Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2013–2015

The OzFoodNet Working Group

# Abstract

This report summarises the incidence of diseases potentially transmitted by food in Australia, and details outbreaks associated with food that occurred during 2013–2015. OzFoodNet sites reported an increasing number of notifications of 12 diseases or conditions that may be transmitted by food (botulism; campylobacteriosis; cholera; hepatitis A; hepatitis E; haemolytic uraemic syndrome (HUS); listeriosis; Salmonella Paratyphi (paratyphoid fever) infection; salmonellosis; shigellosis; Shiga toxin-producing Escherichia coli (STEC) infection; and Salmonella Typhi (typhoid fever) infection), with a total of 28,676 notifications received in 2013; 37,958 in 2014; and 41,226 in 2015. The most commonly-notified conditions were campylobacteriosis (a mean of 19,061 notifications per year over 2013–2015) and salmonellosis (a mean of 15,336 notifications per year over 2013–2015). Over these three years, OzFoodNet sites also reported 512 outbreaks of gastrointestinal illness caused by foodborne, animal-to-person or waterborne disease, affecting 7,877 people, and resulting in 735 hospitalisations and 18 associated deaths. The majority of outbreaks (452/512; 88%) were due to foodborne or suspected foodborne transmission. The remaining 12% of outbreaks were due to waterborne or suspected waterborne transmission (57 outbreaks) and animal-to-human transmission (three outbreaks). Foodborne and suspected foodborne outbreaks affected 7,361 people, resulting in 705 hospitalisations and 18 deaths. Salmonella was the most common aetiological agent identified in foodborne outbreaks (239/452; 53%), and restaurants were the most frequently-reported food preparation setting (211/452; 47%). There were 213 foodborne outbreaks (47%) attributed to a single food commodity during 2013–2015, with 58% (124/213) associated with the consumption of eggs and egg-based dishes.

# Introduction

In Australia, an estimated 4.1 million domestically-acquired cases of foodborne gastroenteritis occur each year, costing an estimated $1.2 billion per year.1–3 The associated losses in productivity and impacts on lifestyle, in addition to direct medical expenses, can result in a substantial burden for Australians. Many of these illnesses are preventable by appropriate interventions. Foodborne disease surveillance can be used to gather evidence to help inform appropriate control measures.4 Health departments conduct surveillance for foodborne diseases, and diseases potentially transmitted by food, to monitor trends in illness; to detect outbreaks; to inform preventative measures; and to evaluate the efficacy of interventions.5,6

Most foodborne diseases manifest as mild self-limiting gastroenteritis, with approximately 28% of affected individuals seeking medical attention.1 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 seven infections that occur in the community, while there are approximately eight cases in the community for every notified case of STEC and ten cases in the community for every notified case of campylobacteriosis.1,7–9

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.10 In Australia, state and territory health departments each conduct surveillance for between ten 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, environments or people, and may be acquired domestically or overseas. They may also be transmitted by contaminated food-preparation equipment or surfaces, or through the consumption of contaminated water. Health departments additionally 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 to conduct applied research into the causes of foodborne illness.11 OzFoodNet aggregates and analyses national-level information on the incidence of diseases caused by pathogens commonly transmitted by food, and investigates foodborne disease outbreaks. The OzFoodNet network in 2013–2015 included foodborne disease epidemiologists from each state and territory health department, and collaborators from the Department of Agriculture, Water and the Environment (Agriculture); Food Standards Australia New Zealand (FSANZ); the Public Health Laboratory Network (PHLN); and the National Centre for Epidemiology and Population Health (NCEPH) at the Australian National University. OzFoodNet is a member of the Communicable Diseases Network Australia (CDNA), which is Australia’s peak body for communicable disease control.12 This is the thirteenth annual report for the OzFoodNet network and summarises the surveillance and outbreak data over the three-year period of 2013 to 2015, including a comparison with data from previous years.

# Methods

## Population under surveillance

The OzFoodNet network covered all Australian states and territories, with an estimated population of 23,145,901 in 2013; of 23,504,138 in 2014; and of 23,850,784 in 2015, as at 30 June of each respective year.13

## 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 local surveillance databases. These surveillance datasets are aggregated into a national database—the National Notifiable Diseases Surveillance System (NNDSS)14—under the auspices of the National Health Security Act 2007. This 2013–2015 report provides analysis of aggregated data from NNDSS and enhanced surveillance data from OzFoodNet sites on the following 12 diseases or conditions: botulism; campylobacteriosis; cholera; hepatitis A virus infection; hepatitis E virus infection; haemolytic uraemic syndrome (HUS); listeriosis; paratyphoid fever (Salmonella Paratyphi infection); salmonellosis; shigellosis; Shiga toxin-producing Escherichia coli (STEC); and typhoid fever (Salmonella Typhi infection).

There may be differences when comparing OzFoodNet enhanced data and NNDSS-derived notifications. This is due to continual adjustments to NNDSS data made by states and territories after the date of data extraction. In addition, some jurisdictions report on notification date rather than onset date. Data for this report was extracted from NNDSS in October 2017 and was analysed by the date of diagnosis within the reporting period 1 January 2013 to 31 December 2015. Date of diagnosis is 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, and for each age group and sex, as at June for each respective year, were used to calculate rates of notified infections.13

### Enhanced surveillance for listeriosis

Commencing in 2010, OzFoodNet collected enhanced surveillance data on all notified cases of listeriosis in Australia via the National Enhanced Listeriosis Surveillance System (NELSS). This enhanced surveillance system adds to the routinely-collected data within NNDSS. NELSS includes a centralised national database that contains 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 system is to enable timely detection of clusters and to initiate appropriate public health responses. Local public health units interview all cases as per the listeriosis national guidelines for public health units.[[1]](#footnote-2) Interviews are conducted at the time individual cases are reported, so as 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 (MJOIs) in Australia. NetEpi allows data to be entered from multiple sites and promotes nationally-consistent data collection and analysis by OzFoodNet epidemiologists.15–17

### Supplementary surveillance

OzFoodNet sites collect supplementary data on infections which may be transmitted by food. Information on travel during the incubation period is collected for cases of hepatitis A infection; hepatitis E infection; Salmonella Enteritidis infection; Shigella infection; and typhoid and paratyphoid fevers. Locally-acquired infection includes people acquiring their infection in Australia from overseas-acquired cases as secondary transmission; from unknown sources of infection; and from possible false-positive testing results where no or inconsistent clinical illness was reported.

Due to extensive changes in testing methodology, including the increased use of multi-locus variable number tandem repeat analysis (MLVA) and the decreased use of traditional phage typing (PT), the completeness of subtyping for salmonellosis notifications was not able to be effectively assessed in this report.

### Outbreaks of gastrointestinal disease including foodborne disease outbreaks

OzFoodNet sites collect summary information on gastrointestinal disease outbreaks that occur in Australia, including those transmitted via the ingestion of contaminated food (foodborne outbreaks). A foodborne outbreak is defined as an incident where two or more persons experienced a similar illness after consuming a common food or meal, and analytical epidemiological and/or microbiological evidence implicated the food or meal as the source of illness. A suspected foodborne outbreak is defined as an incident where two or more persons experienced illness after consuming a common food or meal, and descriptive epidemiological evidence implicated the food or meal as the suspected source of illness. Outbreaks where food-to-person-to-food transmission occurred are included in this definition. A cluster is defined as an increase in infections that were epidemiologically related in time, place or person where there was 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 analysed together within this report. Information collected on each outbreak included the setting where the outbreak occurred; where the food was prepared; the month the outbreak investigation commenced; 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, by food vehicle, and by the setting where the implicated food was prepared. The number of outbreaks and documented causes reported here may vary from summaries previously published by individual states and territories, as investigations take time to finalise. For this 2013–2015 report, person-to-person outbreaks and outbreaks of unknown transmission mode have been excluded. These modes of transmission have historically accounted for the majority of outbreaks each year.18 This is a change in practice from previous annual reports and therefore the total number of outbreaks in this report cannot be directly compared with previous annual reports.

## Data analysis

All analyses were conducted using Microsoft Excel.

# Results

## Summary table of the most commonly-notified foodborne enteric infections

Between 2013 and 2015, OzFoodNet sites reported a yearly increase in the total notifications of 12 diseases or conditions that may be transmitted by food (Table 1).

Table 1: Number of notified cases of diseases or infections commonly transmitted by food, by disease, Australia, 2013–2015

| Disease | 2013 | 2014 | 2015 | Mean notifications 2013–2015 | Mean notifications 2008–2012 |
| --- | --- | --- | --- | --- | --- |
| Botulism | 4 | 1 | 3 | 3 | 1 |
| Campylobacteriosisa | 14,689 | 19,945 | 22,549 | 19,061 | 16,417 |
| Cholera | 3 | 2 | 2 | 2 | 4 |
| Hepatitis A | 190 | 231 | 179 | 200 | 283 |
| Hepatitis E | 34 | 58 | 41 | 44 | 37 |
| Haemolytic uraemic syndrome (HUS) | 15 | 21 | 18 | 18 | 17 |
| Listeriosis | 76 | 80 | 70 | 75 | 79 |
| Paratyphoid | 74 | 70 | 76 | 73 | 71 |
| Salmonellosis | 12,724 | 16,283 | 17,001 | 15,366 | 10,567 |
| Shigellosis | 537 | 1,035 | 1,037 | 870 | 608 |
| Shiga toxin-producing Escherichia coli (STEC) infection | 180 | 115 | 136 | 144 | 103 |
| Typhoid | 150 | 117 | 114 | 127 | 115 |
| **Total** | **28,676** | **37,958** | **41,226** | **35,953** | **28,303** |

a Campylobacteriosis is notifiable in all jurisdictions except New South Wales.

# Botulism

Four forms of naturally-occurring botulism are recognised: foodborne; infant intestinal; wound; and ‘other’, where cases are older than 1 year of age and no plausible exposure is known. Some of these cases are suspected to be due to intestinal colonisation.19 Infant intestinal botulism mostly affects infants less than 1 year of age and occurs when Clostridium botulinum spores are ingested, germinate in the infant’s intestine, and the organism produces botulinum toxin. It does not include cases where the preformed toxin is ingested; these are considered foodborne. Over the reporting period (2013–2015) there were eight notifications of botulism (New South Wales (n = 3); Victoria (n = 3); Queensland (n = 1); and Western Australia (n = 1)). Seven cases were infant botulism, and one case was foodborne botulism suspected to be caused by home-cured ham.

# Campylobacteriosis

Between 2013 and 2015, campylobacteriosis was the most frequently-notified enteric infection, despite not being notifiable in New South Wales. Over the reporting period (2013–2015), national notifications of Campylobacter infection almost doubled, with the largest increases in notifications and crude rates (cases notified per 100,000 population) occurring in Queensland and the Northern Territory (Table 2). In 2013, all jurisdictional crude rates were below their five-year historical mean rates. In both 2014 and 2015, only the crude rates in South Australia did not exceed the respective five-year historical mean rates. From 2013 to 2015, Tasmania consistently had the highest rates of campylobacteriosis (from 136 to 201 cases per 100,000 population). From 2013 to 2015, rates of campylobacteriosis almost doubled (82 to 158 cases per 100,000 population) in Queensland. The increased notifications in 2014 and 2015 are likely, in part, to be reflective of the increased incidence of culture-independent diagnostic testing (CIDT) using the polymerase chain reaction (PCR) technique since 2013.

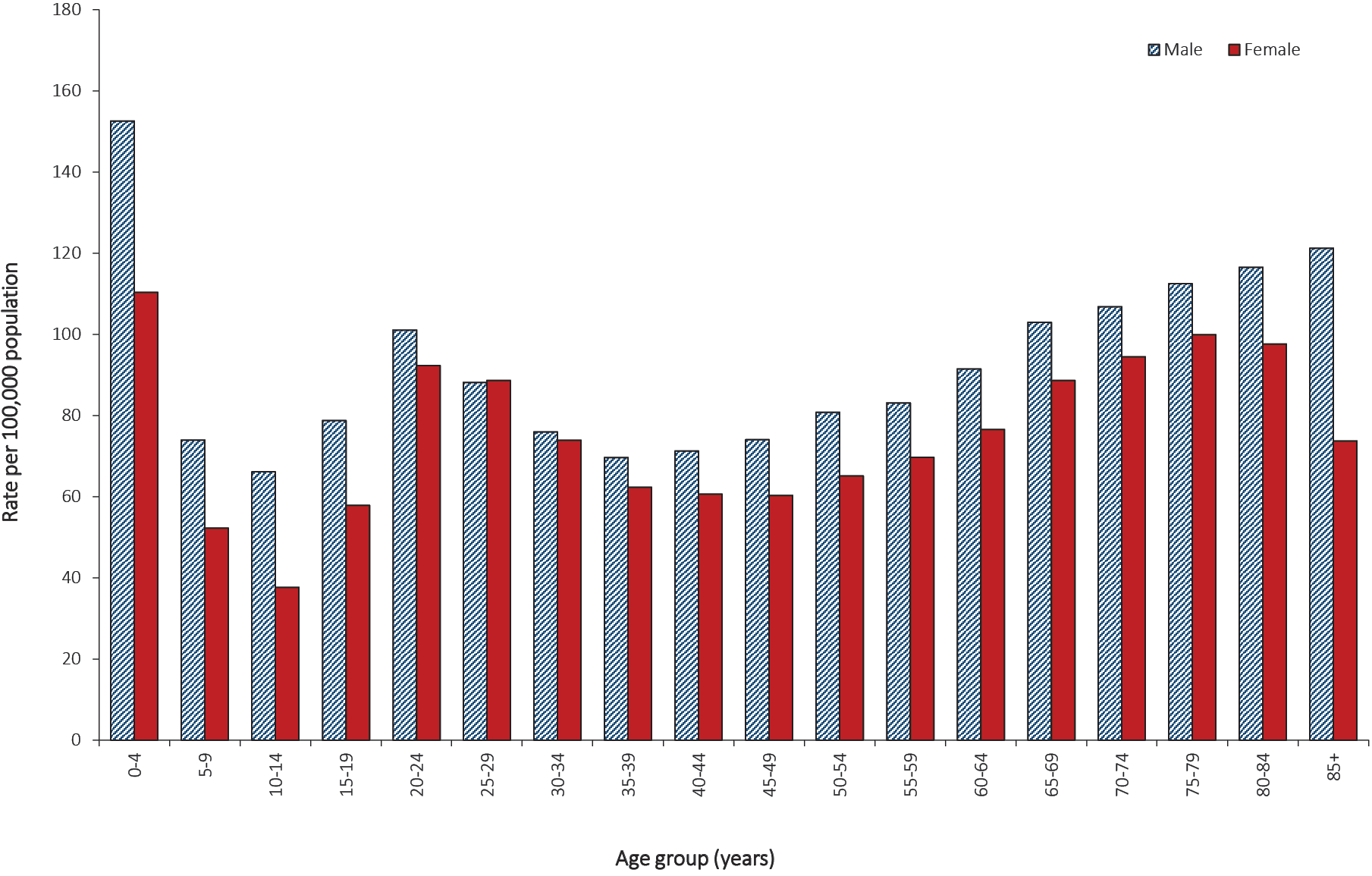
Over the reporting period (2013–2015), 54% of notified campylobacteriosis cases were in males (31,048/57,183). The mean notification rate for 2013–2015 by age group and sex was greater than the five-year historical mean (2008–2012) for both males and females between 0–4 years and for all age groups 25 years and older (Figure 1 and Figure 2).

Table 2: Number of notified cases and crude rate of campylobacteriosis by state or territory, compared with the five-year historical mean rate, Australia, 2013–2015

|  | | ACT | NSWa | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2013 | Notified cases | 375 | NN | 198 | 3,832 | 1,722 | 696 | 5,940 | 1,926 | 14,689 |
| Crude rate | 98 | – | 82 | 82 | 103 | 136 | 103 | 77 | 93 |
| Mean rate 2008–2012 | 132 | – | 84 | 107 | 121 | 143 | 113 | 94 | 110 |
| 2014 | Notified cases | 505 | NN | 294 | 6,226 | 1,807 | 938 | 7,212 | 2,963 | 19,945 |
| Crude rate | 130 | – | 121 | 132 | 107 | 183 | 122 | 117 | 125 |
| Mean rate 2009–2013 | 129 | – | 77 | 100 | 116 | 150 | 112 | 92 | 107 |
| 2015 | Notified cases | 608 | NN | 371 | 7,547 | 1,818 | 1,035 | 8,279 | 2,891 | 22,549 |
| Crude rate | 153 | – | 151 | 158 | 107 | 201 | 137 | 114 | 139 |
| Mean rate 2010–2014 | 128 | – | 84 | 106 | 116 | 161 | 115 | 93 | 110 |

a Not notifiable (NN) in New South Wales.

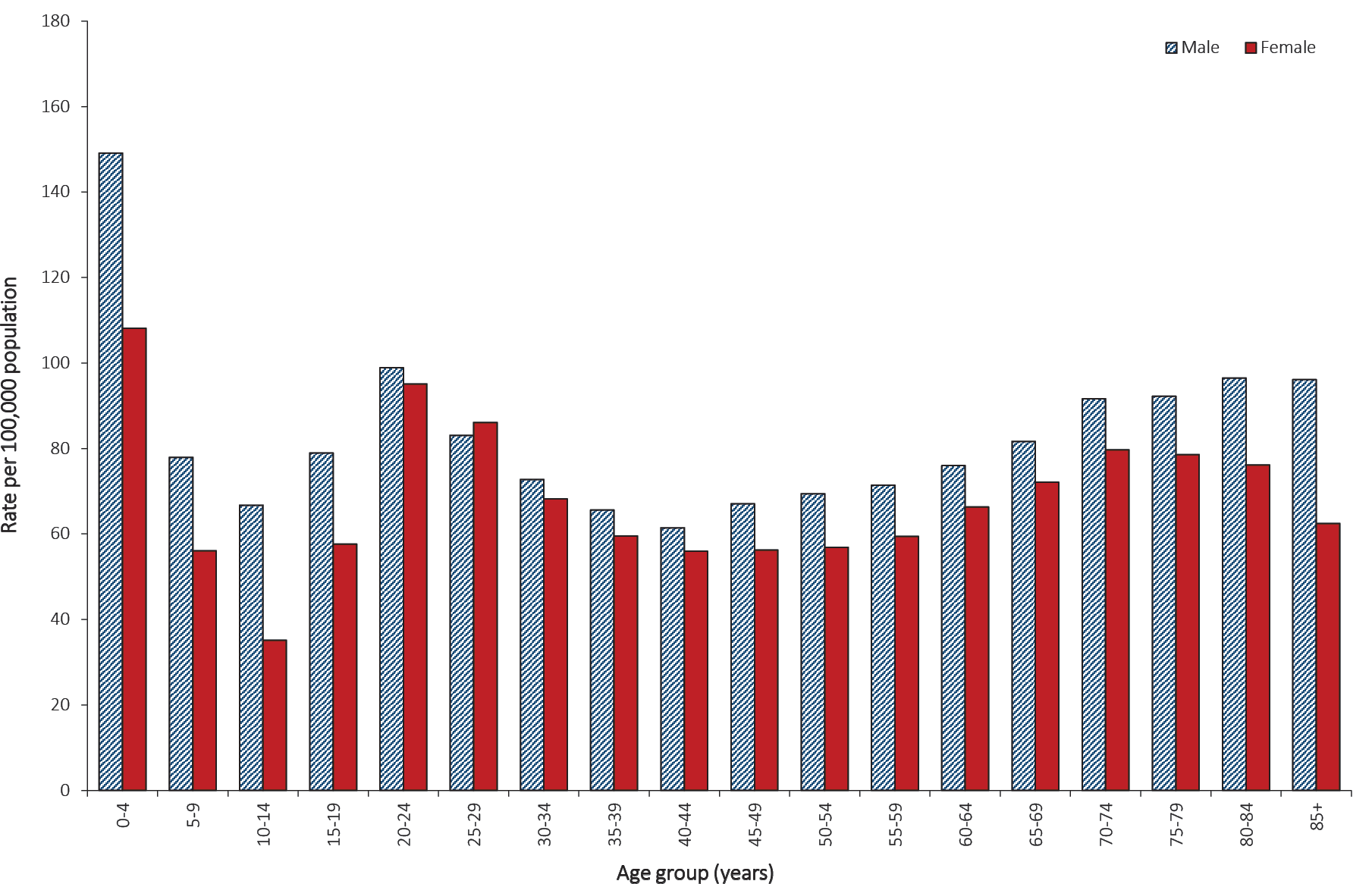
Figure 1: Mean notification rate for campylobacteriosis, by age group and sex,a Australia,b 2013–2015



a Twenty-eight cases missing date of birth so no age group could be calculated; 47 cases missing sex; and five cases missing both date of birth and sex.

b Excludes New South Wales.

Figure 2: Mean notification rate for campylobacteriosis, by age group and sex,a Australia,b 2008–2012



a Sixty-four cases missing date of birth so no age group could be calculated; 95 cases missing sex; and 36 cases missing both date of birth and sex.

b Excludes New South Wales.

# Cholera

Only the toxigenic Vibrio cholerae O1 and O139 serotypes are notifiable in Australia. Over the reporting period (2013–2015), there were seven notifications of cholera, all of which were O1 serotype (2013 n = 3; 2014 n = 2; 2015 n = 2). These notifications were reported by New South Wales (n = 3); Victoria (n = 3); and South Australia (n = 1).

One of the notifications in 2013 was locally acquired in a laboratory,20 with the others over the reporting period all acquired overseas: India (n = 2); Bangladesh (n = 2); Indonesia (n = 1); and Thailand (n = 1).

# Hepatitis A

In 2013, there were 190 notifications of hepatitis A infection in Australia, which increased to 231 notifications in 2014 and decreased to 179 notifications in 2015. This compares to the five-year historical mean (2008–2012) of 283 notifications per year (Table 3). For the reporting period (2013–2015), the median age of cases was 25 years (range 1–85 years) and 58% of the notifications (350/600) were in males.

