



Australian Government
Department of Health

COMMUNICABLE DISEASES INTELLIGENCE

2018 Volume 42
PII: S2209-6051(18)00014-3

Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2012

The OzFoodNet Working Group

COMMUNICABLE DISEASES INTELLIGENCE

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ISSN: 2209-6051 Online

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This journal is indexed by Index Medicus and Medline.

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Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2012

The OzFoodNet Working Group

Abstract

This report summarises the incidence of diseases potentially transmitted by food in Australia and details outbreaks associated with food in 2012. OzFoodNet sites reported 27,976 notifications of diseases or conditions that may be transmitted by food. The most commonly notified infections were *Campylobacter* (15,668 notifications), followed by *Salmonella* (11,249 notifications). OzFoodNet sites also reported 2,180 outbreaks of gastrointestinal illness affecting 40,547 people and resulting in 955 people being hospitalised and 131 associated deaths. The majority of outbreaks (83%, 1,819/2,180) were due to person-to-person transmission, 10%(208) were due to an unknown mode of transmission and 7% (144) were suspected or confirmed to be foodborne. Less than 0.5% of these outbreaks were due to waterborne or suspected waterborne transmission (7 outbreaks) and animal-to-human transmission (2 outbreaks). Foodborne and suspected foodborne outbreaks affected 2,117 persons and included 183 hospitalisations and 9 associated deaths. *Salmonella* was the most common aetiological agent identified in foodborne outbreaks, and restaurants were the most frequently reported food preparation setting. A single food vehicle was identified for 60 outbreaks. There were an additional 30 outbreaks attributed to multiple food vehicles. Of those outbreaks attributed to a single food vehicle 28 (47%) were associated with the consumption of dishes containing raw or minimally cooked eggs and 27 of these outbreaks were due to *S. Typhimurium* with the other due to *S. subsp I ser 4,5,12 :i:-* (commonly known as monophasic *S. Typhimurium*). These data assist agencies to document sources of foodborne disease, develop food safety policies, and prevent foodborne illness.

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, detect outbreaks, 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 7 infections that occur in the community, while there are approximately 8 cases in the community for every notified case of Shiga toxin-producing *Escherichia coli* (STEC) and 10 cases in the community for every notified case of campylobacteriosis.⁷⁻¹⁰

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.¹¹ In Australia, state and territory health departments conduct surveillance for between 10 and 15 different diseases that may be transmitted through food. Most of these diseases are also transmitted by the faecal–oral route and as such may be transmitted by contact with infected animals, 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 conduct applied research into the causes of foodborne illness.¹² 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 2012 included foodborne disease epidemiologists from each state and territory Health department, and collaborators from the Department of Agriculture and Water Resources (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.¹³ This is the 12th annual report for the OzFoodNet network and summarises the 2012 surveillance and outbreak data, including a comparison with data from previous years.

Methods

Population under surveillance

In 2012, the OzFoodNet network covered all Australian states and territories, with the estimated population being 22,680,439 persons as at 30 June 2012.¹⁴

Data sources

Notified infections

All Australian states and territories have public health legislation requiring doctors and pathology laboratories to notify cases of infectious diseases that are important to public health. State and territory health departments record details of notified cases on surveillance databases. These surveillance datasets are aggregated into a national database—the National Notifiable Diseases Surveillance System (NNDSS)¹⁵—under the auspices of the *National Health Security Act 2007*. This 2012 report provides analysis of aggregated data from NNDSS and enhanced surveillance data from OzFoodNet sites on the following 9 diseases or conditions: botulism, campylobacteriosis, salmonellosis, listeriosis, *Salmonella Typhi* (typhoid fever) infection, hepatitis A virus infections, shigellosis, STEC infection and haemolytic uraemic syndrome (HUS).

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. Also, some jurisdictions report on notification date rather than onset date. Data for this report were extracted from NNDSS in August 2015 and were analysed by the date of diagnosis within the reporting period 1 January to 31 December 2012. Date of diagnosis was derived for each case from the earliest date supplied by the jurisdiction, which could be the date of onset of the case’s illness, the date a specimen was collected or the date that a health department received the

notification. Estimated resident populations for each state or territory as at June 2012 were used to calculate rates of notified infections.¹⁴

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 is to enable timely detection of clusters and to initiate a public health response. Local public health unit staff interview all cases with a standard national listeriosis questionnaire. Interviews are conducted at the time individual cases are reported to improve accurate recall of foods consumed during the incubation period. Data are collated nationally via an online open-source database using NetEpi Case Manager. This is a secure web-based reporting system used by OzFoodNet epidemiologists for the enhanced surveillance of listeriosis and multi-jurisdictional outbreaks in Australia. NetEpi allows data to be entered from multiple sites and promotes nationally consistent data collection and analysis by OzFoodNet epidemiologists.¹⁶⁻¹⁸

Supplementary surveillance

OzFoodNet sites also collected supplementary data on infections which may be transmitted by food. Information on travel status was collected for cases of *Salmonella* Enteritidis infection, hepatitis A infection, *Shigella* infection and typhoid fever. Locally-acquired infection includes people acquiring their infection in Australia from overseas-acquired cases, 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. A breakdown of completeness of *Salmonella* serotyping was included.

Outbreaks of gastrointestinal disease including foodborne disease outbreaks

OzFoodNet sites collected summary information on gastrointestinal disease outbreaks that occurred in Australia during 2012, including those transmitted via the ingestion of contaminated food (foodborne outbreaks). A foodborne outbreak was defined as an incident where 2 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 was defined as an incident where 2 or more persons experienced illness after consuming a common meal or food and descriptive epidemiological evidence implicated the food or meal as the suspected source of illness. Outbreaks where food-to-person-to-food transmission occurred were included in this definition. A cluster was defined as an increase in infections that were epidemiologically related in time, place or person where there is no common setting and investigators were unable to implicate a vehicle or determine a mode of transmission.

Summary information for foodborne and suspected foodborne outbreaks has been combined for analysis. 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, food vehicle and the setting where the

implicated food was prepared. Data on outbreaks due to recreational waterborne transmission and from clusters investigated by jurisdictional health departments were also summarised. The number of outbreaks and documented causes reported here may vary from summaries previously published by individual states and territories as these can take time to finalise.

Data analysis

All analyses were conducted using Microsoft Excel.

Results

Rates of the most commonly notified foodborne enteric infections

In 2012, OzFoodNet sites reported 27,976 notifications of 9 diseases or conditions that may be transmitted by food (Table 1), which represents

a 9% decrease compared with a mean of 30,747 notifications per year for the previous 5 years (2007–2011).

Campylobacteriosis

In 2012, OzFoodNet sites (excluding New South Wales where campylobacteriosis was not notifiable) reported 15,668 notifications of *Campylobacter* infection. This equates to a rate of 101.8 notifications per 100,000 population and is an 11% decrease compared with the 5-year historic mean of 113.8 per 100,000 (Table 1, Figure 1). Queensland reported a rate of 91.7 notifications per 100,000 population, a 16% decrease below the 5-year historic mean and Tasmania reported a rate of 172.3 notifications per 100,000 population, a 26% increase above the 5-year historic mean (Table 1).

Overall, 54% of notified cases were males. Notification rates were highest in children 0–4 years of age for both males and females (198.4 and 135.9 notifications per 100,000, respectively)

Figure 1: Notification rate for campylobacteriosis, Australia, by year of diagnosis

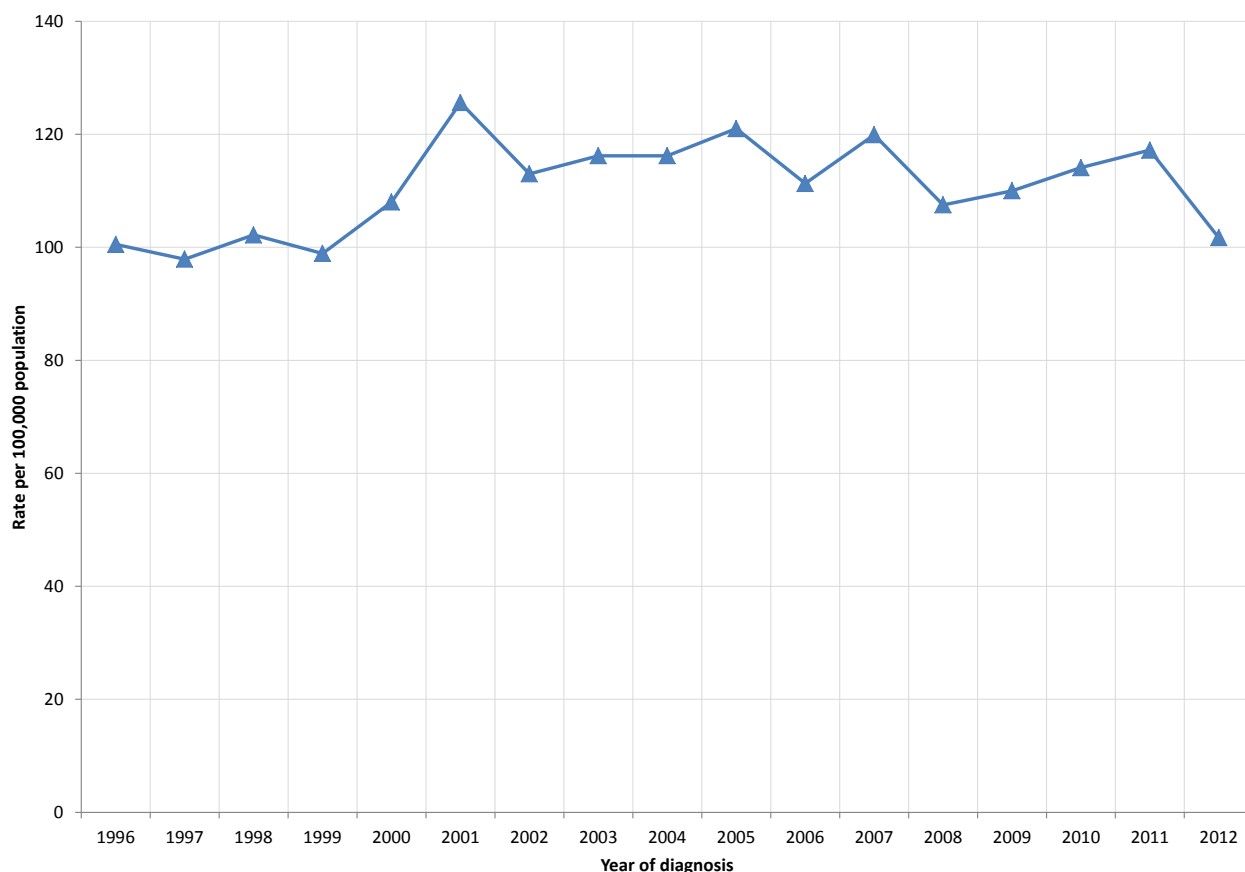


Table 1: Number of notified cases, crude rate and 5-year mean (2007–2011) rate per 100,000 population of diseases or infections commonly transmitted by food, Australia, 2012, by disease and state or territory

Disease/infection	State or territory										Aust.	
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA				
Botulism	0	0	0	0	0	0	0	0	0	0	0	0
Campylobacteriosis*	Notified cases, 2012	477	NN	175	4,182	2,161	882	5,885	1,906	15,668		
	Crude rate, 2012	127.3	NN	74.5	91.7	130.6	172.3	104.7	78.4	101.8		
	Mean rate, 2007-2011	130.9	NN	96.6	109.4	128.7	137.1	116.6	98.5	113.8		
Haemolytic uraemic syndrome (HUS)	Notified cases, 2012	0	10	0	4	0	1	5	0	20		
	Crude rate, 2012	0.0	0.1	0.0	0.1	0.0	0.2	0.1	0.0	0.1		
	Mean rate, 2007-2011	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.0	0.1		
Hepatitis A	Notified cases, 2012	1	42	3	34	7	2	63	14	166		
	Crude rate, 2012	0.3	0.6	1.3	0.7	0.4	0.4	1.1	0.6	0.7		
	Mean rate, 2007-2011	1.2	1.1	1.3	1.0	1.2	0.7	2.1	1.1	1.3		
Listeriosis	Notified cases, 2012	0	39	0	5	4	3	34	8	93		
	Crude rate, 2012	0.0	0.5	0.0	0.1	0.2	0.6	0.6	0.3	0.4		
	Mean rate, 2007-2011	0.4	0.4	0.1	0.2	0.2	0.4	0.4	0.3	0.3		
Salmonellosis	Notified cases, 2012	240	2,947	407	2,811	849	278	2,549	1,168	11,249		
	Crude rate, 2012	64.1	40.4	173.3	61.6	51.3	54.3	45.3	48.1	49.6		
	Mean rate, 2007-2011	46.9	41.1	221.1	58.1	48.7	40.8	37.4	49.3	46.9		
Shiga toxin-producing <i>Escherichia coli</i> (STEC) infection	Notified cases, 2012	6	13	2	27	45	7	11	1	112		
	Crude rate, 2012	1.6	0.2	0.9	0.6	2.7	1.4	0.2	0.0	0.5		
	Mean rate, 2007-2011	0.3	0.2	0.4	0.5	2.8	0.1	0.2	0.2	0.5		
Shigellosis	Notified cases, 2012	6	124	107	81	48	7	120	53	546		
	Crude rate, 2012	1.6	1.7	45.6	1.8	2.9	1.4	2.1	2.2	2.4		
	Mean rate, 2007-2011	1.5	1.6	52.8	2.1	4.2	0.6	1.9	5.3	2.8		
Typhoid Fever	Notified cases, 2012	1	43	4	15	3	1	37	18	122		
	Crude rate, 2012	0.3	0.6	1.7	0.3	0.2	0.2	0.7	0.7	0.5		
	Mean rate, 2007-2011	0.3	0.6	0.8	0.4	0.3	0.3	0.6	0.5	0.5		

* Campylobacteriosis is notifiable in all jurisdictions except New South Wales.
 NN Not notifiable

with additional peaks in the 20–29 years age group and in the >60 year age group. Of particular note is the higher rates for males compared to females in the >80 years age groups (Figure 2).

