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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

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Annual eport

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 trans-mission (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.[i] 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

i http://www.health.gov.au/internet/main/publishing.nsf/Content/cdna-song-listeriosis.htm.

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
Campylobacteriosis[a]	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.

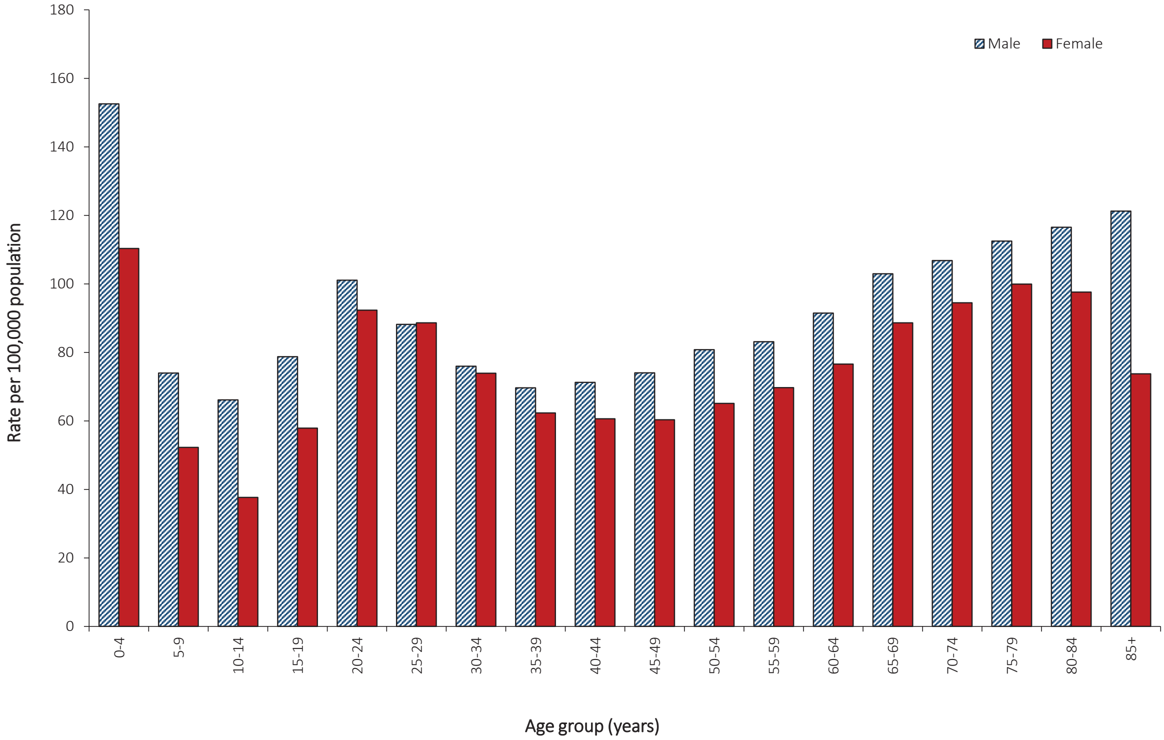
Over the reporting period (2013–2015), 54% of notified campylobacteriosis cases were in males (31,048/57,183). The mean notification rate for 2013–2015 by age group and sex was greater than the five-year historical mean (2008–2012) for both males and females between 0–4 years and for all age groups 25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

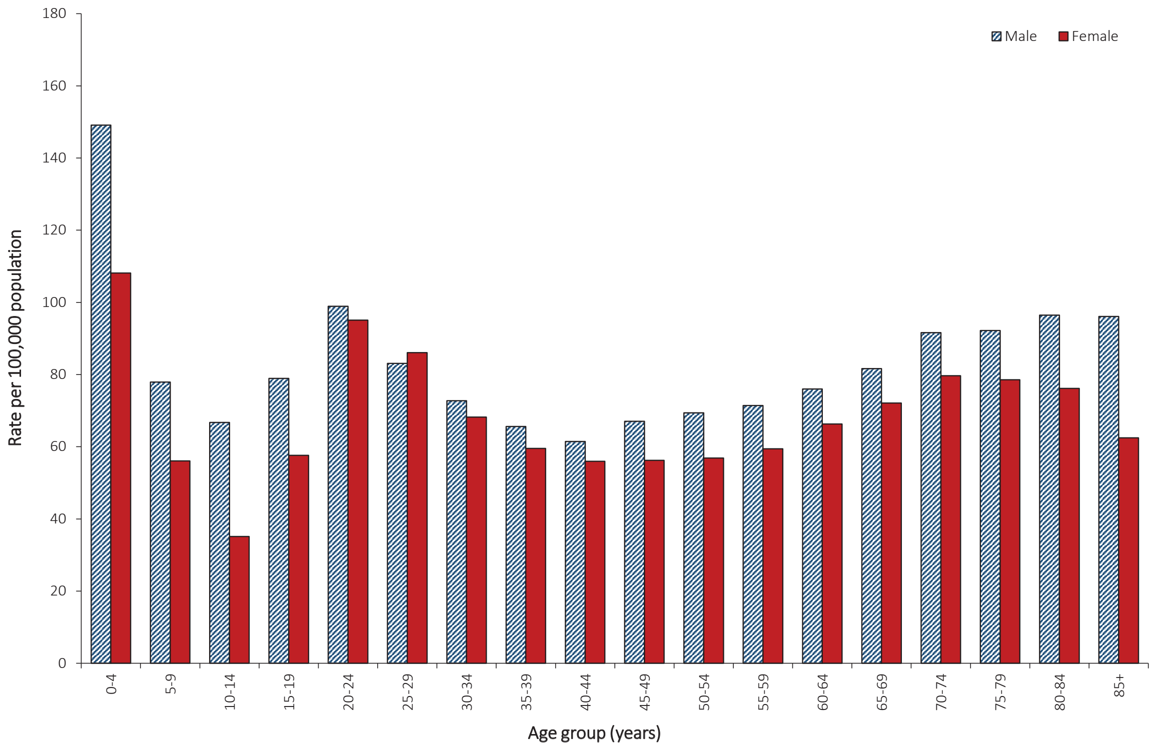
Figure 1: Mean notification rate for campylobacteriosis, by age group and sex,[a] Australia,[b] 2013–2015



