Burden and causes of foodborne disease in Australia: Annual report of the OzFoodNet network, 2005

The OzFoodNet Working Group

Abstract

In 2005, OzFoodNet sites recorded 25,779 notifications of seven potentially foodborne diseases, which was 12.5 per cent higher than the mean for the previous five years. Diseases with significant increases in 2005, when compared to historical reports include: Shiga toxin-producing *Escherichia coli*, shigellosis, haemolytic uraemic syndrome, salmonellosis and campylobacteriosis. The most significant increases were those due to *Salmonella* (13.1%) and *Campylobacter* (5.1%) because of the frequency of these infections. Reports of listeriosis were lower than previous years and there were only four materno-foetal infections compared to seven in 2004. Sites reported 624 outbreaks of gastroenteritis and foodborne disease in 2005. One hundred and two of these were foodborne and affected 1,926 persons, hospitalised 187 and caused four deaths. Among foodborne outbreaks, *Salmonella* Typhimurium was the most common pathogen and restaurants were the most common place where food implicated in outbreaks was prepared. Outbreaks associated with fish, poultry meat, and mixed meat dishes were common. There were several large outbreaks of salmonellosis, including one associated with dips at a Turkish restaurant, one with alfalfa sprouts, and two due to egg-based dishes. In addition, there were several multi-state investigations of *Salmonella* infection during 2005, including one large outbreak of *S.* Typhimurium 135 implicating poultry meat from retail supermarkets. Sites identified a source of infection for 39 per cent (41/104) of investigations into clusters of salmonellosis. Overall, 97.4 per cent of *Salmonella* notifications on state and territory surveillance databases recorded complete information about serotype and phage type. This report highlights the considerable burden of disease from food sources in Australia and the need to continue to improve food safety. *Commun Dis Intell* 2006;30:278–300.

Keywords: surveillance, foodborne disease, disease outbreak, Salmonella, Enteritidis, Campylobacter, Listeria, Shigella, *typhoid*

Introduction

Foodborne disease is a considerable burden on Australian society with 5.4 million cases annually, costing an estimated $1.2 billion dollars.[1] While the majority of cases of foodborne disease are mild and do not require medical attention, the sheer number of affected people taking time from work to recover or care for affected family members make up approximately 60 per cent of these costs. In addition, the costs to food businesses implicated in outbreaks of disease can be significant, although they are difficult to ascertain.[1]

There are over 200 different types of illness that may be transmitted by food, although only a handful are specifically notifiable to health departments.[2] Due to the mild nature of foodborne diseases, most cases do not appear in surveillance statistics collected by health departments. In Australia, for every notification of *Salmonella* and *Campylobacter* there are approximately 6.9 (95% credible interval 4.0–16.4) and 9.6 (95% credible interval 6.2–22.4) cases in the community respectively.[3] The proportion of cases that are notified varies considerably by disease, as the severity of various illnesses differ markedly.[2,3]

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Health departments use surveillance of infectious diseases for observing trends, preventing further spread of infections, detecting outbreaks and monitoring the effects of interventions.[4] The source of infection is difficult to determine in sporadic cases of enteric diseases as they may be acquired from infected persons, animals, contaminated water or foods and other sources within the environment. In outbreaks of enteric diseases the modes of transmission are more likely to be determined. Where these outbreaks are foodborne they can be useful for developing policy to prevent further disease.[5]

In 2000, the Australian Government Department of Health and Ageing established the OzFoodNet network to enhance surveillance for foodborne disease.[6] This built upon an 18-month trial of active surveillance in the Newcastle region of New South Wales. OzFoodNet was modelled on the Centers for Disease Control and Prevention's FoodNet surveillance system. The OzFoodNet network consists of epidemiologists employed by each state and territory health department to conduct investigations and applied research into foodborne disease. The network involves many different collaborators, including the National Centre for Epidemiology and Population Health, and the Public Health Laboratory Network. OzFoodNet is a member of the Communicable Diseases Network Australia, which is Australia's peak body for communicable disease control.[7] The Australian Government Department of Health and Ageing funds OzFoodNet and convenes committees to manage the network, and a committee to review the scientific basis for various research projects.

This is the fifth annual report of OzFoodNet and covers data and activities for 2005.

Methods

Population under surveillance

In 2005, the coverage of the network included the entire Australian population, which was estimated to be 20,328,609 persons.[8] In 2005, the Hunter New England Area Health Service hosted an OzFoodNet site, which supplemented statewide foodborne disease surveillance across New South Wales.

Data sources

Rates of notified infections

All Australian states and territories require doctors and/or pathology laboratories to notify patients with infectious diseases that are important to public health. Western Australia is the only jurisdiction where laboratory notification is not mandatory under legislation, although most laboratories still notify the health department by agreement. OzFoodNet aggregated and analysed data on patients notified with the following diseases or conditions, a proportion of which may be acquired from food:

- *Campylobacter* infections;
- Non-typhoidal *Salmonella* infections;
- *Listeria* infections;
- Shiga toxin producing *Escherichia coli* infections and haemolytic uraemic syndrome;
- typhoid; and
- *Shigella* infections.

To compare notifications in 2005 to historical totals, we compared crude numbers and rates of notification to the mean of the previous five years. Where relevant, we used data from the National Notifiable Diseases Surveillance System (NNDSS) and OzFoodNet sites to analyse data for specific subtypes of infecting organisms.

The date that notifications were received by each jurisdiction was used for analysis. To calculate rates of notification, we used the estimated resident populations for each state or territory as at June 2005.[8] For cases of neonatal listeriosis infections we used birth data from the Australian Institute of Health and Welfare.[9]

Gastrointestinal and foodborne disease outbreaks

OzFoodNet collected information on gastrointestinal and foodborne disease outbreaks that occurred in Australia during 2005. An outbreak of foodborne disease was defined as an increase in the number of reports of a particular infection or illness associated with a common 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. An example is a temporal or geographic increase in the number of cases of a certain type of *Salmonella* serovar or phage type. Another example is a community-wide increase of cryptosporidiosis that extends over some weeks or months. In this category, some outbreaks where the mode of transmission was indeterminate have been included.

OzFoodNet epidemiologists collate summary information about 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, we categorised outbreaks by aetiological agents, food vehicles and settings where the implicated food was prepared. Data on outbreaks due to transmission from animals and cluster investigations were also summarised. The number of outbreaks and documented causes may vary from summaries published by individual jurisdictions.

Surveillance evaluation

OzFoodNet compared the results of surveillance across different sites, including rates of reporting outbreaks, and investigation of clusters of *Salmonella*. To measure the quality of national surveillance data, OzFoodNet examined the completeness of information on state and territory databases in 2005. The proportions of *Salmonella* notifications with serotype and phage type information were compared with results for previous years.

Results

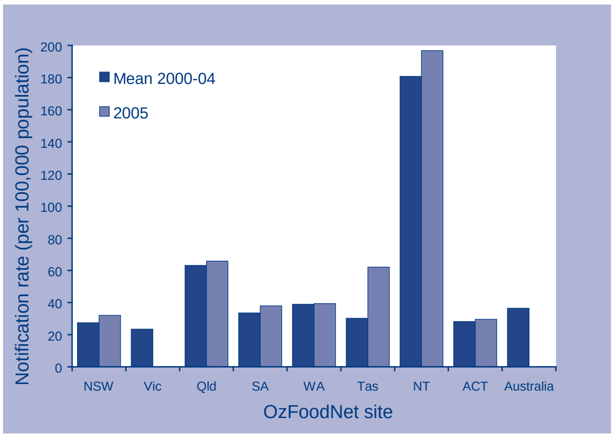
Rates of notified infections

In 2005, OzFoodNet sites reported 25,779 notifications of seven diseases that were potentially foodborne. This was a 12.5 per cent increase from the mean of 22,827 notifications for the previous five years. Reports for these seven diseases make up almost a quarter of notifications to the National Notifiable Diseases Surveillance System.[10] A summary of the number and rates of notifications by OzFoodNet sites is shown in Appendix 1.

Salmonella *infections*

In 2005, OzFoodNet sites reported 8,376 cases of *Salmonella* infection, which equated to 41.2 cases per 100,000 population and an increase of 13.1 per cent from the mean for the previous five years (Figure 1). The rates ranged from 28.3 cases per 100,000 population in Victoria to 196.8 cases per 100,000 population in the Northern Territory, which traditionally has the highest rates of all jurisdictions.

Figure 1. Notification rates of *Salmonella* infections, 2005, compared to the mean of the notification rate (2000–2004), by OzFoodNet site



Overall, notification rates of salmonellosis for 2005 were increased in all states and territories, particularly in Tasmania (105.3%), Victoria (20.8%) and New South Wales (17.0%) compared to historical means. The major increase in Tasmania was due to large outbreaks of *S.* Typhimurium 135 in November and December 2005.

The male to female ratio for salmonellosis was 1:1. The highest age-specific rate of *Salmonella* infection was 200.8 cases per 100,000 population in males aged 0–4 years. Notification rates were also elevated in the 5–9 year age group with a further peak in notification rates in the 20–29 year age group.

Rates of salmonellosis were highest in northern areas of Australia. The highest rate is consistently reported in the Kimberley region of Western Australia.[8] Western Australia reported that the Kimberley region had a rate of 262 per 100,000 population, which represents a 17 per cent decrease for the regional notification rate from the previous year. In Western Australia, rates of salmonellosis were higher in Indigenous people in all age groups, particularly in children aged 0–4 years. In the Northern Territory, Indigenous people had 1.8 times the rate of salmonellosis notifications compared to non-Indigenous people with the highest burden amongst the 0-4 year age group who had 1.4 times the rate of non-Indigenous children in the same age group.