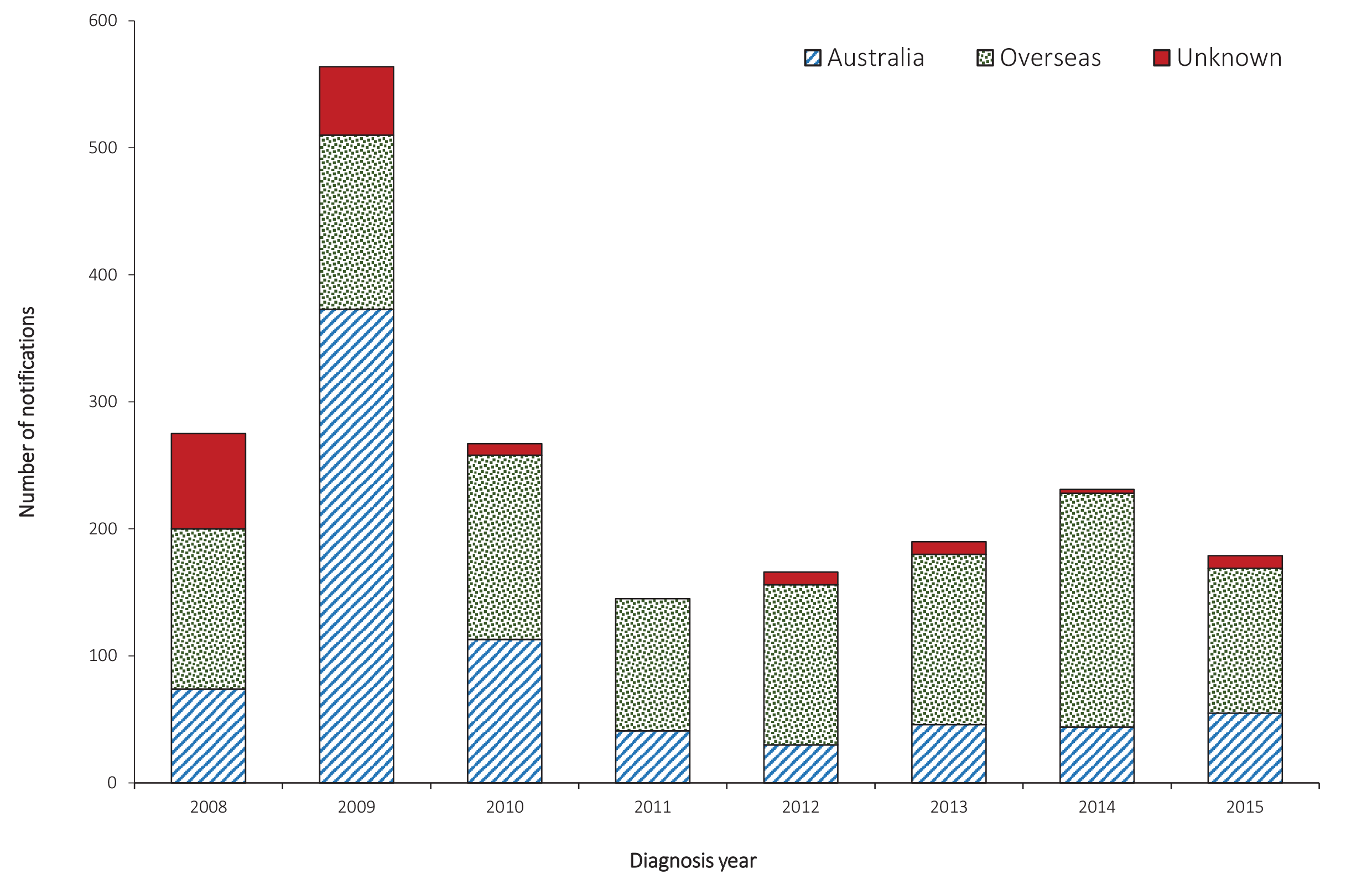
Table 3: Mean notifications 2008–2012, and number of notified cases of hepatitis A, by state or territory, Australia, 2013–2015

| Diagnosis year | ACT | NSW | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2008–2012 (mean notifications per annum) | 4 | 70 | 3 | 46 | 19 | 3 | 116 | 23 | 283 |
| 2013 | 4 | 62 | 0 | 46 | 11 | 0 | 53 | 14 | 190 |
| 2014 | 5 | 83 | 2 | 44 | 7 | 1 | 70 | 19 | 231 |
| 2015 | 3 | 69 | 5 | 33 | 10 | 1 | 33 | 25 | 179 |

Indigenous status was known for 97% of hepatitis A cases (580/600) during the 2013–2015 reporting period. Of these, 2% (11/580) identified as being Aboriginal and/or Torres Strait Islander. This is consistent with the small number of such cases reported during 2008–2012 (n = 14), and marks a shift from the 2004–2006 period when 10–15% of cases per year (28–49 cases) identified as being Aboriginal and/or Torres Strait Islander.21–23

Over the reporting period (2013–2015), 72% of hepatitis A infections (432/600) were acquired overseas. Countries of acquisition included India (62/432; 14%); Fiji (52/432; 12%); and the Philippines (48/432; 11%). The country of acquisition was unknown for 23 notifications, and 145 infections were reported to be acquired in Australia (Figure 3).

Figure 3: Place of acquisition for hepatitis A cases, by year of diagnosis, Australia, 2008–2015



In 2015, the number of notifications acquired in Australia increased to 55, from 44 in 2014. This increase was associated with an outbreak of hepatitis A connected with the consumption of imported frozen berries (see multi-jurisdictional outbreak investigations section). This was the largest outbreak of hepatitis A in Australian since an outbreak in 2009–2010, which was associated with the consumption of semi-dried tomatoes.21,24

# Hepatitis E

In 2013, there were 34 notifications of hepatitis E infection in Australia, which increased to 58 notifications in 2014 and decreased to 41 notifications in 2015. This compares to the five-year historical mean (2008–2012) of 37 notifications per year.

More than half of the notifications (78/133; 59%) during the 2013–2015 reporting period were in New South Wales (Table 4). During the reporting period (2013–2015), the median age of cases was 45 years (range 4–79 years) and more than half of the notifications were in males (81/133; 61%).

Table 4: Mean notifications 2008–2012, and number of notified cases of hepatitis E, by state or territory, Australia, 2013–2015

| Diagnosis year | ACT | NSW | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2008–2012 (mean notifications per annum) | 1 | 15 | 1 | 6 | 0 | 0 | 11 | 4 | 37 |
| 2013 | 1 | 19 | 0 | 2 | 0 | 0 | 8 | 4 | 34 |
| 2014 | 1 | 38 | 0 | 7 | 0 | 0 | 12 | 0 | 58 |
| 2015 | 0 | 21 | 0 | 1 | 1 | 1 | 15 | 2 | 41 |

Hepatitis E in Australia has traditionally been associated with overseas travel. Over the reporting period (2013–2015), 65% of hepatitis E infections (86/133) were acquired overseas. Of these, 45% (39/86) reported travel to India. The country of acquisition was unknown for 14 notifications; 33 infections were reported to be acquired in Australia.

In 2014, 36% of cases (21/58) were locally acquired, with the majority of these reported in New South Wales residents (n = 20). The large number of notified cases among residents from New South Wales can be attributed to an outbreak of hepatitis E infection associated with consumption of pork liver pâté at a specific restaurant in that state.25 This was the first documented locally-acquired outbreak of hepatitis E in Australia.

# Listeriosis

Between 2013 and 2015, notifications of Listeria monocytogenes infection ranged from 70 to 80 cases each year, which was similar to the five-year historical mean (2008–2012) of 79 cases per year (Table 5).

Table 5: Mean notifications 2008–2012, and number of notified cases of listeriosis, by state or territory, Australia, 2013–2015

| Diagnosis year | ACT | NSW | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2008–2012 (mean notifications per annum) | 1 | 29 | 0 | 10 | 3 | 2 | 24 | 8 | 79 |
| 2013 | 1 | 29 | 3 | 9 | 2 | 2 | 22 | 8 | 76 |
| 2014 | 1 | 23 | 2 | 17 | 6 | 4 | 22 | 5 | 80 |
| 2015 | 1 | 28 | 2 | 8 | 4 | 0 | 21 | 6 | 70 |

Over the reporting period (2013–2015), the median age of listeriosis cases was 67 years (range 0–96 years), with 68% of notifications (153/226) occurring in people 60 years of age or older. Fifty-three percent of notifications were in males (119/226). Six cases identified as being Aboriginal and/or Torres Strait Islander (2013 n = 3; 2014 n = 1; 2015 n = 2).

Multi-locus sequence typing (MLST) is determined in silico from whole genome sequencing data. A total of 31 different listeriosis MLST types were reported during the 2013–2015 reporting period (Table 6). A multi-jurisdictional outbreak which commenced in December 2012 and continued through to mid-2013, and was associated with the consumption of brie and/or camembert cheese, was MLST 1.18

Table 6: Most common listeriosis MLST types,a Australia, 2013–2015

| 2013 | | | 2014 | | | | 2015 | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MLST | n | % | MLST | | n | % | MLST | n | % |
| 1 | 27 | 38% | 1 | | 25 | 34% | 3 | 15 | 22% |
| 3 | 13 | 18% | 3 | | 11 | 15% | 1 | 8 | 12% |
| 9 | 6 | 8% | 2 | | 9 | 12% | 2 | 5 | 7% |
| 2 | 3 | 4% | 9 | | 3 | 4% | 87 | 5 | 7% |
| 4 | 3 | 4% | 204 | | 3 | 4% | 155 | 5 | 7% |
| 7 | 3 | 4% | 321 | | 3 | 4% |  |  |  |
| 204 | 3 | 4% | |  |  |  |  | | |

a Excluding cases with isolates not typed (n = 9), and with maternal/foetal infection counted once only (n = 4).

## Perinatal cases

Over the reporting period (2013–2015) there were 28 perinatal listeriosis notifications (Table 7). In 2013, there were six notifications representing three mother/baby pairs (both mother and baby were notified), and one notification in a baby only. In 2014, there were ten notifications representing five mother/baby pairs, and four notifications in a mother only. In 2015, there were three notifications in a mother only and four notifications in a baby only. The outcome for five pregnancies was neonatal death (2013 n = 2; 2014 n = 3); all pregnant women survived.

Table 7: Listeriosis cases, by non-perinatal and perinatal cases, Australia, 2013–2015

| Diagnosis year | Non-perinatal cases | Perinatal cases | Perinatal cases: adults | Perinatal cases: neonates |
| --- | --- | --- | --- | --- |
| 2013 | 69 | 7 | 3 | 4 |
| 2014 | 66 | 14 | 9 | 5 |
| 2015 | 63 | 7 | 3 | 4 |

## Non-perinatal cases

Over the reporting period (2013–2015) there were 198 non-perinatal listeriosis notifications. In 2013 slightly more cases were in females (52%); however, in 2014 and 2015 more cases were in males (58% and 62% respectively). In all years the majority of cases (at least 64%) were aged 65 years or older, with approximately one quarter of cases aged 80 years or older in all years (range 23–29%) (Table 8).

Table 8: Non-perinatal listeriosis cases, by sex and age group, Australia, 2013–2015

| Diagnosis year | Male | | | Female | | | Aged ≥ 65 years | | Aged ≥ 80 years | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| n | % | Rate/100,000 | n | % | Rate/100,000 | n | % | n | % |
| 2013 | 33 | 48% | 0.29 | 36 | 52% | 0.31 | 44 | 64% | 16 | 23% |
| 2014 | 38 | 58% | 0.33 | 28 | 42% | 0.24 | 44 | 67% | 19 | 29% |
| 2015 | 39 | 62% | 0.33 | 24 | 38% | 0.20 | 41 | 65% | 17 | 27% |

During the reporting period (2013–2015), septicaemia was the most common clinical presentation and was associated with the greatest number of deaths (Table 9).

Table 9: Non-perinatal listeriosis cases, by clinical presentation and outcome, Australia, 2013–2015

| Diagnosis year | Septicaemia | | | Meningitis and septicaemia | | | Meningitis | | | Othera | | | Unknown | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| n | % | Deaths | n | % | Deaths | n | % | Deaths | n | % | Deaths | n | % | Deaths |
| 2013 | 45 | 65% | 5 | 9 | 13% | 1 | 3 | 4% | 0 | 6 | 9% | 0 | 6 | 9% | 1 |
| 2014 | 44 | 67% | 5 | 1 | 2% | 0 | – | – | – | 7 | 11% | 3 | 14 | 21% | 1 |
| 2015 | 46 | 73% | 9 | 4 | 6% | 1 | 5 | 8% | 2 | 4 | 6% | 0 | 4 | 6% | 0 |

a ‘Other’ includes: mild illness; septic arthritis; abscesses; bacteraemia; encephalitis; weakness; knee swelling; diarrhoea and weight loss; abdominal distention; non-neutropenic fever; and urosepsis.

Over the reporting period (2013–2015), 12 cases reported no known comorbidities (Table 10). These cases ranged in age between 1 and 95 years. None of these cases reported taking medications including corticosteroids, cyclosporine or other immunosuppressive drugs, antidiarrheal medications, or gastric acid medications in the four weeks prior to illness; however, two cases reported taking antacids in the four weeks prior to illness.

Table 10: Non-perinatal listeriosis cases, by immunocompromising risk factors, Australia, 2013–2015

| Immunocompromising risk factors | 2013 | | 2014 | | 2015 | |
| --- | --- | --- | --- | --- | --- | --- |
| n | % | n | % | n | % |
| No comorbidities | 5 | 7% | 4 | 6% | 3 | 5% |
| Blood disorder | 11 | 16% | 14 | 21% | 9 | 14% |
| Cancer | 22 | 32% | 27 | 41% | 27 | 43% |
| Diabetes | 12 | 17% | 18 | 27% | 16 | 25% |
| Heart disease | 26 | 38% | 22 | 33% | 24 | 38% |
| Liver disease | 9 | 13% | 10 | 15% | 11 | 17% |
| Chronic lung disease (excluding asthma) | 6 | 9% | 4 | 6% | 7 | 11% |
| Organ transplant | 2 | 3% | 3 | 5% | 1 | 2% |
| Renal / kidney disease requiring dialysis | 4 | 6% | 8 | 12% | 6 | 10% |
| Other renal disease | 8 | 12% | 7 | 11% | 10 | 16% |
| Rheumatological condition | 12 | 17% | 15 | 23% | 13 | 21% |

Over the reporting period (2013–2015) the vast majority of cases (93–95% per year) reported at least one illness or condition known to increase the risk of listeriosis infection, with cancer and heart disease the most commonly-reported conditions (Table 10).

# Salmonellosis

During the reporting period (2013–2015), salmonellosis rates continued to increase nationally (Figure 4), with notifications and rates in 2015 the highest on record (17,001 notifications; 71 cases per 100,000 population). The increased notifications in 2014 and 2015 are likely, in part, to be reflective of the increased incidence of CIDT using PCR since 2013.

Figure 4: Notification rate for salmonellosis, by year of diagnosis, Australia, 1991–2015

Table 4 shows the number of notified hepatitis E cases for 2013, 2014 and 2015, and the five year historical mean number of notifications (2008–2012), by state or territory.

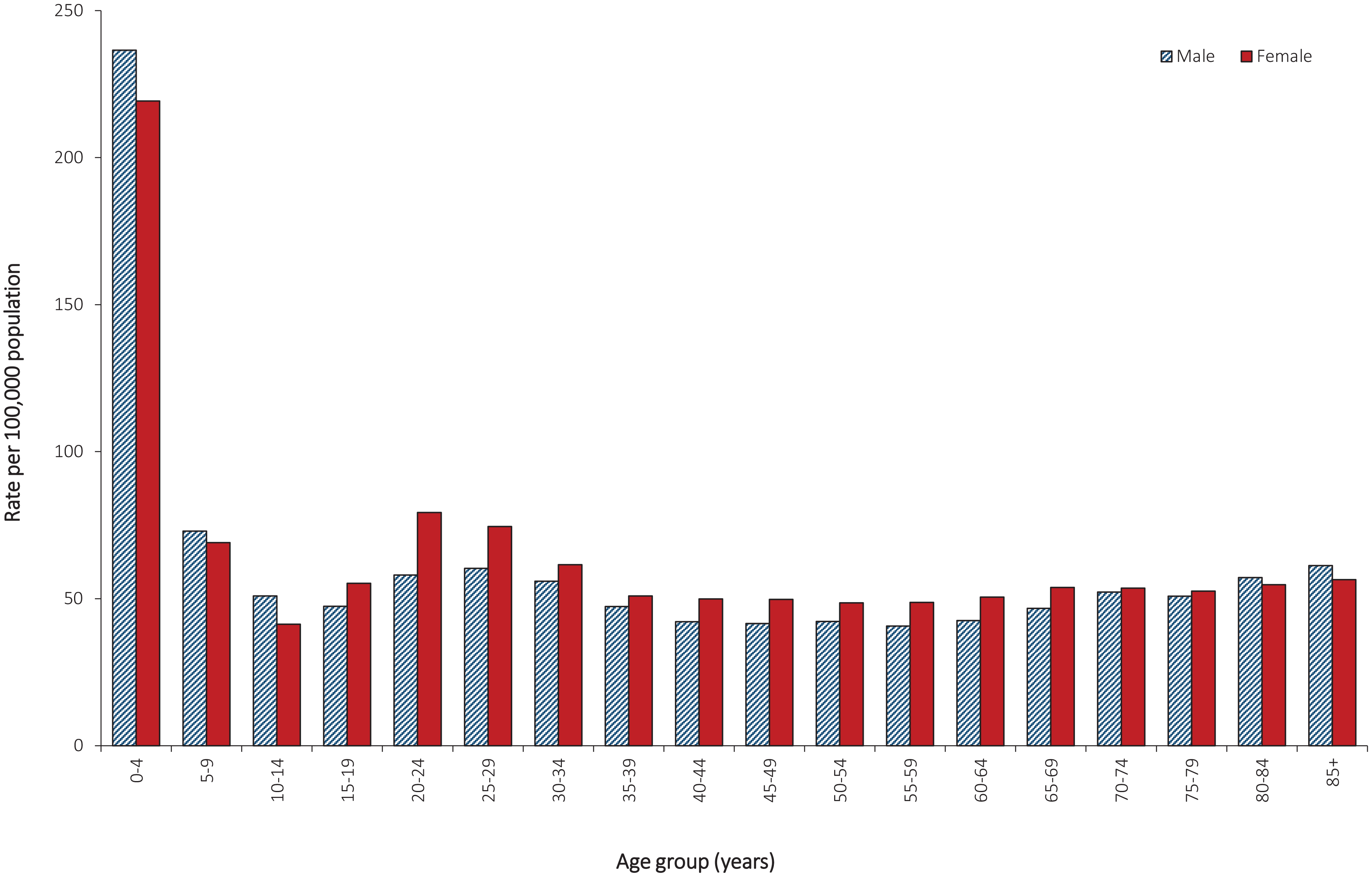

Between 2013 and 2015, all jurisdictions except the Australian Capital Territory saw an increase in salmonellosis notification rates. The highest increase in notification rates was observed in Queensland (64% increase from 2013 to 2015), followed by the Northern Territory (40% increase from 2013 to 2015) (Table 11).

Table 11: Number of notified cases and crude rates of salmonellosis by state or territory, compared with the five-year historical mean rate, Australia, 2013–2015

|  | | ACT | NSW | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2013 | Notified cases | 278 | 3,421 | 387 | 3,208 | 975 | 248 | 2,939 | 1,268 | 12,724 |
| Crude rate | 72 | 46 | 159 | 69 | 58 | 48 | 51 | 51 | 55 |
| Mean rate 2008–2012 | 53 | 42 | 207 | 59 | 48 | 43 | 39 | 50 | 48 |
| 2014 | Notified cases | 221 | 4,286 | 456 | 4,924 | 1,220 | 250 | 3,675 | 1,251 | 16,283 |
| Crude rate | 57 | 57 | 187 | 104 | 72 | 49 | 62 | 50 | 69 |
| Mean rate 2009–2013 | 60 | 45 | 194 | 63 | 51 | 44 | 43 | 52 | 51 |
| 2015 | Notified cases | 237 | 4,057 | 545 | 5,416 | 1,263 | 256 | 3,520 | 1,707 | 17,001 |
| Crude rate | 60 | 53 | 222 | 113 | 74 | 50 | 58 | 67 | 71 |
| Mean rate 2010–2014 | 59 | 49 | 188 | 73 | 58 | 47 | 50 | 52 | 56 |

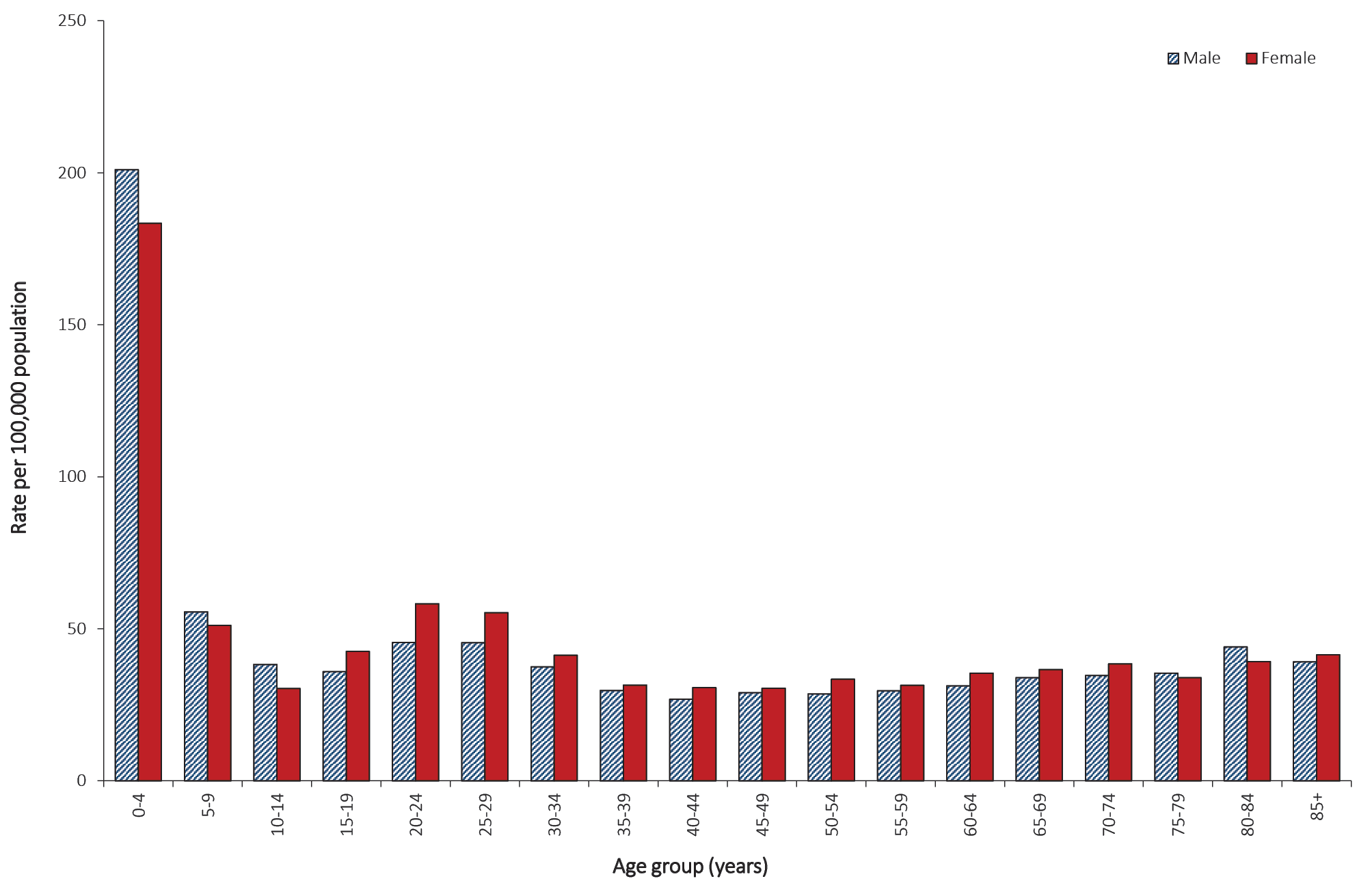
Over the reporting period (2013 to 2015), just over half of the salmonellosis notifications were in females (23,750/46,008; 52%). The mean salmonellosis notification rate for 2013–2015 by age group and sex was higher than the five-year historical mean (2008–2012) across all age and sex categories (Figure 5 compared to Figure 6). Over 2013–2015, notification rates in females and males aged 0–4 years increased 16% and 15% respectively compared to the five-year historical mean (2008–2012) (Figure 5 and Figure 6).

