Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2009

The OzFoodNet Working Group

Abstract

In 2009, OzFoodNet sites reported 27,037 notifications of 9 diseases or conditions that are commonly transmitted by food. The most frequently notified infections were *Campylobacter* (15,973 notifications) and *Salmonella* (9,533 notifications). Public health authorities provided complete serotype and phage type information on 92% of all *Salmonella* infections in 2009. The most common *Salmonella* serotype notified in Australia during 2009 was *Salmonella* Typhimurium, and the most common phage type was S. Typhimurium 170/108. During 2009, OzFoodNet sites reported 1,820 outbreaks of gastrointestinal illness, which affected 36,426 people and resulted in 1,240 people being hospitalised. There were 118 deaths during these outbreaks. The majority (82%, 1,496/1,820) of outbreaks were due to person-to-person spread, 9% (163/1,820) were suspected or confirmed to have been transmitted by contaminated food and 9% (161/1,820) were due to either waterborne transmission or outbreaks with an unknown mode of transmission. Foodborne outbreaks affected 2,679 persons including 342 hospitalisations. Eight deaths were reported during these foodborne outbreaks. *Salmonella* was the most common aetiological agent in foodborne outbreaks and restaurants were the most common setting where foods were prepared. Eighteen outbreaks were related to dishes containing raw or undercooked eggs; the majority (n=14) due to various phage types of S. Typhimurium. This report summarises the incidence of disease potentially transmitted by food in Australia and details outbreaks associated with various food vehicles in 2009. These data assist agencies to identify emerging sources of disease, develop food safety policies, and prevent foodborne illness. *Commun Dis Intell* 2010;34(4):396–426.

Keywords: foodborne disease, surveillance, disease outbreak

Introduction

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

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

Surveillance data are used to monitor trends in the incidence of disease and to detect outbreaks and clusters of disease. Long-term trends in surveillance data also enable the efficacy of public health interventions to be assessed.[7] In Australia, state and territory health departments conduct surveillance for between 10 and 15 different diseases that may be transmitted through food. Most of these diseases are transmitted by the faecal–oral route and as such may also be transmitted by contact with infected animals or people, or through consumption of contaminated water. In addition, health departments collect summary data on all outbreaks of foodborne diseases, which provide robust information on contaminated foods causing illness in Australia.

The Australian Government established OzFoodNet—Australia's enhanced foodborne disease surveillance system—in 2000 to improve national surveillance and conduct applied research into the causes of foodborne illness.[8] OzFoodNet aggregates and analyses national-level information on the incidence of diseases caused by pathogens commonly transmitted by food, as well as foodborne disease outbreaks. The OzFoodNet network includes collaborators from the Public Health Laboratory Network, Food Standards Australia New Zealand (FSANZ), the Department of

Agriculture, Fisheries and Forestry and the National Centre for Epidemiology and Population Health at the Australian National University. OzFoodNet is a member of the Communicable Diseases Network Australia (CDNA), which is Australia's peak body for communicable disease control.[9] This is the 9th annual report for the OzFoodNet network and summarises 2009 surveillance data, which include a comparison with data from previous years.

Methods

Population under surveillance

In 2009, the network covered the whole of the Australian population, which was estimated to be 21,874,920 persons.[10]

Data sources

Notified infections

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

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

There may be differences when comparing state and territory enhanced data totals and NNDSS notifications. This is due to amendments to notification totals by states and territories after the date of data extraction. Data for this report were extracted from NNDSS in June 2010 and were analysed by the date of diagnosis within the reporting period 1 January to 31 December 2009. Date of diagnosis was derived from the earliest date supplied from 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 2009 were used to calculate rates of notified infections.

Enhanced surveillance

OzFoodNet sites collected supplementary data on infections commonly transmitted by foods. Information on travel status was collected for cases of *Salmonella* Enteritidis, hepatitis A, *Shigella* and typhoid. The incidence of infection in returned travellers was compared with the number of travellers to that region using overseas arrivals and departures data from the Department of Immigration and Citizenship. The field 'country where you spent the most time abroad' was used as the numerator. Cases that reported overseas travel to more than one region or continent were counted against each country separately.

To examine the quality of surveillance data collected across Australia, OzFoodNet sites provided data on the completeness of notification databases for *Salmonella* notifications regarding serotype and phage type. Data from Western Australia were excluded from the analysis of phage type completeness, as isolates have not been sent routinely for phage typing since June 2007. To assess completeness, data were analysed using the date a notification was received at the health department.

OzFoodNet sites supplied data on listeriosis cases, which included whether or not a case was materno–foetal and whether the case died. Many cases have severe chronic illnesses prior to their *Listeria* infection so it is difficult to determine if listeriosis is the cause of death for fatal cases, or a contributing factor. For the purpose of surveillance, a woman and her unborn child are counted as 1 case, and where the pregnancy results in a miscarriage, the case is counted as fatal. This affects age specific notification rates for listeriosis and the proportion of reported cases that were female. *Listeria* typically infects immunocompromised patients, the elderly and pregnant women.[11]

For disease counts less than 20 only age specific rates (not and age and sex) are calculated as the low case numbers make the rates unstable.

Gastrointestinal and foodborne disease outbreaks

OzFoodNet sites collected summary information on gastrointestinal and foodborne disease outbreaks that occurred in Australia during 2009. An outbreak of foodborne disease was defined as an incident where two or more persons experience a similar illness after consuming a common food or meal and epidemiological analysis implicate the meal or food as the source of illness. A suspected foodborne

outbreak was defined as an incident where two or more persons experience illness after consuming a common meal or food and a specific meal or food is suspected, but person-to-person transmission cannot be ruled out. 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 were combined for the analysis, and information collected for each outbreak included the setting where the outbreak occurred, where food was prepared, the month the outbreak occurred, the aetiological agent, the number of persons affected, the type of investigation conducted, the level of evidence obtained, and the food vehicle responsible for the outbreak. To summarise the data, outbreaks were categorised by aetiological agents, food vehicles and settings where the implicated food was prepared. Data on outbreaks due to waterborne transmission and data from clusters investigated by jurisdictional health departments were also summarised. The number of outbreaks and documented causes reported here may vary from summaries previously published by individual jurisdictions as these can take time to finalise.

Data analysis

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

Results

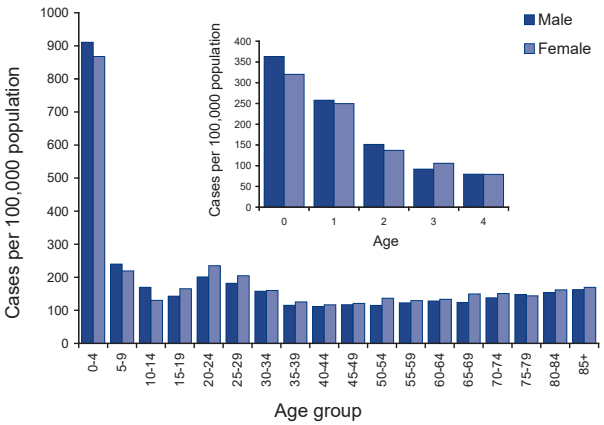
Rates of notified infections

In 2009, OzFoodNet sites reported 27,037 notifications of 9 diseases or conditions that are commonly transmitted by food (Table 1), similar to the mean of 25,637 notifications per year for the previous 5 years (2004–2008).

Salmonella infections

In 2009, OzFoodNet sites reported 9,533 cases of *Salmonella* infection, a rate of 43.6 cases per 100,000 population. The 2009 rate was a 7% increase over the mean of the previous 5 years (40.8) (Table 1). Notification rates ranged from 30 cases per 100,000 population in Victoria to 217 cases per 100,000 population in the Northern Territory, which usually has the highest rate of salmonellosis. Approximately half (49%) of *Salmonella* notifications were in males. The highest age specific rate of *Salmonella* infection was 300 cases per 100,000 population in children aged from 0–1 year (Figure 1). The notification rate decreased dramatically in children aged more than 2 years (Figure 1).

Figure 1: Salmonellosis, Australia, 2009, by age group and sex



Nationally during 2009, the most commonly notified *Salmonella* serotype was *S.* Typhimurium, which was responsible for approximately 41% of all notified infections (Tables 2 and 3). Various phage types of *S.* Typhimurium were the most commonly reported infections in all states and territories, except for Tasmania and the Northern Territory. In particular, the incidence of *S.* Typhimurium phage type 170/108* increased dramatically in several jurisdictions. This increase instigated a cluster investigation of 15 separate outbreaks of *S.* Typhimurium 170/108 occurring in Queensland, New South Wales and the Australian Capital Territory (see cluster investigations). In New South Wales there were 10.0 cases of *S.* Typhimurium 170/108 per 100,000 population, 2.8 cases per 100,000 in Queensland and 38.7 cases per 100,000 in the Australian Capital Territory (Table 2). All of the top 5 serotypes in the Northern Territory, except *S.* Litchfield, exceeded 10 cases per 100,000 population, with *Salmonella* Saintpaul the highest at 25.8 cases per 100,000 population. Tasmania also recorded a high rate for infection due to a specific serotype, *S.* Mississippi, with 14.3 cases of per 100,000 population. *S.* Mississippi is endemic in Tasmania but since 1999 the number of notifications originating from the mainland states and territories has more than doubled. Tasmania is currently conducting a case control study of people infected with *S.* Mississippi on mainland Australia to identify what proportion of infections are linked to Tasmania or to the Pacific and to investigate whether contact with native animals or birds, or consumption of seafood, native animals, untreated water or unpasteurised milk are risk factors for infection.

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

Table 1: Number of notified cases, crude rate and 5-year mean (2004–2008) rate per 100,000 population of diseases or infections commonly transmitted by food, Australia, 2009, by disease and state or territory

Disease		State or territory								
		ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Aust
Salmonella	Notified cases, 2009	225	2,736	487	2,471	681	166	1,647	1,120	9,533
	Crude rate, 2009	64.1	38.5	216.6	56.1	42.0	33.0	30.3	50.1	43.6
	Mean rate, 2004–2008	33.9	32.8	209.4	61.1	41.1	42.4	29.2	39.4	40.8
*Campylobacter**	Notified cases, 2009	357†	NN	205	4,610	1,755	626	5,838	2,582	15,973
	Crude rate, 2009	101.7	NN	91.2	104.6	108.2	124.5	107.6	115.4	108.1
	Mean rate, 2004–2008	118.3	NN	121.7	106.2	143.6	129.0	118.0	99.3	115.1
Listeria	Notified cases, 2009	2	26	0	13	4	3	27	13	88
	Crude rate, 2009	0.6	0.4	0.0	0.3	0.2	0.6	0.5	0.7	0.4
	Mean rate, 2004–2008	0.4	0.4	0.1	0.2	0.3	0.2	0.2	0.4	0.3
Shigella	Notified cases, 2009	8	156	85	115	51	2	85	120	622
	Crude rate, 2009	2.3	2.2	37.8	2.6	3.1	0.4	1.6	5.4	2.8
	Mean rate, 2004–2008	0.8	1.4	74.7	2.1	4.4	0.7	1.9	6.4	3.1
Typhoid	Notified cases, 2009	2	47	0	13	2	1	42	8	115
	Crude rate, 2009	0.6	0.7	0.0	0.3	0.1	0.2	0.8	0.4	0.5
	Mean rate, 2004–2008	0.1	0.5	0.7	0.2	0.2	0.2	0.4	0.4	0.4
Hepatitis A	Notified cases, 2009	6	98	1	56	59	5	303	35	563
	Crude rate, 2009	1.7	1.4	0.4	1.3	3.6	1.0	5.6	1.6	2.6
	Mean rate, 2004–2008	0.7	1.3	11.1	1.0	0.7	0.5	1.2	2.2	1.3
Shiga toxin-producing *Escherichia coli*	Notified cases, 2009	0	21	1	23	63	0	16	6	130
	Crude rate, 2009	0.0	0.3	0.4	0.5	3.9	0.0	0.3	0.3	0.6
	Mean rate, 2004–2008	0.1	0.2	0.5	0.4	2.3	0.1	0.2	0.2	0.4
Haemolytic uraemic syndrome	Notified cases, 2009	0	4	0	2	4	0	2	0	12
	Crude rate, 2009	0.00	0.06	0.00	0.05	0.25	0.00	0.04	0.00	0.05
	Mean rate, 2004–2008	0.06	0.18	0.19	0.06	0.10	0.08	0.05	0.02	0.10
Botulism	Notified cases, 2009	0	0	0	1	0	0	0	0	1

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

† Actual figures for the Australian Capital Territory may differ due to 1 laboratory not reporting *Campylobacter* results for 2009.