During 2005, the most commonly reported *Salmonella* serotype was *S.* Typhimurium. There were 836 notifications of *Salmonella* Typhimurium 135 (including a subgroup locally designated 135a) to OzFoodNet sites making it the most common infection (Table 1). This compared to 578 notifications of this phage type in 2004. *Salmonella* Typhimurium 197 increased dramatically in 2005 with 536 notifications, which was a 102 per cent increase from 266 notifications in 2004. The highest specific rates for single subtypes reported by OzFoodNet sites were *S.* Typhimurium 135 and *S.* Mississippi in Tasmania, and *S.* Ball and *S.* Saintpaul in the Northern Territory with rates of 36.3, 12.2, 23.7, and 23.7 per 100,000 population, respectively. These subtype-specific rates were almost as high as the total rate of *Salmonella* notifications in some other jurisdictions.

Salmonella *Enteritidis*

S. Enteritidis is a serotype that can infect the internal contents of eggs through the oviducts of infected chickens, predominantly with *S.* Enteritidis phage type 4.[11,12] People may often become infected with this serotype after eating raw or undercooked eggs. This phage type has caused major problems in the northern hemisphere where it has become established in commercial egg laying flocks, although the incidence has declined in many countries.[11,12]

Table 1. Numbers, rates and proportions of the top 5 *Salmonella* infections, 2004 to 2005, by OzFoodNet site*

OzFoodNet site	*Salmonella* type (sero/phage type)	Top 5 infections					
		2005 n	Rate†	Proportion‡ (%)	2004 n	Rate	Ratio§
Australian Capital Territory	Typhimurium 170/108	14	4.3	14.6	31	9.6	0.5
	Typhimurium 135	13	4.0	13.5	5	1.5	2.6
	Typhimurium 9	10	3.1	10.4	6	1.9	1.7
	Stanley	5	1.5	5.2	2	0.6	2.5
	Hvittingfoss	4	1.2	4.2	0	0.0	–
	Typhimurium 44	4	1.2	4.2	0	0.0	–
New South Wales	Typhimurium 170/108	373	5.5	17.2	351	5.2	1.1
	Typhimurium 9	154	2.3	7.1	108	1.6	1.4
	Typhimurium 197	109	1.6	5.0	43	0.6	2.5
	Typhimurium 135	181	2.7	8.3	178	2.6	1.0
	Birkenhead	82	1.2	3.8	77	1.1	1.1
Northern Territory	Ball	48	23.7	12.0	50	25.0	1.0
	Saintpaul	48	23.7	12.0	48	24.0	1.0
	Litchfield	21	10.4	5.3	15	7.5	1.4
	Weltevreden	15	7.4	3.8	8	4.0	1.9
	Chester	12	5.9	3.0	12	6.0	1.0
	Kinondoni	10	4.9	2.5	6	3.0	1.7
Queensland	Saintpaul	276	7.0	10.6	225	5.8	1.2
	Virchow 8	190	4.8	7.3	247	6.4	0.8
	Typhimurium 197	145	3.7	5.6	145	3.7	1.0
	Typhimurium 135	137	3.5	5.3	185	4.8	0.7
	Aberdeen	135	3.4	5.2	118	3.0	1.1
	Hvittingfoss	135	3.4	5.2	110	2.8	1.2
South Australia	Typhimurium 9	57	3.7	9.7	46	3.0	1.2
	Infantis	48	3.1	8.2	17	1.1	2.8
	Typhimurium 64	47	3.0	8.0	4	0.3	11.8
	Typhimurium 135	47	3.0	8.0	44	2.9	1.1
	Typhimurium 170/108	33	2.1	5.6	70	4.6	0.5
Tasmania	Typhimurium 135	176	36.3	58.5	2	0.4	88.0
	Mississippi	59	12.2	19.6	63	13.1	0.9
	Typhimurium 9	10	2.1	3.3	4	0.8	2.5
	Typhimurium 170/108	7	1.4	2.3	3	0.6	2.3
	Typhimurium 44	5	1.0	1.7	0	0.0	–
Victoria	Typhimurium 197	279	5.6	19.6	59	1.2	4.7
	Typhimurium 135	191	3.8	13.4	137	2.8	1.4
	Typhimurium 9	118	2.3	8.3	145	2.9	0.8
	Typhimurium 170/108	63	1.3	4.4	88	1.8	0.7
	Typhimurium 44	50	1.0	3.5	7	0.1	7.1
Western Australia	Oranienburg	63	3.1	8.0	5	0.3	12.6
	Typhimurium 135	69	3.4	8.7	74	3.7	0.9
	Enteritidis 6A	35	1.7	4.4	21	1.1	1.7
	Saintpaul	32	1.6	4.0	46	2.3	0.7
	Muenchen	30	1.5	3.8	23	1.2	1.3

Table 1. Numbers, rates and proportions of the top 5 *Salmonella* infections, 2004 to 2005, by OzFoodNet site,* *continued*

OzFoodNet site	*Salmonella* type (sero/ phage type)	Top 5 infections					
		2005 n	Rate†	Proportion‡ (%)	2004 n	Rate	Ratio§
Australia	Typhimurium 135	836	4.1	10.0	578	2.9	1.4
	Typhimurium 197	536	2.6	6.4	266	1.3	2.0
	Typhimurium 170/108	535	2.6	6.4	647	3.2	0.8
	Saintpaul	434	2.1	5.2	395	2.0	1.1
	Typhimurium 9	428	2.1	5.1	360	1.8	1.2

* Where there were multiple fifth ranking *Salmonella* types all data have been shown, giving more than five categories for some sites.

† Rate per 100,000 population.

‡ Proportion of total Salmonella notified for this jurisdiction in 2005.

§ Ratio of the number of reported cases in 2005 compared to the number reported in 2004.

S. Typhimurium 135 includes a local variant phage type 135a, which is not a recognised international classification.

Australia is largely free of *S.* Enteritidis phage type 4 infections except in people returning from overseas. There are other phage types of *S.* Enteritidis that are endemic in Australia, although the sources of these local infections are poorly understood.

In 2005, OzFoodNet concluded data collection for a case control study of *S.* Enteritidis infections to determine the risk factors for infection. OzFoodNet epidemiologists enrolled cases of *S.* Enteritidis that were acquired in Australia between 2001 and 2005 to assess food-based and zoonotic risk factors for infection and compare them to population-based controls. The results of this study are still being collated for analysis.

During 2005, OzFoodNet sites recorded 387 cases of *S.* Enteritidis, of which 84 per cent (289/343) had travelled overseas (Table 2). Relevant travel histories were difficult to obtain, as people had often travelled to several countries before returning to Australia. Asian countries were commonly mentioned, and reflect that they are common travel destinations for Australians. In the Asian region, cases of *S.* Enteritidis infection reported travelling to Bali (37%), Singapore (9%), Indonesia (9%), and Thailand (9%). Travel history could not be determined for 11 per cent (44/387) of cases. The most common infecting phage types were 6a (76 cases), 1b (38), 1 (28) and 4 (21).

Table 2. Number of *Salmonella* Enteritidis infections, 2005, by travel history and state or territory

OzFoodNet site	History of travel overseas			Total
	Yes	No	Unknown	
Australian Capital Territory	8	1		9
New South Wales	67	6	20	93
Northern Territory			1	1
Queensland	20	41	19	80
South Australia	20	1	2	23
Tasmania	2	1		3
Victoria	71	3	2	76
Western Australia	101	1		102
Total	289	54	44	387

Overall, 14 per cent (54/387) of patients infected with *S.* Enteritidis acquired their infection in Australia. The median age of cases was 29 years (age range 0.3–96 years) and 35 per cent were male. Locally-acquired *S.* Enteritidis infections predominantly occurred in Queensland, where 76 per cent (41/54) of all locally-acquired infections were reported. Most locally-acquired infections in Queensland were due to phage type 26 (Table 3). Locally-acquired *S.* Enteritidis infections are strongly seasonal and infections decreased markedly in the winter of 2005 (Figure 2).

Figure 2. *Salmonella* Enteritidis infections acquired in Australia, 2003–05, by phage type and month of notification

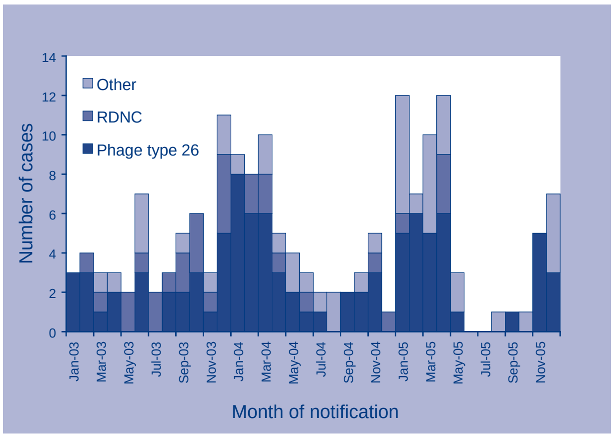


Table 3. Number of locally-acquired *Salmonella* Enteritidis infections, 2005, by phage type and state or territory

Phage type	State or territory							Total
	ACT	NSW	Qld	SA	Tas	Vic	WA	
1		1						1
4			1					1
7	1							1
13			1					1
26			29		1		1	31
14 var			1					1
1B		1						1
21B var				1				1
26 var						2		2
26 var/26						1		1
4B		1						1
6A		3						3
RDNC*			3					3
RDNC/12			1					1
Untypable			5					5
Total	1	6	41	1	1	3	1	54

* 'Reaction Does Not Conform' (RDNC) represents phage type patterns that are not yet assigned.

