eggs taken from the aunt's house, but no *Salmonella* spp. were detected in the internal contents of these eggs.

Chinese restaurant

Salmonella Typhimurium phage type 170 was isolated from pre-prepared ice-cream balls taken from the freezer of the restaurant. No *Salmonella* spp. were detected in the pulp or the external surface of the eggs. The ice-cream used in the preparation of the fried ice-cream was not available for testing.

Table 1: Food-specific attack rates, relative risk and 95% confidence intervals related to illness among restaurant patrons (n=82)

Food item	Ill/exposed/ total (%)	Ill/unexposed/ total (%)	Relative risk (95% CI)	P value
Fried ice-cream	12/12 (100.00)	0/70 (0.00)	Inf (21.45–inf)	<0.001
Red bean soup	0/64 (0.00)	12/18 (66.67)	0.00 (0.00–0.10)	<0.001
Steamed rice	2/67 (2.99)	10/15 (66.67)	0.04 (0.01–0.18)	<0.001
Clear soup	0/56 (0.00)	11/25 (44.00)	0.00 (0.00–0.19)	<0.001
Abalone	4/5 (80.00)	8/77 (10.39)	7.70 (3.50–16.95)	<0.001
Noodles with crab	4/5 (80.00)	8/77 (10.39)	7.70 (3.50–16.95)	<0.001
Chinese tea	1/49 (2.04)	11/33 (33.33)	0.06 (0.01–0.45)	<0.001
Chicken ribs in salty egg yolk	1/46 (2.17)	11/36 (30.56)	0.07 (0.01–0.53)	<0.001
Sautéed mixed seasonal vegetables	1/34 (2.94)	11/48 (22.92)	0.13 (0.02–0.95)	0.012
Fried rice noodle with soy bean sauce	1/1 (100.0)	11/81 (13.58)	7.36 (4.25–12.75)	0.015
Singapore fried noodle	1/1 (100.0)	11/81 (13.58)	7.36 (4.25–12.75)	0.015
Lychees with ice-cream	1/1 (100.0)	11/81 (13.58)	7.36 (4.25–12.75)	0.015
Stir fried venison with XO chilli sauce	0/22 (0.00)	12/60 (20.00)	0.00 (0.00–1.03)	0.023
Pork spare ribs with Peking sauce	0/22 (0.00)	12/60 (20.00)	0.00 (0.00–1.03)	0.023
Steamed barramundi	0/21 (0.00)	11/60 (18.33)	0.00 (0.00–1.08)	0.035
Roast duck	1/28 (3.57)	11/54 (20.37)	0.18 (0.02–1.29)	0.041

Discussion

Salmonella Typhimurium 170 was the aetiology of this outbreak. The symptoms and incubation periods were consistent with infection with *S. Typhimurium*. *Salmonella* Typhimurium 170 was cultured from faecal samples of nine cases that had eaten at the restaurant, as well as from samples of pre-prepared ice-cream balls made at the restaurant.

In Victoria from 1 January to 11 May 2011, *Salmonella* spp. was a causative agent in about one-third of sporadic cases gastroenteritis. Of these cases *Salmonella* Typhimurium accounted for more than two-thirds of all notifications of salmonellosis, while Phage type 170 was the most common serotype (about 20 per cent).²

The most common risk factors for salmonellosis are consumption of meats and eggs (3) and eggs as a raw or incompletely cooked ingredient are often implicated.^{4–10} *Salmonella* Typhimurium 170 was isolated from the ice-cream coated in raw egg/bread crumbs and kept in the freezer. As the same serotype was also isolated from the faecal specimens of the cases and no other pathogens were detected in the faeces and fried ice-cream, the food is the most likely source of infection. Results from the cohort study also implicated the fried ice-cream as the source of the outbreak. *Salmonella* Typhimurium has been implicated in fried ice-cream outbreaks in Australia since 2000.^{7,9,11–13} The ice-cream used in the preparation of this product was purchased from the local supermarket. Although commercially prepared ice-cream has been linked to salmonellosis in

the United States^{14,15} it is unlikely that the ice-cream was the source of the *Salmonella* in this outbreak as no other outbreaks or cases investigated during this period were associated with commercially prepared ice-cream.

The fried ice-cream balls were prepared as follows: ice-cream was scooped from the tub and shaped into balls. It was then coated with raw egg before crumbing and then immediately refrozen until required. When fried ice-cream was ordered by a patron, the product was removed from the freezer and very rapidly fried in hot oil to brown the breadcrumbs. As raw or undercooked eggs are often implicated with salmonellosis, it is likely that the heat-treatment given to the ice-cream balls was not hot enough to kill the bacteria. Food needs to reach a temperature of at least 72°C for 15 seconds for *Salmonella* to be killed (16). This hypothesis is supported by the unsolicited information volunteered by a case that the breadcrumbs around the ice-cream ball did not appear completely cooked.

Eggs may become contaminated with *Salmonella* spp. via two routes: trans-ovarian (vertically) or trans-shell (horizontally)¹⁷. Vertical contamination occurs in vivo in infected birds before the egg is formed. Horizontal infection occurs in vitro by a number of external factors, which means that not every egg in a given batch is likely to be infected. In Australia, horizontal transmission is the primary mode of egg contamination. This may explain why cultures of the outside shell rinse or pulp of the eggs, obtained from the restaurant, did not yield *Salmonella* Typhimurium.

Conclusions and public health outcomes

The causative agent for this outbreak of gastroenteritis, *Salmonella* Typhimurium Phage Type 170, was linked epidemiologically and microbiologically to fried ice-cream prepared by the Chinese restaurant on or around 5th April. Prompt investigation by the Department of Health and confirmation of the source arrested further transmission.

This outbreak highlights the risk of consumption of raw or incompletely cooked eggs and egg products, and provides further evidence for the link between these foods and salmonellosis. The restaurant proprietors were advised to use pasteurised eggs to prepare the ice-cream balls before frying. The restaurant has subsequently resumed serving the fried ice-cream balls—made with pasteurised eggs—with no detectable difference in appearance or taste.

Furthermore, this outbreak highlights the importance of ongoing education of consumers, the food service industry, retailers, wholesalers, and egg producers of the risks associated with the improper handling of eggs and those associated with using raw or lightly cooked eggs in ready-to-eat foods.

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