Salmonella *Enteritidis*

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

During 2009, OzFoodNet sites reported 587 cases of *S.* Enteritidis infection (Table 4). Travel histories were obtained for 93% (547/587) of cases in 2009, compared with 94% (480/511) of cases in 2008. Of those cases where travel status was reported, 93% (508/547) had travelled overseas and cases often reported visiting several countries.

Of the cases that were known to have been acquired overseas, 83% (423/508) reported travel to South East Asia. This compares with only 33% (4,139, 293/12,430,460) of returning travellers coming from South East Asia in 2009 (relative risk [RR] 10, 95% confidence interval [CI] 8–13). Similar to previous years, the most common country of acquisition for overseas-acquired infections was Indonesia, with 56% (283/508) of cases reporting travel there, while comprising only 5% (618,318/12,430,460) of travel undertaken in 2009 (RR 24, 95% CI 20–29). Thailand was the second most common country of acquisition with 11% (58/508) of all notifications that were known to have been acquired overseas, followed by Malaysia with 9% (47/508) and Singapore with 4% (18/508). The most common infecting phage types amongst overseas-acquired cases were 6a (19%, 96/508) and 1b (6%, 33/508) (Table 5).

Table 2: Number, rate and proportion of the top 5 *Salmonella* infections, Australia (excluding Western Australia), 2008 to 2009, by OzFoodNet site*

OzFoodNet site	Sero/phage type	2009		Proportion	2008		Ratio 2009/2008§
		n	Rate†	%‡	n	Rate†	
ACT	*S.* Typhimurium 170/108	136	38.7	60.4	11	3.2	12.4
	S. Typhimurium 135/135a	7	2.0	3.1	12	3.5	0.6
	S. Montevideo	6	1.7	2.7	3	0.9	2.0
	S. Typhimurium 9	5	1.4	2.2	19	5.5	0.3
	S. Kiambu	4	1.1	1.8	0	0.0	
	S. Typhimurium 44	4	1.1	1.8	23	6.7	0.2
NSW	*S.* Typhimurium 170/108	710	10.0	26.0	242	3.5	2.9
	S. Typhimurium 135/135a	199	2.8	7.3	254	3.6	0.8
	S. Typhimurium 9	101	1.4	3.7	150	2.2	0.7
	S. Stanley	64	0.9	2.3	32	0.5	2.0
	S. Birkenhead	64	0.9	2.3	68	1.0	0.9
NT	*S.* Saintpaul	58	25.8	11.9	38	17.3	1.5
	S. Virchow 8	42	18.7	8.6	29	13.2	1.4
	S. Ball	36	16.0	7.4	44	20.0	0.8
	S. Lansing	30	13.3	6.2	27	12.3	1.1
	S. Litchfield	14	6.2	2.9	9	4.1	1.6
Qld	*S.* Saintpaul	207	4.7	8.4	154	3.6	1.3
	S. Birkenhead	143	3.2	5.8	119	2.8	1.2
	S. Aberdeen	123	2.8	5.0	72	1.7	1.7
	S. Typhimurium 170/108	123	2.8	5.0	53	1.2	2.3
	S Typhimurium 135/135a	127	2.9	5.1	159	3.7	0.8
SA	*S.* Typhimurium 9	71	4.4	10.4	75	4.7	0.9
	S. Typhimurium 170/108	69	4.3	10.1	24	1.5	2.9
	S. Typhimurium 193	55	3.4	8.1	27	1.7	2.0
	S. Typhimurium 135/135a	48	3.0	7.0	93	5.8	0.5
	S. Typhimurium 44	27	1.7	4.0	19	1.2	1.4
Tas	*S.* Mississippi	72	14.3	43.4	64	12.8	1.1
	S. Typhimurium 160	14	2.8	8.4	1	0.2	14.0
	S. Typhimurium 135/135a	12	2.4	7.2	58	11.6	0.2
	S. Typhimurium 170/108	9	1.8	5.4	0	0.0	–
	S. Stanley	6	1.2	3.6	3	0.6	2.0
Vic	*S.* Typhimurium 170/108	316	5.8	19.2	128	2.4	2.5
	S. Typhimurium 135/135a	173	3.2	10.5	272	5.1	0.6
	S. Typhimurium 9	124	2.3	7.5	155	2.9	0.8
	S. Typhimurium 44	103	1.9	6.3	194	3.7	0.5
	S. Infantis	44	0.8	2.7	29	0.5	1.5

* Where there were multiple 5th ranking *Salmonella* types all data have been shown; Western Australia data not included due to incomplete phage typing of *S.* Typhimurium, *S.* Enteritidis, and *S.* Virchow in 2009.

† Rate per 100,000 population.

‡ Proportion of total *Salmonella* notified for this jurisdiction in 2009.

§ Ratio of the number of cases in 2009 compared to the number in 2008.

Table 3: Numbers, rates, and proportions of top 5 *Salmonella* serotypes, 2008 to 2009, Western Australia

Serotype	2009		Proportion	2008		Ratio 2009/2008§
	n	Rate†	%‡	n	Rate†	
S. Typhimurium	362	16.2	32.3	296	13.7	1.2
S. Enteritidis	198	8.9	17.7	138	6.4	1.4
S. Saintpaul	72	3.2	6.4	25	1.2	2.9
S. Paratyphi B bv Java	38	1.7	3.4	18	0.8	2.1
S. Singapore	32	1.4	2.9	17	0.8	1.9

† Rate per 100,000 population.

‡ Proportion of total *Salmonella* notified for this jurisdiction in 2009.

§ Ratio of the number of cases in 2009 compared to the number in 2008.

Table 4: Number of *Salmonella* Enteritidis infections, Australia, 2009, by travel history and state or territory

State	Locally acquired	Overseas travel	Unknown	Total
ACT	0	2	0	2
NSW	3	101	7	111
NT	1	6	4	11
Qld	27	55	24	106
SA	1	36	0	37
Tas	0	8	0	8
Vic	3	107	4	114
WA	4	193	1	198
Total	39	508	40	587

Table 5: Number and percentage of each phage type for of overseas-acquired cases of *Salmonella* Enteritidis, Australia, 2009

Phage type	Total	Proportion (%)
6a	96	19
1b	33	6
21	26	5
1	23	5
13	22	4
21b var	18	4
4	10	2
26	9	2
Reactions do not conform (RDNC)	9	2
Untypeable	6	1
Other phage types	52	10
Unknown*	204	40
Total	508	100

* The number of overseas-acquired cases with no phage type available includes 193 cases from Western Australia, where phage typing is not routinely conducted.

Completeness of Salmonella *serotyping and phage typing*

Overall, 92% (7,598/8,250) of *Salmonella* notifications on state and territory databases contained information about serotype and/or phage type for those jurisdictions participating in this typing scheme. For several years OzFoodNet has monitored the completeness of 6 serotypes that are routinely phage typed: Bovismorbificans; Enteritidis; Hadar; Heidelberg; Typhimurium; and Virchow. In 2009, phage typing was greater than 90% complete for serotypes Typhimurium, Virchow and Enteritidis (Table 6). There was an overall decline in the percentage of notifications with phage type reported in 2009 compared with previous years. In 2009, 91.6% of *Salmonella* notifications contained complete information on phage type compared with 94% in 2008.

Table 6: Percentage of *Salmonella* notifications for 6 serotypes notified to state and territory health departments with phage type information available, Australia, 2005 to 2009

Salmonella serotype	2005	2006	2007*	2008	2009
S. Bovismorbificans	94.2	96.8	97.4	83.5	80.0
S. Enteritidis	96.6	98.3	94.5	92.3	92.2
S. Hadar	81.3	100.0	90.0	81.3	33.3†
S. Heidelberg	90.2	94.8	90.0	80.5	74.3
S. Typhimurium	98.5	98.3	98.3	94.8	92.3
S. Virchow	98.7	99.4	95.4	93.4	91.0

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

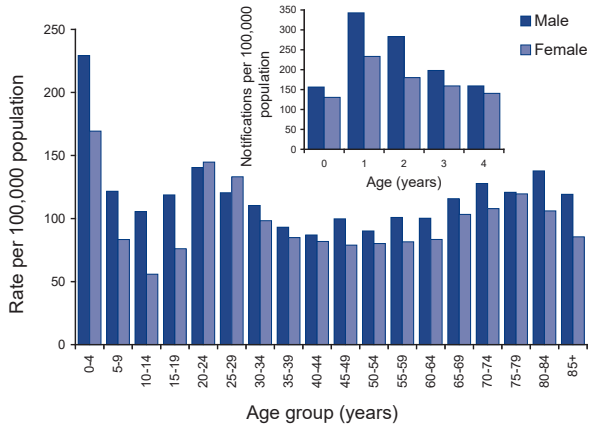
† The Microbiological Diagnostic Unit is waiting on reagents from England to type *S.* Hadar isolates. Completeness will improve as a result.

Campylobacter infections

In 2009, OzFoodNet sites (excluding New South Wales where *Campylobacter* is not notifiable) reported 15,973 cases of *Campylobacter* infection; a rate of 108 cases per 100,000 population (Table 1). The lowest and highest rates of *Campylobacter* notification were in the Northern Territory (91 cases per 100,000 population) and in Tasmania (125 cases per 100,000 population) respectively.

Fifty-four per cent of notified cases were male, which is consistent with previous years. Notification rates were highest among males in nearly all age groups. In 2009, notification rates were highest in males and females aged 0–4 years (229 and 169 notifications per 100,000 population, respectively) with additional peaks in the 20–29 and 70–84 age groups (Figure 2). Amongst children under 5 years of age, the highest notification rates were in infants aged 1 year for both males and females (343 and 233 cases per 100,000 population, respectively)(Figure 2).

Figure 2: Campylobacteriosis notification rates, Australia, 2009, by age group and sex



Listeria infections

OzFoodNet sites reported 88 cases of *Listeria monocytogenes* infection in 2009, a crude rate of 0.4 cases per 100,000 population, which was an increase over the 5-year historical mean of 0.3 cases per 100,000 (60 cases) (Table 1). This increase was due in part to a multi-jurisdictional outbreak of listeriosis associated with the consumption of chicken wraps on domestic airlines (described under multi-jurisdictional outbreak investigations).

Fourteen of these 88 cases (16%) were pregnancy related (Figure 3). Fifty-eight per cent (51/88) of notifications were in people aged 60 years or more. The highest age specific notification rate was in people aged 85 years or more (3.1 cases per 100,000 population, 12 cases) (Figure 4). Fourteen per cent (2/14) of pregnancy related cases and 14% (10/74) of the non-pregnancy associated cases in 2009 were fatal (Figure 3). In 2009, 55% (41/74) of the non-pregnancy related cases were female.

Figure 3: Notification rates and 5 year mean rate for listeriosis, Australia, 2009, by age

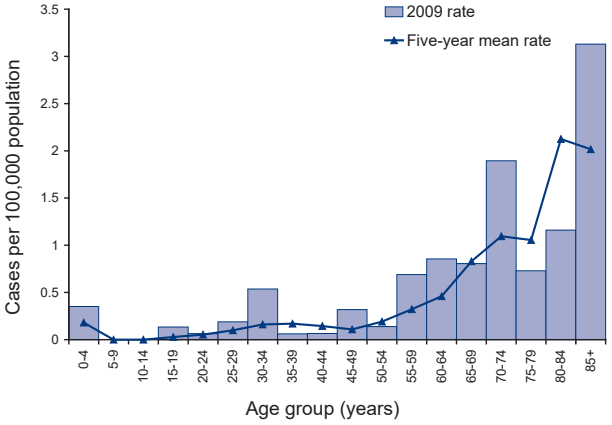
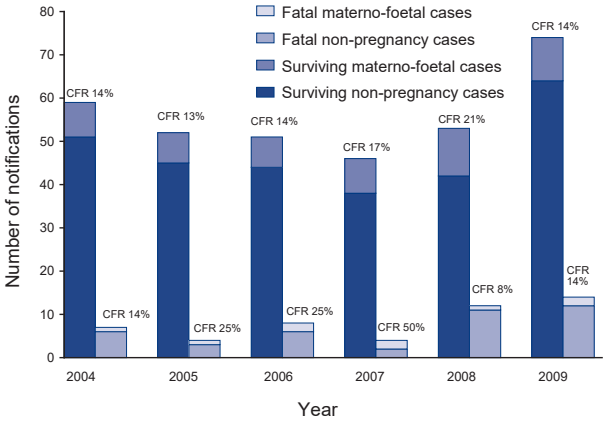


Figure 4: Notifications and case fatality ratio for fatal and surviving listeriosis cases, 2004 to 2009, by pregnancy status



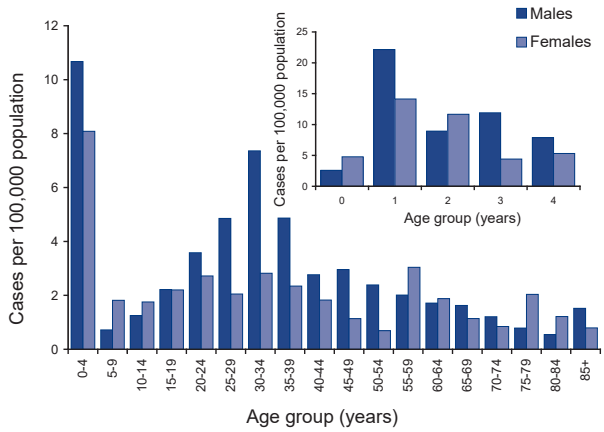
CFR Case fatalitiy rate

Shigella infections

There were 622 notifications of shigellosis in Australia in 2009, a rate of 2.8 notifications per 100,000 population compared with a mean of 645 cases (3.1 notifications per 100,000) per year between 2004 and 2008. As in previous years, the highest notification rate was in the Northern Territory, with 37.8 cases per 100,000 population compared with 74.7 cases per 100,000 population between 2004 and 2008.