Salmonellosis

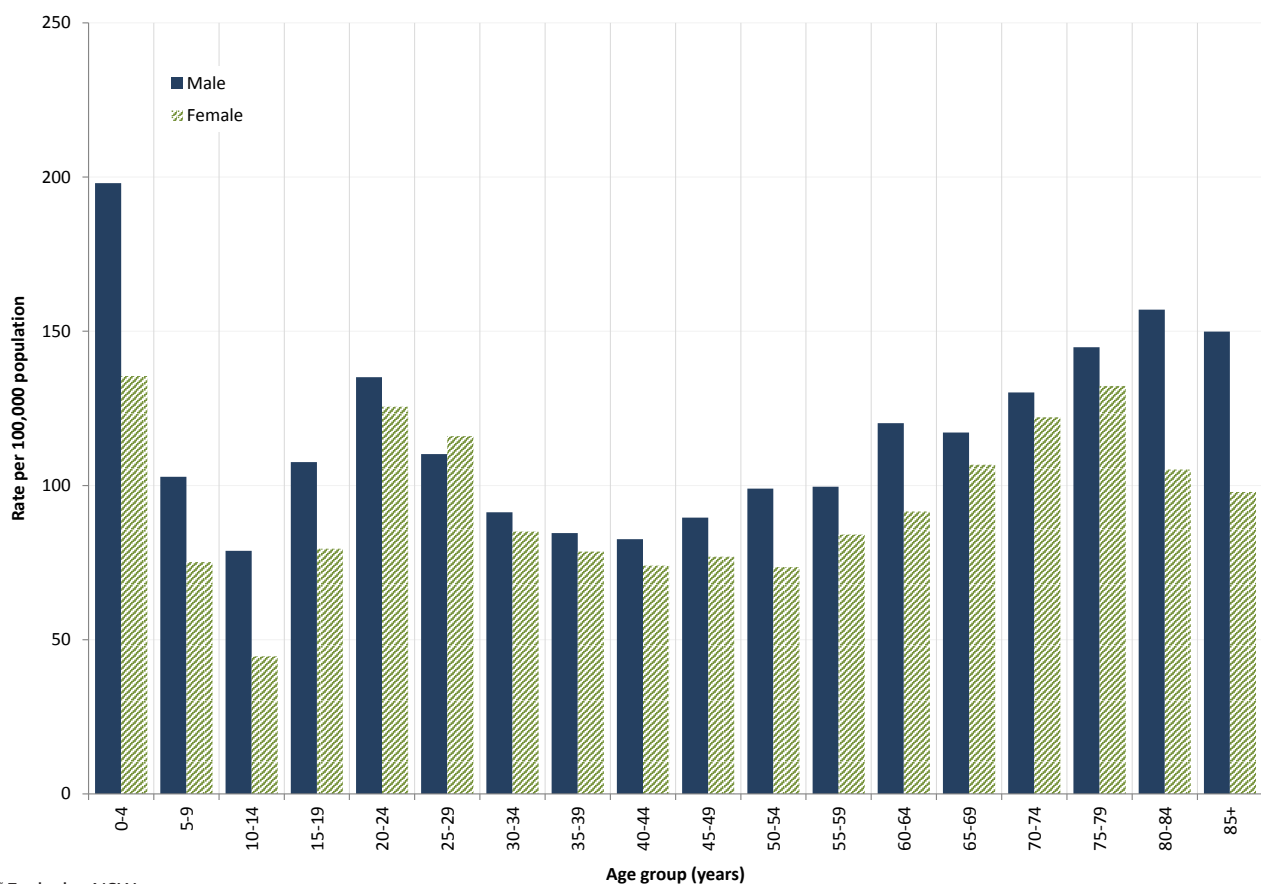
In 2012, Australian jurisdictions reported 11,249 notifications of salmonellosis, at a rate of 49.6 notifications per 100,000 population. This is a 6% increase compared with the mean for the previous 5 years (46.9 notifications per 100,000 population). Compared to the 5-year historic mean, rates in 2012 were reasonably stable in New South Wales and Western Australia, while the Northern Territory had the largest decrease (22%) (Table 1). The remaining jurisdictions had higher rates compared with the 5-year historic mean, with the Australian Capital Territory having the largest percentage increase (37%), followed by Tasmania (33%). Notification rates ranged from 40.4 notifications per 100,000 population in New South Wales, to 173.3 noti-

cations per 100,000 population in the Northern Territory which often has the highest rate of salmonellosis (Table 1). The majority of cases of salmonellosis in the Northern Territory are thought to be due to infection from environmental sources.¹⁹

In 2012, the ratio of male to female cases was equal (1:1). The median age for all salmonellosis notifications was 25 years, similar to 2011 (24 years). The highest notification rates were in children 0–4 years of age for both males and females (190 and 181 notifications per 100,000 population respectively) followed by the 5-9 year age group for males (57.2 notifications per 100,000 population) and the 20-24 year age group for females (56.7 notifications per 100,000 population) (Figure 4).

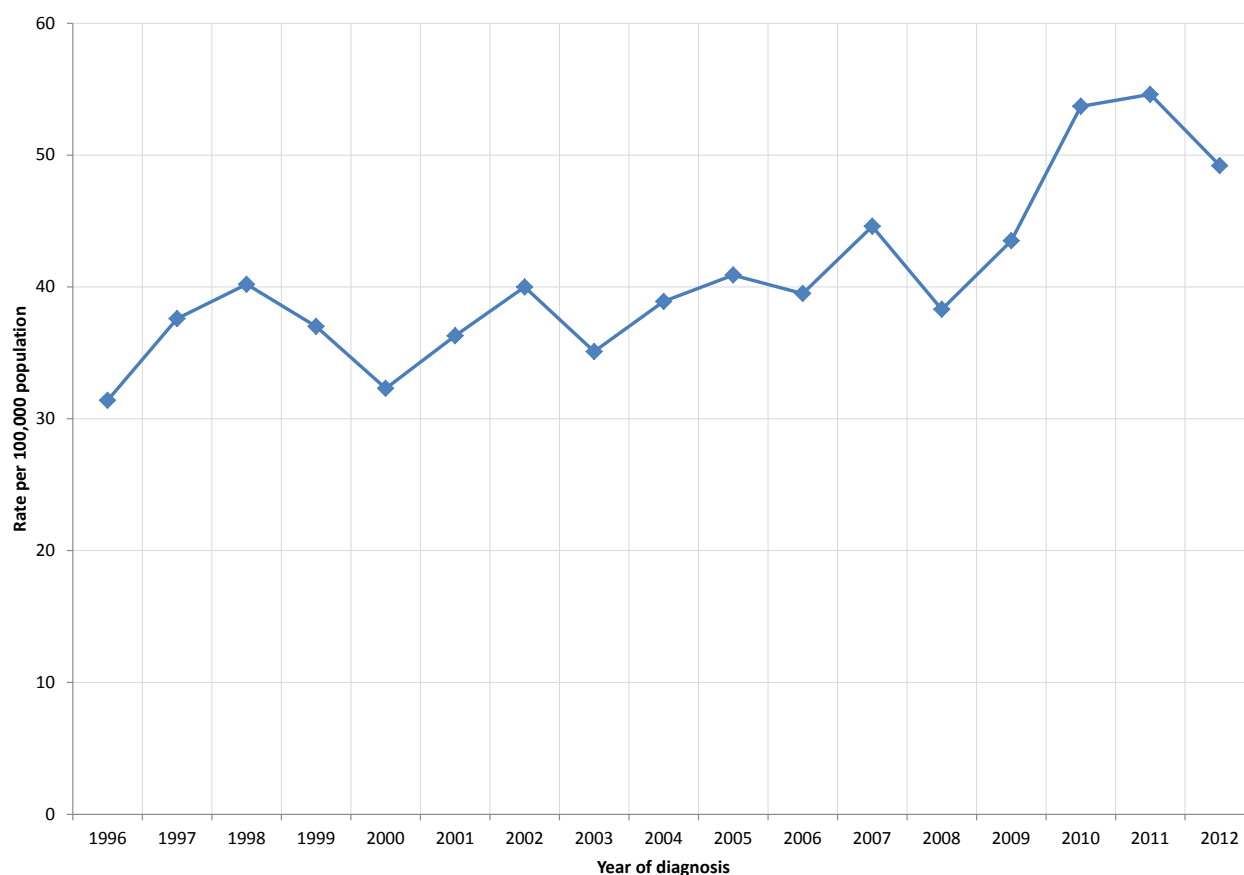
Of the 11,249 salmonellosis notifications in 2012, 98% (10,996) were further typed at an enteric reference laboratory, into 157 unique serovars accounting for 10,484 notifications. The remain-

Figure 2: Notification rate for campylobacteriosis, Australia*, 2012, by age group and sex



* Excludes NSW

Figure 3: Notification rate for salmonellosis, Australia, by year of diagnosis



ing 512 isolates were unable to be assigned a serovar and were grouped into 74 unique incomplete antigenic structures. *S. Typhimurium* was the most commonly notified serovar in 2012, responsible for 4,985 notifications (Table 2).

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.^{20,21} 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.

During 2012, OzFoodNet sites reported 827 cases of *S. Enteritidis* infection (Table 3) compared with 812 notifications in 2011 and 835 notifications in 2010. Travel histories were obtained for 94% (779/827) of cases in 2012, which is similar to the 95% (769/812) obtained for cases in 2011.

Of those cases in 2012 with travel history, 91% (709/779) had travelled overseas and 9% (70) were locally-acquired. Western Australia reported the highest number (29%, 244/827) of notified cases, while Queensland, where *S. Enteritidis* PT 26 is endemic, reported the largest number of locally-acquired cases (Table 3).

In 2012, South-East Asia (92%, 650/709) was the most common region of overseas acquisition for *S. Enteritidis*. Similar to previous years, the most common overseas country of acquisition was Indonesia (63%, 449/709). This was followed by Thailand (8%, 55/709) and Malaysia (6%, 45/709).

Phage typing was performed on 69% (536/779) of the *S. Enteritidis* cases with travel history and the most common phage types among overseas-acquired cases were PT 1 (26%), 6a (10%), 13 (8%), and 21 (8%) (Table 4). Locally-acquired cases were sporadic with no clusters detected by person, place, or time. Similar to previous years,

Table 2: Five most common *Salmonella* serotypes, Australia, 2012, by state or territory compared with the 5-year mean

State or territory	S. Typhimurium	S. Enteritidis	S. Virchow	S. Saintpaul	S. Paratyphi B Bv Java
ACT	Notified cases, 2012	11	5	4	5
	Mean (2007-2011)	9	3	1	3
	% change	22%	67%	300%	67%
NSW	Notified cases, 2012	156	90	35	85
	Mean (2007-2011)	125	95	43	66
	% change	25%	-5%	-19%	29%
NT	Notified cases, 2012	22	50	41	4
	Mean (2007-2011)	10	41	48	11
	% change	120%	22%	-15%	-64%
Qld	Notified cases, 2012	131	251	193	30
	Mean (2007-2011)	107	262	204	37
	% change	22%	-4%	-5%	-19%
SA	Notified cases, 2012	69	12	15	16
	Mean (2007-2011)	43	17	11	13
	% change	60%	-29%	36%	23%
Tas	Notified cases, 2012	14	0	4	7
	Mean (2007-2011)	7	6	2	2
	% change	100%	-100%	100%	250%
Vic	Notified cases, 2012	180	40	34	64
	Mean (2007-2011)	116	47	27	41
	% change	55%	-15%	26%	56%
WA	Notified cases, 2012	244	17	46	62
	Mean (2007-2011)	211	18	43	40
	% change	16%	-6%	7%	56%
Australia	Notified cases, 2012	827	465	372	273
	Mean (2007-2011)	629	490	380	212
	% change	31%	-5%	-2%	29%

Figure 4: Notification rate for salmonellosis, Australia, 2012, by age group and sex

