Foodborne disease investigation across Australia: Annual report of the OzFoodNet network, 2003

The OzFoodNet Working Group

Abstract

In 2003, OzFoodNet conducted enhanced surveillance of foodborne diseases across Australia, which covered all states and territories. During 2003, there were 23,250 notifications of eight potentially foodborne diseases, of which 67 per cent and 30 per cent were due to *Campylobacter* and *Salmonella* infections respectively. The most common *Salmonella* serotype was Typhimurium, as in previous years. Most *S.* Enteritidis were acquired overseas, except for Queensland where 52 per cent of infections were acquired locally. Locally acquired *S.* Enteritidis infections in Australia were predominantly due to phage type 26. The most common serotype of Shiga toxin producing *E. coli* was O157, although for 49 per cent of notified infections serotype was unknown due to the use of polymerase chain reaction based screening tests. There were 12 materno-foetal listeriosis infections in 2003, which was an increase compared to recent years. During 2003, there were 444 outbreaks of gastroenteritis and foodborne disease recorded. Ninety-nine of these were of foodborne origin affecting 1,686 persons, hospitalising 105 and causing six deaths. A wide range of agents and foods caused these outbreaks, with *Salmonella* Typhimurium being the most common pathogen. Outbreaks associated with fish and seafood dishes, poultry meat, and Asian style and imported foods were common. Four outbreaks with international implications were reported: an outbreak of *Salmonella* in Montevideo involving contaminated tahini from the Middle East and three outbreaks of norovirus infection associated with imported Japanese oysters. Outbreak data indicated a need to monitor food safety in aged care settings, restaurants and catering. Eighty-nine investigations into clusters of gastrointestinal illness where a source could not be identified were conducted, including multi-state outbreaks of salmonellosis. One multistate investigation of antibiotic resistant *Salmonella* Paratyphi b Java identified 18 cases who had recent exposure to tropical fish aquariums. Ninety-seven per cent of *Salmonella* notifications on state and territory surveillance databases have complete information on serotype and phage type. In 2003, OzFoodNet demonstrated the benefits of national collaboration to control food borne disease. *Commun Dis Intell* 2004;28:359–389.

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

Introduction

Foodborne disease surveillance is a fundamental part of ensuring a safe food supply.[1] Many countries have conducted passive surveillance of foodborne diseases through statistics of patient encounters with health systems.[2] These systems have several limitations, particularly where the data are based on syndromic diagnoses rather than isolation of micro-organisms. To improve the capacity to interpret surveillance data, some countries have collected extra data on patients infected with foodborne illness, or have collected complementary data from animals and foods.[3,4]

The Centers for Disease Control and Prevention in the United States of America (USA) established the FoodNet active surveillance system in 1995.[3] FoodNet consists of 10 sentinel sites across the USA where laboratories report weekly cases of infections that may be transmitted by food. The system has

The OzFoodNet Working Group is (in alphabetical order): Rosie Ashbolt (Tas), Jenny Barralet (Qld), Robert Bell (Qld), Dennis Bittisnich (DAFF), Barry Combs (SA), Christine Carson (WA), Scott Crerar (FSANZ), Craig Dalton (Hunter PHU), Karen Dempsey (NT), Joy Gregory (Vic), Gillian Hall (NCEPH), Geoff Hogg (MDU), Geetha Isaac-Toua (ACT), Christopher Kenna (DoHA), Martyn Kirk (DoHA), Karin Lalor (Vic), Deon Mahoney (FSANZ), Tony Merritt (Hunter PHU), Jennie Musto (NSW), Lillian Mwanri (SA), Chris Oxenford (DoHA, NCEPH), Rhonda Owen (DoHA), Jane Raupach (SA), Mohinder Sarna (WA), Cameron Sault (Tas), Craig Shadbolt (DoHA), Russell Stafford (Qld), Marshall Tuck (NSW), Leanne Unicomb (Hunter PHU), Kefle Yohannes (DoHA)

Corresponding author: Mr Martyn Kirk, Coordinating Epidemiologist, OzFoodNet, Australian Government Department of Health and Ageing, GPO Box 9848, MDP 15, Canberra ACT 2601. Telephone: +61 2 6289 9010. Facsimile: +61 2 6289 5100. Email: martyn.kirk@health.gov.au

helped to quantify the burden of foodborne illness and understand its causes. FoodNet has provided a major platform for special research into foodborne diseases.

In 2000, the Australian Government Department of Health and Ageing established the OzFoodNet network to enhance surveillance for foodborne disease.[5,6] This built upon an 18-month trial of active surveillance in the Hunter region of New South Wales.

OzFoodNet was modelled on the FoodNet surveillance system, although it differs in some important respects.[3] OzFoodNet:

- does not actively contact laboratories for reports of individual infections (active surveillance), but relies upon Australia's laboratory-based notification system;
- coordinates investigations into outbreaks of national significance;
- collects data on outbreaks of foodborne and gastrointestinal illness due to all modes of transmission;
- covers the whole Australian population; and
- conducts studies of locally important pathogens in different jurisdictions.

OzFoodNet is primarily a national network of epidemiologists that conducts investigations and applied research into foodborne disease. The network involves many different organisations, 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 (CDNA), 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 oversee the scientific quality of its work.

This is the third annual report of OzFoodNet and covers data and activities for 2003.

Methods

Population under surveillance

In 2003, the coverage of the network included the entire Australian population, which was estimated at mid-year to be 19,662,781 persons (Australian Bureau of Statistics (ABS), June 2004).

OzFoodNet sites were located in every state in 2003, there was an OzFoodNet site in the Hunter Area Health Service of New South Wales, which complemented foodborne disease surveillance across New South Wales. The Hunter site conducts thorough local investigation and provides a baseline for foodborne disease incidence in New South Wales. In 2003, the population covered by the Hunter site was estimated to be 544,623 persons.

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. 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;
- *Salmonella* infections;
- *Listeria* infections;
- *Yersinia* infections;
- Shiga toxin producing E. coli infections and haemolytic uraemic syndrome;
- typhoid; and
- *Shigella* infections.

To compare the current rates of disease with previous levels, OzFoodNet compared crude numbers and rates of notification to the means of the previous five years. Where available, numbers and rates of notifications for specific sub-types of infecting organisms were compared to notifications for the previous year.

To calculate rates of notification the estimated resident populations for each state or territory for June 2003, or the specified year, were used (ABS, June 2004). Age specific rates for notified infections in each state or territory were also calculated.

The date that notifications were received was used to analyse notification data. These data are similar to those reported to the National Notifiable Diseases Surveillance System (NNDSS), but may differ for methodological reasons.

Gastrointestinal and foodborne disease outbreaks

OzFoodNet collected information on gastrointestinal and foodborne disease outbreaks that occurred in Australia during 2003. The reports collate summary information about the outbreak setting, the date, the aetiological agent, the number of persons affected, the type of investigation, the level of evidence and the food vehicle. Data on outbreaks due to transmission from animals and cluster investigations were also summarised.

Risk factors for infection

To identify risk factors for foodborne infection in Australia, OzFoodNet reviewed summary data from outbreaks that occurred in 2003 and compared them to previous years. Data from several complementary OzFoodNet studies of foodborne illness in Australia were also examined.

Surveillance evaluation and enhancement

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 2003. The proportions of *Salmonella* notifications with serotype and phage type information were compared with results for the previous three years.

Results

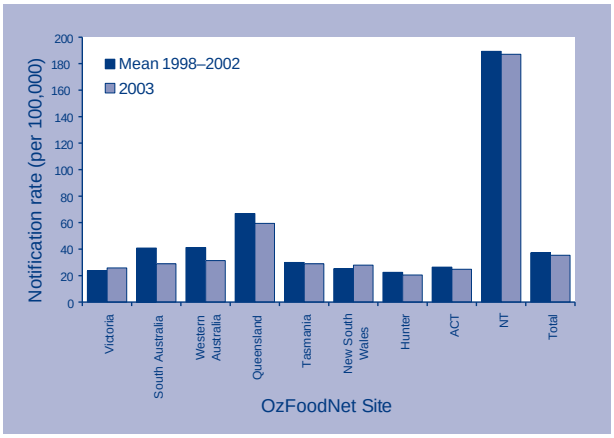
Rates of notified infections

In 2003, OzFoodNet sites reported 23,250 notifications of eight diseases that were potentially foodborne. This was a 5.5 per cent increase from the mean of 22,035 notifications for the previous five years. Reports for these eight diseases make up almost a quarter of notifications to the NNDSS Diseases Surveillance System.[14] A summary of the number and rates of notifications by OzFoodNet sites is shown in Appendix 1.

Salmonella *infections*

In 2003, OzFoodNet sites reported 7,032 cases of *Salmonella* infection, which indicated a rate of 35.4 cases per 100,000 population and a decrease of 4.8 per cent from the mean for the previous five years (Figure 1). The rates ranged from 20.4 cases per 100,000 population in the Hunter region to 187.1 cases per 100,000 population in the Northern Territory.

Figure 1. Notification rates of *Salmonella* infections for 2003 compared to mean rates for 1998 to 2002, by OzFoodNet site



Overall, notification rates of salmonellosis for 2003 were increased in New South Wales (11.2%) and Victoria (9.2%) compared to historical means. There were moderate declines in the notification rate of *Salmonella* in all other states and territories, with more significant declines in South Australia (–29.3%) and Western Australia (–24.0%).

The overall ratio of male to female cases was approximately 1:1, ranging from 1.2:1 in Tasmania to 0.8:1 in South Australia and Western Australia. The median age of cases ranged between 17 and 23 years at all OzFoodNet sites, except for the Northern Territory and Queensland where the median ages were three and 12 years respectively. There were no major changes in the median ages of salmonellosis cases from 2002 to 2003.

The highest rate of *Salmonella* infection was 189.5 cases per 100,000 population in males aged 0 to 4 years of age. The rate was highest in this age group for all sites and ranged from 76.8 cases per 100,000 population in the Australian Capital Territory to 1,432.8 cases per 100,000 population in the Northern Territory. Notification rates were also high in the 5–9 year age group in all jurisdictions. In most jurisdictions there was also a secondary peak in notification rates in the 20–29 year age range for males and females, which was most noticeable in the Northern Territory.

Rates of salmonellosis were highest in northern areas of Australia. The highest rate is consistently reported in the Kimberley region of Western Australia.[8,9] Western Australia reported that the Kimberley region had a rate of 314 cases per 100,000 population, with the majority of infections in Indigenous people. In Western Australia, rates of salmonellosis were higher in Indigenous people in all age groups, particularly in children aged 0–4 years

of age. Thirty-nine per cent (128/330) of *Salmonella* notifications in the Northern Territory were in persons of Aboriginal or Torres Strait Island origin. As in previous years, OzFoodNet sites reported that notification rates of salmonellosis increased from south to north along the eastern seaboard of Australia. The rate of notification increased from 25.8 per 100,000 population in Victoria to 106 per 100,000 population in far north Queensland.

During 2003, the most commonly reported *Salmonella* serotype was *S.* Typhimurium. There were 714 notifications of *Salmonella* Typhimurium 135 (including 135a) to OzFoodNet sites making it the most common infection (Table 1). Eighteen per cent (125/714) of these related to a single outbreak in Victoria. There were 678 notifications of this phage type last year. There were 405 notifications of *S.* Typhimurium 9 in 2003 compared to 583 for the previous year, which represents a 31 per cent drop in this common phage type. *S.* Typhimurium 170 and *S.* Typhimurium 108 continued to emerge as a significant phage type around Australia. In 2002, NSW investigators recognised that these two phage types were in fact the same organism after human specimens went to one laboratory for typing and food samples went to another. This explains why certain states and territories never reported cases of *S*. Typhimurium 170 and others never reported cases of *S.* Typhimurium 108. In the remainder of this report infections due to this organism are referred to as *S*. Typhimurium 170/108. There were 382 cases of *S.* Saintpaul, making it the most common *Salmonella* serovar following *S.* Typhimurium. The highest specific rates for single serotypes reported in OzFoodNet sites were *S*. Ball and *S.* Saintpaul in the Northern Territory and *S.* Mississippi in Tasmania with rates of 22.2, 14.1 and 14.7 per 100,000 population respectively.

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. People may 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.[10] Australia is largely free of *S.* Enteritidis phage type 4 except in people infected overseas. There are other phage types of *S.* Enteritidis that are acquired locally in Australia, although the causes of these local infections are largely unknown.

