Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2011

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 2011. OzFoodNet sites reported 30,957 notifications of 9 diseases or conditions that may be transmitted by food. The most commonly notified infections were *Campylobacter* (17,733 notifications) followed by *Salmonella* (12,271 notifications). The most frequently notified *Salmonella* serotype was *Salmonella* Typhimurium, accounting for 48% of all *Salmonella* notifications. OzFoodNet sites also reported 1,719 outbreaks of gastrointestinal illness affecting 29,839 people and resulting in 872 people being hospitalised and 103 associated deaths. The majority of outbreaks (79% 1,352/1,719) were due to person-to-person transmission, 9% (151/1,719) were suspected or confirmed to be foodborne, 11% (192/1,719) were due to an unknown mode of transmission, 19 were due to community based *Salmonella* clusters, four were due to waterborne or suspected waterborne transmission and 1 outbreak was due to animal-to-person transmission. Foodborne and suspected foodborne outbreaks affected 2,104 persons and included 231 hospitalisations. There were 5 deaths reported during these outbreaks. *Salmonella* was the most common aetiological agent identified in foodborne outbreaks and restaurants were the most frequently reported food preparation setting. A single food source of infection was identified for 49 outbreaks, 26 of which were associated with the consumption of dishes containing raw or minimally cooked eggs and all of these outbreaks were due to *S.* Typhimurium. These data assist agencies to document sources of foodborne disease, develop food safety policies, and prevent foodborne illness. *Commun Dis Intell* 2015;39(2):E236–E264.

Introduction

In Australia, an estimated 4.1 million domestically acquired cases of foodborne gastroenteritis occur annually, costing an estimated $1.2 billion per year.[1–3] 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 public health interventions.[5–7]

Most foodborne diseases manifest as mild self-limiting gastroenteritis, with around 28% of affected people 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.[8–10]

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 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 collect summary data on notified outbreaks of foodborne diseases, providing robust information on the contaminated foods that are 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.[11] OzFoodNet aggregates and analyses national-level information on the incidence of diseases caused by pathogens commonly transmitted by food, as well as investigating foodborne disease outbreaks. The OzFoodNet network in 2011 included foodborne disease epidemiologists from each state and territory health department and collaborators from the Public Health Laboratory Network (PHLN), Food Standards Australia New Zealand

(FSANZ), the then Department of Agriculture, Fisheries and Forestry, and the National Centre for Epidemiology and Population Health at the Australian National University. OzFoodNet is a member of the Communicable Diseases Network Australia (CDNA), which is Australia's peak body for communicable disease control.[12] This is the 11th annual report for the OzFoodNet network and summarises the 2011 surveillance data including a comparison with data from previous years.

Methods

Population under surveillance

In 2011, the OzFoodNet network covered the whole of the Australian population, which was estimated to be 22,618,294 persons as at 30 June 2011.[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 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*.[15] For this 2011 report, OzFoodNet aggregated and analysed data from NNDSS and enhanced surveillance data from OzFoodNet sites on the following 9 diseases or conditions:

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

There may be differences when comparing OzFoodNet enhanced data state totals and NNDSS derived notifications. This is due to continual adjustments to NNDSS data made by states and territories after the date of data extraction, to improve data quality. Also, some jurisdictions report by notification date rather than onset date. Data for this report were extracted from NNDSS in May 2012 and were analysed by the date of diagnosis within the reporting period 1 January to 31 December 2011. 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 2011 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 detailed information regarding the characterisation of *Listeria monocytogenes* isolates by molecular subtyping methods, food histories and exposure data on all notified listeriosis cases in Australia since 2010. 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 using 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 database using NetEpi Case Manager, 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 that may be transmitted by food. Information on travel status was collected for cases of *Salmonella* Enteritidis infection, hepatitis A, shigellosis, paratyphoid, and typhoid. Locally-acquired infection includes people acquiring their infection in Australia from overseas-acquired cases, from unknown sources of infection, and possible false positives where no clinically compatible illness was reported.

To examine the quality of surveillance data collected across Australia, OzFoodNet sites provided data on the completeness of notifications data for *Salmonella* regarding serotype and phage type. Data from Western Australia, New South Wales, and the Australian Capital Territory were excluded from the analysis of phage type completeness, as

pulsed-field gel electrophoresis (PFGE) is predominantly used for typing *S.* Typhimurium in Western Australia, multiple-locus variable number tandem repeat analysis (MLVA) is predominantly used in New South Wales and the Australian Capital Territory employs either phage typing or MLVA depending on to which reference laboratory the specimen is sent. To assess completeness, data were analysed using the date a notification was received by a health department.

Outbreaks of gastrointestinal disease including foodborne disease outbreaks

OzFoodNet sites collected summary information on gastrointestinal disease outbreaks that occurred in Australia during 2011, including those transmitted via the ingestion of contaminated food (foodborne outbreaks). A foodborne outbreak was 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 was defined as an incident where two 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, including outbreaks where food-to-person-to-food transmission occurred. A cluster was defined as an increase in infections that were epidemiologically related in time, place or person where there is no common setting and investigators were unable to implicate a vehicle or determine a mode of transmission.

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

Data analysis

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

Results

Rates of notified enteric infections

In 2011, OzFoodNet sites reported 30,957 notifications of 9 diseases or conditions that may be transmitted by food (Table 1), which was a 15% increase compared with the mean of 26,953 notifications per year for the previous 5 years (2006–2010).

Salmonella infections

In 2011, Australian jurisdictions reported 12,271 notifications of *Salmonella* infection, at a rate of 54.3 cases per 100,000 population. This is a 23% increase compared with the mean rate for the previous 5 years (44.1 cases per 100,000) (Table 1) and 1% higher than for 2010 (53.7 cases per 100,000) (Figure 1). Salmonellosis rates in 2011 were lower in the Northern Territory, Tasmania and the Australian Capital Territory compared with the 5-year mean (Table 1). The remaining jurisdictions had higher rates compared with the 5-year mean, with South Australia having the largest percentage increase (48%), followed by Victoria (47%) and New South Wales (26%). Notification rates ranged from 38.2 cases per 100,000 in Tasmania to 174.5 cases per 100,000 in the Northern Territory, which usually has the highest rate of salmonellosis (Table 1). Most cases of salmonellosis in the Northern Territory are thought to be due to infection from environmental sources.[19]

In 2011, 51% of notified cases were females. The highest notification rates were in children aged 0–4 years for both males and females (228.1 and 194.7 cases per 100,000 respectively) with the next highest rates in the 5–9 years age group for both sexes (68.7 and 64.9 cases per 100,000 respectively) (Figure 2).

Salmonella *serotyping and phage typing*

In 2011, *Salmonella* serotype information was available for 98.6% of all notified cases. Nationally during 2011, the most commonly notified *Salmonella* serotype was *S.* Typhimurium, which was responsible for approximately 48% (5,940/12,271) of all notified infections (Table 2). Rates of *S.* Typhimurium notifications in 2011 increased by 50% compared with the 5-year mean (2006–2010). *S.* Enteritidis, *S.* Virchow and *S.* Paratyphi B biovar Java also had large percentage increases compared with the 5-year mean (Table 2).

Phage typing was conducted for 99% of *S.* Typhimurium isolates from South Australia, Victoria, Tasmania, Queensland and the Northern Territory. The top 5 most common phage types

Table 1: Number of notified cases, crude rate and 5-year mean (2006–2010) rate per 100,000 population of diseases or infections commonly transmitted by food, Australia, 2011, by disease and state or territory

Disease or infection		State or territory								
		ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aust.
Botulism	Notified cases, 2011	0	2	0	0	0	0	0	0	2
*Campylobacter**	Notified cases, 2011	497	NN	157	5,139	2,119	862	6,783	2,176	17,733
	Crude rate, 2011	135.9	NN	68.2	112.2	127.9	168.8	120.7	92.6	115.8
	Mean rate, 2006–2010	128.4	NN	103.0	105.1	133.6	126.4	114.3	99.1	111.9
Haemolytic uraemic syndrome	Notified cases, 2011	0	4	1	1	3	0	4	0	13
	Crude rate, 2011	0.0	0.1	0.4	0.0	0.2	0.0	0.1	0.0	0.1
	Mean rate, 2006–2010	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1
Hepatitis A	Notified cases, 2011	3	57	3	25	6	4	34	12	144
	Crude rate, 2011	0.8	0.8	1.3	0.5	0.4	0.8	0.6	0.5	0.6
	Mean rate, 2006–2010	1.1	1.2	3.6	1.1	1.2	0.7	2.1	1.6	1.4
Listeria	Notified cases, 2011	1	21	1	10	6	2	22	7	70
	Crude rate, 2011	0.3	0.3	0.4	0.2	0.4	0.4	0.4	0.3	0.3
	Mean rate, 2006–2010	0.3	0.4	0.0	0.2	0.2	0.4	0.3	0.4	0.3
Salmonella	Notified cases, 2011	161	3,479	403	2,923	1,058	195	2,734	1,318	12,271
	Crude rate, 2011	44.0	47.8	174.5	64.0	63.7	38.2	48.7	56.1	54.3
	Mean rate, 2006–2010	46.9	38.1	217.2	57.9	43.1	41.1	33.2	46.3	44.1
Shiga toxin-producing *Escherichia coli*	Notified cases, 2011	5	10	1	16	49	2	9	3	95
	Crude rate, 2011	1.4	0.1	0.4	0.3	3.0	0.4	0.2	0.1	0.4
	Mean rate, 2006–2010	0.1	0.2	0.5	0.5	2.6	0.0	0.2	0.2	0.4
Shigella	Notified cases, 2011	9	131	77	63	34	2	95	84	495
	Crude rate, 2011	2.5	1.8	33.4	1.4	2.1	0.4	1.7	3.6	2.2
	Mean rate, 2006–2010	1.2	1.5	54.7	2.3	4.3	0.6	1.8	5.8	2.9
Typhoid	Notified cases, 2011	2	45	3	21	9	3	36	15	134
	Crude rate, 2011	0.5	0.6	1.3	0.5	0.5	0.6	0.6	0.6	0.6
	Mean rate, 2006–2010	0.2	0.5	0.8	0.3	0.2	0.2	0.6	0.4	0.4

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

NN Not notifiable

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

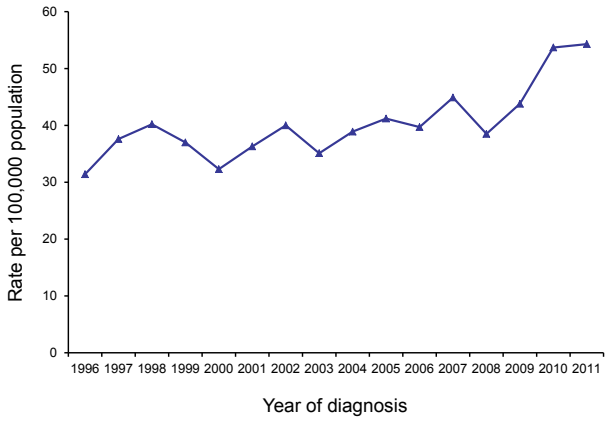


Figure 2: Notification rate for salmonellosis in Australia, 2011, by age group and sex

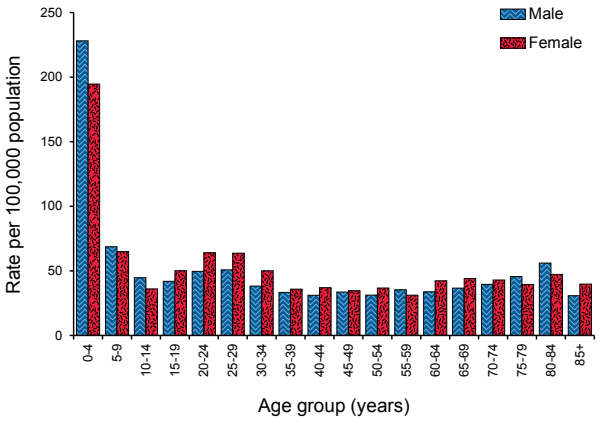


Table 2: Top 5 most common *Salmonella* serotypes, in Australia, 2011, by state or territory, compared with the 5-year mean