Figure 5: Mean notification rate for salmonellosis, by age group and sex,a Australia, 2013–2015



a Eleven cases missing date of birth so no age group could be calculated; 66 cases missing sex; and three cases missing both sex and date of birth.

Figure 6: Mean notification rate for salmonellosis, by age group and sex,a Australia, 2008–2012



a Twenty-two cases missing date of birth so no age group could be calculated; 115 cases missing sex; and eight cases missing both sex and date of birth.

Of the 46,008 salmonellosis notifications during 2013–2015, 93% (n = 42,966) were further typed at an enteric reference laboratory into 334 unique serovars. S. Typhimurium was the most commonly-notified serovar during the reporting period (2013–2015), accounting for just under half (20,795/42,966; 48%) of all typed notifications (Table 12).

Table 12: Number of notifications of the five most common *Salmonella* serotypes, Australia, 2013–2015

|  | | 2013 | 2014 | 2015 | Mean notifications 2008–2012 |
| --- | --- | --- | --- | --- | --- |
| *S.* Typhimurium | n | 5,687 | 7,822 | 7,286 | 4,734 |
| % | 45% | 48% | 43% | 45% |
| *S*. Enteritidis | n | 784 | 823 | 888 | 715 |
| % | 6% | 5% | 5% | 7% |
| *S*. Virchow | n | 561 | 731 | 755 | 483 |
| % | 4% | 4% | 4% | 5% |
| *S*. Saintpaul | n | 366 | 466 | 722 | 379 |
| % | 3% | 3% | 4% | 4% |
| *S*. Paratyphi B biovar Java | n | 301 | 289 | 333 | 239 |
| % | 2% | 2% | 2% | 2% |
| **Total Salmonella** | **n** | **12,724** | **16,283** | **17,001** | **10,567** |

## 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.26,27 The majority of cases in Australia are associated with overseas travel. To monitor incidence of this serotype in Australia, OzFoodNet conducts enhanced surveillance of locally-acquired infections of S. Enteritidis in humans.

Over the reporting period (2013–2015), OzFoodNet sites reported 2,495 cases of S. Enteritidis infection (Table 12), a mean of 832 notifications per year. This compares with the five-year historical mean (2008–2012) of 715 notifications per year; however, annual notifications have been in excess of 800 notifications per year from 2010 onwards.

Travel histories were obtained for 80% of cases (1,985/2,495) during the 2013–2015 reporting period, which is lower than in previous years (94% in 2012 and 95% in 2011). Of those cases during the reporting period (2013–2015) with completed travel history, 92% (1,824/1,985) reported overseas travel and 8% (n = 161) were locally acquired. Western Australia reported the highest number of all notified cases (666/2,495; 26%) and the highest number of locally-acquired cases (51/161; 32%) (Table 13).

Table 13: Number of *Salmonella* Enteritidis infections, by travel history and state or territory, Australia, 2013–2015

| State or territory | Locally acquired | Overseas acquired | Unknown | Total |
| --- | --- | --- | --- | --- |
| ACT | 3 | 21 | 1 | 25 |
| NSW | 28 | 346 | 86 | 460 |
| NT | 2 | 27 | 4 | 33 |
| Qld | 41 | 110 | 369 | 520 |
| SA | 6 | 174 | 0 | 180 |
| Tas. | 9 | 23 | 3 | 35 |
| Vic. | 21 | 524 | 31 | 576 |
| WA | 51 | 599 | 16 | 666 |
| **Total** | **161** | **1,824** | **510** | **2,495** |

Of those S. Enteritidis cases who reported overseas travel, 1,727 cases provided information on the country and/or region of travel. South-East Asia (1,445/1,727; 84%) was the most common region of reported overseas travel. Similar to previous years, the most common reported overseas country of acquisition in South-East Asia was Indonesia (1,000/1,445; 69%), followed by Malaysia (139/1,445; 10%), Thailand (107/1,445; 7%) and Singapore (105/1,445; 7%).

Phage typing was performed on 47% of the S. Enteritidis cases with recorded travel history (873/1,867). The most common phage types among overseas-acquired cases and locally-acquired cases are listed in Table 14. Locally-acquired cases were sporadic with no clusters detected by person, place, or time.

Table 14: Five most common phage types of locally- and overseas-acquired *Salmonella* Enteritidis infections, Australia, 2013–2015

| Overseas-acquired cases | | | Locally-acquired cases | | |
| --- | --- | --- | --- | --- | --- |
| Phage type | n | % of total typed (n = 785) | Phage type | n | % of total typed (n = 88) |
| 1 | 271 | 35% | 26 | 22 | 25% |
| 21 | 75 | 10% | 1 | 17 | 19% |
| 6A | 74 | 9% | RDNC | 16 | 18% |
| RDNCa | 66 | 8% | 6A | 6 | 7% |
| 1B | 52 | 7% | 21 | 5 | 6% |

a RDNC: Reaction does not conform.

# Shigellosis

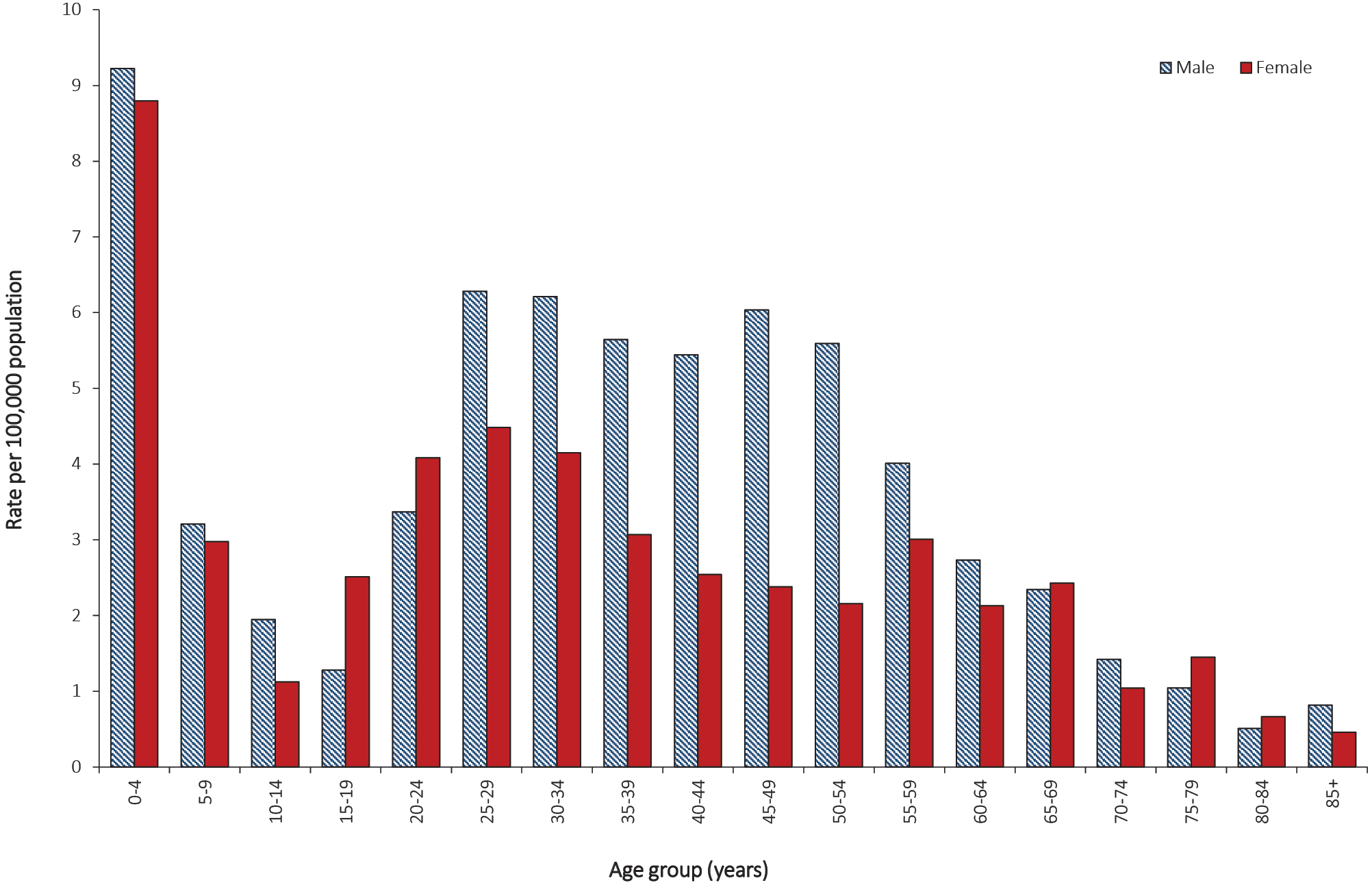
There were 537 notifications of Shigella infection in Australia in 2013, a rate of two cases per 100,000 population, compared with the five-year historical mean of three cases per 100,000 population per year (Table 15). In 2014, the number of national notifications and the national rate of notifications doubled, to 1,035 notifications and a rate of four cases per 100,000 population. This elevated level was maintained in 2015, with 1,037 notifications and a rate of four cases per 100,000 population. The increased notifications in 2014 and 2015 are likely, in part, to be reflective of the increased incidence of CIDT using PCR since 2013.

Table 15: Number of notified cases and crude rates of shigellosis by state or territory, compared with the five-year historical mean rate, Australia, 2013–2015

|  | | ACT | NSW | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2013 | Notified cases | 10 | 149 | 107 | 72 | 29 | 3 | 115 | 52 | 537 |
| Crude rate | 3 | 2 | 44 | 2 | 2 | 1 | 2 | 2 | 2 |
| Mean rate 2008–2012 | 2 | 2 | 46 | 2 | 4 | 1 | 2 | 5 | 3 |
| 2014 | Notified cases | 9 | 200 | 99 | 171 | 22 | 2 | 464 | 68 | 1,035 |
| Crude rate | 2 | 3 | 41 | 4 | 1 | 0 | 8 | 3 | 4 |
| Mean rate 2009–2013 | 2 | 2 | 39 | 2 | 3 | 1 | 2 | 4 | 2 |
| 2015 | Notified cases | 7 | 176 | 136 | 145 | 18 | 6 | 542 | 97 | 1,037 |
| Crude rate | 2 | 2 | 56 | 3 | 1 | 1 | 7 | 4 | 4 |
| Mean rate 2010–2014 | 2 | 2 | 39 | 2 | 2 | 1 | 3 | 3 | 3 |

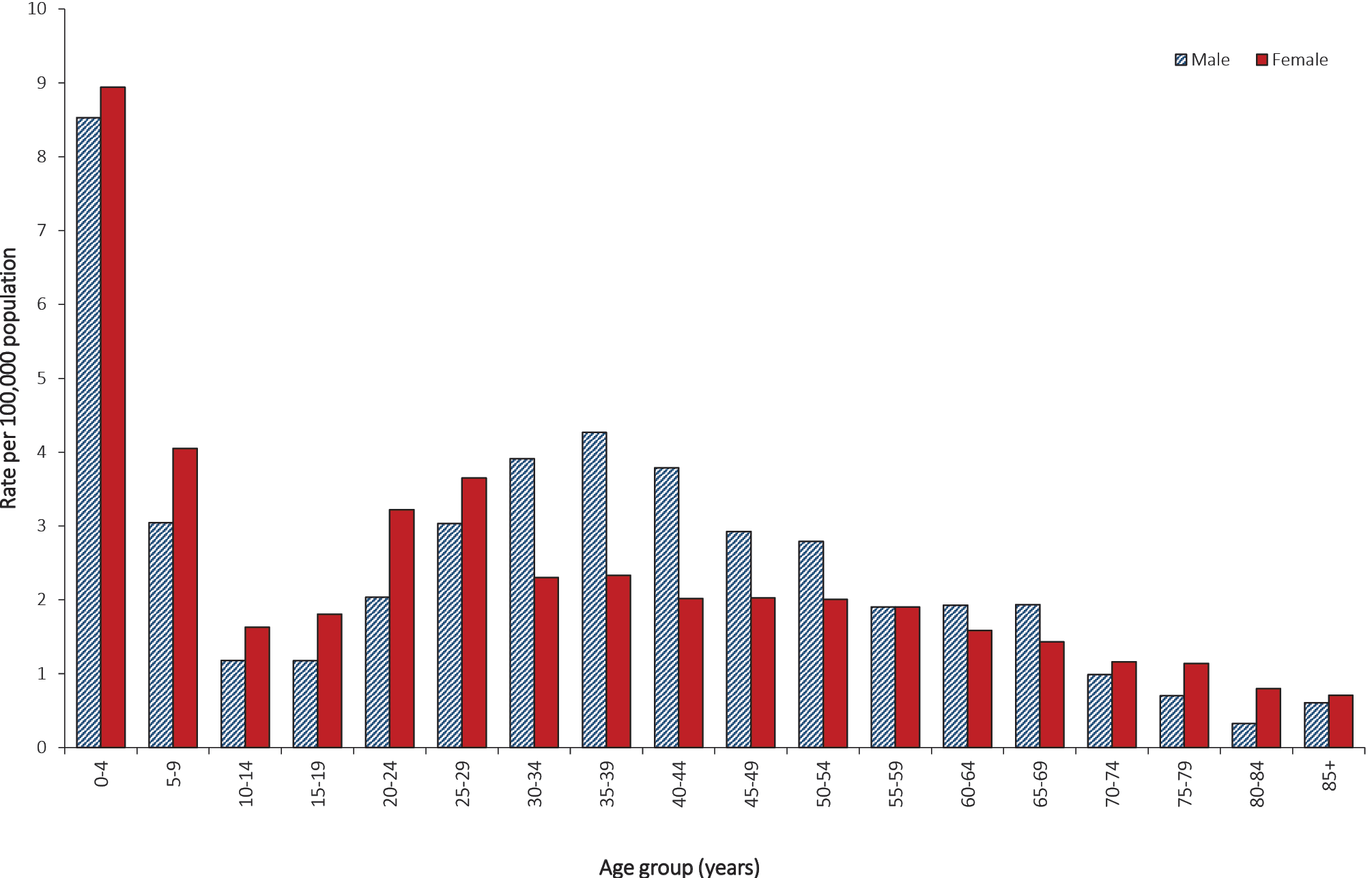
Over the reporting period (2013–2015), more than half of the shigellosis notifications were in males (1,516/2,609; 58%). The mean notification rate for 2013–2015 by age group and sex was greater than the five-year historical mean (2008–2012) for both males and females between 15 and 69 years (Figure 7 and Figure 8). Over the reporting period (2013–2015), Indigenous status was recorded for 88% of shigellosis cases (2,299/2,609). Of these cases, 21% (492/2,299) identified as being Aboriginal and/or Torres Strait Islander.

Figure 7: Mean notification rate for shigellosis, by age and sex,a Australia, 2013–2015



a Three cases missing sex.

Figure 8: Mean notification rate for shigellosis, by age and sex,a Australia, 2008–2012



a One case missing date of birth so no age group could be calculated; and two cases missing sex.

Travel history information was available for 59% of shigellosis notifications (1,541/2,609) over the 2013–2015 reporting period, and of these, 63% (975/1,541) acquired their illness overseas. The countries most commonly reported as the place of acquisition for shigellosis were Indonesia (213/975; 22%) and India (202/975; 21%). The number of shigellosis cases acquired in Indonesia and India each year has increased, as has the total number of overseas-acquired shigellosis notifications (Table 16).

Table 16: Number of notified cases acquired in Indonesia, India; and the total number of overseas-acquired cases, shigellosis, by year, Australia, 2008–2015

| Diagnosis year | Indonesia | India | Total overseas acquired cases | Overseas acquired % of all cases | Total cases |
| --- | --- | --- | --- | --- | --- |
| 2008 | 13 | 17 | 133 | 16% | 830 |
| 2009 | 19 | 11 | 124 | 20% | 617 |
| 2010 | 59 | 24 | 193 | 35% | 552 |
| 2011 | 48 | 27 | 149 | 30% | 493 |
| 2012 | 44 | 40 | 201 | 37% | 548 |
| 2013 | 36 | 47 | 208 | 39% | 537 |
| 2014 | 82 | 55 | 334 | 32% | 1,035 |
| 2015 | 95 | 100 | 433 | 42% | 1,037 |

Table 17: Number of notifications of the ten most common serotypes/biotypes of *Shigella* infections, Australia, 2013–2015

| Biotype | Mean notifications 2008–2012 | 2013 | 2014 | 2015 |
| --- | --- | --- | --- | --- |
| Shigella sonnei biotype g | 173 | 132 | 309 | 238 |
| Shigella sonnei biotype a | 164 | 109 | 101 | 176 |
| Shigella sonnei biotype f | 4 | 25 | 87 | 13 |
| Shigella sonnei biotype unknown | 41 | 25 | 45 | 50 |
| Shigella flexneri serotype 2a | 38 | 34 | 31 | 32 |
| Shigella flexneri serotype 3a | 30 | 25 | 69 | 38 |
| Shigella flexneri serotype 4a | 44 | 51 | 10 | 5 |
| Shigella flexneri serotype unknown | 16 | 23 | 8 | 21 |
| Shigella flexneri serotype 4 | 23 | 18 | 13 | 8 |
| Shigella flexneri serotype 2b | 11 | 7 | 19 | 6 |

Almost three-quarters of Shigella isolates during the reporting period (2013–2015) were typed (1,919/2,609; 74%), which is a decrease on the previous five-year period 2008–2012 (2,958/3,040; 97%). An increase in the number of notifications that were listed as ‘untyped’ occurred in 2014 and 2015, and is likely to be reflective of an increase in CIDT since 2013.

Of the notifications that were typed, Shigella sonnei was the most frequent species notified (1,313/1,919; 68%), followed by Shigella flexneri (550/1,919; 29%). There were also 44 notifications of Shigella boydii and 12 notifications of Shigella dysenteriae.

# Paratyphoid

Salmonella serovars Paratyphi A, B and C (not including S. Paratyphi B biovar Java) cause an enteric fever similar to that caused by S. Typhi but which is typically milder, and is commonly referred to as paratyphoid. On 1 January 2016, CDNA endorsed a surveillance case definition for paratyphoid, meaning it was separated out from cases of Salmonella infection.28 The case definition was applied to all retrospective data.

From 2013–2015, there were 74, 70 and 76 notifications of paratyphoid respectively, compared to the five-year historical mean (2008–2012) of 71 notifications per year. Between 2013 and 2015, just over half of the notifications were in males (119/220; 54%).

Over the reporting period (2013–2015), 88% of paratyphoid notifications (194/220) were caused by S. Paratyphi A infection, with the remainder (26/220) due to S. Paratyphi B infection.

Travel history information was available for the majority of paratyphoid notifications (195/220; 89%) over the 2013–2015 reporting period and of these, 95% (186/195) acquired their illness overseas. The most common overseas countries of acquisition were India (n = 68); Cambodia (n = 33); Indonesia (n = 18); and Bangladesh (n = 10). The country of acquisition was unknown for 25 notifications and nine infections were reported to be acquired in Australia.

# Typhoid

In 2013, there were 150 notifications of Salmonella Typhi infection (typhoid fever) in Australia, which decreased to 117 notifications in 2014 and 114 notifications in 2015. This compares to the five-year historical mean (2008–2012) of 115 notifications per year. Almost two-thirds (248/381; 65%) of notifications during the reporting period (2013–2015) were in New South Wales (n = 146) and Victoria (n = 102) (Table 18). Between 2013 and 2015, just over half of the notifications were in males (200/381; 52%).