OzFoodNet has been conducting a case control study of all locally acquired *S.* Enteritidis infections in Australia to determine the risk factors for infection. The case control study was established in 2001 and assesses food-based and zoonotic risk factors for infection. These are compared to the exposure histories for up to three age-matched controls per case. Cases infected while overseas are not enrolled in the study, but they are asked about the countries they visited.

During 2003, OzFoodNet sites recorded 227 cases of *S.* Enteritidis, of which 63 per cent (142/227) had travelled overseas (Table 2). Travel history was unknown for 15% (33/227) of cases, while 23% (52/227) reported no travel out of Australia. Relevant travel histories were difficult to obtain, as people have often travelled to several countries before visiting Australia. Asian countries were commonly mentioned, reflecting that they are common travel destinations for Australians. In the Asian region, cases of *S.* Enteritidis infection reported travelling to Indonesia and Bali (46%), Singapore (11%), Malaysia (8%), Thailand (7%), and other Asian destinations (6%). Approximately 20 per cent of people acquiring their infection overseas reported travelling to Europe.

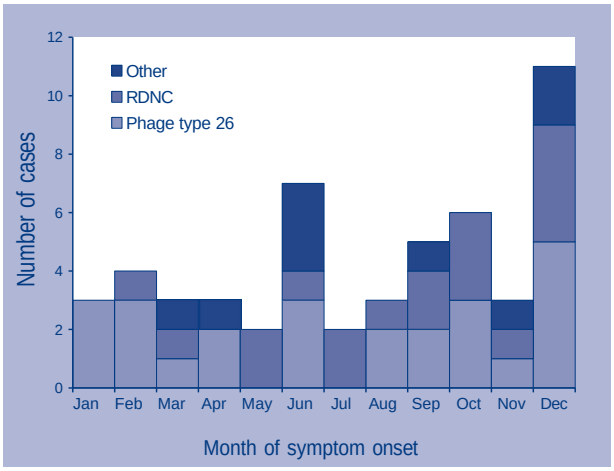
The most common phage types isolated varied with the region that the person travelled to. For people returning from Bali and Indonesia, the most common phage types were 6a, 4, and 4b. In Malaysia and Singapore the most common infecting phage types were 1 and 6a, with no phage type 4 reported at all. Travellers to Thailand were also infected with phage types 1 and 6a, along with phage type 4. Where cases had returned from Pacific countries, phage type 26 predominated. For travellers returning from Europe, phage types 1, 4 and 6 were most common.

OzFoodNet Sites reported a decrease in the total number of overseas-acquired *S*. Enteritidis infections, particularly as fewer travellers visited Bali, where this serotype is endemic. There was also a shift in the numbers of different phage types being notified, with *Salmonella* Enteritidis 4 declining and other phage types such as 6a increasing. Phage type 4b was recognised for the first time in 2002 after reference laboratories commenced testing for this particular phage in September 2001. Isolates of Phage type 4 typed prior to September 2001 have not been retested to determine whether a proportion of them are 4b. It is not possible to say whether there has been a real shift in phage types, from 4 to 4b or whether it is just a result of changed typing methods or changes in travel patterns.

Overall, 23 per cent (52/227) of patients infected with *S.* Enteritidis acquired their infection in Australia (Figure 2). The median age of cases was 24 years old (age range 0–76 years) and 50 per cent were male. Locally-acquired *S.* Enteritidis infections were

much more common in Queensland than in Victoria, with 52 per cent (39/75) versus four per cent (3/49) locally acquired. Most locally acquired infections in Queensland were due to phage type 26 (Table 3). There was a temporal clustering of cases of *S.* Enteritidis Reaction Does Not Conform (RDNC) in December 2003, although no common sources were identified (Figure 2). There were no locally acquired cases of *S.* Enteritidis in Tasmania or the Northern Territory.

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



RDNC: Reaction Does Not Conform.

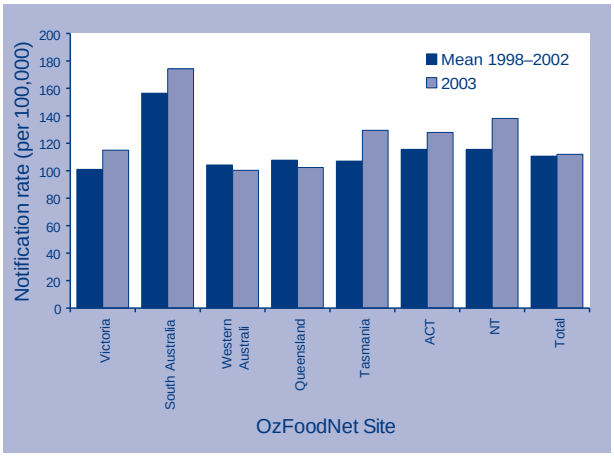
Salmonella *Clustering*

In total, state and territory health departments conducted 73 investigations into clusters and point source outbreaks of salmonellosis during 2002. A source of infection was identified for 47 per cent (34/73) of these investigations. Approximately 55 per cent (40/73) of these investigations were due to various phage types of *S.* Typhimurium.

Campylobacter *infections*

Data for campylobacteriosis were not available for New South Wales, including the Hunter Health Area. With this exception, in 2003 OzFoodNet sites reported 15,464 cases of *Campylobacter* infection, which indicated a rate of 112 cases per 100,000 population. This rate represented a 1.2 per cent increase over the mean for the previous five years (Figure 3). Tasmania, Northern Territory, Victoria and South Australia all recorded a greater than 10 per cent increase in rates of infections compared to the mean of the previous five years. Queensland and Western Australia reported slightly lower rates than for previous years. The highest rates of *Campylobacter* notification were in South Australia (174.2 per 100,000 population) and the lowest rates were in Western Australia (100.3 per 100,000 population).

Figure 3. Notification rates of *Campylobacter* infections for 2003 compared to mean rates for 1998 to 2002, by OzFoodNet site excluding New South Wales



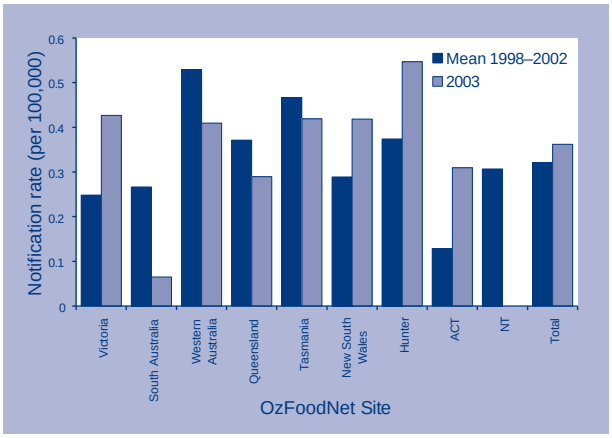
The ratio of male to females cases ranged from 1.1:1 in the Australian Capital Territory and Tasmania to 1.3:1 in the Northern Territory. The median ages of cases ranged from 17 to 30 years, except in the Northern Territory where it was five years of age. The highest age specific rates were in male children in the 0–4 year age group, with a secondary peak in the 20–29 year age range for males and females. The highest age specific rates were in males in the 0–4 year age group in the Northern Territory (958 cases per 100,000 population) and South Australia (433 cases per 100,000 population). There were four identified outbreaks of *Campylobacter* during 2003, two of which occurred in association with visits to farms where school students drank unpasteurised milk and had close contact with animals.

Listeria *infections*

OzFoodNet sites reported 72 cases of listeriosis in 2003, which represents a notification rate of 0.4 cases per 100,000 population (Figure 4). This was a 17 per cent increase in the number of notifications compared to the historical mean. There were no common source outbreaks of listeriosis detected during the period, although sites investigated instances of temporal clustering of cases using Pulsed Field Gel Electrophoresis testing of isolates.

Twelve infections in 2003 (17%) were materno-foetal infections, giving a rate of 4.7 cases per 100,000 live births.[11] This represents a considerable increase from two materno-foetal infections in the previous year. Victoria reported five materno-foetal infections during 2003, compared to a total of three cases in the previous three years. Amongst the Victorian cases, 80 per cent (4/5) of the mothers had previously received information about *Listeria*

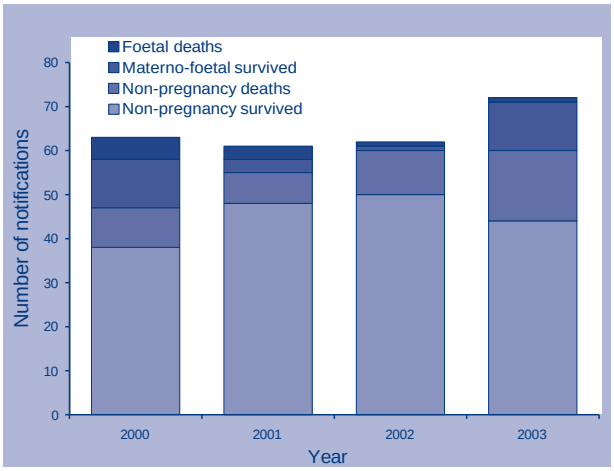
Figure 4. Notification rates of *Listeria* infections for 2003 compared to mean rates for 1998 to 2002, by OzFoodNet site



infection from their doctors. Western Australia had the highest rate with three notifications, although small numbers make rates unstable. The case fatality rate of eight per cent (1/12) for materno-foetal infections was considerably lower than for previous years (Figure 5).

Amongst non-pregnancy related cases, the male to female ratio was 1.1:1. OzFoodNet sites reported that the median ages of non-pregnancy associated cases were between 57–76 years old. The highest age specific rate of 2.1 cases per 100,000 population was in males over the age of 60 years. Twenty seven per cent (16/60) of non-pregnancy associated cases died.

Figure 5. Notifications of *Listeria* infections showing non-pregnancy related infections and deaths and materno-foetal infections and deaths in Australia, 2000 to 2003



Yersinia *infections*

In January 2001, the CDNA agreed to stop reporting notifications of *Yersinia* infections to the NNDSS, due to declines in incidence and lack of identified outbreaks. Victoria has revised regulations to remove yersiniosis from the list of reportable conditions and *Yersinia* is also not notifiable in New South Wales.

In 2002, OzFoodNet sites reported 117 cases of yersiniosis, which equated to a rate of 1.7 notifications per 100,000 population (Figure 6). The overall rate declined 20 per cent from previous years, when adjusted for the absence of reporting from Victoria and New South Wales. Queensland and South Australia recorded the highest rates of infection, with 2.5 and 1.2 notifications per 100,000 population respectively. Queensland reported 80 per cent (94/117) of all cases and the rates of yersiniosis were similar in all three Queensland health zones. The male to female ratio was approximately 1:1 and the highest age specific rate was 16.6 per 100,000 in 0–4 year old Queensland infants.

There was one cluster investigation into four cases of *Yersinia pseudotuberculosis* in South Australia in November 2003. All four children affected were from metropolitan Adelaide and presented with severe abdominal pain. Three underwent surgical intervention resulting in appendectomies. An investigation did not identify any common food or environmental exposure among the infected patients.