State or territory		*Salmonella* Typhimurium	*Salmonella* Enteritidis	*Salmonella* Virchow	*Salmonella* Saintpaul	*Salmonella* Paratyphi B biovar Java
ACT	Notified cases, 2011	116	9	3	3	3
	Mean (2006–2010)	100	9	4	3	3
	% change	16%	0%	–25%	0%	0%
NSW	Notified cases, 2011	1,977	169	160	51	72
	Mean (2006–2010)	1,415	105	77	54	60
	% change	40%	61%	108%	–6%	20%
NT	Notified cases, 2011	48	9	38	48	7
	Mean (2006–2010)	47	10	37	45	12
	% change	2%	–10%	3%	7%	–42%
Qld	Notified cases, 2011	969	116	317	215	45
	Mean (2006–2010)	611	100	273	216	36
	% change	59%	16%	16%	0%	25%
SA	Notified cases, 2011	664	59	15	14	15
	Mean (2006–2010)	383	34	15	11	11
	% change	73%	74%	0%	27%	36%
Tas.	Notified cases, 2011	58	9	5	0	4
	Mean (2006–2010)	73	6	5	3	1
	% change	–21%	50%	0%	N/A	300%
Vic.	Notified cases, 2011	1,681	160	82	38	55
	Mean (2006–2010)	1,001	94	38	34	32
	% change	68%	70%	116%	12%	72%
WA	Notified cases, 2011	427	281	15	37	60
	Mean (2006–2010)	324	169	17	48	33
	% change	32%	66%	–12%	–23%	82%
Australia	Notified cases, 2011	5,940	812	635	406	261
	Mean (2006–2010)	3,953	528	466	413	188
	% change	50%	54%	36%	–2%	39%

N/A Not available.

all had significant increases in notifications compared with the 2-year mean (2009–2010) notifications (Table 3). Phage type (PT) 60 notifications increased significantly, most of these notifications (86%) were notified in Victoria. The *S.* Typhimurium phage type that was associated with the most foodborne disease outbreaks in 2011 was PT 170/108* (n=15 outbreaks), followed by PT 9 (n=12 outbreaks), PT 135 (n=8 outbreaks) and PT 135a (3 outbreaks).

OzFoodNet also monitors the completeness of 6 serotypes that are routinely phage typed: Bovismorbificans; Enteritidis; Hadar; Heidelberg; Typhimurium; and Virchow. In 2011, phage typing was greater than 90% complete for *S.* Heidelberg and *S.* Virchow only. Across these 6 serotypes, phage type completeness declined from 86% in 2010 to 65% in 2011. This decline was predominantly attributable to the change to MLVA typing for Typhimurium in New South Wales.

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.

* Classification of this organism differs between laboratories, with the Microbiological Diagnostic Unit using PT 170 to classify this type of *S.* Typhimurium and SA Pathology using PT 108 due to a difference in the interpretation of 1 phenotypic characteristic.

Table 3: The number of notifications for the top 5 most common *Salmonella* Typhimurium phage types, Australia, 2011, compared with the average of 2009–2010*

Phage types	2011	Average 2009–2010	Ratio†
170/108§	690	518	1.3
9	689	387	1.8
135a	537	372	1.4
135	297	145	2.0
60	281	14	20.1

* Data from jurisdictions that phage type more than 90% of isolates in 2011. Excludes New South Wales, the Australian Capital Territory and Western Australia.

† Ratio of the number of cases in 2011 compared with the average of 2009 and 2010 notifications.

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

During 2011, OzFoodNet sites reported 816 cases of *S.* Enteritidis infection (Table 4) compared with 835 notifications in 2010 and 589 notifications in 2009. Travel histories were obtained for 94% (771) of cases in 2011, similar to 2010 (792/835, 95%). Of those cases in 2011 with travel history information recorded, 89% (690) had travelled overseas and 11% (81) were locally-acquired. Western Australia reported the highest number of notified cases compared with other jurisdictions in 2011. Queensland reported the largest number of locally-acquired cases.

In 2011, South East Asia (86%, 591) was the most common region of overseas acquisition for *S.* Enteritidis. Similarly to previous years, the most common overseas country of acquisition was Indonesia, (62%, 431). Thailand was the second most common overseas country of acquisition (8%, 55), followed by Malaysia (5%, 37).

Phage typing was performed for 67% (544) of the *S.* Enteritidis cases with travel history and the most common phage types among overseas-acquired cases were PT 1 (21%), 6a (13%), 13 (9%), 1b (9%) and 21 (8%). Locally-acquired cases were sporadic with no clusters detected by person, place, or time. The most common phage types among locally-acquired isolates were PT 26 (21%), 4b (17%), RDNC (9%), 1 (6%) and 6a (6%) (Table 5). In addition, PT 13, 1b and 21, which were common among overseas-acquired isolates, were less common among locally-acquired isolates accounting for 3%, 3% and 2% of phage typed isolates respectively.

Table 5: Top 5 most common phage types of locally and overseas-acquired *Salmonella Enteritidis* infections, Australia, 2011

Overseas-acquired cases			Locally-acquired cases		
Phage type	n	% of total typed (n=391)	Phage type	n	% of total typed (n=66)
1	81	21	26	14	21
6a	51	13	4b	11	17
13	36	9	RDNC	6	9
1b	35	9	1	4	6
21	32	8	6a	4	6

RDNC Reactions do not conform.

Campylobacter infections

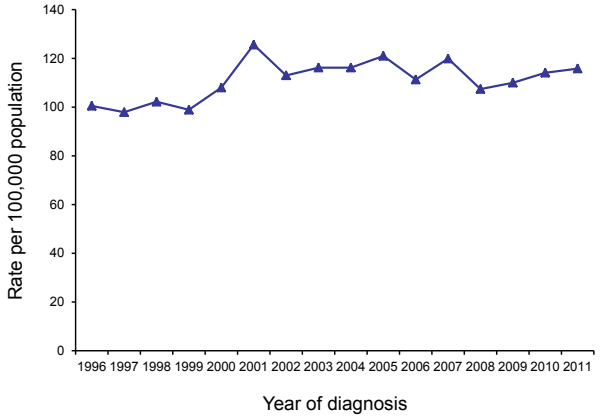
In 2011, OzFoodNet sites (excluding New South Wales where *Campylobacter* infection is not notifiable) reported 17,733 notifications of *Campylobacter* infection, the highest number of notifications recorded in the NNDSS database since records began in 1991.[14] This equates to a rate of 115.8 notifications per 100,000 population (Figure 3, Table 1). This is a 3.5% increase compared with the 5-year mean of 111.9 per 100,000. The Northern Territory

Table 4: Number of *Salmonella Enteritidis* infections, Australia, 2011, by travel history and state or territory

State or territory	Locally-acquired	Overseas-acquired	Unknown	Total
WA	17	263	1	281
NSW	23	137	8	168
Vic.	9	150	1	160
Qld	25	64	32	121
SA	2	55	2	59
NT	0	8	1	9
ACT	2	7	0	9
Tas.	3	6	0	9
Total	81	690	45	816

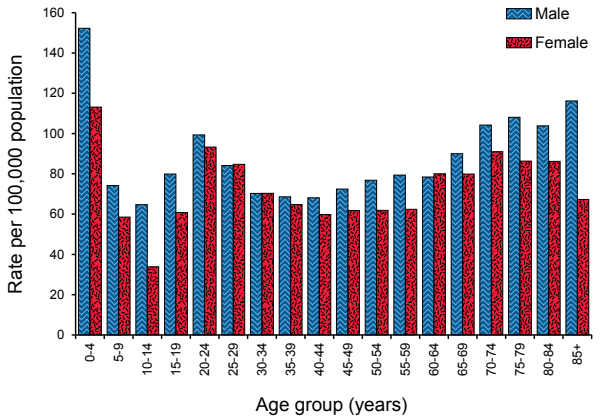
reported a rate of 68.2 cases per 100,000, 34% below the 5-year mean rate and Tasmania reported a rate of 168.8 cases per 100,000, a 34% increase above the 5-year mean (Table 1).

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



Overall, 54% of notified cases were males. Notification rates were highest in children aged 0–4 years for both males and females (152 and 113 notifications per 100,000, respectively) with additional peaks in the 20–24 years age group and in the 65s or over year age group (Figure 4).

Figure 4: Notification rate for campylobacteriosis, Australia, 2011, by age group and sex



Listeria infections

There were 70 notifications of *L. monocytogenes* infection reported in 2011 (0.3 cases per 100,000 population), consistent with the 5-year historical mean rate of 0.3 cases per 100,000 (Table 1). State and territory rates ranged from 0.2 to 0.4 cases per 100,000. Of the 70 notifications in 2011, 74% (n=52) were in people aged 60 years or more and males accounted for 59% (41) of all notifications. Four cases in 2011 were pregnant women with 1 associated neonatal case. The most commonly reported *L. monocytogenes* isolates were serotype 1/2b, 3b, 7; binary type 158 (14%, 10/70) and serotype 4b, 4d, 4e; binary type 254 (14%, 10) (Table 6). These were also the most common types in 2010.

Table 6: Top 5 most common *Listeria monocytogenes* strains, Australia, 2011, by molecular serotype and binary type

Serotype	Binary type	Number of cases
4b, 4d, 4e	254	10
1/2b, 3b, 7	158	10
4b, 4d, 4e	190	9
1/2a, 3a	131	6
1/2a, 3a	155	6

Source: OzFoodNet National Enhanced Listeriosis Surveillance System.

No multi-jurisdictional clusters or outbreaks of listeriosis were detected in 2011. Six cases sharing an identical molecular serotype, binary type, multilocus sequence typing profile but slightly different PFGE types were detected in Victoria. Interviews did not detect any common exposures.

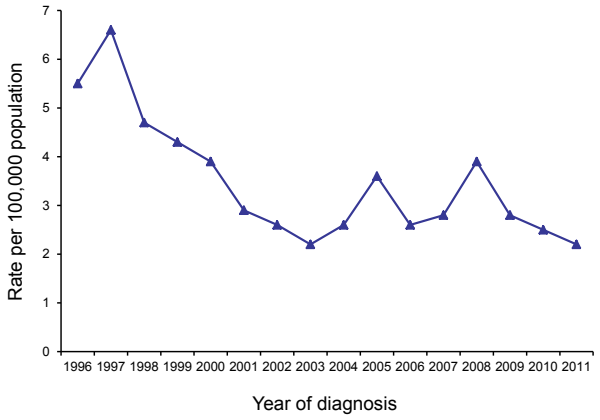
Shigella infections

There were 495 notifications of *Shigella* infection in Australia in 2011, a rate of 2.2 notifications per 100,000 population compared with the 5-year historical mean rate of 2.9 per 100,000 (Figure 5, Table 1). In 2011, compared with the 5-year mean there was a decline (ranging from 6%–51%) in rates of *Shigella* infection for all states and territories apart from New South Wales and the Australian Capital Territory. As in previous years, the highest notification rate was in the Northern Territory, with 33.4 per 100,000 followed by Western Australia with a rate of 3.6 per 100,000.

In 2011, notification rates for shigellosis were highest in males and females aged 0–4 years, with 6.4 and 7.5 notifications per 100,000 population respectively (Figure 6). The overall rate for males was 2.4 per 100,000 in 2011 compared with the female rate of 2.0 per 100,000. Indigenous status was recorded for 87% (432) of shigellosis cases. Of these, 32% (137) identified as Aboriginal and/or Torres Strait Islander people. The Northern Territory and Western Australia reported the most

cases of shigellosis in people who identified as Aboriginal and/or Torres Strait Islander, (49%, 67) and (28%, 39) respectively.

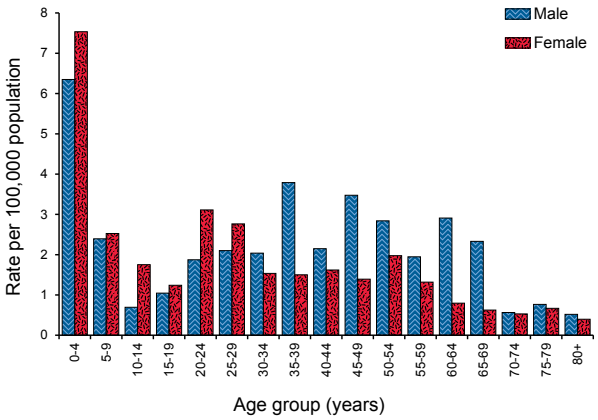
Figure 5: Notification rate for shigellosis, Australia, by year of diagnosis



Travel history information was available for 69% (342/495) of shigellosis notifications in 2011 and of these, 46% (158) acquired their illness overseas. The most common overseas country of acquisition was Indonesia (31%, 49).