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.

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]

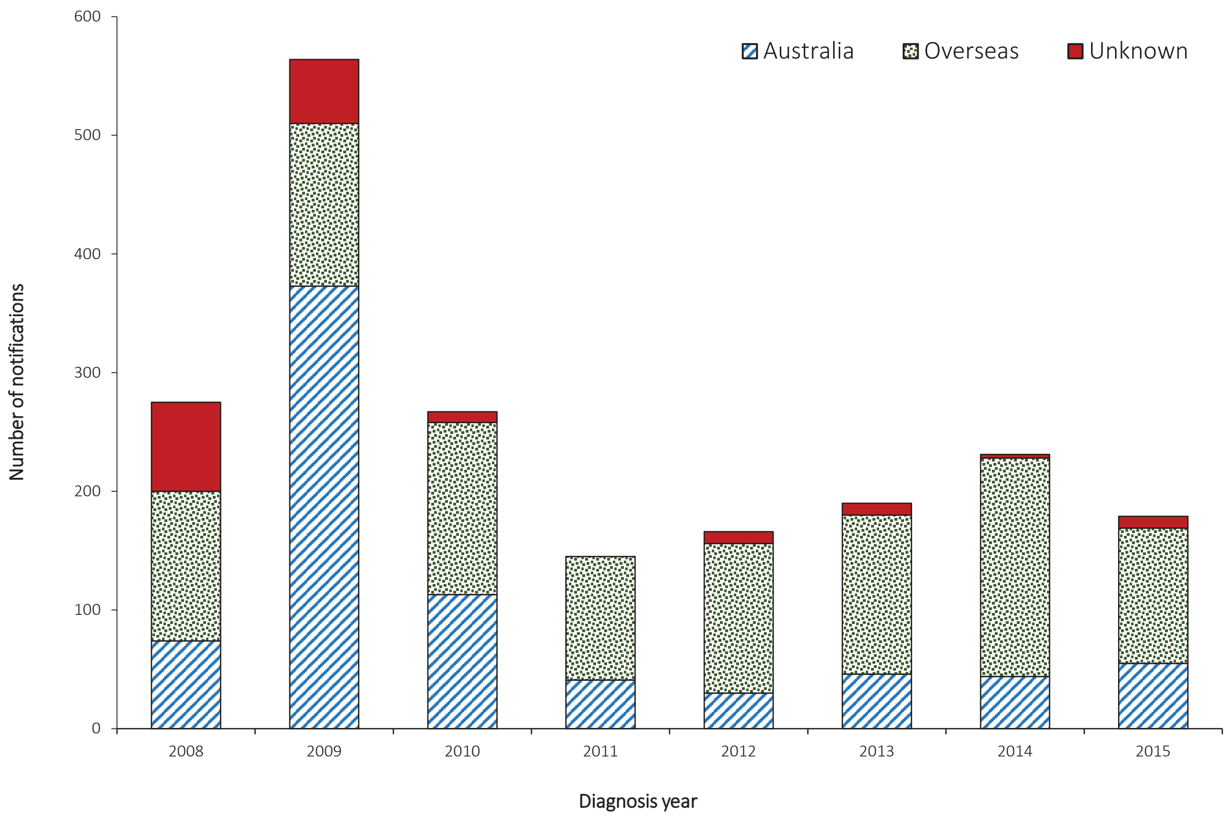
Over the reporting period (2013–2015), 72% of hepatitis A infections (432/600) were acquired overseas. Countries of acquisition included India (62/432; 14%); Fiji (52/432; 12%); and the Philippines (48/432; 11%). The country of acquisition was unknown for 23 notifications, and 145 infections were reported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

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] ■

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**

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



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%).

