Annual reports

# Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2010

The OzFoodNet Working Group

## Abstract

This report summarises the incidence of diseases potentially transmitted by food in Australia and details outbreaks associated with food in 2010. OzFoodNet sites reported 30,035 notifications of 9 diseases or conditions that are commonly transmitted by food. The most frequently notified infections were *Campylobacter* (16,968 notifications) and *Salmonella* (11,992 notifications). The most frequently notified *Salmonella* serotype was *Salmonella* Typhimurium, accounting for 44% of all *Salmonella* notifications. OzFoodNet sites also reported 1,640 outbreaks of gastrointestinal illness affecting 30,193 people and resulting in 722 people being hospitalised. There were 89 deaths associated with these outbreaks. The majority of outbreaks (81%, 1,330/1,640) were due to person-to-person spread, 9% (154/1,640) were suspected or confirmed to have been transmitted by contaminated food, 9% (155/1,640) had an unknown mode of transmission and 1 outbreak was due to transmission from animal to person. Foodborne and suspected foodborne outbreaks affected 2,146 persons and included 157 hospitalisations. Fifteen deaths were reported during these outbreaks. *Salmonella* was the most common aetiological agent identified in foodborne outbreaks and restaurants were the most frequently reported food preparation setting. A single food source was identified for 43 outbreaks, 21 of which were associated with the consumption of dishes containing raw or minimally cooked eggs; the majority (n=20) due to *S.* Typhimurium. These data assist agencies to document sources of foodborne disease, develop food safety policies, and prevent foodborne illness. *Commun Dis Intell* 2012;36(3):E213–E241.

Keywords: foodborne disease, surveillance, disease outbreak

## Introduction

In Australia, an estimated 5.4 million cases of foodborne disease occur annually, costing an estimated $1.2 billion per year.[1] Many of these illnesses are preventable by appropriate interventions. Foodborne disease surveillance can be used to gather evidence to help inform appropriate control measures.[2] Health departments conduct surveillance for foodborne diseases and diseases potentially transmitted by food to monitor trends in illness, detect outbreaks, inform preventative measures and to evaluate the efficacy of interventions.[3,4]

Most foodborne diseases manifest as mild self-limiting gastroenteritis, with around 20% of affected people seeking medical attention. Consequently, surveillance data collected by health departments underestimate the true burden of disease. In Australia, for every case of salmonellosis notified to a health department there are an estimated 7 infections that occur in the community, while there are approximately 8 cases in the community for every notified case of campylobacteriosis and Shiga toxin-producing *Escherichia coli* (STEC).[5,6]

Public Health authorities use surveillance data to detect outbreaks and clusters of disease. Trends in surveillance data also contribute to the assessment of the efficacy of public health interventions.[7] In Australia, state and territory health departments conduct surveillance for between 10 and 15 different diseases that may be transmitted through food. Most of these diseases are also transmitted by the faecal–oral route and as such may be transmitted by contact with infected animals or people. They may also be transmitted by contaminated food or surfaces, or through the consumption of contaminated water. In addition, health departments collect summary data on notified outbreaks of foodborne diseases, providing robust information on contaminated foods causing illness in Australia.

The Australian Government established OzFoodNet—Australia's enhanced foodborne disease surveillance system—in 2000 to improve national surveillance and conduct applied research into the causes of foodborne illness.[8] OzFoodNet aggregates and analyses national-level information on the incidence of diseases caused by pathogens

commonly transmitted by food, as well as food-borne disease outbreaks. The OzFoodNet network includes collaborators from the Public Health Laboratory Network, Food Standards Australia New Zealand, the Department of Agriculture, Fisheries and Forestry and the National Centre for Epidemiology and Population Health at the Australian National University. OzFoodNet is a member of the Communicable Diseases Network Australia, which is Australia's peak body for communicable disease control.[9] This is the 10th annual report for the OzFoodNet network and summarises the 2010 surveillance data including a comparison with data from previous years.

## Methods

### Population under surveillance

In 2010, the network covered the whole of the Australian population, which was estimated to be 22,342,398 persons.[10]

### Data sources

#### *Notified infections*

All Australian states and territories have public health legislation requiring doctors and pathology laboratories to notify cases of infectious diseases that are important to public health. State and territory health departments record details of notified cases on surveillance databases. These surveillance datasets are aggregated into a national database—the National Notifiable Diseases Surveillance System (NNDSS)—under the auspices of the *National Health Security Act 2007*.[11] In 2010, OzFoodNet aggregated and analysed data from NNDSS and enhanced surveillance data from OzFoodNet sites on the following 9 diseases or conditions, which are commonly transmitted by food:

- non-typhoidal *Salmonella* infections;
- *Campylobacter* infections (except in New South Wales);
- *Listeria* infections;
- *Shigella* infections;
- *Salmonella* Typhi (typhoid) infections;
- hepatitis A infections;
- botulism;
- STEC infections; and
- haemolytic uraemic syndrome (HUS).

There may be differences when comparing OzFoodNet enhanced data state totals and NNDSS derived notifications. This is due to amendments to notification totals by states and territories after the date of data extraction. Also, some jurisdictions report on notification date rather than onset date. Data for this report were extracted from NNDSS in November 2011 and were analysed by the date of diagnosis within the reporting period 1 January to 31 December 2010. Date of diagnosis was derived for each case from the earliest date supplied by the jurisdiction, which could be the date of onset of the case's illness, the date a specimen was collected or the date that a health department received the notification. Estimated resident populations for each state or territory as at June 2010 were used to calculate rates of notified infections.[12]

#### *Enhanced surveillance for listeriosis*

Commencing in 2010, OzFoodNet collected enhanced surveillance data on all notified cases of listeriosis in Australia. This enhanced surveillance system adds to the routinely collected data within NNDSS. It is a centralised national database that includes detailed information regarding the characterisation of *Listeria monocytogenes* isolates by molecular subtyping methods, food histories and exposure data on all notified listeriosis cases in Australia. The overall aim of this enhanced surveillance is to enable timely detection of illness and subsequent public health response. Local public health unit staff interview all cases with a standard national listeriosis questionnaire. Interviews are conducted as individual cases are reported to improve accurate recall of foods consumed during the incubation period. Data are collated nationally via an online open-source database using NetEpi Case Manager. This is a secure web-based reporting system used by OzFoodNet epidemiologists for the enhanced surveillance of listeriosis and multi-jurisdictional outbreaks in Australia. NetEpi allows data to be entered from multiple sites and promotes nationally consistent data collection and analysis by OzFoodNet epidemiologists.

#### *Supplementary surveillance*

OzFoodNet sites collected supplementary data on infections commonly transmitted by food. Information on travel status was collected for cases of *Salmonella* Enteritidis, hepatitis A, *Shigella* and typhoid.

To examine the quality of surveillance data collected across Australia, OzFoodNet sites provided data on the completeness of notification databases for *Salmonella* notifications regarding serotype and phage type. Data from Western Australia were excluded from the analysis of phage type completeness, as pulsed-field gel electrophoresis (PFGE) is used for typing *S.* Typhimurium in that state, and isolates have not been sent routinely for phage typing since June 2007. To assess completeness, data were analysed using the date a notification was received by a health department.

### *Gastrointestinal and foodborne disease outbreaks*

OzFoodNet sites collected summary information on gastrointestinal and foodborne disease outbreaks that occurred in Australia during 2010. An outbreak of foodborne disease was defined as an incident where two or more persons experience a similar illness after consuming a common food or meal and analytical epidemiological and/or microbiological evidence implicated the meal or food as the source of illness. A suspected foodborne outbreak was defined as an incident where two or more persons experience illness after consuming a common meal or food and descriptive epidemiological evidence implicated the meal or food as the suspected source of illness, including outbreaks where food-to-person-to-food transmission is involved. A cluster was defined as an increase in infections that were epidemiologically related in time, place or person where there is no common setting and investigators were unable to implicate a vehicle or determine a mode of transmission.

Summary information for foodborne and suspected foodborne outbreaks has been combined for the analysis. Information collected on each outbreak included the setting where the outbreak occurred, where the food was prepared, the month the outbreak occurred, the aetiological agent, the number of persons affected, the type of investigation conducted, the level of evidence obtained, and the food vehicle responsible for the outbreak. To summarise the data, outbreaks were categorised by aetiological agent, food vehicle and the setting where the implicated food was prepared. Data on outbreaks due to waterborne transmission and data from clusters investigated by jurisdictional health departments were also summarised. The number of outbreaks and documented causes reported here may vary from summaries previously published by individual jurisdictions as these can take time to finalise.

### *Data analysis*

Microsoft Excel and Stata version 10.1 were used for all analyses.

## Results

### Rates of notified infections

In 2010, OzFoodNet sites reported 30,035 notifications of 9 diseases or conditions that are commonly transmitted by food (Table 1), which is an increase compared with the mean of 26,190 notifications per year for the previous 5 years (2005–2009).

### *Salmonella* infections

In 2010, OzFoodNet sites reported 11,992 cases of *Salmonella* infection, a rate of 53.7 cases per 100,000. This was an increase compared with the mean rate for the previous 5 years (41.8 cases per 100,000). Notification rates ranged from 40.6 cases per 100,000 in South Australia to 249.5 cases per 100,000 in the Northern Territory, which usually has the highest rate of salmonellosis. Approximately half (48.7%) of salmonellosis notifications were in males.

Nationally during 2010, the most commonly notified *Salmonella* serotype was *S.* Typhimurium, which was responsible for approximately 44% (5,241/11,992) of all notified *Salmonella* infections (Table 2). The serotype with the largest percentage increase was *S.* Infantis with 2.2 times more notifications nationally in 2010 than in 2009.

### *Completeness of* Salmonella *serotyping and phage typing*

Overall, 97.2% (11,651/11,992) of *Salmonella* notifications contained information about serotype. OzFoodNet monitors the completeness of 6 serotypes that are routinely phage typed: Bovismorbificans; Enteritidis; Hadar; Heidelberg; Typhimurium; and Virchow, in those jurisdictions participating in this typing scheme. In 2010, phage typing was greater than 90% complete for only *S.* Enteritidis (Table 3), and across all 6 serotypes, completeness declined from 93.8% in 2009 to 86.3% in 2010.

### *Salmonella* Enteritidis

*S.* Enteritidis is a globally important *Salmonella* serotype that can infect the internal contents of eggs, but is not endemic in Australian egg layer flocks. To monitor the emergence of this strain in Australia, OzFoodNet conducts enhanced surveillance of locally-acquired infections of *S.* Enteritidis in humans. The majority of cases in Australia are associated with overseas travel.

During 2010, OzFoodNet sites reported 835 cases of *S.* Enteritidis infection (Table 4). Travel histories were obtained for 94.9% of cases in 2010 (792/835), compared with 75% of cases in 2009 (443/591). Of those cases where travel status was reported, 92.9% (736/792) had travelled overseas and cases often reported visiting several countries. Western Australia reported the highest number of notified cases compared with other jurisdictions in 2010 and infection was mainly acquired overseas. Queensland reported the largest number of locally-acquired cases.

Of the cases that were known to have been acquired overseas, 84.9% (625/736) reported travel to South East Asia. Similarly to previous years, the most common country of acquisition for overseas-acquired infections was Indonesia, with 64.3% (473/736) of cases reporting travel there. Malaysia was the second most common country of acquisition with 7.9% (58/736) of all notifications that were known to have been acquired overseas, followed by Thailand with 6.9% (51/736).