Table 18: Mean notifications 2008–2012, and number of notified cases of typhoid fever, by state or territory, Australia, 2013–2015

| Diagnosis year | ACT | NSW | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2008–2012 (mean notifications per annum) | 1 | 42 | 2 | 18 | 4 | 1 | 34 | 12 | 115 |
| 2013 | 5 | 59 | 0 | 24 | 8 | 0 | 44 | 10 | 150 |
| 2014 | 1 | 45 | 1 | 17 | 9 | 1 | 29 | 14 | 117 |
| 2015 | 2 | 42 | 0 | 24 | 8 | 1 | 29 | 8 | 114 |

Travel history information was available for 98% of typhoid fever notifications (375/381) over the 2013–2015 reporting period; of these, 95% (357/375) acquired their illness overseas. More than half of the overseas-acquired typhoid fever notifications were acquired in India (211/357; 59%); with Pakistan (n = 29), Bangladesh (n = 25) and Indonesia (n = 17) the next most common countries of acquisition. The country of acquisition was unknown for six notifications and 18 infections were reported to be acquired in Australia. The most commonly-notified phage type was E1 and these infections were mostly associated with travel to India (Table 19).

Table 19: Notifications of *Salmonella* Typhi infection, by phage type and country of acquisition, Australia, 2013–2015

| Phage type | Australia | India | Pakistan | Bangladesh | Indonesia | Other countries | Unknown | Total |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E1 | 5 | 76 | 4 | 2 | 0 | 13 | 2 | 102 |
| E9 | 4 | 10 | 7 | 5 | 0 | 5 | 1 | 32 |
| D2 | 2 | 0 | 0 | 1 | 3 | 13 | 2 | 21 |
| Other types | 4 | 23 | 3 | 5 | 1 | 12 | 1 | 49 |
| Unable to be typed | 0 | 11 | 0 | 0 | 1 | 6 | 0 | 18 |
| Unknown | 3 | 91 | 15 | 12 | 12 | 26 | 0 | 159 |
| **Total** | **18** | **211** | **29** | **25** | **17** | **75** | **6** | **381** |

# Shiga toxin-producing Escherichia coli (STEC) infection

In 2013, there were 180 notifications of STEC infection in Australia, which decreased to 115 notifications in 2014 and then increased to 136 notifications in 2015. This compares to the five-year historical mean (2008–2012) of 103 notifications per year (Table 20). In 2013, a large outbreak (n = 57) of STEC infection associated with a Queensland agricultural show contributed to the high number of notifications seen in that year.29

Table 20: Mean notifications 2008–2012, and number of notified cases of STEC, by state or territory, Australia, 2013–2015

| Diagnosis year | ACT | NSW | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2008–2012 (mean notifications per annum) | 2 | 15 | 1 | 22 | 46 | 2 | 12 | 4 | **103** |
| 2013 | 3 | 25 | 0 | 83 | 53 | 1 | 11 | 4 | **180** |
| 2014 | 0 | 30 | 0 | 28 | 45 | 0 | 10 | 2 | **115** |
| 2015 | 0 | 30 | 0 | 32 | 45 | 0 | 29 | 0 | **136** |

Thirty of the STEC cases notified over the reporting period (2013–2015) were also diagnosed with haemolytic uraemic syndrome (HUS). As per the NNDSS surveillance case definitions,[[2]](#footnote-3) these conditions are notified separately; see the HUS section.

During the reporting period (2013–2015), the median age of STEC cases was 30 years (range 0–91 years) and just over half of the notifications were in females (229/431; 53%).

Notified cases of STEC infection are strongly influenced by state and territory practices regarding the screening of stool specimens.30 In particular, South Australian public health laboratories routinely test all bloody stools with a PCR assay specific for genes coding for Shiga toxins, making rates for this state typically the highest in the country. The serogroups targeted by the South Australian PCR during the reporting period only included O26, O111, O113 and O157.

For the reporting period (2013–2015), serogroup information was available for 68% of STEC cases (292/431). The most common serogroups identified were: O157 (173/292; 59%); O26 (44/292; 15%); O111 (21/292; 7%); and O113 (10/292; 3%). Serogroup information was obtained by serotyping cultured isolates or by PCR targeting serogroup-specific genes. It should be noted that the frequency of serogroups identified may have been influenced by the specific serogroups targeted by these PCRs. The remaining 139 isolates were either not able to be serotyped or were Shiga-toxin positive by PCR only.

# Haemolytic uraemic syndrome (HUS)

From 2013 to 2015 there were 15, 21 and 18 notifications of HUS respectively, compared to the five-year historical mean (2008–2012) of 17 notifications per year (Table 21).

Table 21: Mean notifications 2008–2012, and number of notified cases of HUS, by state or territory, Australia, 2013–2015

| Diagnosis year | ACT | NSW | NT | Qld | SA | Tas. | Vic. | WA | Australia |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2008–2012 (mean notifications per annum) | 0 | 8 | 0 | 4 | 2 | 0 | 4 | 0 | 17 |
| 2013 | 0 | 9 | 1 | 2 | 1 | 0 | 2 | 0 | 15 |
| 2014 | 0 | 6 | 1 | 3 | 4 | 1 | 5 | 1 | 21 |
| 2015 | 0 | 11 | 0 | 2 | 0 | 0 | 4 | 1 | 18 |

During the reporting period (2013–2015), the median age of cases was 8 years (range 0–82 years) and more than half of the notifications were in females (30/54; 56%). Similar to previous years, the majority of cases were in children (33/54; 61%), with the remaining 21 cases in persons over 18 years of age.

Not all diagnoses of HUS are related to enteric pathogens (including those potentially transmitted by food). During the reporting period (2013–2015), 30 notifications of HUS were caused by STEC and 24 were from an unknown cause. Of those caused by STEC, 11 had a serogroup identified, which included serotypes: O157 (n = 3); O111 (n = 3); O26 (n = 2); O28 (n = 2); and O Rough (n = 1). For the remaining 19 HUS cases caused by STEC, isolates were either not able to be serotyped or were Shiga-toxin positive by PCR only.

# Outbreaks of gastrointestinal illness

During 2013–2015, OzFoodNet sites reported 512 outbreaks of gastrointestinal illness caused by foodborne, animal-to-person or waterborne disease, with the totals in each of these years being higher than their respective five-year historical means (Table 22). These outbreaks affected 7,877 people, with 735 hospitalisations and 18 associated deaths. The majority of outbreaks (452/512, 88%) were due to foodborne or suspected foodborne transmission. The remaining 12% of outbreaks were due to waterborne or suspected waterborne transmission (57 outbreaks) and animal-to-human transmission (three outbreaks). Foodborne and suspected foodborne outbreaks affected 7,361 people and resulted in 705 hospitalisations and 18 associated deaths.

Table 22: Outbreaks of gastrointestinal illness reported to state and territory health departments,a Australia, 2013–2015

| Year | Category | Foodborne and suspected foodborne | Animal-to-person | Waterborne and suspected waterborne | Total | Five-year historical mean |
| --- | --- | --- | --- | --- | --- | --- |
| 2013 | Outbreaks | 129 | 2 | 41 | 172 | 145 |
| Number ill | 2,775 | 62 | 293 | 3,130 |  |
| Number hospitalised | 168 | 7 | 16 | 191 |
| Number of fatalities | 6 | 0 | 0 | 6 |
| 2014 | Outbreaks | 166 | 0 | 4 | 170 | 158 |
| Number ill | 2,020 | 0 | 59 | 2,079 |  |
| Number hospitalised | 255 | 0 | 5 | 260 |
| Number of fatalities | 7 | 0 | 0 | 7 |
| 2015 | Outbreaks | 157 | 1 | 12 | 170 | 162 |
| Number ill | 2,566 | 4 | 98 | 2,668 |  |
| Number hospitalised | 282 | 0 | 2 | 284 |
| Number of fatalities | 5 | 0 | 0 | 5 |

a Data regarding person-to-person transmission and outbreaks with an undetermined (unknown) cause were available in previous years; however, these data are not available for this report. Caution should therefore be used when comparing total outbreak numbers with those in previous OzFoodNet annual reports.

# Foodborne and suspected foodborne outbreaks

During 2013–2015, OzFoodNet sites reported 452 outbreaks of foodborne and suspected foodborne disease. The largest number of outbreaks was reported by New South Wales in the 2013–2015 reporting period (135/452; 30%) (Table 23). During this reporting period, foodborne illness outbreaks impacted a mean of 16 persons per outbreak. Foodborne and suspected foodborne outbreaks are reported together within this report.

Table 23: Foodborne outbreaks, by state or territory, Australia, 2013–2015

| Year | State or territorya | Number of outbreaks | Number ill | Mean number of persons ill per outbreak | Number hospitalised | Number of fatalities |
| --- | --- | --- | --- | --- | --- | --- |
| 2013 | MJOI | 2 | 547 | 274 | 1 | 0 |
| ACT | 6 | 362 | 60 | 19 | 0 |
| NSW | 37 | 386 | 10 | 56 | 1 |
| NT | 6 | 32 | 5 | 4 | 0 |
| Qld | 22 | 504 | 23 | 27 | 1 |
| SA | 10 | 101 | 10 | 14 | 0 |
| Tas. | 2 | 43 | 22 | 4 | 0 |
| Vic. | 31 | 615 | 20 | 24 | 4 |
| WA | 13 | 185 | 14 | 19 | 0 |
| **Total** | **129** | **2,775** | **22** | **168** | **6** |
| 2014 | MJOI | 0 | – | – | – | – |
| ACT | 6 | 17 | 3 | 7 | 0 |
| NSW | 41 | 450 | 11 | 88 | 2 |
| NT | 13 | 74 | 6 | 3 | 0 |
| Qld | 35 | 299 | 9 | 27 | 0 |
| SA | 17 | 215 | 13 | 29 | 1 |
| Tas. | 2 | 12 | 6 | 4 | 0 |
| Vic. | 39 | 819 | 21 | 93 | 4 |
| WA | 13 | 134 | 10 | 4 | 0 |
| **Total** | **166** | **2,020** | **12** | **255** | **7** |
| 2015 | MJOI | 1 | 35 | 35 | 16 | 0 |
| ACT | 5 | 66 | 13 | 3 | 0 |
| NSW | 57 | 576 | 10 | 46 | 2 |
| NT | 6 | 66 | 11 | 23 | 0 |
| Qld | 31 | 906 | 29 | 101 | 3 |
| SA | 15 | 149 | 10 | 29 | 0 |
| Tas. | 2 | 128 | 64 | 3 | 0 |
| Vic. | 28 | 427 | 15 | 44 | 0 |
| WA | 12 | 213 | 18 | 17 | 0 |
| **Total** | **157** | **2,566** | **16** | **282** | **5** |
| **2013–2015** | | **452** | **7,361** | **16** | **705** | **18** |

a MJOI: multi-jurisdictional outbreak investigation.

Whole genomic sequencing (WGS) was first used in 2015 by OzFoodNet during the investigation of foodborne disease outbreaks including during a multi-jurisdictional outbreak investigation.

## Aetiologies

Salmonella was the most frequently-identified aetiological agent in foodborne outbreaks during all years of the reporting period (2013–2015), responsible for 53% (n = 239) of all outbreaks and illness in 55% (n = 4,060) of people known to experience foodborne disease during an identified outbreak (Table 24). S. Typhimurium was the most commonly-identified serotype in all years, accounting for 90% (216/239) of Salmonella outbreaks reported during 2013–2015.

Table 24: Foodborne outbreaks and number of ill people, by aetiology, Australia, 2013–2015

| Aetiological agent | 2013 | | 2014 | | 2015 | |
| --- | --- | --- | --- | --- | --- | --- |
| Outbreaks | Number ill | Outbreaks | Number ill | Outbreaks | Number ill |
| *Amanita phalloides* | 0 | – | 1 | 3 | 0 | – |
| *Campylobacter* | 7 | 117 | 3 | 39 | 8 | 125 |
| Ciguatera fish poisoning | 9 | 26 | 15 | 80 | 5 | 18 |
| *Clostridium* | 3 | 58 | 4 | 47 | 4 | 58 |
| *Escherichia coli* | 0 | – | 2 | 9 | 0 | – |
| Fish wax ester | 1 | 4 | 0 | – | 0 | – |
| Haemolytic uraemic syndrome | 0 | – | 1 | 3 | 0 | – |
| Hepatitis A | 1 | 4 | 0 | – | 2 | 40 |
| Hepatitis E | 0 | – | 1 | 17 | 0 | – |
| Histamine fish poisoning (Scombroid) | 2 | 7 | 3 | 12 | 3 | 12 |
| *Listeria monocytogenes* | 2 | 6 | 1 | 3 | 0 | – |
| Norovirus | 15 | 996 | 10 | 224 | 10 | 280 |
| Paralytic shellfish poisoning | 0 | – | 0 | – | 1 | 4 |
| *Salmonella* (other species) | 7 | 89 | 7 | 68 | 9 | 104 |
| *Salmonella* Typhimurium | 44 | 973 | 93 | 1,328 | 79 | 1,498 |
| *Shigella* | 2 | 12 | 2 | 16 | 0 | – |
| *Staphylococcus aureus* | 1 | 8 | 2 | 18 | 0 | – |
| Unknown | 35 | 475 | 21 | 153 | 36 | 427 |
| **Total** | **129** | **2,775** | **166** | **2,020** | **157** | **2,566** |

## Food commodity

Foodborne outbreaks during 2013–2015 were categorised as being attributable to one of 18 food commodities (that is, 17 categories as described by Painter et al,31 with an additional category for lamb meat) 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 outbreak report contained insufficient information to assign the outbreak to a single commodity category, were not attributed to any food category.32

In 47% of foodborne outbreaks (213/452), investigators attributed the outbreak to a single food commodity (Table 25). In 22% of foodborne outbreaks (99/452), the implicated meal contained a mix of ingredients and no single ingredient was implicated. In 31% of foodborne outbreaks (140/452), investigators were unable to definitively attribute the outbreak to a particular food or foods due to a lack of evidence.

Of the 213 outbreaks that were attributed to a single food commodity, the foods most frequently implicated were eggs (124/213, 58%); fish (40/213, 19%); and poultry (27/213, 13%). During these outbreaks 4,145 people became ill, with egg-implicated outbreaks affecting the largest number of people in all years 2013–2015 (2,806/4,145, 68%).

Table 25: Foodborne outbreaks attributed to a single food vehicle,a by food commodity,b Australia, 2013–2015c

| Food commodity | 2013 | | | | 2014 | | | | 2015 | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outbreaks | | Number ill | | Outbreaks | | Number ill | | Outbreaks | | Number ill | |
| n | % | n | % | n | % | n | % | n | % | n | % |
| Beef | 1 | 2% | 4 | < 1% | 1 | 1% | 8 | 1% | 0 | – | – | – |
| Crustaceans | 0 | – | – | – | 1 | 1% | 22 | 2% | 0 | – | – | – |
| Dairy | 1 | 2% | 21 | 1% | 1 | 1% | 3 | < 1% | 0 | – | – | – |
| Eggs | 26 | 47% | 836 | 51% | 47 | 57% | 741 | 74% | 51 | 68% | 1,229 | 81% |
| Fish | 13 | 24% | 41 | 3% | 19 | 23% | 94 | 9% | 8 | 11% | 30 | 2% |
| Fruits and nuts | 0 | – | – | – | 0 | – | – | – | 2 | 3% | 40 | 3% |
| Fungi | 0 | – | – | – | 1 | 1% | 3 | < 1% | 0 | – | – | – |
| Grains and beans | 0 | – | – | – | 1 | 1% | 3 | < 1% | 0 | – | – | – |
| Lamb | 0 | – | – | – | 2 | 2% | 9 | 1% | 0 | – | – | – |
| Leafy greens | 0 | – | – | – | 1 | 1% | 3 | < 1% | 0 | – | – | – |
| Molluscs | 1 | 2% | 525 | 32% | 1 | 1% | 2 | < 1% | 1 | 1% | 4 | < 1% |
| Pork | 0 | – | – | – | 3 | 4% | 43 | 4% | 2 | 3% | 73 | 5% |
| Poultry | 12 | 22% | 193 | 12% | 5 | 6% | 65 | 6% | 10 | 13% | 145 | 10% |
| Root vegetable | 1 | 2% | 4 | < 1% | 0 | – | – | – | 0 | – | – | – |
| Sprouts | 0 | – | – | – | 0 | – | – | – | 1 | 1% | 4 | < 1% |
| **Total** | **55** | **100%** | **1,624** | **100%** | **83** | **100%** | **996** | **100%** | **75** | **100%** | **1,525** | **100%** |

a Excludes outbreaks attributed to multiple food vehicles and outbreaks not attributed to any food vehicle.

b Based on classification by Painter et al.;31 commodities of: game; oils and sugars; and vine-stalk vegetables not represented.

c Percentages do not add to 100 due to rounding.

## Egg-associated outbreaks

Over two-thirds of foodborne outbreaks (312/452; 69%) during 2013–2015 were identified as being attributable to a food vehicle or vehicles. Of these, 40% (124/312) were suspected or confirmed to have been associated with the consumption of eggs and egg-based dishes (Table 26). In 2015, nearly half (51/107, 48%) of the outbreaks with a known food vehicle were associated with eggs.

In almost half (60/124, 48%) of the outbreaks associated with the consumption of eggs or egg-based dishes, egg-based sauces and dressings such as mayonnaise, aioli and hollandaise sauce were implicated. Twenty-nine outbreaks (23%) were associated with the consumption of desserts, predominantly chocolate mousse, tiramisu and fried ice cream. Other implicated egg-containing vehicles included smoothies and milkshakes, pasta containing raw egg, and a variety of breakfast egg dishes.

Table 26: Foodborne outbreaks with a known food vehicle and foodborne outbreaks associated with the consumption of eggs or egg-based dishes, Australia, 2013–2015

| Outbreaks | 2013 | 2014 | 2015 |
| --- | --- | --- | --- |
| Foodborne outbreaks with a known food vehicle or vehicles | 78 | 127 | 107 |
| Egg-associated outbreaks | 26 | 47 | 51 |

## Settings

Restaurants were the most commonly-reported food preparation setting during the reporting period (2013–2015), accounting for 47% (211/452) of all foodborne outbreaks and 43% (3,182/7,361) of the total number of people reportedly affected (Table 27).

Table 27: Foodborne outbreaks, by food preparation setting, Australia, 2013–2015

| Food preparation setting | 2013 | | | | 2014 | | | | 2015 | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outbreaks | | Number ill | | Outbreaks | | Number ill | | Outbreaks | | Number ill | |
| n | % | n | % | n | % | n | % | n | % | n | % |
| Aged care | 4 | 3% | 44 | 2% | 5 | 3% | 55 | 3% | 9 | 6% | 224 | 9% |
| Bakery | 3 | 2% | 91 | 3% | 12 | 7% | 197 | 10% | 3 | 2% | 70 | 3% |
| Camp | 1 | 1% | 23 | 1% | 2 | 1% | 60 | 3% | 0 | – | – | – |
| Child care | 0 | – | – | – | 0 | – | – | – | 1 | 1% | 2 | < 1% |
| Commercial caterer | 9 | 7% | 727 | 26% | 9 | 5% | 184 | 9% | 11 | 7% | 404 | 16% |
| Commercially manufactured | 3 | 2% | 24 | 1% | 0 | – | – | – | 1 | 1% | 33 | 1% |
| Community | 0 | – | – | – | 1 | 1% | 2 | < 1% | 1 | 1% | 85 | 3% |
| Cooking class | 0 | – | – | – | 1 | 1% | 8 | < 1% | 0 | – | – | – |
| Cruise | 0 | – | – | – | 1 | 1% | 3 | < 1% | 0 | – | – | – |
| Fair/festival/mobile service | 0 | – | – | – | 3 | 2% | 19 | 1% | 1 | 1% | 4 | < 1% |
| Grocery store/delicatessen | 2 | 2% | 18 | 1% | 0 | – | – | – | 3 | 2% | 21 | 1% |
| Hospital | 1 | 1% | 9 | < 1% | 1 | 1% | 22 | 1% | 1 | 1% | 37 | 1% |
| Institution | 2 | 2% | 25 | 1% | 2 | 1% | 68 | 3% | 2 | 1% | 107 | 4% |
| Military | 1 | 1% | 85 | 3% | 0 | – | – | – | 0 | – | – | – |
| National franchised fast food | 1 | 1% | 3 | < 1% | 1 | 1% | 7 | < 1% | 1 | 1% | 48 | 2% |
| Overseas military exercise | 0 | – | – | – | 0 | – | – | – | 1 | 1% | 19 | 1% |
| Overseas travel | 1 | 1% | 7 | < 1% | 0 | – | – | – | 0 | – | – | – |
| Picnic | 0 | – | – | – | 0 | – | – | – | 1 | 1% | 4 | < 1% |
| Primary produce | 12 | 9% | 559 | 20% | 17 | 10% | 79 | 4% | 6 | 4% | 53 | 2% |
| Private residence | 22 | 17% | 135 | 5% | 27 | 16% | 175 | 9% | 20 | 13% | 147 | 6% |
| Restaurant | 59 | 46% | 962 | 35% | 72 | 43% | 1,025 | 51% | 80 | 51% | 1,195 | 47% |
| School | 2 | 2% | 40 | 1% | 2 | 1% | 10 | < 1% | 1 | 1% | 8 | < 1% |
| Take-away | 6 | 5% | 23 | 1% | 10 | 6% | 106 | 5% | 14 | 9% | 105 | 4% |

## Investigative methods and levels of evidence

To investigate foodborne outbreaks during the reporting period (2013–2015), epidemiologists in the states and territories conducted 51 (11%) point source cohort studies and 32 (7%) case control studies. Descriptive case series investigations were conducted for 268 outbreaks (59%). In 101 outbreaks (22%), no formal investigation was conducted (Table 28).

Table 28: Foodborne outbreaks, by epidemiological study method, Australia, 2013–2015

| Type of investigation | 2013 | 2014 | 2015 | Totala |
| --- | --- | --- | --- | --- |
| Point source cohort | 21 | 16 | 14 | 51 (11%) |
| Case control study | 11 | 8 | 13 | 32 (7%) |
| Descriptive case series | 74 | 114 | 80 | 268 (59%) |
| No formal study | 23 | 28 | 50 | 101 (22%) |
| **Total** | **129** | **166** | **157** | **452** |

a Percentages do not add to 100 due to rounding.

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, for 15 outbreaks (3%). Investigators relied on analytical evidence alone for 47 outbreaks (10%) and microbiological (or toxicological for non-microbial outbreaks) evidence alone for 70 outbreaks (15%). These confirmed foodborne outbreaks comprised 29% (132/452) of all foodborne outbreaks (Table 29).