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. ■

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**

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).

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]

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.

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).

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

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.

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). ■

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**

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).

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

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%

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

Diagnosis year	Septicaemia			Meningitis and septicaemia			Meningitis			Other[a]			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.

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%

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.

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).

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).

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).

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

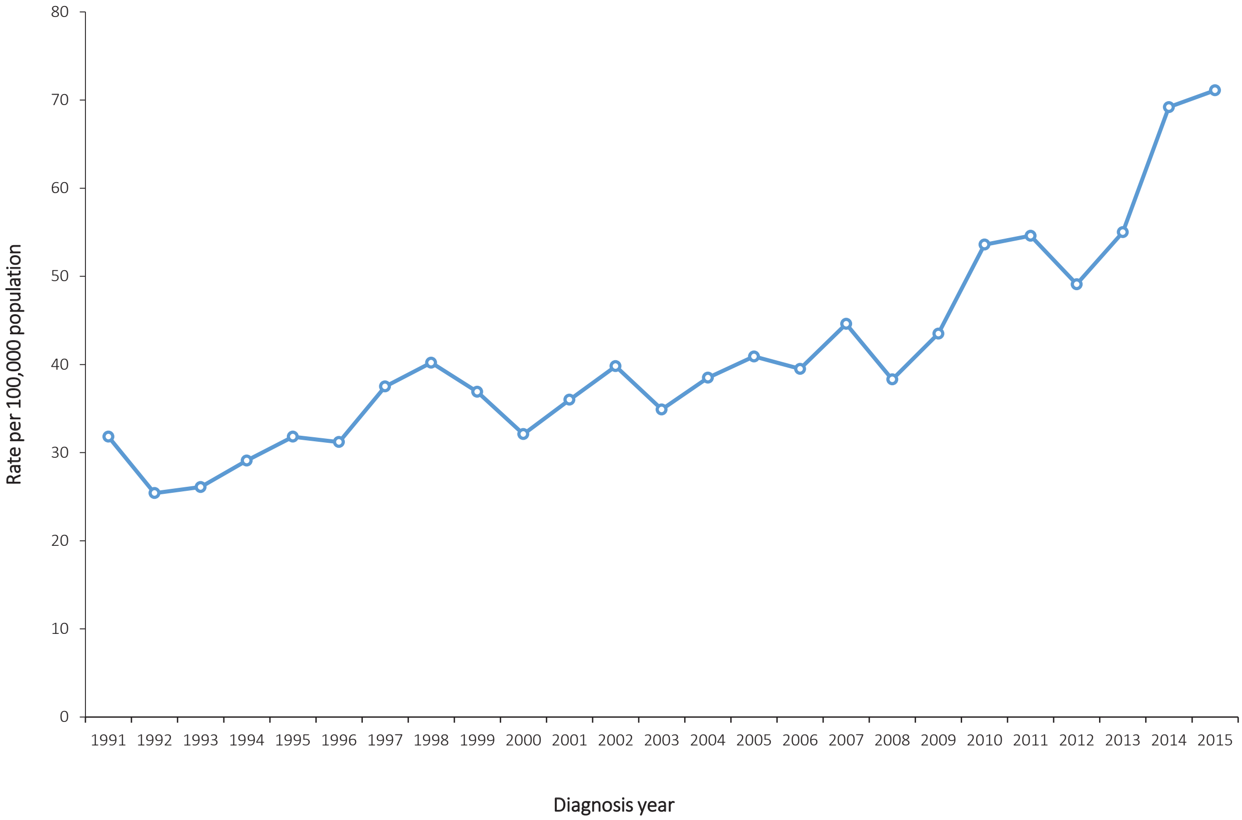
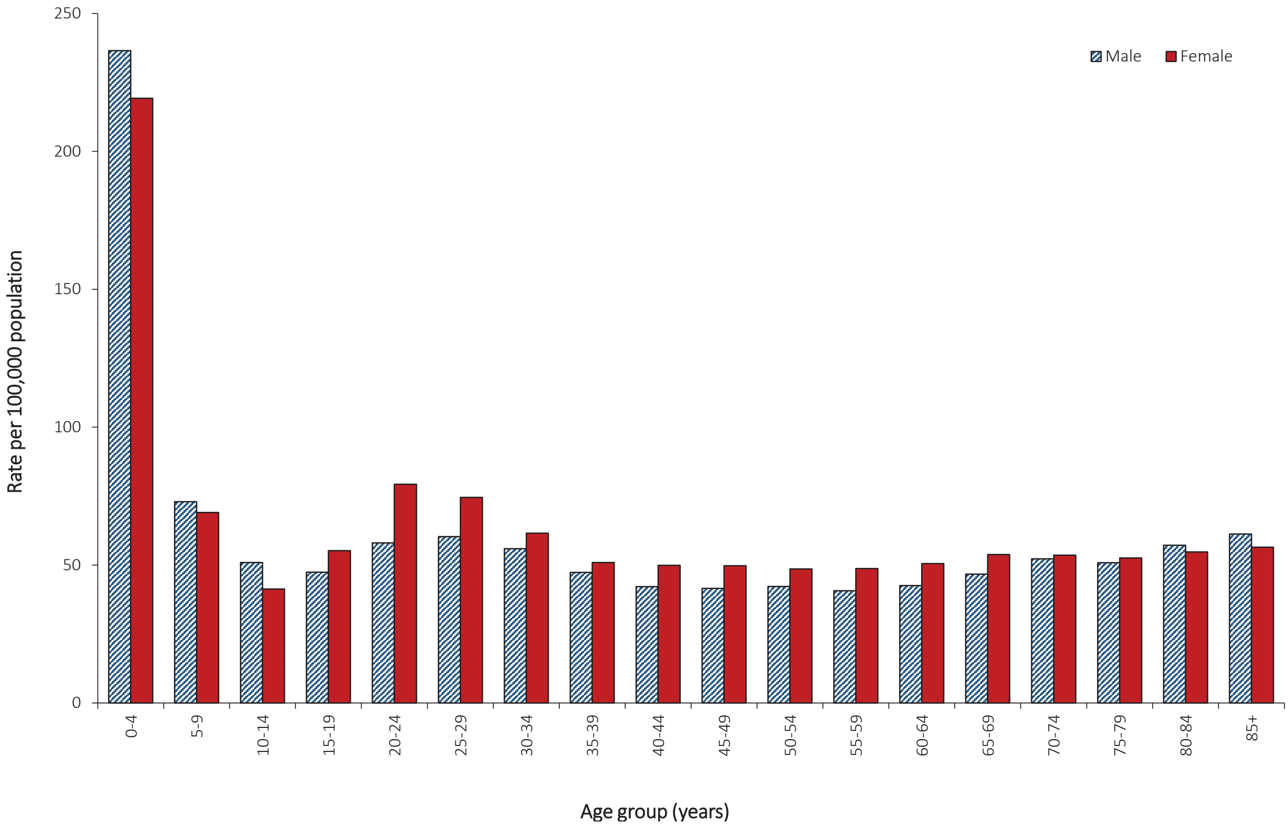