Nearly all *Shigella* isolates were typed (98%, 483) and *Sh. sonnei* was the most frequent species notified (71%, 344), followed by *Sh. flexneri* (27%, 130). There were also 7 notifications of *Sh. boydii* and 2 notifications of *Sh. dysenteriae*. *Sh. sonnei* biotype a was the most frequently notified biotype in 2011 (33.1%, 164), 41% higher than the total for 2010 (Table 7).

Figure 6: Notification rate for shigellosis, Australia, 2011, by age and sex



Typhoid

In 2011, there were 134 notifications of *S.* Typhi infection (typhoid) in Australia, a rate of 0.6 notifications per 100,000 population and a 50% increase above the 5-year historical mean rate (2006–2010) of 0.4 per 100,000 (Table 1). Most cases were notified in New South Wales (n=45) and Victoria (n=36). In 2011, 60% (81) of cases were male. Travel history was known for 99% (132) of cases, with 96% (127) of these infections likely to have been acquired overseas. For the remaining 5 cases, four had spent time in a typhoid endemic country from between 8 and 18 months prior to the onset of their illness. The maximum incubation period of typhoid is up to 60 days, thus these cases may be detections of chronic infections. The 5th case was believed to have contracted their infection from a known typhoid case.

Table 7: Number, percentage and ratio of the top 10 *Shigella* infections, Australia, 2010 to 2011

Biotype	2010 n	2010 %*	2011 n	2011 %†	Ratio‡
Shigella sonnei biotype a	116	21.0	164	33.1	1.4
Shigella sonnei biotype g	191	34.6	139	28.1	0.7
Shigella sonnei untyped	32	5.8	34	6.9	1.1
Shigella flexneri 2a	36	6.5	27	5.5	0.8
Shigella flexneri 4a	38	6.9	18	3.6	0.5
Shigella flexneri 4	22	4.0	18	3.6	0.8
Shigella flexneri 3a	37	6.7	15	3.0	0.4
Shigella flexneri 2b	18	3.3	12	2.4	0.7
Shigella untyped	6	1.1	12	2.4	2.0
Shigella flexneri untyped	13	2.4	10	2.0	0.8

* Proportion of total shigellosis notified in 2010.

† Proportion of total shigellosis notified in 2011.

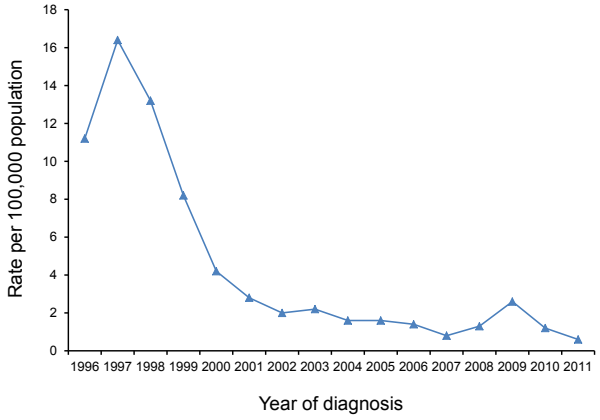
‡ Ratio of the number of cases in 2011 compared with the number in 2010.

Most overseas-acquired cases of typhoid in 2011 had travelled to India (58%, 74) and Indonesia (9%, 12). The most commonly notified phage type was E1 and these infections were mostly acquired in India. Three of the 5 cases without a history of overseas travel were also PT E1 (Table 8).

Hepatitis A

In 2011, there were 144 hepatitis A notifications with a rate of 0.6 notifications per 100,000 population, the lowest total number of notifications and annual rate recorded in the NNDSS database since records began in 1991,[14] and 57% below the 5-year historical mean rate of 1.4 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 2011, noting an increase in 2009 due to la arge multi-jurisdictional outbreak associated with the consumption of semi-dried tomatoes[22,23] (Figure 7). The median age of cases in 2011 was 29 years (range 2–90 years) with 59% being male (85).

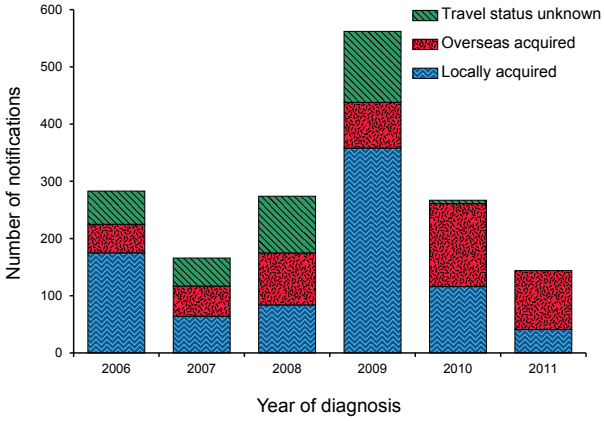
Figure 7: Notification rate for hepatitis A infections, Australia, by year of diagnosis



Indigenous status was known for 93% (134) of hepatitis A cases in 2011. Two cases were identified as Aboriginal and/or Torres Strait Islander people (1%), compared with one in 2010.

In 2011, 72% (103/144) of hepatitis A infections were acquired overseas (Figure 8). Regions of acquisition included South Asia (34%, 35), South East Asia (25%, 26) and Africa (15%, 15). In 2011, 28% (41) of hepatitis A cases were locally-acquired, the lowest number and proportion since supplementary surveillance began in 2006.

Figure 8: Place of acquisition for hepatitis A cases in Australia, by year of diagnosis



Shiga toxin-producing *Escherichia coli* infection

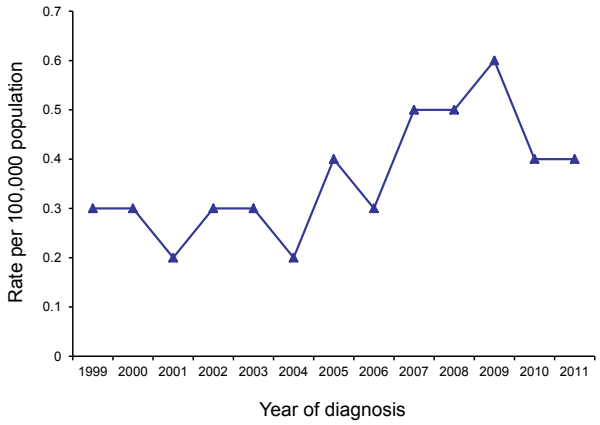
In 2011, there were 95 notifications of STEC infection in Australia; a rate of 0.4 notifications per 100,000 population, equivalent to the 5-year mean rate (Table 1) and the rate from 2010 (Figure 9). Seven of these cases were also diagnosed with HUS. Under the Australian national notifiable disease surveillance case definitions, (http://www.health.gov.au/casedefinitions), these conditions are

Table 8: Notifications of *Salmonella Typhi* infection, Australia, 2011, by phage type and country of acquisition

Phage type	Australia	Bangladesh	India	Indonesia	Other countries	Unknown	Total
E1	3	1	21	0	5	0	30
E9	0	3	16	0	4	0	23
A	1	0	3	2	2	0	8
D2	0	0	0	2	1	0	3
Other types	0	0	5	0	4	1	10
Untypable	0	4	4	1	3	1	13
Unknown	1	3	25	7	11	0	47
Total	5	11	74	12	30	2	134

notified separately. In 2011, 58% (55) of cases were male. The median age of cases was 26 years (range <1–85 years).

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



* Shiga toxin-producing *Escherichia coli* became nationally notifiable in Australia in 1999.

Notified cases of STEC infection are strongly influenced by jurisdictional practices regarding the screening of stool specimens.[24] 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 2011, South Australia had the highest rate of notifications with 3 cases per 100,000 population (n=49) followed by the Australian Capital Territory with 1.4 cases per 100,000 (n=5). The increase in the notification rate for the Australian Capital Territory relates to the commencement of an STEC screening study in October 2011 based in a local laboratory.

In 2011, serogroup information was available for 61% of STEC cases (58/95). The most common serogroups identified were: O157 (38%, 22); O111 (17%, 10); O26 (12%, 7); and O128 (7%, 4). Serotype information was obtained by serotyping cultured isolates or by PCR targeting serotype-specific genes. The remaining 37 isolates either could not be serotyped or were Shiga toxin positive by PCR only. In 2010, O157 accounted for 59% (30/51) and O111 10% (5/51) of serogrouped specimens.

Haemolytic uraemic syndrome

In 2011, OzFoodNet sites reported 13 cases of HUS with a rate of 0.1 cases per 100,000, equating with the 5-year historical mean rate (Table 1). There were 7 male and 6 female cases and the median age was 30 years (range <1 to 84 years). In contrast to previous years, the majority of cases were in adults with only 3 cases in children aged 0–4 years and 2 cases in children aged 5–10 years.

Not all diagnoses of HUS are related to enteric pathogens (including those potentially transmitted by food). In 2011, 54% of HUS cases (7) were positive for STEC with serotypes O157 (n=1), O111 (n=1) and O41:H4 (n=1) detected in 3 cases. The remaining 4 cases were Shiga toxin positive but the isolates were unable to be serotyped.

Botulism

Four forms of naturally occurring botulism are recognised; adult, infant (intestinal), foodborne and wound.[25] 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.

There were 2 cases of intestinal botulism reported in 2011, affecting 1 male infant and one female infant. Both cases were diagnosed in New South Wales and both were due to botulinum toxin A but the cases were not clustered in time or place and no source was identified. There were no notifications in 2010 and 1 case reported in 2009.[23]

Outbreaks of gastrointestinal illness

In 2011, OzFoodNet sites reported 1,719 outbreaks of gastrointestinal illness (including foodborne disease), affecting 29,839 people, of whom 872 were hospitalised (Table 9). There were 103 deaths during these outbreaks. This compares with a 5-year mean (2006–2010) of 1,686 outbreaks.

Outbreaks spread person-to-person

In 2011, 79% of all reported gastrointestinal outbreaks were transmitted from person-to-person (1,352). These outbreaks affected 25,432 people, 537 people were hospitalised and 95 deaths were reported during these outbreaks (Table 9). Aged care facilities (53%, 720) were the most frequently reported setting for person-to-person outbreaks, followed by hospitals (15%, 204). Outbreaks were most commonly due to norovirus (43%, 575) or a suspected viral agent (34%, 458), with 227 of unknown aetiology (17%).

Outbreaks spread animal-to-person

One outbreak was reported to have been transmitted from animal-to-person. The aetiological agent was

Table 9: Outbreaks of gastrointestinal illness reported to state and territory health departments, Australia, 2011

Transmission mode	Number of outbreaks	Number of ill	Number hospitalised	Number died
Foodborne and suspected foodborne	151	2,104	231	5
Person-to-person	1,352	25,432	537	95
Animal-to-person	1	10	4	0
Waterborne or suspected waterborne	4	100	5	0
Unknown	211	2,193	95	3
Total	1,719	29,839	872	103

identified as STEC. The outbreak affected 10 people, with four being hospitalised including 2 cases of HUS, following contact with animals at a petting zoo at an agriculture show in South Australia (Table 9). The aetiological agent for seven of the cases was identified as STEC O111 and for one of the cases identified as STEC O157. STEC isolates from the remaining 2 cases were unable to be serotyped. STEC O111 was detected in environmental samples collected from the two areas of the petting zoo believed to be the source of the infection.

Waterborne outbreaks

There were 4 outbreaks reported to be waterborne or suspected to be waterborne. These outbreaks affected 100 people, with 5 people hospitalised (Table 9). Each outbreak was attributed to a different aetiological agent: *Giardia*, *S.* Typhimurium, *Campylobacter* and *Cryptosporidium*. The source of infection was not confirmed for these outbreaks but was suspected to be the rural community water supply for the first 2 outbreaks (bore water and reticulated supply respectively), a private supply (rainwater tank) and several public swimming pools were implicated in the final outbreak.