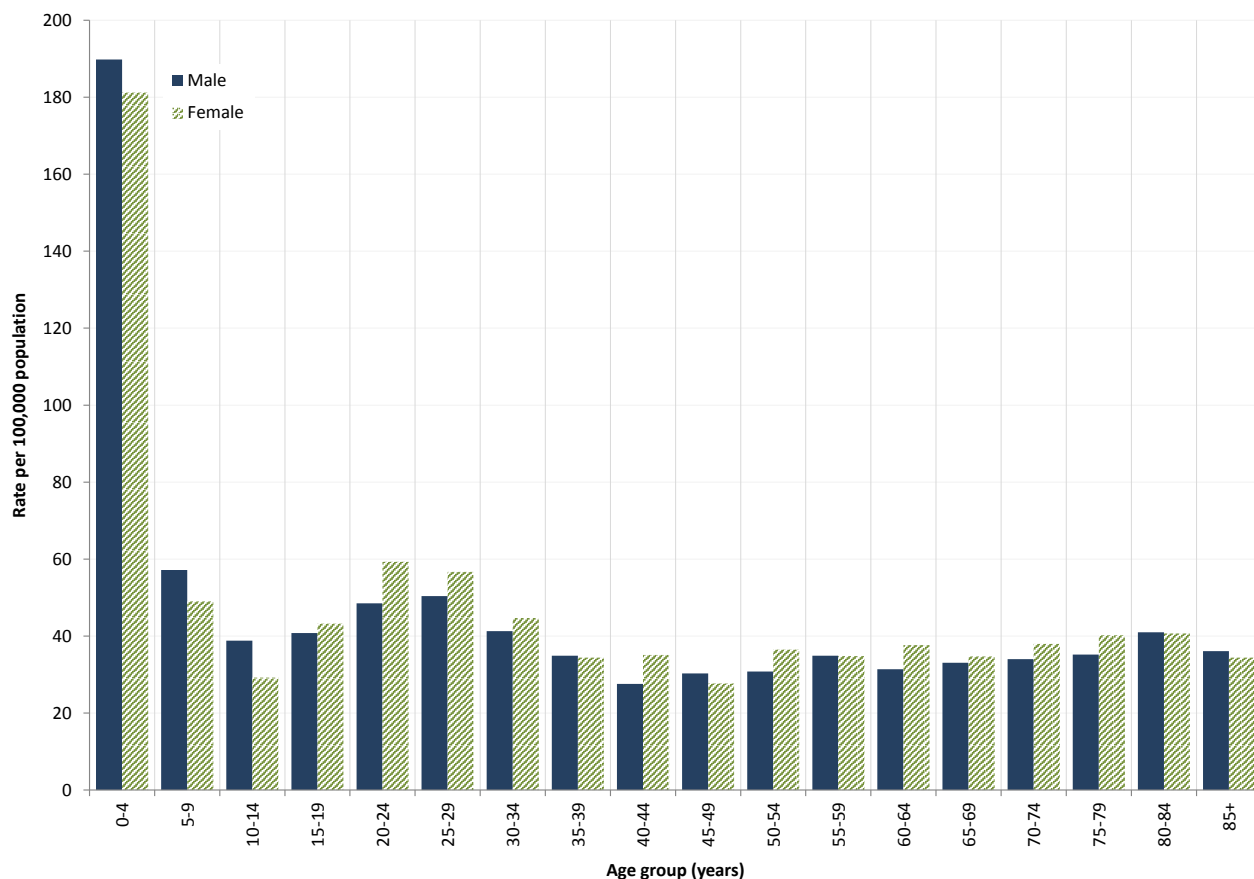


Table 3: Number of *Salmonella* Enteritidis infections, Australia, 2012, by travel history and state or territory

State or territory	Overseas-acquired	Locally-acquired	Unknown	Total
ACT	10	1	0	11
NSW	125	8	23	156
NT	20	0	2	22
Qld	76	41	14	131
SA	67	2	0	69
Tas	11	0	3	14
Vic	174	2	4	180
WA	226	16	2	244
Total	709	70	48	827

Table 4. Five most common phage types of locally and overseas-acquired *Salmonella* Enteritidis infections, Australia, 2012

Overseas-acquired cases			Locally-acquired cases		
Phage type	n	% of total typed (n=468)	Phage type	n	% of total typed (n=68)
1	123	26%	26	16	24%
6a	49	10%	1	9	13%
13	39	8%	RDNC	7	10%
21	39	8%	13	5	7%
RDNC	37	5%	14c	4	6%

^{RDNC} Reactions Do Not Conform

the most common phage types among locally-acquired isolates were PT 26 (24%), and PT 1 (13%) (Table 4).

***Salmonella* Paratyphi (paratyphoid)**

Salmonella serovars Paratyphi A, B and C (not including *S. Paratyphi B* biovar Java) are notified and reported under salmonellosis, however they cause an enteric fever similar to *S. Typhi* but typically milder which is commonly referred to as paratyphoid. In 2012, there were 78 notifications of paratyphoid, compared to 68 in 2011 and a 5-year historic mean of 67. *S. Paratyphi A* infection was the aetiology for 82% (64/78) of paratyphoid notifications, with the remainder (14/78) being due to *S. Paratyphi B* infection. The majority of paratyphoid infections (83%, 65/78) were contracted overseas: most commonly in India (n=29) and Indonesia (n=11). The country of acquisition was unknown for 10 notifications and 3 infections were reported to be acquired in Australia.

Listeriosis

There were 93 notifications of *L. monocytogenes* infection reported in 2012 (0.4 notifications per 100,000 population), higher than the 5-year historical mean (0.3 notifications per 100,000 population) (Table 1). State and territory rates ranged from 0.0 to 0.6 notifications per 100,000 population. Of the 93 notifications, 32% (30) were in people 60 years of age or over and

females accounted for 61% (57). Eleven cases in 2012 were pregnant women with 3 associated neonatal infections.

The most commonly reported *L. monocytogenes* types were serotype 4b, 4d, 4e and binary type (BT) 255 (26%, 24/93) followed by serotype 4b, 4d, 4e and BT 254 (24%, 22) (Table 5).

One multi-jurisdictional outbreak (this investigation continued into 2013 and will be reported in the 2013 annual report) and 2 multi-jurisdictional clusters were investigated in 2012.

Shigellosis

There were 546 notifications of *Shigella* infection in Australia in 2012, a rate of 2.4 notifications per 100,000 population compared with the 5-year historical mean of 2.8 per 100,000 (Figure 5, Table 1). It has been estimated that around 12% of shigellosis cases are acquired via food-borne transmission.² Compared with the 5-year historical mean, there has been an increase in cases in Tasmania (+133%), Victoria (+11%), New South Wales (+6%) and the Australian Capital Territory (+7%) and a decline in cases in Western Australia (-59%), South Australia (-31%), the Northern Territory and Queensland (-14% each). As in previous years, the highest notification rate occurred in the Northern Territory, with 45.6 per 100,000 population. The lowest rate was in Tasmania with 1.4 per 100,000. In 2012, notification rates for shigellosis were high-

Table 5: Five most common *Listeria monocytogenes* strains, Australia, 2012, by molecular serotype and binary type

Serotype	Binary type	Number of cases
4b, 4d, 4e	255	24
4b, 4d, 4e	254	22
1/2c, 3c	82	8
4b, 4d, 4e	190	5
1/2b,3b,7	158	4

Source: OzFoodNet National Enhanced Listeriosis Surveillance System

est in males and females 0–4 years of age, with 6.1 and 7.2 notifications per 100,000 population respectively (Figure 6). The overall rate for males was 2.4 per 100,000 in 2012 compared with the female rate of 2.3 per 100,000. Indigenous status was recorded for 88% (480/546) of shigellosis cases. Of these, 31% (147/480) identified as being Aboriginal or Torres Strait Islander. Data on male-to-male sexual exposure was reported for notifications in the Australian Capital Territory, New South Wales, Queensland, Tasmania and Victoria (62%, 338/546). Of these, 16% (55/338) reported male-to-male sexual contact during their period of acquisition.

Travel history information was available for 68% (371/546) of shigellosis notifications in 2012 and of these, 54% (201/371) acquired their illness overseas. The most common overseas countries of acquisition were Indonesia (12%, 45/371) and India (11%, 39/371). Nearly all *Shigella* isolates were typed (97%, 530/546) with *Shigella sonnei* being the most frequent species notified (70%, 371/530), followed by *Shigella flexneri* (27%, 145/530). There were also 9 notifications of *Shigella boydii* and 5 notifications of *Shigella dysenteriae*. *Shigella sonnei* biotype a was the most frequently notified infection (34%, 187/546) (Table 6).

Figure 5: Notification rate for shigellosis, Australia, by year of diagnosis

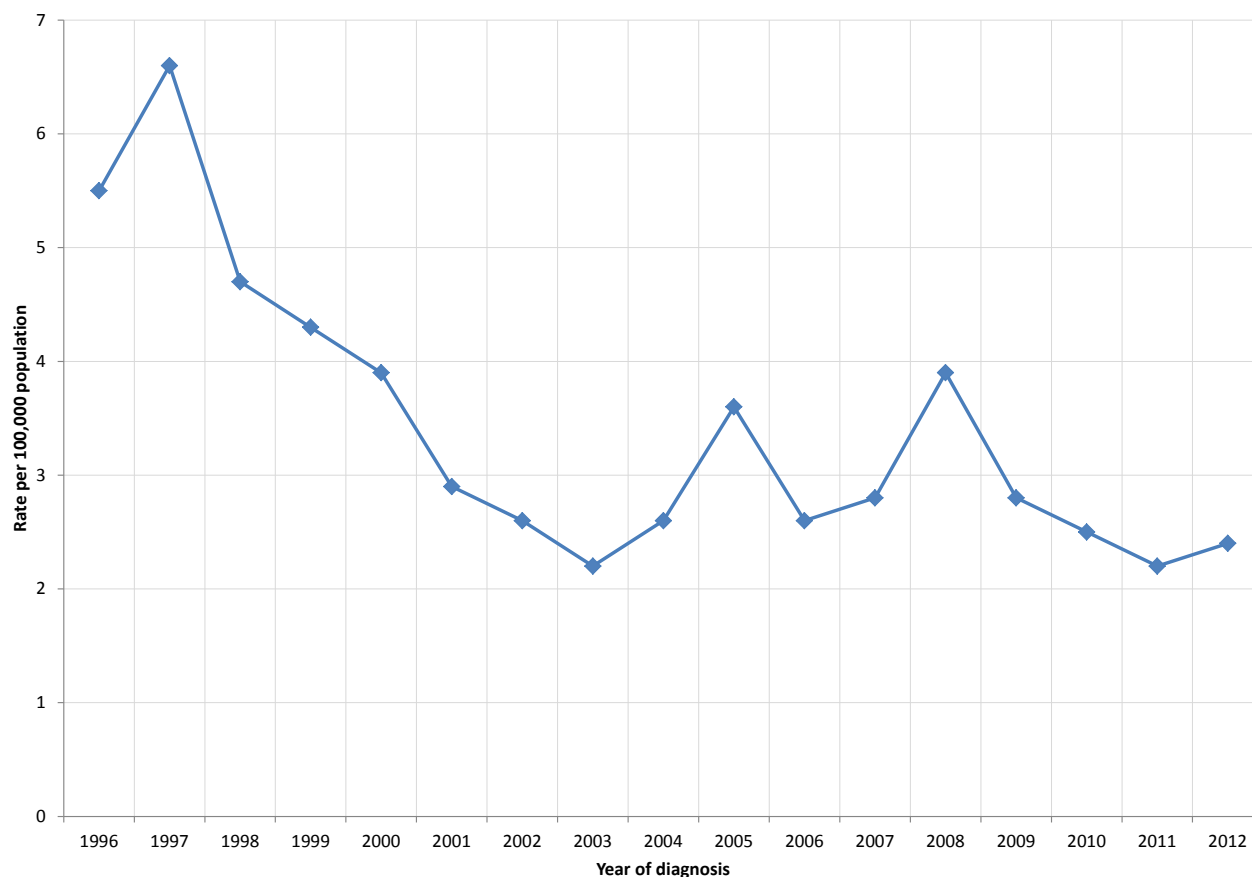
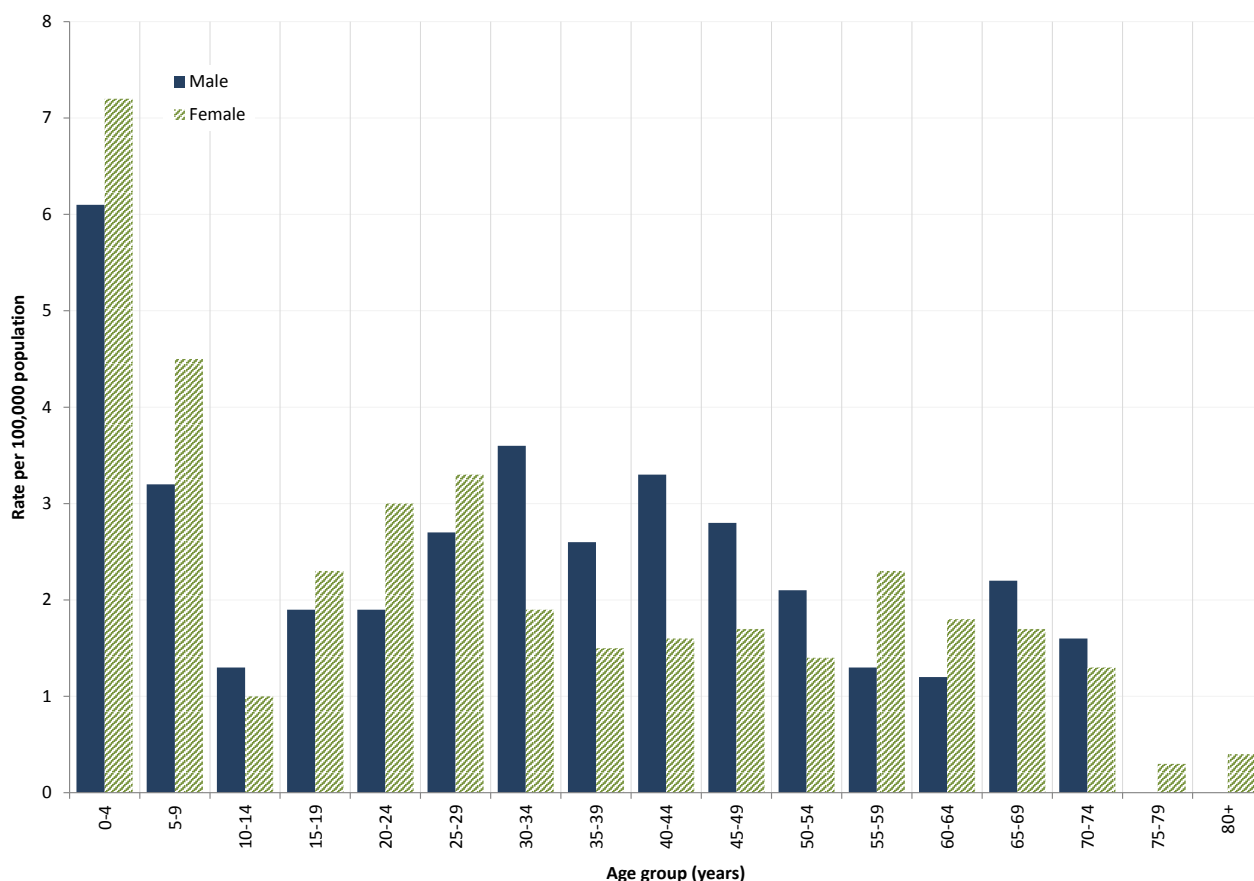


Figure 6: Notification rate for shigellosis, Australia, 2012, by age and sex



Typhoid Fever

In 2012, there were 122 notifications of *Salmonella Typhi* infection (typhoid fever) in Australia, a rate of 0.5 notifications per 100,000 population. This was the same as the 5-year historical mean (2007-2011) of 0.5 per 100,000 population (Table 1). Most notifications were in New South Wales (43/122) and Victoria (37/122). In 2012, 60% (73/122) of cases were male. Travel history was known for 97% (116/122) of cases, with 97% (115/118) of these likely to have acquired the infection overseas.