## Table 1: Number of notified cases, crude rate and 5-year mean (2005–2009) rate per 100,000 of diseases or infections commonly transmitted by food, Australia, 2010, by disease and state or territory

| Disease | | State or territory | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | Aust |
| *Salmonella* | Notified cases, 2010 | 212 | 3,813 | 573 | 2,928 | 668 | 236 | 2,284 | 1,278 | 11,992 |
| | Crude rate, 2010 | 59.1 | 52.7 | 249.5 | 64.8 | 40.6 | 46.5 | 41.2 | 55.7 | 53.7 |
| | Mean rate, 2005–2009 | 40.7 | 34.3 | 213.9 | 57.9 | 42.6 | 44.1 | 30.7 | 43.0 | 41.8 |
| *Campylobacter** | Notified cases, 2010 | 552 | NN | 166 | 4,789 | 1,770 | 726 | 6,641 | 2,324 | 16,968 |
| | Crude rate, 2010 | 153.8 | NN | 72.3 | 106.0 | 107.6 | 143.0 | 119.7 | 101.2 | 112.3 |
| | Mean rate, 2005–2009 | 121.8 | NN | 117.7 | 105.9 | 139.4 | 129.0 | 113.7 | 102.9 | 113.4 |
| *Listeria* | Notified cases, 2010 | 2 | 26 | 0 | 9 | 1 | 3 | 27 | 3 | 71 |
| | Crude rate, 2010 | 0.6 | 0.4 | 0.0 | 0.2 | 0.1 | 0.6 | 0.5 | 0.1 | 0.3 |
| | Mean rate, 2005–2009 | 0.4 | 0.4 | 0.0 | 0.2 | 0.3 | 0.2 | 0.3 | 0.4 | 0.3 |
| *Shigella* | Notified cases, 2010 | 7 | 118 | 75 | 93 | 54 | 5 | 87 | 113 | 552 |
| | Crude rate, 2010 | 2.0 | 1.6 | 32.7 | 2.1 | 3.3 | 1.0 | 1.6 | 4.9 | 2.5 |
| | Mean rate, 2005–2009 | 1.2 | 1.6 | 70.1 | 2.3 | 4.3 | 0.6 | 1.9 | 6.4 | 3.1 |
| Typhoid | Notified cases, 2010 | 2 | 30 | 2 | 21 | 5 | 1 | 24 | 11 | 96 |
| | Crude rate, 2010 | 0.6 | 0.4 | 0.9 | 0.5 | 0.3 | 0.2 | 0.4 | 0.5 | 0.4 |
| | Mean rate, 2005–2009 | 0.1 | 0.5 | 0.6 | 0.2 | 0.2 | 0.2 | 0.5 | 0.4 | 0.4 |
| Hepatitis A | Notified cases, 2010 | 5 | 83 | 3 | 41 | 4 | 4 | 95 | 32 | 267 |
| | Crude rate, 2010 | 1.4 | 1.1 | 1.3 | 0.9 | 0.2 | 0.8 | 1.7 | 1.4 | 1.2 |
| | Mean rate, 2005–2009 | 1.0 | 1.2 | 9.6 | 1.1 | 1.3 | 0.6 | 2.0 | 1.9 | 1.5 |
| Shiga toxin-producing *Escherichia coli* | Notified cases, 2010 | 0 | 10 | 0 | 17 | 33 | 0 | 12 | 8 | 80 |
| | Crude rate, 2010 | 0.0 | 0.1 | 0.0 | 0.4 | 2.0 | 0.0 | 0.2 | 0.3 | 0.4 |
| | Mean rate, 2005–2009 | 0.1 | 0.3 | 0.6 | 0.5 | 2.7 | 0.1 | 0.2 | 0.2 | 0.5 |
| Haemolytic uraemic syndrome | Notified cases, 2010 | 0 | 3 | 0 | 3 | 0 | 0 | 3 | 0 | 9 |
| | Crude rate, 2010 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| | Mean rate, 2005–2009 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 |

* *Campylobacter* is notifiable in all jurisdictions except New South Wales.

## Table 2: Number, rate and proportion of the top 5 *Salmonella* infections, Australia, 2010, by serotype

| Serotype | n | Rate* | %† | Ratio‡ |
|---|---|---|---|---|
| *S.* Typhimurium | 5,241 | 23.5 | 44 | 1.3 |
| *S.* Enteritidis | 836 | 3.7 | 7 | 1.0 |
| *S.* Virchow | 571 | 2.6 | 5 | 1.9 |
| *S.* Saintpaul | 422 | 1.9 | 4 | 1.0 |
| *S.* Infantis | 323 | 1.4 | 3 | 2.2 |

* Rate per 100,000.

† Proportion of total *Salmonella* notified in 2010.

‡ Ratio of the number of cases in 2010 compared with the number in 2009.

## Table 3: Percentage of *Salmonella* notifications with phage type information available for 6 serotypes notified to state and territory health departments, Australia, 2007 to 2010

| *Salmonella* serotype | 2007* % | 2008 % | 2009 % | 2010 % |
|---|---|---|---|---|
| *S.* Bovismorbificans | 100.0 | 87.0 | 84.7 | 75.0 |
| *S.* Enteritidis | 97.0 | 91.7 | 91.6 | 94.8 |
| *S.* Hadar | 87.5 | 87.5 | 80.8 | 63.4 |
| *S.* Heidelberg | 90.2 | 80.5 | 75.0 | 64.9 |
| *S.* Typhimurium | 99.3 | 97.6 | 94.8 | 87.3 |
| *S.* Virchow | 97.2 | 95.0 | 91.0 | 74.4 |

* Routine phage typing ceased in Western Australia in June 2007 and is not included in data from 2007 onwards.

### Table 4: Number of *Salmonella* Enteritidis infections, Australia, 2010, by travel history and state or territory

| | Locally-acquired | Overseas-acquired | Unknown | Total |
|---|---|---|---|---|
| ACT | 0 | 14 | 3 | 17 |
| NSW | 12 | 133 | 3 | 148 |
| NT | 1 | 9 | 5 | 15 |
| Qld | 24 | 66 | 27 | 117 |
| SA | 3 | 54 | 1 | 58 |
| Tas | 0 | 6 | 0 | 6 |
| Vic | 8 | 129 | 2 | 139 |
| WA | 8 | 325 | 2 | 335 |
| Total | 56 | 736 | 43 | 835 |

Amongst locally-acquired *S.* Enteritidis cases in 2010, the most common phage types were 26, 13 and 6A (Table 5).

Phage types 26 and 6A have been the most common amongst locally-acquired cases since 2007. However, in 2010 phage type 13 was the second most commonly reported phage type. There was only 1 notified case of locally-acquired phage type 13 reported in 2008 (Figure 1).

### Table 5: Number and percentage of the top 3 phage types and those where typing information was unknown of locally-acquired cases of *Salmonella* Enteritidis, Australia, 2010

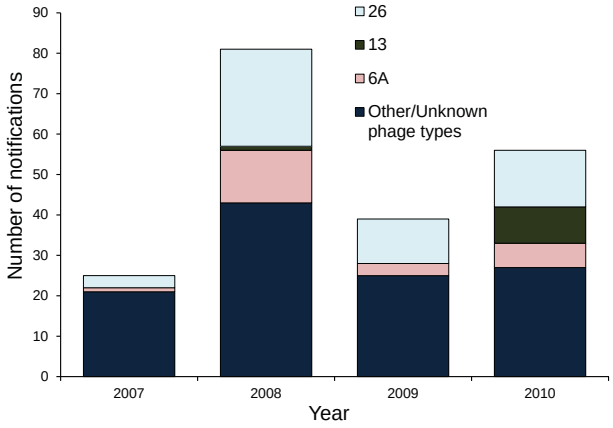
| Phage type | n | %* |
|---|---|---|
| 26 | 14 | 25.0 |
| 13 | 9 | 16.1 |
| 6A | 6 | 10.7 |
| Unknown | 4 | 7.1 |
| Untypable | 3 | 5.4 |

* Proportion of total locally-acquired *Salmonella* Enteritidis (56) notified in 2010.

### *Campylobacter* infections

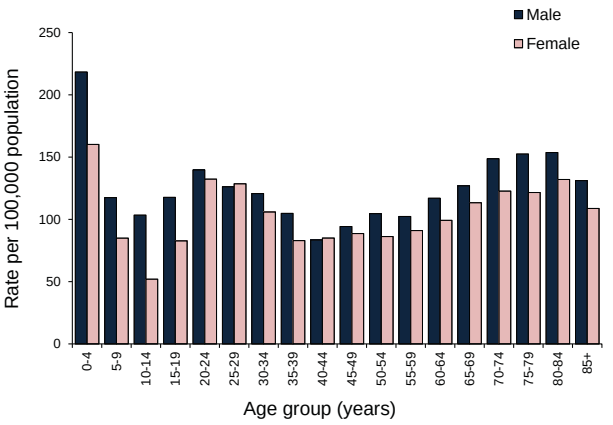
In 2010, OzFoodNet sites (excluding New South Wales) reported 16,968 cases of *Campylobacter* infection; a rate of 112.3 cases per 100,000 (Table 1). The lowest and highest rates of *Campylobacter* infection were in the Northern Territory (72.3 cases per 100,000) and in the Australian Capital Territory (153.8 cases per 100,000) respectively.

### Figure 1: Number of notifications of the top 3 phage types (2010) of locally-acquired cases of *Salmonella* Enteritidis, Australia, 2007 to 2010




Overall, 54 per cent of notified cases were in males, consistent with previous years. In 2010, notification rates were highest in children aged 0–4 years for both males and females (218.3 and 160.2 notifications per 100,000, respectively) with additional peaks in the 20–24 and 80–84 years age groups (Figure 2).

### Figure 2: Notification rates for campylobacteriosis, Australia, 2010, by age group and sex




### *Listeria* infections

OzFoodNet sites reported 71 cases of *Listeria monocytogenes* infection in 2010, a rate of 0.3 cases per 100,000, which is consistent with the 5-year historical mean of 0.3 cases per 100,000 (65 cases) (Table 1). The 2010 notifications included a multi-jurisdictional outbreak linked to melons that affected at least 9 people. This outbreak is discussed later in this report.

Seventy-six per cent (54/71) of notifications in 2010 were in people aged 60 years or more and males accounted for 54% (38/71) of all notifications. Twenty-one per cent of cases died in 2010 (15/71). There was 1 materno-foetal case in 2010, which was not fatal.

The most commonly reported strain of *Listeria monocytogenes* was serotype 1/2b, 3b, 7 binary type 158 (24%, 17/71) (Table 6).

### Table 6: Top 4 listeriosis strains – molecular serotype and binary type, Australia, 2010

| Serotype | Binary type | n |
|---|---|---|
| 1/2b, 3b, 7* | 158* | 17 |
| 4b, 4d, 4e | 254 | 10 |
| 1/2a,3a | 155 | 6 |
| 1/2b, 3b, 7 | 159 | 4 |

Source: OzFoodNet Enhanced National Listeriosis Surveillance System

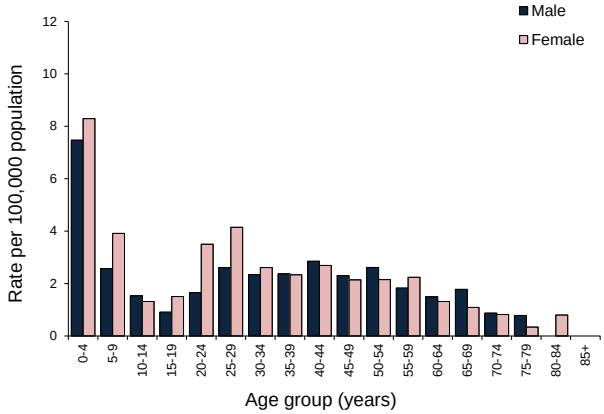
* This strain was associated with the *Listeria* outbreak discussed later in this report.

