An outbreak of *Salmonella* Typhimurium PT135 gastroenteritis associated with a minimally cooked dessert containing raw eggs

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Abstract

In April 2000, we investigated an outbreak of gastroenteritis amongst attendees of a local community dinner in a Perth suburb. Of the 98 people interviewed (response rate 98%), 53 reported gastrointestinal symptoms (attack rate 54%). Faecal cultures from 11 cases, 2 food preparers, 1 waitress and leftover mock ice-cream dessert grew *Salmonella* Typhimurium PT135. Of the 3 food handlers, one was asymptomatic, another gave an unclear history of onset of illness and the waitress claimed illness onset 9 days after the dinner. A cohort study implicated fruit salad (RR 1.64 [95% CI: 1.05-2.58], p=0.017) and/or mock ice-cream dessert (RR 1.78 [95% CI: 0.91-3.52], p=0.045). Eggs used to make the mock ice-cream dessert were supplied directly from the producer who used inappropriate shell cleaning methods. The method of preparation of the dessert encouraged contamination. *Salmonella* species were not isolated in poultry faecal samples collected from the implicated egg farm. The cause of this outbreak was almost certainly the ice-cream dessert with contamination most likely resulting either from the eggs used to make the dessert or one or both of the food preparers, coupled with inadequate cooking of the dessert. Eggs used in preparing food for mass consumption should be sourced from distributors with approved cleaning procedures. Furthermore, pasteurised egg products or egg pulp should be used in the preparation of uncooked or minimally cooked dishes. *Commun Dis Intell* 2002;26:32-37.

Keywords: Salmonella; *outbreak investigation; gastroenteritis*

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Introduction

On 26 April 2000, the Communicable Disease Control Branch (CDCB) of the Health Department of Western Australia received notification that 20 or more persons who had attended a function in the preceding week had experienced acute gastroenteritis characterised predominantly by diarrhoea, abdominal cramps, headaches, nausea and vomiting. All cases had attended a dinner celebrating a religious festival on one or both nights of 19 and 20 April 2000. A local community caterer had catered for the dinner.

Methods

Epidemiological investigation

A structured questionnaire was developed based on information from a set menu and preliminary findings. A retrospective cohort study was conducted among staff and dinner attendees in order to describe the course of the outbreak and determine its cause. Telephone interviews were performed by 2 trained staff of the CDCB between 26 and 30 April 2000.

A case was defined as any person who ate the dinner on either 19 or 20 April 2000 or both, and who reported the onset of gastrointestinal symptoms in the period from the time of the dinner to 25 April 2000. Gastrointestinal symptoms included diarrhoea (defined as two or more loose bowel motions within a 24 hour period) or at least two of the following symptoms: abdominal pain or discomfort; nausea; vomiting; or chills/sweats. An epidemic curve of time of onset of illness following the dinner was generated and relative risks of illness associated with the consumption of individual food items were calculated using Epi Info 6 software.

Environmental health investigation

Site investigation

The kitchen of the community centre was visited by an Environmental Health Officer (EHO) from the local government authority on 28 April 2000 (earlier access was not possible). The kitchen facilities, including food storage and preparation areas were inspected. Temperatures of refrigerators and freezers were measured. The flow of work was assessed through detailed interviews with the food handlers in an effort to identify risky food handling procedures and opportunities for cross-contamination. Samples of leftover food stored in the freezers of the community hall kitchen and in the household of one dinner guest, were obtained for testing. Environmental sampling was not carried out for a number of reasons. Access to the kitchen was not possible until 10 days after the dinner was held. In addition, in keeping with religious customs, the kitchens had been rigorously cleaned after the dinners were held. It was felt by the EHOs from the local authority and the CDCB that environmental sampling would yield little in this situation.

Investigation of the egg farm

In an effort to determine the source of the *Salmonella* infection, the egg farm where the eggs were purchased was inspected. As the likelihood of isolating *Salmonella* species from whole shell eggs was very low, samples of chicken litter and faecal matter were collected from 2 chicken sheds on 7 June 2000 and cultured at PathCentre for *Salmonella* species.