Outbreaks with unknown mode of transmission

There were 211 outbreaks in which cases were clustered in time, place or person, but investigators were unable to develop an adequate hypothesis for the mode of transmission. These outbreaks affected 2,193 people, 95 of whom were hospitalised. There were 3 deaths reported during these outbreaks. Aged care facilities were the most frequently reported settings for these outbreaks (51%, 107), followed by child care facilities (13%, 27) and the community (9%, 20). In 176 (83%) of these outbreaks, both the aetiological agent and transmission mode remained unknown. In 12 (6%) outbreaks the aetiological agent was identified as *S.* Typhimurium and in 6 (3%) outbreaks the agent was norovirus.

Foodborne and suspected foodborne outbreaks

In 2011, OzFoodNet sites reported 151 outbreaks of foodborne and suspected foodborne illness. These outbreaks affected 2,104 people, with 231 hospitalised. Five people were reported to have died during these outbreaks (Table 9). This compares with a 5-year mean (2006–2010) of 137 outbreaks. The overall rate of foodborne disease outbreaks in 2011 was 6.7 outbreaks per million population (Table 10). The highest rates were in the Northern Territory (30.4 outbreaks per million) and the Australian Capital Territory (13.7 outbreaks per million), although these jurisdictions reported only 7 and 5 outbreaks respectively. The largest number of outbreaks (55) was reported by Victoria.

Aetiologies

More than a third of all foodborne and suspected foodborne outbreaks (37%, 56/151) were due to *S.* Typhimurium (Table 11). Other frequently reported pathogens were *Clostridium perfringens* (11%, 16) and *Campylobacter* (6%, 9). There were 47 outbreaks of unknown aetiology (31%), which was similar to 2010 (36%, 55/154).

Food vehicles

Outbreaks were categorised as being attributable to one of 18 food commodities (17 as described by Painter et al[26] with an additional category for lamb) if a single contaminated ingredient was identified or if all ingredients belonged to that food category. Outbreaks that could not be assigned to one of the 18 categories, or for which the report contained insufficient information for food category assignment, were not attributed to any food category.[27]

In 49 foodborne and suspected foodborne outbreaks (32%), investigators attributed the outbreak to a single food commodity, in another 35 outbreaks (23%), the implicated dish contained a mix of ingredients, and no single ingredient was impli-

Table 10: Outbreaks of foodborne and suspected foodborne disease, Australia, 2011 by OzFoodNet site

State or territory	Number of outbreaks	Number ill	Mean size (persons)	Number hospitalised	Outbreak rate per million population
ACT	5	70	14.0	8	13.7
NSW	45	694	15.4	50	6.2
NT	7	28	4.0	2	30.4
Qld	18	227	12.6	37	3.9
SA	10	148	14.8	34	6.0
Tas.	1	5	5.0	0	2.0
Vic.	55	692	12.6	74	9.8
WA	9	224	24.9	23	3.8
Multi-jurisdictional	1	16	16.0	3	N/A
Total	151	2,104	13.9	231	6.7

N/A Not applicable.

Table 11: Number of reported foodborne disease outbreaks and of people number affected, Australia, 2011, 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
Bacillus cereus	1	12	0	0	1	12	0	0
Campylobacter	9	118	3	80	0	0	6	38
Ciguatera fish poisoning	5	17	5	17	0	0	0	0
Clostridium perfringens	16	207	2	58	1	3	13	146
Norovirus	7	216	1	15	2	47	4	154
Salmonella Typhimurium	56	815	30	500	11	126	15	189
Other *Salmonella* serotypes	5	102	3	60	1	37	1	5
Histamine fish poisoning	2	6	2	6	0	0	0	0
Staphylococcus aureus	2	66	0	0	2	66	0	0
Suspected viral	1	3	0	0	0	0	1	3
Unknown	47	542	3	16	17	121	27	405
Total	151	2,104	49	752	35	412	67	940

cated. The majority of outbreaks (44%, 67/151) could not be definitively attributed to a particular food or foods due to a lack of evidence (Table 11).

Of the outbreaks attributed to a single food (n=49), the foods most frequently implicated were eggs (53%, 26), poultry (16%, 8) and fish (16%, 8). From these outbreaks, 752 people were affected, 108 people were hospitalised and 1 person was reported to have died (Table 12).

There were 84 outbreaks with a known food vehicle or vehicles and of these more than one-third (35%, 29) were suspected or confirmed to have been associated with the consumption of eggs and egg-based dishes (Table 13). These egg-associated outbreaks comprised 19% (29/151) of all foodborne outbreaks, just under half (48%, 29/61) of all foodborne *Salmonella* outbreaks, and more than half (59%, 29/49) of the outbreaks that were attributed to a single commodity. In these egg-associated outbreaks, eggs were served in desserts (12 outbreaks), in sauces and dressings such as Caesar salad dressing and mayonnaise (11 outbreaks), in pastries (1 outbreak), in raw dough or batter (3 outbreaks), as a component of meals that were suspected to be undercooked (2 outbreaks), as a binding ingredient of prawn dumplings (1 outbreak) and added to soup

after cooking (1 outbreak). One outbreak occurred in multiple settings and in multiple foods all microbiologically linked to eggs from a single supplier.

Settings

In 2011, foods implicated in foodborne and suspected foodborne outbreaks were most commonly prepared in restaurants (33%, 50/151), in aged care facilities (15%, 22), or private residences (12%, 18) (Table 14). This represents an absolute and proportional decrease from 2010 levels for both restaurants (39%, 60/154)[33] and aged care facilities (21%, 33/154). However, private residences demonstrated an absolute and proportional increase from 2010 (9%, 14/154).

Investigative methods and levels of evidence

To investigate foodborne outbreaks, epidemiologists in the states and territories conducted 28 cohort studies and 6 case-control studies. Descriptive case series investigations were conducted for 97 outbreaks. In 20 outbreaks, no formal study was conducted (Appendix).

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 8 outbreaks. Investigators relied on analytical evidence alone for 10 outbreaks and microbiological (or toxicological for non-microbial outbreaks) evidence alone for 16 outbreaks. These confirmed foodborne outbreaks comprised 23% (34/151) of all foodborne outbreaks (Appendix).

Contributing factors

Investigators collect information about factors that are likely to have contributed to a foodborne outbreak occurring. Contamination factors are those contributing factors that led to the food becoming contaminated or to contaminated products being consumed. Contamination factors for the 34 confirmed foodborne outbreaks were most commonly stated to have been unknown (53%, 18) (Table 15). The contamination factors for the remaining confirmed outbreaks were based on measured evidence (15%, 5), verbal confirmation during inspections (6%, 2), postulated based on detection of the aetiological agent in a food vehicle (9%, 3), or investigator suspicion (18%, 6). Contamination factors varied by the aetiology of outbreaks. In the 2 *Staphylococcus aureus* outbreaks, investigators reported that person-to-food-to-person contamination and unknown contamination were involved, respectively. In the 2 *Campylobacter* outbreaks, ingestion of raw products and unknown contamination were involved, respectively. Of the 16 *S.* Typhimurium outbreaks, ingestion of raw products (8), unknown contamination (4), a combination of ingestion of contaminated raw products and cross contamination from raw ingredients (2), cross-contamination from raw ingredients (1) and inadequate cleaning of equipment (1) were reported.

Significant foodborne and suspected foodborne outbreaks

In 2011, OzFoodNet sites responded to 151 foodborne or suspected foodborne outbreaks (including a multi-jurisdictional *S.* Typhimurium PT 135a outbreak). There were 12 outbreaks that each affected more than 40 people. Five outbreaks were due to *S.* Typhimurium, two were due to norovirus and one each was due to a *Campylobacter*/*S.* Singapore mixed infection, *Cl. perfringens* and *S.* Singapore and 2 outbreaks were of unknown aetiology. These outbreaks affected at least 752 people of whom 81 were hospitalised. There were no reported deaths.

An outbreak of *S.* Typhimurium PT 44 with MLVA profile 03-10-08-09-523 was investigated in New South Wales in January following an increase in hospital emergency department presentations with gastrointestinal symptoms. Case data were suggestive of a point source of infection from pork/

Table 12: Foodborne disease outbreaks attributed to a single food vehicle, Australia, 2011

Food commodities (Painter et al)	Number of outbreaks	Number affected	Number hospitalised	Number of fatalities
Eggs	26	471	88	1
Poultry	8	159	7	0
Fish	8	27	7	0
Beef	2	58	0	0
Fruits-nuts	2	20	0	0
Pork	2	9	2	0
Grains-beans	1	8	4	0
Total	49	752	108	1

Table 13: Outbreaks of foodborne illness associated with egg-based dishes, Australia, 2011 (n=29)

State or territory	Setting prepared	Agent responsible	Number affected	Evidence	Responsible vehicles
ACT	Bakery	*S.* Typhimurium PT 170/108*, MLVA 03-09-07-14-523†	41	M	Chicken Caesar salad roll containing raw egg mayonnaise
NSW	Private residence	*S.* Typhimurium MLVA 03-13-12-10-523	3	D	Homemade hollandaise sauce and semifreddo
	Restaurant	*S.* Typhimurium MLVA 03-11-11-10-523	10	D	Dessert containing raw egg custard
	Restaurant	*S.* Typhimurium PT 3, MLVA 03-13-14-09/10-523	11	M	Caesar salad dressing containing raw egg
	Restaurant	*S.* Typhimurium MLVA 03-09-08-14-523	13	D	Tiramisu containing raw egg
	Restaurant	*S.* Typhimurium MLVA 03-10-08-09-523	8	AM	Chicken and corn soup containing raw egg
	Restaurant	*S.* Typhimurium PT 135, MLVA 03-13-11-09-523	4	D	Prawn dumplings containing raw egg
	Restaurant	*S.* Typhimurium PT 170/108, MLVA 03-09-07-14-523	6	M	Fried ice cream
	Restaurant	*S.* Typhimurium MLVA 03-09-07-13-523	6	D	Raw egg dressing
	Restaurant	*S.* Typhimurium MLVA 03-09-07-15-523	3	D	Raw egg mayonnaise
	Takeaway	*S.* Typhimurium PT 44, MLVA 03-10-08-09-523	85	M	Vietnamese pork, chicken and salad rolls containing raw egg butter
Qld	Multiple settings	*S.* Typhimurium PT 135a, MLVA 03-14-11-11-524	49	M	Multiple foods made with eggs from a single supplier
SA	Bakery	*S.* Typhimurium PT 135	6	M	Pies glazed with raw egg
Vic.	Private residence	*S.* Typhimurium PT 135	4	A	Raw pasta dough
	Private residence	*S.* Typhimurium PT 135a	9	D	Potato salad containing raw egg mayonnaise
	Private residence	*S.* Typhimurium PT 141	2	D	Chocolate mousse containing raw egg
	Private residence	*S.* Typhimurium PT 170/108	2	M	Raw pancake batter
	Private residence	*S.* Typhimurium PT 170/108	2	D	Raw muffin batter
	Private residence	*S.* Typhimurium PT 44	12	D	Tiramisu containing raw egg
	Private residence	*S.* Typhimurium PT 9	4	D	Chocolate mousse containing raw egg
	Private residence	*S.* Typhimurium PT 44	5	D	Tiramisu containing raw egg
	Private residence	*S.* Typhimurium PT 9	7	D	Chocolate mousse containing raw egg
	Restaurant	*S.* Typhimurium PT 170/108	14	D	Chocolate mousse containing raw egg
	Restaurant	*S.* Typhimurium PT 170/108	15	AM	Fried ice cream
	Takeaway	*S.* Typhimurium PT 170/108	15	D	Vietnamese mixed dish including egg
	Takeaway	*S.* Typhimurium PT 170/108	26	D	Sushi containing raw egg mayonnaise
	Takeaway	*S.* Typhimurium PT 170/108	37	M	Pizza with egg and chocolate mousse containing raw egg
	Takeaway	*S.* Typhimurium PT 9	84	M	Sushi containing raw egg mayonnaise
WA	Takeaway	*S.* Typhimurium PT 9	15	D	Vietnamese pork roll made with raw egg butter

D Descriptive evidence implicating the vehicle.

