Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet Network, 2008

The OzFoodNet Working Group

Abstract

In 2008, OzFoodNet sites reported 25,260 notifications of 9 diseases or conditions that are commonly transmitted by food. The most frequently notified infections were *Campylobacter* (15,535 notifications) and *Salmonella* (8,310 notifications). Public health authorities provided complete serotype and phage type information on 94% of all *Salmonella* infections in 2008. The most common *Salmonella* serotype notified in Australia during 2008 was *Salmonella* Typhimurium, and the most common phage type was *S.* Typhimurium 135. During 2008, OzFoodNet sites reported 1,545 outbreaks of gastrointestinal illness; affecting 25,555 people and resulting in 691 people being hospitalised. There were 99 deaths during these outbreaks. The majority (83%, 1,276/1,545) of outbreaks were due to person-to-person spread, but 7% (104/1,545) were transmitted by contaminated food. Foodborne outbreaks affected 1,454 persons including 96 hospitalisations. Eleven deaths were reported during these outbreaks. For these foodborne outbreaks, *Salmonella* was the most common aetiological agent and restaurants were the most common setting where foods were prepared. Twenty of these foodborne outbreaks were related to the consumption of eggs; the majority (n = 18) of these outbreaks were 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 2008. These data assist agencies to identify emerging disease, develop food safety policies, and prevent foodborne illness. *Commun Dis Intell* 2009;33(4):389–413.

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 dollars per year.[1] Many of these illnesses are preventable by appropriate interventions and surveillance helps to identify 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]

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 provides robust surveillance information on contaminated foods causing illness in Australia.

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 10 and 8 cases in the community for every notified case of campylobacteriosis and infection with Shiga-toxin producing *Escherichia coli* (STEC), respectively.[5,6]

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.[7] OzFoodNet aggregates and analyses national 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 National Centre for Epidemiology and Population Health at the Australian National University, the Public Health Laboratory Network, Food Standards Australia New Zealand (FSANZ), and the Department of Agriculture Fisheries and Forestry. OzFoodNet is a member of the Communicable Diseases Network Australia, which is Australia's peak body for communicable disease control.[8] This is the 8th annual

report for the OzFoodNet network and summarises 2008 surveillance data, which includes a comparison with data from previous years.

Methods

Population under surveillance

In 2008, the network covered the whole of the Australian population, which was estimated to be 21,373,998 persons.[9]

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* and the National Health Securities Agreement 2008. 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).

Data for this report were extracted from NNDSS in July 2009 and were analysed by the date of diagnosis within the reporting period 1 January to 31 December 2008. 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 2008 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 and typhoid. We compared the incidence of infection in returned travellers with the number of travellers to that region using customs data derived from incoming passenger cards.[10] The field 'country where you spent the most time abroad' was used as the numerator.

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

OzFoodNet sites supplied data on listeriosis cases, which included whether a case was materno–foetal or not, 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 one of many contributing factors. We did not validate deaths and all cases reported to have died were considered a listeriosis fatality. Materno-foetal pairs (mother and neonate) were counted as a single case with the mother being counted as the primary case. This affects age-specific notification rates for listeriosis and the proportion of reported cases that were female.

Gastrointestinal and foodborne disease outbreaks

OzFoodNet sites collected summary information on gastrointestinal and foodborne disease outbreaks that occurred in Australia during 2008. An outbreak of foodborne disease was defined as two or more people with a particular infection or illness whose common exposure was associated with a specific food or meal. A cluster was defined as an increase in infections that were epidemiologically related in time, place or person where investigators were unable to implicate a vehicle or determine a mode of transmission.

For foodborne and suspected foodborne outbreaks, the summary information collected on 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

We used Microsoft Excel and Stata version 10.1 for all analyses. Where appropriate we compared proportions using χ^2 tests.

Results

Rates of notified infections

In 2008, OzFoodNet sites reported 25,260 notifications of 9 diseases or conditions that are commonly transmitted by food (Table 1), similar to the mean of 25,054 notifications per year for the previous 5 years (2003–2007). There were no cases of botulism in 2008.

Salmonella infections

In 2008, OzFoodNet sites reported 8,310 cases of *Salmonella* infection, a rate of 39 cases per 100,000 population (Table 1). Notification rates among jurisdictions ranged from 31 cases per 100,000 population in Victoria to 226 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 0–4 years (Figure 1). The notification rate increased dramatically in children aged 2 years or under, with rates in children aged 3 or 4 years being similar to the 5–9 year age group.

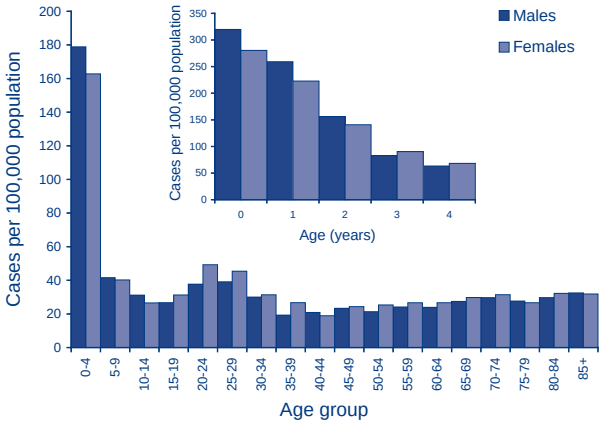
Nationally during 2008, the most commonly notified *Salmonella* serotype was *S.* Typhimurium, which was responsible for approximately 42% of all notified infections (Tables 2 and 3). During 2008, *S.* Typhimurium phage types 135, 44, 170/108 and

Table 1: Number of notified cases, crude rate and 5-year mean (2003–2007) rate per 100,000 population of diseases or infections commonly transmitted by food, Australia, 2008, by disease and state or territory

Disease		State or territory								
		ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Aust
Salmonella	Notified cases, 2008	132	2,261	497	2,047	661	206	1,651	855	8,310
	Rate 2008	38.3	32.5	226.0	47.8	41.3	41.4	31.2	39.5	38.9
	Mean rate, 2003–2007	31.2	31.9	200.3	63.4	38.6	40.4	28.3	37.8	40.1
*Campylobacter**	Notified cases, 2008	381	–	257	4,821	1,992	475	5,780	1,829	15,535
	Rate 2008	110.7	–	116.8	112.7	124.4	95.4	109.1	84.5	107.8
	Mean rate, 2003–2007	121.3	–	125.3	103.9	153.3	136.4	119.2	102.9	116.9
Listeria	Notified cases, 2008	1	34	0	12	1	1	11	8	68
	Rate 2008	0.3	0.5	0.0	0.3	0.1	0.2	0.2	0.4	0.3
	Mean rate, 2003–2007	0.4	0.4	0.1	0.2	0.3	0.2	0.3	0.3	0.3
Shigella	Notified cases, 2008	3	109	175	97	137	4	134	169	828
	Rate 2008	0.9	1.6	79.6	2.3	8.6	0.8	2.5	7.8	3.9
	Mean rate, 2003–2007	0.9	1.3	71.9	1.9	3.1	0.7	1.6	6.0	2.8
Typhoid	Notified cases, 2008	0	43	1	18	3	0	33	8	106
	Rate 2008	0.0	0.6	0.5	0.4	0.2	0.0	0.6	0.4	0.5
	Mean rate, 2003–2007	0.1	0.5	0.6	0.2	0.2	0.2	0.4	0.4	0.3
Hepatitis A	Notified cases, 2008	5	69	3	71	20	1	85	22	276
	Rate 2008	1.5	1.0	1.4	1.7	1.2	0.2	1.6	1.0	1.3
	Mean rate, 2003–2007	0.7	1.5	15.3	0.9	0.6	1.0	1.2	2.9	1.5
Shiga toxin-producing *Escherichia coli*	Notified cases, 2008	0	19	0	37	39	0	11	0	106
	Rate 2008	0.0	0.3	0.0	0.9	2.4	0.0	0.2	0.0	0.5
	Mean rate, 2003–2007	0.1	0.2	0.5	0.3	2.3	0.1	0.1	0.2	0.4
Haemolytic uraemic syndrome	Notified cases, 2008	0	17	1	7	2	0	4	0	31
	Rate 2008	0.00	0.24	0.45	0.16	0.12	0.00	0.08	0.00	0.15
	Mean rate, 2003–2007	0.06	0.14	0.20	0.03	0.12	0.08	0.05	0.03	0.08

* *Campylobacter* is not a notifiable disease in New South Wales.

Figure 1: Salmonellosis notifications, Australia, 2008, by age group and sex



9 were commonly reported, representing four of the top 5 infections nationally. All serotypes in the Northern Territory exceeded 12 cases per 100,000 population, with *Salmonella* Ball being the highest at 20 cases per 100,000 population. Tasmania recorded a high rate for *S.* Mississippi notifications, which was 14.9 cases per 100,000 population. *S.* Mississippi is endemic in Tasmania and is thought to be transmitted from exposure to environments and drinking water that have been contaminated by native animals.[11]

Salmonella *Enteritidis*

Salmonella Enteritidis is a globally 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. The majority of cases in Australia are associated with overseas travel.

During 2008, OzFoodNet sites reported 511 cases of *S.* Enteritidis infection (Table 4). Of those cases where travel status was reported, 83% (399/480) had travelled overseas and cases often reported visiting several countries. A travel history could not be obtained for 6% (31/511) of cases in 2008, compared with 18% of cases (73/396) in 2007 and 24% (72/305) of cases in 2006.