Table 11: Number of notified cases and crude rates of salmonellosis by state or territory, compared with the five-year historical mean rate, Australia, 2013–2015

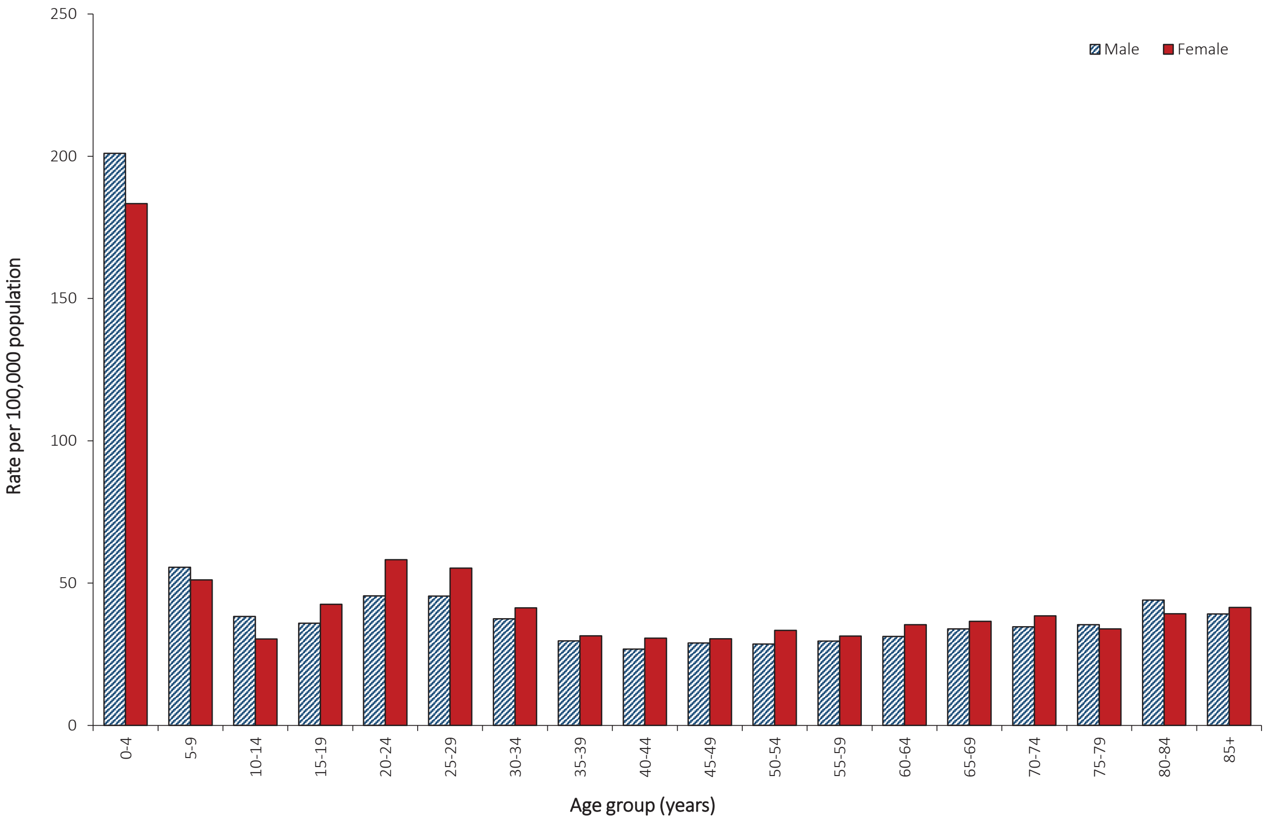
		ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Australia
2013	Notified cases	278	3,421	387	3,208	975	248	2,939	1,268	**12,724**
	Crude rate	72	46	159	69	58	48	51	51	**55**
	Mean rate 2008–2012	53	42	207	59	48	43	39	50	**48**
2014	Notified cases	221	4,286	456	4,924	1,220	250	3,675	1,251	**16,283**
	Crude rate	57	57	187	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**