Salmonella *clustering*

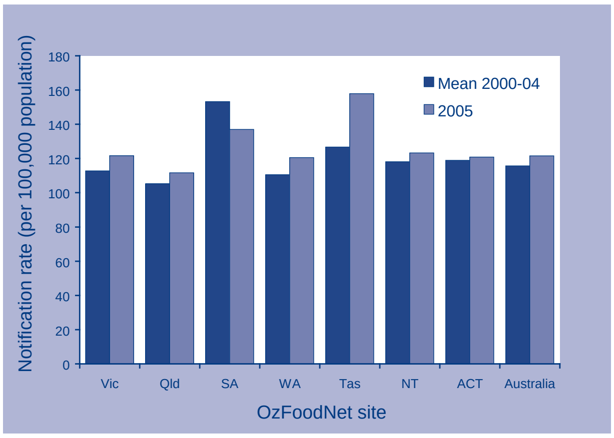
In total, state and territory health departments conducted 104 investigations into clusters and point source outbreaks of salmonellosis during 2005. A source of infection was identified for 39 per cent (41/104) of these investigations. Approximately 61 per cent (63/104) of these outbreaks were due to various phage types of *S.* Typhimurium.

Campylobacter *infections*

In 2005, OzFoodNet sites reported 16,479 cases of *Campylobacter* infection, equating to a rate of 121.6 cases per 100,000 population. This rate represented a five per cent increase over the mean for the previous five years (Figure 3). Tasmania, experienced the greatest increase, with the notification rate in 2005 being 27 per cent above the mean of the previous five years. The only state to experience a decrease in notification rate was South Australia (-11%). The highest and lowest rates of *Campylobacter* notification were in Tasmania (157.9 cases per 100,000 population) and in Queensland (111.7 cases per 100,000 population). Data for campylobacteriosis were not available for New South Wales.

Rates of *Campylobacter* infection were consistently high in all age groups in all jurisdictions. The highest rate of notifications was in males in the 0–4 year age group (268 cases per 100,000 population), with a secondary peak in the 20–29 year age group for both males and females. Fifty-five per cent of notified cases were male. There were 12 identified outbreaks of *Campylobacter* during 2005, nine of which were suspected to be foodborne.

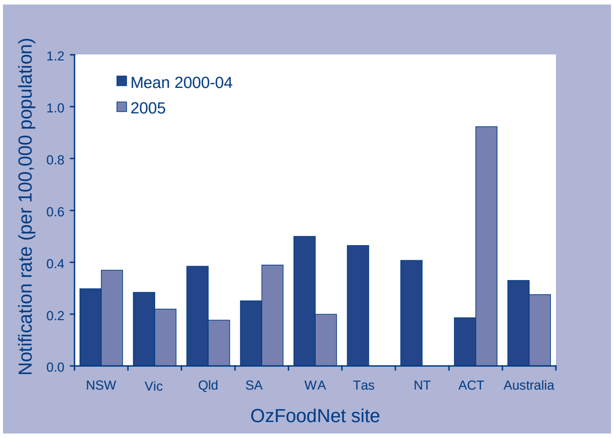
Figure 3. Notification rates of *Campylobacter* infections, Australia, 2005, compared to mean rates for 2000 to 2004, by OzFoodNet site excluding New South Wales



Listeria

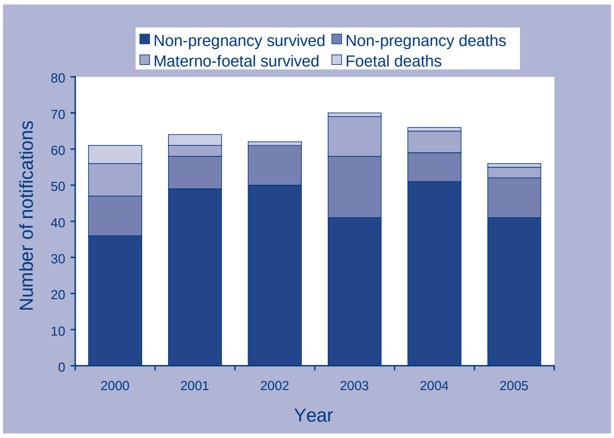
OzFoodNet sites reported 56 cases of listeriosis in 2005, which represents a notification rate of 0.3 cases per 100,000 population (Figure 4). This was a 17 per cent decrease in the notification rate compared to the five-year historical mean. South Australia investigated a common source outbreak of listeriosis associated with cold meats. The Australian Capital Territory investigated three cases during 2005, although no common source was identified.

Figure 4. Notification rates of *Listeria* infections, Australia, 2005, compared to mean rates for 2000–2004, by OzFoodNet site



Four materno-foetal infections were reported during 2005, giving a rate of 1.6 cases per 100,000 births. The rate of materno-foetal infections has been steadily declining in recent years. Victoria, Western Australia, New South Wales and Queensland each reported single cases in neonates during 2005. Twenty-five per cent (1/4) of infected neonates died during 2005 (Figure 5).

Figure 5. Notifications of *Listeria* showing non-pregnancy related infections and deaths, and materno-foetal infections and deaths, Australia, 2000 to 2005

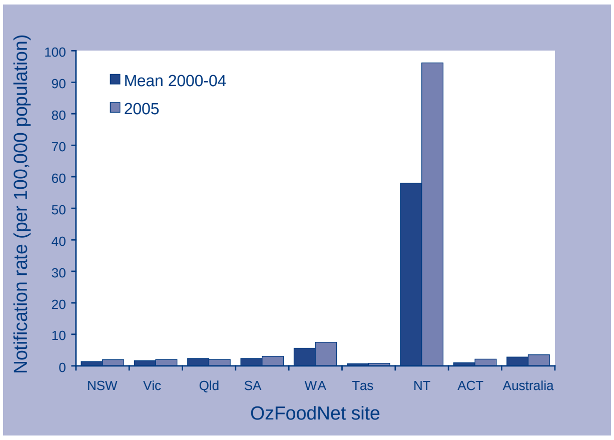


Ninety-three per cent (52/56) of infections during 2005 were reported in persons who were either elderly and/or immunocompromised. Among non-pregnancy related cases, the male to female ratio was approximately 1:1. The highest age specific rate was 1.6 cases per 100,000 population, reported in males in the 60–64 years age group and females over the age of 75 years. Twenty-seven per cent (11/52) of non-pregnancy associated cases died, which was similar to previous years. However, it is difficult to establish whether listeriosis is the cause of death as many cases have terminal illness due to immunocompromising conditions.

Shigella

OzFoodNet sites reported 721 cases of shigellosis during 2005, which equated to a notification rate of 3.5 cases per 100,000 population (Figure 6). This was a 26 per cent increase in the rate of notification compared with historical averages, after adjusting for the introduction of notifications from New South Wales in January 2001.

Figure 6. Notification rates of *Shigella* infections, Australia, 2005, compared to mean rates for 2000 to 2004, by OzFoodNet site*



* Shigellosis became notifiable in New South Wales from 2001 onwards.

The highest rate of notification was in the Northern Territory (96 cases per 100,000 population), which was almost 30 times higher than the overall Australian rate. Rates of shigellosis are considerably higher in Indigenous communities, which is reflected in the rates of states and territories with higher proportions of Indigenous peoples in the general population. In Western Australia, the rates of shigellosis were in excess of 300 cases per 100,000 population in Indigenous people aged 0–4 years and 75 years or older.

Overall, the notification rate for shigellosis was elevated in all jurisdictions, except for Queensland which had 7.2 per cent fewer notifications than the previous five years. The male to female ratio of shigellosis cases was approximately 1:1. The highest age specific notification rates were in males and females in the 0–4 year age group, with 19.1 and 16.6 cases per 100,000 population, respectively. There was one small outbreak of shigellosis of unknown mode of transmission in New South Wales in July 2005.

In 2005, *Shigella sonnei* biotypes a and g were the most common strains infecting people, with 167 and 136 notifications respectively. Mannitol negative *Shigella flexneri* 4a also increased in Central Australia during February and March 2005. These increases were particularly noted in South Australia and the Northern Territory. In Australia, the mode of transmission for the majority of shigellosis infections was through person-to-person transmission or were acquired overseas.

Typhoid

OzFoodNet sites reported 52 cases of typhoid infection during 2005, representing an overall notification rate of 0.3 cases per 100,000 population (Figure 7). The notification rate decreased 22 per cent when compared to the five year historical mean. The highest rates were reported in New South Wales and Western Australia with rates of 0.4 and 0.3 cases per 100,000 population respectively. Tasmania, the Northern Territory and the Australian Capital Territory did not report any cases.

Where travel status was known, sites reported that 96 per cent (45/47) of typhoid cases had recently travelled overseas (Table 4). Thirty per cent (14/47) of these cases had recently travelled from Indonesia or Bali where the predominant phage types were A (3 cases), D2 (2 cases) and E2 (2 cases). Twenty cases had travelled to the Indian subcontinent and the predominant phage type of *S. Typhi* was E1a (5 cases). The two non-travelling cases were either long-term carriers or infected by close contact with a known carrier. Travel status was unknown for five cases. Information on phage type was reported for 81 per cent (42/52) of isolates.