Most of the overseas-acquired cases of typhoid fever notified in 2012 had travelled to India (57%, 65/115), Bangladesh (11%, 13/115) or Indonesia (10%, 12/115). The most commonly notified phage type was PT E1 and these infections were mostly associated with travel to India. Two of the 6 cases with no known history of overseas travel were also PT E1 (Table 7).

Hepatitis A

In 2012, there were 166 hepatitis A notifications with a rate of 0.7 notifications per 100,000 population. This was slightly higher than the rate (0.6 per 100,000 population) reported in 2011¹⁵ and 44% lower than the 5-year historical mean (1.3 notifications per 100,000) (Table 1). There was a large decrease in hepatitis A notifications between 1997 and 2001 and then a more gradual decrease from 2002 to 2012 (Figure 7). Indigenous status was known for 95% (157/166) of hepatitis A cases in 2012. No cases of hepatitis A were identified as being in Aboriginal or Torres Strait Islander peoples. This is consistent with the small percentage of cases reported between 2007 and 2011, and a shift from the 2004 and 2006 period when 10%–15% (28–49 cases) of cases per year identified as being Aboriginal or Torres Strait Islander.²²⁻²⁴

In 2009, the majority of cases notified were part of a large multi-jurisdictional outbreak associated with the consumption of semi-dried

Table 6: Number, percentage and ratio of the top 10 *Shigella* infections, Australia, 2011 and 2012, by biotype

Biotype	2011		2012		Ratio [‡]
	n	%*	n	% [†]	
<i>Shigella sonnei</i> biotype a	164	33%	187	34%	1.1
<i>Shigella sonnei</i> biotype g	139	28%	141	26%	1.0
<i>Shigella sonnei</i> untyped	34	7%	35	6%	1.0
<i>Shigella flexneri</i> 2a	27	6%	32	6%	1.2
<i>Shigella flexneri</i> 4a	18	4%	5	1%	0.3
<i>Shigella flexneri</i> 4	18	4%	15	3%	0.8
<i>Shigella flexneri</i> 3a	15	3%	12	2%	0.8
<i>Shigella flexneri</i> 2b	12	2%	12	2%	1.0
<i>Shigella</i> untyped	12	2%	17	3%	1.4
<i>Shigella flexneri</i> untyped	10	2%	15	3%	1.5

* Proportion of total shigellosis notified in 2011.

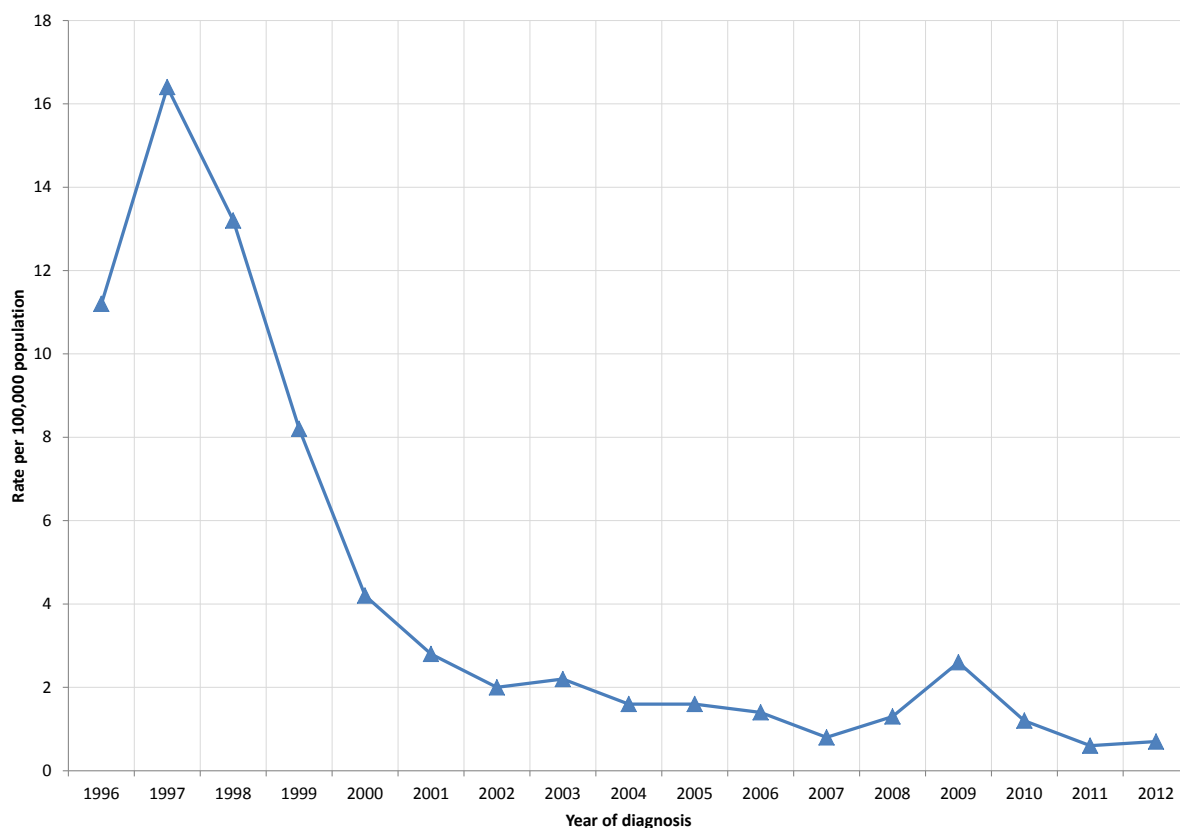
† Proportion of total shigellosis notified in 2012.

‡ Ratio of the number of cases in 2012 compared with the number in 2011.

Table 7: Notifications of *Salmonella Typhi* infection, Australia, 2012, by phage type and country of acquisition

Phage type	Australia	Bangladesh	India	Indonesia	Other countries	Unknown	Total
E1	0	0	22	0	10	2	34
E9	1	3	8	0	5	1	18
A	0	1	1	1	4	0	7
D2	0	0	0	4	1	0	5
Other types	1	3	10	1	0	2	17
Unable to be typed	1	1	10	2	1	1	16
Unknown	0	5	14	4	2	0	25
Total	3	13	65	12	23	6	122

Figure 7: Notification rate for hepatitis A infections, Australia, by year of diagnosis



tomatoes.^{22,25} The median age of cases in 2012 was 27 years (range 1 - 92 years) and 51% were female (85/166).

In 2012, 77% (127/166) of hepatitis A infections were acquired overseas. Countries of acquisition included India (20%, 25/127), Lebanon (13%, 16/127) and Indonesia (10%, 13/127). In the same year, 23% (39/166) of hepatitis A cases were locally-acquired (Figure 8), the lowest number and proportion since recording of country of acquisition began in 2006.

Shiga toxin-producing *Escherichia coli* (STEC) infection

In 2012, there were 112 notifications of STEC infection in Australia, a rate of 0.5 notifications per 100,000 population, equivalent to the 5-year historical mean (Table 1, Figure 9). Twenty of these cases were also diagnosed with HUS. Per the NNDSS surveillance case definitions (available online from: <http://www.health.gov.au/casedefinitions>), these conditions are notified

separately. In 2012, 53% (59/112) of cases were male. The median age of cases was 46 years (range 1–95 years).

Notified cases of STEC infection are strongly influenced by state and territory practices regarding the screening of stool specimens.²⁶ In particular, South Australian public health laboratories routinely test all bloody stools with a polymerase chain reaction (PCR) assay specific for genes coding for Shiga toxins, making rates for this state typically the highest in the country. In 2012, South Australia had the highest rate of notifications with 2.7 notifications per 100,000 population (45/112) followed by the Australian Capital Territory with 1.6 notifications per 100,000 population (6/112). The increase in the notification rate for the Australian Capital Territory relates to the continuation of an STEC screening study which commenced in October 2011 based in a local laboratory.

In 2012, serogroup information was available for 56% of STEC cases (63/112). The most common serogroups identified were: O157 (48%, 30/63);

Figure 8: Place of acquisition for hepatitis A cases, Australia, by year of diagnosis (n=1,862)

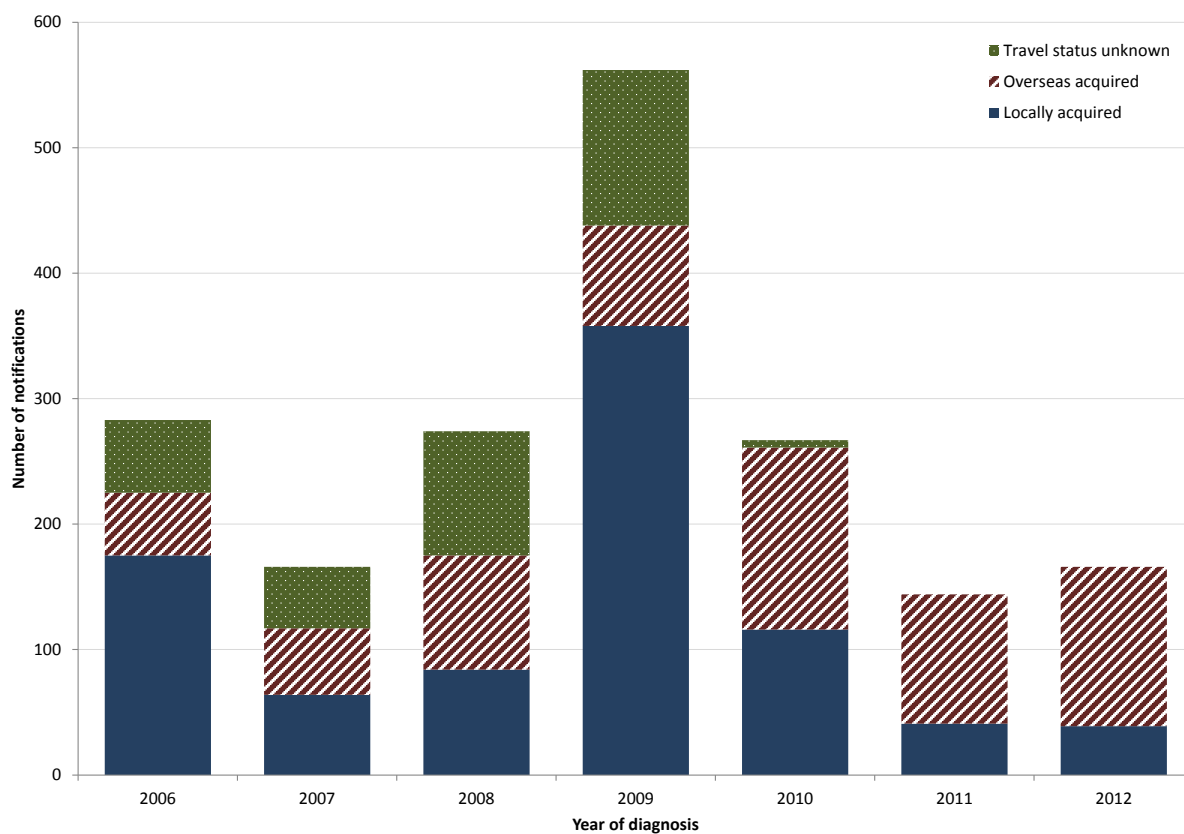
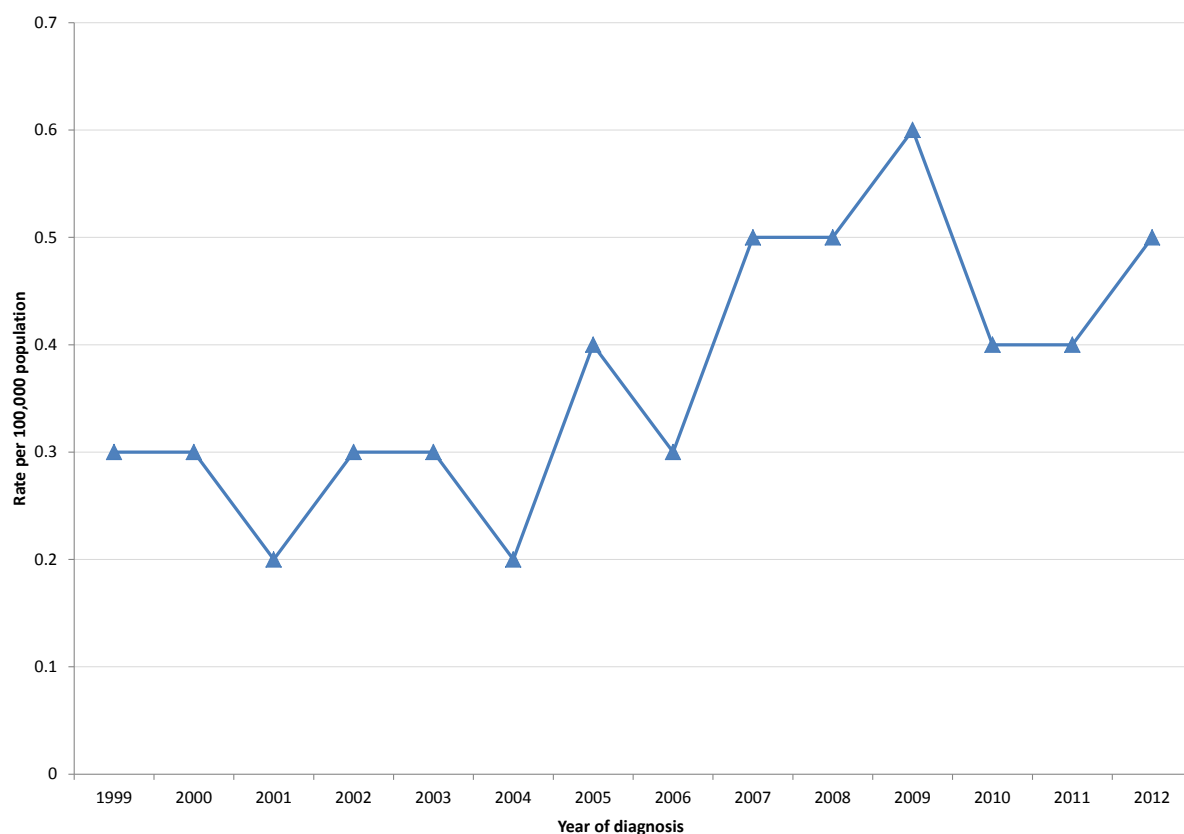


Figure 9: Notification rate for Shiga toxin-producing *Escherichia coli* infections, Australia, by year of diagnosis*



* STEC became notifiable in Australia in 1999.