In 2009, notification rates for shigellosis were highest in males and females aged 0–4 years, with 10.7 and 8.1 notifications per 100,000 population respectively. A secondary peak was observed in males aged 30–44 years, and in females aged 55–59 years. Amongst children under 5 years of age, the highest notification rates were in children aged 1 year (Figure 5).

Figure 5: Notification rates for shigellosis, Australia, 2009, by age and sex



The most frequently reported *Shigella* biotype in 2009 was *S. sonnei* biotype g, followed by *S. sonnei* biotype a. These biotypes accounted for 52.4% of all *Shigella* infections reported in 2009 (Table 7). In 2009, *S. sonnei* biotype g was more frequently reported than in 2008 and 2007, when the most common biotype was *S. sonnei* biotype a (Table 7).

In 2009, information on the following selected risk factors for *Shigella* cases were collated nationally: overseas travel; indigenous status; and whether the case was a man who has sexual contact with other men (MSM). However, the completeness of this information varied as not all jurisdictions collected information on these risk factors. Information on injecting drug use was not available for all states and territories.

Of the *Shigella* cases with known specific risk factor information, the most frequently reported risk factor was Aboriginality, at 47% (193/414), followed by overseas travel, 46% (135/295) and MSM 4.8% (30/622).

Typhoid

In 2009, there were 115 cases of typhoid (*S.* Typhi infection) in Australia, a rate of 0.5 cases per 100,000 population compared with 0.4 cases per 100,000 between 2004 and 2008 (Table 1). In 2009, 48.6% (56/115) of cases were female. Cases were reported from all Australian states and territories except for the Northern Territory. Travel status was known for all cases, with 11.3% (13/115) of cases reporting no overseas travel and 88.7% (102/115) of cases reporting infections known to have been acquired overseas.

Notification rates for typhoid in 2009 were highest in young adults, with 1.6 cases per 100,000 (26 cases)

Figure 6: Notification rates for typhoid, Australia, 2009, by age

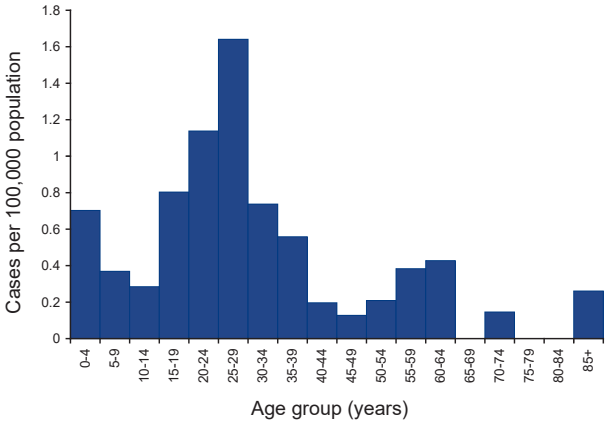


Table 7: Number, percentage and ratio of the top 10 Shigella infections, Australia, 2007 to 2009

Biotype	2007		2008		2009		2009/2007 ratio*	2009/2008 ratio*
	n	%	n	%	n	%		
S. sonnei biotype g	98	16.3	185	22.3	208	33.4	2.1	1.5
S. sonnei biotype a	134	22.3	232	28	118	19.0	0.9	0.7
S. sonnei untyped	37	6.1	48	5.8	57	9.2	1.5	1.6
S. flexneri 3a	37	6.1	41	5	43	6.9	1.1	1.4
S. flexneri 2a	64	10.6	55	6.6	39	6.3	0.6	0.9
S. flexneri untyped	20	3.3	21	2.5	22	3.5	1.1	1.4
S. flexneri 4	49	8.1	35	4.2	22	3.5	0.4	0.8
S. flexneri 4a mannitol neg	69	11.5	103	12.4	21	3.4	0.3	0.3
S. flexneri 4a	12	2.0	13	1.6	12	1.9	0.9	1.2
Shigella species	21	3.5	27	3.3	11	1.7	0.5	0.4

and 1.1 cases per 100,000 (18 cases) amongst the 25–29 years age group and the 20–24 years age group respectively (Figure 6). This is likely to reflect higher rates of overseas travel in these age groups.

India was the most frequently reported country of travel for overseas-acquired cases of typhoid in 2009, with 61.8% (63/102) of cases. Phage type E1 was the most common phage type of typhoid cases with a known travel status (Table 8). Of the cases where no travel was reported, four were suspected or confirmed long term carriers of *S.* Typhi acquiring the infection overseas during childhood, 2 cases were secondary infections acquired from long term carriers and 4 cases were clustered geographically, however no source was identified. Travel history was not available for the remaining 3 cases.

Hepatitis A

The number of hepatitis A cases in Australia in recent years has decreased markedly from over 2,000 cases per year during the 1990s to a mean of 274 cases per year (1.3 cases per 100,000) between 2004 and 2008 (Figure 7). In 2009, there was an increase in the number of infections reported, with 563 cases (2.6 cases per 100,000) due to a large outbreak of locally-acquired cases between 1 March 2009 and 18 March 2010 associated with the consumption of semi-dried tomatoes (described under multi-jurisdictional outbreaks investigations) (Table 1).

Indigenous status was known for 93% of cases in 2009 (Table 9). The proportion of cases of hepatitis A in Australia who identify themselves as Indigenous remains low, with only 1% of cases in 2009 known to have been Indigenous compared with 10%–12% (37 to 53 cases) per year between 2003 and 2006 to less than 2% between 2007 (0 cases) and 2008 (3 cases).

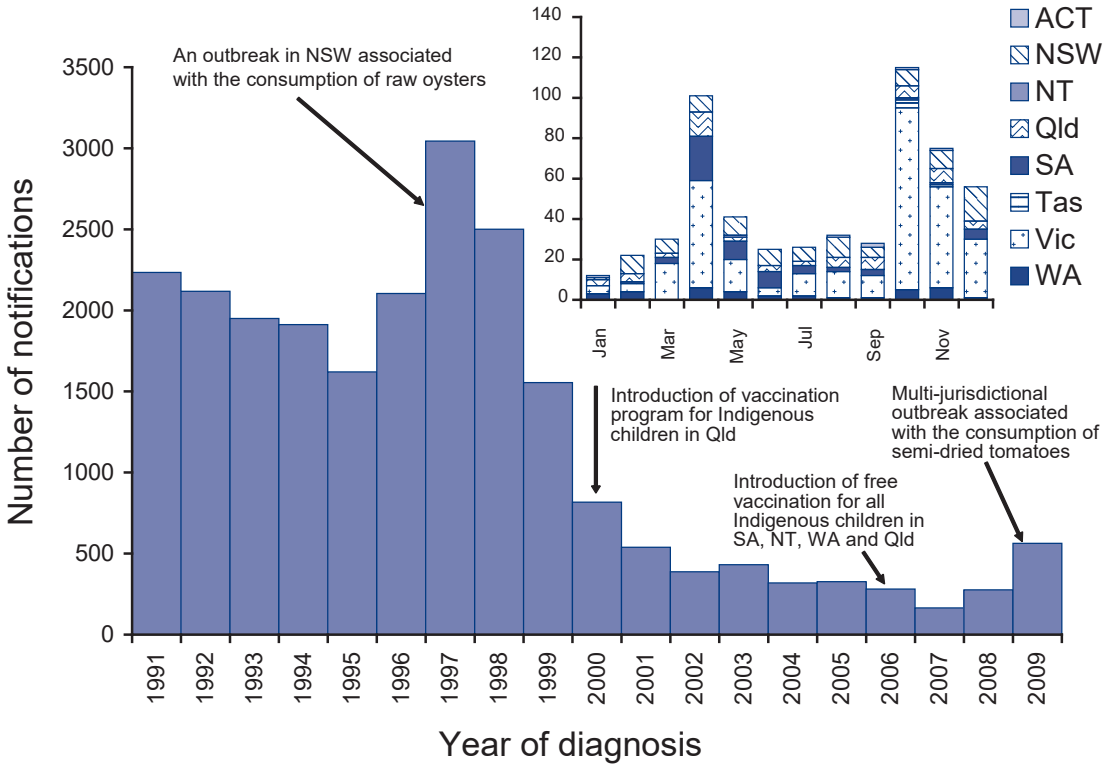
Table 9: Hepatitis A notifications, Australia, 2003 to 2009, by indigenous status

Year	Indigenous		Non-indigenous		Unknown	
	%	n	%	n	%	n
2003	12.3	53	75.4	325	12.3	53
2004	11.6	37	78.7	251	9.7	31
2005	15.0	49	70.9	232	14.1	46
2006	10.0	28	77.6	218	12.5	35
2007	0.0	0	88.5	146	11.5	19
2008	1.1	3	87.7	242	11.2	31
2009	1.4	8	91.1	513	7.5	42

Table 8: *Salmonella* Typhi phage types isolated from cases (n=115)

Country where travelled	Phage type (n)	Number of cases
India	28(1), 36(2), A(3), degraded(4), E1(30), E9(11), O var(1), unknown(3), untypable(3), blank(3), 28(1), E1 var(1)	63
Indonesia	Degraded(1), unknown(1), untypable(4)	6
Samoa	E1(3), E9(2)	5
Bangladesh	E9(1), unknown(1), untypable(2)	4
Pakistan	E1(1), E9(3)	4
Papua New Guinea	D2(3)	3
Morocco	E1(2)	2
Nepal	A(1), E1(1)	2
Thailand	E1(2)	2
Burma (Myanmar)	Untypable(1)	1
Ethiopia	36(1)	1
Fiji	E1a(1)	1
Malaysia	28(1)	1
Pakistan or Singapore	Blank(1)	1
Philippines	E1(1)	1
Somalia	Untypable(1)	1
Sri Lanka	Degraded(1)	1
Sudan	C1(1)	1
Thailand and Nepal	E1(1)	1
Uganda	E var(1)	1
No travel reported	50(1), A(5), E1(3), unknown(1), untypable(1), D1 var(2)	13

Figure 7: Notifications of hepatitis A, Australia, 1991 to 2009, by year of diagnosis[12] and inset, notifications of hepatitis A, by month and state or territory, 2009



This marked decrease in the past 3 years in the number and proportion of cases who are Indigenous is likely due to targeted vaccination programs for Indigenous children in Queensland commencing in 1999[13] and free vaccine from 2006 for Indigenous children in South Australia, the Northern Territory, Western Australia and Queensland.

Data on the place of acquisition for cases of hepatitis A was more complete than in previous years, and this may have been in part due to the multi-jurisdictional outbreak investigation, with more resources invested into complete follow-up for all cases and more complete documentation. A higher than usual proportion of cases were thought to have been locally acquired (67%, 377/563 in 2009 compared with less than 45% between 2004 and 2008), and this was also due to the outbreak. In 2009, 30% of cases (171/563) reported overseas travel during their incubation period for hepatitis A and were considered overseas acquired (Table 10). Overseas acquired cases most frequently reported travel to the Southeast Asian and South Asian regions. India was the most frequently reported country of travel, with 10% (17/171) of overseas acquired cases reporting travel to India, a higher than expected proportion since data on incoming passenger movements to Australia indicate that only 1% (73,299/12,430,460) of travellers report travel there (RR 17, 95% CI 10 to 28).

Table 10: Place of acquisition for cases of hepatitis A, 2004 to 2009, Australia

Year	Locally acquired		Acquired overseas		Unknown	
	%	n	%	n	%	n
2004	44.7	143	30.6	98	24.7	79
2005	36.7	121	31.8	105	31.5	104
2006	42.1	120	37.9	108	20.0	57
2007	30.5	50	57.9	95	11.6	19
2008	37.0	102	55.8	154	7.2	20
2009	67.0	377	30.4	171	2.7	15

Botulism

Four forms of naturally occurring botulism are recognised; adult, infant, foodborne and wound.[14] Infant botulism 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.