Figure 7. Notification rates of typhoid infections, Australia, 2005, compared to mean rates for 2000 to 2004, by OzFoodNet site

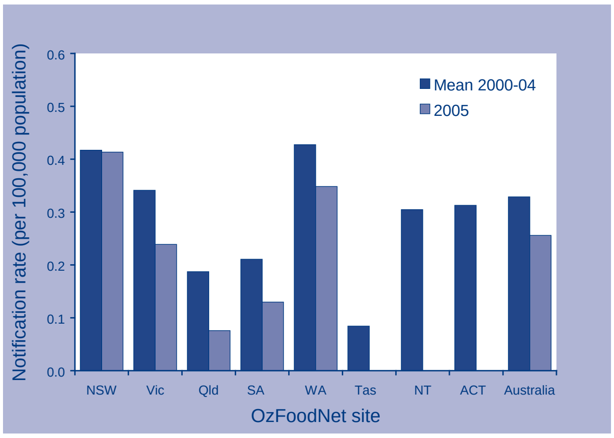


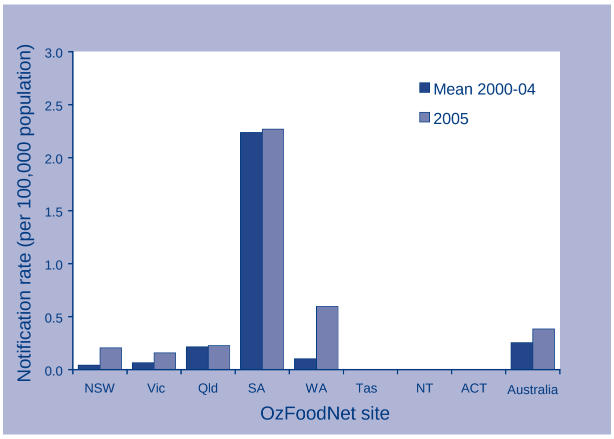
Table 4. Travel status for notified typhoid cases, Australia, 2005

Country	Number of cases	Predominant phage type (cases)
Africa	1	A (1)
Locally acquired	2	E1a (1), untypable (1)
Bali	1	Degraded (1)
Bangladesh	4	E1 (1), E1a (1), E7 (1), unknown (1)
Cambodia	1	E1A (1)
China	1	Unknown (1)
Guinea	1	A (1)
India	12	A (1), E1 (1), E1a (4), E9 (1), E2 (1), untypable (1), degraded (1), Unknown (2)
Indonesia	13	A (3), D2 (2), E2 (2), degraded (1), untypable (2), unknown (3)
Malaysia	1	D2 (1)
Nepal	1	Unknown (1)
Pakistan	3	M1 (2), unknown (1)
Samoa	3	E1a (1), E1 (1), E7 (1)
South America	1	A (1)
Sri Lanka	1	Degraded (1)
Tanzania	1	A (1)
Unknown	5	D2 (1), E1a (2), E2 (1), unknown (1)

Shiga toxin-producing Escherichia coli *infections*

OzFoodNet sites reported 78 cases of Shiga toxin-producing *E. coli* (STEC) infection during 2005, compared to 50 for 2004. These numbers do not include cases of haemolytic uraemic syndrome (HUS) where an STEC organism was isolated or detected in stool samples, as they are reported separately under the category of HUS. The notification rate of 0.4 cases per 100,000 population was a 50.8 per cent increase over the mean rate for previous years (Figure 8). The elevated number of cases reported in 2005 was the result of enhanced screening for STEC in bloody stools in some jurisdictions, such as Western Australia, Victoria, and the Hunter – New England area of New South Wales. Previously, only South Australia has had a program of testing stools containing blood for STEC, which accounts for the consistently high rate of notification in this State.

Figure 8. Notification rates of Shiga toxin-producing *Escherichia coli* infections, 2005, compared to mean rates for 2000–2004, by OzFoodNet site



South Australia (35 cases) reported the majority of cases and had the highest rate of notification of 2.3 cases per 100,000 population. All sites reporting cases had significant increases in the number of cases notified, except for Queensland and South Australia where the notification rates were similar to previous years. There were no cases reported from Tasmania, the Australian Capital Territory or the Northern Territory during 2005. The male to female ratio of cases was 0.8:1, contrasting with a male: female ratio of 0.5:1 in 2004. In 2005, the highest rate of reported infection was in females aged 5–9 and 45–49 years, with a rate of 0.8 cases per 100,000 population in both these age groups. The highest rate reported for males was 0.7 per 100,000 population in the 20–24 years age group.

E. coli serotype O157 was responsible for 39 per cent (15/38) of infections where serotype information was available in 2005, compared to 52 per cent in 2004. *E. coli* O111 was the second most common serotype and was responsible for 26 per cent (10/38) of reports compared to 15 per cent (5/33) in 2004 (Table 5). In 2005, twice as many notified cases of *E. coli* O157 were female compared to males.

Table 5. Number of notified cases of Shiga toxin-producing *Escherichia coli*, 2005, by state and serotype

Serotype	State					Total
	NSW	Qld	SA	Vic	WA	
O157	2	2	5	4	2	15
O111	1	1	7	0	1	10
O26	0	3	1	2	0	6
O113	0	0	3	0	0	3
O103	0	0	1	0	0	1
O77	0	0	0	1	0	1
O112	0	0	1	0	0	1
O166	0	1	0	0	0	1
Non-O157 non-O111	0	0	0	0	9	9
Unknown	11	2	17	1	0	31
Total	14	9	35	8	12	78

There were two clusters of cases investigated during 2005, both of which occurred in the community in South Australia. The mode of transmission and source were not identified for either cluster. In the first cluster, three serotype O111 cases with similar pulsed-field gel electrophoresis (PFGE) patterns attended the same church, but other links were not identified. One of these cases had HUS and another was a sibling of the HUS case. In a cluster of nine cases in November, there were a range of different serotypes including two O111 isolates with identical PFGE patterns.

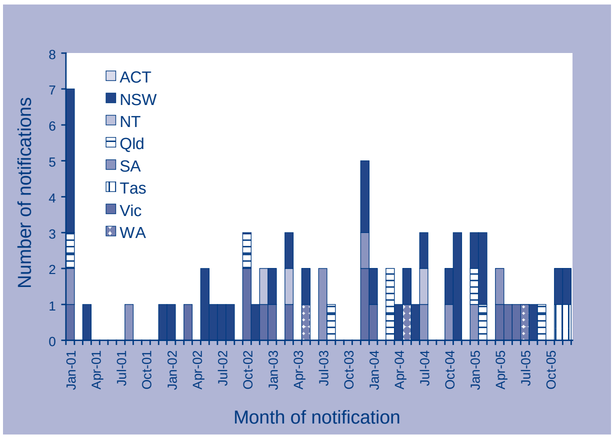
The serotype was not identified in 51 per cent (40/78) of cases as polymerase chain reaction (PCR) tests are commonly used for diagnosis. These PCR tests detect the presence of toxin producing genes, and serotype-specific PCR tests only detect serotypes O157, O111 and O113. Culture of *E. coli* is not routinely carried out. In South Australia, the Hunter and Western Australia only stools containing macroscopic blood were screened for Shiga toxins 1 and 2 genes, unless specifically requested by the treating doctor. 'H' typing information was available for only 34 per cent (16/47) of isolates that were serotyped in 2005. There were six infections due to

E. coli O157:H-, five due to *E. coli* O26:H11, two due to *E. coli* O157:H7, one each of serotypes O111:H-, O166:H15, and O77:H28.

Haemolytic uraemic syndrome

There were 17 cases of haemolytic uraemic syndrome reported during 2005, which was a rate of 0.1 case per 100,000 population. This compared to 16 cases of HUS in 2004. New South Wales reported six of these cases, Victoria and Queensland both reported three cases each, Queensland and Tasmania both reported two cases each, and Western Australia reported 1 case in 2005 (Figure 9).

Figure 9. Numbers of notified cases of haemolytic uraemic syndrome, Australia, 2001 to 2005, by month of notification and state or territory

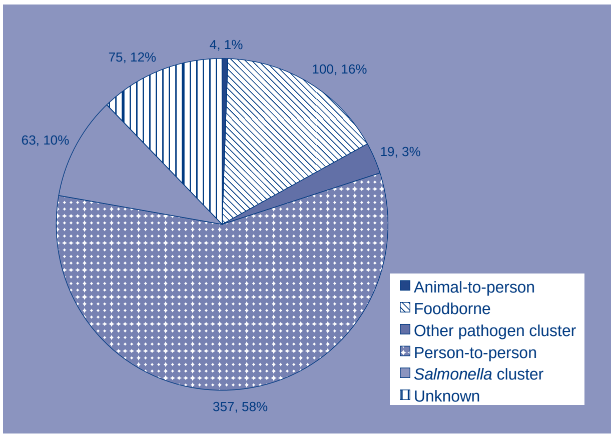


Sixty-five per cent of cases were male. The highest rates of notification were in males and females aged 0–4 years, with rates of 1.2 and 0.7 cases per 100,000 population respectively. Sites reported that STEC were detected in the faeces of 53 per cent (9/17) of cases. Three cases were infected with serotype O111, two cases were infected with O157; one was OR:H- and three cases were STEC positive by PCR. One notified case was due to a non-enteric pathogen—*Streptococcus pneumoniae*. There was some clustering of HUS cases in 2005, with Tasmania investigating two apparently linked cases of *E. coli* O157:H- 54(var) in November and December, although no source was identified.

Gastrointestinal and foodborne disease outbreaks

During 2005, OzFoodNet sites reported 624 outbreaks of gastrointestinal illness affecting 10,865 persons. The mode of transmission for 57 per cent (358/624) of outbreaks was suspected to be person-to-person transmission (Figure 10).

Figure 10. Foodborne and gastroenteritis outbreaks reported by OzFoodNet sites, Australia, 2005, by mode of transmission (*n*=624 outbreaks)



These person-to-person outbreaks were responsible for 66 per cent (7,222/10,865) of all persons affected by outbreaks and three deaths. Forty-six per cent (163/358) of the person-to-person outbreaks occurred in aged care facilities, while 23 per cent (84/358) and 12 per cent (42/358) of outbreaks occurred in child care and hospital settings, respectively. Thirty-seven per cent (134/358) of person-to-person outbreaks were caused by norovirus, while 51 per cent (183/358) were of unknown aetiology, many of which were suspected to be due to a viral pathogen.