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.

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).

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 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**

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%
RDNC[a]	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.

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.

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).

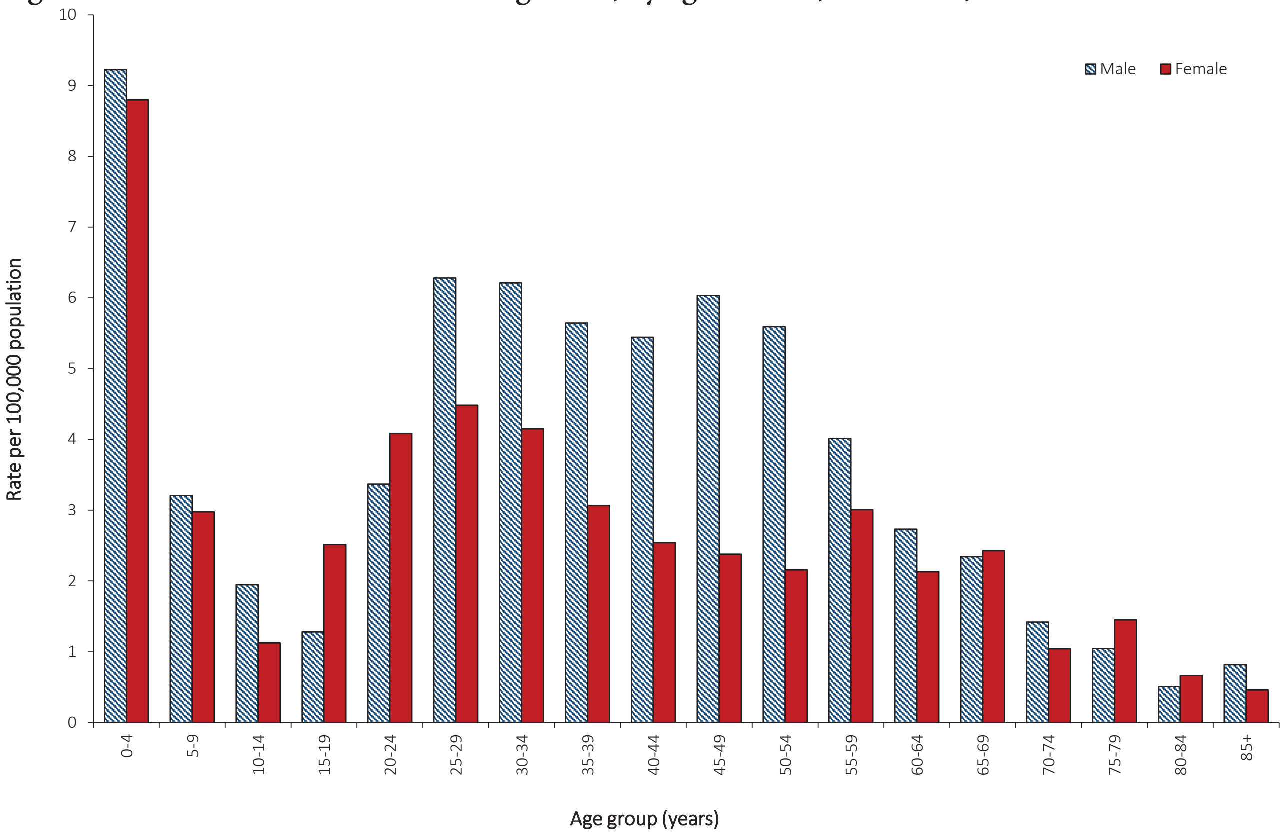
Almost three-quarters of *Shigella* isolates during the reporting period (2013–2015) were typed (1,919/2,609; 74%), which is a decrease on the previous five-year period 2008–2012 (2,958/3,040; 97%). An increase in the number of notifications that were listed as 'untyped' occurred in 2014 and 2015, and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