Laboratory investigation

A total of 13 cases, 2 food preparers and 2 waitresses provided faecal specimens which were cultured for *Salmonella*, *Shigella* and *Campylobacter* species, and examined for parasites with direct and concentrate microscopy. Several items of leftover food were submitted to the Food and Waters laboratory at PathCentre, Perth for testing. These included soup, beef, carrot bake, potato bake, bread, mock ice-cream, wine, grape juice and lemon cordial. Foods were examined for total bacterial plate count, and tested for specific organisms, namely *E. coli*, coagulase positive *Staphylococcus*, *Clostridium perfringens*, *Bacillus cereus* and *Salmonella* species. *Salmonella* isolates were further identified by serotyping. Phage typing was performed at the Microbiological Diagnostic Unit, University of Melbourne.

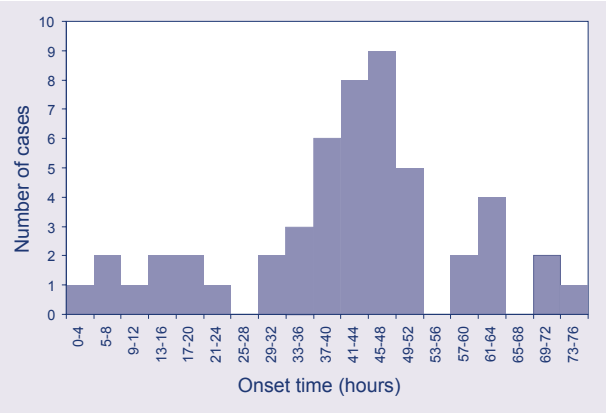
Results

Epidemiological investigation

A total of 107 people attended the dinner over 2 nights: 39 on 19 April and 71 on 20 April 2000, with 3 people attending on both nights. Seven people who attended on the first night did not eat any food and were not ill. Of the remaining 100 people, 98 were interviewed (98% response). Fifty-three fulfilled the case definition, giving an overall attack rate (AR) of 54 per cent. Of these, 22 were female (AR 42%) and 31 were male (AR 58%). Of

those interviewed, 21 of 30 people who attended the dinner on the first night were ill (AR 70%), and 32 of 68 people from the second night were ill (AR 47%) (chi2=4.41, p=0.036). The age range of the cases was 1 to 73 years old (median 27.5 years).

Figure. Number of cases of gastrointestinal illness categorised by onset time after consumption of food



The median onset time of gastrointestinal symptoms was 43 hours after eating the dinner (range 4–75 hours) (Figure). Diarrhoea was the most common symptom (96%), followed by abdominal pain or discomfort (85%), tiredness or weakness (81%), headache (51%), chills (47%), fever (45%), sweats (42%), nausea (40%), abdominal distension (36%) and vomiting (11%). Three cases experienced bloody diarrhoea (6%). The median duration of gastrointestinal symptoms was 4 days (range 1–12 days). Nineteen cases (36%) visited a doctor, and one case was taken to hospital but not admitted. Most cases were ill over the Easter holidays and did not have any time off work.

An analysis of foods eaten on the night found that the mock ice-cream dessert showed the strongest association with illness, with a relative risk (RR) of 1.78 (95% C.I: 0.91-3.52, p=0.045), followed by fruit salad with a RR of 1.64 (95% CI: 1.05-2.58, p=0.017). There was also an elevated RR associated with eating parsley (RR 1.74, 95% CI: 0.91-3.33, p=0.06). The food specific attack rates and relative risks are shown in the Table.

Food for both nights was prepared in one batch and the menu was identical for both nights. There were two food handlers actively involved in food preparation, plus two other staff employed for waitressing. All of them had tasted the mock ice-cream dessert either on the day it was prepared or served, as well as taking home other leftover food items. Faecal specimens were submitted by both food preparers and both waitresses. One of the preparers was asymptomatic. The other food preparer reported an enteric illness, but gave an inconsistent history of onset of illness, ranging from the time of food preparation to 7 days later. One waitress was asymptomatic and the other experienced gastroenteritis 9 days after the function (when the faecal specimen was collected) and denied consumption of any leftover food during the intervening period.

Environmental investigation

Site investigation

The kitchen appeared to be clean on the day of inspection. There was a defined separation of work areas. Refrigerator and freezer temperatures complied with requirements and adequate handwashing facilities were provided.

Food preparation and handling

Food for the dinner was prepared in the kitchen of the community centre on 17, 18 and 19 April 2000 and stored in the refrigerator. This food was reheated and served on the evenings of the dinner. Vegetables were stored uncooked in the chiller, prior to being cooked on the day of the dinner. Salads were prepared on the day of the dinner. The meat was prepared and roasted the morning it was purchased. It was then cooled, cold sliced and refrigerated until the evening of the dinner.