O26 (13%, 8/63); O113 (8%, 5/63) and O111 (5%, 3/63). Serogroup information was obtained by serotyping cultured isolates or by PCR targeting serogroup-specific genes. The remaining 49 isolates were either not able to be serotyped or were Shiga-toxin positive by PCR only with no isolates obtained. In 2011 by comparison, O157 accounted for 38% (22/58) and O111 17% (10/58) of serotyped specimens.²⁴

Haemolytic Uraemic Syndrome (HUS)

In 2012, OzFoodNet sites reported 20 cases of HUS with a rate of 0.1 notifications per 100,000 population, which is equivalent to the 5-year historical mean (Table 1). There were 14 male and 6 female cases and the median age was 13 years (range 1 to 87 years). Similar to previous years, the majority of cases were in children, with 8 cases in children 0-9 years of age, 4 cases in children 10-15 years of age and only 8 cases in persons over 18 years of age.

Not all diagnoses of HUS are related to enteric pathogens (including those potentially transmitted by food). In 2012, all cases of HUS were also positive for STEC and 45% of HUS cases (9/20) had a serogroup identified including serotypes O157 (4/20), O169:H (1), O26 (1), O103 (1), O111:H (1) and O not typed:H11 (1). The remaining 11 cases were Shiga toxin positive but the isolates were unable to be serotyped.

Botulism

Four forms of naturally occurring botulism are recognised; foodborne, infant intestinal, wound, and “other” where cases are older than one year of age and no plausible exposure is known. Some of these cases are suspected to be due to intestinal colonisation.²⁷ Infant intestinal botulism mostly affects infants less than one 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. There were no cases of any type of botulism reported

in 2012. There were a total of 2 notifications of infant intestinal botulism reported in 2011, and none reported in 2010.^{23,24}

Outbreaks of gastrointestinal illness

In 2012, OzFoodNet sites reported 2,180 outbreaks of gastrointestinal illness (including foodborne disease), affecting 40,547 people, of whom 955 were hospitalised (Table 8). There were 131 deaths reported during these outbreaks. This is comparable with the 5-year historic mean (2007-2011) of 1,721 outbreaks. Outbreaks were most commonly due to norovirus (33%, 711/2,179), rotavirus (3%, 62/ 1,721) or other suspected viral agents (13%, 285/ 1,721), with 745 of unknown aetiology (34%).

Outbreaks spread person-to-person

In 2012, 83% of all reported gastrointestinal outbreaks were transmitted from person to person (1,819/2,180). These outbreaks affected 35,999 people, of whom 680 were hospitalised. There were 121 deaths reported during these outbreaks (Table 8). Aged care facilities (49%, 894/1,819) were the most frequently reported setting of exposure for person-to-person outbreaks, followed by childcare centres (27%, 492/1,819).

Outbreaks spread animal-to-person

Two outbreaks in two separate months (April and June) were reported to have been transmitted from animal to person within the same aged care facility (Table 8). The aetiological agent for both outbreaks was identified as *Campylobacter jejuni*. These outbreaks affected a total of 16 people, with one case requiring hospitalisation. A number of cases had *C. jejuni* isolated from stool samples, along with a puppy that lived on-site at the aged care facility.²⁸

Waterborne outbreaks

There were 7 outbreaks reported to be waterborne or suspected to be waterborne. These outbreaks affected 77 people, with 2 people requiring hospitalisation (Table 7). Five out-

Table 8: Outbreaks of gastrointestinal illness reported to state and territory health departments, Australia, 2012

Transmission mode	Number of outbreaks	Number ill	Number hospitalised	Number of deaths reported
Foodborne and suspected foodborne	144	2,117	183	9
Person-to-person	1,819	35,999	680	121
Animal-to-person	2	16	1	0
Waterborne or suspected waterborne	7	77	2	0
Unknown mode	208	2,338	89	1
Total	2,180	40,547	955	131

breaks were attributed to *Cryptosporidium*, one outbreak was suspected viral gastroenteritis and for one outbreak the aetiology was unknown. The source of infection was confirmed for 6 of these outbreaks, with 5 related to exposure at public aquatic facilities and one outbreak was associated with a school camp.

Outbreaks with unknown mode of transmission

There were 208 outbreaks in which cases were clustered in time, place or person, where investigators were unable to develop an adequate hypothesis for the mode of transmission. These outbreaks affected 2,338 people, 89 of whom were hospitalised. There was one death reported during these outbreaks. Aged care facilities were the most frequently reported setting (36%, 74/208), followed by restaurants (10%, 21/208) and child care facilities (10%, 20/208). In 82% (170/208), both the aetiological agent and transmission mode remained unknown. In 8% (16/208) of these outbreaks, the aetiological agent was identified as *Salmonella* spp. and in 6% (12/208) the agent was norovirus.

Foodborne and suspected foodborne outbreaks

In 2012, OzFoodNet sites reported 144 outbreaks of foodborne and suspected foodborne illness. These outbreaks affected 2,117 people, with 183 hospitalised. Nine deaths were reported during

these outbreaks (Table 8). This compares with a 5-year historic mean (2007-2011) of 144 outbreaks annually. The overall rate of foodborne disease outbreaks in 2012 was 6.3 per million population (Table 9). The highest rates were in the Australian Capital Territory (26.7 outbreaks per million population) and the Northern Territory (21.3 outbreaks per million population), although these jurisdictions reported only 10 and 5 outbreaks respectively. The largest number of outbreaks (47) was reported by New South Wales.

Aetiologies

One out of every 5 foodborne and suspected foodborne outbreaks (58/144) were due to *S. Typhimurium* (Table 10). Other frequently reported pathogens were norovirus (10%, 15/144), other *Salmonella* serovars (6%, 8/144), scambrotoxin (4%, 6), *Campylobacter* species (3%, 4/144) and *Clostridium perfringens* (2%, 3/144). There were 39 outbreaks of unknown aetiology (27%), which is similar to the figure reported in 2011 (31%, 47/151).

Food vehicles

Outbreaks were categorised as being attributable to one of 19 food commodities (i.e. 17 as described by Painter et al²⁹ with additional categories for lamb and kangaroo) if a single contaminated ingredient was identified or if all ingredients belonged to that food category. Outbreaks that

Table 9: Outbreaks of foodborne and suspected foodborne disease, Australia, 2012, by OzFoodNet site

State or territory	Number of outbreaks	Number ill	Mean size (persons) per outbreak	Number hospitalised	Outbreak rate per million population
ACT	10	113	11.3	13	26.7
NSW	47	457	9.7	26	6.4
NT	5	45	9.0	1	21.3
Qld	25	205	8.2	20	5.5
SA	9	150	16.7	13	5.4
Tas.	5	103	20.6	8	9.8
Vic.	27	348	12.9	22	4.8
WA	12	225	18.8	36	4.9
NSW/Vic	1	3	3.0	3	N/A
Multi-jurisdictional	3	468	156.0	41	N/A
Total	144	2,117	14.7	183	6.3

could not be assigned to one of the 19 categories, or for which the report contained insufficient information for food category assignment were not attributed to any food category.³⁰

In 60 foodborne and suspected foodborne outbreaks (42%, 60/144), investigators attributed the outbreak to a single food commodity. In another 30 outbreaks (21%), the implicated dish contained a mix of ingredients, and no single ingredient was implicated. Thirty eight per cent of outbreaks (54/144) could not be definitively attributed to a particular food or foods due to a lack of evidence.

Of the outbreaks attributed to a single food (60/144), the foods most frequently implicated were eggs (47%, 28/60), fish (22%, 13/60) and poultry (10%, 6/60). During these outbreaks 882 people became ill, 75 people were hospitalised and 2 people were reported to have died (Table 11). Poultry implicated outbreaks affected the largest number of people (48%, 553/1,142). The majority of those affected (71%, 391/553) were part of a single outbreak of novel *Salmonella* Typhimurium MLVA 03-16/17-09-12-523. This

outbreak was the subject of an OzFoodNet multi-jurisdictional outbreak investigation and is discussed in more detail later in this report.

Egg associated outbreaks

There were 90 outbreaks with a known food vehicle or vehicles and, of these, almost a third (31%, 28/90) were suspected or confirmed to have been associated with the consumption of eggs and egg-based dishes (Table 12). These egg-associated outbreaks comprised 19% (28/144) of all foodborne outbreaks, just under half (42%, 28/66) of all foodborne *Salmonella* outbreaks, and half (51%, 23/45) of the outbreaks that were attributed to a single commodity. In these egg-associated outbreaks, eggs were served in desserts (11 outbreaks), in sauces and dressings such as mayonnaise, tartare or aioli (7 outbreaks), as a raw egg white emulsion (1 outbreak) and other egg containing vehicles (9 outbreaks).

Settings

In 2012, foods implicated in foodborne and suspected foodborne outbreaks were most com-

Table 10: Outbreaks of foodborne disease breaks and number affected, Australia, 2012, by aetiology and food category

Agent category	Total		Attributed to a single food category		Attributed to >1 food category		Not attributed to a food category	
	Number of outbreaks	Number ill	Number of outbreaks	Number ill	Number of outbreaks	Number ill	Number of outbreaks	Number ill
<i>Salmonella</i> Typhimurium*	58	1,196	31	885	9	144	18	167
<i>Salmonella</i> spp. other	8	88	3	56	3	22	2	10
<i>Campylobacter</i> spp.	4	34	3	26	0	0	1	8
<i>Staphylococcus aureus</i>	1	22	1	22	0	0	0	0
STEC	1	5	1	5	0	0	0	0
<i>Clostridium perfringens</i>	3	25	3	25	0	0	0	0
<i>Listeria monocytogenes</i>	2	37	1	34	0	0	1	3
Amatoxin	1	3	1	3	0	0	0	0
Ciguatoxin	2	4	2	4	0	0	0	0
Scombrotoxin	6	21	6	21	0	0	0	0
Norovirus	15	267	3	18	10	171	2	78
Suspected viral	2	44	0	0	1	19	1	25
Suspected bacterial toxin	2	23	1	3	1	20	0	0
Unknown	39	348	4	40	5	51	30	257
Total	144	2,117	60	1,142	30	430	54	545

*Including *S. subsp* I ser 4, 5, 12:it-

Table 11: Foodborne disease outbreaks attributed to a single food vehicle, Australia, 2012

Food Commodities (based on Painter et al 2009)	Number of outbreaks	Number affected	Number hospitalised	Number of fatalities
Eggs	28	320	37	0
Fish	13	51	0	0
Poultry	6	553	35	0
Lamb	2	23	1	0
Pork	2	25	1	0
Leafy greens	2	40	3	0
Fungi	2	13	3	2
Fruit-nuts	1	43	7	0
Dairy	1	34	34	6
Grains-beans	1	22	6	0
Beef	1	13	0	0
Kangaroo	1	5	1	0
Total	60	1,142	128	9

monly prepared in restaurants (49%, 71/144), in private residences (13%, 18/144), or by a commercial caterer (9%, 13/144) (Table 13). This represents an increase in restaurants from 2011 (33%, 50/151). In the same period, outbreaks associated with aged care facilities decreased (from 15% (22/151) in 2011 to 5% (7/144) in 2012.

Investigative methods and levels of evidence

To investigate foodborne outbreaks, epidemiologists in the states and territories conducted 22 point source cohort studies and 8 case-control studies. Descriptive case series investigations were conducted for 90 outbreaks. In 24 outbreaks, no formal study was conducted (Appendix A).

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 4 outbreaks. Investigators relied on analytical evidence alone for 15 outbreaks and microbiological (or toxicological for non-microbial outbreaks) evidence alone for 19 outbreaks.

These confirmed foodborne outbreaks comprised 26% (38/144) of all foodborne outbreaks (Appendix A).

Contributing factors

Investigators collect information about factors that are likely to have contributed to a foodborne 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. The most commonly reported contributing factor for the 38 confirmed foodborne outbreaks was ingestion of contaminated raw products which occurred in 10 outbreaks (26%). Contamination factors varied by the aetiology of outbreaks as described in Table 14.