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

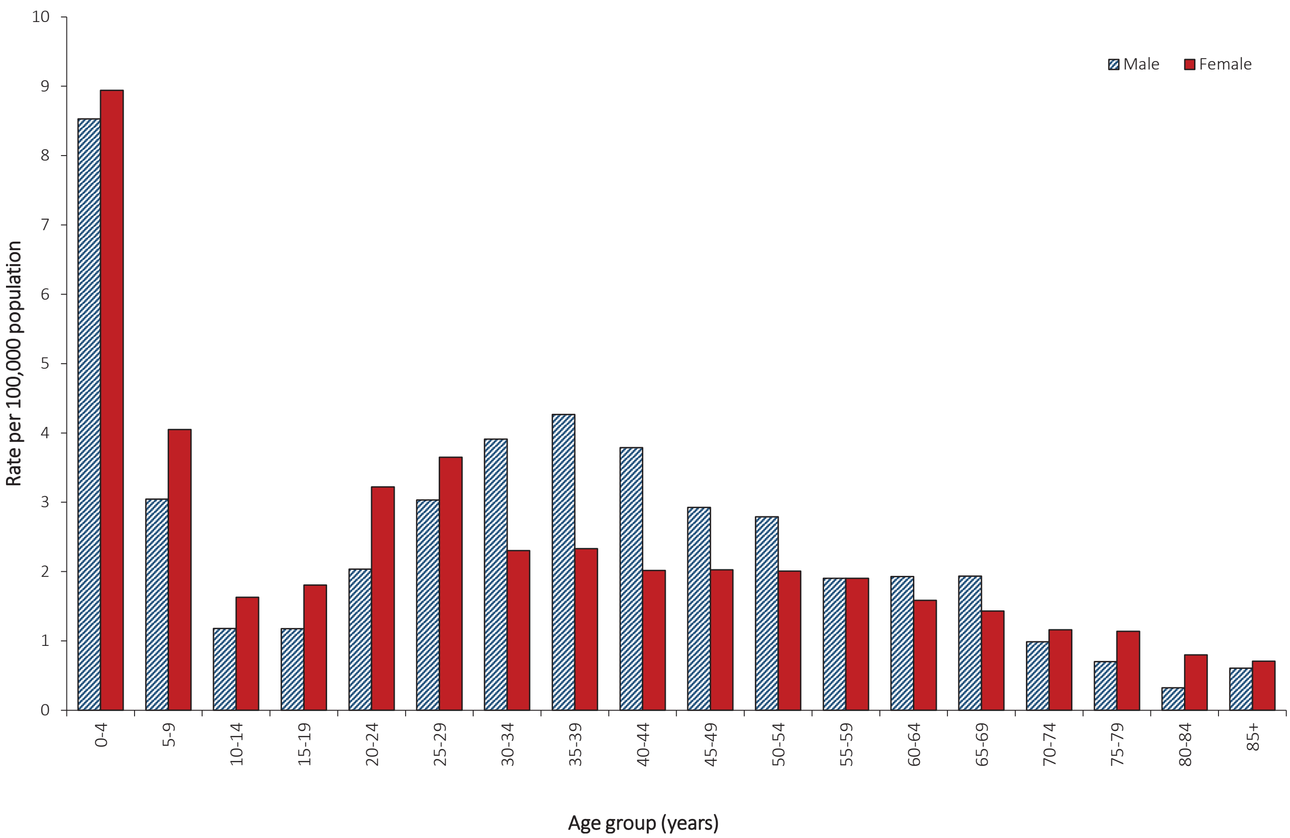
		ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Australia
2013	Notified cases	10	149	107	72	29	3	115	52	**537**
	Crude rate	3	2	44	2	2	1	2	2	**2**
	Mean rate 2008–2012	2	2	46	2	4	1	2	5	**3**
2014	Notified cases	9	200	99	171	22	2	464	68	**1,035**
	Crude rate	2	3	41	4	1	0	8	3	**4**
	Mean rate 2009–2013	2	2	39	2	3	1	2	4	**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**

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.

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

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%).

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 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**

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]

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,[ii] these conditions are notified separately; see the HUS section following.

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. ■

ii Available online from: http://www.health.gov.au/casedefinitions.

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**

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).

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. ■

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**

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. ■

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.

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.

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.

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

Year	State or territory[a]	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.

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.

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.

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**

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%).

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.

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).

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).

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).

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

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

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.

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

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%

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

Type of investigation	2013	2014	2015	Total[a]
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.

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

Type of evidence	2013	2014	2015	Total[a]
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.

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.

of tissue (n = 40) (Table 30). Thirty-one foodborne outbreaks had multiple contamination factors identified during 2013–2015.