Figure 6. Notification rates of *Yersinia* infections for 2003 compared to mean rates for 1998 to 2002, Australia excluding Victoria and New South Wales, by OzFoodNet site

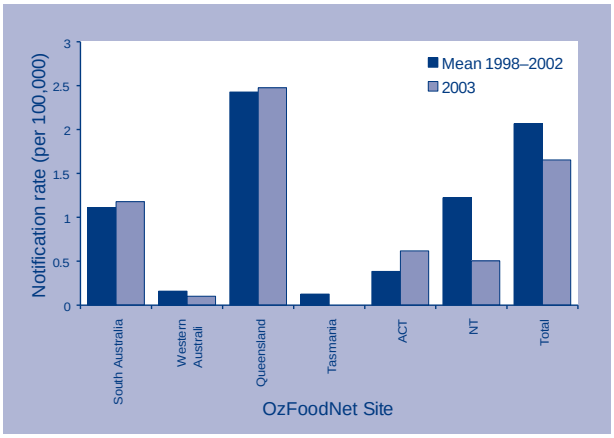


Table 1. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2002 to 2003, by OzFoodNet site*

OzFoodNet site	*Salmonella* type (sero/phage type)	Top 10 infections					
		2003 n	2003 rate†	Proportion (%)‡	2002 n	2003 rate	Ratio§
Australian Capital Territory	Typhimurium 135	25	7.7	31.3	9	2.9	2.8
	Typhimurium 170	4	1.2	5.0	4	1.3	1.0
	Typhimurium 6var1	4	1.2	5.0	0	0.0	–
	Typhimurium 9	4	1.2	5.0	17	5.4	0.2
	Typhimurium U290	4	1.2	5.0	3	1.0	1.3
	Infantis	3	0.9	3.8	1	0.3	3.0
	Bovismorbificans 14	2	0.6	2.5	0	0.0	–
	Mississippi	2	0.6	2.5	0	0.0	–
	Saint Paul	2	0.6	2.5	0	0.0	–
Hunter	Typhimurium 104L	2	0.6	2.5	0	0.0	–
	Typhimurium 170	10	1.8	8.9	7	1.3	1.4
	Typhimurium 4	10	1.8	8.9	2	0.4	5.0
	Infantis	9	1.6	8.0	0	0.0	–
	Typhimurium U290	8	1.5	7.1	8	1.5	1.0
	Bovismorbificans 14	7	1.3	6.3	2	0.4	3.5
	Typhimurium 9	7	1.3	6.3	14	2.6	0.5
	Montevideo	6	1.1	5.4	21	3.9	0.3
	Birkenhead	3	0.5	2.7	2	0.4	1.5
	Chester	3	0.5	2.7	4	0.7	0.8
	Typhimurium 135a	3	0.5	2.7	2	0.4	1.5
	Typhimurium 197	3	0.5	2.7	4	0.7	0.8
New South Wales	Typhimurium 170	233	3.5	12.5	148	2.3	1.6
	Typhimurium 135	134	2.0	7.2	189	2.9	0.7
	Typhimurium 9	133	2.0	7.1	255	3.9	0.5
	Infantis	87	1.3	4.7	38	0.6	2.3
	Birkenhead	68	1.0	3.6	94	1.4	0.7
	Typhimurium 197	68	1.0	3.6	61	0.9	1.1
	Virchow	60	0.9	3.2	74	1.1	0.8
	Chester	40	0.6	2.1	28	0.4	1.4
	Typhimurium 12	38	0.6	2.0	19	0.3	2.0
	Typhimurium 135a	37	0.6	2.0	48	0.7	0.8
Northern Territory	Infantis	12	0.6	2.0	18	0.9	0.7
	Bali	44	22.2	11.9	49	24.8	0.9
	Saintpaul	28	14.1	7.5	19	9.6	1.5
	Anatum	22	11.1	5.9	15	7.6	1.5
	Typhimurium 135	17	8.6	4.6	9	4.6	1.9
	Chester	16	8.1	4.3	18	9.1	0.9
	Muenchen	14	7.1	3.8	14	7.1	1.0

Table 1. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2002 to 2003, by OzFoodNet site* *continued*

OzFoodNet site	*Salmonella* type (sero/phage type)	Top 10 infections					
		2003 n	2003 rate†	Proportion (%)‡	2002 n	2003 rate	Ratio§
Northern Territory *continued*	Havana	11	5.5	3.0	3	1.5	3.7
	Subsp 1 ser 16:1,v	11	5.5	3.0	6	3.0	1.8
	Adelaide	10	5.0	2.7	5	2.5	2.0
	Weltevreden	10	5.0	2.7	5	2.5	2.0
Queensland	Saintpaul	167	4.4	7.4	227	6.3	0.7
	Virchow 8	165	4.3	7.3	279	7.7	0.6
	Typhimurium 135	155	4.1	6.9	110	3.0	1.4
	Birkenhead	109	2.9	4.8	136	3.7	0.8
	Chester	98	2.6	4.3	84	2.3	1.2
	Typhimurium 197	90	2.4	4.0	31	0.9	2.9
	Aberdeen	75	2.0	3.3	112	3.1	0.7
	Hvittingfoss	72	1.9	3.2	114	3.1	0.6
	Typhimurium 170	70	1.8	3.1	138	3.8	0.5
	Muenchen	55	1.4	2.4	60	1.7	0.9
South Australia	Typhimurium 108	32	2.1	7.3	25	1.7	1.3
	Typhimurium 9	28	1.8	6.3	24	1.6	1.2
	Chester	24	1.6	5.4	11	0.7	2.2
	Typhimurium 4	23	1.5	5.2	7	0.5	3.3
	Infantis	20	1.3	4.5	9	0.6	2.2
	Typhimurium 135a	18	1.2	4.1	15	1.0	1.2
	Typhimurium 135	17	1.1	3.9	13	0.9	1.3
	Typhimurium 12	15	1.0	3.4	17	1.1	0.9
	Typhimurium 12a	15	1.0	3.4	15	1.0	1.0
	Saintpaul	13	0.9	2.9	11	0.7	1.2
	Anatum	13	0.9	2.9	1	0.1	13.0
Tasmania	Mississippi	70	14.7	50.7	78	16.6	0.9
	Typhimurium 9	7	1.5	5.1	11	2.3	0.6
	Typhiumurium 135	6	1.3	4.3	15	3.2	0.4
	Saintpaul	5	1.0	3.6	3	0.6	1.7
	Typhimurium 170	5	1.0	3.6	0	0.0	–
	Typhimurium U290	5	1.0	3.6	2	0.4	2.5
	Typhimurium 4	4	0.8	2.9	1	0.2	4.0
	Infantis	3	0.6	2.2	1	0.2	3.0
	Typhimurium 126	3	0.6	2.2	4	0.9	0.8
	Typhimurium 12a	3	0.6	2.2	0	0.0	–

Table 1. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2002 to 2003, by OzFoodNet site* *continued*

OzFoodNet site	*Salmonella* type (sero/phage type)	Top 10 infections					
		2003 n	2003 rate†	Proportion (%)‡	2002 n	2003 rate	Ratio§
Victoria	Typhimurium 135‖	233	4.7	18.4	177	3.7	1.3
	Typhimurium 9	160	3.3	12.6	151	3.1	1.1
	Typhimurium 170	125	2.5	9.9	162	3.4	0.8
	Typhimurium U290	88	1.8	6.9	39	0.8	2.3
	Infantis	54	1.1	4.3	22	0.5	2.5
	Typhimurium 197	21	0.4	1.7	10	0.2	2.1
	Stanley	19	0.4	1.5	12	0.2	1.6
	Typhimurium 12	19	0.4	1.5	8	0.2	2.4
	Typhimurium 126	18	0.4	1.4	61	1.3	0.3
Western Australia	Saintpaul	17	0.3	1.3	43	0.9	0.4
	Typhimurium 135a	41	2.1	6.7	63	3.3	0.7
	Chester	36	1.8	5.9	34	1.8	1.1
	Saintpaul	30	1.5	4.9	42	2.2	0.7
	Typhimurium 135	30	1.5	4.9	30	1.6	1.0
	Muenchen	28	1.4	4.6	27	1.4	1.0
	Oranienburg	21	1.1	3.4	6	0.3	3.5
	Mbandaka	20	1.0	3.3	5	0.3	4.0
	Typhimurium 9	20	1.0	3.3	45	2.4	0.4
	Typhimurium 126	17	0.9	2.8	5	0.3	3.4
	Senftenberg	15	0.8	2.5	8	0.4	1.9
	Anatum	12	0.6	2.0	14	0.7	0.9

* Where there were multiple tenth ranking *Salmonella* types all data have been shown, giving more than 10 categories for some sites.

† Rate per 100,000 population.

‡ Proportion of total *Salmonella* notified for this jurisdiction in 2003.

§ Ratio of the number of reported cases in 2003 compared to the number reported in 2002.

‖ *S.* Typhimurium 135 also includes cases of *S*. Typhimurium 135a.

Table 2. Numbers of *Salmonella* Enteritidis infections acquired overseas and in Australia in 2003, by OzFoodNet site

OzFoodNet site	History of travel overseas			Total
	Yes	No	Unknown	
Australian Capital Territory	2	1	0	3
New South Wales	23	2	15	40
Northern Territory	1	0	0	1
Queensland	19	39	17	75
South Australia	17	5	1	23
Tasmania	3	0	0	3
Victoria	47	2	0	49
Western Australia	30	3	0	33
Total	142	52	33	227

While *Yersinia* notifications have decreased in recent years, continued surveillance for yersiniosis is important to monitor for foodborne outbreaks and the effect of zoonotic control programs. In Queensland, the incidence of yersiniosis has increased each year since 2001 when the lowest rate of 1.5 per 100,000 population was reported.

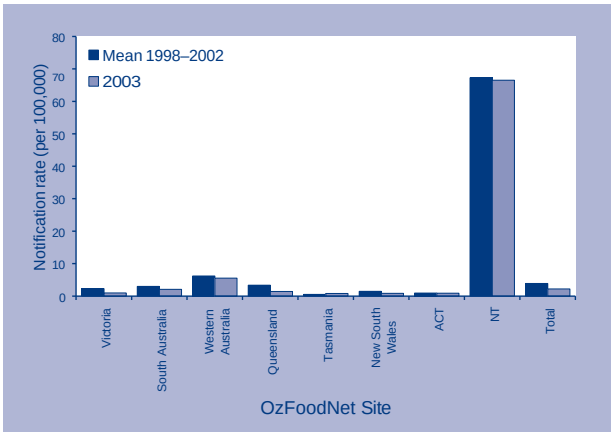
Shigella

OzFoodNet sites reported 443 cases of shigellosis during 2003, which was a notification rate of 2.2 cases per 100,000 population (Figure 7). This was a 43 per cent decrease in the rate of notification compared with historical averages, after adjusting for the introduction of notifications from New South Wales in January 2001.

The highest rate of notification was in the Northern Territory (67 cases per 100,000 population), which was 30 times the overall Australian rate. Rates of shigellosis are considerably higher in Indigenous communities. In Western Australia, the rates of shigellosis approached 300 cases per 100,000 population in Indigenous children aged 0–4 years of age.

Overall the notification rate for shigellosis was 43 per cent lower than the mean of the previous five years, and this observed consistently across jurisdictions. The male to female ratio of shigellosis cases was 1:1. The highest age specific rates were in males (12 cases per 100,000 population) and females (11 cases per 100,000 population) in the 0–4 year old age group.

Figure 7. Notification rates of *Shigella* infections for 2003 compared to mean rates for 1998 to 2002,* by OzFoodNet site



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

There was an outbreak of *Shigella flexneri* 2a reported at a school in Victoria in August 2003. There were also community increases of *Shigella sonnei* biotype A in central Australia during February and March 2003. These increases were noted in Western Australia, South Australia and the Northern Territory. There were no confirmed links with food in any of the outbreaks. In Australia, the majority of shigellosis infections probably were acquired by person-to-person transmission or overseas.

Table 3. Number of locally acquired *Salmonella* Enteritidis infections in 2003, by phage type and state or territory

Phage type	ACT	NSW	QLD	SA	VIC	WA	Total
26	1		24				25
RDNC*			5	4		1	10
RDNC/12			7	1			8
6a						1	1
Untypable			1		1		2
13					1		1
21			1				1
11b						1	1
1b		1					1
21b var			1				1
4b		1					1
Total	1	2	39	5	2	3	52

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

No cases were reported from the Northern Territory or Tasmania

Typhoid

OzFoodNet sites reported 54 cases of typhoid infection during 2003, representing an overall notification rate of 0.3 cases per 100,000 population (Figure 8). The number of notifications was similar to previous years. The highest rates were reported in Western Australia and Victoria with rates of 0.5 and 0.4 cases per 100,000 population respectively. Tasmania, the Northern Territory and the Hunter sites did not report any cases.

Travel status was unknown for six cases. Information on phage type was reported for 78 per cent (42/54) of isolates. Where travel status was known, sites reported that 78 per cent (42/54) of cases of typhoid had recently travelled overseas (Table 4). Twenty-two per cent (12/54) of these cases had recently travelled from Indonesia or Bali and the predominant phage types was D2 (6 cases). Fifteen cases had travelled to the Indian subcontinent and the predominant phage type of *S. Typhi* was degraded (5 cases).

