# Outbreak of *Salmonella* Typhimurium phage type 44 infection among attendees of a wedding reception, April 2009

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## Abstract

On 30 April 2009, the Communicable Disease Control Branch (CDCB) South Australia was notified of a *Salmonella* infection in a person who attended a wedding reception on 25 April 2009. Several other attendees reported becoming unwell with a similar gastrointestinal illness. The CDCB commenced an investigation to: characterise the outbreak in terms of person, place and time; identify probable source or sources; and implement control measures. A retrospective cohort study was undertaken among wedding reception attendees. A questionnaire collecting information on demographics, illness and menu items consumed was given to the majority of attendees. An environmental inspection of the wedding reception premise and food supplier premise, including food sampling was conducted to identify plausible sources of infection. The questionnaire response rate was 77%, from which an attack rate of 20% was calculated. There was a significant association between consumption of garlic aioli and illness (OR 5.4, 95% CI: 1.6, 18.1). Nine wedding reception attendees' stool samples tested positive for *Salmonella* Typhimurium phage type 44. A sample of garlic aioli also tested positive for *Salmonella* Typhimurium phage type 44. The ingredients of the garlic aioli included raw egg yolk, roasted garlic, Dijon mustard, vinegar and vegetable oil. The raw egg yolk was identified as a high risk food item; however no eggs tested positive for *Salmonella*. *Commun Dis Intell* 2011;35(2):192–196.

Keywords: *Salmonella*, outbreak, eggs, garlic aioli, cohort study

## Introduction

*Salmonella* gastroenteritis is characterised by fever, headache, abdominal pain, diarrhoea, nausea and sometimes vomiting.[1] Infection occurs after ingestion of the organism, typically from food derived from infected animals or contaminated by the faeces of an infected animal or human.[1] The incubation period ranges from 6 to 72 hours, however longer incubation periods of up to 16 days have been described associated with low infectious doses.[1]

Salmonellosis is the 2nd most commonly reported notifiable infectious gastrointestinal disease in Australia after campylobacteriosis, with 9,335 cases of *Salmonella* infection recorded by the National Notifiable Diseases Surveillance System (NNDSS) in 2009.[2] The national notification rate of salmonellosis in 2009 was 42.7 per 100 000 population.[2] Within South Australia, in 2009 there were 683 notifications, compared with the 5-year (2004 –2008) mean of 631.[3]

In 2006 and 2005, *S.* Typhimurium 44 was the 7th most common *Salmonella* isolate notified to NNDSS.[4,5] Australia recorded 211 cases in 2006 (16 reported from South Australia) and 228 cases in 2005 (28 reported from South Australia).[4,5]

On 30 April 2009 a doctor contacted the Communicable Disease Control Branch (CDCB) in South Australia to advise that a 24-year-old male patient had been diagnosed with *Salmonella* infection. His onset of illness was 27 April 2009 and he presented with fever, diarrhoea, abdominal cramps and myalgia. The doctor also reported that several other people who had attended the same wedding reception on 25 April 2009 had become unwell with a similar gastrointestinal illness. The *Salmonella* was further characterised as *Salmonella* Typhimurium phage type 44.

As a result of these reports of illness at the wedding reception, an investigation was conducted to characterise the outbreak, identify the source of infection and to prevent further cases of illness.

## Methods

### Epidemiological investigation

A cohort study was initiated to identify the source of infection. The cohort was defined as those who consumed food at the wedding reception at Venue A on Saturday 25 April 2009. A questionnaire for attendees of the wedding reception was developed. The questionnaire sought demographic and illness (prior, during and after the reception) information. It also asked attendees about the consumption of food and drink items at the function. The questionnaire, with an accompanying cover letter explaining the outbreak investigation and a reply-paid envelope, was mailed to the majority of attendees. Those who failed to reply, could not read English, or for whom an address was not supplied, were scheduled to be interviewed by telephone.

The case definition for the outbreak included any person who consumed food at the wedding reception on 25 April 2009 at Venue A and subsequently reported gastrointestinal illness (three or more loose bowel movements in a 24 hour period), or a laboratory confirmed *Salmonella* infection, with an onset on or after 26 April 2009.