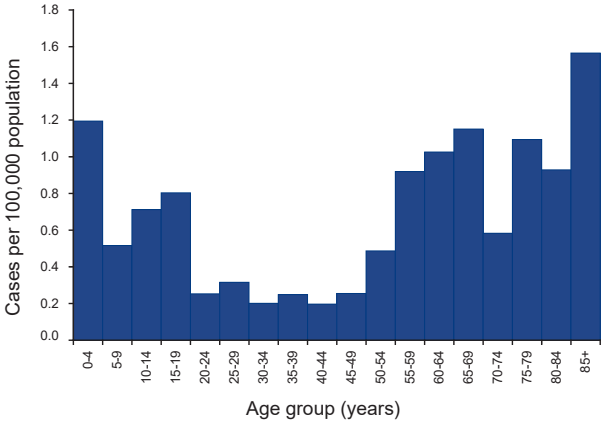
One case of infant botulism was reported in 2009, in a 5 month-old female infant from Queensland. The case was hospitalised in intensive care with onset of symptoms (acute flaccid paralysis) in March 2009. *C. botulinum* toxin was detected in a stool sample and culture by mouse bioassay, and identified as

toxin type B. The infant was entirely breast-fed. The child had not had a bowel motion for approximately 2 weeks prior to admission. It was suspected that the slow transient time within the bowel provided enough time for toxin to develop. Treatment included human immunoglobulin for infant botulism obtained from the United States of America (USA). There were no cases of botulism reported in 2008 and only 1 case was reported in 2007.

Shiga toxin-producing *Escherichia coli* infections

In 2009, there were 130 notifications of STEC in Australia, a rate of 0.6 cases per 100,000 population compared with 0.4 cases per 100,000 population between 2004 and 2008 (Table 1). The number of STEC notifications has increased over the past 5 years, from an average of 6 cases per month between 2004 and 2006 to 9 cases per month between 2007 and 2009 (Figure 8). STEC notifications have a seasonal association, tending to increase during the warmer months (November to April) (Figure 8).

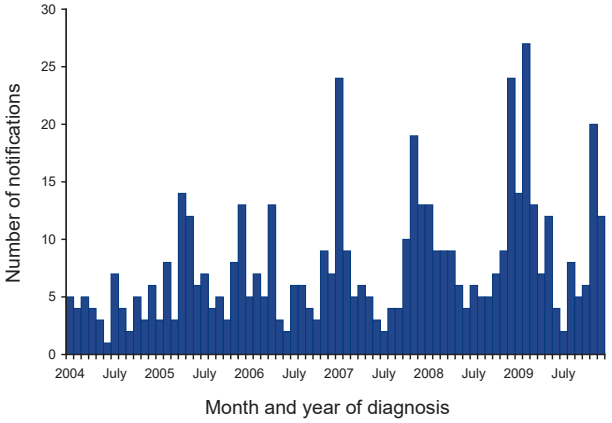
Figure 8: Shiga toxin-producing *Escherichia coli* notifications, Australia, 2004 to 2009, by month and year of diagnosis



There were no cases of STEC in the Australian Capital Territory or Tasmania in 2009. Rates of STEC infection are strongly influenced by jurisdictional practices regarding the screening of stool specimens.[15] In particular, South Australia routinely tests all bloody stools by polymerase chain reaction (PCR) for genes coding for Shiga toxins and other virulence factors, making rates for this State the highest in the country. During 2009, Queensland changed its screening procedures resulting in all stool specimens submitted for STEC testing now being screened for the presence of Shiga toxins using an enzyme immunoassay (EIA – Premier EHEC, Meridian BioScience) method in conjunction with PCR. Cases identified through this laboratory method do not meet the CDNA case definition to be included as a confirmed case. Therefore, they have been classified as 'probable' until the methodology has been reviewed and it is decided whether to include this method in the confirmed case definition. These probable cases (EIA positive only; PCR and/or culture negative) are not notified to the NNDSS.[16]

In 2009, 56.9% of cases were female. The median age of cases was 44 years (range 0–91 years). Age specific notification rates were highest in the youngest (0–19 years) with 35.4% (46/130) and oldest age groups (55 years or older) with 41.5% (54/130). The highest notification rate was amongst people aged 85 years or older (6 cases, 1.56 cases per 100,000 population) (Figure 9).

Figure 9: Age specific notification rates of STEC, Australia, 2009



In 2009, 20% (26/130) of cases were known to be outbreak associated. A further 14 cases were associated with a multi-jurisdictional cluster investigation. The STEC cluster investigation occurred between 23 March and 31 April 2009. The Microbiological Diagnostic Unit Public Health Laboratory typed isolates using pulsed field gel electrophoresis (PFGE) and phage typing and identified that amongst STEC O157 cases, there was a distinct cluster of 14 related cases. OzFoodNet epidemiologists identified several foods of interest through hypothesis generating interviews, but there were no common brands and the number of cases declined before an analytical study could be considered.

The most commonly identified serogroups (obtained by serotyping cultured isolates or by PCR targeting serotype-specific genes) of STEC cases in 2009 were O157, with 57 cases (43.8%), followed by O26 (8 cases, 6.2%) and O111 (6 cases, 4.6%). This is consistent with the serogroups reported in 2008. No organism was isolated or the serogroup was not reported for 36.9% (48/130) of cases.

Haemolytic uraemic syndrome

In 2009, OzFoodNet sites reported 12 cases of haemolytic uraemic syndrome (HUS); a rate of 0.05 cases per 100,000 population (Table 1) compared with a mean of 20 cases per year (0.10 cases per 100,000) for the years 2004 to 2008. Similar to previous years, the highest notification rate in 2009 was in children aged 0–4 years (Figure 10), with 33.3% (4 cases, 0.29 cases per 100,000) of cases notified in this age group.

Not all diagnoses of HUS are related to enteric pathogens (including those potentially transmitted by food), but in Australia cases are commonly associated with STEC. In 2009, an antecedent STEC infection was reported for 41.7% (5/12) of cases, with serogroup information reported for 80% (4/5) of these cases. *E. coli* O111 was reported in 2 instances, while serotypes ONT:H19 and OR:H25 were reported for 1 case each. For 1 HUS case for which *E. coli* infection was not confirmed, contact tracing revealed that the mother of the case was positive for *E. coli* O111 infection but was asymptomatic. Of the remaining non-STEC HUS cases, one was associated with a non-STEC *E. coli* infection, 1 case resulted from *Streptococcus pneumoniae* infection and in the remaining 4 cases, no aetiology was reported though one of these had multiple underlying health conditions.

In Australia, HUS cases show a seasonal pattern, tending to increase during late spring and early summer, with 46.5% (79/170) of cases between 1999 and 2008 occurring in November, December or January (Figure 11) compared with the expected 25% (3/12 months) of cases occurring during these months. In 2009, 33.3% (4/12) of cases occurred in November, December or January (Figure 11).

Gastrointestinal and foodborne disease outbreaks

During 2009, OzFoodNet sites reported 1,820 outbreaks of gastroenteritis, including both foodborne and non-foodborne outbreaks, which affected 36,426 people. During these outbreaks, 1,240 peo-

Figure 10: Age specific notifications of haemolytic uraemic syndrome, Australia, 2009

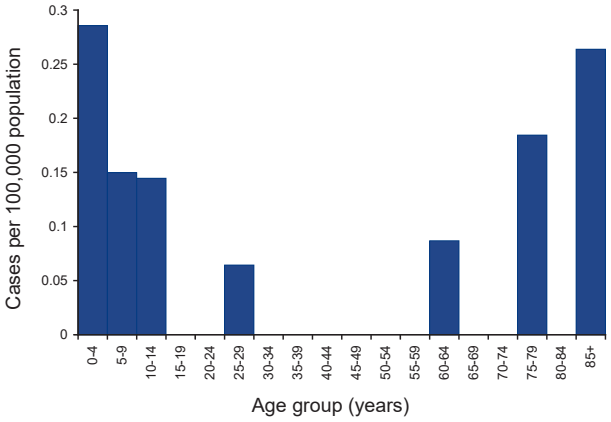


Figure 11: Notifications of haemolytic uraemic syndrome by month of diagnosis, Australia, 1999 to 2008, and inset, notifications of haemolytic uraemic syndrome by month of diagnosis, 2009

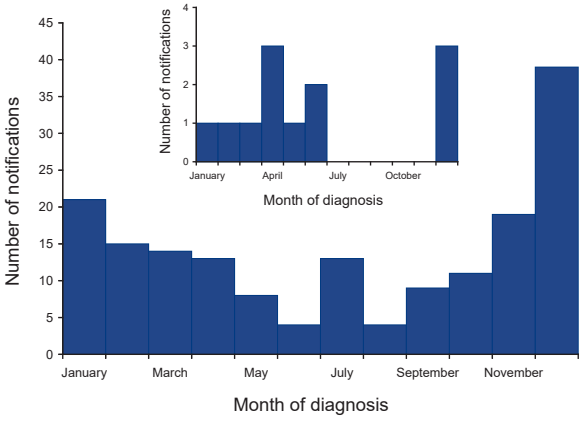


Table 11: Outbreaks of gastroenteritis including foodborne disease reported to state and territory health departments, Australia, 2009

Mode of transmission	Number of outbreaks	Number affected	Hospitalised	Fatalities
Foodborne*	163	2,679	342	8
Person-to-person	1,496	33,070	824	105
Unknown mode (*Salmonella* cluster)	15	168	14	0
Unknown mode (other pathogen cluster)	9	61	18	0
Unknown mode (unknown aetiology)	125	1,266	30	5
Waterborne	12	182	12	0
Total	1,820	36,426	1,240	118

* Includes 3 multi-jurisdictional outbreaks.

ple were hospitalised and there were 118 deaths (Table 11). This compares with the 5-year mean (2004–08) of 1,336 outbreaks reported in Australia.

Outbreaks spread person-to-person

In 2009, 82% (1,496/1,820) of all gastroenteritis outbreaks were reported as person-to-person transmission, affecting 33,070 people with 105 deaths. Aged care facilities (42%, 627/1,496) were the most frequently reported settings for person-to-person outbreaks, followed by hospitals (9%, 134/1,496) and child care centres (9%, 129/1,496). Fifty-two per cent (785/1,496) of person-to-person outbreaks were caused by norovirus and 32% (482/1,496) were of unknown aetiology. The number of person-to-person outbreaks due to norovirus does not include a small number of outbreaks of mixed aetiology that included norovirus or outbreaks where norovirus could not be confirmed as the aetiology of the outbreak. Spring was the peak season for person-to-person outbreaks, with 46% (685/1,496) of outbreaks reported in the months of September to November 2009.

Waterborne outbreaks

There were 12 outbreaks due to waterborne transmission, affecting 182 people. The largest outbreak, which had an unknown aetiology, affected 135 people and illness was suspected to have been associated with contaminated water at a school. *Cryptosporidium spp.* was the causative agent associated with 9 swimming pool outbreaks between January and March. The aetiologies of the remaining 2 outbreaks were unknown.

Outbreaks with unknown mode of transmission

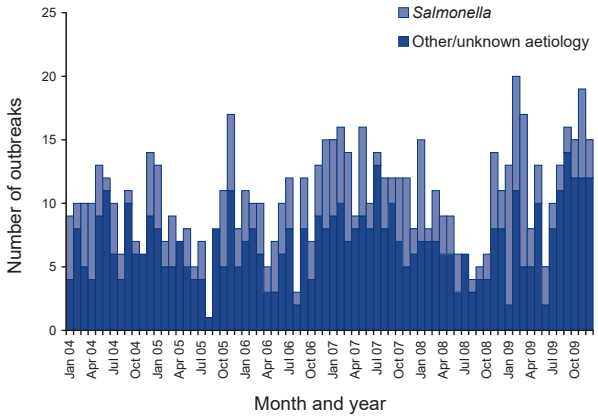
There were 149 outbreaks where the mode of transmission was not determined (clustered in time, place or person where investigators were unable to develop an adequate hypothesis for the source of illness) affecting a total of 1,495 people. There were 15 clusters of *Salmonella*, 9 clusters due to other pathogens and 125 clusters where neither the mode of transmission nor the aetiology could be determined.

Foodborne outbreaks

In 2009, there were 163 outbreaks of foodborne disease affecting 2,679 people of whom 342 people were hospitalised. There were 8 deaths reported during these outbreaks (Appendix). This compares with the 5-year mean (2004–08) of 118 foodborne outbreaks. Three of the 163 outbreaks were multi-jurisdictional, affecting 433 people with 168 hospitalisations and 4 deaths.

The overall rate of reported foodborne disease outbreaks for Australia was 7.5 outbreaks per million population in 2009 (Table 12). The highest rates of reporting were from the Australian Capital Territory (17.1 per million population) and the Northern Territory (13.3 per million population, although representing a small number of outbreaks). Outbreaks were more common in warmer months (Figure 12).