Figure 8. Notification rates of typhoid infections for 2003 compared to mean rates for 1998 to 2002, by OzFoodNet site

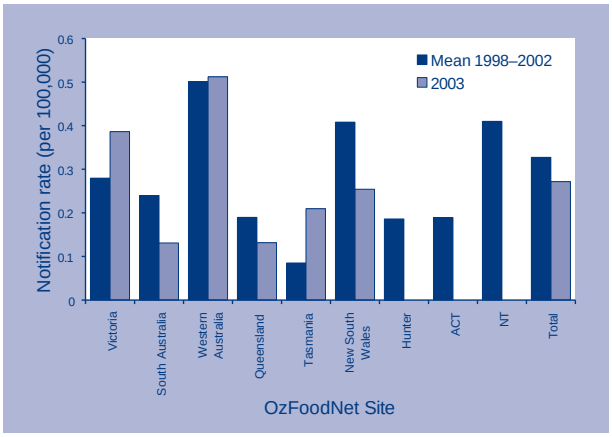


Table 4. Travel status for typhoid cases, Australia, 2003

Country	Number of cases	Phage types
Afghanistan	1	E1a (1)*
Bali	1	D2 (1)
Bangladesh	1	O (1)
India	11	E1a (1), B1var (1), Degraded (5), 1a (1), O (1), Untyped (1), Untypable (2)
Indonesia	10	D2 (5) Untypable (3), Untyped (2)
Indonesia/Singapore	1	Untyped (1)
Kenya	1	Untyped (1)
Lebanon	2	Untyped (2)
Nigeria	1	Degraded (1)
Pakistan	2	M1 (1), Untypable (1)
Philippines	3	B degraded (3)
Thailand	1	M1 (1)
United States of America	1	Degraded (1)
Asymptomatic carrier	4	C4 (1), A (1), A degraded (1), E1a (1),
Locally acquired	4	E9 (1), 40 (1), Untypable (2)
Infected by a carrier	4	C4 (4)
Unknown	6	Untyped (5) E1a (1)
Total	54	

* Numbers in parentheses represent number of cases infected by the phage type.

There were several cases of typhoid infection that were locally acquired in Australia during 2003. These occurred in Western Australia (5), Victoria (5) and New South Wales (2). This included four cases of *S.* Typhi C4 infection in Victoria that were contracted from an asymptomatic carrier who prepared food. Three infections in Western Australia were long-term carriers, while one was locally acquired and another case was suspected to have been infected in a laboratory.

Shiga toxin producing E. coli *infections*

OzFoodNet sites reported 53 cases of Shiga toxin producing *E. coli* (STEC) infection during 2003, compared to 59 for 2002 (Figure 9). This number does not include cases of haemolytic uraemic syndrome where a Shiga toxin producing *E. coli* was isolated. The notification rate of 0.3 cases per 100,000 population was a 13 per cent increase over the mean rate for previous years. South Australia (38 cases) reported the majority of cases and had the highest rate of notification of 2.5 per 100,000 population. All sites reporting cases had an increase in the number of cases notified, except for Victoria and Queensland where there were 38 per cent and 12 per cent declines respectively. There were no cases reported from Tasmania, the Australian Capital Territory or the Northern Territory during 2003. The male to female ratio of cases was 1.1:1, contrasting with a male:female ratio of 0.3:1 in 2002. In 2003, the highest rates of reported infection were in children aged 4–9 years of age.

E. coli O157 was the most common (25%) serotype isolated in 2003, compared to 34 per cent of isolates in 2002. *E. coli* O111 was the second most common and was responsible for 15 per cent of reports in 2003 (Tables 5 and 6). Almost all cases of *E. coli* O111 occurred in females in South Australia, which were notified between February and May 2003 (Figure 10). This temporal clustering of cases was related to infections occurring in an aged care facility, which was suspected to be person-to-person spread. Another cluster of *E. coli* O157 occurred around the same time in metropolitan Adelaide, although no links with any specific foods were identified. Cases of *E. coli* O157 infection were notified throughout the year. Male cases were significantly more likely than females to be recorded as 'toxin producing *E. coli* untyped' (Table 5, Odds ratio 5.3, 95% C.I. 1.4–22.9).

The majority of these untyped infections were the result of positive polymerase chain reaction (PCR) tests for the presence of toxin producing genes, but no culture of *E. coli* was obtained or specific serotype identified. In South Australia all stools containing macroscopic blood are screened for genes encoding for the production of Shiga toxins 1 and 2. Positive specimens are then tested using a multiplex PCR test for the O111, O157 and O28 serotypes, along with various virulence factors. This PCR method is highly sensitive and consequently cultures are often not obtained for further typing. Sixty three per cent (24/38) of cases in South Australia were detected by PCR and no typing details were available. (Table 6)

Figure 9. Notification rates of Shiga toxin producing *E. coli* infections for 2003 compared to mean rates for 1998 to 2002, by OzFoodNet site

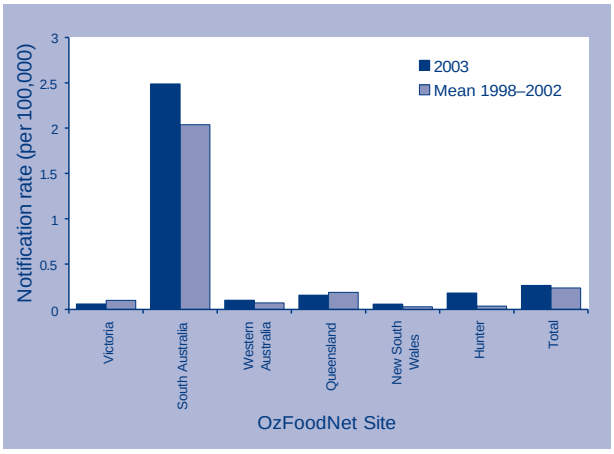
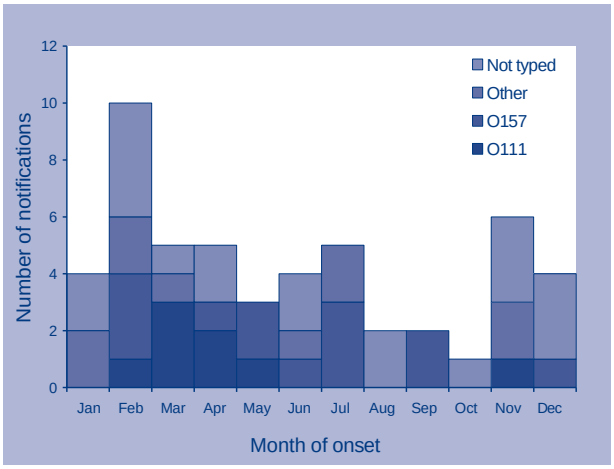


Figure does not include Tasmania, the Australian Capital Territory and the Northern Territory, as they did not report cases of Shiga toxin producing *E. coli* infections during 2003.

Figure 10. Numbers of notification of Shiga toxin producing *E. coli* infections, by month of onset and serotype, Australia, 2003



Does not include two cases, one of which was asymptomatic and another with onset of illness in late 2002.

Table 5. Number of notified cases of Shiga toxin producing *E. coli*, by sex and serotype in 2003, Australia

Serotype	Number of cases		Total
	Female	Male	
O157	8	5	13
O111	7	1	8
O130	0	1	1
O28	1	0	1
O5	0	1	1
Untypeable	1	1	2
Unknown	3	3	6
Not Typed	5	16	21
Total	25	28	53

Table 6. Number of notified cases of Shiga toxin producing *E. coli*, by State and serotype in 2003, Australia

Serotype	Number of cases					Total
	NSW	Qld	SA	Vic	WA	
O157	0	2	8	1	2	13
O111	1	0	7	0	0	8
O130	0	1	0	0	0	1
O28	0	0	0	1	0	1
O5	0	0	0	1	0	1
Untypeable	0	0	2	0	0	2
Unknown	3	3	0	0	0	6
Untyped	0	0	21	0	0	21
Total	4	6	38	3	2	53

H typing information was available for only 12 per cent (6/50) of all cases in 2003. There were three *E. coli* O157:H- infections, one each of serotypes O28:H-, O5:H- and O130:H11.

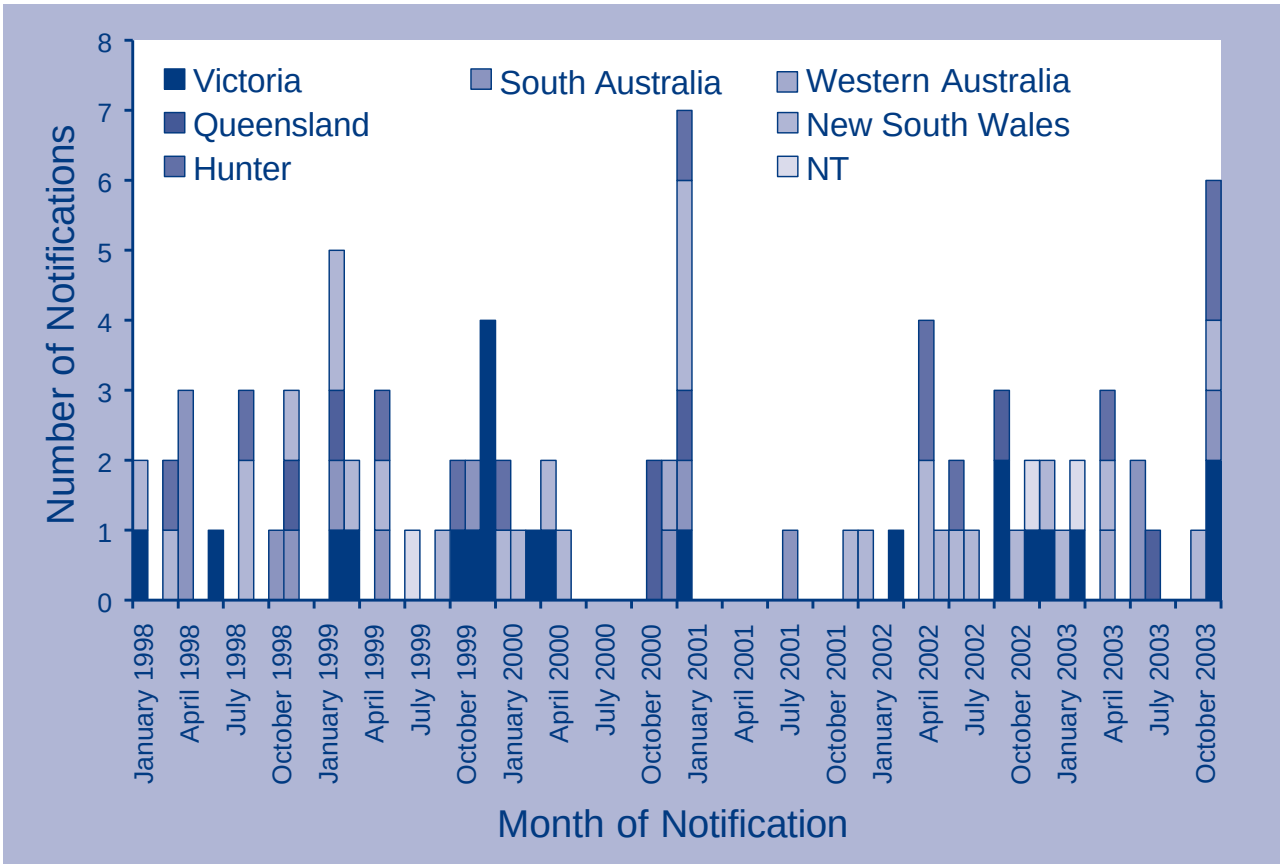
Surveillance for STEC is strongly influenced by screening practices at laboratories. South Australia has the highest rates of infection with STEC because it screens far more bloody diarrhoea specimens using sensitive PCR tests. The proportion of faecal specimens that is positive for STEC is remarkably similar between state public health laboratories in Australia regardless of the method of detection used.[12] In Australia, it is likely that many pathology laboratories do not routinely screen faeces for STEC using Sorbitol MacKonkey agar. Where this agar is used, only *E. coli* that do not ferment sorbitol are detected. In many other countries the predominant *E. coli* serotype—O157:H7—is routinely detected on this agar, although it is less common in Australia. *E. coli* that do not ferment sorbitol only represent a small proportion of this species that produce toxin-based infections.

Haemolytic uraemic syndrome

There were 15 cases of haemolytic uraemic syndrome (HUS) reported during 2003, corresponding to an overall rate of 0.1 case per 100,000 population. This compared to 13 cases of HUS in 2002. New South Wales reported five of these cases, three of which were notified in the Hunter OzFoodNet Site. Victoria reported four cases, South Australia three cases, and Western Australia, Queensland and the Northern Territory each reported a single case (Figure 11).

The male to female ratio of cases was 1:2. The highest rate of infection was in females aged 5–9 years old and males aged 0–5 years old, which were both 0.5 cases per 100,000 population. Sites reported that STEC were isolated from faeces in 20 per cent (3/15) of cases. One case was due to the O157 serotype, while two others were STEC unspecified. There was no obvious clustering of cases in 2003.