The questionnaire data were collated in Microsoft Access 2003 software. Descriptive analysis was conducted using Microsoft Excel 2003 software and Stata 10. Univariate analysis was performed, calculating relative risk and 95% confidence intervals (CI) for individual exposures for illness. A multivariate analysis was conducted using logistic regression to identify independent variables that correlated with illness. All foods from the univariate analysis that had a relative risk of two or greater with the 95% confidence interval not including the null, were added to the model. Statistical analyses were conducted using Stata 10.

### Laboratory investigation

Faecal samples from attendees at the wedding reception that were requested by a medical practitioner were sent to various accredited laboratories in South Australia. On confirmation of a positive *Salmonella* sample, the isolate was then referred to the Australian *Salmonella* Reference Laboratory for further typing.

### Environmental investigation

An environmental inspection of Venue A was conducted by a local council environmental health officer on 30 April and 6 May 2009. The inspection sought details on menu items served, food ingredients, food suppliers and staff illness prior to the function.

Food samples of the garlic aioli served on the night of the wedding, and eggs from Venue A were collected by the environmental health officer and were sent to the Food and Environmental laboratory of the Institute of Medical and Veterinary Science for bacterial testing.

The Food Policy and Programs Branch of the Department of Health also conducted an inspection of the egg and garlic suppliers on 8 May 2009. Food samples of peeled garlic and eggs were collected for bacterial testing.

## Results

### Epidemiological investigation

One hundred and ninety attendees consumed food at the wedding reception at Venue A on 25 April 2009. Completed questionnaires or interviews were obtained from 147 attendees. This represented a response rate of 77%. Of the respondents, 30 met the case definition, representing an attack rate of 20% (30/147) among responders. Dates of onset of illness ranged between 26 April and 3 May 2009 (Figure). The incubation period ranged between 1 day and 8 days (median 2 days).

The median age of wedding reception attendees who consumed food was 33 years (range 2 years to 90 years) with a male to female ratio of 1:1.3. In those who met the case definition, the median age was 30.5 years (range 8 years to 60 years) with a male to female ratio of 1:1.

Diarrhoea was reported in all 30 cases, 10 of these cases reported bloody diarrhoea. Other common symptoms included abdominal pain (77%) and chills (60%). Four people (13%) experienced vomiting.

The analysis identified a significant association between consumption of garlic aioli and prawns and illness (Table 1).

The significant variables of prawns and garlic aioli were added into a multivariate analysis model. The results identified a significant association between the consumption of the garlic aioli and illness (OR 5.4, 95% CI: 1.6, 18.1).

Eight people, two of whom were laboratory confirmed *S.* Typhimurium 44, did not show symptoms during the typical incubation period of 6–72 hours.[1] All of the 8 cases with an onset after 28 April 2009 (i.e. an incubation period of greater than 72 hours) had other household members that attended the same function. Of these, three had family members who had become unwell prior to their own illness. It is possible that the 8 cases were infected by person-to-person transmission from sick or

**Figure: Wedding reception attendees that meet the case definition for gastrointestinal illness, 25 April to 2 May 2009, by date of onset**

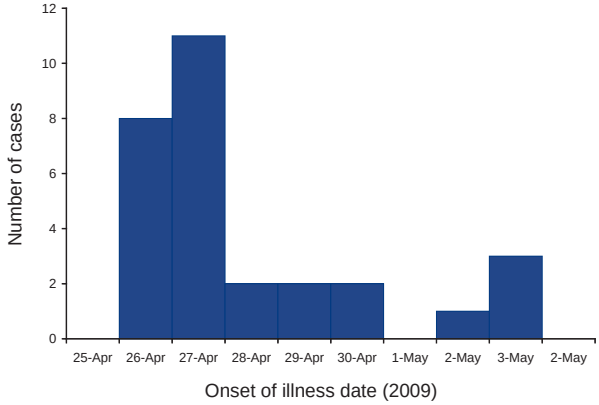

**Table 1: Univariate analysis for a selection of food and drinks consumed exposure status, attack rates and risk ratio analysis**