## *Shigella* infections

There were 552 notifications of *Shigella* infection in Australia in 2010, a rate of 2.5 notifications per 100,000 compared with a mean of 655 cases (3.1 notifications per 100,000) per year between 2005 and 2009.

In 2010, notification rates for shigellosis were highest in males and females aged 0–4 years, with 7.5 and 8.3 notifications per 100,000 respectively (Figure 3). The overall rate for males decreased from 3.4 notifications per 100,000 in 2009 to 2.3 in 2010. This decrease was most prominent in the 0–4, and 20–44 year age groups.

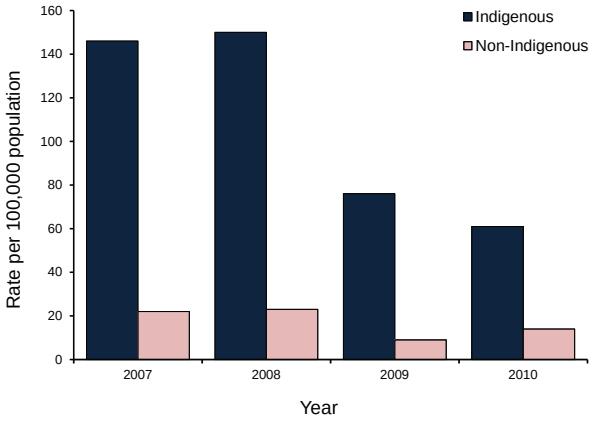
### Figure 3: Notification rates for shigellosis, Australia, 2010, by age and sex




As in previous years, the highest notification rate was in the Northern Territory, with 32.7 cases per 100,000 and a decline compared with an average of 70.1 cases per 100,000 between 2005 and 2009. One factor that may have influenced the decline in cases of shigellosis in the Northern Territory since 2008 (Figure 4) was the 'No germs on me' campaign, first implemented in October 2007. This social marketing campaign targeted remote communities and Indigenous people to raise awareness about the importance of hand washing. An urban campaign was implemented in October 2008, which primarily targeted the non-Indigenous population.

The most frequently reported *Shigella* biotype in 2010 was *S. sonnei* biotype g, followed by *S. sonnei* biotype a. Together these biotypes accounted for 55.6% of all *Shigella* infections reported in 2010 (Table 7).

### Figure 4: Notification rates for shigellosis, Northern Territory, 2007 to 2010, by Indigenous status




## Typhoid

In 2010, there were 96 cases of *Salmonella* Typhi infection (typhoid) in Australia, a rate of 0.4 cases per 100,000, the same as the 5 year mean between 2005 and 2009 (Table 1). In 2010, 42.7% (41/96) of cases were female and cases were reported from all Australian states and territories. Travel status was known for 99.0% (95/96) of cases, with 93 cases reporting infections likely to be acquired overseas.

India was the most frequently reported country of travel for overseas-acquired cases of typhoid in 2010, with 52.7% (49/93) of cases. E1 was the most common phage type for typhoid cases with a known travel status (Table 8).

## Table 7: Number, percentage and ratio of the top 10 *Shigella* infections, Australia, 2009 to 2010

| Biotype | 2009 n | 2009 %* | 2010 n | 2010 %† | Ratio‡ |
|---|---|---|---|---|---|
| *Shigella sonnei* biotype g | 207 | 33.3 | 191 | 34.6 | 0.9 |
| *Shigella sonnei* biotype a | 119 | 19.2 | 116 | 21.0 | 1.0 |
| *Shigella flexneri* 4a | 33 | 5.3 | 38 | 6.9 | 1.2 |
| *Shigella flexneri* 3a | 44 | 7.1 | 37 | 6.7 | 0.8 |
| *Shigella flexneri* 2a | 38 | 6.1 | 36 | 6.5 | 0.9 |
| *Shigella sonnei* untyped | 56 | 9.0 | 32 | 5.8 | 0.6 |
| *Shigella flexneri* 4 | 24 | 3.9 | 22 | 4.0 | 0.9 |
| *Shigella flexneri* 2b | 10 | 1.6 | 18 | 3.3 | 1.8 |
| *Shigella flexneri* untyped | 21 | 3.4 | 13 | 2.4 | 0.6 |
| *Shigella flexneri* 6 | 8 | 1.3 | 11 | 2.0 | 1.4 |

* Proportion of total *Shigella* notified in 2009.

† Proportion of total *Shigella* notified in 2010.

‡ Ratio of the number of cases in 2010 compared with the number in 2009.

## Table 8: *Salmonella* Typhi phage types acquired overseas from cases notified in 2010

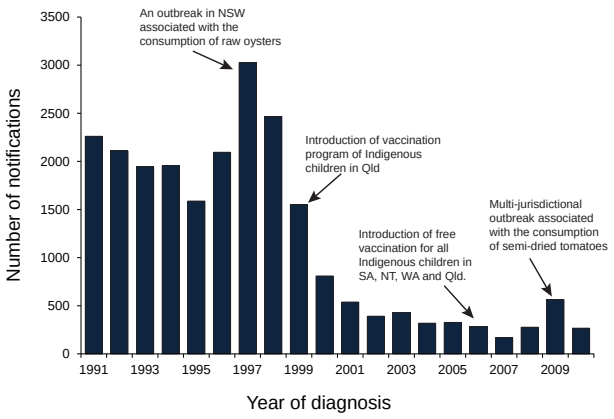
| Pace of acquisition | Phage type | n |
|---|---|---|
| India | Unknown | 17 |
| | E1 | 15 |
| | Untypable | 9 |
| | E9 | 5 |
| | J1 | 2 |
| | A | 1 |
| Bangladesh | Unknown | 5 |
| | Untypable | 1 |
| | E9 | 3 |
| | 46 VAR | 3 |
| Other countries | Unknown | 10 |
| | E1 | 8 |
| | D2 | 5 |
| | E9 | 2 |
| | Untypable | 3 |
| | 40 | 1 |
| | A | 1 |
| | D1 | 1 |
| | O VAR | 1 |
| Total | | 93 |

### Hepatitis A

The number of hepatitis A cases in Australia in recent years has decreased markedly from over 2,000 cases per year during the 1990s to a mean of 323 cases per year between 2005 and 2009 (1.5 cases per 100,000) (Figure 5). In 2010, the number of hepatitis A notifications decreased to 267 (1.2 cases per 100,000) from 564 cases (2.6 cases per 100,000) in 2009. The majority of cases notified in 2009 were part of a large outbreak of locally-acquired hepatitis A associated with the consumption of semi-dried tomatoes. This outbreak occurred over a 12 month period between 1 March 2009 and 18 March 2010.[13,14]

Indigenous status was known for 94.0% (251/267) of cases in 2010 (Table 9). In 2010, 1 case was identified as Indigenous (0.4%), similar to the small percentages reported between 2007 and 2009, and a decrease compared with 10%–15% (28–49 cases) per year between 2004 and 2006. This marked decrease in the past 4 years in the number and proportion of cases who are Indigenous is likely due to targeted vaccination programs. The first state program for Indigenous children commenced in Queensland in 1999.[15] The Commonwealth Government expanded the program by providing free hepatitis A vaccine for all Indigenous

## Figure 5: Notifications of hepatitis A infections, Australia, 1991 to 2010, by year of diagnosis



children aged up to 5 years living in Queensland, the Northern Territory, Western Australia and South Australia from 1 November 2005.[16]

In 2010, the number of locally-acquired hepatitis A cases was similar to the numbers prior to the multi-jurisdiction outbreak of 2009, with 43.8% (117/267) of cases. The number of cases reported as overseas acquired in 2010 increased to 55.1% (147/267) of all cases being locally acquired (Table 10). Overseas-acquired cases most frequently reported travel to the South Asian and Polynesian regions. Fiji (22/147) and India (21/147) were the most frequently reported countries of travel.

### Table 9: Hepatitis A notifications, Australia, 2004 to 2010, by Indigenous status

| | Indigenous | | Non-Indigenous | | Unknown | |
|---|---|---|---|---|---|---|
| Year | n | %* | n | %* | n | %* |
| 2004 | 37 | 11.6 | 251 | 78.7 | 31 | 9.7 |
| 2005 | 49 | 15.0 | 232 | 70.9 | 46 | 14.1 |
| 2006 | 28 | 10.0 | 219 | 77.9 | 34 | 12.1 |
| 2007 | 0 | 0.0 | 148 | 89.7 | 17 | 10.3 |
| 2008 | 3 | 1.1 | 247 | 89.2 | 27 | 9.7 |
| 2009 | 8 | 1.4 | 515 | 91.3 | 41 | 7.3 |
| 2010 | 1 | 0.4 | 250 | 93.6 | 16 | 6.0 |

* Proportion of total hepatitis A cases notified in that year.

### Table 10: Place of acquisition for cases of hepatitis A, 2004 to 2010, Australia

| | Locally-acquired | | Overseas-acquired | | Unknown | |
|---|---|---|---|---|---|---|
| Year | n | %* | n | %* | n | %* |
| 2004 | 143 | 44.8 | 91 | 28.5 | 85 | 26.6 |
| 2005 | 140 | 42.8 | 151 | 46.2 | 36 | 11.0 |
| 2006 | 102 | 36.3 | 69 | 24.6 | 110 | 39.1 |
| 2007 | 74 | 44.8 | 38 | 23.0 | 53 | 32.1 |
| 2008 | 99 | 35.7 | 53 | 19.1 | 125 | 45.1 |
| 2009 | 417† | 73.9 | 68 | 12.1 | 79 | 14.0 |
| 2010 | 117 | 43.8 | 147 | 55.1 | 3 | 1.1 |

* Proportion of total hepatitis A notified in that year.

† High proportion of locally-acquired hepatitis A cases in 2009 due to outbreak associated with the consumption of semi-dried tomatoes.

## Botulism

There were no cases of botulism reported in 2010. The most recent notified case was reported in 2009.[14]

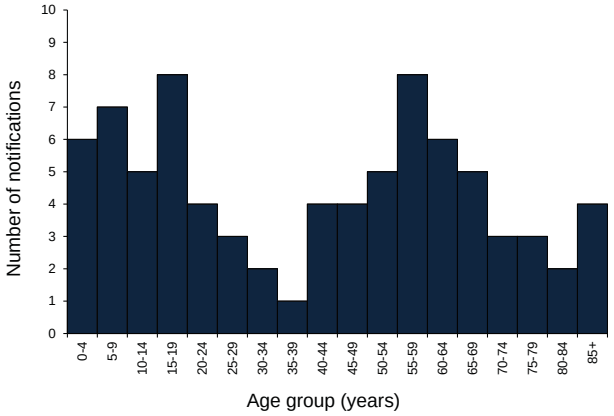
## Shiga toxin-producing *Escherichia coli* infection

In 2010, there were 80 notifications of STEC in Australia, a rate of 0.4 cases per 100,000 compared with a mean of 0.5 cases per 100,000 between 2005 and 2009 (Table 1). These numbers include a case of HUS where an STEC organism was isolated. Under the Australian National Notifiable Disease Surveillance System surveillance case definitions, these are notified separately.[17] There were no cases of STEC in the Australian Capital Territory, the Northern Territory or Tasmania in 2010.