A Analytical epidemiological association between illness and vehicle.

M Microbiological confirmation of aetiology in vehicle and cases.

* Classification of this *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 14: Food preparation setting implicated in foodborne disease outbreaks, Australia, 2011

Setting	Number of outbreaks	Per cent of outbreaks	Number affected
Restaurant	50	33	542
Aged care facility	22	15	220
Private residence	18	12	126
Takeaway	13	9	291
Commercial caterer	13	9	388
Bakery	8	5	142
Hospital	5	3	36
Primary produce*	5	3	17
Unknown†	4	2	164
Camp	3	2	14
Grocery store/ delicatessen	2	1	55
Fair/festival/mobile service	2	1	42
Institution	2	1	13
Private caterer	1	1	17
School	1	1	17
Cruise/airline	1	1	16
National franchised fast food	1	1	4
Total	151	100	2,104

* The 5 outbreaks associated with primary produce were all ciguatera fish poisoning. The implicated fish species were Coral Trout (2 outbreaks) and Spanish Mackerel, Red Bass and an unknown reef fish were implicated in the other 3 outbreaks.

† An outbreak was assigned a setting of unknown when the implicated food was prepared in multiple settings (n=2) or not enough detail was provided to determine the setting (n=2).

Table 15: Factors reported as leading to the contamination of food vehicles in confirmed foodborne disease outbreaks, Australia, 2011, by aetiology

Agent	Contamination factor	Total
Bacillus cereus	Unknown	1
Campylobacter	Ingestion of contaminated raw products	1
	Unknown	1
Clostridium perfringens	Unknown	2
Norovirus	Unknown	2
Other *Salmonella* serotypes	Cross contamination from raw ingredients	2
	Unknown	1
Salmonella Typhimurium	Ingestion of contaminated raw products	8
	Unknown	4
	Ingestion of contaminated raw products and cross contamination from raw ingredients	2
	Cross contamination from raw ingredients	1
	Inadequate cleaning of equipment	1
Histamine fish poisoning	Unknown	1
Staphylococcus aureus	Person-to-food-to-person	1
	Unknown	1
Unknown	Unknown	5
Total		34

chicken/salad rolls with raw egg mayonnaise from a Vietnamese bakery in the area. Of 147 cases who presented to emergency departments and general practitioners, 58 were interviewed and provided information on a further 27 people who were ill. Forty-nine people submitted a stool sample and 47 were positive for *S.* Typhimurium PT 44 (MLVA profile 03-10-08-09-523). The bakery was inspected by the New South Wales Food Authority and shut down for cleaning and disinfection. Thirteen of 21 food samples including raw egg butter, pâté, chicken, pork and salad items and 5 of 11 environmental swabs were positive for *S.* Typhimurium PT 44 (MLVA profile 03-10-08-09-523). Lack of records or supplier information prevented an egg trace back.

Two outbreaks of *S.* Singapore associated with buffet functions on a cruise boat were investigated in New South Wales in February. The first was an 80th birthday party, with 45 of 57 people reporting a gastrointestinal illness. *S.* Singapore was isolated from 5 stool specimens, and *Salmonella* species detected from a 6th specimen. Roast chicken pieces (relative risk [RR] 5.7, 95% confidence intervals [CI] 0.9–35.2), silverside (RR 1.3, 95% CI 1.0–1.8) and potato salad (RR 1.6, 95% CI 1.1–2.4) were found to have an association with illness, but in a multivariate analysis only roast chicken had a statistically significant association with illness (odds ratio [OR] 26.4, 95% CI 2.9–244.4). The 2nd outbreak investigated involved a function held the previous day, with 10 of 35 attendees becoming ill (one with laboratory confirmed *S.* Singapore infection). Similar foods were served at both functions. Five of 7 food handlers were also ill with a similar illness and all 5 cases reported consuming food at both functions. The chicken for both functions was purchased pre-cooked from a supermarket and then plated and stored for use. *S.* Virchow PT 34 was isolated from a sample of chicken obtained from the supermarket; however other food samples and swabs taken from both the supermarket and the cruise owner's premises were negative for pathogens. It is suspected that the outbreak was caused through cross contamination between raw and cooked product, and temperature abuse of the cooked product.

In late January in South Australia, 2 outbreaks of *S.* Typhimurium PT 9 were investigated following a sharp increase in notifications. Through hypothesis-generating interviews, it was found that bakery products were frequently consumed food items. A case-control study identified that custard filled items from 2 different bakeries were significantly associated with illness in a multivariate analysis: custard Berliners (OR 55.9, 95% CI 11.1–282.1) and cannolis (OR 16.8, 95% CI 1.8–157.2). Bakery A made the custard Berliners eaten by 43 cases, 19 of whom were hospitalised. Samples of product, raw materials and environmental swabs collected from bakery A were all negative for *Salmonella*. Bakery B made the cannolis that were eaten by 15 cases, three of whom were hospitalised. Products, raw materials and environmental swabs were collected from bakery B and product samples tested positive for *S.* Typhimurium PT 9. Investigators were unable to identify a common link to both bakeries via staff members, ingredients, processes, distribution chains or suppliers. Several months after the point source outbreaks had ceased, sporadic cases of the MLVA profiles observed during the outbreak were still being reported from the community. Further trace-back of ingredients supplied (but not used in implicated products) to the 2 premises investigated in the January outbreaks, supplemented with information from interviews with sporadic cases, found a common supplier of eggs. An investigation conducted at the egg farm found 3 of 26 samples collected to be positive for *S.* Typhimurium PT 9.

In Victoria in February, a large outbreak of *S.* Typhimurium PT 9 associated with the consumption of sushi containing raw egg mayonnaise was detected through routine surveillance. A number of cases were notified from the same pathology service located at a metropolitan hospital and 4 patients at the same hospital, reported eating sushi from the same premises prior to becoming ill. Three further cases were found through council food poisoning complaints. A total of 8 cases of gastroenteritis, including 59 confirmed cases of *S.* Typhimurium PT 9, were found to have eaten sushi from this premises. Two of the confirmed cases were food handlers at the premises and 19 (23%) cases were hospitalised with their illness. Twenty-five of 59 food samples and 5 of 17 environmental swabs were positive for *S.* Typhimurium PT 9. The mayonnaise used in the sushi hand rolls was made using raw eggs and a sample of the mayonnaise as well as environmental swabs of the blender used to make the mayonnaise were positive for *S.* Typhimurium PT 9. The eggs were traced back to a farm but samples taken on the farm were negative.

During the 1st quarter of 2011 in Queensland, 49 cases of *S.* Typhimurium PT 135a with MLVA profile 03-14-11-11-524 were reported with 6 hospitalisations. Interviews were conducted with 34 cases via a telephone-administered structured questionnaire. A sushi outlet located in a suburban shopping precinct was associated with 7 cases, while others were associated with a restaurant (3 cases), a café (5 cases) and another sushi venue (1 case and 1 epidemiologically-linked case). The remaining cases were community-acquired and not associated with a particular venue. Investigations at each of the premises identified that all were sourcing eggs from the same farm. No other common links were identified

among the food establishments. Food preparation, handling and storage procedures in each of these premises were investigated and environmental sampling conducted. An extensive environmental audit of the implicated farm detected the outbreak strain as well as *S.* Montevideo, *S.* Anatum, *S.* Kottbus and *S.* monophasic Subsp 1. *S.* Montevideo was also detected in eggs sampled at the retail level. No *Salmonella* were detected in environmental samples taken from the sushi outlet that was epidemiologically linked to seven of the cases.

In Queensland in September a suspected foodborne outbreak affecting 38 of 115 guests who attended a catered wedding was investigated. A retrospective cohort study identified multiple foods served at the reception (fried rice, egg fu yung, chicken and mussels) were associated with an increased risk of illness (RR 1.9–2.1). High levels of coagulase positive *Staphylococcus aureus* and emetic and diarrhoeal strains of *Bacillus cereus* were detected in mixed leftover samples of multiple dishes served at the function. High levels of *Cl. perfringens* were reported in samples of fried rice, staphylococcal enterotoxin was detected in samples of fried rice and chicken, and high levels of *Escherichia coli* were detected in corned meat. Six faecal specimens from cases grew coagulase positive staphylococci. Staphylococcal enterotoxin and *B. cereus* were not detected in any of the clinical specimens. Inappropriate timing of food preparation resulting in long holding times, inadequate food storage, inappropriate defrosting of food and lack of knowledge in safe food handling practice were considered major contributing factors in this outbreak.

In Victoria in September an outbreak of gastroenteritis in 41 of 184 attendees at a sports club dinner was investigated. Analysis of food history information for 66 attendees showed a statistically significant association between illness and consumption of roast beef (RR 12.7, 95% CI 3.3–48.0). *Cl. perfringens* enterotoxin was detected in 11 of 12 faecal specimens collected. The beef was roasted the day before the dinner, and then kept in the cool-room. The following day the meat was sliced thinly on a slicing machine and then placed into a warmer, without being re-heated. The meat slicer was found to be unclean with pieces of meat and meat juices behind the blade. No leftover food was available for testing.

In September in Western Australia, an outbreak of gastroenteritis caused by *Campylobacter* and *Salmonella* affected 65 of 705 attendees (attack rate of 9.2%) at a gala dinner at a function centre. Of 6 confirmed cases, two were positive for both *Campylobacter* and *S.* Typhimurium, one was positive for both *Campylobacter* and *S.* Infantis, and 3 were positive for *Campylobacter* only. A self-administered questionnaire regarding illness and food consumed was completed by 136 attendees and multivariate analysis of significant food exposures found that illness was statistically associated with consumption of duck parfait (OR 13, 95% CI 1.9–91.5, $P=0.01$). None of the parfait served at the dinner was available to be tested at the time of the investigation. A sample of frozen duck livers from a different batch to that used in the parfait served at the function was positive for *S.* Orion and *Campylobacter*.

An outbreak of *S.* Typhimurium PT 170/108 with a common MLVA profile 03-09-07-14-523 was identified in the Australian Capital Territory in November following reports of admissions for *Salmonella* gastroenteritis by a local hospital, with the notifying clinician also advising that the cases had eaten at a common bakery. Hypothesis generating interviews revealed most cases had eaten chicken Caesar salad rolls containing raw egg mayonnaise. In total, 41 cases of gastroenteritis were linked to the bakery, including 23 laboratory confirmed cases. The outbreak strain was identified in samples of the raw egg mayonnaise used by the bakery. A trace-back investigation of the eggs used by the bakery identified an egg producer in New South Wales. The outbreak strain was also identified in specimens collected at the farm.

Cluster investigations

In August 2011, in response to a national increase in *S.* Typhimurium PT 193 notifications and *S.* Typhimurium notifications with an MLVA pattern traditionally associated with PT 193, OzFoodNet commenced a national cluster investigation. The aim of this investigation was to form a hypothesis as to the source of the increase. Cases were interviewed using a hypothesis generating questionnaire, which included a trawling section on pork and beef related foods, contact with cows and pigs, contact with dogs and cats and food eaten by cats or dogs including pet treats. The investigation continued into late 2012 and results will be summarised in the 2012 report.