Significant foodborne and suspected foodborne outbreaks

In 2012, OzFoodNet sites responded to 144 foodborne or suspected foodborne outbreaks including 3 multi-jurisdictional outbreak

Table 12: Foodborne disease outbreaks associated with eggs and egg-based dishes, Australia, 2012

State	Setting prepared	Agent responsible	Number affected	Evidence	Responsible vehicles
ACT	Restaurant	<i>S. Typhimurium</i> PT 170/108*, MLVA 03-10-07-12-523†	10	D	Mayonnaise, unspecified
ACT	Restaurant	<i>S. Typhimurium</i> PT 135a, MLVA 03-10-07-12-523	7	D	Eggs, other
ACT	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-08-14-523	23	A	Raw egg white emulsion
ACT	Restaurant	<i>S. Typhimurium</i> PT 135a, MLVA 03-13-12-11-10/09-523	20	AM	Eggs benedict, hollandaise sauce
NSW	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-09-12-523	12	M	Deep fried ice cream
NSW	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-07-12-523	3	D	Ice-cream cake containing raw eggs
NSW	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-07-12-523	14	D	Deep fried ice cream
NSW	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-07-13-523	20	M	Mayonnaise containing raw eggs
NSW	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-09-12-523	5	M	Deep fried ice cream
NSW	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-07-13-523	5	D	Eggs and omelettes
NSW	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-09-12-523	9	D	Deep fried ice cream
NSW	Take-away	<i>S. Typhimurium</i> PT 170/108, MLVA 03-10-07-13-523	14	D	Vietnamese bakery goods
NSW	Commercial caterer	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-08-14-523	14	D	Mayonnaise containing raw eggs
NSW	Restaurant	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-09-12-523	17	D	Bombe Alaska
NSW	Restaurant	<i>S. Typhimurium</i> PT 135a, MLVA 03-13-09-11-550	4	M	Bacon and egg burger
NSW	Bakery	<i>S. Typhimurium</i> PT 170/108, MLVA 03-09-09-12-523	27	M	Numerous bakery goods
NSW	Take-away	<i>S. Typhimurium</i> PT 44, MLVA 03-10-08-09-523	11	D	Vietnamese rolls
Qld	Private residence	<i>S. Typhimurium</i> MLVA 3-13-10-10-524	4	D	Chocolate cake with raw egg meringue
Qld	Restaurant	<i>S. Typhimurium</i> PT 135a, MLVA 3-12-15/16-09-524	2	D	French Toast
Qld	Restaurant	<i>S. Typhimurium</i> PT 16, MLVA 03-13-11-11-524	3	D	Chicken Caesar salad with raw egg dressing
SA	Restaurant	<i>S. Typhimurium</i> PT 9, MLVA 03-15-07-11-550	11	M	Deep fried ice cream
Tas.	Restaurant	<i>S. Typhimurium</i> PT 141	8	D	Egg-based sauce
Tas.	Other	<i>S. Typhimurium</i> PT 135	44	D	Probable raw egg mayonnaise and/or tartare sauce
Vic.	Private residence	<i>S. subsp I ser 4,5,12 :- PT 193</i>	14	M	Raw egg ice cream cake
Vic.	Private residence	<i>S. Typhimurium</i> PT 4	4	D	Raw egg smoothies
Vic.	Private residence	<i>S. Typhimurium</i> PT 135a	7	D	Suspected chocolate mousse containing raw eggs
Vic.	Private residence	<i>S. Typhimurium</i> PT 170/108	3	D	Raw egg drink
Vic.	Private residence	<i>S. Typhimurium</i> PT 135a	5	D	Probable chocolate mousse with raw eggs

Evidence key:

^o 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

* Classification of this *Salmonella* Typhimurium phage type differs between laboratories, with the Microbiological Diagnostic Unit using PT 170 and SA Pathology using PT 108. This is due to a difference of interpretation of 1 phenotypic characteristic.

† Multiple-locus variable number tandem repeat analysis (MLVA) profiles are reported using the Australian coding convention agreed at a MLVA typing harmonisation meeting in Sydney in November 2011.

Table 13: Foodborne disease outbreaks, Australia, 2012, by implicated food preparation setting

Setting	Number of outbreaks	Per cent of outbreaks	Number affected
Restaurant	71	49%	779
Private residence	18	13%	125
Commercial caterer	13	9%	233
Aged care	7	5%	80
Take-away	7	5%	48
Other	4	3%	98
Bakery	4	3%	42
Commercially manufactured	2	1%	37
Primary produce	2	1%	45
Camp	2	1%	15
National franchised fast food	2	1%	8
Community	1	1%	131
Fair/festival/mobile service	1	1%	10
Hospital	1	1%	6
School	1	1%	4
Institution	1	1%	3
Unknown	7	5%	453
Total	144	100%*	2,117

*may not add up to 100 due to rounding

investigations conducted under the Guidelines for the epidemiological investigation of multi-jurisdictional outbreaks that are potentially foodborne (current endorsed version available from: <http://health.gov.au/internet/main/publishing.nsf/Content/cdna-ozfoodnet.htm>) and 2 other outbreaks with cases in 2 jurisdictions each. The median number of people affected in foodborne and suspected foodborne outbreaks was 9 people per outbreak (range 2-391). There were 6 outbreaks that each affected more than 40 people. Five of these outbreaks were due to *S. Typhimurium* and one was due to norovirus. These outbreaks affected at least 702 people of whom 38 people were reported to be hospitalised.

There were 9 deaths reported during foodborne or suspected foodborne outbreak investigations during 2012, 2 caused by amatoxin poisoning due to consumption of “death cap” mushrooms (*Amanita phalloides*), one associated with a listeriosis outbreak in New South Wales and Victoria and 6 associated with a multi-jurisdictional listeriosis outbreak investigation which commenced in 2012 and continued into 2013.

Summaries of significant single jurisdictional outbreaks are included in OzFoodNet quarterly reports.

Multi-jurisdictional outbreak investigations

During August 2012, New South Wales initiated an epidemiological investigation due to the emergence of 2 closely related but novel *S. Typhimurium* strains, MLVA 03-17-09-12-523 and 03-16-09-12-523. These patterns are equivalent to *S. Typhimurium* PT 135. Nationally, 391 cases were identified between May and December 2012, with the majority of cases being from New South Wales and Queensland. The New South Wales Food Authority identified a chicken supplier with *S. Typhimurium* PT 135 during July and August 2012. Supplier samples underwent MLVA testing and were found to have the same MLVA profiles. Industry control measures included destruction of affected flocks, vaccination, increased monitoring of chlorine levels, late processing of contaminated flocks and additional drag swabbing. A joint case control study between New South Wales and Queensland did not identify a significant association with the consumption of chicken.

Table 14: Factors reported as leading to the contamination of food vehicles in confirmed foodborne disease outbreaks, Australia, 2012, by aetiology

Agent	Contamination factor	Number of outbreaks	Number affected
<i>Campylobacter</i>	Cross contamination from raw ingredients	1	15
<i>Clostridium perfringens</i>	Cross contamination/ inadequate cooking time/ temperature	1	7
	Inadequate cooking time/ temperature	1	5
Histamine Fish Poisoning	Toxic substance or part of tissue	2	7
<i>Listeria monocytogenes</i>	Unknown	2	37
Norovirus	Cross contamination with sewage identified during harvest	1	8
	Food handler contamination	1	22
	Person to food to person	2	23
<i>Salmonella</i> Typhimurium	Ingestion of contaminated raw products	7	140
	Cross contamination from raw ingredients	2	61
	Ingestion of contaminated raw products and inadequate cleaning of equipment	1	27
	Potential for cross contamination during production and processing	1	391
	Ingestion of contaminated raw products and cross contamination from raw ingredients	1	131
	Unknown	4	55
Other <i>Salmonella</i> spp.	Cross contamination from raw ingredients	2	16
	Ingestion of contaminated raw products and inadequate cleaning of equipment	1	4
Total		38	1,075

A multi-jurisdictional outbreak investigation commenced on 3 October 2012 into cases of *S. Typhimurium* PT3 in 3 jurisdictions. Initial interviews indicated consumption of raw almonds from a single supermarket chain was a common exposure. There were 40 confirmed cases and 3 suspected cases reported from 6 Australian states with a median age of 33 years (range was 1 to 78 years). There were approximately equal numbers of males and females affected. Seven cases were hospitalised and there were no deaths reported. Onsets of illness ranged from 2 July 2012 to 26 November 2012. Interviews were conducted with 39 of the cases; 37 cases (95%) reported consuming almonds, either as a single food or part of a mixed nut product. The majority of cases who reported consuming almonds (32 cases or 86%) remembered purchasing them from a retailer known to have been supplied with almonds from the implicated company. There were 2 national food recalls of raw almonds and multiple media releases in relation to this outbreak. The investigation closed on 29 November 2012.

A multi-jurisdictional outbreak investigation of *L. monocytogenes* serotype (ST) 4b, 4d, 4e, binary type (BT) 254/255 and with a pulsed-field gel electrophoresis (PFGE) profile of 119A:44A:1* associated with the consumption of brie and/or camembert cheese commenced on 10 December 2012 and continued on to mid 2013. In total there were 34 confirmed cases of infection from 6 jurisdictions with and had illness onsets between 18 August 2012 and 19 April 2013. There were 6 deaths and one miscarriage reported during the outbreak. Brie and camembert cheeses produced by a Victorian manufacturer were implicated, and 2 recalls of a range of soft cheese products from this manufacturer were conducted in December 2012 and January 2013. The outbreak strain of *L. monocytogenes* was detected in brie and camembert produced by the implicated manufacturer, and from product sampled from retailers in Victoria, New

South Wales, Queensland and South Australia. Dairy Food Safety Victoria worked closely with the cheese manufacturer to improve processes, and more stringent routine test and hold protocols were implemented, as well as an extensive environmental testing protocol. The investigation closed on 22 August 2013.

There were 2 further investigations in 2012 with cases in 2 jurisdictions each which were not formally investigated as multi-jurisdictional outbreak investigations. Through its National Enhanced Listeriosis Surveillance System (NELSS), OzFoodNet identified an outbreak of suspected foodborne illness involving 3 cases of *L. monocytogenes* ST 1/2a,3a, BT 58, PFGE 18A:17A:10. Cases occurred in January (New South Wales), late May (Victoria) and early June (Victoria). One case died. A case–case analysis was performed using data from NELSS involving the 3 cases and 56 controls. In univariate analysis, smoked salmon had a statistically significant association between consumption and illness; however, as all 3 cases consumed smoked salmon in the 28 days prior to illness onset, an odds ratio (OR) could not be calculated (OR undefined; 95% CI 2.2 to undefined; P=0.02). All 3 cases consumed the same brand of smoked salmon but 2 of the cases also consumed other brands of smoked salmon. Health authorities met with the company of interest and concluded that it had an extensive program for *Listeria* identification and control in place. The company's test and hold criteria for fish products exceeded the current microbiological requirements of the Australia New Zealand Food Standards Code.³¹ Twenty samples of ready-to-eat cold smoked salmon of varying brands, batches and date coding sampled from retail sites were all negative for *Listeria*.

Investigators detected an outbreak of *S. Typhimurium* PT 135, MLVA 03-14-13-13-524 associated with a catered sporting event in South Australia, with cases from South Australia and Tasmania. A cohort study was conducted, and 36 of 41 players and associated staff were interviewed, with 18 meeting the case definition (diarrhoea and/or stool sample posi-

* PFGE patterns were interpreted with reference to the guidelines proposed by Tenover et al,⁶ the 3 restriction enzymes used for *L. monocytogenes* PFGE typing were: Apa1 : Sma1 : Not1 and a discrete PFGE type was assigned using a nomenclature defined by the Microbiological Diagnostic Unit Public Health Laboratory.

tive for *S. Typhimurium* PT 135). Eleven cases (2 hospitalised) had faecal samples positive for *S. Typhimurium* PT 135 and/or *S. Typhimurium* MLVA 03-14-13-13-524. The illness was suspected to be associated with the consumption of food provided by a private caterer at the sporting venue; however, analytical evidence did not identify a single food item associated with illness. An environmental inspection was conducted where the food was prepared. No pathogens were detected from environmental swabs or food samples. As the outbreak was point source and occurred in South Australia it is included in Appendix A under South Australia.

Cluster investigation outcomes

In August 2011, in response to a national increase in *S. Typhimurium* PT 193 notifications, monophasic *S. Typhimurium* (*S. subsp* I ser 4, 5, 12:i:-) PT 193, and *S. Typhimurium* notifications with an MLVA pattern traditionally associated with PT 193 MLVA 04-15-10/11/12-00-489/490/493, OzFoodNet commenced a national cluster investigation. The aim of this investigation was to form a hypothesis as to the source of the increase in cases. Cases were interviewed using a hypothesis generating questionnaire which included a trawling section on foods containing pork and beef, contact with cows and pigs, contact with dogs and cats and food eaten by cats/dogs including pet treats. These exposures were targeted due to an association with these products and human salmonellosis internationally. However, no clear hypothesis generated at the national or jurisdictional level could identify common food vehicles or the source of infection. Outcome recommendations from this cluster investigation were that OzFoodNet continue to investigate clusters of *S. Typhimurium* PT 193, identify additional information on non-human sources of *S. Typhimurium* PT 193, and increase opportunistic microbiological sampling of meat, poultry, eggs and pet food products.

Discussion

This report documents the incidence of gastrointestinal diseases that may be transmitted by food

in Australia during 2012. The OzFoodNet surveillance network concentrates its efforts on the surveillance of foodborne diseases and outbreak investigation. This is based on 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, the prevention of disease and the assessment of food safety policies and campaigns. A national program of surveillance for foodborne diseases and outbreak investigation such as OzFoodNet has many benefits including the identification of foods that cause human illness both locally and nationally through multi-jurisdictional outbreak investigations. Continuing to strengthen the quality of these data will ensure their use by agencies to develop food safety policy that contributes to preventing foodborne illness. This aims to 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.