The mock ice-cream dessert was made with fresh eggs purchased directly from a local egg farm. The food preparers maintained that only clean, unbroken eggs were used. To prepare the ice-cream base, hand separated yolks were mixed with sugar and whipped with a small electric hand blender. The whipping was done in approximately 10 batches. Lemon juice and hador (a soy milk-based non-dairy substitute) were then added, and the mixture poured into trays and frozen. The whites were kept for the next day to be whipped into a meringue topping with sugar and added to the lemon base. The entire tray was then placed in a hot oven at 225˚C until the top was just brown, taken out, cooled and placed back in the freezer until served. The cooking method was designed to deliver small amounts of heat to the top to brown the egg white, while leaving the base, containing uncooked egg yolks, frozen.

While the salads and cold items were put on the table, all hot food and the mock ice-cream and fruit salad dessert were served in the kitchen, where they were collected by guests.

Investigation of the egg farm

The egg farm consisted of 2 sheds of laying chickens. An interview with the egg farmer revealed that at the time the eggs were sold for this dinner, the usual practice was for visually dirty eggs to be soaked in a large container of water on the egg farm to clean them. It was unclear how long the eggs were soaked or how often the water was changed.

Laboratory investigation

Faecal specimens from 11 of the 13 cases, both food preparers and one waitress (whose illness onset was 9 days after the function), as well as a sample of the leftover mock ice-cream dessert were positive for *Salmonella* Typhimurium PT135. No organisms were isolated from other leftover foods tested. *Salmonella* species were not cultured from any poultry faecal matter or chicken litter samples obtained from the egg farm.

Table. Food specific attack rates and relative risks

Food	Persons who ate item			Persons who did not eat					
	No. ill	Total	Attack rate (%)	No. ill	Total	Attack rate (%)	Relative risk	(95% CI)	p value
Boiled egg	48	85	56	5	12	42	1.36	0.68-2.72	0.34
Soup	49	91	54	4	6	67	0.81	0.44-1.47	0.69
Beef	44	76	57	9	21	43	1.35	0.80-2.29	0.22
Carrot bake	31	55	56	22	42	52	1.08	0.74-1.56	0.70
Potato bake	39	66	59	14	31	45	1.31	0.85-2.03	0.20
Cabbage salad	30	48	63	23	49	47	1.33	0.92-1.93	0.13
Bread (n=96)	52	95	55	0	1	0	-	-	-
Green salad	33	53	62	20	44	45	1.37	0.93-2.01	0.1
Herbs (n=87)	34	63	54	9	24	38	1.44	0.82-2.53	0.17
Haroset (n=83)	34	65	52	7	18	39	1.35	0.72-2.51	0.32
Parsley (n=87)	36	65	55	7	22	32	1.74	0.91-3.33	0.06
Mock ice-cream	47	79	59	6	18	33	1.78	0.91-3.52	0.045
Fruit salad	39	61	64	14	36	39	1.64	1.05-2.58	0.018
Wine	34	62	55	19	35	54	1.01	0.69-1.48	0.96
Grape juice	35	62	56	18	35	51	1.10	0.74-1.62	0.63
Other juice	42	73	58	11	24	46	1.26	0.78-2.02	0.32

(n=97 except where indicated)

Discussion

This report describes the investigation of a well-defined *Salmonella* Typhimurium PT135 point source outbreak with a high attack rate (54%), suggestive of a high level of contamination.[1] Two food preparers and one waitress were also infected. The range and sequence of symptoms, and the incubation period (6 to 72 hours) are consistent with *Salmonella* infection. It is not clear why higher attack rates were seen in those who attended on the first night. Food for both nights was prepared in one batch and the menu was identical for both nights. Speculatively an extra day's storage at appropriate temperatures may have resulted in some diminution in the number of microorganisms in the suspect foods.

An analysis of foods eaten on the 2 nights of the dinner showed non-significant elevations in risk for several foods. The highest risk and significant associations were seen with consumption of the ice-cream dessert and fruit salad. A portion of the ice-cream was served together with a helping of fruit salad to each person on the same plate and diners were not offered a choice of fruit salad or ice-cream separately. Hence the common association of these foods with risk of illness is not surprising. Unfortunately, no leftover fruit salad was available for testing. Furthermore, laboratory confirmation that the *Salmonella* Typhimurium PT135 cultured from faecal samples and the mock ice-cream dessert were indistinguishable, provides strong corroborative evidence of the causative agent and the contaminated food. The near significant association of parsley is puzzling and could reflect chance or cross-contamination within the kitchen.