Multi-jurisdictional outbreak investigations

On 17 March 2011, OzFoodNet commenced multi-jurisdictional outbreak investigations into *S.* Virchow PT 34 and *S.* Typhimurium PT 170/108. The *S.* Virchow PT 34 investigation was commenced after a temporal cluster of 13 cases was detected in Victoria (the Victorian 5-year average for the same time period was 2 cases). Cases were also notified in South Australia, Tasmania, Queensland, New South Wales and the Australian Capital Territory during the same period. Jurisdictions conducted hypothesis-generating

interviews with notified cases of *S.* Virchow PT 34 using a standardised *Salmonella* questionnaire developed in Victoria. Data from the interviews were entered onto a national database and analysed for common exposures to develop food frequencies. Victoria also conducted targeted sampling of some high risk foods identified during case interviews. Forty-nine cases of *S.* Virchow PT 34 were interviewed by jurisdictions during the investigation (26 from Victoria). Two of these were considered to have been secondary cases. The median age of cases was 11 years (range 4 months to 90 years). *S.* Virchow 34 was isolated from the external surface of one batch of eggs sampled in Victoria during the investigation. A trace back investigation of this brand of eggs identified the source farm but no samples taken at the farm were positive for S. Virchow 34. While a range of foods such as eggs were consumed by the majority of cases, the products were from a range of retailers and were different brands, and no source of infection was definitively identified. The investigation was stood down on 1 June 2011 due to notifications returning to background levels.[28]

In 2011, *S.* Typhimurium PT 170/108 was observed to be the largest single contributor to a substantial increase in *Salmonella* notifications nationally and warranted further investigation. From January to May 2011, OzFoodNet epidemiologists investigated 13 point source *S.* Typhimurium PT 170/108 outbreaks that affected at least 124 people with 35 hospitalisations (hospitalisation rate 28.2%) and 1 death (case fatality rate 0.8%). A food vehicle was identified for nine of the 13 foodborne outbreaks. Seven of the 9 (77%) outbreaks with a known food vehicle were suspected to be due to eggs, or a food containing raw or lightly cooked eggs (Table 13, Appendix). As this phage type was the largest single contributor to the increase in *Salmonella* notifications nationally and because these point source outbreaks only accounted for 12% of the cases of *S.* Typhimurium PT 170/108 notified during this period, the investigation also included interviewing sporadic cases not linked to any of the identified point source outbreaks. Investigation of the sporadic cases of *S.* Typhimurium PT 170/108 notified during this period did not provide any additional evidence of the source(s) of infection. As cases demonstrated poor recall of food histories, associations between illness and the consumption of specific food items were difficult to establish for commonly eaten foods such as chicken and eggs. The investigation ceased on 1 June 2011 with declining notifications.[28]

A multi-jurisdictional outbreak investigation was initiated in December following reports of gastroenteritis in passengers (from New South Wales, Victoria, South Australia and Western Australia) and crew aboard a West Australian-owned ship cruising Papua New Guinea (PNG). There were 3 confirmed *S.* Typhimurium PT 135a cases (1 case each from South Australia, Victoria and Western Australia) (Appendix). Sixteen of the 31 passengers and crew reported illness. Of these, questionnaires were completed for 7 passengers and 7 crew members. Two crew members and 1 passenger were hospitalised. There was no epidemiological association between illness and eating a particular food item. The majority of food consumed on the ship was supplied from Australia, mostly from Queensland. All meat was from Western Australia. Some produce from PNG was used on board, including eggs, fruits, cucumber, pumpkin and coconut. A number of sauces, (mayonnaise, hollandaise and anglaise) and desserts (ice cream and tiramisu) contained raw eggs. An inspection of the vessel was conducted, but no samples were collected and the food vehicle was not identified. The investigation was completed in early 2012.

Discussion

This report documents the incidence of gastrointestinal diseases that may be transmitted by food in Australia during 2011. The OzFoodNet surveillance network concentrates its efforts on the surveillance and outbreak investigation of foodborne diseases. This is based on partnerships with a range of stakeholders, including state and territory health departments, food safety regulators, public health laboratories, and government departments of primary industries. These partnerships and the analysis of data on notified cases and outbreaks contribute to public health action, the prevention of disease and the assessment of food safety policies and campaigns. A national program of surveillance for foodborne diseases and outbreak investigation such as OzFoodNet has many benefits including identifying foods that cause human illness through investigation of outbreaks that occur across state and territory borders. Continuing to strengthen the quality of these data will ensure their use by agencies to develop food safety policy contributing to the prevention of foodborne illness. This aims to reduce the cost of foodborne illness to the community, such as healthcare costs and lost productivity, and those to industry such as product recalls and loss of reputation.

Campylobacter continues to be the most frequently notified enteric pathogen under surveillance by OzFoodNet despite not being notifiable in New South Wales. In fact, 2011 saw the highest number of notifications for campylobacteriosis since the commencement of the NNDSS in 1991. *Campylobacter* species were only implicated in 10 of 151 (7%) foodborne or suspected foodborne outbreaks in 2011, similar to 2010 (9/154, 6%).

Subtyping of *Campylobacter* species is not routinely performed in Australia hampering outbreak detection, but many previous OzFoodNet outbreak investigations have identified consumption of undercooked poultry livers as a particular risk for outbreaks of campylobacteriosis. It is important that poultry livers are handled in such a way as to avoid cross-contamination and are cooked thoroughly before eating.[29] As a result of the increasing notifications of campylobacteriosis in Australia, OzFoodNet put 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 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 *Salmonella* notifications (12,271) and the national notification rate of 54.3 cases per 100,000 population were also at the highest levels since the commencement of the NNDSS in 1991, surpassing 2010 the previous highest year (11,992 notifications, 53.7 cases per 100,000) and a 23% increase on the 5-year historical mean rate (44.1 cases per 100,000). OzFoodNet sites reported 151 foodborne or suspected foodborne outbreaks, including a multi-jurisdictional outbreak investigation. *Salmonella* continued to be the leading cause of reported outbreaks of foodborne illness in Australia, with 40% of outbreaks (61/151) due to this pathogen and 92% of these (56/61) due to *S*. Typhimurium. Of these 56 *S*. Typhimurium outbreaks, including community clusters, 52% (29/56) were associated with egg-based dishes.

OzFoodNet has been monitoring a national increase in *Salmonella* outbreaks associated with the consumption of raw or minimally cooked eggs since 2008. *S*. Typhimurium PT 170/108 and related MLVA types have most frequently been associated with these outbreaks. In 2011, *S*. Typhimurium PT 170/108 was the aetiological agent identified in 9 of these outbreaks across a range of settings and food vehicles, compared with 13 in 2010. Food vehicles identified during outbreak investigations included raw egg mayonnaise and dressings, desserts containing raw eggs such as tiramisu and chocolate mousse and raw cake batter. Notifications of salmonellosis peaked in January and the multi-jurisdictional investigation was launched in March because *S*. Typhimurium PT 170/108 was recognised as the largest contributor to the national increase.

OzFoodNet established a working group to describe the national epidemiology of egg-associated salmonellosis outbreaks and state and territory food safety authorities developed communication and education programs in relation to the use of raw egg products in commercial settings. The *Primary Production and Processing Standard for Eggs and Egg Products* was also gazetted in May 2011 and in force from 26 November 2012.[20] 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 on the Department of Health web site (http://www.health.gov.au/internet/main/publishing.nsf/Content/foodsecretariat-isc-model.htm).

This was the 1st full year of the OzFoodNet NELSS. Typing, demographic and exposure data for all nationally notified listeriosis cases were entered by OzFoodNet epidemiologists into a centralised national database from which fortnightly and ad hoc reports were generated and shared through all OzFoodNet sites. Creating a standardised national database of typing and risk exposures allowed rapid cluster detection and facilitated case–case analysis.[30] No multi-jurisdictional clusters or outbreaks were detected, but a cluster of 6 cases was identified and investigated in Victoria. An evaluation found that NELSS was meeting its objectives of monitoring the epidemiology of invasive listeriosis infections over time and detecting clusters and outbreaks.[31]

The largest recorded international outbreak of STEC occurred in northern Germany in 2011. Up to 15 other countries also recorded cases among people who had travelled to northern Germany during the outbreak. With a total of 3,816 cases, including 845 cases of HUS and 54 deaths, the outbreak was attributed to consumption of contaminated fenugreek sprouts.[32] On 3 June 2011, CDNA held an emergency teleconference that included OzFoodNet, the PHLN and FSANZ that confirmed that Australia has the surveillance and testing capacity to detect any possible cases of the outbreak strain (STEC O104:H4) if they arose in Australia. OzFoodNet monitored the outbreak closely and assessed Australia's capacity to respond to an outbreak of similar magnitude from the epidemiological perspective. OzFoodNet also collaborated closely with FSANZ to ensure that the implicated foods had not been imported into Australia.

South Australia experienced a significant STEC outbreak in 2011 associated with a petting zoo at an agricultural show. As a result of the inves-

tigation into this outbreak, OzFoodNet funded a review of the existing *South Australia Petting Zoo Infection Control Guidelines* with a view to formulating national guidelines.

Hepatitis A notifications (144) and the notification rate (0.6 per 100,000 population) reached the lowest levels in 2011 ever recorded in the NNDSS. There were also only 2 notified cases of hepatitis A infection in Aboriginal and Torres Strait Islander people in Australia in 2011, which represented only 1.4% of the total notifications. This compares with rates of 10%–15% in the early 2000s.[33] This is further evidence of the success of the staged introduction of hepatitis A vaccination programs targeted at young Aboriginal and Torres Strait Islander children from 1999 onwards in Queensland, the Northern Territory, South Australia and Western Australia.[34, 35]

OzFoodNet recognises some of the limitations of the data used in this report. Where there are small numbers of notifications, caution must be used in comparisons between jurisdictions and over time. Some of the most common enteric pathogens such as norovirus and *Cl. perfringens* are not notifiable in any Australian jurisdiction, 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.

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Appendix: Summary of foodborne and suspected foodborne disease outbreaks reported by OzFoodNet sites, Australia, 2011 (n=151)

State or territory	Month*	Setting prepared	Agent responsible	Ill	Hospitalised	Deaths	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
MJOI	Nov	Cruise/ airline	*S.* Typhimurium PT 135a, PFGE 0039, MLVA 03-08-10-14/16-523	16	3	0	D	Point source cohort	Unknown	Not attributed	Unknown
ACT	Feb	Takeaway	*S.* Typhimurium PT 197	9	1	0	D	Case series	Kebabs	Poultry, lamb	Other source of contamination and inadequate cleaning of equipment
ACT	Jun	Restaurant	Unknown	6	0	0	D	Case series	Burgers, schnitzels, chips and salad	Multiple	Unknown
ACT	Jun	Private residence	*S.* Typhimurium PT 135	5	1	0	D	No formal study	Spit roasted pig	Pork	Cross contamination from raw ingredients and ingestion of contaminated raw products
ACT	Oct	Commercial caterer	Unknown	9	0	0	D	Case series	Mixed sandwiches	Not attributed	Person to food to person
ACT	Nov	Bakery	*S.* Typhimurium PT 170/108, MLVA 03-09-07-14-523	41	6	0	M	Case series	Chicken caesar roll containing raw egg mayonnaise	Eggs	Ingestion of contaminated raw products
NSW	Jan	Grocery store/ delicatessen	*S.* Singapore	45	2	0	AM	Point source cohort	Roast chicken pieces served cold	Poultry	Cross contamination from raw ingredients
NSW	Jan	Grocery store/ delicatessen	*S.* Singapore	10	0	0	M	Case series	Roast chicken pieces served cold	Poultry	Cross contamination from raw ingredients
NSW	Jan	Restaurant	*S.* Typhimurium PT 3, MLVA 03-13-14-9/10-523	11	1	0	M	Case series	Caesar salad dressing – raw egg	Eggs	Ingestion of contaminated raw products
NSW	Jan	Restaurant	*S.* Typhimurium, MLVA 03-11-11-10-523	10	0	0	D	Case series	Dessert containing raw egg custard	Eggs	Unknown
NSW	Jan	Bakery	*S.* Typhimurium PT 135, MLVA 03-12-09-10-550	9	0	0	D	Case series	Unknown	Not attributed	Cross contamination from raw ingredients and inadequate cleaning of equipment
NSW	Jan	Takeaway	*S.* Typhimurium PT 44, MLVA 03-10-08-09-523	85	17	0	M	Case series	Vietnamese pork/ chicken/salad rolls containing raw egg butter	Eggs	Ingestion of contaminated raw products and cross contamination from raw ingredients
NSW	Jan	Restaurant	Unknown	7	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Jan	School	*S.* Typhimurium PT 170/108, MLVA 03-09-08-13-523	17	1	0	D	Point source cohort	Apple turnover	Multiple	Unknown
NSW	Jan	Restaurant	Unknown	5	0	0	D	No formal study	Unknown	Not attributed	Unknown

Appendix, *continued*: Summary of foodborne and suspected foodborne disease outbreaks reported by OzFoodNet sites, Australia, 2011 (n=151)