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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References

1. Kirk M, Glass K, Ford L, Brown K, Hall G. *Foodborne illness in Australia: Annual incidence circa 2010*. Canberra: Australian National University, National Centre for Epidemiology and Population Health; 2014. Available from: https://www1.health.gov.au/internet/main/publishing.nsf/Content/E829FA59A59677C0CA257D6A007D2C97/$File/Foodborne-Illness-Australia-circa-2010.pdf.

2. Kirk M, Ford L, Glass K, Hall G. Foodborne illness, Australia, circa 2000 and circa 2010. *Emerg Infect Dis*. 2014;20(11):1857–64.

3. Australian Government Department of Health and Ageing. *The annual cost of foodborne illness in Australia*. Canberra: Australian Government Department of Health and Ageing; 2006.

4. Centers for Disease Control and Prevention (CDC). Preliminary FoodNet Data on the incidence of infection with pathogens transmitted commonly through food--10 States, 2008. *MMWR Morb Mortal Wkly Rep*. 2009;58(13):333–7.

5. Allos BM, Moore MR, Griffin PM, Tauxe RV. Surveillance for sporadic foodborne disease in the 21st century: the FoodNet perspective. *Clin Infect Dis*. 2004;38(Suppl 3):S115–20.

6. Hocking AD, ed. *Foodborne microorganisms of public health significance*. (Sixth edition.) Sydney: Australian Institute of Food Science and Technology (NSW Branch) Food Microbiology Group; 2003.

7. Majowicz SE, Edge VL, Fazil A, McNab WB, Doré KA, Sockett PN et al. Estimating the under-reporting rate for infectious gastrointestinal illness in Ontario. *Can J Public Health*. 2005;96(3):178–81.

8. Hall G, Raupach J, Yohannes K. An estimate of the under-reporting of foodborne notifiable diseases: *Salmonella*, *Campylobacter*, Shiga-toxin producing *Escherichia coli* (STEC). Canberra : National Centre for Epidemiology and Population Health, Australian National University; 2006.

9. Hall G, Yohannes K, Raupach J, Becker N, Kirk M. Estimating community incidence of *Salmonella*, *Campylobacter*, and Shiga toxin-producing *Escherichia coli* infections, Australia. *Emerg Infect Dis*. 2008;14(10):1601–9.

10. Rothman KJ, Greenland S, Lash TJ. *Modern Epidemiology*. (Third edition.) Philadelphia: Lippincott Williams and Wilkins; 2008.

11. Kirk MD, McKay I, Hall GV, Dalton CB, Stafford R, Unicomb L et al. Food safety: foodborne disease in Australia: the OzFoodNet experience. *Clin Infect Dis*. 2008;47(3):392–400.

12. Lindenmayer P. Networking for health protection: the Communicable Diseases Network Australia. *Commun Dis Intell Q Rep*. 2001;25(4):266–9.

13. Australian Bureau of Statistics. 3101.0 - Australian Demographic Statistics. [Internet.] Canberra: Australian Bureau of Statistics. Available from: https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population.

14. Miller M, Roche P, Spencer J, Deeble M. Evaluation of Australia's National Notifiable Disease Surveillance System. *Commun Dis Intell Q Rep*. 2004;28(3):311–23.

15. Churches T, Conaty SJ, Golmour RE, Muscatello DJ. Reflections on public health surveillance of pandemic (H1N1) 2009 influenza in NSW. *N S W Public Health Bull*. 2010;21(1–2):19–25.

16. Munnoch SA, Ward K, Sheridan S, Fitzsimmons GJ, Shadbolt CT, Piispanen JP et al. A multi-state outbreak of *Salmonella* Saintpaul in Australia associated with can-

taloupe consumption. *Epidemiol Infect*. 2009;137(3):367–74.

17. Popovic I, Heron B, Covacin C. Listeria: an Australian perspective (2001–2010). *Foodborne Pathog Dis*. 2014;11(6):425–32.

18. OzFoodNet Working Group. Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet Network, 2012. *Commun Dis Intell Q Rep*. 2018;42. pii: S2209-6051(18)00014-3.

19. Heymann DL. *Control of communicable diseases manual*. (Twentieth edition.) Washington DC: American Public Health Association; 2015.

20. NNDSS Annual Report Writing Group. Australia's notifiable disease status, 2013: Annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell Q Rep*. 2015;39(3):E387–478.

21. OzFoodNet Working Group. Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: annual report of the OzFoodNet network, 2009. *Commun Dis Intell Q Rep*. 2010;34(4):396–426.

22. OzFoodNet Working Group. Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: annual report of the OzFoodNet network, 2010. *Commun Dis Intell Q Rep*. 2012;36(3):E213–41.

23. OzFoodNet Working Group. Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: annual report of the OzFoodNet network, 2011. *Commun Dis Intell Q Rep*. 2015;39(2):E236–64.

24. Donnan EJ, Fielding JE, Gregory JE, Lalor K, Rowe S, Goldsmith P et al. A multistate outbreak of hepatitis A associated with semidried tomatoes in Australia, 2009. *Clin Infect Dis*. 2012;54(6):775–81.