Campylobacter continues to be the most frequently notified enteric pathogen under surveillance by OzFoodNet despite not being notifiable in New South Wales. In 2011, the highest number of notifications for campylobacteriosis occurred since the commencement of the NNDSS in 1991 (17,733 notifications). There was a slight decrease in notification of campylobacteriosis in 2012 (15,668 notifications). *Campylobacter* was implicated in 3% (4/144) of foodborne or suspected foodborne outbreaks in 2012, fewer than that reported in 2011 (7%) and 2010 (6%). Subtyping of *Campylobacter* species is not routinely performed in Australia, hampering outbreak detection, but previous OzFoodNet outbreak investigations have identified consumption of undercooked poultry livers as a particular risk for outbreaks of campylobacteriosis. In 2012, 3 of the 4 foodborne or suspected foodborne *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.³² This is also an association that has been recognised internationally.³³ As a result of the increasing notifications of campylobacteriosis in Australia, OzFoodNet provided information on this issue to the Food Safety Information Council (<http://www.foodsafety.asn.au/>) – a non-government organisation that produces and disseminates community food safety information. The Food Safety Information Council then made campylobacteriosis prevention a major focus for their Australian Food Safety Week 2012 campaign. FSANZ also published a fact sheet on how to cook poultry liver safely (<http://www.foodstandards.gov.au/consumer/safety/poultryliver/pages/default.aspx>).

In 2011, both total salmonellosis notifications (12,271) and the national notification rate of 54.3 notifications per 100,000 population were at the highest levels since the commencement of the NNDSS in 1991. There was a slight decrease in 2012 in the number of notifications (11,249) and rate (49.6 notifications per 100,000 population). *Salmonella* Typhimurium remains the most frequently isolated serovar in humans in Australia.

OzFoodNet sites reported a total of 144 foodborne or suspected foodborne outbreaks in 2012, including 3 multi-jurisdictional outbreak investigations. Foodborne outbreak data can be useful to help estimate the proportion of illness attributable to different commodities and/or foods.³⁴ *Salmonella* continued to be the leading cause of reported outbreaks of foodborne illness in Australia, with 46% of outbreaks (66/144) due to *Salmonella*. Of these, 88% (58/66) were due to *S. Typhimurium* (including 2 outbreaks of *S. subsp I ser 4, 5, 12:i:-*). Of the 58 *S. Typhimurium* outbreaks, 48% (28) were associated with egg-based dishes. OzFoodNet has monitored and reported on a national increase in *Salmonella* outbreaks associated with the consumption of raw or minimally cooked eggs (2001-2011).³⁵ Food vehicles that were identified during egg associated outbreak investigations included mayonnaise, dressings and desserts containing raw egg.

The Primary Production and Processing Standard for Eggs and Egg Products was gazetted in May 2011 and in-force from 26 November 2012.³⁹ This Standard places legal obligations on egg producers and processors to introduce measures to reduce food safety hazards. It also includes traceability of individual eggs for sale or used to produce egg pulp. Further information on the implementation of the egg standard at the state and territory level is available from: <http://www.health.gov.au/internet/main/publishing.nsf/Content/foodsecretariat-isc-model.htm>.

In 2012, the first outbreak of *Salmonella* in Australia associated with almonds was detected. Internationally, raw or unprocessed almonds have been associated with *Salmonella* contamination in Canada (2000/2001)⁴⁰ and the US (2003/2004).⁴¹ Other low moisture tree nuts, peanuts, and sesame seeds have also been associated with *Salmonella* contamination.⁴²

There were no cases of hepatitis A identified in Indigenous Australians in 2012; compared with 2 in 2011 and one in 2010. This is further evidence of the success of the staged introduction of hepatitis A vaccination programs targeted to young Aboriginal children from 1999 onwards in Queensland, the Northern Territory, South Australia and Western Australia.^{36,37}

Rates of STEC infection remained stable between the years 2000 and 2010³⁸ and have remained so over 2011 and 2012.

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, which is why investigation of outbreaks is important. A further limitation relates to the outbreak data provided by OzFoodNet sites for this report

and the potential for variation in categorising features of outbreaks depending on investigator interpretation and circumstances. State and territory representatives are involved in a continuous program aimed at harmonising the collection and recording of the outbreak data via the Outbreak Register Working Group.

Acknowledgements

We thank the many epidemiologists, Masters of Applied Epidemiology scholars, project officers, interviewers and research assistants at each of the OzFoodNet sites who contributed to this report. We acknowledge the work of various public health professionals and laboratory staff around Australia who interviewed patients, tested specimens, typed isolates and investigated outbreaks. We would particularly like to thank jurisdictional laboratories, the Australian *Salmonella* Reference Centre at SA Pathology, the Institute of Clinical Pathology and Medical Research, Queensland Health Forensic and Scientific Services, the Microbiological Diagnostic Unit Public Health Laboratory, the National Enteric Pathogen Surveillance Scheme and PathWest for their help with foodborne disease surveillance in 2012. The quality of their work was the foundation of this report. OzFoodNet is an initiative of the Australian Government.

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Appendix A: Foodborne and suspected foodborne outbreak summary for OzFoodNet sites, Australia, 2012

State or territory	Month	Setting prepared	Agent responsible	Number ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
MJOI	Aug	Unknown	<i>Salmonella</i> Typhimurium PT 135, MLVA 03-16/17-09-12-523	391	Unknown	0	M	Case control study	fresh pre-cut chicken pieces	Poultry	Potential for cross contamination during production and processing
MJOI	Oct	Primary produce	<i>Salmonella</i> Typhimurium PT 3, PFGE 0434	43	7	0	M	Case series	Raw Almonds	Fruit-nuts	Ingestion of contaminated raw products
MJOI	Dec	Commercially manufactured	<i>Listeria monocytogenes</i> PFGE type 119A;44A:1	34	34	6	AM	Case series	Brie and/or camembert cheese	Dairy	Unknown
ACT	Jan	Restaurant	<i>Amanita phalloides</i>	3	3	2	D	No formal study	Wild mushrooms	Fungi	Toxic substance or part of tissue
ACT	Feb	Restaurant	Suspected viral gastroenteritis	25	0	0	D	Point source cohort	Unknown	Not attributed	Unknown
ACT	Feb	Fair/festival/mobile service	<i>Salmonella</i> Typhimurium PT 9, MLVA 03-12-16-13-526	10	3	0	D	Case series	Chicken Doner kebab	Not attributed	Unknown
ACT	Feb	Restaurant	Unknown	5	0	0	D	No formal study	Oysters	Fish	Unknown
ACT	Feb	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108*, MLVA 03-10-07-12-523	10	1	0	D	Case series	Mayonnaise, unspecified	Eggs	Ingestion of contaminated raw products
ACT	Feb	Restaurant	<i>Salmonella</i> Typhimurium PT 135a, MLVA 03-10-07-12-523	7	3	0	D	Case series	Eggs, other	Eggs	Ingestion of contaminated raw products
ACT	Mar	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-08-14-523	23	1	0	A	Point source cohort	Cold emulsion (raw egg white containing)	Eggs	Ingestion of contaminated raw products
ACT	Apr	Restaurant	<i>Salmonella</i> Typhimurium PT 135a, MLVA 03-13/12-11-10/09-523	20	2	0	AM	Case control study ³⁴ (Moffatt et al., 2012)	Eggs benedict, hollandaise sauce	Eggs	Ingestion of contaminated raw products

State or territory	Month	Setting prepared	Agent responsible	Number ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
ACT	May	Private residence	<i>Campylobacter</i>	7	0	0	D	Case series	Chicken liver pate	Poultry	Ingestion of contaminated raw products
ACT	Nov	Take-away	Suspected bacterial toxin	3	0	0	D	No formal study	Sashimi	Fish	Unknown
NSW	Jan	Restaurant	Unknown	12	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Jan	Private residence	<i>Salmonella</i> Give	10	1	0	D	Case series	Suspected cold pasta salad	Not attributed	Unknown
NSW	Jan	Restaurant	<i>Salmonella</i> Typhimurium MLVA 03-09-09-12-523	10	3	0	M	Point source cohort	Profiteroles	Not attributed	Unknown
NSW	Jan	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-07-13-523	5	0	0	D	Case series	Eggs and omelettes	Eggs	Inadequate cooking and cooling time/temperature
NSW	Feb	Other	<i>Salmonella</i> Muenchen	16	1	0	D	No formal study	Leg of Ham	Pork	Inadequate cleaning of equipment
NSW	Feb	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-12-523	9	0	0	D	Case series	Deep fried ice-cream containing raw eggs	Eggs	Inadequate cooking time/temperature
NSW	Feb	Restaurant	Unknown	4	1	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Mar	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-12-523	17	1	0	M	Point source cohort	Bombe Alaska	Eggs	Ingestion of contaminated raw products
NSW	Mar	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-10-07-15-523	15	0	0	D	Case series	Unknown	Not attributed	Cross contamination of equipment and environment
NSW	Mar	Take-away	<i>Salmonella</i> Typhimurium PT 44, MLVA 03-10-08-09-523	11	0	0	D	Case series	Vietnamese rolls	Eggs	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
NSW	Mar	Restaurant	Unknown	10	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Mar	Commercial caterer	<i>Salmonella</i> Typhimurium MLVA 03-15/16-11-10/11-523	8	Unknown	0	D	Point source cohort	Unknown	Not attributed	Unknown
NSW	Mar	Restaurant	<i>Salmonella</i> Typhimurium PT 135a, MLVA 03-13-09-11-550	4	2	0	M	Case series	Bacon and egg burger	Eggs	Unknown
NSW	Feb	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-07-13-523	20	3	0	M	Case series	Mayonnaise containing raw eggs	Eggs	Ingestion of contaminated raw products
NSW	Apr	Private residence	Suspected viral gastroenteritis	19	0	0	A	Point source cohort	Home-made cakes	Not attributed	Suspected person-to-food-person
NSW	Apr	Commercial caterer	Unknown	16	1	0	A	Point source cohort	Lamb salad	Lamb	Unknown
NSW	Jan	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-07-12-523	14	2	0	D	Case series	Deep fried ice-cream containing raw eggs	Eggs	Unknown
NSW	Apr	Take-away	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-10-07-13-523	14	0	0	D	Case series	Vietnamese bakery goods	Eggs	Inadequate cooling time/temperature
NSW	Apr	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-09-12-523	5	1	0	M	Case series	Deep fried ice-cream containing raw eggs	Eggs	Ingestion of contaminated raw products
NSW	Apr	Restaurant	Unknown	3	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Mar	Take-away	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-08-13-523	3	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Apr	Other	<i>Salmonella</i> Wangata	3	0	0	D	No formal study	Unknown	Not attributed	Inadequate cleaning of equipment
NSW	Apr	Restaurant	Unknown	3	0	0	D	No formal study	Unknown	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
NSW	May	Bakery	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-09-12-523	27	Unknown	0	M	Case series	Numerous bakery goods	Eggs	Ingestion of contaminated raw products and inadequate cleaning of equipment
NSW	May	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-09-12-523	12	0	0	M	No formal study	Deep fried ice-cream containing raw eggs	Eggs	Ingestion of contaminated raw products
NSW	May	Private residence	Histamine Fish Poisoning	3	0	0	D	Case series	Tuna	Fish	Toxic substance or part of tissue
NSW	Jun	Commercial caterer	<i>Staphylococcus aureus</i>	22	6	0	AM	Point source cohort	Fried rice	Grains-beans	Unknown
NSW	Jun	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-07-12-523	3	0	0	D	Case series	Ice-cream cake containing raw eggs	Eggs	Ingestion of contaminated raw products
NSW	Jun	Institution	<i>Salmonella</i> Typhimurium MLVA 03-14-09-14-523	3	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Aug	Restaurant	Unknown	3	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Sep	Commercial caterer	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-08-14-523	14	0	0	D	Case series	Mayonnaise containing raw eggs	Eggs	Ingestion of contaminated raw products
NSW	Sep	Restaurant	Unknown	10	0	0	D	Case series	Mushroom sauce	Fungi	Unknown
NSW	Sep	Unknown	<i>Salmonella</i> Typhimurium MLVA 03-27-08-21-496	9	Unknown	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Oct	Restaurant	Unknown	20	0	0	D	No formal study	Unknown	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
NSW	Oct	Restaurant	Norovirus genotype II.4.2009 (New Orleans)	8	0	0	M	Case series	Oysters	Fish	Cross contamination of sewerage identified during harvest
NSW	Oct	Restaurant	<i>Clostridium perfringens</i>	5	0	0	M	Case series	Chicken burrito	Poultry	Inadequate cooking time/temperature
NSW	Sep	Restaurant	Unknown	10	0	0	D	Case series	Unknown	Not attributed	Inadequate cooking time/temperature
NSW	Nov	Restaurant	<i>Salmonella</i> Singapore	7	3	0	D	Case series	Unknown	Not attributed	Cross contamination/inadequate cooking time/temperature
NSW	Sep	Restaurant	Unknown	5	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Nov	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-08-13-523	3	1	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Aug	Restaurant	<i>Salmonella</i> Typhimurium PT 135, MLVA 03-17-09-12-523	2	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Dec	Restaurant	Unknown	16	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Dec	Restaurant	<i>Clostridium perfringens</i>	13	0	0	D	Case series	Roast beef	Beef	Unknown
NSW	Dec	Restaurant	Unknown	12	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Dec	Restaurant	Unknown	8	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Dec	Restaurant	Unknown	7	0	0	D	No formal study	Unknown	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number Ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
NSW	Dec	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-08-13-523	4	0	0	D	Case series	Unknown	Not attributed	Unknown
NT	Jan	Private residence	Norovirus	6	0	0	D	No formal study	Salad sandwiches suspected	Not attributed	Person to food to person
NT	Jan	Private residence	Unknown	8	0	0	D	No formal study	Unknown	Not attributed	Unknown
NT	Jan	Restaurant	Norovirus	22	0	0	A	Point source cohort	Suspected egg or chicken sandwiches	Not attributed	Food handler contamination
NT	Mar	Take-away	Unknown	4	0	0	D	No formal study	Unknown	Not attributed	Unknown
NT	Oct	Camp	STEC	5	1	0	D	Point source cohort	Kangaroo Meat	Kangaroo	Ingestion of contaminated raw products, raw products, foods eaten undercooked
Qld	Jan	Private residence	<i>Salmonella</i> Typhimurium MLVA 03-13-10-10-524	4	0	0	D	Case series	Chocolate cake with raw egg meringue	Eggs	Ingestion of contaminated raw products
Qld	Jan	Restaurant	<i>Salmonella</i> Infantis	2	2	0	M	Case series	Prawn Salad Rolls	Not attributed	Cross contamination from raw ingredients
Qld	Feb	Unknown	<i>Salmonella</i> Typhimurium MLVA 03-14-09-13-524	30	Unknown	0	D	Case control study	Unknown	Not attributed	Unknown
Qld	Feb	National franchised fast food	Unknown	4	0	0	D	Case series	Potato & Gravy	Not attributed	Unknown
Qld	Feb	Restaurant	<i>Salmonella</i> Typhimurium MLVA 03-09-07-13-524	6	1	0	D	Case series	Unknown	Not attributed	Unknown
Qld	Mar	Restaurant	<i>Salmonella</i> Typhimurium PT 135a, MLVA 03-12-13-09-524	5	1	0	D	Case series	Suspected deep fried icecream	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number Ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
Qld	Mar	Other	Unknown	35	0	0	D	Case series	Unknown	Not attributed	Unknown
Qld	Apr	Restaurant	<i>Salmonella</i> Typhimurium PT 193, MLVA 03-13-14-10-524	3	0	0	D	Case series	Unknown	Not attributed	Unknown
Qld	May	Private residence	Histamine Fish Poisoning	4	0	0	D	Case series	Seafood - unknown	Fish	Toxic substance or part of tissue
Qld	May	Unknown	<i>Salmonella</i> subsp I MLVA 03-14-00-00-490	10	3	0	D	Case series	Unknown	Not attributed	Unknown
Qld	Jun	Restaurant	<i>Salmonella</i> Typhimurium PT 135a, MLVA 03-12-15/16-09-524	2	2	0	D	Case series	French Toast	Eggs	Unknown
Qld	Jul	Restaurant	<i>Clostridium perfringens</i>	7	0	0	A	Point source cohort	Lamb Curry	Lamb	Cross contamination/ inadequate cooking time/ temperature
Qld	Jul	Private residence	Histamine Fish Poisoning	4	0	0	M	Case series	Fresh Mullet Fillets	Fish	Toxic substance or part of tissue
Qld	Jul	Restaurant	Unknown	5	0	0	D	Case series	Unknown	Not attributed	Unknown
Qld	Jul	Restaurant	Norovirus	6	0	0	D	Case series	Oysters	Fish	Ingestion of contaminated raw products
Qld	Aug	Private residence	Ciguatera Fish Poisoning	2	0	0	D	Case series	Coral Trout	Fish	Toxic substance or part of tissue
Qld	Aug	Restaurant	<i>Salmonella</i> Typhimurium PT 16, MLVA 03-13-11-11-524	3	3	0	D	Case series	Chicken Caesar Salad with raw egg dressing	Eggs	Unknown
Qld	Sep	Primary produce	Ciguatera Fish Poisoning	2	0	0	D	Case series	Coral Trout	Fish	Toxic substance or part of tissue