Table 29: Foodborne outbreaks, by type of evidence obtained, Australia, 2013–2015

| Type of evidence | 2013 | 2014 | 2015 | Totala |
| --- | --- | --- | --- | --- |
| Analytical and microbiological evidence | 5 | 2 | 8 | 15 (3%) |
| Analytical evidence | 13 | 18 | 16 | 47 (10%) |
| Microbiological evidence | 9 | 32 | 29 | 70 (15%) |
| Descriptive evidence | 102 | 114 | 104 | 320 (71%) |
| **Total** | **129** | **166** | **157** | **452** |

a Percentages do not add to 100 due to rounding.

## Contributing factors

During foodborne outbreak investigations, investigators collect information about factors that are likely to have contributed to an outbreak occurring. This information may be based on measured evidence, inspections, interview data, observations, or an investigator’s suspicion. Contamination factors are those that may have led to the food becoming contaminated or to contaminated products being consumed. During the reporting period (2013–2015), ingestion of contaminated raw products was the most reported contamination factor (n = 132), followed by cross-contamination from raw ingredients (n = 50) and toxic substance or part of tissue (n = 40) (Table 30). Thirty-one foodborne outbreaks had multiple contamination factors identified during 2013–2015.

Table 30: Foodborne outbreaks, by factors reported as leading to the contamination of food vehicles,a Australia, 2013–2015

| Contamination factor | 2013 | | 2014 | | 2015 | |
| --- | --- | --- | --- | --- | --- | --- |
| Outbreaks | No. ill | Outbreaks | No. ill | Outbreaks | No. ill |
| Cross-contamination from raw ingredients | 10 | 616 | 22 | 306 | 18 | 221 |
| Food handler contamination | 6 | 266 | 7 | 168 | 4 | 67 |
| Inadequate cleaning of equipment | 1 | 6 | 9 | 154 | 5 | 132 |
| Inadequate washing of food eaten uncooked | 1 | 7 | 0 | 0 | 1 | 8 |
| Ingestion of contaminated raw products | 28 | 846 | 56 | 759 | 48 | 1,241 |
| Other source of contamination | 6 | 553 | 3 | 14 | 6 | 100 |
| Person to food to person | 6 | 87 | 4 | 89 | 6 | 67 |
| Storage in contaminated environment | 0 | 0 | 2 | 34 | 1 | 23 |
| Toxic substance or part of tissue | 12 | 37 | 19 | 95 | 9 | 34 |
| Unknown | 64 | 735 | 58 | 589 | 71 | 899 |

a Thirty-one foodborne outbreaks had multiple contamination factors identified, therefore this table does not sum to the total number of outbreaks or ill persons.

## Significant foodborne and suspected foodborne outbreaks

During 2013–2015, OzFoodNet sites responded to 452 foodborne or suspected foodborne outbreaks, including three multi-jurisdictional outbreaks.

There were 29 outbreaks that each affected more than 40 people, and ten of these outbreaks each affected more than 100 people. Of these ten outbreaks, six were due to S. Typhimurium, three were due to norovirus, and one was suspected to be due to a bacterial toxin. These ten outbreaks affected a total of 2,119 people, of whom 90 were hospitalised, and there was one associated death reported.

### Multi-jurisdictional outbreak investigations

#### 2013: Norovirus

OzFoodNet commenced a multi-jurisdictional outbreak investigation on 3 April 2013. Tasmanian oysters associated with a gastroenteritis outbreak were confirmed to have been distributed to several states, and suspected cases had been identified in Victoria and New South Wales. There were 525 cases of illness associated with this outbreak. This included 306 cases in Tasmania; 209 in Victoria; eight in New South Wales; and two in Queensland. One case was hospitalised. Of the ten human samples sent for testing, eight faecal specimens had norovirus detected and one sample also had Campylobacter detected. An environmental survey of the area where the oyster lease was located identified a leaking underwater sewerage pipe as the suspected source of the contamination. The pipe was crimped by the sewerage authority and the leak stopped. The operator of the oyster lease was advised to withdraw the product from retail sale. There was no consumer-level food recall due to business closures over the Easter period and the short shelf life of the product. Urgent media releases were issued and Tasmanian suppliers were instructed to immediately withdraw the remaining product from sale.

#### 2013: Salmonella Typhimurium MLVA 03-11-10-11-523

OzFoodNet commenced a multi-jurisdictional outbreak investigation on 14 October 2013 upon identifying a cluster of salmonellosis cases among persons from the Australian Capital Territory, New South Wales, South Australia and Victoria who all attended a national sporting institution in Canberra. A case was defined as any person consuming food at the institute between 23 September and 2 October who subsequently developed gastroenteritis, with a confirmed case having a faecal specimen positive for S. Typhimurium MLVA 03-11-10-11-523. In total, 22 cases were linked to the outbreak, including 14 laboratory-confirmed infections. A cohort study was conducted among the Victorian attendees (29/43 attendees were interviewed, with 14 cases identified). Univariate analysis identified a number of food items associated with increased risk of illness, including consuming fruit smoothies on 26 September (Risk Ratio (RR) 3.1; 95% Confidence Intervals (CI) 1.3–7.6; p = 0.005), muffins on 26 September (RR 2.9; 95% CI 1.6–5.0; p = 0.004) and chicken and leek pie on 24 September (RR 2.6; 95% CI 1.1–5.7; p = 0.016). Multivariate analysis did not identify any exposures associated with increased risk of illness. Environmental investigations showed the on-site kitchen where these foods were prepared to be well managed, with no obvious concerns noted. Due to case reports of egg consumption and the frequent implication of eggs as a vehicle for foodborne salmonellosis, trace back of eggs used by the kitchen was undertaken. This revealed the eggs were produced at a New South Wales farm. Environmental sampling performed by primary industry investigators yielded a number of exact or closely related S. Typhimurium isolates, including those from chicken faeces, laying sheds and grading areas. The probable cause of this outbreak is transfer of Salmonella from eggs used in the institute kitchen; however, a precise transfer mechanism or food vehicle could not be determined.

#### 2015: Hepatitis A genotype IA

OzFoodNet commenced a multi-jurisdictional outbreak investigation on 16 February 2015 into nine cases of locally-acquired hepatitis A (HAV) in Victoria, New South Wales and Queensland, associated with consumption of the same brand of frozen mixed berries. Two days earlier, Food Standards Australia New Zealand (FSANZ) coordinated a voluntary recall of the frozen mixed berries. A descriptive epidemiological investigation into all HAV cases who had spent part of their acquisition period in Australia with onset of illness between 1 October 2014 and 27 May 2015 identified 35 confirmed cases with the outbreak genetic sequence, seven probable cases, and 25 possible cases. Of the 35 confirmed cases, 28 had consumed the implicated brand of frozen mixed berries, three were secondary cases (linked to confirmed outbreak cases), two had consumed frozen berries but could not recall the brands, and two could not recall eating any frozen berries and had no other risk factors. A case control study of 23 cases and 47 controls found statistically significant results for consuming any frozen berries (Odds Ratio (OR) 49; 95% CI 6.2–2,073; p < 0.05), consuming any frozen mixed berries (OR 88; 95% CI 10.5–3,727; p < 0.05) and consuming the implicated brand of frozen mixed berries (OR 440; 95% CI 32–18,531; p < 0.05). Among all study participants who ate frozen berries, 70% of 17 cases and 0% of 41 controls had exclusively consumed the implicated brand of frozen mixed berries. The implicated mixed berry product was packed in two factories in China. Strawberries, blackberries and raspberries were sourced from China and blueberries were sourced from Canada. Three opened packets of the implicated brand of frozen mixed berries were obtained from cases’ homes during the investigation and 15 unopened packets were obtained from retail premises that removed product from sale during the recall. A sample from one of the three open packets was confirmed to contain HAV RNA with the outbreak sequence, but genotyping on a HAV RNA sample from an unopened packet could not be conducted.

# Animal-to-person outbreaks

OzFoodNet sites reported three animal-to-person outbreaks during the reporting period (2013 – 2015) (Table 22). Animal-to-person outbreaks are rarely identified in Australia. Two outbreaks investigated in 2013 included an STEC outbreak affecting 57 children and adults associated with an animal nursery in Queensland, and a S. Typhimurium outbreak affecting five children associated with a petting zoo in Western Australia. One outbreak investigated in 2015 was a S. subsp I ser 4,5,12:i:- outbreak affecting four people following contact with cattle in Tasmania.

# Waterborne and suspected waterborne outbreaks

OzFoodNet sites reported 57 waterborne or suspected waterborne outbreaks during the reporting period (2013–2015) (Table 22). These outbreaks affected 450 people, with 23 people requiring hospitalisation. Of the reported outbreaks, 50 were associated with swimming pools and attributed to Cryptosporidium, and seven outbreaks were associated with the consumption of water. Of the seven water consumption outbreaks, five were associated with campgrounds and were attributed to *S*. Eastbourne, *S*. Mississippi, *S*. Saintpaul, *S*. Virchow, and one outbreak where the aetiology was unknown. Two outbreaks were associated with consumption of tank and rain water respectively and were attributed to *Campylobacter* and *S*. Typhimurium.

Due to differences in reporting across jurisdictions, it is important to note that this data does not represent all waterborne and suspected waterborne outbreaks in Australia, and should therefore be interpreted with caution. For example, in New South Wales while swimming pools and other swimming facilities that are associated with more the one case of cryptosporidiosis are reviewed for compliance with state requirements, data are not included in this report as they are not reported as outbreaks.

# Discussion

This report documents the incidence of gastrointestinal diseases that may be transmitted by food in Australia during 2013–2015. The OzFoodNet surveillance network concentrates its efforts on the surveillance of foodborne diseases and outbreak investigations. This occurs through partnerships with a range of stakeholders, including the Australian Government and individual 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, to the prevention of disease and to 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 the identification of foods that cause human illness both locally and nationally through multi-jurisdictional outbreak investigations. Continuing to strengthen the quality of these investigations and data will ensure their use by agencies to develop and enhance food safety policies that contribute to preventing foodborne illness. Increasing food safety will reduce the cost of foodborne illness to the community, such as healthcare costs and lost productivity; and the costs to industry, such as product recalls and loss of reputation.

While it remains difficult to quantify the impact of changes in diagnostic laboratory testing procedures, including the increasing uptake of CIDT using PCR and introduction of multiplex PCR (which can detect multiple enteric pathogens on one test), it is suspected these laboratory changes have resulted in an increase in case notifications for a number of bacterial enteric diseases, including campylobacteriosis; salmonellosis; shigellosis; and STEC, since 2013. PCR offers increased sensitivity and more rapid results for some enteric pathogens; however, non-viable organisms or residual nucleic acid may also be detected.33–36 Multiplex PCR may also detect enteric organisms that would not have otherwise been tested for in the absence of clinical symptoms, or may identify organisms which are of doubtful pathogenicity. While CIDT has the potential to improve disease estimates, such incidental findings may have ambiguous public health significance in terms of morbidity.36,37 These changes mean interpretation of disease trends over time should be carefully considered. Additional reasons for increasing case notifications may include increased access to diagnostic testing; cheaper diagnostic testing; and improved laboratory processes.

Campylobacter continues to be the most frequently-notified enteric pathogen under surveillance by OzFoodNet, despite not being notifiable in New South Wales during the period covered by this report. Year-on-year increases in campylobacteriosis were observed during 2013–2015, with notifications reaching 22,549 notifications in 2015. Campylobacter was implicated in 4% (18/452) of foodborne or suspected foodborne outbreaks during 2013–2015. Subtyping of Campylobacter species is not routinely performed in Australia, hampering outbreak detection, although previous OzFoodNet outbreak investigations have identified consumption of undercooked poultry livers as a particular risk for outbreaks of campylobacteriosis. During 2013–2015, six of the 18 Campylobacter outbreaks had strong associations with the consumption of poultry livers. It is important that poultry livers are handled in such a way as to avoid cross-contamination and are cooked thoroughly before eating.38

During 2013–2015, salmonellosis notifications increased to the highest levels since the commencement of the NNDSS in 1991. In 2015, there were 17,001 salmonellosis notifications, with a national notification rate of 71 cases per 100,000 population. Salmonella Typhimurium remains the most frequently-isolated serovar in humans in Australia.

OzFoodNet sites reported a total of 452 foodborne or suspected foodborne outbreaks during 2013–2015, including three multi-jurisdictional outbreak investigations. Foodborne outbreak data can help estimate the proportion of illness attributable to different commodities and/or foods.39 Salmonella continued to be the leading cause of reported outbreaks of foodborne illness in Australia, with 53% of outbreaks (239/452) due to Salmonella. Of these, 90% (216/239) were due to S. Typhimurium. Of the 216 S. Typhimurium outbreaks, 55% (n = 118) were associated with egg-based dishes. As in previous years, food vehicles that were identified during egg-associated outbreak investigations included mayonnaise, dressings and desserts containing raw egg.

In 2014, the first locally-acquired outbreak of hepatitis E in Australia was identified and was found to be related to consumption of pork liver pâté at a specific restaurant.25 The outbreak highlighted the importance of ensuring pork products are thoroughly cooked before consumption, in order to reduce the risk of hepatitis E virus transmission. In 2015, the first outbreak of hepatitis A in Australia linked to consumption of imported frozen berries was detected, resulting in a product recall. The hepatitis A virus is resistant to freezing;40 internationally, there have been a number of outbreaks associated with the consumption of minimally-processed ready-to-eat frozen foods such as frozen fruits.41

OzFoodNet used WGS for the first time during foodborne outbreak investigations in 2015. The use of this advancing technology means clusters of illness can be more accurately defined during the active investigation, and subsequent actions in response to the outbreak source can be targeted with greater confidence. Through utilisation of WGS, communicable disease pathogens can be analysed, interpreted and stored, and then shared across national and international borders to enable rapid identification of outbreaks.

# Limitations

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 states and territories, and over time. Some of the most common enteric pathogens such as norovirus and Clostridium perfringens are not notifiable in any state or territory, and Campylobacter is not notifiable in New South Wales. A further limitation relates to the outbreak data provided by OzFoodNet sites for this report and to 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. As a result, data is subject to revision over time.

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# Appendix A: Foodborne and suspected foodborne outbreak summary for OzFoodNet sites, Australia, 2013

Appendix A: Foodborne and suspected foodborne outbreak summary for OzFoodNet sites, Australia, 2013