Sites conducted investigations into 147 different clusters or point source outbreaks where the mode of transmission was not determined, including 63 clusters due to various strains of *Salmonella.* Four outbreaks were suspected to be due to animal-to-person infection, three of these were due to *Salmonella* and one was due to *Cryptosporidium*.

Foodborne disease outbreaks

In 2005, there were 102 foodborne disease outbreaks giving an overall rate of 5.0 outbreaks per million population. These outbreaks affected 1,975 persons, hospitalised 166 persons and caused four deaths. A summary description of all foodborne outbreaks is shown in Appendix 2.

Queensland reported the largest number of outbreaks (31%, 32/102 of all outbreaks reported) (Table 6). The reporting rates of foodborne outbreaks for different OzFoodNet sites ranged from 0.7 per million population in New South Wales to 15.4 per million population in the Australian Capital Territory. The majority of outbreaks occurred in summer and autumn (Figure 11).

Aetiological agents

The most common agent responsible for foodborne disease outbreaks was *Salmonella*, which caused 32 per cent (33/102) of outbreaks (Table 7). These outbreaks affected a total of 1,200 persons with a hospitalisation rate of 13 per cent (150/1,200). *S.* Typhimurium was responsible for 79 per cent (26/33) of foodborne *Salmonella* outbreaks. Four fatalities were reported from three separate outbreaks of *Salmonella,* two of which occurred in aged care homes and one other occurred in an institutional setting. The highest hospitalisation rate was for listeriosis although this was only one small outbreak.

Figure 11. Outbreaks of foodborne disease, Australia, 2001 to 2005, by selected aetiological agents

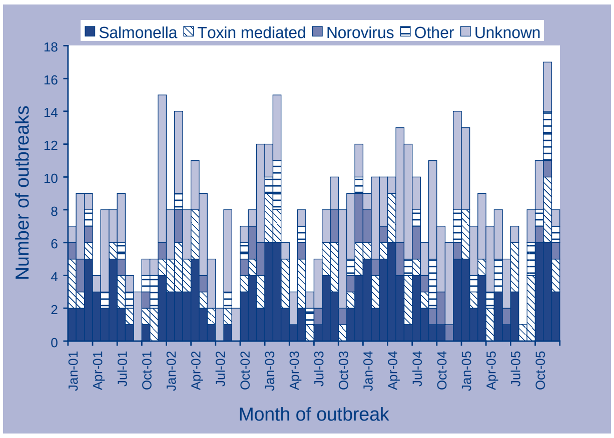


Table 6. Outbreaks of foodborne disease in Australia, 2005, by OzFoodNet site

State or territory	Number of outbreaks	Persons affected	Mean size (persons)	Hospitalised	Fatalities	Outbreaks per million population
Australian Capital Territory	5	51	10.2	4	0	15.4
New South Wales	19	246	12.9	24	1	0.7
Northern Territory	2	9	4.5	1	0	9.9
Queensland	32	292	9.1	69	3	8.1
South Australia	6	163	27.2	5	0	3.9
Tasmania	6	205	34.2	10	0	12.4
Victoria	27	808	29.9	40	0	5.4
Western Australia	5	198	39.6	13	0	2.5
Total	102	1,975	19.4	166	4	5.0

Table 7. Aetiological agents responsible for foodborne disease outbreaks, number of outbreaks and persons affected, Australia, 2005

Agent category	Number of outbreaks	Persons affected	Mean outbreak size (persons)	Hospitalised	Fatalities
Campylobacter sp.	9	93	10.3	2	0
Ciguatera	10	57	5.7	2	0
Clostridium perfringens	4	76	19.0	0	0
Histamine poisoning	5	12	2.4	0	0
Listeria monocytogenes	1	3	3.0	3	
Norovirus	4	91	22.8	2	0
Salmonella other	7	180	25.7	24	4
Salmonella Typhimurium	26	1,020	39.2	126	0
Staphylococcus aureus	2	4	2.0	0	0
Vibrio parahaemolyticus	1	2	2.0	0	0
Unknown	33	437	13.2	7	0
Total	102	1,975	19.4	166	4

Fifteen of the 21 outbreaks of illness due to toxins in 2005 were related to contaminated fish. Outbreaks of ciguatera and histamine poisoning, were small with a mean of 5.7 and 2.4 persons affected respectively. There were four outbreaks of *Clostridium perfringens* intoxication and two of *Staphylococcus aureus* intoxication. There were nine outbreaks of *Campylobacter* affecting 93 people, and one outbreak of vibriosis affecting two people. There were four outbreaks of norovirus affecting 91 people. Thirty-two per cent (33/102) of outbreaks were of unknown aetiology, which affected 437 persons including seven cases who were hospitalised.

Food vehicles

There was a wide variety of foods implicated in outbreaks of foodborne disease during 2005 (Table 8), although investigators could not identify a specific food vehicle in 30 per cent (31/102) of outbreaks. Contaminated fish was the most common food vehicle and was responsible for 16 per cent (16/102) of outbreaks. Ten were due to ciguatera fish poisoning and five due to small outbreaks of histamine poisoning. Queensland reported nine of the ciguatera outbreaks from locally-caught fish, with Victoria reporting one ciguatera outbreak caused by fish sourced from Fiji. Four out of five outbreaks of histamine poisoning were associated with the consumption of tuna, with the remaining outbreak associated with an unknown species of fish.

Table 8. Categories of food vehicles implicated in foodborne disease outbreaks, Australia, 2005

Agent category	Number of outbreaks	Persons affected	Hospitalised
Fish	16	80	2
Mixed meat dish	9	152	19
Poultry	9	76	4
Sauces and gravy	6	125	11
Mixed dish	4	38	4
Cakes	3	129	13
Dessert	3	56	34
Dips	3	475	26
Sandwiches	3	123	0
Seafood	3	57	22
Suspected eggs	3	28	2
Egg-based dishes	2	11	2
Salad dishes	2	162	12
Water	2	34	2
Pizza	1	9	0
Pork	1	25	1
Suspected water	1	22	0
Unknown	31	373	12
Total	102	1,975	166

Poultry and mixed meat dishes were responsible for nine outbreaks each. Sauces and gravies were implicated as the cause of six outbreaks, which included four outbreaks relating to eggs. Egg-based dishes caused two outbreaks, and a further three outbreaks were suspected as being due to eggs. In addition, there were two outbreaks due to desserts containing raw eggs; and two due to cakes and one due to sandwiches where cross contamination from eggs was suspected. In total, investigators identified 14 outbreaks of salmonellosis where eggs were suspected or proven to be the actual source of contamination of the implicated food.

There were two outbreaks associated with drinking water, one of which was associated with a municipal water supply. There were three outbreaks due to dips, including one very large outbreak associated with food served at a Turkish restaurant in Victoria. Outbreaks due to desserts had the highest hospitalisation rate, with 61 per cent (34/56) of people affected in three outbreaks being admitted to hospital.

Outbreak settings

The most common settings where food was prepared in outbreaks was at restaurants (33%), followed by the home (12%), events catered for by professional companies (11%) and aged care homes (8%) (Table 9). Foods that were contaminated in primary production environments, such as fish contaminated with ciguatoxin, were classified as 'primary produce' and were responsible for 12 per cent of outbreaks. Food prepared in bakeries and at takeaway stores were responsible for five outbreaks each, while food prepared at school camps was responsible for three outbreaks. The setting where people ate the food was similar to where it was prepared. There were 11 outbreaks in aged care homes, two of which were due to food prepared elsewhere and one was suspected to be due to contaminated tank water.

Investigative methods and levels of evidence

States and territories investigated 24 outbreaks using retrospective cohort studies and 10 outbreaks using case control studies, with one investigation using both methodologies. Forty-two per cent (10/24) of cohort studies were used for outbreaks of unknown aetiology, which is similar to previous years. Thirty-eight per cent (9/24) of investigations using cohort studies were for *Salmonella* outbreak investigations. Sixty-five outbreaks relied on descriptive information

Table 9. Settings where food implicated in disease outbreaks was prepared, Australia, 2005

Setting category	Number of outbreaks	Persons affected	Hospitalised
Restaurant	34	956	73
Private residence	20	180	40
Commercial caterer	11	218	10
Aged care	8	117	3
Takeaway	5	19	4
Bakery	5	141	13
Camp	3	32	0
Hospital	2	14	3
Institution	2	40	4
Other	2	36	4
Primary produce	2	7	0
Grocery store/ delicatessen	2	6	0
Not applicable	1	8	0
School	1	36	1
Child care facility	1	33	0
Unknown	3	132	11
Total	102	1,975	166

to attribute a foodborne cause or identify a food vehicle, while no individual patient data was collected in two outbreaks.

To attribute the cause of the outbreak to a specific food vehicle, investigators obtained analytical evidence from epidemiological studies of 19 outbreaks. Microbiological evidence of contaminated food was found in 12 outbreaks, with a further five outbreak investigations obtaining both microbiological and analytical evidence. Investigators obtained analytical and/or microbiological evidence for 39 per cent (13/33) of *Salmonella* outbreaks, which was similar to 33 per cent for 2004. Sixty-three per cent (66/102) of outbreaks relied on descriptive evidence to implicate a food or foodborne transmission. These were mainly smaller outbreaks or were in settings where patient interviews were difficult to collect such as aged care facilities.

Significant outbreaks

There were five outbreaks affecting 50 or more persons in 2005, which is similar to previous years. Four were due to *Salmonella* Typhimurium and one was due to *Salmonella* Oranienburg. Two of the outbreaks occurred at restaurants, two in the community and one was associated with a bakery. The largest outbreak was due to *S.* Typhimurium 197 in Victoria during January. This outbreak affected in excess of 448 people and was related to dips served at a Turkish restaurant.