Of the cases that were known to have been acquired overseas, 80% (321/399) reported travel to South East Asia. This compares with only 13% (714,000 of 5,551,600) of returning travellers coming from South East Asia in 2008 (relative risk [RR] 28, 95% confidence interval [CI] 22–36).[10] Similar to previous years, the most common country of acquisition for overseas-acquired cases was Indonesia, with 43% (173/399) of cases reporting travel there, while comprising only 2% (94,000 of 5,551,600) of travel undertaken in 2008 (RR 44, 95% CI 36–54). Thailand was the 2nd most common country of acquisition with 16% (63/399) of all notifications that were known to have been acquired overseas, followed by Malaysia with 10% (40/399) and Singapore with 6% (25/399). The most common infecting phage types amongst overseas-acquired cases were 6a (17.5%) and 1 (11.3%) (Table 5).

All states and territories except the Australian Capital Territory reported locally acquired *S.* Enteritidis cases in 2008. In total, 16% (81/511) of *S.* Enteritidis infections were locally-acquired, which was higher than previous years. There was an average of 44 locally-acquired cases per year between 2003 and 2007. In 2008, 30% (24/81) of locally-acquired infections were due to *S.* Enteritidis 26, while 16% (13/81) were due to *S.* Enteritidis 6a. No phage type was recorded for 22% (18/81) of locally-acquired cases, the majority of which were reported from New South Wales. Queensland reported 90% (19/21) of *S.* Enteritidis 26 cases with infections occurring throughout the year, except during winter months. In contrast, *S.* Enteritidis 6a occurred mainly in the last half of 2008 and affected 3 jurisdictions; Queensland, New South Wales and Tasmania.

Completeness of Salmonella *serotyping and phage typing*

Overall, 94% (6,983/7,464) of *Salmonella* notifications on state and territory databases contained information about serotype and/or phage type (excluding Western Australia). In Australia, 6 serotypes are routinely phage typed: Bovismorbificans; Enteritidis; Hadar; Heidelberg; Typhimurium; and Virchow. In 2008, 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 2008 compared with previous years, with 94.1% containing complete information on phage type during 2008 (excluding Western Australia where routine phage typing ceased after June 2007).

Campylobacter infections

In 2008, OzFoodNet sites (excluding New South Wales) reported 15,535 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 Western Australia (84.5 cases per 100,000 population) and in South Australia (124 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 and particularly in males

Table 2: Numbers, rates and proportions of the top 5 *Salmonella* infections, Australia (excluding Western Australia), 2007 to 2008,* by OzFoodNet site

OzFoodNet site	Sero/phage type	2008		Proportion	2007		2008/2007 ratio§
		n	Rate†	(%)‡	n	Rate†	
Australian Capital Territory	*S.* Typhimurium 44	23	6.7	17	6	1.8	3.8
	S. Typhimurium 9	19	5.5	14	6	1.8	3.2
	S. Typhimurium 135	12	3.5	9	8	2.4	1.5
	S. Typhimurium 170/108	11	3.2	8	5	1.5	2.2
	S. Infantis	5	1.5	4	3	0.9	1.7
New South Wales	*S.* Typhimurium 135	256	3.7	11	232	3.4	1.1
	S. Typhimurium 170/108	240	3.4	11	138	2.0	1.7
	S. Typhimurium 9	146	2.1	6	363	5.3	0.4
	S. Typhimurium 44	70	1.0	3	86	1.2	0.8
	S. Birkenhead	68	1.0	3	105	1.5	0.6
Northern Territory	*S.* Ball	44	20.0	9	38	17.7	1.2
	S. Saintpaul	38	17.3	8	32	14.9	1.2
	S. Weltevreden	31	14.1	6	16	7.4	1.9
	S. Virchow 8	29	13.2	6	15	7.0	1.9
	S. Lansing	27	12.3	5	10	4.7	2.7
Queensland	*S.* Typhimurium 135	159	3.7	8	154	3.7	1.0
	S. Saintpaul	155	3.6	8	219	5.2	0.7
	S. Birkenhead	119	2.8	6	116	2.8	1.0
	S. Virchow 8	99	2.3	5	183	4.4	0.5
	S. Aberdeen	72	1.7	4	121	2.9	0.6
South Australia	*S.* Typhimurium 135	93	5.8	14	66	4.2	1.4
	S. Typhimurium 9	75	4.7	11	124	7.8	0.6
	S. Infantis	39	2.4	6	42	2.7	0.9
	S. Typhimurium 29	36	2.2	5	77	4.9	0.5
	S. Typhimurium 193	27	1.7	4	22	1.4	1.2
Tasmania	*S.* Mississippi	74	14.9	36	118	23.9	0.6
	S. Typhimurium 135	58	11.6	28	43	8.7	1.3
	S. Typhimurium 44	11	2.2	5	2	0.4	5.5
	S. Virchow 8	5	1.0	2	2	0.4	2.5
	S. Typhimurium 9	4	0.8	2	4	0.8	1.0
	S. Enteritidis 6a	4	0.8	2	0	–	–
Victoria	*S.* Typhimurium 135	272	5.1	16	214	4.1	1.3
	S. Typhimurium 44	196	3.7	12	283	5.4	0.7
	S. Typhimurium 9	154	2.9	9	141	2.7	1.1
	S. Typhimurium 170/108	130	2.5	8	112	2.2	1.2
	S. Stanley	40	0.8	2	44	0.8	0.9

* 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 2008.

† Rate per 100,000 population.

‡ Proportion of total *Salmonella* notified for this jurisdiction in 2008.

§ Ratio of the number of cases in 2008 compared to the number in 2007.

Table 3: Numbers, rates, and proportions of top 5 *Salmonella* infections, Western Australia, 2007 to 2008

OzFoodNet site	Serotype	2008		Proportion (%)†	2007		2008/2007 ratio‡
		n	Rate*		n	Rate	
Western Australia	*S.* Typhimurium	302	14.0	35	392	18.6	0.8
	S. Enteritidis	139	6.4	16	105	5.0	1.3
	S. Saintpaul	25	1.2	3	48	2.3	0.5
	S. Chester	24	1.1	3	26	1.2	0.9
	S. Kiambu	20	0.9	2	9	0.4	2.2
	S. Muenchen	20	0.9	2	23	1.1	0.9

* Rate per 100,000 population.

† Proportion of total *Salmonella* notified for this jurisdiction in 2008.

‡ Ratio of the number of cases in 2008 compared to the number in 2007.

Table 4: Number of *Salmonella* Enteritidis infections, Australia, 2008, by travel history and state or territory

State or territory	History of overseas travel			
	Yes	No	Unknown	Total
Australian Capital Territory	8	0	1	9
New South Wales	72	29	0	101
Northern Territory	4	2	0	6
Queensland	59	37	19	115
South Australia	34	2	2	38
Tasmania	6	2	0	8
Victoria	89	1	5	95
Western Australia	127	8	4	139
Total	399	81	31	511

Table 5: Number and percentage of each phage type for of overseas-acquired cases of *Salmonella* Enteritidis, Australia, 2008

Phage type	Total	
	n	%
6a	70	17.5
1	45	11.3
4	20	5.0
1b	19	4.8
21	19	4.8
Reactions do not conform	17	4.3
Untypable	10	2.5
21b var	8	2.0
8	7	1.8
21c	7	1.8
26	6	1.5
Other phage types	32	8.0
No phage type was provided	139	34.8
Total	399	100.0

* The number of overseas-acquired cases with no phage type available includes 123 cases from Western Australia, where phage typing ceased in June 2007.

aged less than 5 years and greater than 65 years. The highest age-specific rate of notifications was in 1-year-old infants for both males and females (233 and 180 cases per 100,000 population, respectively) with additional peaks in the 20–29 year age group (Figure 2).

Listeria infections

OzFoodNet sites reported 65 cases of *Listeria monocytogenes* infection in 2008 representing a crude rate of 0.3 per 100,000 population; the same as the 5-year historical mean (Table 1).

Similar to previous years, 18% (12/65) of cases were pregnancy-associated infections. In 2008, 47% (25/53) of the non-pregnancy related cases were female. Fifty-one per cent (33/65) of notifications were in people aged 60 years or over. The highest age-specific notification rate was in people aged 85 years or over (1.9 cases per 100,000 population, 7 cases) (Figure 3). Eight per cent (1/12) of pregnancy related cases and 21% (11/53) of non-pregnancy associated cases in 2008 were fatal (Figure 4).

Table 6: Percentage of *Salmonella* notifications for 6 serotypes notified to state and territory health departments with phage type information available, Australia,* 2003 to 2008

Salmonella serotype	2003	2004	2005	2006	2007	2008
S. Bovismorbificans	94.7	95.9	95	96.9	97.4	83.5
S. Enteritidis	97.6	95.2	97.6	98.1	94.1	92.3
S. Hadar	100.0	90.0	87.0	100.0	90.0	81.3
S. Heidelberg	96.3	89.5	88.4	95.0	90.0	80.5
S. Typhimurium	98.8	98.7	98.6	98.3	98.3	94.8
S. Virchow	98.9	99.8	98.7	99.2	95.4	93.4

* 2007 to 2008 data excluding Western Australia, where phage typing ceased in June 2007.