State or territory	Month*	Setting prepared	Agent responsible	Ill	Hospitalised	Deaths	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
NSW	Feb	Restaurant	*Campylobacter*	11	0	0	AM	Point source cohort	Chicken liver pâté on toast	Poultry	Unknown
NSW	Feb	Restaurant	Unknown	3	0	0	D	Case series	Unclear	Not attributed	Unknown
NSW	Feb	Restaurant	*S.* Typhimurium PT 170/108, MLVA 03-09-07-14-523	6	2	0	M	Case series	Fried ice cream	Eggs	Ingestion of contaminated raw products
NSW	Feb	Restaurant	Unknown	36	0	0	D	No formal study	Suspected dessert	Not attributed	Unknown
NSW	Mar	Restaurant	Unknown	7	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Mar	Takeaway	*S.* Typhimurium PT 170/108, MLVA 03-09-07-14-523	2	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Mar	Takeaway	*S.* Typhimurium PT 9, MLVA 03-10-14-12-496	5	2	0	D	No formal study	Beef kebab with onion, lettuce, tomato, cheese, BBQ & garlic sauce	Not attributed	Cross contamination from raw ingredients
NSW	Apr	Restaurant	Unknown	3	0	0	D	Case series	Suspect prawn and pesto pizza	Not attributed	Unknown
NSW	Apr	Private residence	*S.* Typhimurium MLVA 03-13-12-10-523	3	0	0	D	Case series	Homemade hollandaise sauce and semifreddo	Eggs	Unknown
NSW	Apr	Restaurant	Unknown	6	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Apr	Other	Unknown	80	0	0	D	Point source cohort	Unknown	Not attributed	Unknown
NSW	May	Commercial caterer	Norovirus G II-6	23	0	0	A	Point source cohort	Suspect chocolate and mandarin pie	Not attributed	Unknown
NSW	May	Restaurant	*S.* Typhimurium MLVA 03-10-08-09-523	8	0	0	M	Case series	Chicken and corn soup with raw egg added	Poultry, eggs	Cross contamination from raw ingredients
NSW	May	Takeaway	Unknown	4	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	May	Restaurant	Norovirus	79	12	0	D	Point source cohort	Person-to-person transmission via infected food handler	Not attributed	Food handler contamination
NSW	May	Restaurant	*S.* Typhimurium PT 135, MLVA 03-13-11-09-523	4	2	0	D	Case series	Suspect prawn dumplings with egg to bind	Crustaceans, leafy vegetables, eggs	Unknown
NSW	Jul	Takeaway	Unknown	3	1	0	D	No formal study	Unknown	Not attributed	Unknown

Appendix, *continued*: Summary of foodborne and suspected foodborne disease outbreaks reported by OzFoodNet sites, Australia, 2011 (n=151)

State or territory	Month*	Setting prepared	Agent responsible	Ill	Hospitalised	Deaths	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
NSW	Jul	Restaurant	Unknown	2	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Jul	Restaurant	Unknown	2	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Jul	Restaurant	*S.* Typhimurium, MLVA 03-09-08-14-523	13	1	0	D	Case series	Tiramisu containing raw egg	Eggs	Ingestion of contaminated raw products
NSW	Aug	Restaurant	*S.* Typhimurium, MLVA 03-09-07-13-523	6	0	0	D	Case series	Raw egg dressing	Eggs	Ingestion of contaminated raw products
NSW	Aug	Restaurant	*S.* Typhimurium, MLVA 03-09-07-15-523	3	0	0	D	Case series	Raw egg mayonnaise	Eggs	Ingestion of contaminated raw products
NSW	Aug	Commercial caterer	Unknown	25	0	0	D	Point source cohort	Unknown	Not attributed	Unknown
NSW	Aug	Restaurant	Unknown	11	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Sep	Restaurant	Unknown	3	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Sep	Restaurant	*Campylobacter*	2	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Sep	Commercial caterer	Unknown	87	0	0	A	Point source cohort	Salad of poached prawns with Thai herbs	Multiple	Unknown
NSW	Sep	Restaurant	Unknown	4	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Sep	Restaurant	Unknown	6	0	0	D	No formal study	Madras chicken curry with rice	Not attributed	Unknown
NSW	Oct	Camp	Unknown	8	4	0	D	No formal study	Cooked pasta	Grains-beans	Other source of contamination
NSW	Oct	Bakery	Unknown	3	0	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Oct	Restaurant	*S.* Typhimurium PT 9	3	1	0	D	Case series	Unknown	Not attributed	Unknown
NSW	Nov	Commercial caterer	Unknown	16	0	0	AM	Point source cohort	Suspect lamb curry	Not attributed	Unknown
NSW	Nov	Restaurant	Unknown	4	4	0	D	Case series	Tuna	Fish	Toxic substance or part of tissue
NSW	Nov	Restaurant	Unknown	12	0	0	D	No formal study	Unknown	Not attributed	Unknown
NSW	Nov	Restaurant	*Campylobacter*	2	0	0	D	Case series	Unknown	Not attributed	Unknown
NT	Jan	Camp	*S.* Typhimurium PT 9	3	0	0	D	No formal study	Unknown	Not attributed	Unknown
NT	Feb	Camp	Suspected viral	3	1	0	D	No formal study	Unknown	Not attributed	Unknown
NT	Feb	Aged care	Unknown	4	1	0	D	No formal study	Unknown	Not attributed	Unknown
NT	May	Commercial caterer	*S.* Typhimurium PT 141	5	0	0	D	No formal study	Unknown	Not attributed	Unknown
NT	Jul	Private residence	*S.* Saintpaul	5	0	0	D	No formal study	Unknown	Not attributed	Unknown

Appendix, *continued*: Summary of foodborne and suspected foodborne disease outbreaks reported by OzFoodNet sites, Australia, 2011 (n=151)

State or territory	Month*	Setting prepared	Agent responsible	Ill	Hospitalised	Deaths	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
NT	Sep	Fair/festival/ mobile service	*S.* Saintpaul	5	0	0	D	Case series	Suspect mango	Fruits-nuts	Unknown
NT	Oct	Takeaway	Unknown	3	0	0	D	Point source cohort	Unknown	Not attributed	Unknown
Qld	Jan	Unknown	*S.* Typhimurium PT 135a, MLVA 03-14-11-11-524	49	6	0	M	Case series	Eggs	Eggs	Ingestion of contaminated raw products
Qld	Mar	Primary produce	Ciguatera fish poisoning	3	0	0	D	Case series	Red Bass	Fish	Toxic substance or part of tissue
Qld	Jun	Private residence	*Campylobacter*	4	0	0	D	Case series	Chicken kebabs	Poultry	Ingestion of contaminated raw products
Qld	Jul	Primary produce	Ciguatera fish poisoning	3	0	0	D	Case series	Reef fish (unknown species)	Fish	Toxic substance or part of tissue
Qld	Jul	Restaurant	*Clostridium perfringens*	3	0	0	M	Case series	Chicken curry	Poultry, vegetables, grains	Unknown
Qld	Aug	Primary produce	Ciguatera fish poisoning	3	0	0	D	Case series	Coral trout	Fish	Toxic substance or part of tissue
Qld	Sep	Hospital	*Campylobacter*	5	5	0	D	Case series	Unknown	Not attributed	Unknown
Qld	Sep	Commercial caterer	*Staphylococcus aureus*	38	1	0	AM	Point source cohort	Fried rice; chicken; egg fu yung; mussels	Not attributed	Person to food to person
Qld	Sep	Commercial caterer	*S.* Typhimurium PT 170/108, MLVA 03-09-07-12-524	14	11	0	D	Case series	Unknown	Not attributed	Inadequate cleaning of equipment
Qld	Oct	Restaurant	Unknown	3	Unknown	0	D	Case series	Unknown	Not attributed	Unknown
Qld	Oct	Restaurant	Norovirus	6	0	0	D	Case series	No vehicle identified	Not attributed	Person to food to person
Qld	Nov	Restaurant	Histamine fish poisoning	3	3	0	M	Case series	Yellow-tail kingfish	Fish	Toxic substance or part of tissue
Qld	Nov	Fair/festival/ mobile service	*S.* Birkenhead	37	9	0	D	Point source cohort	Pumpkin or potato curry	Multiple	Unknown
Qld	Nov	Restaurant	Unknown	19	0	0	D	Point source cohort	No vehicle identified	Not attributed	Unknown
Qld	Nov	Primary produce	Ciguatera fish poisoning	6	0	0	D	Case series	Spanish mackerel	Fish	Toxic substance or part of tissue

Appendix, *continued*: Summary of foodborne and suspected foodborne disease outbreaks reported by OzFoodNet sites, Australia, 2011 (n=151)

State or territory	Month*	Setting prepared	Agent responsible	Ill	Hospitalised	Deaths	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
Qld	Dec	Primary produce	Ciguatera fish poisoning	2	0	0	D	Case series	Coral trout	Fish	Toxic substance or part of tissue
Qld	Dec	Restaurant	*S.* Typhimurium 197, MLVA 04-15-09-09-490	25	2	0	D	Point source cohort	Unknown	Not attributed	Unknown
Qld	Dec	National franchised fast food	Unknown	4	0	0	D	Case series	Unknown	Not attributed	Unknown
SA	Jan	Bakery	*S.* Typhimurium PT 9, MLVA 03-24-11-10/11-523	43	19	0	A	Case control study	Custard berliner bun	Multiple	Unknown
SA	Jan	Bakery	*S.* Typhimurium PT 9 MLVA 03-24-11-10/11-523	15	3	0	AM	Case control study	Custard cannolis	Multiple	Unknown
SA	Feb	Bakery	*S.* Typhimurium PT 44	8	0	0	D	Case series	Unknown	Not attributed	Unknown
SA	Feb	Bakery	*S.* Typhimurium PT 135	6	2	0	M	Case series	Egg glaze	Eggs	Cross contamination from raw ingredients
SA	Mar	Private residence	Unknown	16	1	0	D	No formal study	Unknown	Not attributed	Unknown
SA	Jul	Institution	*S.* Typhimurium PT 170/108 and *Campylobacter*	4	0	0	D	Case series	Unknown	Not attributed	Unknown
SA	Aug	Institution	*Campylobacter*	9	0	0	D	Point source cohort	Unknown	Not attributed	Unknown
SA	Sep	Private residence	Norovirus	16	0	0	D	Point source cohort	Unknown	Not attributed	Unknown
SA	Sep	Restaurant	*S.* Typhimurium PT 126	4	2	0	D	Case series	Unknown	Not attributed	Unknown
SA	Nov	Commercial caterer	*S.* Typhimurium PT 9, MLVA 03-24-13-11-523	27	7	0	D	Case series	Multiple foods	Not attributed	Cross contamination from raw ingredients and inadequate cleaning of equipment
Tas.	Nov	Unknown	*Campylobacter*	5	0	0	D	No formal study	Unknown	Not attributed	Unknown
Vic.	Jan	Aged care	Unknown	9	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Jan	Takeaway	*S.* Typhimurium PT 9	84	19	0	M	Case series	Mayonnaise (raw eggs)	Eggs	Ingestion of contaminated raw products
Vic.	Jan	Takeaway	*S.* Typhimurium PT 170/108	15	6	0	D	Case series	Salty fish, pork and egg dish	Fish, pork, eggs	Unknown
Vic.	Jan	Private residence	*S.* Typhimurium PT 44	5	0	0	D	Case series	Tiramisu	Eggs	Ingestion of contaminated raw products
Vic.	Feb	Aged care	*Clostridium perfringens*	23	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Feb	Aged care	*Clostridium perfringens*	7	0	0	D	Case series	Unknown	Not attributed	Unknown

Appendix, *continued*: Summary of foodborne and suspected foodborne disease outbreaks reported by OzFoodNet sites, Australia, 2011 (n=151)