Two large outbreaks of *S.* Typhimurium 135 occurred in Tasmania during October and December, and affected a total of 184 people. These outbreaks were associated with cakes prepared at a bakery and raw egg sauces from a restaurant. A common egg-farm supplied eggs to both of the implicated premises. Eggs from this farm were associated with two additional smaller outbreaks in Tasmania.

In November, the Western Australian Department of Health investigated an outbreak of *Salmonella* Oranienburg. The outbreak extended into the first four months of 2006, and affected at least 125 people. The Health Department conducted a case control study that implicated commercially produced alfalfa sprouts, which was later confirmed microbiologically. The other outbreak affecting more than 50 people occurred in South Australia and involved 81 people with 46 of them diagnosed with *S.* Typhimurium 64 after eating rolls with various fillings from a restaurant.

There were 20 outbreaks affecting between 20 and 50 persons. Six of these outbreaks occurred in association with food prepared at restaurants and five with food prepared by commercial caterers. A wide range of food vehicles were responsible for these outbreaks. Six outbreaks were due to *Salmonella*, of which serotype Typhimurium was responsible for five of these.

Cluster investigations

During 2005, states and territories conducted 82 investigations of clusters of enteric diseases that affected 1,076 people and hospitalising at least 65 people. Investigators were unable to determine the mode of transmission or source of infections for these clusters, which were due to organisms such as *Salmonella*, *Campylobacter*, Shiga toxin-producing *E. coli* and hepatitis A. These clusters do not include all investigations conducted at the state, territory or public health unit level, but the number is indicative of the effort to investigate enteric diseases in Australia. Seventy-seven per cent (63/82) of these investigations related to clusters of *Salmonella,* where the mean number of cases was 10.8 and the total number of persons affected was 683. *S.* Typhimurium was responsible for 49 per cent (31/63) of cluster investigations. Investigations of clusters of *S.* Typhimurium involved more cases with a mean of 13.5 persons than for non-Typhimurium strains with a mean of 8.3 persons. Of the remaining 32 investigations, 24 other different *Salmonella* serovars were involved.

During 2005, there were major increases in *Cryptosporidium* infections in eastern States of Australia. This was reflected in 53 per cent (10/19) of cluster investigations relating to *Cryptosporidium*. The mean size of *Cryptosporidium* cluster investigations was 33.1 persons, which was considerably larger than that for other pathogens. Five of the investigations of *Cryptosporidium* infection were related to contaminated swimming pool water, and the source was unknown for the remaining five outbreaks.

There were three investigations into clusters of campylobacteriosis, two each of *Giardia* and STEC infections, and one each of *Shigella* and hepatitis A infections. The true number of clusters investigated is difficult to ascertain, as public health units or local governments do not record all cluster investigations they conduct. States and territories may also have different definitions and triggers for investigating clusters.

In 2005, OzFoodNet investigated several multi-state clusters of *Salmonella*, including:

- cases of *S.* Typhimurium 135 in the Australian Capital Territory, and New South Wales associated with a yum cha meal in Sydney;
- *S.* Hvittingfoss infections in eastern States of Australia in June and July;
- *S.* Havana cases in New South Wales, Western Australia, South Australia and Victoria in November; and
- *S.* Typhimurium phage types 44 and 135 in all Australian states and territories, except the Northern Territory, in November and December.

OzFoodNet site epidemiologists and state and territory investigators conducted case control studies for two of these multi-state investigations. In June, the source of *S.* Hvittingfoss infections were investigated using a case control study, although no source was identified.[13] In the investigation of *S.* Typhimurium phage types 135 and 44, OzFoodNet initiated a case control study investigating the association between infection with these two phage types and consumption of chicken or eggs. Phage type 135 was significantly associated with consumption of chicken purchased from retail supermarkets. The findings of the case control study for *S.* Typhimurium 44 were equivocal, although 62 per cent (8/13) of point source outbreaks of this phage type occurring during this investigation were suspected to be associated with consumption of eggs.

Surveillance evaluation

Australian surveillance of infectious diseases notified under legislation to state and territory health departments is very effective. The high quality of the data is due to the quality of laboratory services, including reference testing, and awareness of the medical community about the need to notify. In the past 10–15 years, there have been progressive improvements in the capacity of health departments to detect and investigate foodborne diseases at state and territory and national levels. To improve surveillance, OzFoodNet regularly evaluates surveillance and compares data collected at different sites.

National information sharing

In 2005, all jurisdictions contributed to a fortnightly national report to identify clusters of foodborne illness that were occurring across state and territory boundaries. The cluster report was useful for identifying common events affecting different parts of Australia. The cluster report supplemented information sharing on a closed list server, teleconferences and at quarterly face-to-face meetings. In addition, all jurisdictions contributed data to the NNDSS for several diseases that were potentially transmitted by food. In 2005, OzFoodNet made greater use of NNDSS data on specific serotypes and phage types of *Salmonella*, which allowed the detection of clusters and outbreaks at the national level.

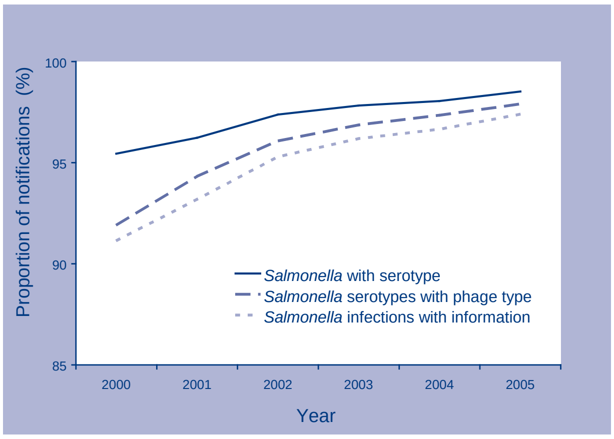
Outbreak reporting and investigation

During 2005, the Australian Capital Territory site reported the highest reporting rate of outbreaks of foodborne disease (15.4 outbreaks per million population), along with Tasmania (12.4 outbreaks per million population). Tasmania also reported the highest rate of foodborne salmonellosis outbreaks (8.2 outbreaks per 100,000 population). The rates of other sites reporting foodborne *Salmonella* outbreaks ranged between 0.5–4.9 outbreaks per million population. Queensland investigated the largest number of foodborne disease outbreaks (32 outbreaks; 8.1 per million population). States and territories conducted 36 analytical studies (cohort or case control studies) to investigate foodborne disease outbreaks, which was slightly less than that of the previous year.

Completeness of Salmonella *serotype and phage type reports*

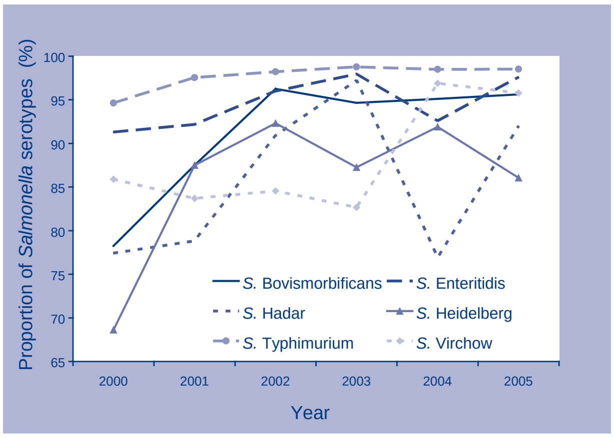
Overall, 97.4 per cent (8,153/8,371) of *Salmonella* notifications on state and territory surveillance databases in 2005 contained information about serotype and/or phage type (Figure 12). This was an increase of 0.7 per cent from 2004.

Figure 12. Proportion of *Salmonella* infections notified to state and territory health departments with serotype and phage type information available, Australia, 2000 to 2005



Phage type recording on the four most prevalent serotypes—Typhimurium, Bovismorbificans, Enteritidis and Virchow—were all greater than 95 per cent complete for phage type information on surveillance databases. Phage type recording was lowest for serotypes Heidelberg and Hadar, with 18.0 per cent (6/43) and 8.0 per cent (2/25) of reports on databases missing the phage type, respectively (Figure 13). Queensland had the highest proportion of complete *Salmonella* notification (99.8%), while six sites reported 95 per cent or higher.

Figure 13. Proportion of *Salmonella* infections for six serotypes notified to state and territory health departments with phage type information available, Australia, 2000 to 2005



Discussion

This report highlights the rates of diseases due to microbiologically contaminated food in Australia. In particular the increasing notification rates of *Salmonella* and *Campylobacter* are concerning. For *Salmonella* in 2005, reports of several phage types of *S.* Typhimurium were increased and health departments conducted at least 63 investigations of *S.* Typhimurium illness clustered in time, place or person. The rate of campylobacteriosis was particularly high despite health departments conducting relatively few investigations. If we extrapolate using estimated rates of under-reporting, there may have been as many as 153,000 to 554,000 cases of *Campylobacter* occurring in the community during 2005.[2,3] It is likely that approximately 75 per cent of these *Campylobacter* infections would be foodborne in origin.[14]

The notification rates of *Campylobacter* and *Salmonella* in Australia are ten and three times higher respectively than for FoodNet sites in the United States of America (USA).[15,16] The reasons for this are unclear, but are currently being explored. The USA has observed declining incidence of campylobacteriosis in recent years.[16,17] In comparison to New Zealand, Australia has similar rates of salmonellosis and lower rates of campylobacteriosis.[18] New Zealand has seen progressively increasing rates of campylobacteriosis for several years.[19] The reasons for the elevated rates in New Zealand are unclear, but local risk factors for infection include consumption of under-cooked poultry and contact with animals. Australian case control studies of campylobacteriosis have also found that these are important risk factors for infection.[20]

The overall rate of typhoid infections decreased in 2005 and there were fewer locally-acquired typhoid infections. In contrast, the rate of travel-acquired *Salmonella* Enteritidis remained similar to previous years. The number of locally-acquired *S.* Enteritidis infections in 2005 was similar to previous years, and were predominantly reported from Queensland. It was concerning to see an outbreak of *S.* Enteritidis 26var in an aged care home in January 2005 in Victoria, although this was an isolated event. Human surveillance of *S.* Enteritidis infections is very important to monitor for the incursion of this serotype into egg-laying flocks of poultry.[20,21]

In previous years' reports we have noted the considerable variation of the rates of STEC notifications in different Australian states and territories.[23] During 2005, Western Australia, Victoria and the Hunter enhanced surveillance for STEC, which was reflected in increased rates in these regions. Internationally, *E. coli* O157:H7 is the predominant strain reported from surveillance data.[16] In Australia, *E. coli* O157 was also the most common, but the rates were much lower than those observed overseas and many other strains were also common in Australia. Jurisdictions investigated clustering of cases for both STEC and HUS, although they were unable to identify common sources of infection.