The environmental health inspection did not detect any clear breaches in food handling or food safety practices, although the method of preparing the mock ice-cream dessert encouraged contamination as it involved much manual handling with hundreds of eggs being separated by hand. The origin of the bacterial contamination for the outbreak remains unclear. As meat was prepared and cooked on the morning it was purchased, any *Salmonella* originating from the meat had little opportunity to multiply or contaminate other foods. Isolation of *S.* Typhimurium from the mock ice-cream dessert implicates the eggs as a possible source of contamination, although shedding by either or both of the food preparers, one of whom was asymptomatic and possibly a carrier pre-dating the outbreak, cannot be excluded. Moreover, the other food preparer gave an inconsistent history regarding the time of onset of illness.

The investigation also revealed that the batch of eggs bought for the dinner was soaked in a tub of water on the farm to clean them of any poultry faecal matter. *Salmonellae* are widespread in the poultry industry through the food chain, and therefore can be present on the outside of eggs.[2,3] It was unclear how long the eggs were soaked or how often the water was changed. This manner of cleaning the eggs is inappropriate as it is thought to make the eggshell more permeable and thus more susceptible to bacterial contamination, especially if the water used for soaking has a high microbial load.[4] The practice has now been discouraged by the Egg Board and currently, eggs that are not too dirty are scraped clean with a knife or grinding wheel and sold as unwashed eggs through a retail outlet on the premises. Any badly soiled eggs are sold to the local Egg Board, who then pulp and pasteurise the mixture.

Whatever the mode of transmission, once the egg mixture was contaminated, bacteria had ample opportunity to multiply given the method of preparing the dessert over 2 successive days, with minimal cooking. This combination of circumstances may have led to the contamination of the mock ice-cream dessert, resulting in the outbreak. Although *Salmonellae* were not isolated from chicken faecal matter from the farm, this does not rule out contamination of the egg mixture with *S.* Typhimurium PT135 originating from shell eggs.

Between 400 and 900 notifications of salmonellosis are received annually in Western Australia,[5] with the predominant serovar being *S.* Typhimurium (42% in 2000), most frequently phage type 135.[5] *Salmonella* Typhimurium PT135 has strong epidemiological associations with the cattle and poultry industry.[2] To date the most common serovars found in cloacal and drag swabs in the poultry industry in Western Australia have been *S.* Sofia and *S.* Infantis, and more recently, *S.* Kiambu (Kim Leighton, Health Department of Western Australia, personal communication).

Outbreaks of foodborne disease originating from the use of either unpasteurised whole shell eggs or cracked and dirty eggs have been reported both in Australia[6,7] (Dr Jeffrey Hanna, Tropical Public Health Unit, Queensland, personal communication), and elsewhere.[8] The first 2 reports detailed investigations that found the incorporation of raw eggs into dishes that received minimal or no further cooking. The lack of a national outbreak register in Australia makes it difficult to accurately assess the

incidence of foodborne disease attributable to eggs as a vehicle for transmission.

An inquiry report by the Australia New Zealand Food Authority in 1996, reviewed egg and egg products and proposed to prohibit the retail sale and use of unpasteurised egg products for catering purposes and include a mandatory warning and advisory statement regarding all cracked eggs and unpasteurised egg products.[9] However, no nationally consolidated data are available regarding the levels of important pathogens in eggs with intact shells or egg products.[10]

In summary, two key points result from the investigation of this outbreak. Firstly, eggs used in preparing food for mass consumption should be sourced from distributors with approved cleaning procedures. A distinction should be made between eggs bought through large-scale commercial suppliers where the eggs undergo a rigorous and controlled sanitising and cleaning process, and farm-direct outlets that may not have adequate procedures in place to clean shell eggs. Secondly, caterers should be educated about good food handling practices when handling shell eggs. A survey of raw egg use by home caterers highlighted the level of ignorance among food handlers when handling raw eggs.[11] Over 40 per cent of caterers reported not washing their hands after handling intact shell eggs. Eggs should be included as one of the foodstuffs where thorough handwashing after handling is mandatory, as is the case with raw meat and vegetables. Caterers should be encouraged to opt for the use of pasteurised egg products or egg pulp in the preparation of dishes where the dish is subsequently not cooked or minimally cooked.

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