Figure 11. Numbers of notifications of haemolytic uraemic syndrome, by month of notification and jurisdiction, Australia, 1998 to 2003



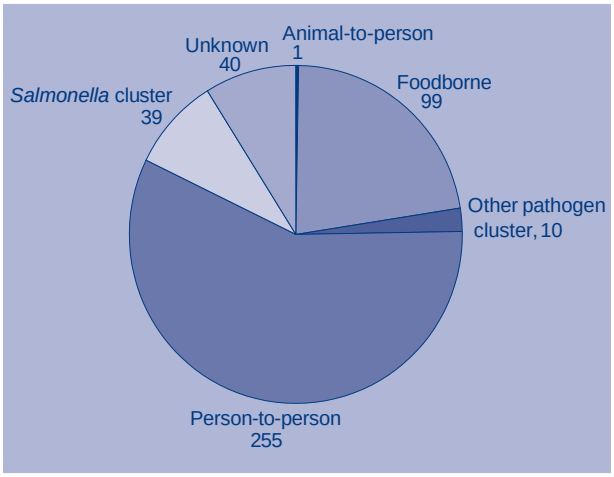
Gastrointestinal and foodborne disease outbreaks

During 2003, OzFoodNet sites reported 444 outbreaks of gastroenteritis illness affecting 10,368 persons. Five-hundred and one people were hospitalised and 10 people died as a result of these outbreaks. Fifty seven per cent (255/444) of outbreaks were suspected to be spread from infected persons to other people (Figure 12).

Outbreaks of gastroenteritis spread by person to person contact were responsible for 71 per cent (7,388/10,368) of all persons affected by gastroenteritis outbreaks, and three deaths. Fifty three per cent (135/255) of person to person gastroenteritis outbreaks were reported in aged care facilities, while 16 per cent (41/255) and 11 per cent (27/255) of outbreaks were reported in hospitals and childcare settings. Forty three per cent (109/255) of person-to-person outbreaks were due to norovirus, while 48 per cent (123/255) were of unknown aetiology many of which would have been viral.

Sites conducted investigations into 89 different clusters where the mode of transmission was not determined, or a foodborne source was not identified.

Figure 12. Outbreaks of gastrointestinal and foodborne disease, Australia, 2003



Foodborne disease outbreaks

In 2003, 99 foodborne disease outbreaks affected 1,686 persons, hospitalised 105 persons and caused six deaths (Table 7). This equates to an overall rate of 5.0 outbreaks of foodborne disease per million population. Appendix 2 shows a summary description of each outbreak.

Table 7. Outbreaks of foodborne disease in Australia, 2003, by OzFoodNet site

State	Number of outbreaks	Number affected	Hospitalised	Deaths	Mean number cases per outbreak	Outbreaks per million population
Australian Capital Territory	3	35	7	1	11.7	9.3
New South Wales	29	521	29	1	18.0	4.3
Northern Territory	7	110	4	0	15.7	35.3
Queensland	30	311	28	2	10.4	7.9
South Australia	1	6	1	0	6.0	0.7
Tasmania	1	22	2	0	22.0	2.1
Victoria	20	499	27	1	25.0	4.1
Western Australia	8	182	7	1	22.8	4.1
Total	99	1,686	105	6	17.0	5.0

Queensland reported the largest number of outbreaks, which represented 30 per cent (30/99) of all outbreaks reported (Table 7). The reporting rates of foodborne outbreaks for different OzFoodNet sites ranged from 0.7 per million population in South Australia to 35.3 per million population in the Northern Territory. The majority of outbreaks occurred in summer and autumn (Figure 13).

Aetiological agents

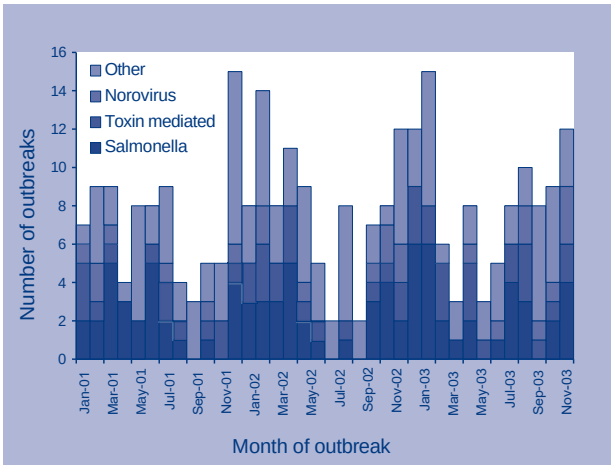
The most common agent responsible for foodborne disease outbreaks was *Salmonella*, which caused 31 per cent (31/99) of outbreaks (Table 8). These outbreaks affected a total of 710 persons with a hospitalisation rate of 12 per cent (82/710). S. Typhimurium was responsible for 81 per cent (25/31) of foodborne *Salmonella* outbreaks. Five of 6 fatalities were reported from four separate outbreaks of *S.* Typhimurium.

Many of the 21 outbreaks of illness due to toxins in 2003 were associated with contaminated fish. While ciguatera poisoning caused 48 per cent (10/21) of these outbreaks, all were small with a mean of 4.7 persons affected and a hospitalisation rate of 11 per cent. In comparison, four outbreaks of ciguatera poisoning in 2002 resulted in 50 per cent (7/14) of cases requiring admission to hospital. Histamine

Table 8. Aetiological agents responsible for foodborne disease outbreaks showing number of outbreaks and numbers of persons affected in Australia, 2003

Agent	Number of outbreaks	Number affected	Average size of outbreak	Hospitalised	Deaths
Campylobacter sp.	3	34	11.3	1	0
C. perfringens	5	116	23.2	0	1
Ciguatera	10	47	4.7	5	0
Escolar	2	23	11.5	0	0
Hepatitis A	2	24	12.0	2	0
Histamine poisoning	4	29	7.3	2	0
Norovirus	9	258	28.7	0	0
S. aureus	2	21	10.5	4	0
S. Other	6	38	6.3	4	0
S. Typhimurium	25	672	26.9	78	5
Sorbic acid	1	23	23.0	0	0
Unknown	30	401	13.4	9	0
Total	99	1,686	17.0	105	6

Figure 13. Outbreaks of foodborne disease, by selected aetiological agents, Australia, 2001 to 2003



poisoning from contaminated fish caused four outbreaks affecting 29 people. There were two outbreaks of kerriorhea due to consumption of Escolar fish, which affected 23 people. Escolar fish contain high levels of indigestible wax esters, which result in excessively oily stools. They are not considered toxins per se, but may result in outbreaks of oily diarrhoea.

There were five outbreaks *Clostridium perfringens* intoxication and two of *Staphylococcus aureus* intoxication. One outbreak of *C. perfringens* resulted in a death in a nursing home resident. There were three outbreaks of *Campylobacter* that affected 34 people.

There were eleven outbreaks of known viral aetiology, nine of which were due to norovirus. These outbreaks of norovirus affected 258 persons, but no one was hospitalised. The other outbreaks of viral illness were due to hepatitis A, which affected 24 persons. Thirty per cent (30/99) of outbreaks were of unknown aetiology, which affected 401 persons including nine cases who were hospitalised.

Food vehicles

There was a wide variety of foods implicated in outbreaks of foodborne disease during 2003 (Table 9), although investigators could not identify a vehicle for 34 per cent (34/99) of outbreaks. Contaminated fish was the most common food vehicle and was responsible for 17 per cent (17/99) of outbreaks. Poultry were responsible for or suspected as the cause of eight outbreaks, while pork was responsible for four outbreaks. Egg dishes, oysters, sandwiches, rice dishes and mixed foods were implicated in three outbreaks each. There was one outbreak associated with Vietnamese pork rolls and one associated with contaminated tahini from the Middle East. Outbreaks involving egg dishes had a hospitalisation rate of 20 per cent (23/117) and resulted in two deaths.

Outbreak settings

The most common setting for the occurrence of outbreaks was at restaurants (34%), followed by the home (20%), events catered for by professional companies (14%) and aged care facilities (9%) (Table 10). There were six outbreaks in school camps or excursions and three outbreaks each community settings and take away food stores.

Investigative methods and levels of evidence

States and territories investigated 26 outbreaks using retrospective cohort studies and nine outbreaks using case control studies. Cohort studies were conducted for only 31 per cent (8/26) outbreaks of unknown aetiology, compared to 50 per cent in 2002. Twenty-seven per cent of investigations using cohort studies were for norovirus outbreaks.

To attribute the cause of the outbreak to a specific food vehicle, investigators obtained analytical evidence from epidemiological studies for nine outbreaks. Microbiological evidence of contaminated food was found in nine outbreaks, with a further seven outbreaks investigations obtaining both microbiological and analytical evidence. Investigators obtained analytical and/or microbiological evidence for 39 per cent (12/31) of *Salmonella* outbreaks. Seventy-four per cent (74/99) of outbreaks relied on descriptive evidence to implicate a food or foodborne transmission.

Significant outbreaks

There were five outbreaks affecting 50 or more persons in 2003, compared to six in 2002. Three were due to *Salmonella* Typhimurium, one to norovirus and one was of unknown aetiology. Three of the outbreaks occurred at restaurants, one was associated with a bakery and one with a commercial caterer. One of the outbreaks of *S.* Typhimurium

occurred at a restaurant and was associated with dishes containing eggs, while another was associated with Vietnamese rolls from a bakery. The third outbreak was due to pigeon meat contaminated with with *S.* Typhimurium 99. Apple strudel served at a restaurant was responsible for a large outbreak of norovirus. The catering associated outbreak did not identify a food vehicle or aetiological agent.

There were 23 outbreaks affecting between 20 and 50 persons. Three of these outbreaks occurred in aged care facilities and were due to *C. perfringens* or *Salmonella.* Seafood was implicated in four of these outbreaks, including two due to oysters from Japan contaminated with norovirus. Nine outbreaks were due to *Salmonella* Typhimurium, of which phage types 135 (4 outbreaks) and 108 (2 outbreaks) were the most common causes. Two of these *S.* Typhimurium outbreaks were due to roast pork, while three were related to Asian foods.

The Tasmanian Department of Health and Human Services investigated an outbreak of hepatitis A following a four-day festival in the Northern Territory in April 2003. Four notifications of hepatitis A infection triggered an investigation involving OzFoodNet

Table 9. Categories of food vehicles implicated in foodborne disease outbreaks in Australia, 2003

Vehicle category	Number of outbreaks	Number affected	Hospitalised	Deaths
Beverage	1	19	0	0
Cakes	2	73	1	0
Cheese	1	23	0	0
Dessert	1	31	0	0
Egg dishes	1	52	4	0
Escolar fish	3	45	0	0
Fish (other)	14	57	7	0
Mixed vehicle	3	62	10	0
Oysters	3	100	0	0
Pasta	2	29	0	0
Pizza	1	18	0	0
Pork	4	57	3	0
Pork rolls	1	213	22	1
Poultry	5	98	8	0
Red meat/meat products	1	7	0	0
Rice dish	3	47	5	1
Sandwiches	3	38	0	0
Seafood	2	21	0	0
Sesame seed products	1	3	0	0
Unknown	34	483	18	2
Unpasteurised milk	1	13	0	0
Asian foods	2	40	3	0
Salad	2	26	1	0
Sliced meats	1	1	0	0
Suspected poultry	3	37	2	0
Suspected egg dishes	2	65	19	2
Raw vegetables	2	28	2	0
Total	99	1,686	105	6

Table 10. Categories of settings where food was prepared or consumed for foodborne disease outbreaks, Australia, 2003

Setting category	Number of outbreaks	Number affected	Hospitalised	Deaths
Aged care facility	9	167	17	3
Bakery	1	213	22	1
Community	4	35	3	0
Home	20	115	12	0
Hospital	2	22	10	1
Institution	2	49	7	0
Restaurant	34	619	25	1
School	1	19	0	0
Take away	4	67	0	0
Camp/Excursion	6	80	6	0
Caterer	14	264	3	0
Childcare	2	36	0	0
Total	99	1,686	105	6

Sites in Queensland, New South Wales, Victoria, Western Australia and Tasmania. A retrospective cohort study of 213 out of 350 people attending the event identified 21 cases of hepatitis A. People who consumed cordial or coleslaw were at higher risk of developing hepatitis A. All food handlers tested were found to be negative for hepatitis A IgM and environmental investigations did not reveal any cause of the outbreak.