While notifications of enteric infections provide information on the burden of disease they are hard to interpret due to the difficulties in establishing the sources of transmission. Summaries of foodborne disease outbreaks provide a systematic way to assess information for the development of food safety policy.[5,24] Australian outbreak data for 2005 highlights several areas where continued vigilance or improvements in food safety are needed, including: fish-related outbreaks, alfalfa sprout production, and poultry and egg-associated salmonellosis.

Fish is the most common food vehicle for identified outbreaks in Australia, although they usually only affect small numbers of people.[25] The two most common intoxications associated with fish—ciguatera and histamine poisoning—are poorly recognised by clinicians and often not reported to health departments. Ciguatera outbreaks in Australia occur almost exclusively in Queensland where amateur fishermen catch fish on affected reefs. However during 2005, three outbreaks of ciguatera occurred where people purchased contaminated fish from retailers. The outbreaks of histamine poisoning in 2005 were almost all associated with tuna. Some of these investigations implicated tuna imported from Asia, although these were unable to be traced back to a common source (personal communication, C Shadbolt, New South Wales Food Authority, July 2006). It was encouraging to see that there were no outbreaks associated with escolar fish in 2005, which has previously caused outbreaks of oily diarrhoea or histamine poisoning.[26]

There were nine outbreaks related to consumption of poultry, making it the second most common food vehicle following fish. *Salmonella* was the aetiological agent in two of these outbreaks, *Campylobacter* in two, *Clostridium perfringens* in one and the aetiology was not determined for the remaining four outbreaks. In addition to these nine outbreaks, OzFoodNet coordinated investigations into a large multi-state cluster of *S.* Typhimurium 135 in November and December 2005. In this investigation microbiological and epidemiological evidence indicated that poultry from retail stores was the likely cause for the outbreak. Food Standards Australia New Zealand are preparing a primary production standard for poultry meat in cooperation with industry and other stakeholders, which will aim to reduce human illness associated with poultry meat.

During 2005, there were four outbreaks of *S.* Typhimurium 135 in Tasmania linked to the same egg farm. Eggs are a common cause of foodborne disease outbreaks, despite Australia not having *S.* Enteritidis endemic in layer flocks.[25] OzFoodNet found that eggs may be responsible for 14 per cent of all foodborne disease outbreaks in 2005, which is higher than previous years. The predominant cause of these outbreaks was *S.* Typhimurium, which has a lower potential for trans-ovarian transmission in layer flocks than *S.* Enteritidis.[27] Outbreaks in Australia may be occurring from surface contamination of eggs or through very low rates of trans-ovarian transmission.[25] Food Standards Australia New Zealand are in the process of establishing a committee to develop a national standard for the primary production of eggs.

The outbreak of *S.* Oranienburg associated with contaminated alfalfa sprouts in Western Australia was the first well-documented outbreak associated with sprouts in Australia. There have been many outbreaks of sprout-associated illness overseas, some of which have implicated seed originating from Australia.[28] These overseas outbreaks traced back to Australian seed have been due to a variety of pathogens, including: *E. coli* O157:NM; *S*. Kottbus; *S*. Bovismorbificans; and *S*. Saintpaul.[28–31] The National Enteric Pathogen Surveillance Scheme records 26 isolations of various serotypes of *Salmonella* from sprouts over the last 20 years (personal communication, Joan Powling, March 2006). The Western Australian outbreak highlighted several areas where alfalfa seed production may be vulnerable to contamination, including growing lucerne pasture and processes within sprouting facilities.[28] Following the outbreak, the Implementation Sub-Committee of the Food Regulation Standing Committee formed a working group to consider ways to improve food safety of these products.

Forty-four per cent of foodborne outbreaks occurred in association with foods prepared at restaurants and commercial caterers, which is similar to previous years. Aged care homes were also common settings for foodborne disease outbreaks and resulted in three of the four outbreak-associated deaths in 2005. Foodborne outbreaks constituted only 6 per cent (11/189) of all outbreaks in aged care homes, but the risk of residents dying was significantly higher for foodborne transmission when compared to other modes of transmission (relative risk 10.2, 95 per cent confidence interval 2.0–58.2). Outbreaks in aged care settings are very difficult to investigate due to the poor recall of food consumption by patients, meaning that a food vehicle was identified in only three outbreaks.

It is important to recognise some of the limitations of the data in this report. Surveillance data are inherently biased and require careful interpretation. These biases include the higher likelihood that certain population groups will be tested, and different testing regimes may be used in different states and territories, resulting in different rates of disease.[3] Some of the numbers of notifications are small, as are populations in some jurisdictions. This can make rates of notification unstable and meaningful interpretation difficult. Importantly, some of the most common enteric pathogens are not notifiable, particularly norovirus and enteropathogenic *E. coli.* There are some pathogens, such as *Campylobacter,* that are very common but are not often recognised as causing outbreaks. This means relying on outbreak data to set food safety policy will under-estimate the importance of certain pathogens and food vehicles as a cause of human illness and over-estimate others.[5] There can also be considerable variation in assigning causes to outbreaks depending on investigation methods, number of cases and circumstances of the outbreak.

Health agencies conducting surveillance for foodborne disease must constantly improve their practices and evaluate their efforts. This should involve stakeholders such as laboratories, clinicians, and other government departments. The number of analytical studies that health departments used to investigate outbreaks is evidence of robust inquiry into the causes of these diseases. During 2005, OzFoodNet coordinated or participated in the investigation of several multi-state outbreaks. For these multi-state investigations, outbreak investigation team members entered de-identified data into a web-based database—NetEpi—for hypothesis generation and case control studies.[13] This method of data collection was very rapid compared to other methods. Using the Internet to collect information in outbreak settings is a powerful tool for widely dispersed outbreaks and will become routine in the future.[32]

OzFoodNet has shown the benefits of regular communication about surveillance data for detecting national outbreaks. In May 2005, OzFoodNet and the NSW Health Department held an advanced outbreak investigation workshop to improve Australian epidemiologists' abilities to respond to foodborne disease outbreaks. This follows a consultation that OzFoodNet held in 2004, which identified that training and capacity building in disease investigation were important for national preparedness.

It is important that this report assist with the development of food safety policy for Australia. In previous years we have identified similar food vehicles and settings where food is prepared, which indicate that current controls may be inadequate. National surveillance of foodborne diseases is critical to provide data to evaluate these efforts. Ideally, these data would be compared in a timely fashion with data arising from surveillance of hazards in foods and pathogens in animals, as many foodborne diseases have a zoonotic origin.[33,34]

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Appendix 1. Number of cases and rates per 100,000 population of potentially foodborne diseases reported to OzFoodNet sites, Australia, 2005

Condition		State or territory								
		ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Aust
Campylobacter	cases	393	NN	250	4,427	2,113	766	6,108	2,422	16,479
	rate	120.9	NN	123.3	111.7	137.0	157.9	121.6	120.5	121.6
Salmonella	cases	96	2,174	399	2,607	586	301	1,422	791	8,376
	rate	29.5	32.1	196.8	65.8	38.0	62.0	28.3	39.4	41.2
Shiga toxin *Escherichia coli*	cases	0	14	0	9	35	0	8	12	78
	rate	0.0	0.2	0.0	0.2	2.3	0.0	0.2	0.6	0.4
Haemolytic uraemic syndrome	cases	0	6	0	3	2	2	3	1	17
	rate	0.0	0.1	0.0	0.1	0.1	0.4	0.1	0.0	0.1
Typhoid	cases	0	28	0	3	2	0	12	7	52
	rate	0.0	0.4	0.0	0.1	0.1	0.0	0.2	0.3	0.3
Shigella	cases	7	134	195	80	47	4	103	151	721
	rate	2.2	2.0	96.2	2.0	3.0	0.8	2.1	7.5	3.5
Listeria	cases	3	25	0	7	6	0	11	4	56
	rate	0.9	0.4	0.0	0.2	0.4	0.0	0.2	0.2	0.3

NN Not notifiable.