25. Yapa, CM, Furlong C, Rosewell A, Ward KA, Adamson S, Shadbolt C et al. First reported outbreak of locally acquired hepatitis E virus infection in Australia. *Med J Aust*. 2016;204(7):274.

26. Egg Scientific Advisory Panel. *Proposal P301: Primary Production and Processing Standard for Eggs & Egg Products - Risk Assessment of Eggs and Egg Products*. Canberra: Food Standards Australia New Zealand (FSANZ); September 2009. Available from: https://www.foodstandards.gov.au/code/proposals/documents/P301%20Eggs%20PPPS%20DAR%20SD1%20Risk%20Assessment.pdf.

27. Animal Health Australia. Salmonella enteritidis infection in Poultry. National Animal Health Information System - Information Sheet. [Internet.] Canberra: Animal Health Australia; 2011. [Accessed in November 2014.] Available from: http://nahis.animalhealthaustralia.com.au/pmwiki/pmwiki.php?n=Factsheet.154-2?skin=factsheet.

28. Australian Government Department of Health. Australian national notifiable diseases case definitions. Paratyphoid case definition. [Internet.] Canberra: Australian Government Department of Health; 11 March 2016. [Accessed on 27 November 2017.] Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-surveil-nndss-casedefs-cd_paratyhoid.htm.

29. Vasant BR, Stafford RJ, Jennison AV, Bennett SM, Bell RJ, Doyle CJ et al. Mild illness during outbreak of Shiga toxin–producing *Escherichia coli* O157 infections associated with agricultural show, Australia. *Emerg Infect Dis*. 2017;23(10):1686–9.

30. Combs BG, Raupach JCA, Kirk MD. Surveillance of Shiga toxigenic *Escherichia coli* in Australia. *Commun Dis Intell Q Rep*.

2005;29(4):366–9.

31. Painter JA, Ayers T, Woodruff R, Blanton E, Perez N, Hoekstra RM et al. Recipes for foodborne outbreaks: a scheme for categorizing and grouping implicated foods. *Foodborne Pathog Dis*. 2009;6(10):1259–64.

32. Centers for Disease Control and Prevention. Surveillance for foodborne disease outbreaks--United States, 2009-2010. *MMWR MorbMortal Wkly Rep*. 2013;62(3):41–7.

33. Atkinson R, Maguire H, Gerner-Smidt P. A challenge and an opportunity to improve patient management and public health surveillance for food-borne infections through culture-independent diagnostics. *J Clin Microbiol*. 2013;51(8):2479–82.

34. Cronquist AB, Mody RK, Atkinson R, Besser J, D'Angelo MT, Hurd S et al. Impacts of culture-independent diagnostic practices on public health surveillance for bacterial enteric pathogens. *Clin Infect Dis*. 2012;54(Suppl 5):S432–9.

35. Qin X, Klein EJ, Galanakis E, Thomas AA, Stapp JR, Rich S et al. Real-time PCR assay for detection and differentiation of Shiga toxin-producing *Escherichia coli* from clinical samples. *J Clin Microbiol*. 2015;53(7):2148–53.

36. Langley G, Besser J, Iwamoto M, Lessa FC, Cronquist A, Skoff TH et al. Effect of culture-independent diagnostic tests on future Emerging Infections Program surveillance. *Emerg Infect Dis*. 2015;21(9):1582–8.

37. May FJ, Stafford RJ, Carroll H, Robson JM, Vohra R, Nimmo GR et al. The effects of culture independent diagnostic testing on the diagnosis and reporting of enteric bacterial pathogens in Queensland, 2010 to 2014. *Commun Dis Intell Q Rep*. 2017;41(3):E223–30.

38. Merritt T, Combs B, Pingault N. Campylobacter outbreaks associated with poultry liver dishes. *Commun Dis Intell Q Rep*. 2011;35(4):299–300.

39. Ebel ED, Williams MS, Cole D. Travis CC, Klontz KC, Golden NJ et al. Comparing characteristics of sporadic and outbreak-associated foodborne illnesses, United States, 2004–2011. *Emerg Infect Dis*. 2016;22(7):1193–200.

40. Butot S, Putallaz T, Amoroso R, Sánchez G. Inactivation of enteric viruses in minimally processed berries and herbs. *Appl Environ Microbiol*. 2009;75(12):4155–61.

41. Franklin N, Camphor H, Wright R, Stafford R, Glasgow K, Sheppeard V. Outbreak of hepatitis A genotype IB in Australia associated with imported frozen pomegranate arils. *Epidemiol Infect*. 2019;147:e74. doi: https://doi.org/10.1017/S0950268818003515.

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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory	Month[a]	Setting prepared	Agent responsible[b]	No. ill	No. hospitalised	No. of fatalities	Evidence[c]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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 territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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

State or territory[a]	Month[b]	Setting prepared	Agent responsible[c]	No. ill	No. hospitalised	No. of fatalities	Evidence[d]	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
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.