There were four outbreaks involving foods imported into Australia, highlighting the international implications of foodborne disease. One outbreak of *S.* Montevideo in Victoria affected 3 persons and was linked to tahini from Lebanon. This followed a previous outbreak in New South Wales in 2002, with cases of *S.* Montevideo being reported well into 2003. In total, there were 58 cases of *S.* Montevideo from these two separate outbreaks associated with sesame seed products in New South Wales and Victoria. As a result there were several local recalls of contaminated tahini and helva along with an international alert to investigators. The international alert identified a further ten human infections in New Zealand and assisted food safety agencies in Canada and the United Kingdom to identify contaminated food products, with subsequent recalls of contaminated tahini and helva in these countries.

Salmonella contamination of sesame seed based products continues to be a problem worldwide. Australian and New Zealand food safety authorities have implemented routine microbiological testing for imported foods containing crushed sesame seeds. However, since detecting low concentrations of sporadic contamination with *Salmonella* from random testing is very difficult, human health surveillance of *Salmonella* infections plays a vital role in ensuring the safety of these types of products.

There were three other outbreaks with international implications in Western Australia[2] and Northern Territory[1] in November 2003 that were associated with oysters. The oysters were Individually Quick Frozen (IQF) meat imported from Japan, although they were different importers and brands. The labelling on some of these oyster products indicated the need to 'cook before consumption'. Despite this, the two outbreaks in Western Australia were both due to caterers using the oyster meat uncooked in 'oyster shooter' cocktails. The third outbreak in the Northern Territory occurred in a popular restaurant where the oysters were cooked for 8–10 minutes. Norovirus was detected in patients' faeces in two of these outbreaks and suspected as the cause of the third. Norovirus was also detected in the oyster meat in the outbreak that occurred in the Northern Territory. Traceback investigations identified that all oyster products were supplied by a single company in Japan and the two batches were harvested at similar times.

Cluster investigations

A cluster is defined as an increase in infections that are epidemiologically related in time, place or person where investigators are unable to implicate a food 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. In this category, some outbreaks where the mode of transmission was indeterminate have been included.

During 2003, states and territories conducted 89 investigations of clusters of enteric diseases that affected 1,298 people, hospitalising 88 people and causing one fatality. 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* 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. Forty-four per cent (39/89) of these investigations related to clusters of *Salmonella,* which affected 427 persons with 33 cases hospitalised. *S.* Typhimurium was responsible for 36 per cent (14/39) these *Salmonella* cluster investigations. Of the remaining 25 investigations, 17 other different *Salmonella* serovars were involved.

Many of the cluster investigations were suspected to be related to animal or food-based exposures, which could not be confirmed. An example was an investigation into four cases of *S*. Reading in Queensland in February 2003. It was likely that most of the infections were acquired by zoonotic transmission, as all four cases had contact with farm animals including calves, pigs and chickens in the week prior to the onset of illness. Another example was a small household cluster of *S.* Typhimurium 108 in Tasmania suspected to be related to a cat with diarrhoea.

In April 2003, a laboratory reported a 64 per cent increase in *Campylobacter* cases in a regional area of Victoria compared to the same time period in 2002. Local government personnel interviewed 29 cases of *Campylobacter* infection, which showed that a higher proportion of cases had consumed chicken fillet and had contact with pets compared to community based controls from an earlier study. Molecular typing of 27 *Campylobacter jejuni* isolates revealed 16 different patterns, making it unlikely that cases consumed the same type or batch of food product. It was discovered that the primary pathology laboratory in the area had changed its laboratory methods for *Campylobacter* detection in late November 2002. Plates were incubated for three rather than two days, and this methodological change coincided with the increase in *Campylobacter* cases notified from December 2002 onwards. While this may not be the sole reason for the increase, as the laboratory did state that higher numbers of faecal specimens had been submitted, it may explain some of the increase.

An investigation of an apparent cluster of *S.* Enteritidis PT 21b amongst eight people in Queensland took place in early September 2003. Further investigation revealed that all of the positive specimens came from the same pathology laboratory and all except one were collected on the same day. Two of the eight cases had a history of overseas travel, which was not consistent with a single outbreak source. Hypothesis-generating interviews did not suggest any common exposures among the cases. Following discussions with the pathology laboratory, further investigation identified a laboratory error among all but one case. Results of the investigation determined that there was a single case of *S*. Enteritidis PT 21b who acquired their infection whilst travelling through Malaysia.

In early 2003, OzFoodNet continued to investigate a multi-state cluster of *S.* Potsdam involving New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania. OzFoodNet Site epidemiologists interviewed 50 cases of *S.* Potsdam using hypothesis-generating questionnaires, although a cause for the outbreak was not determined.

In 2003, there was an increase in cases of *Salmonella* Paratyphi B Java, particularly phage type 3b var 10. In response OzFoodNet commenced a case series investigation, in collaboration with the National Enteric Pathogen Surveillance Scheme. Between May 2003 and April 2004, state and territory health departments interviewed all notified cases of *S*. Paratyphi B Java using a standard questionnaire. Cases were excluded if they were unable to be contacted by telephone or had a history of overseas travel, which is quite common amongst patients infected with *S.* Paratyphi B Java. Of the 22 case patients interviewed as part of the national cluster investigation, the median age was three years old (range 0–48 years) and the male to female ratio was 1:1.2. Eighty-two per cent (18/22) of cases reported contact with tropical fish aquariums during their incubation period. This association between *Salmonella* Paratyphi B Java infection and contact with tropical fish has been reported previously.[14,15,16] Four cases had no fish exposure but one owned a snake. All isolates of *S*. Paratyphi B Java 3b var 10 (n=10) were resistant to ampicillin, streptomycin, tetracycline, chloromycin, sulfadiazine, spectinomycin (ASTCSuSp), which is similar to the profile for *S.* Typhimurium definitive type 104.[17] The exposure histories of cases are currently being analysed to

determine risk behaviours associated with illness. It is important to for people to wash their hands after feeding fish or cleaning aquariums to avoid infection from *Salmonella* and other pathogens, such as atypical mycobacteria.

State, Territory and OzFoodNet personnel also investigated clusters of pathogens other than *Salmonella*. In South Australia, for example there was an investigation of an outbreak of campylobacteriosis following a school camp at a dairy farm. Investigation of the cluster identified both food-based and environmental risk factors, including consumption of unpasteurised milk.

The true number of clusters investigated was difficult to determine, as the figures did not include all cluster investigations conducted in public health units or local government areas. States and Territories have different definitions and triggers for investigating clusters.

Risk factors for infection

During 2003, OzFoodNet identified several important risk factors and settings for foodborne illness as a result of outbreak investigations and from preliminary results of case control studies.

Fish and Seafood

There were more outbreaks of foodborne illness related to fish and seafood in 2003 than in previous years. Sixty four per cent (14/22) of these outbreaks were from Queensland, of which 71 per cent (10/14) were outbreaks of ciguatera poisoning. All of these outbreaks of ciguatera occurred in the home, except for one that occurred in a restaurant. Preventing ciguatera intoxications relies on increased awareness to prevent people catching and eating large reef fish from reefs affected by ciguatera.

Four outbreaks of histamine poisoning were more than has been reported in previous years. New South Wales reported a small outbreak of two cases of hepatitis A associated with prawns at a restaurant meal. There were three outbreaks due to Escolar fish, one of which was histamine poisoning and possibly kerriorrhoea. All three outbreaks occurred at restaurants showing that this fish is still being sold to the food industry.[16]

The three outbreaks of gastroenteritis due to consumption of individually quick frozen oysters led to considerable concern over the safety of these products for the Australian market. Food Standards Australia New Zealand (FSANZ) has assessed that these oysters from polluted growing areas presented a high risk for outbreaks, even where the products may be cooked.[18] During the outbreaks there was considerable debate about epidemiological evidence as a basis for food recalls when complementary microbiological evidence was absent. Food safety and communicable disease agencies are still considering these issues.

Chicken and poultry

There were eight outbreaks caused or possibly caused by poultry, which was the most common vehicle following fish and seafood. *Salmonella* was the aetiological agent in five of these outbreaks, *Campylobacter* in one and two were of unknown aetiology. The largest of these outbreaks was due to *S.* Typhimurium 99 in contaminated pigeon meat served at a birthday party, which affected 61 people. Poultry may have had a role in some of the cluster investigations of salmonellosis during 2003, although the association was unable to be confirmed. Concurrent isolation of the same serotype from routine samples of raw poultry meat at the same time as a cluster investigation were common. It is important to recognise that poultry consumption is very common, with approximately 80% of people having eaten it in the previous 7 days. This makes epidemiological comparison of ill and well people's food histories very difficult. FSANZ are currently preparing a primary production standard for poultry meat in cooperation with industry and other stakeholders.

Asian foods

There were seven outbreaks of foodborne illness associated with Asian style foods in 2003 that affected a total of 355 people. Five of these outbreaks were due to *S.* Typhimurium infection, including one outbreak of *S.* Typhimurium 135 associated with Vietnamese pork rolls affecting 213 people and associated with one fatality. Vietnamese pork rolls are a particularly high-risk food, which continue to cause outbreaks despite attempts by regulatory agencies to improve the safety of these foods.[19] The other food vehicles included 'fried tofu dish', 'pigs ear salad and ducks gizzards', 'pigeon meat', 'prawns', 'rice beef and black bean sauce' and 'fried rice'. Asian foods often use imported ingredients and have shorter cooking periods than are required to kill pathogens.[20] Food safety in this sector of the restaurant industry needs to continue to be a high priority to prevent foodborne infections.

Imported foods

The four outbreaks associated with imported foods during 2003 were essentially continuation of outbreaks due to these products in 2002. This illustrated how long shelf life products can remain in the market and continue to cause disease. The outbreak of *S.* Montevideo associated with tahini in Victoria and

the follow-on from the outbreak in the Hunter from 2002 highlighted the potential for sesame-based products as a vehicle for *Salmonella*.[26] The outbreaks of illness due to the oysters highlights how oysters grown in contaminated waters may result in foodborne illness. Oysters grown in contaminated water have cause large outbreaks, including previous outbreaks associated with oysters grown in Australia and New Zealand.[21,22] Contaminated oysters have commonly caused outbreaks of gastroenteritis in Japan and approximately nine per cent are positive for norovirus using reverse transcriptase polymerase chain reaction tests.[23,24,25]

Aged care

People resident in aged care settings may be at higher risk for foodborne disease. In 2003, there were nine outbreaks in this setting compared to five in 2002. The food vehicle could not be determined in any of these outbreaks, although raw egg drink was suspected as the cause in one and gravy added into vitamised meals in another. The main reason for difficulty in determining specific foods in these outbreaks was the often poor recall of foods consumed by elderly residents and the lack of accurate menus and dietary histories maintained by the facility. Four outbreaks in aged care settings were due to *C. perfringens* and three due to *Salmonella*. The *C. perfringens* outbreaks clearly indicate the need for better control of preparation and handling of foods in this sector.

Restaurants and catered events

Outbreaks due to this sector constituted 48 per cent (48/99) of outbreaks, compared to 54 per cent in 2002. The two most common aetiological agents *Salmonella* and norovirus were responsible for 21 per cent (10/48) and 17 per cent (8/48) of outbreaks respectively, although outbreaks of unknown aetiology were most common (42 per cent). It is likely that many outbreaks of unknown aetiology are actually due to norovirus. Staff members who handle foods should not work when they are ill, as they can cause large outbreaks of gastroenteritis when food becomes a fomite for enteric pathogens. Many outbreaks in restaurant and catering settings result from breaches in food safety that could be prevented by proper application of food safety programs. Clearly there is a need to continue to monitor the causes of outbreaks in this sector.

Camps and excursions

There were six outbreaks of foodborne illness associated with camps or excursions during 2003. There were a range of pathogens responsible for these outbreaks, two of which were either toxin related or suspected toxins. These outbreaks point to the potential for poor temperature control when large quantities of food are prepared.

There was one outbreak of campylobacteriosis due to drinking unpasteurised milk in Victoria. There was also another outbreak of campylobacteriosis in South Australia associated with either drinking unpasteurised milk or swimming. Unpasteurised milk is a high risk food for contamination with organisms spread from animal-to-person, such as *E. coli*, *Cryptosporidium*, *Campylobacter* and *Salmonella*.[27] While the sale of unpasteurised milk is now prohibited in all states and territories, this does not prevent people drinking this product in settings such as school camps. Camps and excursions can present a higher risk for waterborne illness where water supplies are inadequately treated.