Appendix 2. Outbreak summary for OzFoodNet sites, Australia, 2005

State	Month of outbreak	Setting prepared	Agent category	Number affected	Hospitalised	Evidence*	Epidemiological study†	Responsible vehicles
Australian Capital Territory	Jan	Commercial caterer	Unknown	7	0	A	C	Strawberries, smoked salmon & grapes
	Mar	Restaurant	*S.* Hessarek	5	2	AM	C	Hollandaise sauce
	Apr	Restaurant	*Campylobacter*	11	1	A	C	Chicken salad & chicken pasta
	Jun	Commercial caterer	Norovirus	25	1	A	CCS	Pork bruschetta & duck tart
	Jul	Restaurant	Unknown	3	0	A	CCS	Unknown
New South Wales	Jan	Private residence	*S.* Typhimurium 197	43	13	A	CCS	Lambs liver
	Mar	Commercial caterer	Unknown	13	0	A	CCS	Beef casserole
	Mar	Restaurant	Unknown	3	2	D	D	Chicken Caesar salad burger
	Apr	Restaurant	Unknown	5	0	D	D	Lamb & beef
	Apr	Restaurant	Unknown	2	0	D	D	Chicken
	May	Institution	Unknown	37	1	D	CCS/C	Self serve salad bar
	May	Restaurant	Unknown	2	0	D	C	Chicken
	Jul	Restaurant	*S.* Typhimurium 9	16		D	D	Suspected raw egg dishes
	Aug	Aged care	Unknown	12		D	N	Unknown
	Aug	Restaurant	Unknown	3	0	D	D	Suspected coleslaw
	Sep	Restaurant	Unknown	9	0	A	C	Ham pizza
	Oct	Child care facility	*S.* Typhimurium 197	33	0	D	C	Unknown
	Oct	Takeaway	*Campylobacter*	5	0	D	D	Unknown
	Oct	Institution	*S.* Birkenhead	3	3	D	D	Suspected pureed food
	Nov	Restaurant	*C. perfringens*	23	0	D	C	Suspected yellow rice
	Nov	Restaurant	*S.* Typhimurium 44	8	2	D	D	Caesar salad dressing
	Nov	Takeaway	*S.* Typhimurium 9	4	3	D	D	Chicken, rice, coleslaw, potatoes
	Nov	Private residence	Histamine poisoning	4	0	M	N	Tuna steak
	Unknown	Restaurant	Unknown	24	0	D	D	Pasta + pizza
Northern Territory	May	Private residence	Unknown	5	0	D	D	Vietnamese pork rolls
	Jul	Private residence	*S.* Typhimurium RDNC	4	1	D	D	Vietnamese rice paper rolls

Appendix 2. Outbreak summary for OzFoodNet sites, Australia, 2005, *continued*

State	Month of outbreak	Setting prepared	Agent category	Number affected	Hospitalised	Evidence*	Epidemiological study†	Responsible vehicles
Queensland	Jan	Aged care	*C. perfringens*	36	0	M	D	Braised steak & gravy
	Jan	Not applicable	Mixed *Salmonella*	8	0	M	D	Rainwater
	Jan	Primary produce	Ciguatera	4	0	D	D	Mackerel
	Jan	Primary produce	Ciguatera	2	0	D	D	Black trevally
	Feb	Other	*S.* Typhimurium 12	10	2	D	D	Unknown
	Mar	Primary produce	Ciguatera	2	0	D	D	Yellowtail kingfish
	Apr	Primary produce	Ciguatera	17	2	D	D	Spanish mackerel
	Apr	Commercial caterer	Unknown	11	0	D	C	Unknown
	Apr	Grocery store/ delicatessen	*S. aureus*	2		M	D	Custard filled dumplings
	May	Bakery	*S.* Typhimurium 197	13	7	D	D	Egg based bakery products
	May	Private residence	*Campylobacter*	5	0	D	D	Unknown
	May	Takeaway	*S.* Typhimurium 170/108	2	1	D	D	Chicken meat
	Jul	Restaurant	*S.* Typhimurium 9	40	29	A	C	Bread and butter pudding
	Jul	Restaurant	*C. perfringens*	3	0	M	D	Beef rendang
	Jul	Restaurant	Histamine poisoning	2	0	D	D	Yellowfin tuna
	Sep	Primary produce	Ciguatera	5	0	D	D	Black kingfish
	Sep	Aged care	*Campylobacter*	3	0	D	D	Unknown
	Sep	Unknown	*Campylobacter*	2	0	D	D	Unknown
	Sep	Primary produce	Ciguatera	2	0	D	D	Spanish mackerel
	Sep	Primary produce	Ciguatera	2	0	D	D	Trevally
	Sep	Takeaway	*S. aureus*	2		M	D	Chips and gravy
	Oct	Other	*S.* Chester/Saintpaul	26	2	AM	CCS	Municipal water
	Oct	Commercial caterer	*S.* Potsdam	6	4	D	D	Unknown
	Nov	Restaurant	Unknown	18	0	A	CCS	Seafood mornay & rice
	Nov	Restaurant	*C. perfringens*	14	0	M	D	Chicken and lamb guvec
	Nov	Restaurant	Unknown	5	0	D	D	Unknown
	Nov	Private residence	*S.* Typhimurium 44	3	0	D	D	Egg and bacon roll
	Nov	Camp	*S.* Typhimurium 44	2	0	D	D	Unknown

Appendix 2. Outbreak summary for OzFoodNet sites, Australia, 2005, *continued*

State	Month of outbreak	Setting prepared	Agent category	Number affected	Hospitalised	Evidence*	Epidemiological study†	Responsible vehicles
Queensland, *continued*	Dec	Private residence	*S.* Typhimurium 44	23	22	D	D	Prawn soup
	Dec	Primary produce	Ciguatera	10	0	D	D	Barracuda
	Dec	Primary produce	Ciguatera	8	0	D	D	Yellowtail kingfish
	Dec	Grocery store/ delicatessen	*Campylobacter*	4	0	D	D	Chicken kebabs
South Australia	Feb	Restaurant	*S.* Typhimurium 9	13	0	A	CCS	Unknown
	May	Restaurant	*S.* Typhimurium 170/108	9		A	CCS	Marinated chicken roll
	Jun	Restaurant	*S.* Typhimurium 64	81		A	C	Bread roll with fillings
	Nov	School	*Campylobacter*	36	1	D	C	Unknown
	Nov	Hospital	*Listeria*	3	3	M	D	Cold meats
	Dec	Restaurant	Norovirus	21	1	D	D	Dips
Tasmania	Feb	Restaurant	Histamine poisoning	2	0	D	D	Yellowfin tuna
	May	Private residence	*Vibrio*	2	0	D	D	Suspected seafood
	Oct	Bakery	S. Typhimurium 135‡	107	6	AM	C	Bakery products
	Oct	Restaurant	S. Typhimurium 135	11	2	D	D	Sauces/dressings containing raw egg
	Nov	Bakery	S. Typhimurium 135	6	0	D	D	Salad rolls/sandwiches
	Dec	Restaurant	S. Typhimurium 135	77	2	AM	C	Mayonnaise & tartare sauce
Victoria	Jan	Restaurant	S. Typhimurium 197	448	25	M	D	Dips
	Jan	Commercial caterer	Unknown	40	0	A	CCS	Veal rolls & red curry
	Jan	Aged care	Unknown	30	0	D	D	Unknown
	Jan	Commercial caterer	Unknown	29	0	A	C	Chicken vol-au-vents
	Jan	Private residence	Unknown	10	1	D	D	Unknown
	Jan	Aged care	*S.* Enteritidis 26var	7	2	D	D	Suspected eggs
	Jan	Private residence	*S.* Typhimurium 126 var 4	5	0	D	D	Suspected eggs
	Feb	Camp	*Campylobacter*	22	0	M	C	Suspected water
	Feb	Restaurant	Unknown	16	0	A	C	Seafood platter, baked fish & octopus
	Feb	Bakery	Unknown	6	0	D	D	Suspect pork rolls
	Mar	Private residence	*S.* Typhimurium 12	15	0	D	C	Unknown
	Mar	Commercial caterer	*S.* Typhimurium 9	14	5	D	C	Chocolate mousse

Appendix 2. Outbreak summary for OzFoodNet sites, 2005, *continued*

State	Month of outbreak	Setting prepared	Agent category	Number affected	Hospitalised	Evidence*	Epidemiological study†	Responsible vehicles
Victoria, *continued*	Mar	Restaurant	*S.* Typhimurium 9	13	5	M	D	Hollandaise sauce
	Mar	Aged care	Unknown	11	0	D	D	Unknown
	Mar	Takeaway	Unknown	6	0	M	D	Hommus dip
	Jul	Restaurant	Histamine poisoning	2	0	A	D	Tuna
	Jun	Commercial caterer	Unknown	17	0	A	C	Gravy & pork
	Jun	Hospital	Unknown	11	0	D	D	Unknown
	Aug	Primary produce	Ciguatera	5	0	D	D	Fijian snapper
	Sep	Restaurant	Unknown	11	0	A	C	Suspected Spanish mackerel
	Oct	Commercial caterer	Norovirus	36	0	A	C	Sandwiches
	Oct	Aged care	Unknown	6	0	D	D	Unknown
	Nov	Aged care	Unknown	12	1	D	D	Unknown
	Nov	Bakery	Norovirus	9	0	D	D	Cakes
	Nov	Unknown	*Campylobacter*	5	0	D	D	Unknown
	Nov	Primary produce	Histamine poisoning	2	0	D	D	Fish
	Dec	Restaurant	*S.* Typhimurium 170/108	20	1	D	C	Suspected pork
Western Australia	Apr	Commercial caterer	Unknown	20	0	D	D	Unknown
	Jun	Private residence	Unknown	17	1	D	D	Unknown
	Oct	Restaurant	Unknown	21	1	D	C	Unknown
	Oct	Restaurant	Unknown	15	0	D	C	Unknown
	Nov	Primary produce	*S.* Oranienburg	125	11	AM	CCS	Alfalfa sprouts

* A=analytical epidemiological evidence; D=descriptive evidence: M=microbiological evidence.

† C=cohort study; CCS=case control study; D=descriptive study; N=individual patient data not collected.

‡ All four outbreaks of *S.* Typhimurium 135 in Tasmania were due to the local variant phage type 135a, which is not a recognised international classification