Figure 12: Outbreaks of foodborne disease reported to state and territory health departments, by aetiology month of outbreak, Australia, 2004–9 (n=751)



Aetiological agents

The mostly commonly implicated aetiological agent in outbreaks of foodborne illness was *Salmonella*, which caused 36% (59/163) of outbreaks and 80% (47/59) of these were due to *S.* Typhimurium (Table 13). The most commonly implicated *S.* Typhimurium subtype was phage type 170/108 (26 outbreaks) and included the following multi-locus variable number of tandem repeats analysis (MLVA) patterns 3-9-8-12-523 (6 outbreaks), MLVA 3-9-7-13-523 (4 outbreaks), MLVA 3-9-7-13-523 (2 outbreaks) and MLVA 3-9-7-12-532 (1 outbreak). There were also 5 outbreaks of phage type 44.

Toxin-mediated outbreaks comprised 9% (15/163) of all foodborne outbreaks, with 33% (5/15) of these due to fish toxins (2 outbreaks of ciguatera fish poisoning and 3 outbreaks of scombroid or histamine poisoning) and 67% (10/15) due to foodborne intoxications with *Clostridium perfringens*.

There were 3 foodborne outbreaks of *Campylobacter*, and norovirus was confirmed in 30 outbreaks. In the USA contamination of foods with norovirus is thought to be principally due to poor hygiene practices of foodhandlers.[17] In 2009, 27% (44/163) of foodborne outbreaks were of unknown aetiology compared with 37% in the previous year. Outbreaks

Table 12: Outbreaks of foodborne disease in Australia, 2009, by OzFoodNet site

State	Number of outbreaks	People affected	Mean size (persons)	Hospitalised	Outbreaks per million population
ACT	6	85	14.2	1	17.1
NSW	67	903	13.5	74	9.4
NT	3	2	0.7	0	13.3
Qld	20	164	8.2	11	4.5
SA	14	190	13.6	36	8.6
Tas	3	58	19.3	0	6.0
Vic	29	574	19.8	20	5.3
WA	18	270	15.0	32	8.1
Multijurisdictional	3	433	144.3	168	0.1*
Australia	163	2,679	16.4	342	7.5

* Calculated using Australia's total population.

Table 13: Aetiological agents responsible for foodborne disease outbreaks, number of outbreaks and persons affected, Australia, 2009

Agent category	Number of outbreaks	People affected	Mean size (persons)	Hospitalised
Salmonella Typhimurium	47	646	13.7	110
Norovirus	30	731	24.4	7
Other *Salmonella* serotypes	12	119	9.9	22
Foodborne intoxication	10	139	13.9	2
Ciguatera/histamine poisoning	5	15	3	6
Hepatitis A	4	411	102.8	170
Campylobacter	3	44	14.7	0
Shiga toxin-producing *Escherichia coli*	2	37	18.5	8
Listeria monocytogenes	2	38	19	4
Fish wax ester	2	30	15	0
Escherichia coli	1	Unknown	Unknown	0
Yersinia enterocolitica	1	3	3	0
Unknown	44	466	10.6	13
Total	163	2,679	16.4	342

due to hepatitis A and fish wax ester outbreaks were implicated in 2% (4/163) and 1% (2/163) of all foodborne outbreaks respectively. STEC and *L. monocytogenes* were each implicated in 1% of outbreaks (2/163) and 1 outbreak (1%, 1/163) was due to *E. coli*. *Yersinia enterocolitica* was identified in 1 outbreak (1% of all foodborne outbreaks).

Food vehicles

A wide variety of food vehicles were implicated in outbreaks of foodborne disease in 2009, and investigators were unable to identify a food vehicle in 58% (94/163) outbreaks (Table 14).

There were 18 outbreaks (11% of all foodborne outbreaks) associated with eggs (Table 15). Eight of these outbreaks were suspected or confirmed to have involved desserts that commonly contain raw egg (such as tiramisu and fried ice-cream), five were due to egg based sauces or dressings (such as aioli and mayonnaise), 4 outbreaks were suspected to have been caused by chicken and/or eggs and 1 outbreak was due to eggs as a whole food. These outbreaks affected a total of 343 people and hospitalised 54 people.

Ten (6%) of the 163 foodborne outbreaks were due to mixed dishes where investigators were unable to implicate a particular ingredient, 10 (6%) were due to or suspected to be due to fish or seafood dishes (including the multi-jurisdictional outbreak of *S.* Litchfield suspected to be associated with a barramundi meal) and 9 (6%) were confirmed or suspected to be due to be salads and/or sandwiches.

Table 14: Categories of food vehicles implicated in foodborne disease outbreaks, Australia, 2009

Vehicle category	Number of outbreaks	Number affected	Mean size (persons)	Hospitalised
Mixed dishes	10	123	12.3	15
Fish/seafood	8	47	5.9	6
Egg containing desserts	7	88	12.6	12
Suspected salad and/or sandwiches	7	75	10.7	9
Egg based sauces and dressing	5	187	37.4	28
Meat and meat containing dishes	5	75	15.0	0
Chicken and chicken containing dishes	4	103	25.8	2
Suspected chicken and/or eggs	4	23	5.8	5
Semi dried tomatoes	3	406	135.3	169
Fruit	3	36	12.0	6
Salads and/or sandwiches	2	46	23.0	0
Dessert	2	25	12.5	0
Suspected gravy	2	31	15.5	6
Suspected meat and meat containing dishes	2	11	5.5	2
Suspected seafood	2	8	4.0	1
Suspected vitamised foods	1	22	22.0	0
Eggs	1	39	39.0	7
Suspected egg containing desserts	1	6	6.0	2
Unknown	94	1,328	14.1	72
Total	163	2,679	16.4	342

Four per cent (7/163) were due to or suspected to be caused by meat or meat containing dishes. Two per cent (4/163) were due to chicken or chicken containing dishes (including the multi-jurisdictional outbreak of *Listeria* associated with chicken wraps) and 4% (6/163) were due to produce (including the multi-jurisdictional outbreak of hepatitis A associated with semi-dried tomatoes). The remaining outbreaks were suspected to have been due to gravy (2), dessert (2) and suspected vitamised foods (1) .

Settings where food was prepared

In 2009, foods implicated in outbreaks were most commonly prepared in restaurants (39%, 64/163), aged care facilities (12%, 20/163) or by commercial caterers (11%, 18/163) (Table 16).

In 2009, implicated foods that were contaminated in primary produce environments (6%, 10/163) were Spanish mackerel, escolar fish, tuna, anchovies, semi-dried tomatoes, berries, fresh chilli, and paw-paw.

Investigative methods and levels of evidence

To investigate these foodborne outbreaks, epidemiologists in the states and territories conducted 37 retrospective cohort studies and 8 case control studies. Descriptive case series investigations were conducted for 108 outbreaks. There was no patient data collected for 10 outbreaks. Analytical evidence and microbiological evidence were obtained for 5 outbreaks, analytical evidence alone was obtained for 14 outbreaks and microbiological evidence alone was obtained for 14 outbreaks. Investigators relied on descriptive evidence implicating the food vehicle in 128 outbreaks and 1 outbreak relied on descriptive and microbiological evidence.

Significant outbreaks

In 2009, there were 9 outbreaks of foodborne illness affecting 40 or more people per outbreak; 1 outbreak of *C. perfringens,* 2 outbreaks of norovirus, 2 outbreaks of *S.* Typhimurium 170 and 1 outbreak of unknown aetiology. In total these outbreaks affected 453 people, ranging between 40 and 165 people per outbreak with 19 people hospitalised. There were 3 multi-jurisdictional outbreaks that also affected more than 40 people (described under multi-jurisdictional outbreak investigations).

Victoria reported 3 significant outbreaks.

- An outbreak of gastrointestinal illness affected 165/284 people from 2 separate groups attending a restaurant on 2 consecutive nights in November. Only 1 stool sample was collected, which was positive for norovirus. The symptoms and median incubation period for cases were consistent with norovirus aetiology. A food vehicle was not identified.

Table 15: Outbreaks of foodborne illness associated with eggs, Australia, 2009 (n=18)

State	Setting prepared	Agent responsible	Number affected	Evidence	Responsible vehicles
ACT	Restaurant	*Salmonella* Typhimurium 170	20	A	Tiramisu
NSW	Restaurant	*Salmonella* Singapore	3	M	Fried ice cream prepared with raw eggs
	Restaurant	*Salmonella* Typhimurium 170 MLVA 3-9-7-12-523	33	AM	Fried ice cream prepared with raw eggs
	Restaurant	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	40	A	Hollandaise sauce prepared with raw eggs
	Commercial caterer	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	68	AM	Mayonnaise prepared with raw eggs
	Bakery	*Salmonella* Virchow	10	D	Suspected Margarine/butter prepared with raw eggs
	Bakery	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	9	D	Suspected chicken and/or eggs
	Private residence	*Salmonella* Typhimurium MLVA 3-13-9-11-550	6	D	Suspected tiramisu prepared with raw eggs
	Restaurant	*Salmonella* Typhimurium 170 MLVA 3-9-7-13-523	2	D	Suspected chicken and/or eggs
NT	Private residence	*Salmonella* Typhimurium U302	2	D	Suspected Tiramisu
SA	Private residence	*Salmonella* Typhimurium 44	16	A	Tiramisu
	Restaurant	*Salmonella* Typhimurium 135	7	D	Fried ice cream
	Restaurant	*Salmonella* Typhimurium 44	30	A	Garlic aioli
Vic	Private residence	*Salmonella* Typhimurium 3	6	D	Suspected eggs
WA	Restaurant	*Salmonella* Typhimurium 170	39	A	Scrambled eggs
	Restaurant	*Salmonella* Singapore	6	D	Suspected chicken and/or eggs
	Restaurant	*Salmonella* Saintpaul	7	M	Fried ice cream
	Takeaway	*Salmonella* Typhimurium 170	39	D	Raw egg mayonnaise

D Descriptive evidence implicating the vehicle

A Analytical epidemiological association between illness and vehicle

M Microbiological confirmation of aetiology in vehicle and cases

Table 16 Food preparation settings implicated in disease outbreaks, Australia, 2009

Setting prepared	Number of outbreaks	Proportion of all outbreaks (%)	Number affected (persons)
Restaurant	64	39	921
Aged care facility	20	12	294
Commercial caterer	18	11	343
Private residence	11	7	74
Primary produce	10	6	471
Takeaway	9	5	149
Other	8	5	128
Bakery	4	2	51
Camp	4	2	89
Military	2	1	23
School	1	1	37
Child care	1	1	18
Fair/festival/mobile service	1	1	3
National franchised fast food	1	1	3
Unknown	9	5	75
Total	163	100	2,679

- An outbreak of gastrointestinal illness affected 87 people from 8 separate groups dining at the same restaurant on 3 consecutive days in August. Illness was suspected to be due to contamination of food during a smorgasbord service of meals. Two out of 7 people interviewed were food handlers at the restaurant and reported illness with onset dates consistent with the patrons. Thirteen cases were confirmed with norovirus.
- An outbreak of gastroenteritis was reported among 41/86 people after consuming foods prepared by a commercial caterer in October. The description of symptoms, incubation period, duration of symptoms and 1 secondary case was consistent with a viral aetiology. The analysis of the cohort study revealed no significant associations with any specific food or illness. There were no reports of any illness at the function and no food handlers were reported to have been ill. It is suspected that this outbreak was foodborne although there was no definitive evidence of foodborne transmission.

New South Wales reported 2 significant foodborne outbreaks.

- An outbreak of gastroenteritis was reported amongst 68 of 120 people who consumed foods prepared by a commercial caterer in January. Fourteen people were hospitalised due to illness. Twenty-four of 30 collected stool samples were positive for *S.* Typhimurium 170 MLVA 3-9-8-12-523. A homemade raw egg mayonnaise served by the commercial caterer was found to contain *S.* Typhimurium 170 MLVA 3-9-8-12-523.
- An outbreak of gastrointestinal illness affected 40 of 100 people at a restaurant in January. Five people were hospitalised due to illness. *S.* Typhimurium 170 MLVA 3-9-8-12-523 was isolated in 2 of 8 stool samples. A cohort study found an association with hollandaise sauce prepared with raw eggs; however there was no food remaining from the function that could be tested.

The Australian Capital Territory reported an outbreak of gastroenteritis illness affecting 52 of 126 residents of an aged care facility in July. Aetiology of the outbreak was confirmed as *C. perfringens* with 8 of 52 stool samples from residents positive for *C. perfringens* enterotoxin A. There were no food isolates available for testing; however a cohort study suggested an association between illness and the level of service offered to residents (which reflected meal options).

Multi-jurisdictional outbreak investigations

In 2009 there were 3 multi-jurisdictional outbreak investigations coordinated by OzFoodNet.