| State or territorya | Monthb | Setting prepared | Agent responsiblec | No. ill | No. hospitalised | No. of fatalities | Evidenced | Epidemiological study | Responsible vehicles | Commodity | Contamination factor |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MJOI | Apr | Primary produce | Norovirus | 525 | 1 | 0 | D | No formal study | Oysters | Molluscs | Other source of contamination |
| MJOI | Oct | Institution | *Salmonella* Typhimurium, PT 29, MLVA 03-11-10-11-523. | 22 | 0 | 0 | AM | Point source cohort | Unknown | Not attributed | Unknown |
| ACT | Jan | Private residence | *Salmonella* Typhimurium, PT 44, MLVA 03-11-07-11-523 | 10 | 0 | 0 | D | Case series | Unknown | Not attributed | Other source of contamination |
| ACT | Feb | Private residence | Unknown (suspected toxin) | 6 | 0 | 0 | D | Case series | Beef, chicken, bean and rice dishes | Not attributed | Unknown |
| ACT | May | Take-away | Unknown (suspected toxin) | 3 | 0 | 0 | D | Case series | Chicken doner kebab | Poultry | Other source of contamination |
| ACT | May | Restaurant | Unknown (suspected toxin) | 125 | 0 | 0 | AM | Point source cohort | Curried Prawns | Not attributed | Cross contamination from raw ingredients |
| ACT | May | Restaurant | *Salmonella* Typhimurium, PT 170, MLVA 03-09-07-13-523 | 164 | 19 | 0 | AM | Case control study | Potato salad containing raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| ACT | Oct | Commercial caterer | *Campylobacter jejuni* | 54 | 0 | 0 | AM | Point source cohort | Chicken liver pâté | Poultry | Ingestion of contaminated raw products |
| NSW | Jan | Restaurant | Norovirus | 3 | 0 | 0 | D | Case series | Salad | Not attributed | Unknown |
| NSW | Jan | Restaurant | *Salmonella* Cerro | 3 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, PT 44, MLVA 03-09-08-09-523 | 5 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Jan | Take-away | Unknown | 3 | 0 | 0 | D | Case series | Chicken burger | Poultry | Unknown |
| NSW | Jan | Private residence | *Salmonella* Typhimurium, MLVA 03-27-08-21-496 | 8 | 2 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jan | Take-away | *Salmonella* Typhimurium, PT 170, MLVA 03-17-09-12-523 | 3 | 3 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Feb | Restaurant | Unknown (suspected toxin) | 4 | 0 | 0 | D | Case series | Beef taco | Beef | Unknown |
| NSW | Feb | Private residence | *Salmonella* Birkenhead | 12 | 3 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Feb | Take-away | Unknown | 2 | 0 | 0 | D | No formal study | BBQ pork sandwiches | Not attributed | Unknown |
| NSW | Feb | Restaurant | *Salmonella* Typhimurium, PT 170, MLVA 03-09-07/08-14-523 | 7 | 3 | 0 | M | Case series | Fried ice cream | Eggs | Ingestion of contaminated raw products |
| NSW | Mar | Commercially manufactured | *Listeria monocytogenes*, PFGE 4A:4:1, Serotype 1/2b, 3b, 7Binary type 233, MLVA 04-17-16-05-03-11-14-00-16 | 3 | 3 | 1 | M | Case series | Profiteroles | Not attributed | Ingestion of contaminated raw products |
| NSW | Mar | Commercial caterer | Unknown | 10 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Mar | Private residence | *Salmonella* Zanzibar | 5 | 4 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Mar | Private residence | *Salmonella* Typhimurium, PT 135, MLVA 03-17-09-12-523 | 4 | 4 | 0 | D | Case series | Raw egg smoothies | Eggs | Ingestion of contaminated raw products |
| NSW | Apr | Restaurant | Unknown (suspected toxin) | 3 | 0 | 0 | D | No formal study | Chicken burger containing raw egg aioli | Not attributed | Other source of contamination |
| NSW | Apr | Restaurant | *Salmonella* Typhimurium, PT 135, MLVA 03-17-09-12-523 | 16 | 3 | 0 | D | Case control study | Unknown | Not attributed | Unknown |
| NSW | Apr | Private residence | *Salmonella* Typhimurium, PT 135a, MLVA 03-13-11-09-523 | 3 | 3 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Apr | Restaurant | Unknown | 4 | 0 | 0 | D | No formal study | Beef pie | Not attributed | Unknown |
| NSW | Apr | Restaurant | Unknown | 15 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Apr | Restaurant | Unknown | 6 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jun | Restaurant | Unknown (suspected toxin) | 5 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Jun | Restaurant | Unknown (suspected toxin) | 5 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Jun | Private residence | Unknown | 3 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jun | Private residence | *Salmonella* Typhimurium, PT 9, MLVA 03-23-23-11-523 | 17 | 5 | 0 | D | Case series | Raw egg Béarnaise sauce | Eggs | Ingestion of contaminated raw products |
| NSW | Jul | Restaurant | Unknown | 12 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jul | Restaurant | Unknown | 8 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jul | Take-away | Unknown (suspected viral) | 6 | 0 | 0 | D | No formal study | Hamburger with salad | Not attributed | Unknown |
| NSW | Jul | Restaurant | *Campylobacter jejuni* | 17 | 1 | 0 | A | Point source cohort | Duck liver parfait | Poultry | Ingestion of contaminated raw products |
| NSW | Aug | Restaurant | Norovirus | 5 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Aug | Restaurant | Unknown | 6 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Aug | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Aug | Restaurant | Unknown (suspected viral) | 38 | 0 | 0 | A | Point source cohort | Unknown | Not attributed | Unknown |
| NSW | Sep | Restaurant | Unknown (suspected toxin) | 2 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Oct | Grocery store/delicatessen | Norovirus | 14 | 0 | 0 | A | Point source cohort | Turkey, ham and salami wraps | Not attributed | Unknown |
| NSW | Oct | Bakery | *Salmonella* Typhimurium, PT 170, MLVA 03-10-07-14-523 | 49 | 21 | 0 | M | Case series | Vietnamese rolls containing raw egg mayonnaise | Eggs | Cross contamination from raw ingredients |
| NSW | Nov | Restaurant | Unknown | 8 | 0 | 0 | D | Point source cohort | Unknown | Not attributed | Unknown |
| NSW | Dec | Restaurant | Norovirus | 69 | 0 | 0 | D | Point source cohort | Unknown | Not attributed | Unknown |
| NT | Jan | Private residence | *Salmonella* Typhimurium, PT 9 | 4 | 2 | 0 | D | No formal study | Caesar salad dressing | Eggs | Ingestion of contaminated raw products |
| NT | Feb | Private residence | *Shigella sonnei*, biotype a | 5 | 1 | 0 | D | No formal study | Curried meat (unspecified) | Not attributed | Food handler contamination |
| NT | Feb | Private residence | Unknown (suspected viral) | 11 | 0 | 0 | D | Point source cohort | Luncheon items | Not attributed | Unknown |
| NT | May | Private residence | *Salmonella* Typhimurium, PT 108 | 5 | 1 | 0 | D | Case series | Gravy | Not attributed | Cross contamination from raw ingredients, other source of contamination |
| NT | Oct | Primary produce | Unknown | 4 | 0 | 0 | D | No formal study | Mackerel | Fish | Unknown |
| NT | Dec | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| Qld | Jan | Restaurant | *Staphylococcus aureus* | 8 | 0 | 0 | M | Case series | Chicken sushi | Not attributed | Person to food to person |
| Qld | Jan | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-25-16-11-524 | 3 | 1 | 0 | D | Case series | Duck liver pâté | Poultry | Ingestion of contaminated raw products |
| Qld | Feb | National franchised fast food | Unknown | 3 | 0 | 0 | D | Case series | Pizza | Not attributed | Unknown |
| Qld | Feb | Primary produce | Ciguatera fish poisoning | 3 | 0 | 0 | D | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Mar | Primary produce | Ciguatera fish poisoning | 4 | Unknown | 0 | M | Case series | Red Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Jul | Restaurant | *Salmonella* Typhimurium, PT 16, MLVA 03-13-10-11-524 | 30 | 3 | 0 | A | Case control study | Eggs Benedict | Eggs | Ingestion of contaminated raw products |
| Qld | Aug | Restaurant | *Salmonella* Typhimurium, PT 135, MLVA 03-13-10-11-524 | 10 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Qld | Oct | Primary produce | Ciguatera fish poisoning | 3 | 0 | 0 | D | Case series | Coral Perch | Fish | Toxic substance or part of tissue |
| Qld | Oct | Primary produce | Ciguatera fish poisoning | 3 | Unknown | 0 | D | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Oct | Primary produce | Norovirus | 4 | Unknown | 0 | D | Case series | Oysters | Not attributed | Unknown |
| Qld | Oct | Restaurant | Unknown | 9 | Unknown | 0 | D | Case series | Seafood buffet | Not attributed | Unknown |
| Qld | Nov | Commercial caterer | *Salmonella* Typhimurium, PT 16, MLVA 03-13-10-12-524 | 350 | 12 | 1 | AM | Case control and cohort | Potato salad containing raw egg mayonnaise | Eggs | Ingestion of contaminated raw products, cross contamination from raw ingredients |
| Qld | Nov | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Cod | Fish | Toxic substance or part of tissue |
| Qld | Nov | Restaurant | Histamine fish poisoning (Scombroid) | 4 | 0 | 0 | D | Case series | Mahi Mahi | Fish | Toxic substance or part of tissue |
| Qld | Nov | Commercial caterer | Norovirus | 16 | 0 | 0 | A | Point source cohort | Sandwiches | Not attributed | Person to food to person |
| Qld | Nov | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-12-09-524 | 12 | 4 | 0 | A | Point source cohort | Unknown | Not attributed | Unknown |
| Qld | Nov | Restaurant | *Salmonella* Typhimurium, PT 170, MLVA 03-09-07-14-524 | 20 | 5 | 0 | A | Case control study | Raw egg chocolate mousse | Eggs | Ingestion of contaminated raw products |
| Qld | Dec | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Blue Spot Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Dec | Primary produce | Ciguatera fish poisoning | 4 | 0 | 0 | D | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Dec | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Dec | Primary produce | Ciguatera fish poisoning | 3 | 0 | 0 | D | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Dec | Restaurant | *Salmonella* Typhimurium, MLVA 03-10-07-09-524 | 9 | 2 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Mar | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-15-06-11-550 | 9 | 2 | 0 | D | Case series | Eggs Benedict with raw egg Hollandaise sauce | Eggs | Cross contamination from raw ingredients |
| SA | Mar | Restaurant | Norovirus | 14 | 1 | 0 | D | Point source cohort | Unknown | Not attributed | Unknown |
| SA | Jun | Restaurant | *Salmonella* Virchow, PT 23 | 6 | 1 | 0 | D | Case series | Unknown | Not attributed | Inadequate cleaning of equipment |
| SA | Jun | School | *Campylobacter jejuni* | 6 | 0 | 0 | D | Case series | Honey soy chicken wings | Poultry | Ingestion of contaminated raw products |
| SA | Jul | Restaurant | *Salmonella* Typhimurium, PT 135a, MLVA 03-14-10-10-523 | 9 | 3 | 0 | D | Case series | Tartare sauce | Eggs | Ingestion of contaminated raw products |
| SA | Aug | Private residence | *Salmonella* Typhimurium, PT 9, MLVA 03-24-11-10-523 | 4 | 0 | 0 | D | Point source cohort | Unknown | Not attributed | Unknown |
| SA | Sep | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-24-12-10-523 | 15 | 1 | 0 | A | Point source cohort | Coleslaw containing raw egg aioli | Eggs | Ingestion of contaminated raw products |
| SA | Sep | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-24-12-10-523 | 11 | 4 | 0 | D | Case series | Raw egg aioli | Eggs | Ingestion of contaminated raw products |
| SA | Sep | Restaurant | *Salmonella* Typhimurium, PT 135, MLVA 03-12-09-11-523 | 4 | 2 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Oct | Camp | *Campylobacter* | 23 | 0 | 0 | D | Case series | Chicken patties | Poultry | Ingestion of contaminated raw products |
| Tas. | Jan | Restaurant | *Salmonella* Mississippi | 36 | 3 | 0 | A | Point source cohort | Salad | Not attributed | Unknown |
| Tas. | Oct | Overseas travel | *Shigella flexneri* | 7 | 1 | 0 | D | Case series | Unknown | Not attributed | Inadequate washing of food eaten uncooked, other source of contamination |
| Vic. | Jan | Institution | *Salmonella* Typhimurium, PT 135a | 3 | 1 | 0 | D | Case series | Protein shake containing raw eggs | Eggs | Ingestion of contaminated raw products |
| Vic. | Jan | Commercial caterer | Unknown (suspected viral) | 32 | 1 | 0 | A | Case control study | Sandwiches | Not attributed | Unknown |
| Vic. | Jan | Restaurant | Norovirus | 6 | 0 | 0 | D | Case series | Unknown | Not attributed | Food handler contamination |
| Vic. | Jan | Restaurant | Norovirus | 7 | 0 | 0 | D | Case series | Salad | Not attributed | Unknown |
| Vic. | Jan | Private residence | *Salmonella* Typhimurium, PT 135a | 10 | 1 | 0 | D | Point source cohort | Tiramisu containing raw egg | Eggs | Ingestion of contaminated raw products |
| Vic. | Jan | Bakery | *Salmonella* Infantis | 21 | 5 | 0 | D | Case series | Vietnamese pork rolls containing raw egg butter | Eggs | Cross contamination from raw ingredients |
| Vic. | Feb | Commercial caterer | Unknown (suspected viral) | 35 | 0 | 0 | D | Case control study | Unknown | Not attributed | Unknown |
| Vic. | Feb | Aged care | Unknown (suspected *Clostridium perfringens*) | 9 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Feb | Restaurant | *Campylobacter jejuni* | 2 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Mar | Private residence | *Salmonella* Typhimurium, PT 64 | 3 | 1 | 0 | D | Case series | Frittata | Eggs | Ingestion of contaminated raw products |
| Vic. | Mar | Restaurant | *Salmonella* Typhimurium, PT 44 | 22 | 2 | 0 | A | Point source cohort | Scrambled eggs | Eggs | Ingestion of contaminated raw products |
| Vic. | Apr | Bakery | *Salmonella* Typhimurium, PT 170 | 21 | 1 | 0 | M | Point source cohort | Cake with whipped cream | Dairy | Cross contamination from raw ingredients |
| Vic. | May | Private residence | *Salmonella* Typhimurium, PT 44 | 3 | 1 | 0 | D | Case series | Raw egg aioli | Eggs | Ingestion of contaminated raw products |
| Vic. | May | Private residence | *Salmonella* Typhimurium, PT 9 | 2 | 0 | 0 | M | Case series | Raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| Vic. | May | Restaurant | *Salmonella* Typhimurium, PT 44 | 36 | 7 | 0 | M | Case series | Raw egg tartare and aioli sauces | Eggs | Ingestion of contaminated raw products |
| Vic. | May | Military | Norovirus | 85 | Unknown | 0 | A | Case control study | Unknown | Not attributed | Unknown |
| Vic. | May | Restaurant | Histamine fish poisoning (Scombroid) | 3 | 0 | 0 | D | Case series | Tuna | Fish | Toxic substance or part of tissue |
| Vic. | May | Restaurant | Unknown | 3 | 0 | 0 | D | Case series | Foie gras parfait | Poultry | Unknown |
| Vic. | Jun | Grocery store/delicatessen | *Salmonella* Typhimurium, PT 126 | 4 | 2 | 0 | D | Case series | BBQ chicken | Poultry | Unknown |
| Vic. | Jul | Restaurant | *Salmonella* Typhimurium, PT 135a | 6 | 0 | 0 | D | Case series | Egg and bacon roll | Eggs | Ingestion of contaminated raw products |
| Vic. | Aug | Commercial caterer | Unknown (suspected viral) | 24 | 0 | 0 | A | Case control study | Hot savouries/chicken vol au vents | Not attributed | Unknown |
| Vic. | Aug | Aged care | *Clostridium perfringens* | 12 | Unknown | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Sep | Hospital | *Salmonella* Typhimurium, PT 135 | 9 | 0 | 2 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Oct | Commercially manufactured | *Salmonella* Typhimurium, PT 135 | 18 | Unknown | 2 | D | Case series | Eggs | Eggs | Cross contamination from raw ingredients |
| Vic. | Oct | Private residence | *Salmonella* Typhimurium, PT 170 | 5 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Oct | Restaurant | *Campylobacter coli* | 4 | 0 | 0 | D | Case series | Chicken mousse | Poultry | Ingestion of contaminated raw products |
| Vic. | Oct | Restaurant | Fish wax ester | 4 | 0 | 0 | D | No formal study | Rudderfish | Fish | Toxic substance or part of tissue |
| Vic. | Nov | Private residence | *Salmonella* Typhimurium, PT 9 | 3 | 0 | 0 | D | Case series | Pasta containing raw egg | Eggs | Unknown |
| Vic. | Nov | Aged care | *Campylobacter jejuni* | 11 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Nov | Commercial caterer | Norovirus | 178 | 0 | 0 | D | Case series | Unknown | Not attributed | Food handler contamination |
| Vic. | Nov | Restaurant | Norovirus | 34 | 0 | 0 | D | Point source cohort | Unknown | Not attributed | Food handler contamination |
| WA | Feb | Restaurant | Unknown (suspected norovirus) | 39 | 1 | 0 | D | Case control study | Duck pancakes | Poultry | Food handler contamination |
| WA | Feb | Commercially manufactured | *Listeria monocytogenes* | 3 | 3 | 0 | M | Case series | Frozen meals | Not attributed | Unknown |
| WA | Feb | Take-away | *Salmonella* Infantis, PFGE 2 | 6 | 1 | 0 | D | Case series | Unknown | Not attributed | Cross contamination from raw ingredients |
| WA | Mar | Restaurant | *Salmonella* Typhimurium, PFGE 151 | 5 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | May | Private residence | Hepatitis A, genotype IA | 4 | 4 | 0 | D | Case series | Kava | Root vegetable | Food handler contamination, person to food to person |
| WA | Jul | Restaurant | *Salmonella* Typhimurium, PT 135a, PFGE 39 | 12 | 4 | 0 | D | Case series | Scrambled eggs, raw egg Hollandaise sauce and French toast | Eggs | Ingestion of contaminated raw products and cross contamination from raw ingredients |
| WA | Jul | Private residence | *Salmonella* Typhimurium, PT 170, PFGE 11 | 8 | 6 | 0 | D | Case series | Turkish bread soaked in egg mix | Eggs | Ingestion of contaminated raw products |
| WA | Jul | Restaurant | Unknown (suspected viral) | 3 | 0 | 0 | D | Point source cohort | Unknown | Not attributed | Unknown |
| WA | Aug | School | *Clostridium perfringens* | 34 | 0 | 0 | D | Case series | Chicken curry | Poultry | Unknown |
| WA | Sep | Aged care | *Clostridium perfringens* | 12 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | Oct | Restaurant | Unknown | 23 | 0 | 0 | D | Case control study | Unknown | Not attributed | Person to food to person |
| WA | Dec | Restaurant | Norovirus | 8 | 0 | 0 | D | Case series | Salad | Not attributed | Person to food to person |
| WA | Dec | Commercial caterer | Norovirus | 28 | 0 | 0 | D | Point source cohort | Unknown | Not attributed | Person to food to person |

a MJOI: Multi-jurisdictional outbreak investigation.

b Month of outbreak is the month of onset of the first case or month of notification of the first case or the month the investigation into the outbreak commenced.

c PT: Phage type; PFGE: Pulse field gel electrophoresis; MLVA: Multi-locus variable number tandem repeat analysis.

d Evidence categories. D: Descriptive evidence implicating the vehicle. A: Analytical epidemiological association between illness and vehicle. M: Microbiological confirmation of aetiology in vehicle and cases. AM: Analytical association and microbiological confirmation of aetiology.

# Appendix B: Foodborne and suspected foodborne outbreak summary for OzFoodNet sites, Australia, 2014

Appendix B: Foodborne and suspected foodborne outbreak summary for OzFoodNet sites, Australia, 2014