Surveillance evaluation and enhancement

Continuous monitoring and improvement of surveillance systems is important to ensure that outbreaks of foodborne illness are investigated rapidly and effectively. To facilitate improvements in surveillance and investigative procedures, outcome indicators have been compared at OzFoodNet sentinel sites.

National information sharing

In 2003, all jurisdictions contributed to a fortnightly national cluster report to identify foodborne illness that was occurring across state and territory boundaries. The cluster report was useful for identifying common events affecting different parts of Australia. The cluster report is useful for tracking the investigation of multi-state clusters, such as hepatitis A and norovirus infections associated with oysters. The cluster report supplemented information sharing on a closed list server, teleconferences and at quarterly face-to-face meetings.

Outbreak reporting and investigation

During 2003, the Northern Territory Site recorded the highest reporting rate of outbreaks of foodborne disease (35.3 per 100,000 population) and foodborne salmonellosis (5.0 per 100,000 population). The rates of other Sites reporting foodborne *Salmonella* outbreaks ranged between 0–3.1 outbreaks per million population. Queensland investigated the largest number of foodborne disease outbreaks (30 outbreaks; 7.9 per million population).

Figure 14. Proportion of *Salmonella* notifications on State and Territory databases with appropriate information, by year, 2000 to 2003

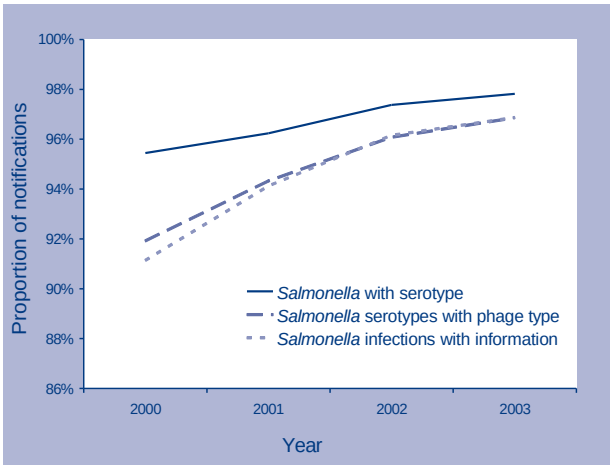
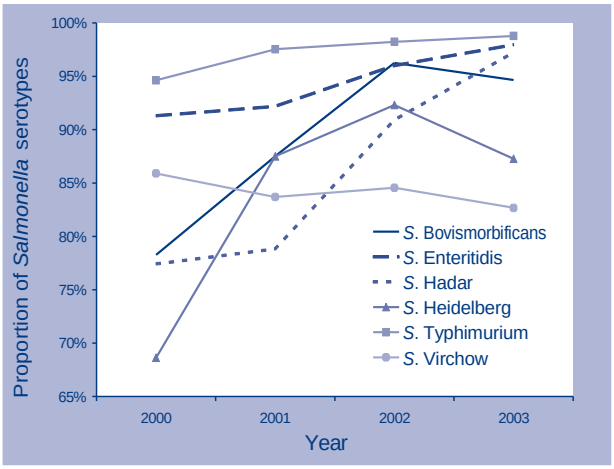


Figure 15. Proportion of *Salmonella* serotype notifications on State and Territory databases with phage type information, by serotype and year, 2000 to 2003



States and territories conducted 51 analytical studies (cohort or case control studies) to investigate foodborne disease outbreaks or clusters of suspected foodborne illness. Investigators used analytical studies for 31% (31/99) of foodborne disease outbreaks, which was slightly lower than 2002 (40%). The Northern Territory had the highest rate for investigations of foodborne disease or potentially foodborne clusters using analytical studies, followed by the Australian Capital Territory.

Completeness of Salmonella *serotype and phage type reports*

There was considerable improvement in the completeness of *Salmonella* data available on state and territory surveillance databases between the years 2000 to 2003 (Figure 14). Overall 97 per cent (6,740/6,952) of *Salmonella* notifications on databases contained either serotype or phage type, which was an increase of 2.4 per cent from 2001 and 0.7 per cent from 2002 (Table 11).

Queensland had the highest proportion of complete *Salmonella* notification (99.7%), while four sites reported 98 per cent or higher. New South Wales reported the lowest rate of completeness, but recorded an 11.8 per cent improvement when compared to the figures for 2000. The majority of missing records on the New South Wales database related to phage typing information, particularly for the Virchow serotype. Phage type recording for serotypes Virchow and Heidelberg, with only 82.7 per cent (291/352) and 87.3 per cent (48/55) of reports on databases recording this information respectively (Figure 15). From 2002 to 2003, recording phage types of serotype Bovismorbificans declined by 1.7 per cent. Phage type reports on state and territory databases were increased for all other serotypes.

It is important to recognise that this information on completeness does not reflect the practices of reference laboratories that serotype and phage type *Salmonella* in Australia. The information on completeness presented here mostly relates to the recording practices of state and territory health departments on surveillance databases.

Discussion

Approximately 5.4 million (credible interval 4.0–6.9 million) people experience foodborne ill- ness each year in Australia.[6] The infections and outbreaks documented in this report represent only a small proportion of the total burden of these illnesses, as the majority of cases are never reported to health departments.[3] In 2003, both notifications of potentially foodborne infections and outbreaks of foodborne disease were higher than historical means. Reports of listeriosis and Shiga toxin producing *E. coli* were 17 per cent and 16 per cent higher than the mean reports for the previous five years respectively. These rates of infection are similar to many other developed countries.[28]

Rates of reported *Salmonella* and *Campylobacter* infections were considerably higher in Australia than

Table 11. Number of *Salmonella* infections notified and proportion of notifications with serotype and phage type information available on surveillance databases in Australia, 2000 to 2003, by OzFoodNet site

OzFoodNet Site	Year	*Salmonella* notifications	*Salmonella* with serotype	Serotype with phage type information	Salmonella infections with information
Australian Capital Territory	2000	102	96.1	98.5	95.1
	2001	76	98.7	100.0	98.7
	2002	96	97.9	93.8	92.7
	2003	80	98.8	98.3	96.3
Hunter	2000	86	94.2	87.8	87.2
	2001	117	97.4	92.7	92.3
	2002	170	95.9	96.6	94.1
	2003	112	98.2	93.9	94.6
New South Wales	2000	1334	92.2	78.1	78.9
	2001	1668	94.2	86.4	85.4
	2002	2078	94.8	88.9	88.0
	2003	1868	96.4	90.6	90.7
Northern Territory	2000	329	90.9	82.5	88.8
	2001	387	90.4	98.4	90.2
	2002	337	96.7	100.0	96.7
	2003	371	98.7	100.0	98.7
Queensland	2000	1818	97.3	94.8	95.0
	2001	2169	97.0	95.0	97.8
	2002	2722	97.5	98.5	99.4
	2003	2255	97.8	99.4	99.7
South Australia	2000	452	99.6	100.0	99.6
	2001	613	99.8	100.0	99.8
	2002	520	100.0	100.0	100.0
	2003	441	99.3	100.0	99.3
Tasmania	2000	127	96.9	97.9	96.1
	2001	159	98.7	97.1	98.1
	2002	165	99.4	100.0	99.4
	2003	138	97.8	100.0	97.8
Victoria	2000	1005	98.0	99.3	97.5
	2001	1090	97.7	100.0	97.7
	2002	1208	99.3	100.0	99.3
	2003	1267	99.3	100.0	99.3
Western Australia	2000	936	93.2	93.6	89.9
	2001	850	95.9	95.2	93.8
	2002	729	99.3	99.2	98.9
	2003	612	97.6	99.2	97.2
Australia	2000	6103	95.4	91.9	91.1
	2001	7012	96.2	94.3	94.1
	2002	7855	97.4	96.1	96.2
	2003	7032	97.8	96.9	96.9

in the United States of America (USA). This was despite the use of active surveillance to ascertain cases in the USA. The ratio of reported *Salmonella* and *Campylobacter* rates for OzFoodNet Sites and FoodNet Sites in 2003 were 2.4 (35.4/14.5) and 8.9 (112.0/12.6) times higher respectively.[29] Even after adjusting for the likelihood of people attending a doctor or having a stool specimen tested, these differences still persist.[30] The likely reasons for these international variations include differences in laboratory testing procedures, and different levels of exposures to these organisms in the general community.

Outbreaks of STEC are rarely identified in Australia even where screening for this organism is intense.[6] South Australia identified two clusters of toxigenic *E. coli* in 2003, although a specific food vehicle was not identified in either outbreak. There is considerable variation in rates of STEC infection in Australian states and territories, which primarily relates to the rate of screening stools for this organism. The proportion of diarrhoeal stool tested that is subsequently reported as positive in reference laboratories is relatively consistent around Australia, and ranges from 1.2–6.9 per cent.[12]

Salmonella caused the most foodborne outbreaks of any agent during 2003 similar to previous years. Foodborne *Salmonella* infections are a serious concern for Australia along with many other countries. In 2003, there were at least an equal number of investigations of *Salmonella* where no food vehicle was identified. For every case of salmonellosis reported to Australian surveillance systems there may be between 5–25 cases in the community.[31] Improved diagnostic tests have also shown the importance of norovirus as a cause of foodborne illness. In this report, norovirus was also identified as a significant cause of outbreaks that were spread from person-to-person. These outbreaks result in considerable costs to the aged care and healthcare sectors, as they cause significant illnesses in staff and patients and can result in ward or facility closures.

There were six deaths associated with foodborne outbreaks in Australia in 2003. This was higher than previous years, although small numbers make comparison with other years unreliable. Four deaths occurred in aged care or hospital settings, while two occurred in outbreaks in community settings. Four deaths occurred in outbreaks of *Salmonella* Typhimurium 135, while another occurred in an outbreak of *Salmonella* Typhimurium 170. The remaining outbreak where a death occurred in a nursing home was due to *Clostridium perfringens* and was believed to be associated with blended food. Approximately 42 per cent of outbreaks were associated with restaurants and caterers. The hospitalisation rate was highest in outbreaks in hospital and aged care settings.

Seafood and fish were the cause of several outbreaks during 2003. Seafood is a major cause of foodborne illness globally, although the total amount in Australia is difficult to estimate.[29] There have been six different norovirus or suspected viral outbreaks associated with imported Japanese Individually Quick Frozen (IQF) oyster meat in Australia in the last two years. New Zealand investigators have also identified Korean IQF oyster meat to be contaminated with norovirus (Pers Comm. G Simmons, July 2004). This highlights increasing concerns about seafood safety and the global distribution of foods that may cause widespread illness.[29]

In 2003, the outbreak of *Salmonella* Montevideo linked to sesame seed products continued from 2002. Numerous associated products were positive for *S.* Montevideo, which resulted in international alerts. These sesame seed products had very low concentrations of *Salmonella*, which might not have been detected using conventional microbiology. Following the outbreak in 2002, the Australian Quarantine and Inspection Service added tahini to the risk list where all imported products are tested. New Zealand elevated the risk category of sesame-based products following an outbreak in 2003 that was detected through the international alert about the Australian outbreak.

It is important to recognise some of the many limitations of the data that OzFoodNet 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 in different states and territories, resulting in different rates of disease. 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 many causes of illness that do not result in outbreaks, particularly for organisms such as *Campylobacter*. There can also be considerable variation in assigning causes to outbreaks depending on investigators and circumstances.

Health agencies conducting surveillance for foodborne disease need to constantly improve their practices and evaluate their efforts. The large number of analytical studies used in investigations of outbreaks is evidence of robust inquiry into the causes of these diseases. During 2003, OzFoodNet coordinated or participated in the investigation

of several multi-state outbreaks. The success of OzFoodNet is a testimony to the value of regular and informed communication.

The data arising from OzFoodNet's assessment of foodborne disease risks need to feed into the development of food safety policy for Australia. While many risk factors occur commonly from year-to-year, they require constant vigilance. The occurrence of repeated outbreaks with similar food vehicles or settings of preparation may indicate the need for enforcement of controls. National surveillance of foodbourne diseases is vitally important to provide data to evaluate these efforts. OzfoodNet needs to prioritise work for coming years to identify potential gaps in food safety and measure the impact on food safety of interventions in the national food safety work program.

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References

1. Rocourt J, Moy G, Vierk K, Schlundt J. 2003 The present state of foodborne disease in OECD countries. World Health Organization, Geneva. Available from: http://www.who.int/foodsafety/publications/foodborne_disease/oecd/en/ Accessed 6 August 2004.