Figure 2: Campylobacteriosis notification rates and sex, Australia, 2008, by age group

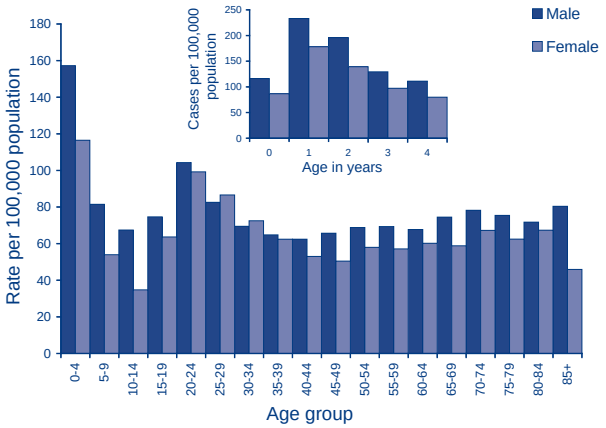
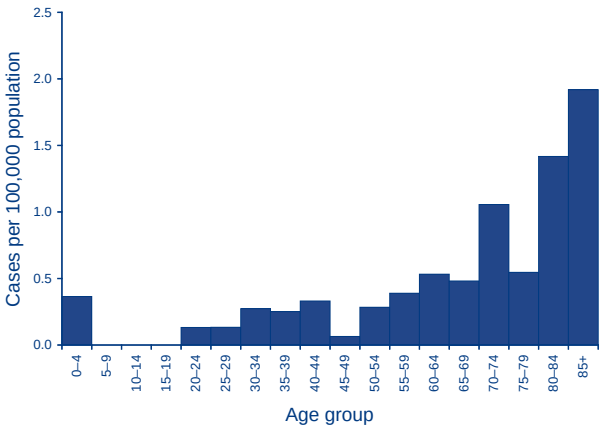


Figure 3: Listeriosis notifications, Australia, 2008, by age group

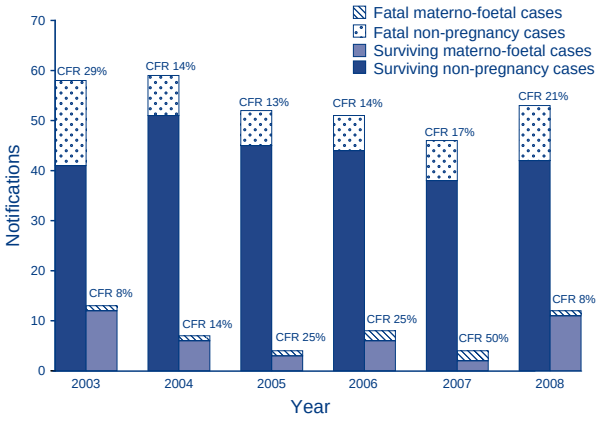


Shigella infections

There were 828 notifications of shigellosis in Australia in 2008; a rate of 3.9 notifications per 100,000 population compared with a mean of 568 cases (2.8 notifications per 100,000 population) per year between 2003 and 2008 (Table 1). As in previous years, the Northern Territory reported the highest notification rate with 79.6 cases per 100,000 population compared with a mean of 71.9 cases per 100,000 population between the years 2003 and 2007.

The increased notification rate of shigellosis in 2008 compared with previous years is in part explained by an outbreak of *S. sonnei* biotype g with matching antibiotic resistance profiles amongst men who have sexual contact with other men (MSM), with cases in New South Wales (n = 12), Queensland (n = 4), Victoria (n = 29) and Western Australia (n = 2). Victoria also reported an outbreak of *S. sonnei* biotype g with matching antibiotic resistance profiles (different to the MSM cluster) amongst members of the Jewish community in Melbourne, with 12 cases and a further 2 cases from the same geographical area, although no source for the outbreak was identified. South Australia reported clusters of *S. flexneri* 6 with 3 cases and *S. sonnei* biotype a with 8 cases.

Figure 4: Notifications and case fatality ratio (CFR %) for fatal and surviving listeriosis cases, Australia, 2003 to 2008, by pregnancy status



In 2008, notification rates for shigellosis were highest in males and females aged 0–4 years, with

12.5 and 13.9 notifications per 100,000 population respectively. Secondary peaks were observed in children aged 5–9 years and in males aged 30–44 years (Figure 5). Amongst children aged less than 5 years, the highest notification rates were in children aged 1 year. In 2008, 50% of all shigellosis cases were male. In 2008, 38.4% (318/828) of infections occurred in people of Aboriginal or Torres Strait Island origin and this proportion varied by state or territory.

The most frequently reported *Shigella* biotype in 2008 was *S. sonnei* biotype a, followed by *S. sonnei* biotype g. Together these biotypes accounted for 50% of all *Shigella* infections reported in 2008 (Table 7).

Typhoid

In Australia during 2008, there were 106 cases of typhoid due to *Salmonella* serotype Typhi infection. This equated to a rate of 0.5 cases per 100,000 population compared with a mean of 0.3 cases per 100,000 between 2003 and 2007 (Table 1). Cases were reported from all Australian states and territories except for the Australian Capital Territory and Tasmania.

Notification rates for typhoid in 2008 were highest in young adults, with 1.4 cases per 100,000 (21 cases) and 1.1 cases per 100,000 (16 cases) amongst the 20–24 year and 25–29 year age groups, respectively (Figure 6). Overseas travel was the primary risk factor for typhoid in Australia in 2008 with 92.5% (98/106) of cases known to have been acquired overseas. In 2008, 59.4% (63/106) of cases were male.

India was the most frequently reported country of travel for overseas-acquired cases of typhoid in 2008, with 50% (49/98) of cases, followed by Bangladesh, Indonesia, and Pakistan, each reported as a travel destination by 9% (9/98) of overseas-acquired cases (Table 8). The most common phage type of *S.* Typhi isolated from cases was E1 (36.8%, 39/106), and the majority of cases infected with E1 (79%, 30/39) reported travel to India (including cases who also reported travel to Bangladesh and Thailand). This was consistent with previous years, with approxi-

Figure 5: Age and sex specific notification rates of shigellosis, Australia 2008

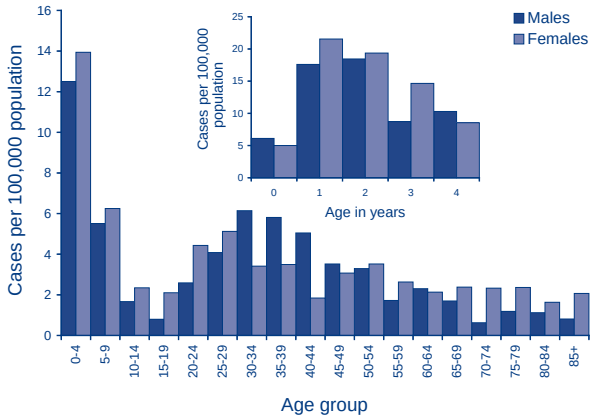


Figure 6: Age specific notification rates for typhoid, Australia, 2008

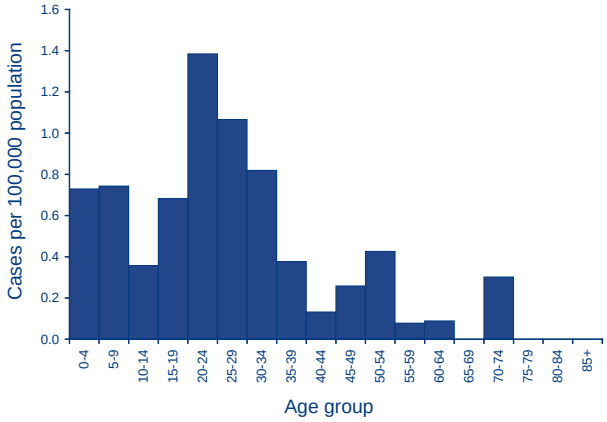


Table 7: Number, percentage and ratio of the top 10 *Shigella* infections, Australia, 2006 to 2008

Biotype	2006		2007		2008		2008/2006 ratio*	2008/2007 ratio*
	n	%	n	%	n	%		
Shigella sonnei biotype a	80	14.7	134	22.3	232	28.0	1.9	1.3
Shigella sonnei biotype g	76	13.9	98	16.3	185	22.3	1.6	1.4
Shigella flexneri 2a	54	9.9	64	10.6	55	6.6	0.7	0.6
Shigella flexneri 4a mannitol neg	94	17.2	69	11.5	103	12.4	0.7	1.1
Shigella sonnei untyped	31	5.7	37	6.1	48	5.8	1.0	0.9
Shigella flexneri 4	84	15.4	49	8.1	35	4.2	0.3	0.5
Shigella flexneri untyped	15	2.7	20	3.3	21	2.5	0.9	0.8
Shigella flexneri 6	16	2.9	3	0.5	16	1.9	0.7	3.9
Shigella flexneri 3a	18	3.3	37	6.1	41	5.0	1.5	0.8
Shigella	22	4.0	21	3.5	27	3.3	0.8	0.9

Table 8: *Salmonella* Typhi phage types isolated from cases (n = 106), Australia, 2008