| State or territory | Montha | Setting prepared | Agent responsibleb | No. ill | No. hospitalised | No. of fatalities | Evidencec | Epidemiological study | Responsible vehicles | Commodity | Contamination factor |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ACT | Jan | Take-away | *Escherichia coli* | 3 | 0 | 0 | M | Case series | Tabouli or parsley | Leafy greens | Cross contamination from raw ingredients, ingestion of contaminated raw products |
| ACT | Feb | Restaurant | *Campylobacter jejuni* | 3 | 1 | 0 | D | Case series | Duck or chicken liver parfait | Poultry | Ingestion of contaminated raw products |
| ACT | Feb | Take-away | Unknown (suspected toxin *Bacillus cereus*) | 3 | 0 | 0 | D | Case series | Fried rice | Grains and beans | Other source of contamination |
| ACT | Apr | Private residence | *Amanita phalloides* (Death cap mushrooms) | 3 | 3 | 0 | D | No formal study | Curry containing mushrooms | Fungi | Toxic substance or part of tissue |
| ACT | Apr | Private residence | *Salmonella* Typhimurium, PT 9 | 2 | 2 | 0 | D | Case series | Raw egg milkshake | Eggs | Ingestion of contaminated raw products |
| ACT | Dec | Private residence | *Salmonella* Typhimurium, PT 135 | 3 | 1 | 0 | D | Case series | Egg nog containing raw egg | Eggs | Ingestion of contaminated raw products |
| NSW | Jan | Bakery | *Salmonella* Typhimurium, MLVA 03-17-10-11-523 | 24 | 9 | 0 | M | Case series | Vietnamese rolls containing pâté | Poultry | Ingestion of contaminated raw products |
| NSW | Jan | Cruise | *Salmonella* Typhimurium, MLVA 03-12-13-09-523 | 3 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Jan | National franchised fast food | *Salmonella* Typhimurium, MLVA 03-09-07-12-523 | 7 | 1 | 0 | D | Case series | Café meals | Not attributed | Cross contamination from raw ingredients, inadequate cleaning of equipment |
| NSW | Jan | Take-away | *Escherichia coli*, O157:H- | 6 | 5 | 0 | D | Case series | Kebabs | Not attributed | Cross contamination from raw ingredients |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-24-12-12-523 | 2 | 0 | 0 | D | Case series | Raw egg Caesar salad dressing | Eggs | Ingestion of contaminated raw products |
| NSW | Feb | Commercial caterer | *Shigella sonnei*, biotype f | 9 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Feb | Restaurant | Ciguatera fish poisoning | 5 | 3 | 0 | D | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| NSW | Feb | Cooking class | *Salmonella* Typhimurium, MLVA 03-10/11-07-12-523 | 8 | 2 | 0 | D | Case series | Raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| NSW | Feb | Bakery | *Salmonella* Typhimurium, MLAV 03-16-09-12-523 | 23 | 3 | 0 | D | Case series | Vietnamese rolls containing raw egg butter | Eggs | Ingestion of contaminated raw products |
| NSW | Mar | Bakery | *Salmonella* Typhimurium, MLVA 03-09-07-12-523 | 12 | 7 | 0 | M | Case series | Sliced deli meats | Not attributed | Cross contamination from raw ingredients, inadequate cleaning of equipment |
| NSW | Mar | Private residence | Ciguatera fish poisoning | 9 | 9 | 0 | D | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| NSW | Mar | Restaurant | *Listeria monocytogenes*, Binary type 158, MLVA 04-17-16-05-03-11-14-00-16, serotype 1/2b, 3b, 7, PFGE 4:4:5A | 3 | 3 | 1 | M | Case series | Sandwiches | Not attributed | Ingestion of contaminated raw products |
| NSW | Mar | Restaurant | *Salmonella* Typhimurium, MLVA 03-13-10-11-523 | 4 | 0 | 0 | D | No formal study | Buffet meal | Not attributed | Unknown |
| NSW | Mar | Take-away | *Salmonella* Typhimurium, MLVA 03-26-07-20-496 | 11 | 2 | 0 | M | Case series | Raw egg salad dressing | Eggs | Ingestion of contaminated raw products |
| NSW | Mar | Bakery | *Salmonella* Typhimurium, MLVA 03-17-10-11-523 | 33 | 7 | 0 | M | Case series | Vietnamese rolls containing raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| NSW | May | Private residence | *Salmonella* Typhimurium, MLVA 03-17/18-09-11-523 | 8 | 6 | 1 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | May | Restaurant | Norovirus | 6 | 0 | 0 | D | Case series | Garden salad | Not attributed | Ingestion of contaminated raw products |
| NSW | May | Private residence | *Salmonella* Typhimurium, MLVA 03-24-12/13-10-523 | 13 | 0 | 0 | D | Case series | Tiramisu containing raw egg | Eggs | Ingestion of contaminated raw products |
| NSW | May | Take-away | *Salmonella* Typhimurium, MLVA 03-10-07-12-523 | 11 | 1 | 0 | D | Case series | Vietnamese rolls containing raw egg butter | Eggs | Ingestion of contaminated raw products |
| NSW | May | Restaurant | Hepatitis E | 17 | 6 | 0 | A | Point source cohort | Pork liver pâté | Pork | Ingestion of contaminated raw products |
| NSW | Jun | Private residence | Histamine fish poisoning (Scombroid) | 2 | 2 | 0 | M | Case series | Tuna steaks | Fish | Toxic substance or part of tissue |
| NSW | Jun | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-12-09-523 | 9 | 1 | 0 | D | No formal study | Buffet meal | Not attributed | Unknown |
| NSW | Jul | Restaurant | Histamine fish poisoning (Scombroid) | 8 | 0 | 0 | D | No formal study | Seafood (various) | Fish | Toxic substance or part of tissue |
| NSW | Jul | Restaurant | *Salmonella* Typhimurium, MLVA 03-24-12-10-523 | 4 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jul | Restaurant | Unknown | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Aug | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Oysters | Not attributed | Unknown |
| NSW | Sep | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-11-14/15-523 | 38 | 6 | 0 | AM | Point source cohort | Chocolate milk mixed in a blender | Not attributed | Cross contamination from raw ingredients |
| NSW | Sep | Take-away | *Salmonella* Typhimurium, MLVA 03-26-13-08-523 | 13 | Unknown | 0 | D | No formal study | Raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| NSW | Sep | Aged care | Unknown | 8 | Unknown | 0 | D | Case series | Roast beef | Beef | Unknown |
| NSW | Sep | Restaurant | Unknown | 4 | 0 | 0 | D | No formal study | Cold spring rolls and raw salmon sushi rolls | Not attributed | Unknown |
| NSW | Sep | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Pork belly and mashed potato | Not attributed | Unknown |
| NSW | Sep | Restaurant | Unknown | 8 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Oct | Take-away | *Salmonella* Typhimurium, MLVA 03-10-07-12-523 | 26 | 0 | 0 | D | Case series | Raw egg chocolate mousse cake | Eggs | Ingestion of contaminated raw products |
| NSW | Oct | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-12-09-523 | 13 | 0 | 0 | D | Case series | Unknown | Not attributed | Cross contamination from raw ingredients, inadequate cleaning of equipment |
| NSW | Oct | Fair/festival/mobile service | *Salmonella* Typhimurium, MLVA 03-12-12-09-523 | 4 | 1 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Oct | Restaurant | *Salmonella* Typhimurium, MLVA 03-09-07-12-523 | 4 | 0 | 0 | D | No formal study | Beef burger | Not attributed | Unknown |
| NSW | Oct | Restaurant | *Staphylococcus aureus* | 11 | 4 | 0 | M | No formal study | Sushi | Not attributed | Ingestion of contaminated raw products |
| NSW | Nov | Restaurant | *Salmonella* Typhimurium, MLVA 03-09/10-08-12-523 | 16 | 4 | 0 | M | Case series | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-11-14-523 | 35 | 0 | 0 | M | Point source cohort | Pre-prepared lamb ragout meal | Not attributed | Cross contamination from raw ingredients |
| NSW | Dec | Restaurant | *Salmonella* Typhimurium, MLVA 03-09-08-12-523 | 3 | 0 | 0 | D | Case series | Satay chicken and fried ice cream | Not attributed | Unknown |
| NSW | Dec | Restaurant | *Salmonella* Typhimurium, MLVA 03-17-09-11-523 | 19 | 4 | 0 | M | No formal study | Unknown | Not attributed | Cross contamination from raw ingredients |
| NT | Jan | Private residence | *Salmonella* Typhimurium, PT 6 | 3 | 0 | 0 | D | No formal study | Roast turkey | Not attributed | Other source of contamination |
| NT | Mar | Restaurant | Unknown | 2 | 0 | 0 | D | No formal study | Chicken Caesar salad | Not attributed | Unknown |
| NT | Apr | Restaurant | *Salmonella* Typhimurium, PT 9 | 9 | 3 | 0 | D | Point source cohort | Hollandaise sauce | Eggs | Ingestion of contaminated raw products |
| NT | Apr | Restaurant | *Salmonella* Typhimurium, PT 9 | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NT | Apr | Restaurant | Unknown (suspected viral) | 2 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NT | May | Private residence | *Salmonella* Typhimurium, PT 9 | 3 | 0 | 0 | D | No formal study | Seafood and chicken curry | Not attributed | Unknown |
| NT | May | Restaurant | Unknown (suspected toxin) | 2 | 0 | 0 | D | No formal study | Cut fruit | Not attributed | Unknown |
| NT | Jul | Fair/festival/mobile service | *Shigella sonnei*, biotype g | 7 | 0 | 0 | D | No formal study | Unknown | Not attributed | Food handler contamination |
| NT | Aug | Camp | *Salmonella* Saintpaul | 30 | 0 | 0 | A | Point source cohort | Cordial | Not attributed | Inadequate cleaning of equipment, storage in contaminated environment |
| NT | Sep | Primary produce | Unknown (suspected toxin) | 2 | 0 | 0 | D | No formal study | Hake | Fish | Unknown |
| NT | Oct | Restaurant | Unknown | 4 | 0 | 0 | D | No formal study | Unknown | Not attributed | Cross contamination from raw ingredients, storage in contaminated environment |
| NT | Nov | Restaurant | Unknown (suspected viral) | 3 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NT | Dec | Restaurant | Unknown | 2 | 0 | 0 | D | Point source cohort | Unknown | Not attributed | Unknown |
| Qld | Jan | Primary produce | Histamine fish poisoning (Scombroid) | 2 | 0 | 0 | M | Case series | Bonito fish stew | Fish | Toxic substance or part of tissue |
| Qld | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 04-15-09-09-490 | 18 | 3 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Qld | Jan | Institution | *Salmonella* Typhimurium, MLVA 03-09-04-12-524 | 10 | 3 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| Qld | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-12-09-524 | 10 | 1 | 0 | M | Case series | Raw egg sauces | Eggs | Ingestion of contaminated raw products, cross contamination from raw ingredients |
| Qld | Feb | Bakery | *Salmonella* Typhimurium, MLVA 03-17-09-11-524 | 12 | 3 | 0 | D | Case series | Bakery items (various) | Not attributed | Ingestion of contaminated raw products |
| Qld | Feb | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Feb | Primary produce | Ciguatera fish poisoning | 9 | 0 | 0 | D | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Mar | Primary produce | Ciguatera fish poisoning | 18 | Unknown | 0 | D | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Mar | School | *Salmonella* Typhimurium, MLVA 03-09-07-12-524 | 5 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Qld | Apr | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-13-09-524 | 3 | 2 | 0 | D | Case series | Egg & lettuce sandwiches | Not attributed | Ingestion of contaminated raw products |
| Qld | Apr | Institution | *Salmonella* Typhimurium, MLVA 03-09-07-12-524 | 58 | 4 | 0 | D | Case control study | Unknown | Not attributed | Unknown |
| Qld | Apr | Bakery | *Salmonella* Typhimurium, MLVA 03-09-07-11-524 | 8 | 0 | 0 | D | Case series | Bakery items (including custard buns) | Not attributed | Ingestion of contaminated raw products |
| Qld | Apr | Primary produce | Ciguatera fish poisoning | 3 | 0 | 0 | M | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Apr | Restaurant | Unknown | 2 | 0 | 0 | D | Case series | Raw oysters | Molluscs | Ingestion of contaminated raw products |
| Qld | Aug | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Coral Trout and Red-throat Emperor | Fish | Toxic substance or part of tissue |
| Qld | Aug | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-13-09-524 | 9 | 2 | 0 | D | Case series | Sushi | Not attributed | Unknown |
| Qld | Sep | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-12-09-524 | 12 | 1 | 0 | D | Case series | Eggs Benedict with potato rosti | Eggs | Ingestion of contaminated raw products |
| Qld | Sep | Bakery | *Salmonella* Typhimurium, MLVA 03-12-11-09-524 | 2 | 2 | 0 | D | Case series | Vietnamese style rolls | Not attributed | Ingestion of contaminated raw products |
| Qld | Sep | Primary produce | Ciguatera fish poisoning | 9 | 0 | 0 | D | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Sep | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | M | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Oct | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-12-09-524 | 11 | 2 | 0 | M | Case control study | Duck pancakes | Eggs | Cross contamination from raw ingredients, inadequate cleaning of equipment |
| Qld | Oct | Private residence | *Salmonella* Chester | 3 | 1 | 0 | D | Case series | Offal stew (lamb intestine, tripe, liver and kidney) | Lamb | Ingestion of contaminated raw products |
| Qld | Oct | Bakery | Unknown (suspected viral) | 13 | 0 | 0 | A | Case series | Cake | Not attributed | Person to food to person |
| Qld | Oct | Primary produce | Ciguatera fish poisoning | 4 | 0 | 0 | M | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Oct | Primary produce | Ciguatera fish poisoning | 3 | 0 | 0 | M | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Oct | Primary produce | Ciguatera fish poisoning | 4 | 0 | 0 | D | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Oct | Primary produce | Ciguatera fish poisoning | 3 | 0 | 0 | M | Case series | Coronation Trout | Fish | Toxic substance or part of tissue |
| Qld | Nov | Restaurant | *Salmonella* Typhimurium, PT U307, MLVA 03-12-11-12-524 | 12 | Unknown | 0 | M | Case series | Chocolate mousse | Eggs | Ingestion of contaminated raw products |
| Qld | Nov | Private residence | *Salmonella* Chester | 6 | 3 | 0 | D | Case series | Offal (lamb intestine) | Lamb | Ingestion of contaminated raw products |
| Qld | Nov | Private residence | *Staphylococcus aureus* | 7 | 0 | 0 | M | Case series | Taro cake | Not attributed | Food handler contamination |
| Qld | Nov | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | M | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Nov | Restaurant | *Clostridium befermentans* | 14 | 0 | 0 | M | Case series | Butter chicken | Poultry | Ingestion of contaminated raw products |
| Qld | Dec | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-11-12-524 | 6 | 0 | 0 | D | Case series | Chocolate mousse | Eggs | Ingestion of contaminated raw products |
| Qld | Dec | Restaurant | *Salmonella* Typhimurium, PT U307, MLVA 03-12-11-12-524 | 10 | Unknown | 0 | M | Case series | Fried ice cream | Eggs | Ingestion of contaminated raw products, cross contamination from raw ingredients |
| Qld | Dec | Primary produce | Ciguatera fish poisoning | 5 | 0 | 0 | D | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| SA | Jan | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-24-11/12-10-523 | 4 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Jan | Take-away | *Salmonella* Typhimurium, PT 9, MLVA 03-24-11-10-523 | 5 | 2 | 0 | D | Case series | Vietnamese rolls containing raw egg sauce | Eggs | Ingestion of contaminated raw products |
| SA | Feb | Fair/festival/mobile service | *Salmonella* subsp 1 ser 4,5,12:i:-, MLVA 04-15-12-00-490 | 8 | 0 | 0 | D | Case series | Roast pork | Pork | Unknown |
| SA | Feb | Restaurant | *Salmonella* Typhimurium, PT 135, MLVA 03-12-09-11-523 | 4 | 2 | 0 | M | Case series | Raw egg aioli | Eggs | Ingestion of contaminated raw products |
| SA | Mar | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-26-15-09-523 and MLVA 03-26-11-09-523 | 33 | 5 | 0 | AM | Case control study | Egg dish and pesto | Eggs | Cross contamination from raw ingredients, inadequate cleaning of equipment |
| SA | Mar | Take-away | *Salmonella* Typhimurium, PT 108, MLVA 03-09-07-12-523 | 17 | 2 | 0 | D | Case series | Vietnamese rolls containing raw egg butter | Eggs | Ingestion of contaminated raw products, inadequate cleaning of equipment |
| SA | Apr | Bakery | *Salmonella* Typhimurium, PT 108, MLVA 03-09-07-12-523 | 12 | 1 | 0 | D | Case series | Vietnamese rolls containing raw egg butter | Eggs | Ingestion of contaminated raw products, inadequate cleaning of equipment |
| SA | Aug | Restaurant | *Salmonella* Typhimurium, PT 44, MLVA 03-10-08-09-523 | 12 | 4 | 0 | M | Case series | Breakfast eggs (served a number of ways) | Eggs | Cross contamination from raw ingredients |
| SA | Aug | Private residence | *Salmonella* subsp 1 ser 4,5,12:i:-, MLVA 04-15-12-00-490 | 18 | 0 | 0 | D | Case series | Pork spit roast | Pork | Unknown |
| SA | Sep | School | *Salmonella* Typhimurium, PT9, MLVA 03-24-24-10-523 | 5 | 1 | 0 | D | Case series | Chicken burger | Not attributed | Unknown |
| SA | Sep | Commercial caterer | Unknown | 25 | 0 | 0 | D | No formal study | Sandwiches | Not attributed | Person to food to person |
| SA | Oct | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-15-08-11-550 | 10 | 2 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Oct | Restaurant | *Campylobacter jejuni* | 22 | 2 | 0 | A | Case control study | Prawns | Crustaceans | Cross contamination from raw ingredients |
| SA | Dec | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-15-06-12-550 | 7 | 0 | 0 | D | Case series | Unknown | Not attributed | Cross contamination from raw ingredients |
| SA | Dec | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-14-06-12-550 | 11 | 4 | 1 | M | Case series | Raw egg aioli | Eggs | Cross contamination from raw ingredients |
| SA | Dec | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-24-13-10-523 | 8 | 1 | 0 | D | Case series | Raw egg aioli | Eggs | Other source of contamination |
| SA | Dec | Private residence | *Salmonella* Typhimurium, PT 9, MLVA 03-24-13-10-523 | 14 | 3 | 0 | A | Point source cohort | Tiramisu containing raw egg | Eggs | Ingestion of contaminated raw products |
| Tas. | Jan | Private residence | *Salmonella* Typhimurium, PT 44 | 3 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Tas. | Nov | Restaurant | Norovirus | 9 | 4 | 0 | A | Point source cohort | Fruit salad | Not attributed | Unknown |
| Vic. | Jan | Private residence | *Salmonella* Typhimurium, PT 9 | 12 | 3 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Jan | Restaurant | *Salmonella* Typhimurium, PT 136 | 94 | 17 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Jan | Community | *Salmonella* Typhimurium, PT 9 | 2 | 1 | 0 | D | Case series | Eggs | Eggs | Unknown |
| Vic. | Jan | Restaurant | *Salmonella* Typhimurium, PT 135a | 2 | 0 | 0 | D | Case series | Eggs and/or hollandaise sauce | Eggs | Ingestion of contaminated raw products |
| Vic. | Jan | Private residence | *Salmonella* Typhimurium, PT 9 | 4 | 0 | 0 | D | Case series | Hamburger with egg | Eggs | Ingestion of contaminated raw products |
| Vic. | Jan | Restaurant | *Salmonella* Typhimurium, PT 9 | 6 | 0 | 0 | D | Case series | Undercooked eggs | Eggs | Ingestion of contaminated raw products |
| Vic. | Jan | Restaurant | *Salmonella* Typhimurium, PT 9 | 3 | 1 | 0 | D | Case series | Undercooked eggs | Eggs | Ingestion of contaminated raw products |
| Vic. | Feb | Commercial caterer | Unknown (suspected *Clostridium perfringens*) | 25 | 0 | 0 | A | Point source cohort | Lentil curry (dahl) | Not attributed | Unknown |
| Vic. | Feb | Restaurant | *Salmonella* Typhimurium, PT 9 | 242 | 26 | 0 | M | Case series | Mayonnaise | Eggs | Ingestion of contaminated raw products |
| Vic. | Feb | Restaurant | *Salmonella* Typhimurium, PT 9 | 3 | 2 | 0 | D | Case series | Raw egg aioli | Eggs | Ingestion of contaminated raw products |
| Vic. | Feb | Restaurant | *Salmonella* Typhimurium, PT 9 | 2 | 1 | 0 | D | Case series | Raw egg aioli | Eggs | Ingestion of contaminated raw products |
| Vic. | Feb | Restaurant | *Salmonella* Typhimurium, PT 9 | 15 | 1 | 0 | D | Case series | Raw egg aioli | Eggs | Ingestion of contaminated raw products |
| Vic. | Feb | Restaurant | *Salmonella* Typhimurium, PT 9 | 14 | 5 | 0 | M | Case series | Raw egg Hollandaise sauce | Eggs | Ingestion of contaminated raw products |
| Vic. | Feb | Private residence | *Salmonella* Typhimurium, PT 9 | 3 | 0 | 0 | D | Case series | Tiramisu containing raw egg | Eggs | Ingestion of contaminated raw products |
| Vic. | Feb | Restaurant | *Salmonella* Typhimurium, PT 9 | 13 | 5 | 0 | D | Case series | Undercooked eggs | Eggs | Ingestion of contaminated raw products |
| Vic. | Mar | Aged care | *Campylobacter jejuni* | 14 | 0 | 1 | D | Case series | Chicken patties | Poultry | Unknown |
| Vic. | Mar | Private residence | *Salmonella* Typhimurium, PT 44 | 6 | 3 | 1 | D | Case series | Pasta containing raw egg | Eggs | Unknown |
| Vic. | Mar | Private residence | *Salmonella* Typhimurium, PT 135a | 13 | 1 | 0 | D | Case series | Tiramisu containing raw egg | Eggs | Ingestion of contaminated raw products |
| Vic. | Apr | Private residence | *Salmonella* Typhimurium, PT 135a | 4 | 1 | 0 | D | Case series | Raw brownie batter | Eggs | Ingestion of contaminated raw products |
| Vic. | Apr | Restaurant | *Salmonella* Typhimurium, PT 9 | 21 | Unknown | 0 | D | Case series | Raw egg aioli/mayonnaise | Eggs | Ingestion of contaminated raw products |
| Vic. | Apr | Bakery | *Salmonella* Typhimurium, PT 170 | 24 | 1 | 0 | M | Case series | Raw egg chocolate mousse | Eggs | Ingestion of contaminated raw products |
| Vic. | May | Primary produce | Haemolytic uraemic syndrome / Cryptosporidium | 3 | 3 | 1 | D | Case series | Unpasteurised milk | Dairy | Ingestion of contaminated raw products |
| Vic. | May | Restaurant | Norovirus | 46 | Unknown | 0 | A | Point source cohort | Grain salad | Not attributed | Food handler contamination |
| Vic. | May | Private residence | *Salmonella* Typhimurium, PT 135a | 6 | 5 | 0 | D | Case series | Raw egg chocolate mousse | Eggs | Ingestion of contaminated raw products |
| Vic. | May | Private residence | *Salmonella* Typhimurium, PT 99 | 3 | 0 | 0 | D | Case series | Raw egg chocolate mousse | Eggs | Ingestion of contaminated raw products |
| Vic. | Jun | Hospital | *Salmonella* Typhimurium, PT 135 | 22 | 1 | 1 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Jul | Aged care | *Clostridium perfringens* | 9 | Unknown | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Jul | Bakery | *Salmonella* Typhimurium, PT 135 | 10 | 5 | 0 | M | Case series | Vietnamese rolls containing chicken liver pâté | Poultry | Unknown |
| Vic. | Aug | Bakery | *Salmonella* Typhimurium, PT 170 | 24 | 4 | 0 | D | Case series | Vietnamese pork/chicken rolls containing raw egg mayonnaise | Eggs | Unknown |
| Vic. | Oct | Restaurant | *Salmonella* Singapore | 15 | 0 | 0 | D | Case series | Beef wraps | Not attributed | Cross contamination from raw ingredients |
| Vic. | Oct | Restaurant | Unknown (suspected toxin) | 13 | Unknown | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| Vic. | Nov | Commercial caterer | Norovirus | 53 | 1 | 0 | A | Case control study | Thai beef salad | Not attributed | Food handler contamination |
| Vic. | Nov | Restaurant | *Salmonella* Typhimurium, PT 170 | 19 | 3 | 0 | M | Case series | Rice paper rolls | Not attributed | Cross contamination from raw ingredients |
| Vic. | Nov | Aged care | *Clostridium perfringens* | 5 | Unknown | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Nov | Commercial caterer | Norovirus | 20 | 2 | 0 | A | Point source cohort | Brownies or cut fresh fruit | Not attributed | Food handler contamination |
| Vic. | Nov | Commercial caterer | Norovirus | 14 | 0 | 0 | A | Point source cohort | Potato salad | Not attributed | Food handler contamination |
| Vic. | Nov | Commercial caterer | Norovirus | 19 | 1 | 0 | A | Point source cohort | Lamb, lettuce and tomato | Not attributed | Unknown |
| Vic. | Nov | Private residence | *Salmonella* Typhimurium, PT 44 | 10 | 0 | 0 | A | Point source cohort | Roast beef or frittata | Not attributed | Cross contamination from raw ingredients |
| Vic. | Dec | Restaurant | Norovirus | 6 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | Jan | Private residence | *Salmonella* Typhimurium | 4 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | Feb | Primary produce | *Salmonella* Singapore | 6 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | Feb | Private residence | *Salmonella* Typhimurium | 3 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | Mar | Take-away | Unknown | 11 | 0 | 0 | A | Case control study | Unknown | Not attributed | Unknown |
| WA | Mar | Commercial caterer | *Salmonella* Infantis | 6 | 0 | 0 | D | Case series | Nasi-Lemak | Not attributed | Unknown |
| WA | Mar | Restaurant | *Salmonella* Infantis | 2 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | Apr | Private residence | *Salmonella* Typhimurium, PT 135, PFGE 3 | 10 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | May | Restaurant | *Salmonella* Typhimurium, PFGE type 1 | 5 | 0 | 0 | A | Case control study | Lamb shanks or salad | Not attributed | Cross contamination from raw ingredients, ingestion of contaminated raw products |
| WA | Sep | Aged care | *Clostridium perfringens* | 19 | 0 | 0 | D | Case series | Unknown | Not attributed | Inadequate cleaning of equipment |
| WA | Sep | Restaurant | *Salmonella* Typhimurium, PT 9, PFGE 1 | 4 | 1 | 0 | D | Case series | Slow cooked pork hock | Not attributed | Cross contamination from raw ingredients |
| WA | Dec | Commercial caterer | Unknown (suspected *Clostridium perfringens*) | 13 | 0 | 0 | A | Case control study | Roast meats (turkey, pork, beef) | Not attributed | Unknown |
| WA | Dec | Camp | Norovirus | 30 | 2 | 0 | A | Point source cohort | Unknown | Not attributed | Person to food to person |
| WA | Dec | Restaurant | Norovirus | 21 | 0 | 0 | A | Point source cohort | Salad | Not attributed | Food handler contamination, person to food to person |

a Month of outbreak is the month of onset of the first case or month of notification of the first case or the month the investigation into the outbreak commenced.

b PT: Phage type; PFGE: Pulse field gel electrophoresis; MLVA: Multi-locus variable number tandem repeat analysis.

c Evidence categories. D: Descriptive evidence implicating the vehicle. A: Analytical epidemiological association between illness and vehicle. M: Microbiological confirmation of aetiology in vehicle and cases. AM: Analytical association and microbiological confirmation of aetiology.