Notified cases of STEC infection are strongly influenced by jurisdictional practices regarding the screening of stool specimens.[18] In particular, South Australia routinely tests all bloody stools and use polymerase chain reaction (PCR) for genes coding for Shiga toxins for diagnosis, making rates for this State the highest in the country. In 2009, Queensland changed its screening procedures resulting in all stool specimens submitted for STEC testing being screened for the presence of Shiga toxins using an enzyme immunoassay (EIA – Premier EHEC, Meridian BioScience) method in conjunction with PCR. Cases identified through the EIA method do not meet the surveillance case definition, therefore these cases were classified as 'probable'. These probable cases (EIA positive only; PCR and/or culture negative) are not notified to the NNDSS.[19]

In 2010, 61.3% of cases were females (49/80). The median age of cases was 44 years (range 1–98 years) (Figure 6).

### Figure 6: Notifications of Shiga toxin-producing *Escherichia coli*, Australia, 2010, by age group




In 2010, serotype O157 accounted for 58.8% (30/51) of STEC cases with available serotype information (obtained by serotyping cultured isolates or by

PCR targeting serotype-specific genes), followed by O111 (5 cases, 9.8%). A serotype was not identified in 36% (29/80) of cases. This is consistent with the serogroups reported in 2009.

### Haemolytic uraemic syndrome

In 2010, OzFoodNet sites reported 9 cases of HUS (Table 1), compared with a mean of 20 cases per year between 2005 and 2009. Similarly to previous years, the majority of notifications were in children, with 66.7% (6 cases) of cases aged 0–4 years.

Not all diagnoses of HUS are related to enteric pathogens (including those potentially transmitted by food), but in Australia, cases are commonly associated with STEC. In 2010 however, an antecedent STEC infection was reported in only 1 case. In 5 cases *Streptococcus pneumoniae* was detected and for the remaining 3 cases no organism was identified as the causative agent.

### Outbreaks of gastrointestinal illness

In 2010, OzFoodNet sites reported 1,640 outbreaks of gastrointestinal illness (including foodborne disease), affecting 30,193 people, of whom 722 were hospitalised (Table 11). There were 89 deaths during these outbreaks. This compares with a 5 year mean of 1,483 outbreaks.

### Person-to-person outbreaks

In 2010, 81% of reported outbreaks were transmitted from person-to-person. There were 26,661 illnesses associated with these outbreaks, 519 people were hospitalised and 71 people died. Outbreaks were most commonly reported from aged care facilities (57%, 752/1,330) or child-care centres (22%, 297/1,330). Outbreaks were most commonly due to norovirus (42%, 564/1,330) or were of unknown aetiology (36%, 485/1,330).

### Animal-to-person outbreaks

One outbreak was reported to have been due to animal-to-person transmission. The outbreak affected 10 children in a child-care centre following a visit to a farm, and was caused by *Cryptosporidium* sp.

### Outbreaks with unknown mode of transmission

There were 155 outbreaks in which cases were clustered in time, place or person, but investigators were unable to determine the mode of transmission (Table 11). These outbreaks affected 1,376 people, 45 of whom were hospitalised and three died. Outbreaks were most commonly reported from aged care facilities (50%, 78/155), the community (11%, 17/155) and child-care centres (10%, 15/155). *Salmonella* was the aetiological agent in 15 of these outbreaks and norovirus in 15 outbreaks. In 118 outbreaks (76%), both the aetiology and the transmission mode remain unknown.

### Foodborne outbreaks

In 2010, OzFoodNet sites reported 154 outbreaks of foodborne and suspected foodborne illness. These outbreaks affected 2,146 people, of whom 157 were hospitalised and 15 died (Table 11). This compares with a 5 year mean of 127 outbreaks. The overall rate of foodborne disease outbreaks in 2010 was 6.9 per million population (Table 12). The highest rates were in the Northern Territory (30.5 per million) and Tasmania (11.8 per million), although these jurisdictions reported only 7 and 6 outbreaks respectively. The largest number of outbreaks was reported from New South Wales (55 outbreaks).

#### *Aetiologies*

More than one-third of all foodborne and suspected outbreaks (34%, 53/154) were due to *S.* Typhimurium. Other frequently reported aetiologies were *Campylobacter* and *Clostridium perfringens*

**Table 11: Outbreaks of gastroenteritis reported to state and territory health departments, Australia, 2010**

| Transmission mode | Number of outbreaks | Number ill | Number hospitalised | Number died |
|---|---|---|---|---|
| Foodborne and suspected foodborne | 154 | 2,146 | 157 | 15 |
| Person-to-person | 1,330 | 26,661 | 519 | 71 |
| Animal-to-person | 1 | 10 | 1 | 0 |
| Unknown mode (*Salmonella* cluster) | 15 | 87 | 12 | 0 |
| Unknown mode (other pathogen) | 22 | 251 | 15 | 0 |
| Unknown mode (unknown pathogen) | 118 | 1,038 | 18 | 3 |
| Total | 1,640 | 30,193 | 722 | 89 |

## Table 12: Outbreaks of foodborne disease, Australia, 2010, by OzFoodNet site

| State or territory | Number of outbreaks | Number ill | Mean size (persons) | Number hospitalised | Outbreaks per million population |
|---|---|---|---|---|---|
| ACT | 3 | 59 | 19.7 | 5 | 8.4 |
| NSW | 55 | 641 | 11.7 | 80 | 7.6 |
| NT | 7 | 121 | 17.3 | 4 | 30.5 |
| Qld | 23 | 184 | 8.0 | 13 | 5.1 |
| SA | 8 | 134 | 16.8 | 6 | 4.9 |
| Tas | 6 | 157 | 26.2 | 2 | 11.8 |
| Vic | 39 | 399 | 10.2 | 30 | 7.0 |
| WA | 11 | 128 | 11.6 | 9 | 4.8 |
| Multi-jurisdictional | 2 | 323 | 161.5 | 8 | N/A |
| Total | 154 | 2,146 | 13.9 | 157 | 6.9 |

(6% each, 9/154) (Table 13). More than a third of all outbreaks were of unknown aetiology (36%, 55/154) compared with 27% (44/163) in 2009.

### *Food vehicles*

Outbreaks were categorised as being attributable to one of 18 foods (17 described by Painter et al[20] with an additional category for lamb) if a single contaminated ingredient was identified or if all ingredients belonged to that food category. Outbreaks that could not be assigned to one of the 18 categories, or for which the report contained insufficient information for food category assignment were not attributed to any food category.[21]

In 43 foodborne outbreaks (28%), investigators attributed the outbreak to a single food (Table 13),

## Table 13: Number of reported foodborne disease outbreaks and number affected, Australia, 2010, by aetiology and food category

| Agent category | Total number of outbreaks | Total number ill | Attributed to a single food category | | Attributed to >1 food category | | Not attributed to a food category | |
|---|---|---|---|---|---|---|---|---|
| | | | Number of outbreaks | Number ill | Number of outbreaks | Number ill | Number of outbreaks | Number ill |
| *Salmonella* Typhimurium | 53 | 746 | 23 | 416 | 10 | 169 | 20 | 161 |
| *Clostridium perfringens* | 10 | 134 | 1 | 4 | 0 | 0 | 9 | 130 |
| *Campylobacter* | 9 | 103 | 2 | 15 | 1 | 18 | 6 | 70 |
| Ciguatera fish poisoning | 6 | 22 | 6 | 22 | 0 | 0 | 0 | 0 |
| Norovirus | 8 | 117 | 0 | 0 | 1 | 17 | 7 | 100 |
| Other *Salmonella* serotypes | 5 | 47 | 2 | 31 | 1 | 7 | 2 | 9 |
| *Listeria monocytogenes* | 2 | 15 | 1 | 9 | 1 | 6 | 0 | 0 |
| *Staphylococcus aureus* | 2 | 9 | 2 | 9 | 0 | 0 | 0 | 0 |
| *Cyclospora* sp. | 1 | 314 | 0 | 0 | 0 | 0 | 1 | 314 |
| *Bacillus cereus* | 1 | 24 | 1 | 24 | 0 | 0 | 0 | 0 |
| Scrombroid confirmed | 1 | 4 | 1 | 4 | 0 | 0 | 0 | 0 |
| Other viral | 1 | 19 | 0 | 0 | 0 | 0 | 1 | 19 |
| Unknown | 55 | 592 | 4 | 21 | 9 | 88 | 42 | 483 |
| Total | 154 | 2,146 | 43 | 555 | 23 | 305 | 88 | 1,286 |

in another 23 outbreaks (15%), the implicated dish contained a mix of ingredients, and no single ingredient was implicated. The majority of outbreaks (57%, 88/154) could not be attributed to a particular food due to a lack of evidence.

In outbreaks attributed to a single food (n=43), the foods most frequently implicated were eggs (49%, 21/43), fish (19%, 8/43), poultry (9%, 4/43) and fruits/nuts (7%, 3/43). In these outbreaks, 71% of those affected were in outbreaks involving eggs (394/555) whilst outbreaks involving poultry accounted for a further 8% (45/555) of cases.

Nearly one-third of foodborne outbreaks with a known food vehicle (32%, 21/66) were suspected or confirmed to have been associated with the consumption of eggs and egg-based dishes (Table 14). These egg-associated outbreaks comprised 14% (21/154) of all foodborne outbreaks, 36% (21/58) of all *Salmonella* outbreaks and 49% (21/43) of the outbreaks that were attributed to a single commodity. In these outbreaks, eggs were served as a whole food (4 outbreaks), in sauces and dressings such as hollandaise and aioli (8 outbreaks), in desserts (6 outbreaks), in a milkshake (1 outbreak), in salads or wraps (1 outbreak) and as a binding ingredient of salmon patties (1 outbreak). Investigators frequently reported that eggs and egg-based dishes included

**Table 14: Outbreaks of foodborne illness associated with egg-based dishes (n=21), Australia, 2010**

| State or territory | Setting prepared | Aetiology | Number affected | Evidence | Food vehicle |
|---|---|---|---|---|---|
| ACT | Private residence | *S.* Typhimurium 170/108* | 4 | D | Chocolate mousse |
| NSW | Private residence | *S.* Typhimurium 170/108 | 5 | D | Suspected mayonnaise prepared with raw eggs |
| | Private residence | *S.* Typhimurium 170/108 | 9 | D | Suspected raw eggs contained in one batch of individual servings of tiramisu |
| | Private residence | *S.* Typhimurium 170/108 | 9 | D | Suspected mousse cake with raw eggs |
| | Restaurant | *S.* Typhimurium 170/108 | 2 | D | Suspected salmon patties made with egg |
| | Restaurant | *S.* Typhimurium 170/108 | 6 | M | Tartare sauce prepared with raw egg |
| | Restaurant | *S.* Typhimurium 170/108 | 14 | M | Fried ice cream |
| | Restaurant | *S.* Typhimurium 9 | 168 | A | Aioli prepared with raw egg |
| | Takeaway | *S.* Singapore | 5 | D | Suspect foods containing eggs (egg and salad wrap, egg salad) |
| | Takeaway | *S.* Typhimurium 170/108 | 9 | M | Mayonnaise made with raw egg |
| Qld | Private residence | *S.* Typhimurium | 4 | D | Banana milkshake containing raw egg |
| | Restaurant | *S.* Typhimurium 135a | 34 | AM | Citrus aioli containing raw egg |
| | Restaurant | *S.* Typhimurium 170/108 | 3 | M | Deep fried ice cream |
| Tas | Restaurant | *S.* Typhimurium 170/108 | 43 | A | Homemade ice cream |
| Vic | Private residence | *S.* Typhimurium 170/108 | 4 | M | Eggs (fried soft) |
| | Private residence | *S.* Typhmurium 170/108 | 12 | D | Raw egg mayonnaise |
| | Restaurant | *S.* Typhmurium 9 | 8 | D | Suspected eggs |
| | Restaurant | *S.* Typhmurium 9 | 10 | D | Hollandaise sauce |
| | Restaurant | *S.* Typhmurium 9 | 13 | D | Uncooked egg |
| WA | Restaurant | *S.* Typhimurium 170/108 | 7 | D | Scrambled eggs |
| | Restaurant | *S.* Typhimurium 170/108 | 25 | D | Aioli and Caesar salad |

Evidence

D Descriptive evidence implicating the vehicle

A Analytical epidemiological association between illness and vehicle

M Microbiological confirmation of aetiology in vehicle and cases.