Country where travelled	Phage type (n)	Number of cases
India	E1(29), 36(2), A (3), D2 (2), degraded (2), E9 (2) J1(5), untypeable (2)	47
Bangladesh	E7 (1), E9 (2), non-typeable(6)	9
Indonesia	D2 (2), degraded(1), E2(1), E2 var(1), M1(1), non-typeable (2), unknown(1)	9
Pakistan	E9 (6), T(1), non-typeable(1), 51(1)	9
Samoa	E1 (4), E7 (1)E9 (1)	6
Papua New Guinea	D2 (2), G3 (1)	3
Philippines	A (1), B1 var 1(1), degraded (1)	3
Thailand and Burma	O var (3)	3
Cambodia	E1 (1)	1
China and India	36 (1)	1
India and Bangladesh	E1 (1)	1
India or Thailand	D2 (1)	1
Malaysia	E1 (1)	1
Malaysia and Thailand	D1 (1)	1
Nepal	E1 (1)	1
Sudan	Degraded (1)	1
Thailand and China	Untypeable (1)	1
No travel reported	E1 (2), untypeable (1), degraded (1), A (2), 40 (1), C4 (1)	8

mately half of overseas-acquired cases in 2007 (51%, 42/83) reporting travel to India and 40% (19/48) being phage type E1.[12]

Hepatitis A

Hepatitis A notifications declined in 2008, with 276 cases reported compared with a mean of 306 cases per year between 2003 and 2007 (Table 1 and Figure 7).[13] This decline may have been due to increased uptake of vaccine amongst high risk groups such as travellers, and targeted vaccination programs for Indigenous children.[13]

In 2008, the median age of notified cases was 24 years old (range 1–97 years) and 57% (158/276) of cases were male. Indigenous status was known for 88.8% of cases in 2008. The proportion of cases of hepatitis A among Indigenous persons declined from a mean of 14% (167/1,193) of cases for the years 2003 to 2006 to 1.2% (3/245) of cases in 2008. This marked decrease in the number and proportion of cases that were Indigenous may have been due to targeted vaccination programs for Indigenous children in Queensland commencing in 1999[14] as well as free vaccine for Indigenous children in South Australia, Western Australia and the Northern Territory from 2006.

Overseas travel was found to be the most frequently reported risk factor for infection amongst cases of hepatitis A in 2008, with 54.7% (151/276) reporting overseas travel (Table 9). The most commonly reported overseas travel destinations were India (29 cases), Indonesia (11 cases) and Pakistan (8 cases). Household contact with confirmed cases was identified as a risk factor for 4.3% (12/276) of cases, highlighting the importance of post-exposure prophylaxis for contacts. In 2008, 3.6% (10/276) of notified hepatitis A cases were suspected to be associated with foodborne transmission.

Shiga toxin-producing *Escherichia coli* infections

In 2008, there were 106 notifications of STEC in Australia, equating to a rate of 0.5 cases per 100,000 population. This was an increase over a mean of 0.4 cases per 100,000 population between 2003 and 2007 (Table 1). Cases were reported from South Australia (39), Queensland (37), New South Wales (19) and Victoria (11). There were no cases in the Australian Capital Territory, the Northern Territory, Tasmania or Western Australia in 2008. 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 gene coding for Shiga toxins and other virulence factors, making rates for this State the highest in the country.

In 2008, 51.9% of cases were female. The median age of cases was 24 years (range 0–89 years). Notification rates were highest in people aged 85 years or older, young people aged 10–14 years and children aged 4 years or under (Figure 8).

Figure 7: Trends in notifications of hepatitis A, Australia, 1991 to 2008, by month of diagnosis and inset, notifications of hepatitis A, 2008, by month and state or territory

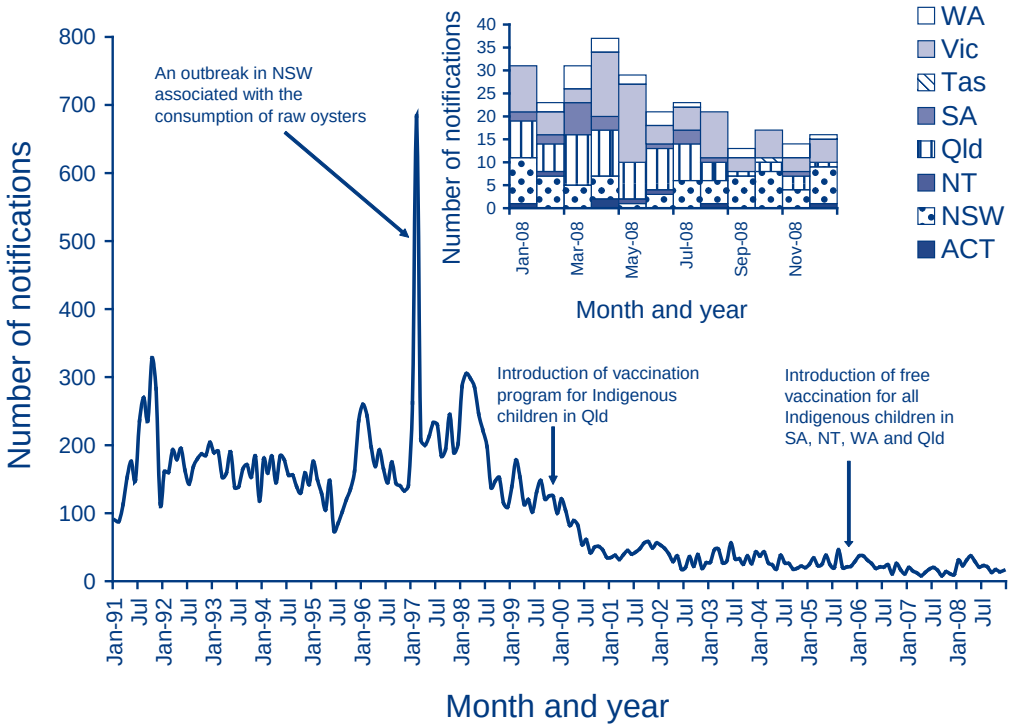


Table 9: Risk factors identified for cases of hepatitis A, Australia, 2008

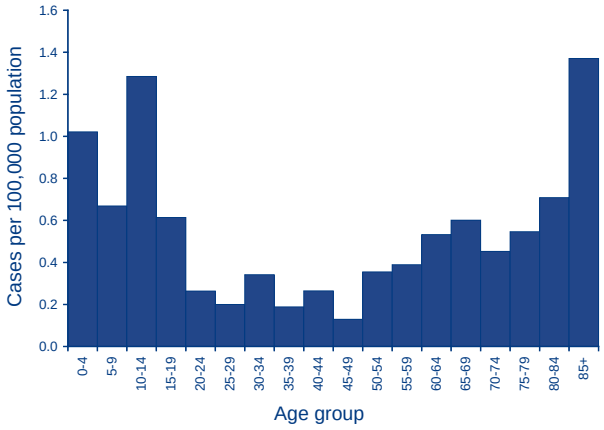
Risk factor	Number of cases	Percentage of cases
Overseas travel	151	54.7
Household contact with confirmed cases	12	4.3
Associated with foodborne outbreak	10	3.6
Contact with confirmed cases	3	1.1
Overseas travel and contact with cases	2	0.7
Contact with injecting drug users	1	0.4
Contact with possible cases	1	0.4
Injecting drug use	1	0.4
Overseas travel and male-to-male sexual contact	1	0.4
Recent migrant from endemic area	1	0.4
No known risk factors	73	26.4
Unknown	20	7.2
Total	276	100

The number of STEC notifications has increased over the past 5 years, from an average of 5 cases per month between 2003 and 2006 to 9 cases per month between 2007 and 2008 (Figure 9). Seven cases of STEC in 2008 were associated with an outbreak due to waterborne transmission at a camp in Queensland. STEC notifications have a seasonal association, tending to increase during the warmer months (November to April).

The most commonly identified serogroups* of STEC cases in 2008 were O157, with 27 cases (25.5%), followed by O111 (8 cases, 7.5%) and O26 (7 cases, 6.6%). No organism was isolated or the serogroup was reported for 33.0% (35/106) of cases.

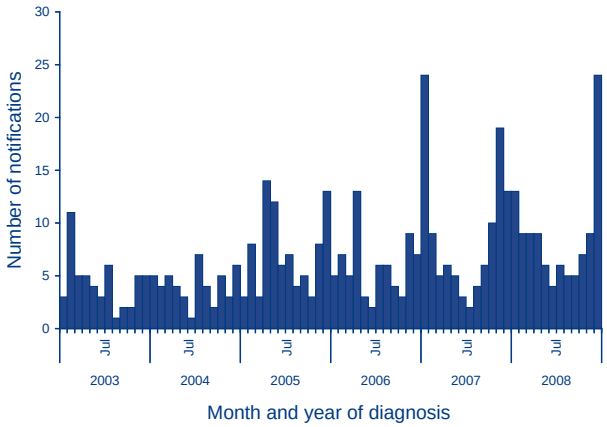
* Serotype reported may have been obtained by serotyping cultured isolates, or by polymerase chain reaction targeting serotype-specific genes.

Figure 8: Age specific notification rates of Shiga toxin-producing *Escherichia coli*, Australia, 2008



* Low case numbers make rates unstable and only age specific rates (not age and sex) have been calculated for Shiga toxin-producing *Escherichia coli*, with counts of less than 20 in all groups.