State or territory	Month*	Setting prepared	Agent responsible	Ill	Hospitalised	Deaths	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
Vic.	Feb	Hospital	*S.* Typhimurium PT 135	7	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Feb	Takeaway	*S.* Typhimurium PT 170/108	26	6	0	D	Case series	Mayonnaise (raw eggs)	Eggs	Ingestion of contaminated raw products
Vic.	Feb	Aged care	*Campylobacter*	15	2	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Feb	Private residence	*S.* Typhimurium PT 170/108	2	1	0	D	Case series	Uncooked muffin batter	Eggs	Ingestion of contaminated raw products
Vic.	Mar	Aged care	Unknown	9	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Mar	Aged care	*Clostridium perfringens*	9	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Mar	Bakery	*S.* Typhimurium PT 135	17	3	0	M	Case series	Chicken liver pâté	Poultry	Unknown
Vic.	Mar	Aged care	Unknown	9	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Mar	Aged care	*S.* Typhimurium PT 170/108	6	5	1	D	Case series	Unknown	Not attributed	Unknown
Vic.	Mar	Private residence	*S.* Typhimurium PT 141	2	1	0	D	Case series	Chocolate mousse containing raw eggs	Eggs	Ingestion of contaminated raw products
Vic.	Apr	Restaurant	*S.* Typhimurium PT 170/108	15	2	0	AM	Point source cohort	Fried ice cream	Eggs	Ingestion of contaminated raw products
Vic.	Apr	Private residence	*S.* Typhimurium PT 170/108	2	2	0	M	Case series	Pancake batter	Eggs	Ingestion of contaminated raw products
Vic.	Apr	Private residence	*S.* Typhimurium PT 135a	9	5	0	D	Case series	Raw egg mayonnaise on potato salad	Eggs	Ingestion of contaminated raw products
Vic.	Apr	Aged care	*Clostridium perfringens*	5	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Apr	Private residence	*S.* Typhimurium PT 9	9	1	0	D	Point source cohort	Unknown	Not attributed	Unknown
Vic.	May	Aged care	*Clostridium perfringens*	13	0	1	D	Case series	Unknown	Not attributed	Unknown
Vic.	May	Aged care	Unknown	10	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	May	Aged care	*Clostridium perfringens*	8	0	1	D	Case series	Unknown	Not attributed	Unknown
Vic.	May	Aged care	Unknown	12	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	May	Aged care	Unknown	6	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	May	Restaurant	Norovirus	24	4	0	D	Point source cohort	Chicken parmigiana	Not attributed	Unknown
Vic.	Jun	Hospital	*Clostridium perfringens*	11	Unknown	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Jun	Restaurant	Unknown	9	0	0	D	Case series	Curries	Not attributed	Unknown
Vic.	Jun	Aged care	Unknown	8	0	0	A	Point source cohort	Vitamised food	Multiple	Unknown

Appendix, *continued*: Summary of foodborne and suspected foodborne disease outbreaks reported by OzFoodNet sites, Australia, 2011 (n=151)

State or territory	Month*	Setting prepared	Agent responsible	Ill	Hospitalised	Deaths	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
Vic.	Jun	Aged care	Unknown	5	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Jun	Aged care	Unknown	5	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Jun	Restaurant	Norovirus	15	0	0	A	Point source cohort	Fruit	Fruits-nuts	Unknown
Vic.	Jun	Restaurant	Unknown	7	0	0	D	Case series	Beef rendang or pork satay	Multiple	Unknown
Vic.	Jun	Private residence	*S.* Typhimurium PT 9	7	0	0	D	Case series	Chocolate mousse containing raw eggs	Eggs	Ingestion of contaminated raw products
Vic.	Jul	Aged care	Clostridium perfringens	11	1	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Aug	Restaurant	*S.* Typhimurium PT 170/108	14	1	0	A	Point source cohort	Chocolate mousse	Eggs	Ingestion of contaminated raw products
Vic.	Aug	Private residence	*S.* Typhimurium PT 135	4	0	0	A	Point source cohort	Uncooked pasta dough containing eggs	Eggs	Unknown
Vic.	Aug	Aged care	*Clostridium perfringens*	7	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Sep	Aged care	*Clostridium perfringens*	14	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Sep	Commercial caterer	*Staphylococcus aureus*	28	1	1	AM	Point source cohort	Lamprias	Fish, beef, vine-stalks	Unknown
Vic.	Sep	Commercial caterer	*Clostridium perfringens*	41	0	0	A	Point source cohort	Roast beef	Beef	Unknown
Vic.	Sep	Private residence	*S.* Typhimurium PT 44	12	0	0	D	Case series	Tiramisu containing raw eggs	Eggs	Ingestion of contaminated raw products
Vic.	Oct	Hospital	*Clostridium perfringens*	8	Unknown	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Oct	Restaurant	Histamine fish poisoning	3	0	0	D	Case series	Tuna	Fish	Unknown
Vic.	Oct	Hospital	*Clostridium perfringens*	5	Unknown	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Oct	Private caterer	*Clostridium perfringens*	17	0	0	D	Case series	Roast beef suspected	Beef	Unknown
Vic.	Nov	Private residence	*S.* Typhimurium PT 9	4	0	0	D	Case series	Chocolate mousse	Eggs	Unknown
Vic.	Dec	Aged care	*Clostridium perfringens*	25	0	0	D	Case series	Unknown	Not attributed	Unknown
Vic.	Dec	Takeaway	*S.* Typhimurium PT 9	3	1	0	D	Case series	Chicken hand rolls	Poultry	Cross contamination from raw ingredients
Vic.	Dec	Restaurant	*Bacillus cereus*	12	0	0	M	Case series	Multiple foods	Multiple	Unknown

Appendix, *continued*: Summary of foodborne and suspected foodborne disease outbreaks reported by OzFoodNet sites, Australia, 2011 (n=151)

State or territory	Month*	Setting prepared	Agent responsible	Ill	Hospitalised	Deaths	Evidence	Epidemiological study	Responsible vehicles	Commodity	Contamination factor
Vic.	Dec	Restaurant	Unknown	4	1	0	A	Point source cohort	Moroccan chicken salad	Poultry	Unknown
Vic.	Dec	Restaurant	Unknown	14	0	0	A	Point source cohort	Mango sticky rice	Dairy, eggs, grains-beans, oils-sugars, fruits-nuts	Unknown
Vic.	Dec	Private residence	*S.* monophasic (I:4,5,12:I:-) PT 193	4	1	0	M	Case series	Pork salami	Pork	Unknown
Vic.	Dec	Takeaway	*S.* Typhimurium PT 170/108	37	11	1	M	Case series	Pizza and chocolate mousse containing raw egg	Eggs	Unknown
WA	Jan	Restaurant	*S.* Typhimurium PT 170/108, MLVA 03-10-07-13-526, PFGE 0011	4	1	0	D	Case series	Unknown	Not attributed	Unknown
WA	Jan	Takeaway	*S.* Typhimurium PT 9	15	5	0	D	Case series	Vietnamese pork roll made with raw egg butter	Eggs	Unknown
WA	Jan	Restaurant	*S.* Typhimurium PT 135, PFGE 0003	23	15	0	D	Case series	Unknown	Not attributed	Unknown
WA	Apr	Other	*S.* Typhimurium PT 193, PFGE 386	30	2	0	D	Case control study	Unknown	Not attributed	Unknown
WA	Jul	Restaurant	Norovirus	53	0	0	D	Case control study	Salad	Not attributed	Person to food to person
WA	Sep	Commercial caterer	*Campylobacter* and *S.* Infantis	65	0	0	AM	Case control study	Duck liver parfait	Poultry	Ingestion of contaminated raw products
WA	Nov	Private residence	Unknown	17	0	0	D	Case series	Chicken biryani	Multiple	Unknown
WA	Dec	Restaurant	Unknown	7	0	0	D	Case series	Unknown	Not attributed	Unknown
WA	Dec	Commercial caterer	Unknown	10	0	0	D	Case control study	Unknown	Not attributed	Unknown

* Month of outbreak is the month of onset of first case or month of notification/investigation of the outbreak. The number of people affected and hospitalised relate to the findings of the outbreak investigation at the time of writing and not necessarily in the month specified.

MJOI Multi-jurisdictional investigation

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

References

1. Kirk M, Glass K, Ford L, Brown K, Hall G. Foodborne illness in Australia: Annual incidence circa 2010. Canberra, ACT: National Centre for Epidemiology and Population Health, Australian National University; 2014.
2. Kirk M, Ford L, Glass K, Hall G. Foodborne Illness, Australia, circa 2000 and circa 2010. *Emerg Infect Dis* 2014;20(11):1857–1864.
3. Abelson P, Potter Forbes M, Hall G. *The Annual Cost of Foodborne Illness in Australia*. Canberra: Australian Government Department of Health and Ageing; 2006.
4. Centers for Disease Control and Prevention. 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):333–337.
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–S120.
6. Hocking AD, ed. *Foodborne Microorganisms of Public Health Significance*. 6th edn. Australian Institute of Food Science and Technology Incorporated; 2003.
7. Rothman KJ, Lash TJ, Greenland S. *Modern Epidemiology*. 3rd edn. Philadelphia, USA: Lippincott Williams and Wilkins; 2008.
8. 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):178–181.
9. Hall G, Raupach J, Yohannes K, Halliday L, Unicomb L, Kirk M. 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.
10. 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):1601–1609.
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* 2001;25(4):266–269.
13. Australian Bureau of Statistics. Australian Demographic Statistics. Report No.: 3101.0. Canberra: ABS; 2011.
14. Miller M, Roche P, Spencer J, Deeble M. Evaluation of Australia's National Notifiable Disease Surveillance System. *Commun Dis Intell* 2004;28(3):311–323.
15. *National Health Security Act, 2007*. Accessed on November 2014. Available from: http://www.comlaw.gov.au/Details/C2007A00174
16. Churches T, Conaty SJ, Gilmour 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.
17. 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 cantaloupe consumption. *Epidemiol Infect* 2009;137(3):367–374.
18. Popovic I, Heron B, Covacin C. *Listeria*: an Australian perspective (2001–2010). *Foodborne Pathog Dis* 2014;11(6):425–432.
19. Williams S. What is environmental *Salmonella*? *The Northern Territory Disease Control Bulletin* 2005;12(4):3.
20. Food Standards Australia New Zealand. Proposal P301: Primary Production and Processing Standard for Eggs and Egg Products – Risk Assessment of Eggs and Egg Products; 2009.
21. Animal Health Australia. *Salmonella enteritidis* infection in poultry. 2011. Accessed November 2014. Available from: http://nahis.animalhealthaustralia.com.au/pmwiki/pmwiki.php?n=Factsheet.154–2?skin=factsheet
22. 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):775–781.
23. 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* 2010;34(4):396–426.
24. Combs BG, Raupach JC, Kirk MD. Surveillance of Shiga toxigenic *Escherichia coli* in Australia. *Commun Dis Intell* 2005;29(4):366–369.
25. Heymann DL. *Control of Communicable Diseases Manual*. 19 edn: American Public Health Association; 2008.
26. 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):1259–1264.
27. Centers for Disease Control and Prevention. Surveillance for foodborne disease outbreaks—United States, 2009–2010. *MMWR Morb Mortal Wkly Rep* 2013;62(3):41–47.
28. OzFoodNet Working Group. OzFoodNet quarterly report, 1 January to 31 March 2011. *Commun Dis Intell* 2011;35(4):301-311.
29. Merritt T, Combs B, Pingault N. *Campylobacter* outbreaks associated with poultry liver dishes. *Commun Dis Intell* 2011;35(4):299–300.
30. Pogreba-Brown K, Ernst K, Harris RB. Case–case methods for studying enteric diseases: A review and approach for standardization. *OA Epidemiology* 2014:2(1):1–9.
31. Astridge K. Bound Volume for the Degree of Master of Applied Epidemiology. Canberra ACT: Australian National University; 2011.
32. Frank C, Werber D, Cramer JP, Askar M, Faber M, an der Heiden M, et al. Epidemic profile of Shiga toxin-producing *Escherichia coli* O104:H4 outbreak in Germany. *N Engl J Med* 2011;365(19):1771–1780.
33. OzFoodNet Working G. Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: annual report of the OzFoodNet network, 2010. *Commun Dis Intell* 2012;36(3):E213–E241.
34. Hanna JN, Hills SL, Humphreys JL. Impact of hepatitis A vaccination of Indigenous children on notifications of hepatitis A in north Queensland. *Med J Aust* 2004;181(9):482–485.
35. Australian Technical Advisory Group on Immunisation. *The Australian Immunisation Handbook*: 10th edn. 2013 (updated January 2014). Australian Government Department of Health. Canberra, ACT; 2014.