# Appendix C: Foodborne and suspected foodborne outbreak summary for OzFoodNet sites, Australia, 2015

| State or territorya | Monthb | Setting prepared | Agent responsiblec | No. ill | No. hospitalised | No. of fatalities | Evidenced | Epidemiological study | Responsible vehicles | Commodity | Contamination factor |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| MJOI | Feb | Primary produce | Hepatitis A | 35 | 16 | 0 | AM | Case control study | Frozen mixed berries | Fruits and nuts | Ingestion of contaminated raw products |
| ACT | Jun | Commercial caterer | *Clostridium perfringens* | 29 | 0 | 0 | AM | Point source cohort | Butter chicken | Poultry | Other source of contamination |
| ACT | Jun | Private residence | *Salmonella* Typhimurium, PT 135, MLVA 03-17-08-12-525 | 2 | 2 | 0 | D | Case series | Raw egg milkshake | Eggs | Ingestion of contaminated raw products |
| ACT | Jul | Private residence | *Salmonella* Typhimurium, PT 9 | 3 | 1 | 0 | D | Case series | Raw egg milkshake | Eggs | Ingestion of contaminated raw products |
| ACT | Nov | Commercial caterer | Norovirus | 29 | 0 | 0 | A | Point source cohort | Chicken wraps | Not attributed | Food handler contamination |
| ACT | Dec | Private residence | Histamine fish poisoning (Scombroid) | 3 | 0 | 0 | D | Case series | Tuna | Fish | Toxic substance or part of tissue |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-11-14-523 | 12 | 0 | 0 | D | No formal study | Breakfast eggs | Eggs | Ingestion of contaminated raw products |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-11-14-523 | 2 | 0 | 0 | D | No formal study | Chicken salad containing raw egg mayonnaise | Eggs | Cross contamination from raw ingredients |
| NSW | Jan | Commercially manufactured | *Salmonella* Bovismorbificans, PT 14 | 33 | 12 | 2 | M | Case series | Baked desserts | Not attributed | Other source of contamination |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-13-09-523 | 13 | 3 | 0 | D | Case series | Chinese meal | Not attributed | Unknown |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-09-07-12-523 and MLVA 03-12-12-09-523 | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-09-08-12-523 | 3 | 0 | 0 | D | No formal study | Tiramisu (not containing raw egg) | Not attributed | Cross contamination from raw ingredients |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-10-08-12-523 | 9 | 0 | 0 | M | No formal study | Shared mixed platters | Not attributed | Cross contamination from raw ingredients |
| NSW | Jan | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Beef noodles | Not attributed | Unknown |
| NSW | Jan | Restaurant | *Salmonella* Typhimurium, MLVA 03-09-08-11-523 | 24 | 2 | 0 | M | Case series | Fried ice cream | Eggs | Ingestion of contaminated raw products |
| NSW | Feb | Restaurant | *Salmonella* Virchow | 3 | 1 | 0 | D | No formal study | Egg dishes | Eggs | Cross contamination from raw ingredients |
| NSW | Feb | Take-away | Histamine fish poisoning (Scombroid) | 7 | 0 | 0 | M | No formal study | Canned tuna | Fish | Toxic substance or part of tissue |
| NSW | Feb | Restaurant | *Salmonella* Typhimurium | 7 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Feb | Picnic | *Salmonella* Typhimurium, PT 12a | 4 | 3 | 0 | D | No formal study | Pancake batter containing raw eggs | Eggs | Ingestion of contaminated raw products |
| NSW | Feb | Take-away | Unknown (suspected *Salmonella*) | 30 | 0 | 0 | D | No formal study | Vietnamese rolls containing raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| NSW | Mar | Restaurant | *Salmonella* Typhimurium, MLVA 03-09-07-13-523 | 4 | 0 | 0 | D | Case series | Eggs | Eggs | Ingestion of contaminated raw products |
| NSW | Mar | Restaurant | *Salmonella* species | 5 | 1 | 0 | D | No formal study | Tiramisu containing raw egg | Eggs | Ingestion of contaminated raw products |
| NSW | Apr | Private residence | Ciguatera fish poisoning | 4 | 1 | 0 | D | No formal study | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| NSW | Apr | Restaurant | *Clostridium perfringens* | 4 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Apr | Restaurant | *Campylobacter jejuni* | 2 | 1 | 0 | D | No formal study | Chicken liver pâté | Poultry | Ingestion of contaminated raw products |
| NSW | Apr | Take-away | *Salmonella* Agona | 3 | 0 | 0 | M | No formal study | Tuna mix for sushi | Not attributed | Cross contamination from raw ingredients |
| NSW | Apr | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-12-09-523 | 11 | 0 | 0 | D | No formal study | Undercooked eggs | Eggs | Ingestion of contaminated raw products |
| NSW | May | Restaurant | Unknown | 9 | 1 | 0 | D | No formal study | Pizza and salad | Not attributed | Unknown |
| NSW | May | Restaurant | Unknown | 7 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | May | Take-away | Unknown | 6 | 0 | 0 | D | No formal study | Beef doner kebabs | Not attributed | Cross contamination from raw ingredients |
| NSW | May | Commercial caterer | Unknown (suspected viral) | 12 | 1 | 0 | A | Point source cohort | Unknown | Not attributed | Unknown |
| NSW | Jul | Restaurant | Unknown | 10 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jul | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Jul | Take-away | Unknown | 9 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Aug | Bakery | Norovirus | 18 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Aug | Restaurant | Unknown | 5 | 0 | 0 | D | No formal study | Seafood | Not attributed | Unknown |
| NSW | Aug | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Sep | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-11-14-523 | 40 | 0 | 0 | M | Point source cohort | Fried ice cream | Eggs | Ingestion of contaminated raw products |
| NSW | Sep | Take-away | *Salmonella* Typhimurium, MLVA 03-12-11-14-523 | 5 | 0 | 0 | D | Case series | Raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| NSW | Sep | Private residence | Ciguatera fish poisoning | 4 | 0 | 0 | M | No formal study | Red-throat Emperor and Purple Rock Cod | Fish | Toxic substance or part of tissue |
| NSW | Sep | Restaurant | Norovirus | 39 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Sep | Restaurant | Unknown | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Sep | Restaurant | Unknown | 29 | 0 | 0 | A | Point source cohort | Unknown | Not attributed | Unknown |
| NSW | Sep | Take-away | *Salmonella* Typhimurium, MLVA 03-16-09-11-523 | 12 | 9 | 0 | M | Case series | Vietnamese pork rolls containing raw egg mayonnaise | Eggs | Cross contamination from raw ingredients |
| NSW | Oct | Restaurant | *Salmonella* Typhimurium, MLVA 03-26-13-08-523 | 40 | 2 | 0 | A | Point source cohort | Raw egg sauces | Eggs | Ingestion of contaminated raw products |
| NSW | Oct | Private residence | Histamine fish poisoning (Scombroid) | 2 | 2 | 0 | D | No formal study | Fish (unknown type) | Fish | Toxic substance or part of tissue |
| NSW | Oct | Restaurant | Unknown | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Oct | Restaurant | Unknown (suspected viral) | 14 | 1 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Oct | Restaurant | Unknown | 13 | 0 | 0 | D | Point source cohort | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | *Salmonella* Typhimurium, MLVA 03-10-09-09-523 | 3 | 0 | 0 | D | No formal study | Chinese meal | Eggs | Unknown |
| NSW | Nov | Restaurant | *Salmonella* Typhimurium, MLVA 03-26-17-10-523 | 4 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | Unknown (suspected norovirus) | 10 | 0 | 0 | D | Case series | Unknown | Not attributed | Food handler contamination |
| NSW | Nov | Grocery store/delicatessen | Unknown | 4 | 0 | 0 | D | No formal study | Oysters | Not attributed | Unknown |
| NSW | Nov | Private residence | *Salmonella* Typhimurium, MLVA 03-09-07-12-523 | 3 | 3 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | Unknown | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | Unknown | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | Unknown | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | Unknown (suspected viral) | 5 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | Unknown (suspected viral) | 30 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Nov | Restaurant | *Campylobacter* | 2 | 1 | 0 | D | No formal study | Chicken liver pâté | Poultry | Ingestion of contaminated raw products |
| NSW | Dec | Restaurant | *Salmonella* Typhimurium, MLVA 03-26-13-08-523 | 2 | 0 | 0 | D | No formal study | Battered fish | Not attributed | Unknown |
| NSW | Dec | Restaurant | Unknown (suspected viral) | 18 | 0 | 0 | D | No formal study | Unknown | Not attributed | Unknown |
| NSW | Dec | Take-away | Unknown | 2 | 0 | 0 | D | No formal study | Chicken curry | Not attributed | Unknown |
| NT | Jun | Restaurant | *Salmonella* Typhimurium, PT 9 | 23 | 4 | 0 | A | Point source cohort | Duck prosciutto | Poultry | Ingestion of contaminated raw products, storage in contaminated environment |
| NT | Aug | Restaurant | Unknown | 3 | 0 | 0 | D | No formal study | Raw egg aioli | Eggs | Ingestion of contaminated raw products |
| NT | Aug | Fair/festival/mobile service | *Salmonella* Typhimurium, PT 168a | 4 | 0 | 0 | D | No formal study | Unknown | Not attributed | Ingestion of contaminated raw products, other source of contamination |
| NT | Sep | Overseas military exercise | *Campylobacter* | 19 | 19 | 0 | D | Case series | Unknown | Not attributed | Food handler contamination, other source of contamination |
| NT | Oct | Grocery store/delicatessen | Unknown | 7 | 0 | 0 | D | No formal study | Juice | Not attributed | Unknown |
| NT | Nov | Grocery store/delicatessen | Unknown (suspected norovirus) | 10 | 0 | 0 | D | No formal study | Supermarket platters | Not attributed | Unknown |
| Qld | Jan | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Cod | Fish | Toxic substance or part of tissue |
| Qld | Jan | National franchised fast food | *Salmonella* Typhimurium, PT U307, MLVA 03-12-11-12-524 | 48 | 14 | 0 | M | Case series | Chocolate mousse | Eggs | Ingestion of contaminated raw products |
| Qld | Jan | Aged care | *Salmonella* Typhimurium | 4 | 1 | 0 | M | No formal study | Unknown | Not attributed | Unknown |
| Qld | Jan | Restaurant | *Salmonella* Typhimurium, PT U307, MLVA 03-12-11-12-524 | 138 | Unknown | 0 | AM | Case control study | Fried ice cream | Eggs | Ingestion of contaminated raw products |
| Qld | Jan | Restaurant | *Salmonella* Typhimurium, PT U307, MLVA 03-12-12-12-524 and MLVA 03-10-07-12-524 | 16 | 0 | 0 | AM | Point source cohort | Fried ice cream | Eggs | Ingestion of contaminated raw products |
| Qld | Jan | Community | *Salmonella* Typhimurium, PT U307, MLVA 03-12-11-12-524 | 85 | Unknown | 0 | M | Case series | Kimbap style sushi | Eggs | Ingestion of contaminated raw products |
| Qld | Feb | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-13-09-524 | 17 | 2 | 0 | A | Case control study | Roast duck | Not attributed | Cross contamination from raw ingredients |
| Qld | Feb | Private residence | *Salmonella* Typhimurium, MLVA 03-12-10-12-524 | 6 | 1 | 0 | D | Case series | Sushi | Not attributed | Ingestion of contaminated raw products, cross contamination from raw ingredients |
| Qld | Feb | Restaurant | Norovirus | 18 | 0 | 0 | D | Case series | Unknown | Not attributed | Person to food to person |
| Qld | Feb | Restaurant | *Salmonella* Typhimurium, MLVA 03-12-12-09-524 | 7 | 1 | 0 | D | Case series | Eggs Benedict and raw egg Béarnaise sauce | Eggs | Ingestion of contaminated raw products |
| Qld | Feb | Commercial caterer | *Salmonella* Typhimurium, MLVA 03-12-12-09-524 | 30 | 3 | 0 | M | Case series | Unknown | Not attributed | Ingestion of contaminated raw products |
| Qld | Feb | Restaurant | *Salmonella* Typhimurium | 3 | 0 | 0 | D | Case series | Lamb tartare containing raw eggs | Not attributed | Inadequate cleaning of equipment, cross contamination from raw ingredients |
| Qld | Feb | Commercial caterer | *Salmonella* Typhimurium, MLVA 03-12-12-09-524 | 140 | 9 | 0 | AM | Case control study | Rum and raisin bread cake with custard | Eggs | Ingestion of contaminated raw products |
| Qld | Mar | Private residence | *Salmonella* Typhimurium, MLVA 03-12-10-11-524 | 20 | 4 | 0 | M | Case series | Chicken long soup (containing egg and chicken) | Poultry | Ingestion of contaminated raw products, cross contamination from raw ingredients |
| Qld | Mar | Restaurant | *Salmonella* Typhimurium, MLVA 03-17-09-11-524 | 44 | 23 | 0 | AM | Case control study | Eggs Benedict | Eggs | Ingestion of contaminated raw products |
| Qld | Mar | Primary produce | Ciguatera fish poisoning | 6 | 1 | 0 | D | Case series | Spanish Mackerel | Fish | Toxic substance or part of tissue |
| Qld | Apr | Private residence | Norovirus | 17 | 0 | 0 | D | Case series | Cake | Not attributed | Person to food to person |
| Qld | May | Private residence | *Salmonella* Hvittingfoss | 23 | Unknown | 0 | M | Case series | Unknown | Not attributed | Unknown |
| Qld | May | Restaurant | *Salmonella* Typhimurium, MLVA 03-17-09-11-524 | 8 | 2 | 0 | D | Case series | Banquet meal | Not attributed | Cross contamination from raw ingredients, inadequate washing of food eaten uncooked |
| Qld | May | Restaurant | *Salmonella* Typhimurium, MLVA 05-21-08-14-457 | 14 | 6 | 0 | D | Case series | Unknown | Not attributed | Ingestion of contaminated raw products |
| Qld | Jun | Restaurant | *Salmonella* Typhimurium, MLVA 03-16-09-11-524 | 7 | 0 | 0 | D | Case series | Raw egg aioli | Eggs | Ingestion of contaminated raw products |
| Qld | Aug | Aged care | *Salmonella* Typhimurium, MLVA 03-17-09-11-524 | 22 | 2 | 1 | D | No formal study | Unknown | Not attributed | Unknown |
| Qld | Sep | Restaurant | *Salmonella* Typhimurium, MLVA 03-17-09-11-524 | 76 | 16 | 0 | M | Case series | Raw egg aioli/mayonnaise | Eggs | Ingestion of contaminated raw products, inadequate cleaning of equipment |
| Qld | Oct | Restaurant | *Salmonella* Typhimurium, MLVA 04-14-09-09-436 | 7 | 1 | 0 | D | Case series | Raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| Qld | Oct | Restaurant | *Campylobacter jejuni* | 63 | Unknown | 0 | D | Case series | Sliced ham | Pork | Cross contamination from raw ingredients |
| Qld | Nov | Aged care | *Salmonella* Virchow | 22 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Qld | Nov | Primary produce | Ciguatera fish poisoning | 2 | 0 | 0 | D | Case series | Coral Trout | Fish | Toxic substance or part of tissue |
| Qld | Dec | Commercial caterer | *Salmonella* Typhimurium, MLVA 03-24-13-10-524 | 20 | 4 | 0 | D | Case series | Pork rolls with raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| Qld | Dec | Restaurant | *Salmonella* Typhimurium, MLVA 03-17-09-11-524 | 4 | 0 | 0 | D | Case series | Raw egg hollandaise sauce | Eggs | Ingestion of contaminated raw products |
| Qld | Dec | Bakery | *Salmonella* Typhimurium, MLVA 03-12-11-09-524 | 12 | 2 | 0 | D | Case series | Vietnamese rolls containing raw egg butter | Eggs | Ingestion of contaminated raw products, cross contamination from raw ingredients |
| Qld | Dec | Aged care | *Salmonella* Typhimurium, MLVA 05-12-10-10-490 | 25 | 8 | 2 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Feb | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-15-06-11-550 | 7 | 2 | 0 | D | Case series | Eggs | Eggs | Unknown |
| SA | Feb | Restaurant | *Salmonella* Typhimurium, PT 135a, MLVA 03-13-10-10-523 | 2 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Feb | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-24-13-10-523 | 7 | 2 | 0 | M | Case series | Unknown | Not attributed | Inadequate cleaning of equipment |
| SA | Feb | Take-away | *Salmonella* Typhimurium, PT 9, MLVA 03-14-08-11-550 | 4 | 1 | 0 | D | Case series | Unknown | Not attributed | Person to food to person |
| SA | Feb | Restaurant | *Salmonella* Typhimurium, PT 135a, MLVA 03-12-12-09-523 | 3 | 0 | 0 | D | Case series | Raw egg aioli | Eggs | Unknown |
| SA | Feb | Restaurant | *Salmonella* Typhimurium, PT 135, MLVA 03-12-09-11-523 | 7 | 1 | 0 | D | Case series | Raw egg sundried tomato aioli | Eggs | Unknown |
| SA | Mar | Private residence | *Salmonella* subsp 1 ser 4,5,12:i:-, MLVA 04-15-11-00-490 | 6 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Apr | Private residence | *Salmonella* Typhimurium, PT 135a, MLVA 03-11-12-14-523 | 4 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Apr | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-24-11-10-523 | 9 | 3 | 0 | M | Case series | Eggs | Eggs | Cross contamination from raw ingredients, inadequate cleaning of equipment |
| SA | May | Private residence | *Salmonella* Typhimurium, PT 108, MLVA 03-09-07-12-523 | 9 | 2 | 0 | M | No formal study | Egg-battered chicken and veal schnitzels | Eggs | Unknown |
| SA | May | Bakery | *Salmonella* Typhimurium, PT 9, MLVA 03-14-08-11-550 | 40 | 8 | 0 | D | Case series | Vietnamese rolls containing raw egg butter | Eggs | Ingestion of contaminated raw products |
| SA | Jul | Take-away | *Salmonella* Typhimurium, PT 9, MLVA 03-24-11-10-523 | 5 | 0 | 0 | D | Case series | Egg based crepes | Eggs | Unknown |
| SA | Jul | Hospital | *Salmonella* Typhimurium, PT 9, MLVA 03-24-12-10-523 | 37 | 6 | 0 | M | Case series | Egg based crumb | Eggs | Cross contamination from raw ingredients, inadequate cleaning of equipment |
| SA | Sep | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-15-06-12-550 | 3 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| SA | Sep | Take-away | *Salmonella* Typhimurium, PT 135, MLVA 03-11-15-09-523 | 6 | 3 | 0 | D | Case series | Unknown | Not attributed | Cross contamination from raw ingredients |
| Tas. | May | Aged care | Norovirus | 124 | 1 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Tas. | Oct | Primary produce | Paralytic shellfish poisoning | 4 | 2 | 0 | M | Case series | Mussels | Molluscs | Toxic substance or part of tissue |
| Vic. | Jan | Aged care | Unknown (suspected *Clostridium perfringens*) | 4 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Feb | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-24-15/16-12-525 | 18 | 5 | 0 | M | Case series | Chicken sandwiches containing raw egg mayonnaise | Eggs | Unknown |
| Vic. | Feb | Restaurant | *Salmonella* Typhimurium, PT 135a, MLVA 03-13-10-10-525 | 10 | 1 | 0 | A | Case control study | Pork | Pork | Unknown |
| Vic. | Feb | Aged care | *Salmonella* Typhimurium, PT 135a, MLVA 03-11-11-16-525 | 2 | 0 | 0 | D | Case series | Vitamised foods | Not attributed | Cross contamination from raw ingredients |
| Vic. | Mar | Take-away | *Salmonella* Typhimurium, PT 135a, MLVA 03-15-11-10-540 | 6 | 6 | 0 | D | Case series | Chicken | Not attributed | Unknown |
| Vic. | Mar | Restaurant | *Salmonella* Typhimurium, PT 135a, MLVA 03-13-09-14-525 | 3 | 0 | 0 | M | Case series | Raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| Vic. | Apr | Private residence | *Salmonella* Typhimurium, PT 9, MLVA 03-23-23-10-523 | 11 | 0 | 0 | D | Point source cohort | Pasta carbonara | Eggs | Ingestion of contaminated raw products |
| Vic. | Apr | Private residence | *Salmonella* Typhimurium, PT 44 | 6 | 2 | 0 | D | Case series | Pasta containing raw egg | Eggs | Ingestion of contaminated raw products |
| Vic. | Apr | Restaurant | Unknown | 4 | 0 | 0 | D | Case series | Vietnamese meal | Not attributed | Unknown |
| Vic. | Apr | Private residence | *Salmonella* Typhimurium, PT 135a | 6 | 1 | 0 | M | Case series | Raw egg chocolate mousse | Eggs | Ingestion of contaminated raw products |
| Vic. | May | Commercial caterer | *Salmonella* Typhimurium, PT 135 | 16 | 2 | 0 | A | Case control study | Desserts | Not attributed | Unknown |
| Vic. | May | Institution | *Salmonella* Typhimurium, PT 135 | 23 | 1 | 0 | M | Case series | Chicken | Poultry | Unknown |
| Vic. | Jun | Aged care | *Clostridium perfringens* | 12 | Unknown | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Jun | Restaurant | Unknown | 14 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Jul | Restaurant | *Salmonella* Typhimurium, PT 170, MLVA 03-09-09-15-525 | 133 | 22 | 0 | AM | Point source cohort | Chicken sandwiches containing raw egg mayonnaise | Eggs | Ingestion of contaminated raw products |
| Vic. | Jul | Commercial caterer | Unknown (suspected *Clostridium perfringens*) | 14 | 0 | 0 | A | Case control study | Roast meats | Not attributed | Unknown |
| Vic. | Jul | Aged care | Unknown (suspected *Clostridium perfringens*) | 9 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Jul | School | *Campylobacter* | 8 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Aug | Private residence | *Salmonella* species, subsp I | 5 | 1 | 0 | D | Case series | Raw cookie dough | Eggs | Ingestion of contaminated raw products |
| Vic. | Aug | Restaurant | Unknown | 8 | 0 | 0 | D | Case series | Banquet meal | Not attributed | Unknown |
| Vic. | Sep | Restaurant | Norovirus | 9 | 0 | 0 | A | Case control study | Salad | Not attributed | Person to food to person |
| Vic. | Sep | Restaurant | *Campylobacter* | 4 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| Vic. | Sep | Commercial caterer | Norovirus | 46 | 0 | 0 | A | Point source cohort | Cheese, fruit and dip platters | Not attributed | Unknown |
| Vic. | Oct | Restaurant | Norovirus | 10 | 0 | 0 | D | Case series | Shared antipasto platters | Not attributed | Person to food to person |
| Vic. | Oct | Take-away | *Salmonella* species, subsp I | 6 | 3 | 0 | M | Case series | Chicken and gravy | Poultry | Unknown |
| Vic. | Nov | Restaurant | *Campylobacter* | 16 | 0 | 0 | A | Case control study | Peking duck | Poultry | Unknown |
| Vic. | Nov | Restaurant | *Clostridium perfringens* | 13 | 0 | 0 | A | Case control study | Chicken | Poultry | Unknown |
| Vic. | Dec | Restaurant | *Campylobacter* | 11 | 0 | 0 | A | Case control study | Chicken liver parfait | Poultry | Ingestion of contaminated raw products |
| WA | Jan | Restaurant | Norovirus | 9 | 0 | 0 | A | Point source cohort | Salads | Not attributed | Food handler contamination, Person to food to person |
| WA | Jan | Institution | *Salmonella* Typhimurium, PFGE type 3, MLVA 03-11-15-10-523 | 84 | 4 | 0 | M | Case series | Raw egg mayonnaise and raw egg milkshakes | Eggs | Ingestion of contaminated raw products |
| WA | Mar | Commercial caterer | Norovirus | 7 | 0 | 0 | D | Case series | Unknown | Not attributed | Unknown |
| WA | Mar | Take-away | *Salmonella* Typhimurium, PFGE type 13, MLVA 05-04-14/15-11-490 | 4 | 0 | 0 | D | Case series | Premade sandwiches | Not attributed | Unknown |
| WA | Mar | Restaurant | *Salmonella* Typhimurium, PT 9, PFGE 1 | 5 | 2 | 0 | D | Case series | Semifreddo containing raw egg | Eggs | Other source of contamination |
| WA | Apr | Restaurant | *Salmonella* Typhimurium, PT 9, PFGE 1 | 10 | 1 | 0 | M | Case series | Breakfast eggs | Eggs | Other source of contamination |
| WA | Aug | Child care | *Salmonella* Typhimurium, PFGE 1, MLVA 03-10-15-11-496 | 2 | 0 | 0 | D | Case series | Raw cake mix | Eggs | Ingestion of contaminated raw products |
| WA | Oct | Primary produce | *Salmonella* Muenchen | 4 | 2 | 0 | M | Case series | Snow pea sprouts | Sprouts | Ingestion of contaminated raw products |
| WA | Oct | Private residence | Hepatitis A | 5 | 2 | 0 | M | Case series | Frozen mixed berries | Fruits and nuts | Ingestion of contaminated raw products |
| WA | Nov | Restaurant | *Salmonella* Typhimurium, PT 9, MLVA 03-10-14/15/16-11-496 | 14 | 4 | 0 | D | Case series | Breakfast eggs | Eggs | Unknown |
| WA | Nov | Commercial caterer | Unknown (suspected toxin) | 61 | 1 | 0 | A | Case control study | Roast beef and pork | Not attributed | Unknown |
| WA | Dec | Private residence | *Salmonella* Typhimurium, PT 9, PFGE 1, MLVA 03-26-13-11-523 | 8 | 1 | 0 | AM | Point source cohort | Tiramisu containing raw egg | Eggs | Ingestion of contaminated raw products |

a MJOI: Multi-jurisdictional outbreak investigation.

b Month of outbreak is the month of onset of the first case or month of notification of the first case or the month the investigation into the outbreak commenced.

c PT: Phage type; PFGE: Pulse field gel electrophoresis; MLVA: Multi-locus variable number tandem repeat analysis.

d Evidence categories. D: Descriptive evidence implicating the vehicle. A: Analytical epidemiological association between illness and vehicle. M: Microbiological confirmation of aetiology in vehicle and cases. AM: Analytical association and microbiological confirmation of aetiology.

**Communicable Diseases Intelligence**

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1. http://www.health.gov.au/internet/main/publishing.nsf/Content/cdna-song-listeriosis.htm. [↑](#footnote-ref-2)
2. Available online from: http://www.health.gov.au/casedefinitions. [↑](#footnote-ref-3)