Figure 9: Shiga toxin-producing *Escherichia coli* notifications, Australia, 2003 to 2008, by month and year of diagnosis

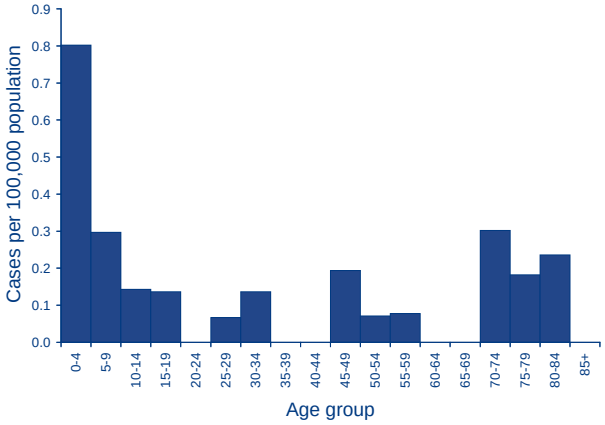


Haemolytic uraemic syndrome

In 2008, OzFoodNet sites reported 31 cases of HUS; a rate of 0.15 cases per 100,000 population (Table 1), compared with a mean of 0.08 cases per 100,000 population for the years 2003 to 2007. New South Wales reported the largest number of cases (17 cases), followed by Queensland (7 cases) and Victoria (4 cases). Similar to previous years, the highest notification rate in 2008 was in children aged 0–4 years (Figure 10), with 35.5% (11/31) of cases notified in this age group.

HUS may be due to causes other than Shiga toxin-producing *E. coli*, including other non-foodborne pathogens and genetic predisposition. In 2008, an antecedent STEC infection was reported for 52% (16/31) of cases, with serogroup information

Figure 10: Age specific notifications of haemolytic uraemic syndrome, Australia, 2008



reported for 56% (9/16) of these cases. *E. coli* O111 was reported in 5 instances, while serogroup O157 and O166 were reported for 1 case each. In 2008, 1 case of HUS was known to be due to a non-bacterial cause, 2 cases resulted from *Streptococcus pneumoniae* infection, and in the remaining 11 cases no aetiology was reported.

In Australia, HUS cases are more common during late spring and early summer,[12] with 37.4% (58/155) of cases occurring in the months of November, December or January for the years 2003 to 2008 (Figure 11). This was significantly more than expected ($P = 0.01$).

Gastrointestinal and foodborne disease outbreaks

During 2008, OzFoodNet sites reported 1,545 outbreaks of gastroenteritis, including foodborne disease, which affected 25,555 people and hospitalised 691 (Table 10). There were 99 deaths during these

Figure 11: Notifications of haemolytic uraemic syndrome by month and year of diagnosis, Australia, 2003 to 2008

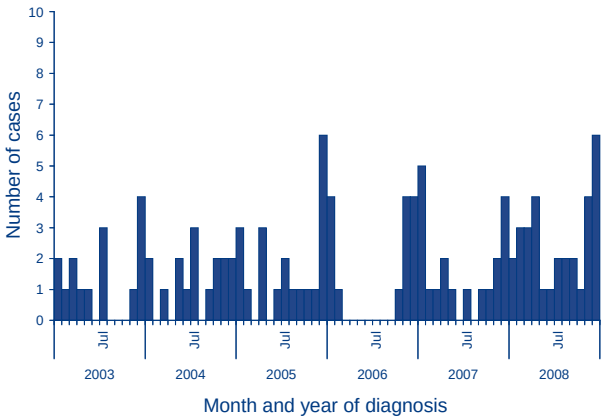


Table 10: Outbreaks of gastroenteritis including foodborne disease reported to state and territory health departments, Australia, 2008

Mode of transmission	Number of outbreaks	Number affected	Hospitalised	Fatalities
Foodborne	104	1,454	96	11
Person-to-person	1,276	22,508	502	81
Unknown mode (*Salmonella* cluster)	22	309	46	0
Unknown mode (other pathogen)	22	157	19	1
Unknown mode (unknown aetiology)	118	1,085	26	6
Waterborne	1	7	1	0
Total	1,545	25,555	691	99

* Two outbreaks are included that commenced in December 2007, but were notified and investigated in 2008, one of them foodborne transmission and the other person-to-person.

outbreaks. This compares with 1,882 and 1,544 outbreaks reported across Australia in 2007 and 2006, respectively.

Outbreaks due to person-to-person spread

In 2008, 83% (1,276/1,545) of all gastroenteritis outbreaks were due to person-to-person spread. There were 22,508 people affected in these outbreaks and 81 deaths. These outbreaks were most common in aged care homes, with 61% (784/1,276) of outbreaks occurring in this setting, followed by 17% (211/1,276) and 15% (189/1,276) in hospitals and child care centres respectively. Approximately 40% (513/1,276) of outbreaks spread from person-to-person were caused by norovirus,† followed by only 3% of outbreaks caused by rotavirus. Forty-two per cent (531/1,276) of outbreaks due to person-to-person spread were of unknown aetiology. Late winter and early spring were the peak seasons for person-to-person outbreaks, with 38% (487/1,276) of outbreaks reported in the months of August to October 2008.

Waterborne outbreaks

There was 1 outbreak due to waterborne transmission; an outbreak of *E. coli* (multiple serotypes) associated with the consumption of tank water, affecting 7 people at a camp.

Outbreaks with unknown mode of transmission

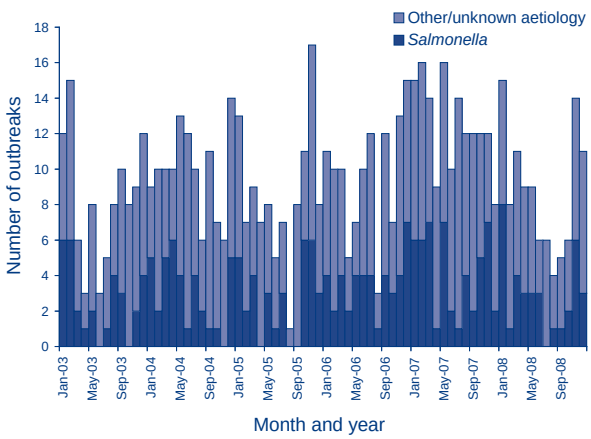
There were 162 outbreaks where the mode of transmission was not determined, affecting a total of 1,551 people. There were 22 investigations of *Salmonella* and 22 investigations of other pathogens that were clustered in time, place or person where investigators were unable to develop an adequate hypothesis for the source of illness. There were 118 outbreaks where investigators were unable to determine the mode of transmission or the aetiology.

Foodborne outbreaks

In 2008, there were 104 outbreaks of foodborne disease affecting 1,454 people, compared with 149 and 115 foodborne outbreaks in 2007 and 2006, respectively (Appendix). There were 96 people hospitalised and 11 deaths reported during these outbreaks.

The overall rate of reported foodborne disease outbreaks for Australia was 4.9 outbreaks per million population in 2008 (Table 11). The highest rates of foodborne outbreak reporting were from the Northern Territory with 22.7 per million population and New South Wales with 7.6 per million population. Outbreaks were more common in warmer months (Figure 12).

Figure 12: Outbreaks of foodborne *Salmonella* infections and other aetiological agents (n = 687) reported to state and territory health departments, Australia, 2003–2008, by month and year of outbreak



† This 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.

Aetiological agents

The mostly commonly implicated aetiological agent in outbreaks of foodborne illness was *Salmonella*, which caused 34% (35/104) of outbreaks; 89% (31/35) of these being due to *S.* Typhimurium (Table 12).

Toxin-mediated outbreaks comprised 18% (19/104) of all foodborne outbreaks, with 32% (6/19) of these due to fish toxins (5 outbreaks of ciguatera fish poisoning, and 1 outbreak of histamine poisoning) and 68% (13/19) due to foodborne intoxications with *Bacillus cereus*, *Clostridium perfringens* or *Staphylococcus aureus*.

There were also 4 foodborne outbreaks of *Campylobacter*, and 8 outbreaks were caused by viral agents. In 2008, 37% (38/104) of foodborne outbreaks were of unknown aetiology compared with 38% in the previous year.

Food vehicles

A wide variety of food vehicles were implicated in outbreaks of foodborne disease in 2008. Investigators were unable to identify a food vehicle in 28% (29/104) of outbreaks (Table 13).

There were 20 outbreaks associated with eggs; these comprised 19% of all foodborne outbreaks and included all outbreaks that investigators considered to be egg-associated (Table 14). Nine of these outbreaks involved desserts that commonly contain raw egg (such as chocolate mousse and tiramisu), five were due to egg-based sauces or dressings (such as aioli or hollandaise sauce), three were due to eggs as a whole food and 1 outbreak each was due to mixed dishes, a dish containing eggs and suspected chicken and/or eggs. These outbreaks affected a total of 289 people and hospitalised 36 people.

Fifteen per cent (16/104) of outbreaks were due to mixed dishes, including buffets where a variety of dishes were served, and investigators were unable to implicate a particular ingredient (1 outbreak was suspected to be egg-associated). Nine per cent (9/104) of outbreaks were due to chicken or dishes containing chicken and 7% (7/104) were due to meat or dishes containing meat, 6% (6/104) due to fish and 6% (6/104) due to salads and/or sandwiches and 4% (4/104) due to molluscs. The remaining outbreaks were due to pasta dishes (3), vitamised foods (2), a rice-based dish (1) and a non-egg-based sauce or gravy (1).