| | Person who ate item | | | Person who did not eat item | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Food or drink item | Number ill | Total number | Attack rate (%) | Number ill | Total number | Attack rate (%) | Relative risk | 95% CI | *P* value |
| Octopus | 21 | 86 | 24 | 9 | 61 | 15 | 1.66 | 0.8,3.4 | 0.15 |
| Feta | 22 | 89 | 25 | 8 | 58 | 14 | 1.79 | 0.9, 3.8 | 0.11 |
| Prosciutto | 25 | 106 | 24 | 5 | 41 | 12 | 1.93 | 0.8, 4.7 | 0.12 |
| Prawns | 26 | 95 | 27 | 4 | 52 | 8 | 3.56 | 1.3, 9.7 | 0.00 |
| Garlic aioli | 24 | 68 | 35 | 6 | 79 | 8 | 4.64 | 2.0, 10.7 | 0.00 |
| Warm potato and red onion salad | 14 | 78 | 18 | 16 | 69 | 23 | 0.77 | 0.4, 1.5 | 0.43 |
| Sweet potato | 10 | 57 | 18 | 20 | 90 | 22 | 0.79 | 0.4, 1.5 | 0.49 |
| Potato | 8 | 64 | 13 | 22 | 83 | 27 | 0.47 | 0.2, 1.0 | 0.04 |
| Zucchini | 10 | 69 | 14 | 20 | 78 | 26 | 0.57 | 0.3, 1.1 | 0.09 |
| Asparagus | 11 | 64 | 17 | 19 | 83 | 23 | 0.75 | 0.4,1.5 | 0.39 |
| Vegetarian curry with couscous | 0 | 9 | 0 | 30 | 138 | 22 | undefined | undefined | 0.12 |
| Salt | 9 | 34 | 26 | 21 | 113 | 19 | 1.42 | 0.7, 2.8 | 0.31 |
| Wedding cake | 6 | 55 | 11 | 24 | 92 | 26 | 0.42 | 0.2, 1.0 | 0.03 |
| White wine | 14 | 55 | 25 | 16 | 92 | 17 | 1.5 | 0.8, 2.8 | 0.24 |
| Orange juice | 6 | 22 | 27 | 24 | 125 | 19 | 1.4 | 0.7, 3.1 | 0.38 |
| Spirits | 12 | 44 | 27 | 18 | 103 | 17 | 1.6 | 0.8, 3.0 | 0.18 |

CI Confidence interval.

asymptomatic household members. To account for this possibility, the analysis was repeated excluding the 8 cases with onset after the 28 April 2009. The outcome was the same, a significant association being demonstrated between consumption of garlic aioli and illness (RR 4.4, 95% CI: 1.2, 17.0). As the infection could have occurred from low dose ingestion, and the outcome did not change, all cases were included in the final analysis.

### Laboratory investigation

Ten people with gastrointestinal symptoms submitted a stool sample for laboratory testing. Nine specimens were positive for *S*. Typhimurium 44.

### Environmental investigation

Two environmental inspections of Venue A were conducted by the local council environmental health officer on 30 April and 6 May 2009. No issues were noted during these inspections. Hygiene and food handling preparation were found to be of a high standard. No staff members reported illness. The egg samples collected tested negative for *Salmonella*. A sample of garlic aioli that was served on the night of the wedding was positive for *S*. Typhimurium 44.

An inspection of the premises of both the supplier of eggs and of the garlic was conducted by the Food Policy and Programs Branch of the Department of Health. No significant hygiene issues were identified. Samples of peeled garlic and eggs were negative for *Salmonella*. The supplier had inadequate traceability records to confirm the source of the eggs purchased.

## Discussion

The investigation of this outbreak has demonstrated epidemiological and statistical links between illness due to *S*. Typhimurium 44 and consumption of garlic aioli by attendees of a wedding reception. The ingredients in the garlic aioli consisted of raw eggs, vinegar, roasted garlic, mustard and oil.