* Classification of this phage type differs between laboratories, with the Institute of Medical and Veterinary Science using phage type 108 to classify this type of *S.* Typhimurium and Microbiological Diagnostic Unit using phage type 170 due to a difference in the interpretation of 1 phenotypic characteristic.

raw eggs and/or were insufficiently cooked (95%, 20/21). In 8 of these outbreaks, eggs were confirmed as the source of illness through microbiological or analytical evidence or both, whilst in the remaining 13 outbreaks, eggs were suspected as the food vehicle due to descriptive evidence collected during the course of the outbreak.

### *Settings*

Implicated foods were most commonly prepared in restaurants (39%, 60/154), in aged care facilities (21%, 33/154), private residences (9%, 14/154) or at takeaway premises (8%, 12/154) (Table 15).

### *Evidence*

To investigate these outbreaks, state and territory investigators conducted 23 retrospective cohort studies and 3 case-control studies (including 1 outbreak for which both a case-control study and a retrospective cohort study were conducted) (Appendix). Descriptive case series were collected for a further 100 outbreaks. In 29 outbreaks, no individual patient data were collected.

For 1 outbreak, there was an analytical association between illness and the implicated food as well as microbiological evidence of the aetiological agent in the epidemiologically implicated food. Investigators relied on analytical evidence alone for 24 outbreaks and microbiological (or toxicological for non-microbial outbreaks) evidence alone for 18 outbreaks. These confirmed outbreaks comprised 28% (43/154) of all foodborne outbreaks.

### *Contributing factors*

Investigators collect information about factors that are likely to have contributed to a foodborne outbreak occurring. Contributing factors may be based on measured evidence, inspections, interview data, observations or investigator suspicion. Contamination factors are those contributing factors that led to the food becoming contaminated or to contaminated products being consumed. Contamination factors for confirmed foodborne outbreaks were most commonly stated to have been unknown (42%, 18/43) (Table 16). Contamination factors varied by the aetiology of outbreaks. In norovirus outbreaks, investigators reported that person-to-food-to-person transmission (2/3) and foodhandler contamination (1/3) were involved, while for *S.* Typhimurium outbreaks, ingestion of raw products (8/18) and cross-contamination from raw ingredients (4/18) were reported.

### *Significant outbreaks and multi-jurisdictional outbreaks investigated*

In 2010, there were 8 outbreaks that each affected more than 40 people. Four outbreaks were due to *S.* Typhimurium, one was due to *Cyclospora cayetanensis* (a multi-jurisdictional outbreak) and 3 outbreaks were of unknown aetiology. These out-

**Table 15: Food preparation setting implicated in disease outbreaks, Australia, 2010**

| Setting | Number of outbreaks | Per cent of outbreaks | Number affected |
|---|---|---|---|
| Restaurant | 60 | 39 | 842 |
| Aged care | 33 | 21 | 425 |
| Private residence | 14 | 9 | 93 |
| Takeaway | 12 | 8 | 156 |
| Primary produce | 5 | 3 | 25 |
| Commercial caterer | 4 | 3 | 40 |
| Institution | 4 | 3 | 35 |
| Camp | 3 | 2 | 62 |
| Other | 5 | 3 | 56 |
| Unknown | 3 | 2 | 16 |
| Fair/festival/mobile service | 2 | 1 | 10 |
| National franchised fast food | 2 | 1 | 10 |
| Bakery | 2 | 1 | 13 |
| Commercially manufactured | 1 | 1 | 3 |
| Cruise/airline | 1 | 1 | 314 |
| Military | 1 | 1 | 21 |
| Picnic | 1 | 1 | 6 |
| School | 1 | 1 | 19 |
| Total | 154 | 100 | 2,146 |

**Table 16: Factors reported as leading to the contamination of food vehicles in confirmed foodborne disease outbreaks, Australia, 2010, by aetiology**

| Agent | Contamination factor | Total |
|---|---|---|
| *Bacillus cereus* | unknown | 1 |
| *Campylobacter* | unknown | 1 |
| | ingestion of contaminated raw products | 1 |
| *Clostridium perfringens* | not applicable | 1 |
| *Cyclospora* sp. | ingestion of contaminated raw products | 1 |
| *Listeria monocytogenes* | unknown | 1 |
| | ingestion of contaminated raw products | 1 |
| Norovirus | Person-to-food-to-person | 2 |
| | food handler contamination | 1 |
| Other *Salmonella* serotypes | cross contamination from raw ingredients | 1 |
| *Salmonella* Typhimurium | ingestion of contaminated raw products | 8 |
| | unknown | 5 |
| | cross-contamination from raw ingredients | 4 |
| | other source of contamination | 1 |
| Scombroid | not applicable | 1 |
| *Staphylococcus aureus* | other source of contamination | 1 |
| | inadequate cleaning of equipment | 1 |
| Unknown | unknown | 10 |
| | poisonous substance | 1 |
| Total | | 43 |

breaks affected at least 687 people of whom 34 were hospitalised. There were no reported deaths. Two multi-jurisdictional outbreaks were investigated; an outbreak of listeriosis affecting 9 people, and the *Cyclospora* outbreak noted above.

An outbreak of *S.* Typhimurium 170/108 in Tasmania in December was linked to the consumption of restaurant prepared ice cream containing raw egg yolk. There were 19 microbiologically confirmed cases linked to the outbreak and at least 2 people were hospitalised. Of those initially contacted, 38/70 (54%) reported symptoms and investigations identified a further 5 cases. The attack rate among interviewees who had eaten ice cream was 100%. Approximately 400 diners ate at the restaurant over the 5 day risk period and many consumed ice cream. A sample of ice cream tested positive for *S.* Typhimurium 170/108. The restaurant received eggs from several suppliers during the period of interest and detailed trace-back was not possible.

An outbreak of suspected foodborne gastroenteritis was reported amongst 43 of 90 attendees at a church camp in April 2010 in South Australia. A cohort study was conducted, and rice was identified as the likely food vehicle due to biological plausibility and high attack rate (68.2%), but the risk ratio (RR) could not be calculated as all attendees consumed this food. No leftover food was available for testing and the 3 clinical specimens submitted were negative for pathogens.

An outbreak of 31 confirmed cases of *S.* Typhimurium 170/108 was detected through follow-up of 2 separate complaints to the NSW Food Authority, enhanced surveillance of gastroenteritis cases presenting to local emergency departments, and enhanced surveillance of laboratory notifications of *Salmonella* infection. Cases were infected with one of 3 outbreak multi-locus variable number of tandem repeats analysis (MLVA) profiles, 3-9-7-13-523* (n=1), 3-9-7-14-523 (n=16) and 3-9-7-15-523 (n=14). Illness amongst confirmed cases was associated with consuming kebabs (30 cases), mainly those filled with chicken, hummus, tabouli, lettuce, and tomato from a food outlet in a shopping centre. A further 14 probable cases were linked to the food outlet. Samples of cooked chicken kebab, hummus and tabouli and several environmental samples were positive for *S.* Typhimurium MLVA profile 3-9-7-15-523. One environmental swab was positive for both *S.* Typhimurium 170/108 MLVA profile 3-9-7-15-523 and *S.* Typhimurium 193. A sample of marinated raw chicken was positive for

* Reported in the nomenclature used by the Institute of Clinical Pathology and Medical Research (ICPMR), New South Wales.

*Salmonella* Infantis. The business temporarily closed and stopped preparing chicken kebab logs on site to reduce the risk of cross-contamination.

Public health staff in the Australian Capital Territory identified a link between cases and a local takeaway salad bar after investigating a higher than expected number of *Salmonella* infections, including hospitalised cases. Investigators identified 47 outbreak cases, 41 of which were laboratory confirmed with *S.* Typhimurium 170/108 infection (MLVA 3-9-7-13-523* or MLVA 3-9-7-14-523). Cases reported eating a variety of salads purchased from the salad bar, including tandoori chicken, chicken and avocado, chicken pesto, roast pumpkin fetta and baby spinach, green beans and asparagus, and Caesar and Greek salads. *Salmonella* was isolated from 2 food samples; a chicken pesto salad and a Greek salad. Environmental swabs yielded *Klebsiella oxytoca* and *Enterobacter cloacae* and an environmental health inspection identified issues including inadequate cleaning and disinfection, and ready-to-eat foods being held at inappropriate temperatures. Cross-contamination of ready-to-eat foods from an unknown source was the suspected cause.

In July 2010, an outbreak of gastroenteritis was reported in an aged care facility in Tasmania with 49/221 (22%) residents and 21/96 (22%) staff becoming ill. Seven out of 11 stool samples collected tested positive for norovirus. No food samples were available for testing as leftover food was disposed of at the end of each day. Many cases suffered from dementia therefore detailed food histories could not be collected for the majority of residents. Food histories were only obtained from 4 residents; 3 cases and 1 non-case. The aged care facility also delivered meals to the community and 82% (36/44) of the meal recipients were interviewed by phone. Six recipients reported developing symptoms of gastroenteritis. Those who became ill were more likely to have reported consuming pork sausages and gravy (4/7, attack rate 57%, crude relative risk: 3.71; 95% confidence interval: [CI] 0.95, 14.55), but numbers were small and it is unclear if this meal was also consumed by the residents who became ill.

An outbreak of *S.* Typhimurium 9 (MLVA 2-27-16-12-526) in regional New South Wales was associated with eating products containing aioli prepared with raw eggs from a takeaway burger business. Interviews were conducted with 189 people who ate at the outlet over a period of 6 days and 168 of these reported symptoms of diarrhoea and/or vomiting, fever, abdominal pain, myalgia and bloody stools. Stool specimens for 104 of these people were laboratory confirmed *S.* Typhimurium 9 MLVA type 2-27-16-12-526. The outbreak strain was also isolated from aioli prepared with raw egg and from swabs of 2 chopping boards. The business was closed under a NSW Food Authority prohibition order and reopened after implementation of revised cleaning and sanitising procedures and on the provision that they would cease the production of raw egg sauces. The egg farm that supplied the eggs used to prepare the aioli was inspected but no *Salmonella* was detected on the farm.

An outbreak of *Cyclospora cayetanensis* affected 314 people, the majority from Western Australia, but also from New South Wales (1 case), South Australia (1 case), Victoria (4 cases) and Queensland (2 cases). Cases were amongst passengers and crew of 2 successive cruises on the same ship that departed from and returned to Fremantle, Western Australia in May and June 2010, visiting south-east Asian destinations.[22] Follow-up of laboratory confirmed cases and passenger enquiries identified 34 ill passengers associated with the first cruise, with 26 of these being laboratory confirmed. From the second cruise 232 passengers and 48 crew members were reported to have been affected, with 46 passengers and 1 crew member laboratory confirmed. A case-control study conducted among crew members focused on fresh produce and water consumed on board, and on-shore visits. In a univariate analysis, lettuce was mostly strongly associated with illness (Odds Ratio [OR] $= 4.7$, 95% CI 1.7–14.1, $P = 0.0005$). Eating rockmelon, chives and lettuce were significantly associated with illness ($P < 0.05$) in a multivariate analysis. It was concluded that illness was most likely related to eating fresh produce items taken on board in a south-east Asian port during the first cruise and also used during the second voyage. However, the case-control study did not provide enough evidence to definitively determine which fresh produce item was the likely cause of illness. Australia advised the International Health Regulations (IHR) National Focal Point of the relevant country as per Article 44 (Collaboration and Assistance) of the IHR (2005) to facilitate any local epidemiological investigations or follow-up.