Salmonella Litchfield

An outbreak of *Salmonella* Litchfield occurred in June during a charity car rally travelling through Queensland and the Northern Territory.[18] The investigation team contacted 286 participants inviting them to complete an online survey. In total, 43% (76/176) of respondents were ill with gastroenteritis, including 5 confirmed cases of *S.* Litchfield across four jurisdictions; New South Wales (2), Victoria (1), Queensland (1) and Western Australia (1). Consumption of a variety of foods and meals were associated with illness, with barramundi having the highest relative risk (RR= 3.8, 95% CI 1.0–14.2) for illness. A source of illness was not definitively identified.

Listeria monocytogenes

A multi-jurisdictional outbreak of 13 laboratory-confirmed cases of invasive listeriosis (*Listeria monocytogenes* molecular serotype: 1/2c, binary gene type: 82) occurred between January and July with cases in Queensland (5), Victoria (3), New South Wales (2), South Australia (1), Western Australia (1) and Tasmania (1). In addition, there were 23 epidemiologically-linked cases of non-invasive illness associated with this outbreak, 22 with clinical symptoms of gastroenteritis only. Headaches (100%), fever (100%), diarrhoea (100%), abdominal pain (96%) and vomiting (43%) were the most commonly reported symptoms among the 22 clinical cases.

A case–case comparison study of outbreak cases and non-outbreak sporadic cases was conducted to identify potential risk factors associated with the outbreak. Eight of the 13 of the laboratory-confirmed cases were materno-foetal infections with 3 foetal deaths at 15, 20 and 40 weeks gestation. Eight of the 13 laboratory-confirmed cases and 17 of 22 clinical cases reported consuming chicken wraps on a particular domestic airline. Laboratory confirmed cases infected with the outbreak strain (n = 13) were more likely to have flown on a domestic airline in the 3 months before onset of illness (OR 30.0, 95% CI: 2.3, 885.7, $P < 0.001$) and more likely to have consumed chicken wraps (OR 27.2, 95% CI: 2.2, 758.5, $P = 0.001$), when compared with sporadic cases of *L. monocytogenes* infected with other strains (n = 40). Traceback investigation subsequently led to the isolation of the outbreak strain of *Listeria* from pre-packaged chicken sandwiches and wraps. The cooked diced chicken meat used in the sandwiches and wraps was supplied by a New South Wales food processing business to a food manufacturer in Queensland where the sandwiches and wraps were prepared. The food manufacturer in Queensland was a supplier of the chicken wraps to the domestic airline and several other food businesses. An

environmental investigation identified deficiencies in the food safety program for the production of chicken meat.

Hepatitis A

A large outbreak of locally-acquired hepatitis A (genotype 1B†) was investigated between 1 March 2009 and 18 March 2010 (the outbreak period) manifesting as 2 separate temporal clusters peaking in April and November 2009 (Figure 7).

In May 2009, OzFoodNet reported an increase in locally-acquired hepatitis A cases in Victoria, South Australia, and Queensland triggering a multi-jurisdictional outbreak investigation. The number of reported cases of hepatitis A nationally returned to expected levels by the end of May. Victoria commenced investigating a second wave of cases beginning at the end of June 2009 and the multi-jurisdictional outbreak investigation was re-opened on 2 November 2009. Three separate case control studies were conducted to investigate the outbreak, and each confirmed associations between illness and the consumption of semi-dried tomatoes.[19,20]

There were 415 locally-acquired cases of hepatitis A in Australia during the outbreak period, the majority (64%, 267/415) of them from Victoria. Cases were considered to have been locally acquired if they had no reported overseas travel in the 50 days prior to the onset of symptoms. There were 372 primary cases, 43 secondary cases (considered likely to have been due to person-to-person transmission from previously reported cases) and three were unknown. Of the 244 primary cases who were interviewed, nearly half (47%, 115/244) reported consuming semi-dried tomatoes, while 25% (61/244) could not recall. A tiered case definition was used to define outbreak cases. A confirmed outbreak case was a locally-acquired and laboratory-confirmed case of hepatitis A virus (HAV) infection with genotype 1B, a suspected outbreak case was a locally-acquired and laboratory-confirmed case of HAV infection with subtype pending or unavailable and a sporadic case was locally acquired and laboratory confirmed as infected with a HAV genotype other than 1B. There were 169 confirmed and 223 suspected outbreak cases during the outbreak period, 67% (261/392) of them from Victoria. Nearly half of all suspected and confirmed outbreak cases were hospitalised (42%, 165/392) and 1 case from Victoria was fatal.

A range of public health actions resulted from the investigations. Trade level recalls were conducted in South Australia in May 2009 following the outcomes of the first case control study and in Victoria in October 2009 after product of a particular brand tested positive for HAV genetic material. In November 2009, Victoria's Chief Health Officer exercised an emergency power under the *Victorian Food Act 1984,* requiring manufacturers of semi-dried tomatoes to either pasteurise finished semi-dried tomato products or to ensure that all tomatoes used in the production were sanitised prior to drying. Media releases were issued by Victoria, South Australia and Queensland in May 2009 advising about the first recall and not to eat specific brands and by Victoria, Western Australia and Tasmania in November 2009 advising consumers not to eat semi-dried tomatoes unless thoroughly cooked.

Information provided through a notification under the World Health Organization (WHO) *International Health Regulations* (2005), via the WHO International Food Safety Authorities Network (INFOSAN) and the European Centre for Disease Control prompted the Euro virology network to compare sequences and identify a related cluster of hepatitis A in The Netherlands. The sequences of the Australian outbreak strain and the cluster in The Netherlands were found to be identical.[21] The sequence of the hepatitis A virus from the outbreak in France was similar but not the same as the virus from The Netherlands and Australian outbreaks.[21] In an outbreak in France, investigators were alerted to the possibility of an epidemiological link with semi-dried tomatoes. Case-control studies identified semi-dried tomatoes as the source of infection in both countries.[21 22]

Cluster investigations

In 2009, OzFoodNet epidemiologists and state and territory health departments investigated 24 clusters of various aetiologies. A cluster is defined as an increase in a specific infection in terms of time, place, or person where a source and mode of transmission remains unknown. The majority of these investigations involved *Salmonella* serotypes (15) for which no common food vehicle or source of infection could be identified: *S.* Havana, *S.* Singapore, *S.* Stanley, *S.* Typhimurium (phage types 141 and 170 and MLVA type 3-9-7-13-523), *S.* Virchow, *S.* Wangata, *S.* Infantis and *S.* Heidelberg. However, a multi-jurisdictional cluster of *Salmonella* Typhimurium 170/108 occurring between 3 April and 20 May 2009 in Queensland, New South Wales and the Australian Capital Territory was suspected to have been associated with chicken and/or eggs. The multi-jurisdictional cluster consisted of 15 smaller outbreaks of *S.* Typhimurium 170/108 that were counted as individual foodborne outbreaks (described under gastrointestinal and

† The designation 1B has been agreed amongst the 3 laboratories conducting genotyping of isolates for this outbreak and may not be directly comparable to results obtained in other laboratories or over time.

foodborne outbreaks). The remaining 9 clusters were due to a variety of infections; *Campylobacter, Cryptosporidium, Shigella, Yersinia* and STEC.

Discussion

This report documents changes in the incidence of gastrointestinal diseases commonly transmitted by food in Australia. Foodborne disease surveillance provides information to assist immediate public health action, the prevention of these diseases and the assessment of food safety policies and campaigns. A national program of surveillance for foodborne diseases and outbreak investigation has many benefits including identifying foods that cause human illness through investigation of outbreaks that occur across state and territory borders. Continuing efforts 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.

Similar to 2008, higher rates of campylobacteriosis were observed in males than in females, particularly those over the age of 45 years.[12] In Australia, the primary source of *Campylobacter* infection is thought to be chicken consumption, causing an estimated 29.3% of all infections.[23] This is consistent with findings from other countries, although recent work in New Zealand highlights that the proportion of campylobacteriosis due to chicken meat consumption may be higher.[24] In 2009, the New Zealand Food Safety Authority announced that the poultry industry had successfully reduced the prevalence of *Campylobacter* in chicken meat, which had lead to a marked decline in human cases.[25] In March 2010, the FSANZ Board approved a draft Primary Production and Processing Standard for Poultry Meat, which will introduce new requirements within the poultry industry with the aim of reducing the prevalence of *Campylobacter* and *Salmonella* in poultry meat.[26]

In 2009, the proportion of *Salmonella* isolates that contained appropriate information on serotype and/or phage type decreased by 2.4% compared with 2008. Typing is vital for outbreak detection and monitoring trends. Western Australia's *Salmonella* isolates are phage typed in other jurisdictions and in 2007 as an alternative, Western Australia started using PFGE, which is conducted within the jurisdiction. PFGE is a discriminatory technique for typing *Salmonella* but not routinely used by other Australian laboratories.[27] Other jurisdictions used MLVA to compare strains during outbreaks, which proved rapid and very useful. Inconsistencies in typing schemes, including differences in MLVA nomenclature between states and territories, cause complexity during multi-jurisdictional investigations. Despite this there is increasing harmonisation in typing schemes used by Australian laboratories. OzFoodNet has identified the need for more complete and consistent *Salmonella* subtyping (serotypes, MLVA, phage typing and PFGE for clusters) nationally to better identify multi-jurisdictional outbreaks. The CDNA's National Surveillance Committee has acknowledged this by including salmonellosis on its national typing priority list in 2010.

The Department of Foreign Affairs and Trade provides specific country information to travellers about health risks and measures that can be taken to reduce the risk of infection.[28] In this report we summarised 3 infections commonly associated with travel overseas; typhoid (89% of cases), hepatitis A (30% of cases) and *S.* Enteritidis (87% of cases). The percentage of overseas acquired infections of hepatitis A are lower than previous years (in 2008 54.7% cases were overseas acquired) due to larger numbers of locally-acquired hepatitis A cases attributed to a large outbreak of hepatitis A associated with semi dried tomatoes. Travel to South East Asia and India were the most common place of acquisition for these infections. People who travel overseas are at a higher risk of developing infections without recommended preventative vaccinations for particular infections or appropriate caution when consuming water and food in overseas countries.

In 2009, OzFoodNet sites reported 1,820 outbreaks of gastrointestinal disease, which was 18% more than that reported in 2008 (1,545).[12] Similar to previous years, the majority of outbreaks in 2009 were transmitted from person-to-person (82%) and were most frequently caused by norovirus (52%) followed by those of unknown aetiology (44%). Aged care facilities (42%) was the most commonly reported setting for person-to-person infections, reflecting the frequency with which outbreaks of gastrointestinal illness occur, the ease of transmission in this setting and the improved reporting practices of these facilities. Case reporting of gastrointestinal outbreaks in aged care settings are well established, with outbreak preparedness enhanced through the introduction of resources, such as the Department of Health and Ageing Gastroenteritis Kit for Aged Care[29] to manage and prevent outbreaks in this setting.

Norovirus is one of the most common causes of gastroenteritis outbreaks globally. In response to increasing reports of outbreaks in 2005, CDNA proposed developing national guidance regarding outbreaks of norovirus and suspected viral gastroenteritis. A CDNA working group developed the *Guidelines for the public health management of gastroenteritis outbreaks due to norovirus or suspected viral agents in Australia*.[30] The guidelines are designed to assist state and territory health departments and public health units in managing outbreaks of gastroenteritis due to norovirus or suspected viral agents, and provide advice to aged care homes regarding management of suspected viral outbreaks. The guidelines comple-

ment existing state and territory protocols and the guidelines and were endorsed by CDNA and the Australian Health Protection Committee (AHPC) in early 2010.

In 2009, OzFoodNet sites reported 163 foodborne or suspected foodborne outbreaks (including 3 multi-jurisdictional outbreak investigations), a rate of 7.5 outbreaks per million population. This is a higher reporting rate than in 2008 with 4.9 outbreaks per million population, which was comparable with an estimated 4.18 outbreaks per million in the USA in 2006.[31] *Salmonella* continues to be the leading cause of reported outbreaks of foodborne illness in Australia, with 36% of outbreaks due to this pathogen, the majority of them due to *S.* Typhimurium (80%). In 2009, there were 9 large outbreaks of foodborne illness (affecting 40 or more people) including 3 multi-jurisdictional outbreaks. Excluding the multi-jurisdictional outbreaks, the largest of these large outbreaks was suspected to have been due to norovirus and affected 165 people who dined at the same restaurant over 2 consecutive nights. A food vehicle was not identified in this outbreak.