Table 11: Outbreaks of foodborne disease, Australia, 2008, by OzFoodNet site

State	Number of outbreaks	People affected	Mean size (persons)	Hospitalised	Outbreaks per million population
ACT	1	24	24.0	2	2.9
NSW	53	632	11.9	31	7.6
NT	5	36	7.2	7	22.7
Qld	14	137	9.8	3	3.3
SA	4	66	16.5	14	2.5
Tas	2	81	40.5	9	4.0
Vic	21	328	15.6	27	4.0
WA	4	150	37.5	3	1.8
Australia	104	1454	14.0	96	4.9

Table 12: Aetiological agents responsible for foodborne disease outbreaks, number of outbreaks and persons affected, Australia, 2008

Agent category	Number of outbreaks	People affected	Mean size (people)	Hospitalised
Salmonella Typhimurium	31	443	14	67
Foodborne intoxication	13	348	27	6
Viral	8	238	30	4
Ciguatera/histamine poisoning	6	22	4	2
Campylobacter	4	16	4	0
Other *Salmonella* serotypes	4	43	11	4
Unknown	38	344	9	13
Total	104	1,454	14	96

Table 13: Categories of food vehicles implicated in foodborne disease outbreaks, Australia, 2008

Vehicle category	Number of outbreaks	Number affected	Mean size (persons)	Hospitalised
Mixed dishes	17	300	6	8
Egg-containing desserts	9	98	9	10
Chicken and chicken-containing dishes	9	104	12	7
Meat and meat-containing dishes	7	90	13	2
Fish	6	22	4	2
Salads and/or sandwiches	6	68	11	6
Molluscs	4	19	5	0
Egg-based sauces and dressings	5	133	27	12
Eggs	3	26	9	8
Pasta dish	3	43	14	3
Vitamised foods	2	45	23	7
Egg-containing dish	1	3	3	1
Rice based dish	1	3	3	0
Sauces and gravies	1	31	31	0
Suspected chicken and/or eggs	1	14	14	2
Unknown	29	455	16	28
Total	104	1,454	14	96

Table 14: Outbreaks of foodborne illness associated with egg-based dishes (n = 20), Australia, 2008

State	Setting prepared	Agent responsible	Number affected	Evidence	Responsible vehicles
ACT	Restaurant	*S.* Typhimurium 44	24	A	Hollandaise sauce and poached eggs
NSW	Private residence	*S.* Typhimurium	20	D	Eggs
	Private residence	*S.* Typhimurium 170	17	D	Eggs used to make cake filling
	Restaurant	*S.* Typhimurium 126	3	D	Chicken salad made with raw egg dressing
	Unknown	Unknown	14	D	Suspected chicken and/or eggs
	Aged care facility	*S.* Typhimurium 144	10	M	Chocolate mousse with raw eggs
	Bakery	*S.* Typhimurium	10	A	Chocolate mousse cake
	Bakery	*S.* Typhimurium	16	D	Chocolate mousse cake
	Restaurant	*S.* Typhimurium 170 var	24	A	Raw eggs in Caesar salad dressing
	National franchised fast food	*S.* Typhimurium 44	3	D	Bacon and egg sandwich
	Restaurant	Unknown	5	D	Aioli made with raw eggs
NT	Restaurant	*S.* Typhimurium 9	2	D	Suspected raw egg mayonnaise/Caesar salad dressing
SA	Bakery	*S.* Typhimurium 9	15	A	Sweet bakery products
Tas	Restaurant	*S.* Typhimurium 135a	78	AM	Aioli
	Private residence	*S.* Typhimurium 135a	3	D	Cake mix containing raw egg
Vic	Private residence	*S.* Typhimurium 135a	7	M	Ice cream cake made with raw eggs
	Private residence	*S.* Typhimurium 44	12	D	Lemon dessert made with raw eggs
	Restaurant	Unknown	4	D	Desserts suspected
	Restaurant	*S.* Typhimurium 44	4	D	Desserts suspected
	Restaurant	*S.* Typhimurium 170	4	D	Tiramisu

D Descriptive evidence implicating the vehicle

A Analytical epidemiological association between illness and vehicle

M Microbiological confirmation of aetiology in vehicle and cases.

Settings where food was prepared

In 2008, foods implicated in outbreaks were most commonly prepared in restaurants (43%, 45/104), by commercial caterers (12%, 12/104) or in private residences (12%, 12/104). Outbreaks were less frequently reported as being associated with foods prepared in aged care facilities (7%, 7/104), takeaway premises (6%, 6/104) or primary produce (5%, 5/104) (Table 15). In 2008 the only implicated foods that were contaminated in primary produce environments were fish involved in ciguatera fish poisoning outbreaks. The species of fish involved in these outbreaks included yellowtail kingfish, black kingfish, red throat emperor/reef snapper, yellow king/Samson fish and cod.

Investigative methods and levels of evidence

To investigate these foodborne outbreaks, state and territory investigators conducted 28 retrospective cohort studies and 4 case control studies. Descriptive case series were obtained for 62 outbreaks. No individual data were collected on patients in 10 outbreaks. An analytical association between illness and the implicated food as well as microbiological evidence of the aetiological agent in the implicated food was obtained for 3 outbreaks. Analytical evidence alone was obtained for 14 outbreaks and microbiological evidence alone for 9 outbreaks. These confirmed outbreaks comprised 25% (26/104) of all outbreaks compared with 46% in 2007 and 41% in 2006. Investigators relied on descriptive evidence implicating the food vehicle in 54 outbreaks, and there were no data available on the evidence obtained for 24 outbreaks (many of these were not attributed to a specific food vehicle).

Significant outbreaks

In 2008 there were 8 outbreaks of foodborne illness affecting 40 or more people: 2 outbreaks of *C. perfringens;* 1 mixed outbreak of *C. perfringens* and *B. cereus;* 3 outbreaks of norovirus; one of *S.* Typhimurium 135a; and one of unknown aetiology. In total, these outbreaks affected 481 people, with a range of 41 to 78 people affected per outbreak. Nine people were hospitalised, all of them associated with a *Salmonella* outbreak.

Tasmania reported the largest of these outbreaks; an outbreak of *S.* Typhimurium 135a affecting 78 people who dined at the same restaurant over a 4-day period. A cohort study of 212 restaurant patrons showed a very strong association between the consumption of aioli and illness (odds ratio [OR] = 511, 95% CI 90–4,709), $P < 0.000$). *S.* Typhimurium 135a was isolated from 4 food items collected from the food premises; the aioli, 2 foods containing the aioli, and a guacamole, which was considered by the investigators likely to have been cross-contaminated. Eggs supplied to the food business were from the same producer who was implicated in outbreaks of this *Salmonella* strain in 2005 and 2007.[16,17]

Table 15: Food preparation settings implicated in disease outbreaks, Australia, 2008

Setting prepared	Number of outbreaks	Proportion of all outbreaks (%)*	Number affected (persons)
Restaurant	45	43	530
Commercial caterer	12	12	259
Private residence	12	12	107
Aged care facility	7	7	178
Takeaway	6	6	77
Primary produce	5	5	21
Bakery	4	4	42
Institution	4	4	101
Camp	2	2	29
Grocery store/delicatessen	1	1	2
Institution – other	1	1	15
Military	1	1	45
National franchised fast food	1	1	3
School	1	1	26
Unknown	2	2	19
Total	104		1,454

* Percentages do not add up to 100% due to rounding.

New South Wales reported 3 outbreaks of foodborne intoxication affecting more than 40 people:

- an outbreak of gastrointestinal illness affecting all 75 guests of a birthday party where food had been supplied by an unregistered catering business. Several foods contained *C. perfringens* and *B. cereus* enterotoxins, and the proprietor was advised to cease preparing any foods for sale until the premises used for food preparation was brought up to a satisfactory standard.
- an outbreak of gastroenteritis affecting 45 of 100 people at an army training facility. A cohort study found an association between a curry meal and illness. Seven stool specimens were positive for *C. perfringens* enterotoxin type A. Temperature abuse of foods and inadequate equipment were considered by investigators to have been contributing factors in this outbreak.
- an outbreak of gastrointestinal illness affected 69 of 131 residents of an aged care facility over a 1 month period beginning in June. The outbreak may have involved two or more smaller peaks of illness accounting for the long time period of the outbreak. Seven out of 10 stool specimens were positive for *C. perfringens* enterotoxin type A. Consumption of vitamised or pureed diets and living in the high dependency unit were found to increase the risk of illness, although these 2 factors were not independent. Food handling and hygiene practices were found to be satisfactory.

A large outbreak of norovirus affected 56 of 138 attendees on a 5-day training course at a Brisbane academy in March. A retrospective cohort study identified an association between a cold meat and salad dish, provided by an outside caterer, and illness (RR = 2.0, 95% CI 1.5–2.7, $P = 0.004$). Eight stool specimens were positive for norovirus.[18]

An outbreak of norovirus gastroenteritis affected 75 of 366 people eating a buffet meal at a Western Australian restaurant. A Thai fish curry was the only food significantly associated with illness (RR = 1.30, $P < 0.05$), however this food was consumed by only 28% of cases. Six faecal specimens obtained were positive for norovirus. An inspection of the premises did not identify any major deficiencies and there were no reports of staff illness.[19]

An outbreak of norovirus at an aged care facility in Western Australia affected 42 people including residents and staff. The index case was a chef who had prepared food while he was ill with gastroenteritis. Other staff and residents subsequently became ill over a 24 hour period. No single food was identified as the vehicle in this outbreak, and some person-to-person spread may have been possible.