An increase in a common strain of invasive *L. monocytogenes* (PCR serogroup 1/2b, 3b, 7, binary gene type 158 and PFGE 121:119:1†) infection was observed on the eastern seaboard of Australia, and a multi-jurisdictional outbreak investigation was commenced. Between January and August 2010, 9 cases of listeriosis met the case definition (cases occurring since January 2010 that were serogroup 1/2b, 3b, 7, binary gene type 158 and the Medical Diagnostic Unit designated PFGE 121:119:1 or serogroup not established, binary gene type 158 and Medical Diagnostic Unit designated PFGE 122:4N:1). A case–case analysis using non-outbreak cases as controls found that outbreak-associated

* Reported in the nomenclature used by the Institute of Clinical Pathology and Medical Research (ICPMR), New South Wales.

† Reported in the nomenclature used by the Microbiological Diagnostic Unit, University of Melbourne, Victoria.

cases were more likely to have consumed rockmelons (OR = 11.1, 95% CI 1.0–550.8, $P = 0.02$). As part of a separate investigation in one jurisdiction, 3 samples taken from a fruit salad manufacturer (honey dew melon washings, fruit rinse water and juice from mixed fruit waste) were positive for a combination of the multi-jurisdictional outbreak strains of *L. monocytogenes*. In addition, 2 samples of fruit salad sampled in May were also positive for the outbreak strains. These samples were taken by local government authorities from two separate food premises as part of their routine food sampling program. These 2 food premises reported that they purchased a combination of different whole fruits (including honey dew and rockmelon) to make the fruit salad at their retail food outlets. Trace-back of the melons used by the fruit salad manufacturer found that they were produced in a particular region of New South Wales, where melons are harvested between January and April each year. Following this outbreak, the NSW Food Authority assisted the New South Wales Department of Primary Industries to develop an information package for producers and packers increasing awareness of the outbreak and the risks of *L. monocytogenes* on melons as well as recommending effective mitigation strategies to prevent contamination.

## Discussion

This report documents the incidence of gastrointestinal diseases commonly transmitted by food in Australia during 2010. The OzFoodNet surveillance network concentrates its efforts on the surveillance and outbreak investigation of foodborne diseases. This is based on partnerships with a range of stakeholders, including state and territory health departments, food safety regulators, public health laboratories, and government departments of primary industries. These partnerships and the analysis of data on notified cases and outbreaks contribute to public health action, the prevention of disease and the assessment of food safety policies and campaigns. A national program of surveillance for foodborne diseases and outbreak investigation such as OzFoodNet has many benefits including identifying foods that cause human illness through investigation of outbreaks that occur across state and territory borders. Continuing to strengthen the quality of these data will ensure their use by agencies to develop food safety policy contributing to the prevention of foodborne illness. This aims to reduce the cost of foodborne illness to the community, such as healthcare costs and lost productivity, and those to industry such as product recalls and loss of reputation.

*Campylobacter* continues to be the most frequently notified enteric pathogen under surveillance of OzFoodNet despite not being notifiable in New South Wales. The number of annual notifications has fluctuated between 14,000 and 17,000 annually over the past 10 years. However, *Campylobacter* was identified as the aetiological agent in only nine of 154 foodborne disease outbreaks reported by OzFoodNet during 2010. Three of these were attributed to foodborne transmission through contaminated chicken. In the remaining 6 outbreaks, investigators were unable to identify a food vehicle or source of infection.

There is likely to be under-reporting of *Campylobacter* outbreaks in Australia due to the lack of an efficient standardised discriminatory typing scheme and the likely under-reporting of smaller household outbreaks by the public and/or treating medical practitioner to public health authorities. A more rapid and sustainable typing method would assist OzFoodNet's activities given the large burden of *Campylobacter* infection in the community.[23–25] Evidence from these outbreak investigations would provide important risk factor information for public health action by food safety authorities to prevent further cases of disease.

In Australia, poultry is the primary source of *Campylobacter* infection. OzFoodNet estimates that about 75% of *Campylobacter* infections in the general population are acquired through foodborne transmission with approximately 30% of infections attributed to eating chicken.[26] Other cases of foodborne infection are likely to occur through food vehicles other than chicken, including foods subject to cross-contamination from raw products, especially chicken.[27,28]

The value of collaboration between public health authorities, food safety regulators and industry to reduce the incidence of foodborne *Campylobacter* infection has been recently demonstrated in New Zealand.[29] The notification rate of campylobacteriosis in New Zealand declined from an average annual rate of 353.8 per 100,000 population for the period 2002–2006 to an annual rate of 161.5 per 100,000 in 2008. A similar decline was seen for hospitalisations. This reduction was attributed to the introduction of a range of voluntary and regulatory interventions implemented as part of the risk management strategy introduced by the New Zealand Food Safety Authority in late 2006.[30] Control of *Campylobacter* in poultry meat is a major challenge for food safety authorities, regulators, agencies and industry representatives. The Primary Production Standard for Poultry Meat was implemented in May 2012 to assist in reducing the incidence of campylobacteriosis and salmonellosis in Australia.[31] The standard requires poultry growers to identify and control food safety hazards, verify the effectiveness of the control measures, and have the capacity to trace their products. Public health strategies aimed at educating the consumer should also be included as one of the interventions in a combined approach to reduce the

disease burden from *Campylobacter*. Monitoring the incidence of notified campylobacteriosis to the NNDSS together with poultry consumption rates in the Australian population would assist in measuring the effectiveness of these interventions. Any decline in the incidence of campylobacteriosis attributed to public health or primary industry interventions in Australia would need to account for trends in poultry consumption rates.

In 2010, OzFoodNet sites reported 154 foodborne or suspected foodborne outbreaks, including 2 multi-jurisdictional outbreak investigations. *Salmonella* continues to be the leading cause of reported outbreaks of foodborne illness in Australia, with 58 outbreaks due to this pathogen, the majority of them due to *S.* Typhimurium (n = 53).

Past OzFoodNet annual reports identified fish as the most common food vehicle for identified outbreaks in Australia[32] although they usually only affected small numbers of people. The most common intoxications associated with fish were ciguatera and histamine poisoning. It was encouraging to note that there were only 8 outbreaks, including six from ciguatera poisoning, associated with fish in 2010; a reduction from 16 in 2005.[32]

OzFoodNet has identified a national increase since late 2008, in the number of *Salmonella* outbreaks associated with the consumption of raw or minimally cooked eggs. These outbreaks are usually associated with *S.* Typhimurium, most commonly phage type 170/108 and related MLVA types. In 2010, investigators identified 21 outbreaks associated with raw or minimally cooked egg dishes. *S.* Typhimurium 170/108 was identified in 13 of these outbreaks across a range of settings and food vehicles. Food vehicles included desserts commonly made with raw eggs, such as chocolate mousse and tiramisu, sauces (mayonnaise, aioli), milkshakes and cake mixture. Outbreaks were also associated with food items suspected to be cross-contaminated with eggs during their preparation.

These outbreak investigations highlight the continued importance of eggs as a source of salmonellosis. A challenge in these outbreaks is to identify the factors that led to the outbreak. While the source of many of these outbreaks is likely to be from surface contamination of an egg,[33] the challenges are to determine if factors at time of food preparation were the main contributor to an outbreak. Authorities recognise that it is difficult to confidently identify the factors that lead to such outbreaks and continue to work towards a better understanding of the cause of contamination.[34] Further limitations of these investigations includes the difficulty in establishing a link between the outbreak setting or premises and egg suppliers, as trace-back to producer or farm level was not always possible. Investigations are also limited, in some cases, by poor recall of food consumption. Associations between illness and the consumption of specific food items were sometimes difficult to establish, particularly because food items such as egg and chicken are commonly consumed in the community. In addition, eggs (especially raw eggs) as ingredients of food such as desserts and dressings are not always apparent to the consumers of these foods. To contribute to the prevention of further outbreaks, regulators could consider prohibiting the sale of raw or minimally cooked egg products in commercial settings or recommend the use of pasteurised egg products in dishes that are to be served raw or lightly cooked.

Food Standards Australia New Zealand has coordinated the development of the *Primary Production and Processing Standard for Eggs and Egg Products,* which will be implemented from 26 November 2012.[35] The work has involved a risk assessment of egg production and processing in Australia and extensive consultation with industry, scientists, government agencies and the public. The new Standard places legal obligations on egg producers and processors to introduce measures to reduce food safety hazards. It also includes traceability of individual eggs for sale or used to produce egg pulp. While the onus is on the food business to have systems in place that demonstrate compliance with the Standard, the egg industry must be encouraged to work even more closely with health departments and food safety regulators to achieve demonstrable decreases in the incidence of salmonellosis.

OzFoodNet has shown that use of raw or minimally cooked eggs is currently the single largest cause of foodborne *Salmonella* outbreaks and therefore likely to be a significant source of the national increase in 'sporadic' salmonellosis seen in recent years. Measures to address this burden of illness require the collaboration of industry, food safety regulators and health representatives.

Cases of hepatitis A continued to be associated with a sustained outbreak of 415 locally-acquired cases of hepatitis A that commenced in 2009 and lasted until March 2010.[14] Detailed investigations implicated semi-dried tomatoes as the likely source of this outbreak.[13,14] Issues associated with this outbreak will continue to provide challenges for public health agencies, laboratories, industry, and food regulators. The challenges include laboratory capacity to detect viruses in food and trace-back complexities associated with international food distribution.[13] Jurisdictions investigate locally-acquired cases of hepatitis A with the aim of identifying cases associated with foodborne transmission or other risk factors for illness, and to offer contacts post-exposure prophylaxis.

Notified cases of hepatitis A infection in Indigenous people decreased from 49 cases in 2005 to a single case in 2010. This decrease occurred following the targeted hepatitis A vaccination program, which was introduced at the end of 2005. We now see the near elimination of notified cases of locally-acquired hepatitis A from the Indigenous population in Australia.[36]

In 2010, OzFoodNet continued to investigate a cluster of cases of thyroid dysfunction associated with a soy milk product that was fortified with seaweed and first reported in 2009.[14] Testing of product samples showed unusually high levels of iodine as a cause of thyroid dysfunction leading to a recall of these products. OzFoodNet coordinated the national collection of epidemiological and clinical data on cases (n=50). The response to this incident included the provision of advice to medical practitioners on hyperthyroidism in infants, developed in consultation with endocrinologists and public health physicians. This advice was circulated through professional networks to physicians and general practitioners.

This report summarises 3 preventable infections more commonly associated with travel overseas; typhoid (97% of cases), hepatitis A (55% of cases) and *S.* Enteritidis (88% of cases). Travellers are encouraged to consider the information available on the Smartraveller travel health web site (www.smartraveller.gov.au) and to seek medical advice prior to travel. Smartraveller provides specific country information to travellers about health risks. This advice, including vaccination where available, can minimise or prevent the risk of these and other infections commonly associated with travel overseas.