Eggs were suspected as the cause of 26% (18/69) of foodborne outbreaks where investigators were able to identify a food vehicle. Eggs are a commonly consumed food, used as an ingredient of many dishes, and may be served raw or lightly cooked in dishes such as aioli, sauces and desserts. It is important that egg safety continues to be improved in Australia. During 2009, FSANZ continued developing a primary production and processing standard for eggs that is considering safety of the whole production chain from farm through to retail.[32]

It is important to recognise some of the limitations of the data used in this report. Where there are small numbers of notifications, caution must be used in comparisons between jurisdictions and over time. Some of the most common enteric pathogens are not notifiable, particularly norovirus and *C. perfringens*, which is why surveillance of outbreaks is important. A limitation of the outbreak data provided by OzFoodNet sites for this report is the potential for variation in categorising features of outbreaks depending on investigator interpretation and circumstances. States and territories are working towards harmonising surveillance and outbreak data to address some of these issues.

In 2004, DoHA commissioned an evaluation of Australia's capacity to investigate outbreaks of foodborne illness. It was clear from the assessment that while there had been a marked improvement in capacity since the establishment of OzFoodNet in 2000, there was no national plan describing who would perform what functions during major national outbreaks, or during more common smaller multi-jurisdiction cluster investigations. In response to this evaluation, OzFoodNet developed its *Guidelines for the investigation and management of multi-jurisdictional outbreaks of foodborne illness* (the Guidelines) which have been used by the network in draft form since May 2009. The Guidelines provide clear guidance framework to the OzFoodNet network for national management and investigation of multi-jurisdictional outbreaks potentially linked to contaminated food sources in a timely, appropriate, consistent and coordinated manner. The Guidelines formalise current arrangements between agencies that investigate multi-jurisdictional outbreaks of foodborne illness and complement the National Food Incident Response Protocol developed by FSANZ. The Guidelines were endorsed by CDNA in September 2010 and are pending endorsement by the AHPC. The effectiveness of each multi-jurisdictional outbreak investigation is assessed by OzFoodNet, and any necessary enhancements made to the Guidelines, through a structured audit process, using the template provided in the Guidelines.

On 11 February 2010, representatives of OzFoodNet's national and jurisdictional sites, state health departments, the NSW Food Authority, FSANZ and public health laboratories met in Newcastle to conduct a debrief of the response to the 2009 multi-state outbreak of listeriosis. The debrief identified the need for nationally standardised rapid subtyping of *Listeria* isolates from humans and for the centralised collection of epidemiological data. An action arising from the meeting was to develop a conceptual plan for the surveillance of human *Listeria* isolates to ensure they are typed using a national approach and that epidemiological data are available for rapid analysis of clusters. This plan also requires states and territories to undertake molecular serogroup and binary typing of *Listeria* isolates to enable clearer identification of clusters and outbreaks. This plan has been endorsed by Public Health Laboratory Network.

While the proportion of hepatitis A infections that may be foodborne is thought to be less than 10%, it is important to keep this infection under surveillance as it can manifest in large outbreaks of foodborne disease. This was observed in the 2009 outbreak of hepatitis A associated with semi-dried tomatoes, an outbreak of international public health concern.[33,34] The outbreak was a major investigative and control effort for all of the agencies involved; state and territory health authorities, Food Standards Australia New Zealand, OzFoodNet (in the jurisdictions and in the Department of Health and Ageing) and laboratory staff. The hepatitis A outbreak occurred concurrently with the 2009 pandemic influenza A (H1N1) between mid-May and late September 2009[35] and many foodborne disease epidemiologists and laboratory technicians were also

integral to surveillance and response efforts for the pandemic. The hepatitis A outbreak highlighted the effectiveness of the OzFoodNet surveillance model, with enhanced inter-jurisdictional communication and collaboration of epidemiological laboratory and traceback evidence leading to early detection and a rapid response. Sharing information internationally about the outbreak in Australia was vital to investigators finding the source of infection for outbreaks occurring overseas. The WHO INFOSAN network proved an effective network for coordination of the international investigation, and Australia's ability to liaise and investigate potential sources of contaminated raw product overseas was greatly enhanced by the network.

In 2009, OzFoodNet provided epidemiological support to the investigation of a cluster of thyroid conditions thought to be associated with the consumption of particular seaweed and products containing seaweed that were found to contain high levels of iodine and were subsequently recalled. Between 23 December 2009 and 6 October 2010, 50 cases of thyroid dysfunction that were suspected to be associated with the consumption of products containing excessive levels of iodine, were reported to state and territory health authorities, and collected into a national database. Forty-seven of these cases were associated with Bonsoy soy milk, two were associated with an unknown brand soy milk and one was due to consumption of a dried seaweed product prepared as a soup. Cases were reported from Victoria (25), New South Wales (20), South Australia (2), Western Australia (2) and the Australian Capital Territory (1).

In May 2009, DoHA hosted the WHO's 9th annual Global Salm-Surv Steering Committee meeting in Canberra. The Steering Committee oversees WHO's international program for the enhancement of laboratory-based foodborne disease surveillance and outbreak detection and response worldwide. WHO's Global Salm-Surv Steering Committee members attended the 9th annual meeting from WHO, Switzerland; National Food Institute, Denmark; National Institute of Public Health, Japan; Public Health Agency of Canada; OzFoodNet, Australia; and the Centres for Disease Control and Prevention, United States. At the meeting, the Steering Committee agreed to change its name to the Global Foodborne Infections Network: A WHO network building capacity to detect, control and prevent foodborne and other enteric infections from farm to table.

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Appendix : Foodborne outbreak summary for OzFoodNet sites, Australia, 2009

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
ACT	February	Private residence	Scombroid	2	1	0	D	Descriptive case series	Tuna steak	Fish/seafood
	February	Restaurant	*Salmonella* Typhimurium 170	20	0	0	A	Case control study	Tiramisu	Egg containing desserts
	March	Private residence	*Salmonella* Typhimurium 170	5	0	0	D	Descriptive case series	Zucchini bake	Mixed dishes
	May	primary produce	Rudderfish/escolar	3	0	0	D	Descriptive case series	Rudderfish	Fish/seafood
	July	Aged care facility	*Clostridium perfringens*	52	0	0	A	Cohort	Sweet and sour pork probable food vehicle	Meat and meat containing dishes
	July	Restaurant	*Yersinia enterocolitica*	3	0	0	D	Descriptive case series	BBQ pork or roast pork	Meat and meat containing dishes
NSW	January	Aged care facility	*Salmonella* Typhimurium 170 MLVA 3-9-7-13-523	4	0	0	D	N	Unknown	Unknown
	January	Bakery	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	9	1	0	D	Descriptive case series	Suspected cross-contamination with raw mince through piping bag, of chocolate, custard and cream cakes	Suspected chicken and/or eggs
	January	Commercial caterer	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	68	14	0	AM	Cohort	Mayonnaise prepared with raw eggs	Egg based sauces and dressing
	January	National franchised fast food	*Salmonella* Typhimurium 170 MLVA 3-9-7-13-523	3	1	0	D	Descriptive case series	Suspected bacon and beef burgers	Suspected meat and meat containing dishes
	January	Primary produce	Histamine	2	1	0	M	N	Tinned anchovies imported from Morocco	Fish/seafood
	January	Private residence	*Salmonella* Typhimurium MLVA 3-15-16-14-523	4	1	0	D	Descriptive case series	Unknown	Unknown
	January	Restaurant	*Salmonella* Chester	14	2	0	M	Descriptive case series	Fresh chillies used to prepare chilli sauce	Salads and/or sandwiches
	January	Restaurant	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	40	5	0	A	Cohort	Hollandaise sauce prepared with raw eggs	Egg based sauces and dressing
	January	Takeaway	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	2	1	0	D	Cohort	Suspected chicken salad roll with homemade mayonnaise	Suspected salad and/or sandwiches

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2009, *continued*

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
NSW, cont'd	February	Aged care facility	*Clostridium perfringens* enterotoxin A	25	0	0	M	Descriptive case series	Suspected vegetable gravy	Suspected gravy
	February	Commercial caterer	*Salmonella* Montevideo	10	2	0	D	Descriptive case series	Unknown	Unknown
	February	Restaurant	Unknown	5	0	0	D	Descriptive case series	Unknown	Unknown
	February	School	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	37	0	0	D	Cohort	Unknown	Unknown
	February	Takeaway	*Salmonella* Typhimurium 170	3	1	0	M	Descriptive case series	Unknown	Unknown
	February	Takeaway	Unknown	6	6	0	D	N	Unknown - suspected gravy	Suspected gravy
	March	Aged care facility	*Salmonella* Typhimurium 170 MLVA 3-9-8-12-523	26	2	0	D	Descriptive case series	Unknown	Unknown
	March	Bakery	*Salmonella* Typhimurium 170 MLVA 3-9-7-13-523	8	1	0	D	Descriptive case series	Suspected chicken/pork rolls	Suspected meat and meat containing dishes
	March	Bakery	*Salmonella* Virchow	10	3	0	D	Cohort	Suspected bread rolls with pork filling (with homemade margarine/ butter with raw egg)	Egg based sauces and dressing
	March	Restaurant	*Campylobacter*	4	0	0	D	N	Suspected steak with chips and salad	Mixed dishes
	March	Restaurant	*Salmonella* Typhimurium 170 MLVA 3-9-7-12-523	33	9	0	AM	Cohort	Fried ice cream prepared with raw eggs	Egg containing desserts
	March	Restaurant	*Salmonella* Typhimurium 170 MLVA 3-9-7-13-523	2	1	0	D	Descriptive case series	Unknown - Fijian chicken suspected	Suspected chicken and/ or eggs
	March	Restaurant	*Salmonella* Virchow	3	1	0	D	N	Unknown	Unknown
	March	Restaurant	Unknown	10	0	0	D	Descriptive case series	Unknown	Unknown
	April	Aged care facility	*Clostridium perfringens*	16	2	2	D	Cohort	Unknown	Unknown
	April	Other	Unknown	7	0	0	D	Descriptive case series	Unknown	Unknown
	April	Restaurant	Norovirus	16	0	0	D	Cohort	Unknown	Unknown

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2009, *continued*

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
NSW cont'd	April	Restaurant	Unknown	5	0	0	D	Case control study	Suspected lasagne, chicken Caesar salad	Mixed dishes
	May	Other	Unknown	15	0	0	D	Case control study	Unknown	Unknown
	May	Restaurant	Unknown	3	1	0	M	Descriptive case series	Unknown	Unknown
	May	Takeaway	Unknown	4	1	0	D	Descriptive case series	Unknown - sandwiches suspected	Suspected salad and/or sandwiches
	June	Commercial caterer	Unknown	23	0	0	D	Cohort	Unknown	Unknown
	June	Restaurant	Unknown	15	2	0	D	Descriptive case series	Unknown	Unknown
	July	Restaurant	Unknown	2	0	0	D	N	Unknown	Unknown
	July	Restaurant	Unknown	6	0	0	D	Descriptive case series	Unknown - sandwiches suspected	Suspected salad and/or sandwiches
	August	Commercial caterer	Norovirus	33	0	0	D	Cohort	Unknown	Unknown
	August	Private residence	Unknown	8	0	0	D	Descriptive case series	Unknown	Unknown
	August	Restaurant	Norovirus	27	0	0	D	Descriptive case series	Unknown	Unknown
	August	Restaurant	Norovirus	31	0	0	D	Cohort	Unknown	Unknown
	August	Restaurant	Unknown	2	0	0	D	N	Unknown	Unknown
	August	Restaurant	Unknown	28	2	0	D	Descriptive case series	Unknown	Unknown
	September	Aged care facility	*Salmonella* Typhimurium 170 MLVA 3-9-8-13-523	9	1	0	D	N	Unknown	Unknown
	September	Camp	Unknown	31	0	0	D	Descriptive case series	Unknown	Unknown
	September	Commercial caterer	Norovirus	Unknown	0	0	M	Descriptive case series	Unknown	Unknown
	September	Commercial caterer	Unknown	12	0	0	D	Descriptive case series	Unknown	Unknown
	September	Other	Norovirus	22	0	0	D	Cohort	Unknown	Unknown
	September	Restaurant	Norovirus	13	0	0	D	Cohort	Suspected salad items	Suspected salad and/or sandwiches