Victoria reported an outbreak of unknown aetiology affecting 41 people from 3 different groups who ate at a large buffet restaurant in October. While *C. perfringens* enterotoxin was suspected as the cause of this outbreak, it was detected in only one out of 13 stool specimens collected. Univariate analysis showed that illness was associated with consumption of lamb tenderloin (RR 4.0; 95% CI 2.3–7.0), chicken cacciatore (RR 2.0; 95% CI 1.4–2.8) and roast pork (RR 2.4; 95% CI 1.4–4.0).[20]

Discussion

This report documents changes in the incidence of gastrointestinal diseases commonly transmitted by food in Australia. There was a decrease in the number of notifications of *Salmonella* and *Campylobacter* compared with previous years. Despite these declines, these 2 infections continue to be reported at higher rates than in other developed countries.[2,21] This is the first time hepatitis A has been included in the annual report. 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 cause large outbreaks of foodborne disease.[22,23]

Similar to 2007, higher rates of campylobacteriosis were observed in males than in females, particularly those over the age of 45 years.[12] The reasons for this were unclear, but may relate to higher susceptibility of males in this age group due to the use of acid suppressive medications.[24] In Australia, the primary source of *Campylobacter* infection is thought to be chicken consumption, causing an estimated 29.3% of all infections.[25] This is consistent with findings from other countries, although recent work in New Zealand highlights that the fraction of campylobacteriosis due to chicken meat consumption may be considerably higher.[26] The New Zealand Food Safety Authority recently announced that the poultry industry had successfully reduced the prevalence of *Campylobacter* on chicken meat, which had lead to a marked decline in human cases.[27]

In 2008, the proportion of *Salmonella* isolates that contained appropriate information on serotype and/or phage type decreased by 3% compared with 2007. Typing is vital for outbreak detection and monitoring trends. Western Australia ceased phage typing isolates in 2007 in favour of pulsed field gel electrophoresis, which is a discriminatory technique for typing *Salmonella* but not routinely used by other Australian laboratories.[28] Other jurisdictions used multi-locus variable number of tandem repeats analysis to compare strains during outbreaks, which proved rapid and very useful. The use of these different typing schemes caused some complexity dur-

ing multi-jurisdictional investigations. Despite this there is increasing harmonisation in typing schemes used by Australian laboratories.

Despite travel warnings and vaccine recommendations, travellers continue to acquire infections abroad, the risk being higher for long-term travellers and people who visit friends or relatives.[29] In this report, we summarised data on 3 infections that are commonly acquired overseas; typhoid (96% of cases), hepatitis A (54.7% of cases) and *S.* Enteritidis (83% of cases). A large proportion of hepatitis A infections are likely to be acquired while visiting friends or relatives, with a recent study in New South Wales showing travellers who were born in endemic areas were at higher risk of infection.[30] Travellers visiting friends or relatives may be less likely than other travellers to seek advice from a website such as the Department of Foreign Affairs' Smartraveller (http://www.smartraveller.gov.au), or from a travel clinic or general practitioner prior to travel, due to a perception of lower risk and lack of access to culturally and linguistically appropriate advice. It is important that prevention information is targeted at these groups. We compared the reported country and region of acquisition for *S.* Enteritidis infections with the proportion of all returning travellers who had nominated that place as their primary destination and observed that cases were more likely to have travelled to the South East Asian region.

In 2008, OzFoodNet sites reported 1,545 outbreaks of gastrointestinal disease, which was less than that reported in 2007.[12] Similar to previous years, the majority of outbreaks in 2008 were transmitted from person to person (83%), with 61% of these reported from aged care facilities, 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. Outbreaks transmitted person-to-person were most frequently of unknown aetiology (42%) followed by norovirus (40%). Norovirus outbreaks peaked in late winter and early spring in 2008.

In 2008, OzFoodNet sites reported 104 foodborne or suspected foodborne outbreaks, a rate of 4.9 outbreaks per million people, with a mean outbreak size of 14 people affected per outbreak. This compares with 7.1 outbreaks per million in Australia in 2007, and an estimated 4.2 outbreaks per million in the United States in 2006.[31] *Salmonella* continues to be the leading cause of reported outbreaks of foodborne illness in Australia, with 34% of outbreaks due to this pathogen, the majority of them due to *S.* Typhimurium. In 2008, there were 8 large outbreaks of foodborne illness (affecting 40 or more people). The largest of these was due to *S.* Typhimurium 135a, which affected 78 people who dined at the same restaurant over a 4-day period. Eggs used at the restaurant were supplied by a producer who had been implicated in previous foodborne outbreaks.

Eggs were suspected as the cause of 27% (20/75) of foodborne outbreaks where investigators were able to identify a food vehicle. Eggs are a commonly consumed food, and 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 and egg products that is considering safety of the whole production chain from farm through to retail.[32]

Since the commencement of OzFoodNet in 2000, the network has successfully enhanced surveillance and conducted applied research into foodborne diseases in Australia. In 2008, OzFoodNet and the New South Wales Food Authority conducted the National Gastroenteritis Survey II (NGSII), which repeated the original survey in 2001–2002.[33] The NGSII survey was completed in early 2009 and is currently being analysed. OzFoodNet continues to be engaged in regional capacity building activities through the World Health Organization's Global Foodborne infections network, and has sent epidemiologists as trainers to 2 training workshops (held in Papua New Guinea and Thailand) in 2008.

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 so 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.

Foodborne disease surveillance provides information to assist in not only immediate public health action and the prevention of these diseases, but also to 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 by identifying 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 and thereby help prevent foodborne illness.

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Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008

State	Month of outbreak	Setting prepared	Aetiology	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Food vehicle category
ACT	November	Restaurant	*Salmonella* Typhimurium 44	24	2	0	A	CCS	Hollandaise sauce and poached eggs	Egg-based sauces and dressings
NSW	December	Aged care facility	*Salmonella* Typhimurium	6	2	0		D	Unknown	Unknown
	February	Commercial caterer	*Bacillus cereus* and *Clostridium perfringens*	75	0	0	M	D	Curry pumpkin, curry chicken, rice with lamb	Mixed dishes
	June	Institution	Unknown	14	0	0	D	D	Lasagne	Pasta dish
	January	Institution	Unknown	6	0	0		D	Unknown	Unknown
	January	Private residence	Unknown	3	0	0		D	Mussels - fresh	Bivalves and molluscs
	March	Private residence	*Salmonella* Typhimurium 170	17	2	0	D	D	Eggs used to make cake filling	Egg-containing desserts
	January	Private residence	*Salmonella* Typhimurium	20	6	0	D	D	Eggs	Eggs
	July	Restaurant	Unknown	4	0	0	D	D	Oysters	Bivalves and molluscs
	September	Restaurant	*Staphylococcus aureus*	7	1	0	M	D	Chicken	Chicken & chicken-containing dishes
	May	Restaurant	*Salmonella* Anatum	11	0	0	D	D	Chicken meal	Chicken & chicken-containing dishes
	December	Restaurant	Unknown	5	0	0	D	D	Aioli made with raw eggs	Egg-based sauces and dressings
	March	Restaurant	*Salmonella* Typhimurium 126	3	1	0		D	Chicken salad with raw egg dressing	Egg-containing dish
	January	Restaurant	Unknown	2	0	0	D	D	Suspected ham	Meat and meat-containing dishes
	April	Restaurant	*Salmonella* Typhimurium U290	7	0	0		D	Most likely chilli beef	Meat and meat-containing dishes
	April	Restaurant	*Salmonella* Typhimurium U290	4	1	0	M	D	Variety of Chinese foods	Mixed dishes
	December	Restaurant	Unknown	5	0	0		D	Unknown - suspected Indian takeaway food	Mixed dishes
	December	Restaurant	Unknown	3	0	0		D	Rice, naan, butter chicken and lamb sabjwala	Mixed dishes

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

State	Month of outbreak	Setting prepared	Aetiology	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Food vehicle category
NSW, *cont*	May	Restaurant	Unknown	4	0	0		D	Stir fry beef with dried hot chilli and peanut	Mixed dishes
	April	Restaurant	Unknown	7	0	0		D	Rice or salt and pepper prawn	Mixed dishes
	March	Restaurant	Unknown	3	0	0	D	D	Spring roll, suspected	Mixed dishes
	September	Restaurant	Unknown	5	1	0		D	Barramundi, lamb, salad	Mixed dishes
	July	Restaurant	Unknown	3	0	0		D	Fried rice	Rice based dish
	November	Restaurant	Unknown	3	0	0		D	Unknown, possibly pizza	Unknown
	April	Restaurant	Unknown	25	3	0		D	Unknown	Unknown
	December	Restaurant	Unknown	3	0	0		D	Unknown	Unknown
	February	Restaurant	Unknown	4	0	0		D	Unknown	Unknown
	January	Restaurant	Unknown	7	0	0	D	D	Unknown	Unknown
	November	Restaurant	Unknown	6	0	0		D	Unknown	Unknown
	October	Restaurant	Unknown	6	1	0		D	Unknown	Unknown
	September	Takeaway	Unknown	5	0	0		D	Lamb kebab suspected	Meat and meat-containing dishes
	November	Takeaway	Unknown	4	0	0		D	Pasta with tomato sauce (suspected)	Pasta dish
	December	Takeaway	Unknown	25	1	0	D	D	Unknown	Unknown
	January	Takeaway	Unknown	3	0	0		D	Unknown	Unknown
	May	Unknown	Unknown	14	2	0		D	Unknown but likely chicken and or eggs	Suspected chicken and/or eggs
	January	Bakery	Scombroid	1	1	0	D	N	Tuna from can used to prepare tuna salad roll in hot bread shop	Fish
	November	Camp	*Campylobacter*	6	0	0		N	Unknown	Unknown
	November	Grocery store/ delicatessen	*Salmonella* Typhimurium	2	1	0		N	Cabanossi and pepperoni sausages	Meat and meat-containing dishes
	December	National franchised fast food	*Salmonella* Typhimurium 44	3	2	0	D	N	Bacon and egg sandwich - likely eggs	Eggs
	January	Private residence	Unknown	2	0	0		N	Mussels - fresh	Bivalves and molluscs