OzFoodNet recognises some of the limitations of the data used in this report. Where there are small numbers of notifications, caution must be used in comparisons between jurisdictions and over time. Some of the most common enteric pathogens are not notifiable, particularly norovirus and *Clostridium perfringens*, which is why investigation of outbreaks is important. A further limitation relates to the outbreak data provided by OzFoodNet sites for this report and the potential for variation in categorising features of outbreaks depending on investigator interpretation and circumstances. State and territory representatives are involved in a continuous program aimed at harmonising the collection and recording of the outbreak data via the Outbreak Register Working Group.

In 2009, OzFoodNet began requesting molecular subtyping (including at least PCR serogroup and binary type) for all cases of listeriosis. National collation of subtyping information and interview data allow OzFoodNet epidemiologists to rapidly detect clusters and analyse exposure information for any possible common source(s). The OzFoodNet plan for the National Surveillance of human *Listeria monocytogenes* infection was endorsed by the Public Health Laboratory Network on 21 September 2010. It is a flexible and stable system that is able to produce timely surveillance updates and analysis. Cooperation between OzFoodNet epidemiologists and public health laboratories will continue to be an important foundation of this system. The enhanced listeriosis surveillance system identified one outbreak during 2010 with an epidemiological link to melons. Pre-cut melons and pre-made fruit salad may present higher risks of foodborne transmission of *Listeria* because once the bacterium is introduced into a food (from the surface or through processing equipment) it can proliferate under cold storage. People who may be at higher risk of infection (the elderly, pregnant women and other persons who are immunocompromised) should avoid these foods. While the scale of the outbreak investigated in 2010 was small, it was an excellent 'proof of concept' for the *Listeria* surveillance plan. During an outbreak, effective partnerships between OzFoodNet epidemiologists, public health laboratory staff and food regulatory personnel facilitated sharing of epidemiological and microbiological intelligence that enabled the early detection and characterisation of this outbreak leading to timely public health action.