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2009, *continued*

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
NSW, cont'd	September	Restaurant	Unknown	3	0	0	D	Cohort	Unknown	Unknown
	September	Restaurant	Unknown	10	0	0	D	Descriptive case series	Unknown	Unknown
	September	Unknown	*Salmonella* Heidelberg	7	1	0	D	Descriptive case series	Unknown	Unknown
	September	Unknown	Unknown	8	0	0	D	Cohort	Unknown	Unknown
	October	Commercial caterer	*Salmonella* Typhimurium 170 MLVA 3-9-8-13-532	4	0	0	M	Descriptive case series	Layered chocolate cake, prepared with cream and ganache icing (no raw eggs used)	Desserts
	October	Fair/festival/ mobile service	Unknown	3	1	0	D	Descriptive case series	Suspected prawns and calamari	Suspected seafood
	October	Other	Norovirus	20	2	0	D	N	Unknown	Unknown
	October	Other	Unknown	24	0	0	D	Descriptive case series	Unknown	Unknown
	October	Other	Unknown	24	0	0	D	N	Unknown	Unknown
	October	Private residence	Unknown	8	0	0	D	Cohort	Unknown	Unknown
	October	Restaurant	Unknown	4	0	0	D	Descriptive case series	Suspected salad items	Suspected salad and/or sandwiches
	October	Restaurant	Unknown	4	0	0	D	Descriptive case series	Unknown	Unknown
	October	Restaurant	Unknown	7	0	0	D	Descriptive case series	Unknown	Unknown
	November	Commercial caterer	Unknown	28	0	0	D	Cohort	Unknown	Unknown
	November	Private residence	*Salmonella* Typhimurium MLVA 3-13-9-11-550	6	2	0	D	Descriptive case series	Suspected tiramisu prepared with raw eggs	Suspected egg containing dessert
	November	Restaurant	*Salmonella* Typhimurium MLVA 3-12-12-13-523	3	0	0	M	Descriptive case series	Cooked pork mince and leftover food (mix of tofu, rice, duck)	Mixed dishes
	November	Restaurant	Unknown	7	0	0	D	Cohort	Unknown	Unknown
	November	Takeaway	*Salmonella* Stanley MLVA 2-15 (14)-0-0-496	32	7	0	D	Descriptive case series	Suspected salads, wraps, burgers	Suspected salad and/or sandwiches
	December	Other	Unknown	12	0	0	D	Cohort	Unknown	Unknown

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2009, *continued*

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
NSW, cont'd	December	Restaurant	*Salmonella* Singapore	3	0	0	M	Descriptive case series	Fried ice cream prepared with raw eggs	Egg containing desserts
	December	Takeaway	Norovirus	30	0	0	D	Descriptive case series	Unknown	Unknown
NT	March	Private residence	*Salmonella* Typhimurium u302	2	0	0	D	Descriptive case series	Suspect tiramisu	Egg containing desserts
	November	Commercial caterer	Norovirus	Unknown	0	0	D	Descriptive case series	Unknown	Unknown
	December	Restaurant	*Escherichia coli*	Unknown	0	0	D	Descriptive case series	Unknown	Unknown
Qld	January	Aged care facility	*Salmonella* Typhimurium pt 135a	3	0	0	D	Descriptive case series	Unknown	Unknown
	January	Aged care facility	*Salmonella* Typhimurium pt 44	20	4	0	AM	Descriptive case series	Unknown	Unknown
	January	Private residence	Norovirus	10	1	0	D	Descriptive case series	Unknown	Unknown
	February	Aged care facility	*Salmonella* Typhimurium pt 170	3	Unknown	0	D	Descriptive case series	Unknown	Unknown
	February	Commercial caterer	Norovirus	20	1	0	A	Cohort	Unknown	Mixed dishes
	February	Primary produce	Ciguatera fish poisoning	3	2	0	D	Descriptive case series	Spanish Mackerel	Fish/seafood
	February	Restaurant	Unknown	6	0	0	D	Descriptive case series	Unknown	Unknown
	April	Restaurant	*Salmonella* Typhimurium pt 170	3	0	0	D	Descriptive case series	Unknown	Unknown
	May	Primary produce	Histamine	6	0	0	M	Descriptive case series	Tuna	Fish/seafood
	May	Restaurant	Norovirus	17	1	0	D	Cohort	Unknown	Unknown
	May	Takeaway	Unknown	2	0	0	D	Descriptive case series	Prawn Roll	Fish/seafood
	June	Restaurant	*Salmonella* Typhimurium pt 141	7	0	0	D	Descriptive case series	Unknown	Mixed dishes
	July	Bakery	Norovirus	24	Unknown	0	D	Descriptive case series	Sandwiches (various fillings)	Salads and/or sandwiches
	July	Restaurant	Unknown	2	0	0	D	Descriptive case series	Unknown	Unknown

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2009, *continued*

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
Qld cont'd	August	Primary produce	Ciguatera fish poisoning	2	2	0	D	Descriptive case series	King snapper/jobfish green	Fish/seafood
	August	Restaurant	*Clostridium perfringens*	4	0	0	D	Descriptive case series	Unknown - suspected roast beef, vegetables and gravy	Meat and meat containing dishes
	September	Restaurant	Unknown	4	0	0	D	Descriptive case series	Unknown	Unknown
	October	Restaurant	Norovirus	3	0	0	D	Descriptive case series	Unknown	Unknown
	October	Restaurant	Norovirus	23	0	0	A	Cohort	Chicken Caesar salad; roast chicken	Chicken and chicken containing dishes
	December	Restaurant	*Clostridium perfringens*	2	0	0	D	Descriptive case series	Unknown	Mixed dishes
SA	January	Unknown	*Salmonella* Typhimurium 9	20	5	0	D	Descriptive case series	Unknown	Unknown
	February	Aged care facility	Unknown	3	Unknown	Unknown	D	Descriptive case series	Unknown	Unknown
	February	Unknown	STEC	6	3	0	D	Descriptive case series	Unknown	Unknown
	March	Unknown	*Salmonella* Typhimurium 108	11	6	0	D	Descriptive case series	Unknown	Unknown
	April	Restaurant	*Salmonella* Typhimurium 44	30	0	0	A	Cohort	Garlic aioli	Egg based sauces and dressing
	May	Restaurant	*Salmonella* Typhimurium 135	7	0	0	D	Descriptive case series	Fried ice cream	Egg containing desserts
	July	Unknown	*Salmonella* Anatum	5	2	0	D	Descriptive case series	Unknown	Unknown
	August	Commercial caterer	Norovirus	22	0	0	D	Descriptive case series	Sandwiches and baguettes	Salads and/or sandwiches
	August	Unknown	*Salmonella* Typhimurium u302	7	2	0	D	Descriptive case series	Unknown	Unknown
	November	Camp	STEC	31	5	0	A	Cohort	Potato salad and pasta salad	Mixed dishes
	November	Restaurant	Norovirus	21	0	0	A	Cohort	Berry cheesecake	Desserts
	November	Unknown	*Salmonella* Virchow 8	4	9	0	D	Descriptive case series	Unknown	Unknown

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2009, *continued*

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
SA. Cont'd	December	Private residence	*Salmonella* Typhimurium 44	16	2	0	A	Cohort	Tiramisu	Egg containing desserts
	December	Unknown	*Salmonella* Typhimurium 44	7	2	0	D	Descriptive case series	Unknown	Unknown
Tas	September	Restaurant	*Campylobacter*	35	0	0	A	Cohort	chicken liver parfait	Chicken and chicken containing dishes
	September	Restaurant	Unknown	9	0	0	A	Cohort	chicken liver parfait	Chicken and chicken containing dishes
	November	Commercial caterer	Norovirus	14	0	0	A	Cohort	green salad suspected	Suspected salad and/or sandwiches
Vic	February	Commercial caterer	*Salmonella* Typhimurium 170	4	1	0	D	Descriptive case series	Unknown	Unknown
	February	Restaurant	Not further specified	10	0	0	D	Descriptive case series	Suspected stews and casseroles	Meat and meat containing dishes
	February	Restaurant	*Salmonella* Typhimurium 197	2	2	0	D	Descriptive case series	Unknown	Unknown
	March	Aged care facility	Clostridium perfringens	22	0	0	D	Descriptive case series	Vitamised meals	Suspected vitamised foods
	March	Camp	Unknown	13	0	0	D	Cohort	Unknown	Unknown
	March	Child care	*Salmonella* Typhimurium 170	18	1	0	D	Descriptive case series	Unknown	Unknown
	March	Private residence	*Salmonella* Typhimurium 44	7	1	0	D	Descriptive case series	Unknown	Unknown
	April	Aged care facility	*Salmonella* Typhimurium 170	12	0	0	D	Descriptive case series	Unknown	Unknown
	April	Restaurant	Not further specified	6	0	0	D	Descriptive case series	Unknown	Unknown
	May	Aged care facility	Norovirus	17	1	0	D	Descriptive case series	Unknown	Unknown
	May	Aged care facility	Not further specified	7	0	0	D	Descriptive case series	Unknown	Unknown
	July	Aged care facility	Unknown	4	0	0	D	Descriptive case series	Unknown	Unknown
	August	Restaurant	Norovirus	87	0	0	D	Descriptive case series	Unknown	Unknown
	August	Restaurant	Unknown	3	0	0	D	Descriptive case series	Unknown	Unknown

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2009, *continued*

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
Vic, cont'd	September	Aged care facility	Unknown	7	0	0	D	Descriptive case series	Unknown	Unknown
	September	Restaurant	Norovirus	10	0	0	D	Cohort	Unknown	Unknown
	October	Commercial caterer	Not further specified	41	0	0	D	Cohort	Unknown	Unknown
	November	Aged care facility	Not further specified	6	0	0	D	Descriptive case series	Unknown	Meat and meat containing dishes
	November	Aged care facility	*Salmonella* Typhimurium 170	20	2	1	D	Descriptive case series	Unknown	Unknown
	November	Aged care facility	*Salmonella* Typhimurium 170	22	5	1	D	Descriptive case series	Unknown	Unknown
	November	Other	*Clostridium perfringens*	4	0	0	D	Descriptive case series	Unknown	Unknown
	November	Primary produce	Fish wax ester	27	0	0	D	Descriptive case series	Escolar	Fish/seafood
	November	Private residence	*Salmonella* Typhimurium 3	6	3	0	D	Descriptive case series	suspect eggs	Suspected chicken and/ or eggs
	November	Restaurant	Norovirus	165	(blank)	0	D	Descriptive case series	Unknown	Unknown
	November	Restaurant	Not further specified	17	0	0	D	Descriptive case series	Unknown	Unknown
	December	Military	*Campylobacter*	5	Unknown	0	D	Descriptive case series	Unknown	Unknown
	December	Military	Norovirus	18	1	0	D	Descriptive case series	Unknown	Unknown
	December	Restaurant	Hepatitis A	5	1	0	D	Descriptive case series	Food contaminated with HAV either from an infected food handler or SDT	Unknown
	December	Restaurant	Hepatitis A	9	2	0	D	Descriptive case series	Food contaminated with HAV either from an infected food handler or SDT	Semi dried tomatoes
WA	February	Aged care facility	Unknown	16	0	0	D	Descriptive case series	Unknown	Unknown
	February	Restaurant	*Salmonella* Saintpaul	7	1	0	M	Descriptive case series	Fried ice cream	Egg containing desserts
	March	Restaurant	*Salmonella* Singapore	6	0	0	D	Descriptive case series	Unknown - chicken suspected	Suspected chicken and/ or eggs

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2009, *continued*

State or territory	Month of outbreak	Setting prepared	Agent responsible	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Vehicle category
WA, cont'd	May	Community	Hepatitis A	5	1	0	M	Descriptive case series	Berries	Fruit
	May	Restaurant	*Salmonella* Typhimurium	8	2	0	D	Descriptive case series	Unknown	Unknown
	May	Restaurant	*Salmonella* Typhimurium 6	5	0	0	D	Descriptive case series	Unknown	Unknown
	June	Restaurant	*Salmonella* Typhimurium 135a	7	1	0	D	Descriptive case series	Unknown	Unknown
	July	Takeaway	*Salmonella* Typhimurium 193 var 1	31	9	0	M	Descriptive case series	Vietnamese Pork Roll	Mixed dishes
	August	Primary produce	*Salmonella* Saintpaul	17	3	0	M	Descriptive case series	Pawpaw	Fruit
	September	Commercial caterer	Norovirus	15	0	0	A	case control study	Rice paper rolls	Mixed dishes
	October	Restaurant	*Listeria*	2	2	0	DM	Descriptive case series	Unknown	Unknown
	October	Restaurant	*Salmonella* Typhimurium 170	39	7	0	A	case control study	Scrambled eggs	Eggs
	October	Takeaway	*Salmonella* Typhimurium 170	39	6	0	D	Descriptive case series	Raw egg mayonnaise	Egg based sauces and dressing
	November	Commercial caterer	Norovirus	8	0	0	D	Cohort	Unknown	Unknown
	December	Camp	Norovirus	14	0	0	D	Cohort	Unknown	Unknown
	December	Restaurant	Norovirus	11	0	0	D	Case control study	Unknown	Unknown
	December	Restaurant	Norovirus	18	0	0	D	Case control study	Unknown	Unknown
	December	Restaurant	Norovirus	22	0	0	D	Cohort	Unknown	Unknown

Evidence

D Descriptive evidence implicating the vehicle

A Analytical epidemiological association between illness and vehicle

M Microbiological confirmation of aetiology in vehicle and cases.

Epidemiological study

N Individual patient data not collected.