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

State	Month of outbreak	Setting prepared	Aetiology	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Food vehicle category
NSW, *cont*	November	Restaurant	*Salmonella* Typhimurium 170 var	24	1	0	A	N	Raw eggs in Caesar salad dressing	Egg-based sauces and dressings
	August	Aged care facility	*Salmonella* Typhimurium 144	10	0	0	M	C	Chocolate mousse with raw eggs	Egg-containing desserts
	June	Aged care facility	*Clostridium perfringens*	69	0	7	AM	C	Unknown possibly pureed food	Unknown
	November	Bakery	*Salmonella* Typhimurium	10	1	0	A	C	Chocolate mousse cake	Egg-containing desserts
	November	Bakery	*Salmonella* Typhimurium	16	0	0	D	C	Chocolate mousse cake	Egg-containing desserts
	August	Commercial caterer	Viral	8	0	0	D	C	Mixed sandwiches	Salads and/or sandwiches
	April	Commercial caterer	*Clostridium perfringens*	31	0	0	A	C	Gravy	Sauces and gravies
	August	Institution	*Clostridium perfringens*	25	3	0	AM	C	Macaroni bolognaise	Pasta dish
	March	Military	*Clostridium perfringens*	45	0	0	D	C	Curry	Meat and meat-containing dishes
	July	Restaurant	Unknown	10	0	0	A	C	Oysters	Bivalves and molluscs
	May	Restaurant	Unknown	17	0	0	A	C	Fattouch salad	Salads and/or sandwiches
	November	Restaurant	Unknown	4	0	0	M	C	Unknown	Unknown
	October	Restaurant	Unknown	5	0	0	D	C	Unknown	Unknown
	December	Takeaway	Unknown	25	1	0	D	C	Unknown	Unknown
NT	November	Restaurant	*Salmonella* Typhimurium 9	2	0	0	D	N	Suspect raw egg mayonnaise/ Caesar salad dressing	Egg-based sauces and dressings
	November	Restaurant	Unknown	3	0	0	D	N	Unknown	Unknown
	June	Takeaway	*Salmonella* Weltevreden	15	3	0	D	N	Unknown	Unknown
	January	unknown	*Salmonella* Typhimurium 182	5	1	0	D	N	Unknown	Unknown
	March	Restaurant	Unknown	11	3	0	D	C	Steak and/ or fried rice	Mixed dishes

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

State	Month of outbreak	Setting prepared	Aetiology	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Food vehicle category
Qld	March	Commercial caterer	Unknown	6	0	0	D	CCS	Unknown	Unknown
	October	Camp	*Staphylococcus aureus*	23	2	0	D	D	Roast chicken	Chicken & chicken-containing dishes
	December	Primary produce	Ciguatera fish Poisoning	3	0	0	D	D	Cod	Fish
	July	Primary produce	Ciguatera fish Poisoning	4	Unknown	0	D	D	'Yellow king' - Samson fish	Fish
	July	Primary produce	Ciguatera fish Poisoning	6	1	0	D	D	Red throat emperor/ reef snapper	Fish
	March	Primary produce	Ciguatera fish Poisoning	6	Unknown	0	D	D	Black kingfish	Fish
	March	Primary produce	Ciguatera fish Poisoning	2	0	0	D	D	Yellowtail kingfish	Fish
	October	Private residence	*Salmonella* Virchow 8	3	0	0	D	D	Chicken curry	Chicken & chicken-containing dishes
	February	Restaurant	*Campylobacter*	4	0	0	D	D	Chicken liver pate	Chicken & chicken-containing dishes
	February	Restaurant	*Campylobacter*	2	0	0	D	D	Chicken	Chicken & chicken-containing dishes
	April	Restaurant	*Clostridium perfringens*	2	0	0	M	D	Refried Mexican beans	Mixed dishes
	November	Restaurant	*Staphylococcus aureus*	4	0	0	D	D	Unknown	Unknown
	November	Commercial caterer	*Staphylococcus aureus*	16	Unknown	0	M	C	Multiple foods	Mixed dishes
	March	Institution	Norovirus	56	0	0	A	C	Deli meat & salad dish	Mixed dishes
SA	December	Bakery	*Salmonella* Typhimurium 9	15	3	0	A	CCS	Sweet bakery products	Mixed dishes
	January	Private residence	*Salmonella* Typhimurium 9	15	6	0	D	D	Unknown	Unknown
	June	Aged care facility	*Salmonella* Typhimurium 135	31	5	3	A	C	Unspecified vitamised food	Vitamised foods
	September	Commercial caterer	Norovirus	5	0	0	D	C	No specific food identified	Unknown

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

State	Month of outbreak	Setting prepared	Aetiology	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Food vehicle category
Tas	March	Private residence	*Salmonella* Typhimurium 135a	3	0	0	D	D	Raw egg	Eggs
	January	Restaurant	*Salmonella* Typhimurium 135a	78	9	0	AM	C	Aioli	Egg-based sauces and dressings
Vic	February	Aged care facility	*Clostridium perfringens*	6	0	0	D	D	Unknown	Unknown
	September	Aged care facility	*Salmonella* Typhimurium 44	14	2	1	D	D	Vitamised food	Vitamised foods
	March	Commercial caterer	*Salmonella* Typhimurium 44	24	10	0	D	D	Unknown	Unknown
	August	Institution – other	*Clostridium perfringens*	15	0	0	D	D	Savoury mince	Meat and meat-containing dishes
	January	Private residence	*Salmonella* Typhimurium 135a	7	1	0	M	D	Ice cream cake made with raw eggs	Egg-containing desserts
	June	Private residence	*Salmonella* Typhimurium 135a	4	3	0	D	D	Suspect egg/custard dessert	Egg-containing desserts
	April	Restaurant	*Salmonella* Typhimurium 44	4	1	0	D	D	Desserts suspected	Egg-containing desserts
	October	Restaurant	*Salmonella* Typhimurium 170	18	1	0	D	D	Tiramisu	Egg-containing desserts
	May	Restaurant	*Salmonella* Johannesburg	14	1	0	M	D	Roast pork	Meat and meat-containing dishes
	May	Restaurant	Norovirus	14	0	0	D	D	Breakfast meals	Mixed dishes
	June	Restaurant	Unknown	9	unknown	0	D	D	Ready to eat uncooked foods such as salads	Salads and/or sandwiches
	May	Restaurant	Hepatitis A	12	4	0	D	D	Ready to eat foods such as salads and sandwiches	Salads and/or sandwiches
	December	Restaurant	Norovirus	26	0	0	D	D	Unknown	Unknown
	May	Commercial caterer	Unknown	21	1	0	A	C	Chicken curry	Chicken & chicken-containing dishes
	February	Commercial caterer	Unknown	21	0	0	A	C	Continental custard cake	Mixed foods
	February	Commercial caterer	*Salmonella* Typhimurium 170	18	2	0	A	C	Chicken and pasta salad and ham	Salads and/or sandwiches

Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

State	Month of outbreak	Setting prepared	Aetiology	Number affected	Hospitalised	Fatalities	Evidence	Epidemiological study	Responsible vehicles	Food vehicle category
Vic, *cont'd*	February	Commercial caterer	*Campylobacter*	4	0	0	A	C	Chicken and pasta salad	Salads and/or sandwiches
	January	Private residence	*Salmonella* Typhimurium 44	12	1	0	D	C	Lemon dessert made with raw eggs	Egg-containing desserts
	January	Private residence	*Salmonella* Typhimurium 135a	18	0	0	D	C	Several foods had statistically significant associations with illness.	Mixed dishes
	October	Restaurant	Unknown	41	0	0	A	C	Lamb tenderloin and gravy or roast pork or chicken cacciatore	Mixed dishes
	May	School	*Salmonella* Typhimurium 44	26	0	0	D	C	Unknown	Unknown
WA	July	Commercial caterer	*Clostridium perfringens*	30	0	0	D	CCS	BBQ Asian chicken	Chicken & chicken-containing dishes
	April	Aged care facility	Norovirus	42	0	0	D	D	Unknown	Unknown
	January	Private residence	*Salmonella* Typhimurium 9	3	3	0	D	D	Chicken	Chicken & chicken-containing dishes
	April	Restaurant	Norovirus	75	0	0	D	C	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

C Cohort study.

D Descriptive case series.

CCS Case-control study.

N Individual patient data not collected.