It is plausible that the raw eggs may have been responsible for the contamination. Eggs have been associated with numerous *Salmonella* outbreaks in Australia.[7–11] An analysis of the OzFoodNet outbreak register data from January 2001 to December 2008 identified 23 outbreaks of *S*. Typhimurium 44 associated with egg consumption.[12] In particular, Victoria has experienced several outbreaks during recent years, predominantly at the end of 2006 and early in 2007. Six of these outbreaks showed a probable association with the consumption of contaminated eggs.[12]

Based upon this evidence the raw egg yolk in the garlic aioli was identified as a high risk food item; however no eggs tested positive for *Salmonella*. To reduce the risk of further infections, it was recommended to the catering company to consider amending their food preparation techniques and use pasteurised eggs instead of raw eggs for products not subject to cooking.

The other ingredients of the garlic aioli, including roasted garlic, Dijon mustard, vinegar and vegetable oil, cannot be excluded as the contaminated food item in the garlic aioli. As the garlic was roasted it reduces the risk of it being the responsible agent. Poor hygiene measures including cross contamination by kitchen staff or an infected food handler also cannot be excluded. The inspection indicated that no staff reported illness and the garlic aioli was appropriately prepared, handled and stored prior to serving.

The raw egg was hypothesised to be the most plausible source of the contamination in the aioli. Further investigations into the eggs could have determined that the other ingredients or cross contamination was even less likely to have caused the outbreak. However, this was not possible as the egg supplier to Venue A did not have adequate traceability records to confirm the source of the eggs purchased. A trace back to the egg farm may have provided further evidence in the investigation e.g. the same *Salmonella* strain could have been found on the farm. This investigation has highlighted the need for improved record keeping and supports the introduction of stamping eggs to allow their source to be identified.

Prawns also had an elevated risk ratio that was statistically significant on univariate analysis. However this was no longer statistically significant once adjustment for consumption of garlic aioli was made during multivariate analysis. It is therefore likely that this apparent association between prawns and illness was due to confounding by garlic aioli consumption as prawns were served with the garlic aioli as a dipping sauce. It is also more plausible that eggs were the source of infection than prawns as a single egg could contaminate the aioli that was served to a number of guests, while a large number of prawns would need to be contaminated in order to cause illness in a group of people.

There was potential for selection bias during the investigation as some attendees did not receive a questionnaire as their address was unknown or they were unable to speak English. Some of these people (16%) were interviewed by telephone, which could have introduced interviewer bias. This was limited by having one interviewer involved in interviewing attendees.

Ten people responded 'unknown' for consumption of aioli. These people may have been unfamiliar with the terminology of 'aioli' and therefore answered unknown, resulting in reporting bias. However this seems less likely given that other food items, including those that are commonly understood, particularly those served as a complement to the main dish e.g. sweet potato, warm potato and red onion salad, and asparagus had a higher 'unknown' response rate (average 18 'unknown').

It is possible that illness affected the likelihood that someone would respond to the questionnaire. Although the attack rate was found to be 20%, as the response rate was 77%, the attack rate could have been as low as 16% or as high as 38% using the extreme assumptions that those of unknown illness status were all not ill or all were ill. However, non-response would only bias the strength or direction of the association between food consumed and illness if the likelihood of responding varied with food consumed, which is less likely.

Individuals who have experienced gastrointestinal symptoms may be more likely to think about the foods eaten prior to the onset of their illness than those unaffected by illness, resulting in recall bias. This could lead to either an underestimation or overestimation of the effect of the association between exposure and disease, depending on whether the cases recall their exposure to a greater or lesser extent than non-cases.

Whilst the investigation could not determine the source of the *Salmonella* in the garlic aioli, the vehicle was successfully identified with both epidemiological and microbiological evidence. Raw eggs, as a high risk food item for *Salmonella* are a plausible cause of the contamination in this outbreak. This outbreak has highlighted the need for more stringent regulations on the production and sale of eggs, including product traceability. Commercial food outlets should reduce the risk to the public and cease serving dishes that contain raw eggs. The public would also benefit from being better informed on the risks of consuming raw egg products.

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