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# Appendix

## Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Qld | Jan | Restaurant | *Salmonella* Typhimurium 170/108 | 3 | 0 | 0 | M | Case series | Deep fried ice cream | Eggs | Other source of contamination |
| Vic | Jan | Restaurant | *Salmonella* Typhimurium 9 | 13 | 1 | 0 | D | No formal study | Uncooked egg | Eggs | Ingestion of contaminated raw products |
| WA | Jan | Restaurant | *Salmonella* Typhimurium 170/108 | 25 | 5 | 0 | D | Case series | Aioli and caesar salad | Eggs | Other source of contamination |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium 9 | 168 | 19 | 0 | A | Point source cohort | Aioli prepared with raw egg | Eggs | Ingestion of contaminated raw products |
| NSW | Jan | Takeaway | *Salmonella* Singapore | 5 | 0 | 0 | D | Case series | Unknown: suspect foods containing eggs (egg and salad wrap, egg salad) | Eggs | Unknown |
| NSW | Jan | Private residence | *Salmonella* Typhimurium 170/108 | 5 | 4 | 0 | D | Case series | Probably mayonnaise prepared with raw eggs | Eggs | Ingestion of contaminated raw products |
| Qld | Jan | Private residence | Ciguatera fish poisoning | 4 | 4 | 0 | D | Case series | Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Jan | Primary produce | Ciguatera fish poisoning | 6 | 0 | 0 | D | Case series | Fish (unspecified) | Fish | Toxic substance or part of tissue |
| NSW | Jan | Restaurant | Unknown | 5 | 0 | 0 | D | Case series | Mehi-mehi fish fillets | Fish | Toxic substance or part of tissue |
| SA | Jan | Other | *Salmonella* Typhimurium 9 | 20 | 1 | 0 | D | Case series | Bakery products, no specific item identified | Not assigned | Unknown |
| SA | Jan | Private residence | *Salmonella* Typhimurium 9 | 6 | 0 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| Qld | Jan | Private residence | Norovirus | 6 | 1 | 0 | D | No formal study | No vehicle identified | Not assigned | Unknown |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Qld | Jan | Restaurant | *Salmonella* Typhimurium 170/108 | 6 | 1 | 0 | D | Case series | No vehicle identified | Not assigned | Unknown |
| Qld | Jan | Restaurant | Unknown | 4 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| Qld | Jan | Restaurant | *Salmonella* Typhimurium 89 | 4 | 0 | 0 | M | Case series | No vehicle identified | Not assigned | Unknown |
| Vic | Jan | Private residence | Unknown | 19 | 0 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| Vic | Jan | Aged care | Unknown | 9 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Jan | Private residence | *Salmonella* Typhimurium 135a | 5 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| NSW | Jan | Takeaway | Unknown | 3 | 0 | 0 | D | Case series | Assorted pizzas (beef, cheese, chicken) | Not assigned | Unknown |
| NSW Jan | | Restaurant | *Salmonella* Typhimurium 9 | 2 | 1 | 0 | D | Case series | Probably a pork bun | Not assigned | Inadequate cleaning of equipment |
| NSW | Jan | Aged care | *Salmonella* Typhimurium 170/108 | 2 | 0 | 0 | D | Case series | Unknown pureed food | Not assigned | Unknown |
| NSW | Jan | Restaurant | Unknown | 25 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Feb | Restaurant | *Salmonella* Typhimurium 9 | 8 | 1 | 0 | D | Case series | Suspect eggs | Eggs | Ingestion of contaminated raw products |
| MJOI | Feb | Primary produce | *Listeria monocytogenes* | 9 | 8 | 2 | M | Case series | Melons | Fruits/nuts | Ingestion of contaminated raw products |
| Qld | Feb | Restaurant | *Salmonella* Typhimurium 135a | 9 | 1 | 0 | D | Case series | Unknown | Not assigned | Cross contamination from raw ingredients |
| Vic | Feb | Commercial caterer | *Salmonella* Typhimurium 141 | 15 | 1 | 0 | A | Point source cohort | Pasta salad | Not assigned | Cross contamination from raw ingredients |
| Vic | Feb | Aged care | *Clostridium perfringens* | 9 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| Vic | Feb | Aged care | *Campylobacter* | 5 | 0 | 0 | D | No formal study | Unknown | Not assigned | Ingestion of contaminated raw products |
| Vic | Feb | Unknown | *Listeria monocytogenes* | 6 | 6 | 4 | M | Case series | Cold meat | Not assigned | Unknown |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSW | Feb | Restaurant | *Salmonella* Typhimurium 170 var | 3 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Tas | Feb | Restaurant | Unknown | 26 | 0 | 0 | A | Point source cohort | Chicken mushroom and bacon cream sauce | Not assigned | Unknown |
| NSW | Feb | Restaurant | Unknown | 3 | 0 | 0 | D | Case series | Probably chicken or beef | Not assigned | Unknown |
| NSW | Feb | Restaurant | Unknown | 4 | 0 | 0 | D | No formal study | Possibly lamb, beef & chicken skewers and an assortment of vegetables | Not assigned | Unknown |
| NSW | Feb | Restaurant | Unknown | 4 | 0 | 0 | D | No formal study | Unknown | Not assigned | Not reported |
| NSW | Feb | Takeaway | *Salmonella* Typhimurium 204 | 4 | 3 | 0 | M | Case series | Barbecued pork | Pork | Cross contamination from raw ingredients |
| ACT | Mar | Private residence | *Salmonella* Typhimurium 170/108 | 4 | 0 | 0 | D | Case series | Chocolate mousse | Eggs | Ingestion of contaminated raw products |
| NSW | Mar | Restaurant | *Salmonella* Typhimurium 170/108 | 6 | 3 | 0 | M | Case series | Tartare sauce, prepared with raw egg | Eggs | Ingestion of contaminated raw products |
| NSW | Mar | Private residence | *Salmonella* Typhimurium 170/108 | 9 | 1 | 0 | D | Case series | Probably raw eggs contained in one batch of individual servings of tiramisu | Eggs | Ingestion of contaminated raw products |
| NSW | Mar | Commercially manufactured | Unknown | 3 | 0 | 0 | D | Case series | Orange and mango fruit drink | Fruits/nuts | Not applicable |
| NSW | Mar | Restaurant | *Salmonella* Typhimurium 170/108 | 19 | 0 | 0 | M | Case series | Suspected peanut/cashew mixture | Fruits/nuts | Unknown |
| Vic | Mar | Aged care | Unknown | 4 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Vic | Mar | Aged care | *Clostridium perfringens* | 17 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Mar | Aged care | *Clostridium perfringens* | 16 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| WA | Mar | Restaurant | Unknown | 12 | 0 | 0 | D | No formal study | Karage chicken and rice | Not assigned | Unknown |
| NSW | Mar | Takeaway | Unknown | 3 | 1 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| NSW | Mar | National franchised fast food | *Salmonella* Typhimurium 9 | 4 | 1 | 0 | D | Case series | Possibly chicken pieces from franchised restaurant | Poultry | Unknown |
| NSW | Apr | Takeaway | *Salmonella* Typhimurium 170/108 | 9 | 0 | 0 | M | Case series | Mayonnaise made with raw egg | Eggs | Ingestion of contaminated raw products |
| SA | Apr | Camp | Unknown | 43 | 0 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| Vic | Apr | Aged care | Unknown | 6 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| NSW | Apr | Restaurant | *Salmonella* Typhimurium 170/108 | 16 | 9 | 0 | D | Case series | Suspected fried rice | Not assigned | Not applicable |
| NSW | Apr | Aged care | *Salmonella* Infantis | 26 | 5 | 2 | A | Point source cohort | Suspected fluid thickener contaminated by raw chicken mince | Poultry | Cross contamination from raw ingredients |
| Qld | May | Restaurant | Norovirus | 11 | 0 | 0 | D | Case series | Unknown | Not assigned | Person-to-food-to-person |
| Qld | May | Restaurant | Norovirus | 12 | 0 | 0 | D | Case series | Unknown | Not assigned | Person-to-food-to-person |
| Vic | May | Aged care | Unknown | 9 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| MJOI | May | Cruise/airline | *Cyclospora cayetanensis* | 314 | 0 | 0 | A | Case control study | | Not assigned | Ingestion of contaminated raw products |
| NSW | May | Takeaway | Unknown | 2 | 0 | 0 | D | Case series | Suspect Mongolian lamb or fried rice | Not assigned | Unknown |
| NSW | May | Restaurant | Unknown | 26 | 1 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| NSW | May | Restaurant | Unknown | 7 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSW | May | Fair/festival/ mobile service | *Salmonella* Saintpaul | 7 | 3 | 0 | D | Case series | Suspected salmon & couscous dish | Not assigned | Unknown |
| NSW | May | Restaurant | *Campylobacter jejuni* | 10 | 0 | 0 | A | Point source cohort | Raw chicken | Poultry | Ingestion of contaminated raw products |
| Qld | Jun | Restaurant | *Salmonella* Typhimurium 135a | 34 | 1 | 0 | AM | Point source cohort | Citrus aioli | Eggs | Ingestion of contaminated raw products |
| NSW | Jun | Private residence | *Salmonella* Typhimurium 170/108 | 9 | 5 | 0 | D | Case series | Unknown: possibly mousse cake with raw eggs | Eggs | Unknown |
| Qld | Jun | Restaurant | *Clostridium perfringens* | 4 | 0 | 0 | M | Case series | Rotti curry lamb | Lamb | Not applicable |
| SA | Jun | Other | Unknown | 10 | 0 | 0 | Other lab evidence | No formal study | Milk | Milk | Poisonous substance |
| NSW | Jun | Restaurant | Unknown | 3 | 0 | 0 | D | Case series | Suspected oysters | Molluscs | Unknown |
| Vic | Jun | Aged care | *Campylobacter* | 15 | 1 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Jun | Aged care | Unknown | 8 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| WA | Jun | Aged care | *Clostridium perfringens* | 10 | 0 | 0 | D | Case series | Unknown | Not assigned | Not applicable |
| NT | Jun | Restaurant | Norovirus | 19 | 0 | 0 | A | Point source cohort | | Not assigned | Person to food to person |
| NSW | Jun | Restaurant | Unknown | 10 | 0 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| NSW | Jun | Takeaway | *Salmonella* Typhimurium 170/108 | 45 | 8 | 0 | M | Case series | Chicken, hommus, tabouli | Not assigned | Cross contamination from raw ingredients |
| NSW | Jun | Restaurant | Unknown | 15 | 2 | 0 | D | Case series | Unknown | Not assigned | Not applicable |
| NSW | Jun | Restaurant | Unknown | 7 | 0 | 0 | D | Case series | Suspected chicken in cheese sauce, mixed vegetables | Not assigned | Ingestion of contaminated raw products |
| NSW | Jun | Restaurant | Unknown | 12 | 0 | 0 | D | Case series | Unknown | Not assigned | Not reported |
| NSW | Jun | Restaurant | Unknown | 4 | 0 | 0 | D | No formal study | Suspected beef pie | Not assigned | Not reported |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSW | Jun | Takeaway | Unknown | 9 | 0 | 0 | D | Case series | Unknown | Not assigned | Not reported |
| Vic | Jul | Private residence | *Salmonella* Typhimurium 170/108 | 4 | 2 | 0 | M | Case series | Eggs (fried soft) | Eggs | Ingestion of contaminated raw products |
| Vic | Jul | Private residence | Scrombroid confirmed | 4 | 0 | 0 | Other lab evidence | Case series | Tuna | Fish | Not applicable |
| Vic | Jul | Aged care | *Clostridium perfringens* | 16 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Jul | Aged care | *Salmonella* Typhimurium 186 | 4 | 2 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| WA | Jul | Restaurant | *Salmonella* Typhimurium | 3 | 1 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| WA | Jul | Other | Unknown | 6 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| WA | Jul | Restaurant | Norovirus | 17 | 0 | 0 | A | Case control study | Lasagne | Not assigned | Food handler contamination |
| NT | Jul | School | Viral | 19 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| NT | Jul | Unknown | *Salmonella* Typhimurium 135a | 7 | 4 | 0 | D | Case series | Unknown | Not assigned | Cross contamination from raw ingredients |
| NSW | Jul | Restaurant | *Salmonella* Typhimurium 9 | 9 | Unknown | 0 | D | No formal study | Unknown | Not assigned | Not reported |
| Tas | Jul | Aged care | Unknown | 70 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Tas | Jul | Aged care | Unknown | 6 | 0 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| NSW | Jul | Aged care | *Salmonella* Typhimurium 170/108 | 7 | 0 | 0 | A | Point source cohort | Unknown, possibly minced or pureed diet | Not assigned | Unknown |
| NSW | Aug | Restaurant | *Salmonella* Typhimurium 170/108 | 14 | 4 | 0 | M | Case series | Fried ice cream | Eggs | Ingestion of contaminated raw products |
| Qld | Aug | Primary produce | Ciguatera fish poisoning | 4 | 0 | 0 | D | Case series | Fish head soup | Fish | Toxic substance or part of tissue |
| Qld | Aug | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Coral trout | Fish | Toxic substance or part of tissue |
| SA | Aug | Restaurant | *Campylobacter jejuni* | 18 | 2 | 0 | A | Point source cohort | Steak with chicken liver pate | Not assigned | Unknown |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SA | Aug | Institution | Unknown | 8 | 0 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| Vic | Aug | Aged care | *Salmonella* Typhimurium 197 | 23 | 4 | 2 | D | Case series | Unknown | Not assigned | Cross contamination from raw ingredients |
| Vic | Aug | Camp | *Salmonella* Typhimurium 9 | 6 | 1 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| WA | Aug | Aged care | *Salmonella* Typhimurium | 7 | 0 | 1 | D | Case series | Unknown | Not assigned | Unknown |
| NT | Aug | Picnic | *Salmonella* Virchow 8 | 6 | 0 | 0 | D | Case series | Unknown | Not assigned | Not reported |
| NSW | Aug | Restaurant | Unknown | 27 | 0 | 0 | A | Point source cohort | Suspect assorted wraps | Not assigned | Unknown |
| NSW | Aug | Aged care | *Clostridium perfringens* | 8 | 1 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| Vic | Sept | Restaurant | *Salmonella* Typhimurium 9 | 10 | 2 | 0 | D | Case series | Hollandaise sauce | Eggs | Ingestion of contaminated raw products |
| Qld | Sept | Fair/festival/ mobile service | *Staphylococcus aureus* | 3 | Unknown | 0 | M | Case series | Rice noodle | Grains/beans | Other source of contamination |
| SA | Sept | Other | *Salmonella* Typhimurium 9 | 10 | 0 | 0 | D | No formal study | None implicated | Not assigned | Not applicable |
| Qld | Sept | Aged care | *Campylobacter* | 7 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| ACT | Sept | Restaurant | Unknown | 8 | 0 | 0 | D | No formal study | Unknown | Not assigned | Cross contamination from raw ingredients |
| Vic | Sept | Aged care | Unknown | 12 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| WA | Sept | Other | Unknown | 10 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| WA | Sept | Military | Norovirus | 21 | 0 | 0 | D | Case series | Unknown | Not assigned | Food handler contamination |
| NT | Sept | Camp | Unknown | 13 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| NSW | Sept | Restaurant | Unknown | 4 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Tas | Sept | Commercial caterer | Unknown | 6 | Unknown | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| NSW | Sept | Takeaway | *Salmonella* Typhimurium 170/108 | 15 | 3 | 0 | M | Case series | Unknown | Not assigned | Cross contamination from raw ingredients |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Vic | Oct | Restaurant | *Bacillus cereus* | 24 | 0 | 0 | A | Point source cohort | Rice (and /or beef curry) | Grains/beans | Unknown |
| Qld | Oct | Restaurant | Unknown | 9 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Qld | Oct | Institution | *Campylobacter jejuni* | 17 | 1 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| ACT | Oct | Takeaway | *Salmonella* Typhimurium 170/108 | 47 | 5 | 0 | D | Case series | Assorted salads | Not assigned | Cross contamination from raw ingredients |
| Vic | Oct | Aged care | Unknown | 7 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Oct | Aged care | *Clostridium perfringens* | 28 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Oct | Aged care | Unknown | 10 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Oct | Aged care | Unknown | 5 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Oct | Restaurant | *Salmonella* Typhimurium 9 | 2 | 2 | 0 | D | Case series | Broken rice | Not assigned | Unknown |
| Vic | Oct | Aged care | *Clostridium perfringens* | 11 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Oct | Unknown | *Campylobacter jejuni* | 3 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Oct | Restaurant | *Salmonella* Typhimurium 9 | 4 | 2 | 0 | D | Case series | Mixed dishes | Not assigned | Unknown |
| NSW | Oct | Restaurant | Unknown | 5 | 0 | 0 | A | Point source cohort | Unknown | Not assigned | Unknown |
| NSW | Oct | Takeaway | Unknown | 6 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| NSW | Nov | Restaurant | *Salmonella* Typhimurium 170/108 | 2 | 1 | 0 | D | No formal study | Suspected salmon patties made with egg | Eggs | Unknown |
| Qld | Nov | Primary produce | Ciguatera fish poisoning | 4 | 0 | 0 | D | Case series | Passionfruit trout | Fish | Toxic substance or part of tissue |
| Qld | Nov | Aged care | *Campylobacter jejuni* | 23 | 1 | 1 | D | No formal study | Unknown | Not assigned | Unknown |
| Vic | Nov | Aged care | Unknown | 7 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| NT | Nov | Commercial caterer | Norovirus | 12 | 0 | 0 | A | Point source cohort | Unknown | Not assigned | Person-to-food-to-person |
| NT | Nov | Restaurant | Unknown | 45 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NSW | Nov | Commercial caterer | *Salmonella* Typhimurium | 7 | 2 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| NSW | Nov | Restaurant | Unknown | 6 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| NSW | Nov | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| NSW | Nov | Bakery | *Salmonella* Typhimurium | 10 | 0 | 0 | D | Case series | Probably pork roll | Not assigned | Unknown |
| Qld | Dec | Private residence | *Salmonella* Typhimurium | 4 | 2 | 0 | D | Case series | Banana milkshake | Eggs | Ingestion of contaminated raw products |
| Vic | Dec | Private residence | *Salmonella* Typhmurium 170/108 | 12 | 1 | 0 | D | Case series | Raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| WA | Dec | Restaurant | *Salmonella* Typhimurium 170/108 | 7 | 1 | 0 | D | Case series | Scrambled eggs | Eggs | Unknown |
| Tas | Dec | Restaurant | *Salmonella* Typhimurium 170/108 | 43 | 2 | 0 | A | Case control and cohort | Homemade ice cream | Eggs | Ingestion of contaminated raw products |
| Qld | Dec | Private residence | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Mangrove jack fish | Fish | Toxic substance or part of tissue |
| Qld | Dec | National franchised fast food | *Staphylococcus aureus* | 6 | 1 | 0 | M | Case series | Milkshake | Milk | Inadequate cleaning of equipment |
| SA | Dec | Restaurant | Norovirus | 19 | 3 | 0 | D | Case series | Unknown | Not assigned | Food handler contamination |
| Vic | Dec | Aged care | *Salmonella* Typhimurium 170/108 | 18 | 3 | 3 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Dec | Aged care | Unknown | 5 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| Vic | Dec | Aged care | *Clostridium perfringens* | 15 | 1 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| WA | Dec | Restaurant | *Salmonella* Typhimurium 170/108 | 10 | 2 | 0 | D | Case series | Unknown | Not assigned | Not applicable |
| NSW | Dec | Institution | Unknown | 5 | 0 | 0 | D | Case series | Unknown | Not assigned | Unknown |
| NSW | Dec | Bakery | *Salmonella* Infantis | 3 | Unknown | 0 | D | Case series | Bakery products | Not assigned | Unknown |

## Appendix *continued:* Foodborne outbreak summary for OzFoodNet sites, Australia, 2010

| State or territory | Month | Setting | Agent responsible | Ill | Hospitalised | Fatalities | Evidence | Epidemiological study | Food vehicle | Commodity[20] | Contamination factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tas | Dec | Restaurant | Unknown | 6 | Unknown | 0 | D | No formal study | Unknown | Not assigned | Not applicable |
| NSW | Dec | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| NSW | Dec | Restaurant | Unknown | 5 | 0 | 0 | D | No formal study | Unknown | Not assigned | Unknown |
| NSW | Dec | Takeaway | *Salmonella* Typhimurium 170/108 | 8 | 3 | 0 | M | No formal study | Suspected pork rolls | Not assigned | Ingestion of contaminated raw products |
| Vic | Dec | Institution | *Campylobacter jejuni* | 5 | 0 | 0 | D | Case series | Chicken | Poultry | Ingestion of contaminated raw products |

MJOI Multijurisdictional outbreak investigation.

Evidence

D Descriptive evidence implicating the vehicle

A Analytical epidemiological association between illness and vehicle

M Microbiological confirmation of aetiology in vehicle and cases.

Epidemiological study

N Individual patient data not collected.