State or territory	Month	Setting prepared	Agent responsible	Number Ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
Qld	Sep	Aged care	<i>Salmonella</i> Typhimurium PT 16, MLVA 03-13-10-11-524	14	0	0	D	Case series	Unknown	Not attributed	Unknown
Qld	Oct	Restaurant	Unknown	12	0	0	D	Case series	Unknown	Not attributed	Unknown
Qld	Nov	Restaurant	Norovirus genotype II.4 2009 (New Orleans)	4	0	0	D	Case series	Raw Oysters	Fish	Ingestion of contaminated raw products
Qld	Nov	Private residence	Histamine Fish Poisoning	3	0	0	M	Case series	Mahi Mahi	Fish	Toxic substance or part of tissue
Qld	Dec	Hospital	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-07-12-524	6	3	0	D	Case series	Unknown	Not attributed	Cross contamination from raw ingredients and inadequate cleaning of equipment
Qld	Dec	Restaurant	<i>Salmonella</i> Typhimurium PT 170/108, MLVA 03-09-07-15-524	29	5	0	M	Case series	Sushi (unspecified)	Not attributed	Unknown
Qld	Dec	Restaurant	Histamine Fish Poisoning	3	0	0	D	Case series	Mahi Mahi	Fish	Toxic substance or part of tissue
SA	Feb	Commercial caterer	<i>Salmonella</i> Typhimurium PT 9, MLVA 03-15-07-11-550	25	4	0	D	Point source cohort	Unknown	Not attributed	Unknown
SA	Mar	Commercial caterer	<i>Salmonella</i> Typhimurium PT 135, MLVA 03-14-13-13-524	18	2	0	D	Point source cohort	Unknown	Not attributed	Unknown
SA	May	Restaurant	Unknown	3	0	0	D	No formal study	Unknown	Not attributed	Unknown
SA	May	National franchised fast food	Unknown	4	0	0	D	No formal study	Unknown	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
SA	May	Commercial caterer	<i>Salmonella</i> Typhimurium PT 44, MLVA 03-10-09-09-523	50	2	0	AM	Point source cohort	Multiple foods	Not attributed	Cross contamination from raw ingredients
SA	Jul	Bakery	<i>Salmonella</i> Typhimurium PT 9, MLVA 03-15-07-11-550	4	3	0	D	Case series	Unknown	Not attributed	Unknown
SA	Jul	Restaurant	<i>Campylobacter</i>	15	1	0	A	Point source cohort	Chicken liver pâté	Poultry	Cross contamination from raw ingredients
SA	Sep	Restaurant	<i>Salmonella</i> Typhimurium PT 9, MLVA 03-15-07-11-550	11	1	0	M	Case series	Deep fried ice-cream containing raw eggs	Eggs	Cross contamination from raw ingredients
SA	Oct	Aged care	Suspected bacterial toxin	20	0	0	A	Point source cohort	Vitamised foods	Not attributed	Unknown
Tas.	Feb	Restaurant	<i>Salmonella</i> Typhimurium PT 141	8	3	0	D	Case series	Egg-based sauce	Eggs	Unknown
Tas.	Apr	Other	<i>Salmonella</i> Typhimurium PT 135	44	2	0	D	No formal study	Suspected raw egg mayonnaise and/or tartare sauce	Eggs	Ingestion of contaminated raw products
Tas.	Jul	Commercial caterer	Unknown	10	0	0	D	Case series	Unknown	Not attributed	Unknown
Tas.	Jul	Commercial caterer	Unknown	5	0	0	D	Case series	Unknown	Not attributed	Unknown
Tas.	Dec	Restaurant	<i>Salmonella</i> Mississippi	36	3	0	D	Point source cohort	Suspected salad	Leafy greens	Unknown
Vic.	Jan	Take-away	Unknown	9	1	0	D	Case series	Fish and Chips	Not attributed	Unknown
Vic.	Jan	Commercial caterer	Unknown	8	0	0	D	Case series	Unknown	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number Ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
Vic.	Feb	Commercial caterer	Norovirus	27	0	0	D	Case series	Suspected sandwiches	Not attributed	Person to food to person
Vic.	Feb	Aged care	Unknown	10	0	0	A	Point source cohort	Vitamised food	Not attributed	Unknown
Vic.	Feb	Aged care	Unknown	5	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Mar	Restaurant	<i>Salmonella</i> Typhimurium PT170/108	13	3	0	D	Case series	Multiple foods	Not attributed	Unknown
Vic.	Mar	Unknown	<i>Campylobacter</i>	8	2	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Apr	Aged care	<i>Salmonella</i> Typhimurium PT 170/108	12	1	0	A	Point source cohort	Vitamised meals	Not attributed	Unknown
Vic.	Apr	Private residence	<i>Salmonella</i> subsp I ser 4,5,12 :- PT193	14	2	0	M	Case series	Raw egg ice-cream cake	Eggs	Cross contamination from raw ingredients
Vic.	Apr	Private residence	<i>Salmonella</i> Typhimurium PT 4	4	4	0	D	Case series	Raw egg smoothies	Eggs	Ingestion of contaminated raw products
Vic.	Apr	Restaurant	Norovirus	27	0	0	D	Case series	Multiple foods	Not attributed	Food handler contamination
Vic.	May	School	Histamine Fish Poisoning	4	0	0	D	Case series	Tuna	Fish	Toxic substance or part of tissue
Vic.	Jun	Restaurant	<i>Salmonella</i> Newport	10	0	0	D	Case series	Kebabs	Not attributed	Unknown
Vic.	Jul	Private Residence	<i>Salmonella</i> Typhimurium PT135a	7	0	0	D	Case series	Chocolate Mousse containing raw eggs	Eggs	Ingestion of contaminated raw products
Vic.	Aug	Restaurant	Unknown	5	0	0	D	Case series	Unknown	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number Ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
Vic.	Aug	Unknown	Unknown	2	1	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Sep	Restaurant	Norovirus	43	0	0	D	Point source cohort	Unknown	Not attributed	Unknown
Vic.	Oct	Restaurant	Norovirus	17	1	0	D	Case series	Salads prepared by an ill food handler	Not attributed	Person to food to person
Vic.	Oct	Private Residence	<i>Salmonella</i> Typhimurium PT 12a	12	1	0	D	Case series	Noodles with chicken and egg	Not attributed	Unknown
Vic.	Nov	Private Residence	Norovirus	10	0	0	A	Case control study	Cake	Not attributed	Person to food to person
Vic.	Nov	Private Residence	<i>Salmonella</i> Typhimurium PT 135a	5	1	0	D	Case series	Suspected chocolate mousse with raw eggs	Eggs	Ingestion of contaminated raw products
Vic.	Nov	Restaurant	Norovirus	13	0	0	D	Case series	Multiple foods contaminated by infectious food handler/s	Not attributed	Person to food to person
Vic.	Dec	Restaurant	Norovirus	32	1	0	D	Case series	Suspected salad	Not attributed	Unknown
Vic.	Dec	Restaurant	Norovirus	35	0	0	D	Case control study	Unknown	Not attributed	Unknown
Vic.	Dec	Unknown	<i>Salmonella</i> Typhimurium PT 170/108	3	1	0	D	Case series	Scrambled eggs or chicken Teriyaki	Not attributed	Unknown
Vic.	Dec	Private Residence	<i>Salmonella</i> Typhimurium PT 170/108	3	3	0	D	Case series	Raw egg drink	Eggs	Ingestion of contaminated raw products
Vic.	Dec	Aged care	Unknown	10	0	0	D	Case series	Unknown	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
WA	Jan	Community	<i>Salmonella</i> Typhimurium PT 135a, PFGE 039	131	34	0	M	Case series	Chicken meat	Poultry	Ingestion of contaminated raw products and cross contamination from raw ingredients
WA	Feb	Commercial caterer	Unknown	21	0	0	A	Case control study	Grapes and caramel slice	Not attributed	Person to food to person
WA	Feb	Take-away	<i>Salmonella</i> Anatum	4	0	0	M	Case series	Multiple salads	Leafy greens	Ingestion of contaminated raw products and inadequate cleaning of equipment
WA	Mar	Aged care	Unknown	9	0	0	D	Case series	Unknown	Not attributed	Unknown
WA	Apr	Restaurant	<i>Salmonella</i> Typhimurium PT 135a, PFGE 0436	4	1	0	D	Case series	Unknown	Not attributed	Unknown
WA	May	Restaurant	<i>Campylobacter</i>	4	0	0	D	No formal study	Suspected chicken liver pate	Poultry	Ingestion of contaminated raw products
WA	Sep	Bakery	Norovirus	4	1	0	D	Case series	Multiple foods	Not attributed	Unknown
WA	Sep	Camp	Unknown	10	0	0	D	Case series	Unknown	Not attributed	Unknown
WA	Oct	Restaurant	Unknown	9	0	0	A	Point source cohort	Pork belly main meal	Pork	Unknown
WA	Nov	Restaurant	Norovirus	13	0	0	A	Point source cohort	Pickled octopus, prawns, asparagus	Not attributed	Person to food to person
WA	Dec	Commercial caterer	Unknown	9	0	0	A	Case control study	Unknown	Not attributed	Unknown

State or territory	Month	Setting prepared	Agent responsible	Number Ill	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
WA	Dec	Bakery	Unknown	7	0	0	D	Case series	Assorted sandwiches/rolls	Not attributed	Unknown
NSW/ Vic.	Jul	Commercially manufactured	<i>Listeria monocytogenes</i> ST 1/2a,3a, BT 58, PFGE 18A:17A:10	3	3	1	A	Case control study	Suspected smoked salmon	Not attributed	Unknown

Key

* Note this MJOI continues into 2013 (numbers reported are up to end of Dec 2012)

^{PT} Phage Type

^{PFGE} Pulse field gel electrophoresis

^{MILVA} Multi-locus variable number tandem repeat analysis

Evidence

^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