2. World Health Organization 2003, Methods for Foodborne Disease Surveillance in Selected Sites Report of a WHO consultation 18–21 March 2002, Leipzig, Germany WHO/CDS/CSR/EPH/2002.22 Available at: www.who.int/salmsurv/links/en/Leipzigmeetingreport.pdf Accessed on: 6 August 2004.

3. Allos BM, Moore MR, Griffin PM, Tauxe RV. Surveillance for sporadic foodborne disease in the 21st century: the FoodNet perspective. *Clin Infect Dis* 2004;38 Suppl 3:S115–S120.

4. Wegener HC, Hald T, Lo Fo Wong D, Madsen M, Korsgaard H, Bager F, Gerner-Smidt P, Molbak K. Salmonella control programs in Denmark. *Emerg Infect Dis*. 2003;9:774–780.

5. Ashbolt R, Givney R, Gregory JE, Hall G, Hundy R, Kirk M, McKay I, Meuleners L, Millard G, Raupach J, Roche P, Prasopa-Plaizier N, Sama MK, Stafford R, Tomaska N, Unicomb L, Williams C; OzFoodNet Working Group. Enhancing foodborne disease surveillance across Australia in 2001: the OzFoodNet Working Group. *Commun Dis Intell* 2002;26:375–406.

6. OzFoodNet Working Group. Foodborne disease in Australia: incidence, notifications and outbreaks. Annual report of the OzFoodNet network, 2002. *Commun Dis Intell* 2003;27:209–243.

7. Lindenmayer P. Networking for health protection: the Communicable Diseases Network Australia. *Commun Dis Intell* 2001;25:266–269.

8. Yohannes K, Roche P, Blumer C, Spencer J, Milton A, Bunn C, Gidding H, Kirk M, Della-Porta T. Australia's notifiable diseases status, 2002: Annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell* 2004;28:6–68.

9. Powling J, Lightfood D, Veitch M, Hogg G. Human Annual Report 2003. Report of the National Enteric Surveillance Scheme, 2004, Melbourne.

10. Cogan TA, Humphrey TJ. The rise and fall of Salmonella Enteritidis in the UK. *J Appl Microbiol* 2003;94 Suppl:114S–119S.

11. Australian Institute of Health and Welfare NPSU 2003. Australia's mothers and babies 2000. AIHW Cat. No. PER 21.

12. Combs B, Raupach J, Kirk M. National Survey of STEC Screening Practices. OzFoodNet Unpublished Report 2004, Adelaide.

13. Anon. Outbreak of salmonella paratyphi b linked to aquariums in the province of Quebec, 2000. *Can Commun Dis Rep* 2002;28:11.

14. Riley A, Hanson M, Ramsey C. Tropical fish as a source of Salmonella Java infection. *Comm Dis Env Health Scotland* 1992;26:4–5.

15. Lightfoot D, Genobile D and O'Brien E. Are fish tanks a health hazard? Abstract for presentation at Communicable Diseases Conference, Canberra, April 2001.

16. Shadbolt C, Kirk M, Roche P. Diarrhoea associated with consumption of escolar (rudderfish). *Commun Dis Intell* 2002;26:436–438.

17. Mulvey MR, Boyd D, Cloeckaert A, Ahmed R, Ng K. Emergence of Multidrug-resistant Salmonella Paratyphi B dT+, Canada. *Emerg Infect Dis* 2004;10:1307–1310.

18. Kirkland KB, Meriwether RA, Leiss JK, Mac Kenzie WR. Steaming oysters does not prevent Norwalk-like gastroenteritis. *Public Health Rep* 1996;111:527–530.

19. Andrews R, Feldheim J, Givney R, Carman J, Murray C, Beers M, Lanser J, Nguyen M, Cameron S, Hall R. Concurrent outbreaks of Salmonella Typhimurium in South Australia. *Commun Dis Intell* 1997;21:61–62.

20. Ying J. Chinese-style barbecued meats: a public health challenge. *Can J Public Health* 2000;91:386–389.

21. Simmons G, Greening G, Gao W, Campbell D. Raw oyster consumption and outbreaks of viral gastroenteritis in New Zealand: evidence for risk to the public's health. *Aust N Z J Public Health* 2001;25:234–240.

22. Stafford R, Strain D, Heymer M, Smith C, Trent M, Beard J. An outbreak of Norwalk virus gastroenteritis following consumption of oysters. *Commun Dis Intell* 1997;21:317–320.

23. Terajima J, Tamura K, Hirose K, Izumiya H, Miyahara M, Konuma H, Watanabe H. A multi-prefectural outbreak of Shigella sonnei infections associated with eating oysters in Japan. *Microbiol Immunol* 2004;48:49–52.

24. Inouye S, Yamashita K, Yamadera S, Yoshikawa M, Kato N, Okabe N. Surveillance of viral gastroenteritis in Japan: pediatric cases and outbreak incidents. *J Infect Dis* 2000;181 Suppl 2:S270–S274.

25. Nishida T, Kimura H, Saitoh M, Shinohara M, Kato M, Fukuda S, Munemura T, Mikami T, Kawamoto A, Akiyama M, Kato Y, Nishi K, Kozawa K, Nishio O. Detection, quantitation, and phylogenetic analysis of noroviruses in Japanese oysters. *Appl Environ Microbiol* 2003;69:5782–5786.

26. Brockmann SO, Piechotowski I, Kimmig P. Salmonella in sesame seed products. *J Food Prot* 2004;67:178–180.

27. Harper CM, Cowell NA, Adams BC, Langley AJ, Wohlsen TD. Outbreak of Cryptosporidium linked to drinking unpasteurised milk. *Commun Dis Intell* 2002;26:449–450.

28. World Health Organization. 8th Report of the WHO Surveillance Programme for Control of Foodborne Infections and Intoxications in Europe, 1999–2000., 2004, Germany.

29. The FoodNet Working Group. Preliminary FoodNet Data on the Incidence of Infection with Pathogens Transmitted Commonly Through Food – Selected Sites, United States, 2003. *Morb Mortal Wkly Rep* 2004;53;338–343.

30. Vally H, Kirk M, Scallan E, Angulo FJ, Hall G. Higher Incidence of *Campylobacter* Infection in Australia Compared with the United States in 2001. Conference Abstract. International Conference on Emerging Infectious Diseases, 2004, Atlanta

31. Hall G. How much foodborne disease is there in Australia? National Centre for Epidemiology Working Paper, 2003.

32. Butt AA, Aldridge KE, Sanders CV. Infections related to the ingestion of seafood Part I: Viral and bacterial infections. *Lancet Infect Dis* 2004;4:201–212.

Appendices

Appendix 1. Summary of gastrointestinal infections notified to OzFoodNet sites potentially due to food, 2003

		ACT	Hunter	NSW	NT	Qld	SA	Tas	WA	Vic	Total
Campylobacter	Cases	413	NN	NN	274	3,886	2,661	618	1,959	5,653	15,464
	Rate	127.9	NN	NN	138.1	102.4	174.2	129.5	100.3	115.0	112.0
Salmonella	Cases	80	112	1,868	371	2,255	441	138	612	1,267	7,032
	Rate	24.8	20.4	27.9	187.1	59.4	28.9	28.9	31.3	25.8	35.4
Yersinia	Cases	2	NN	NN	1	94	18	0	2	0	117
	Rate	0.6	NN	NN	0.5	2.5	1.2	0.0	0.1	0.0	1.7
STEC	Cases	0	1	4	0	6	38	0	2	3	53
	Rate	0.0	0.2	0.1	0.0	0.2	2.5	0.0	0.1	0.1	0.3
HUS	Cases	0	3	5	1	1	3	0	1	4	15
	Rate	0.0	0.3	0.1	0.2	0.0	0.1	0.0	0.0	0.1	0.1
Typhoid	Cases	0	0	17	0	5	2	1	10	19	54
	Rate	0.0	0.0	0.3	0.0	0.1	0.1	0.2	0.5	0.4	0.3
Shigella	Cases	3	NR	58	132	55	32	4	109	50	443
	Rate	0.9	NR	0.9	66.6	1.4	2.1	0.8	5.6	1.0	2.2
Listeria	Cases	1	3	28	0	11	1	2	8	21	72
	Rate	0.3	0.5	0.4	0.0	0.3	0.1	0.4	0.4	0.4	0.4

NN Not notifiable.

NR Not reported.

Appendix 2. Summary of foodborne disease outbreaks reported by OzFoodNet sites, 2003

State	Month of outbreak	Setting Category	Agent category	Number affected	Hospitalised	Evidence *	Epidemiolgical study†	Responsible vehicles
Australian Capital Territory	Apr	Home	Unknown	3	0	D	D	Fish
	Apr	Hospital	*S*. Typhimurium	19	7	D	D	Unknown
	Nov	Childcare	Unknown	13	0	D	D	Vegetable pasta salad
New South Wales	Jan	Restaurant	*S*. Other	4	1	D	D	Pork dish
	Jan	Restaurant	*S*. Typhimurium	3	0	D	D	Chicken
	Jan	Restaurant	*Campylobacter*	2	1	D	D	Caesar salad
	Jan	Restaurant	Unknown	3	1	D	D	Unknown
	Feb	Camp/Excursion	*Campylobacter*	19	0	D	D	Chicken
	Feb	Restaurant	*S*. Typhimurium	11	1	M	D	Rice salad
	Feb	Restaurant	Hepatitis A	2	0	D	D	Prawns
	Mar	Home	Histamine poisoning	2	2	D	D	Sardines
	Mar	Take away	*S*. Typhimurium	12	0	M	D	Chicken
	Mar	Restaurant	Unknown	3	0	D	D	Fried rice
	May	Restaurant	Norovirus	67	0	A	CCS	Apple strudel
	May	Restaurant	Unknown	24	0	D	D	Suspected salad
	May	Restaurant	*S*. Typhimurium	61	5	M	C	Pigeon meat
	Jul	Home	Unknown	1	0	D	N	Soccerball ham
	Aug	Take away	*S*. Typhimurium	20	0	M	N	Pigs ear salad, ducks gizzards
	Aug	Restaurant	*S*. Typhimurium	20	3	D	CCS	Tofu dish
	Aug	Restaurant	Unknown	4	0	D	D	Unknown
	Sep	Community	*S*. Typhimurium	20	2	D	D	Suspected chicken/eggs
	Sep	Restaurant	Unknown	4	0	D	D	Unknown
	Sep	Institution	S. Typhimurium	20	1	D	N	Unknown
	Oct	Caterer	Unknown	23	2	D	D	Unknown

State	Month of outbreak	Setting Category	Agent category	Number affected	Hospitalised	Evidence *	Epidemiolgical study†	Responsible vehicles
New South Wales *continued*	Oct	Caterer	Unknown	19	0	D	N	Unknown
	Oct	Caterer	Unknown	78	1	D	CCS	Unknown
	Oct	Restaurant	Unknown	6	0	D	N	Unknown
	Nov	School	*S.* Typhimurium	19	0	AM	CCS	Cordial like drink
	Nov	Hospital	Unknown	3	3	D	N	Chicken Schnitzel
	Nov	Restaurant	*S.* Typhimurium	33	4	AM	CCS	Fried rice
	Dec	Home	Unknown	13	2	D	D	Unknown
	Dec	Restaurant	Unknown	25	0	D	CCS	Unknown
Northern Territory	Feb	Take away	*S.* Typhimurium	7	nil	D	D	Suspected roast turkey
	Feb	Caterer	Unknown	11	nil	D	C	Unknown
	Aug	Home	Unknown	18	0	D	C	Pizza
	Aug	Camp/Excursion	*S. aureus*	5	4	D	D	Rice, beef and black been sauce
	Oct	Caterer	Norovirus	11	0	D	C	Curried egg sandwich
	Nov	Caterer	Unknown	10	0	D	C	Suspected quail
	Dec	Restaurant	Norovirus	48	0	AM	C	Japanese IQF oysters
Queensland	Jan	Home	Ciguatera	2	0	D	D	Coral Trout
	Jan	Restaurant	Histamine poisoning	3	0	M	D	Dolphin Fish
	Jan	Home	Ciguatera	3	0	D	D	Mackerel Steaks
	Jan	Aged care facility	S. Other	2	0	D	D	Unknown
	Jan	Restaurant	S. Typhimurium	5	0	D	D	Unknown
	Jan	Restaurant	Unknown	6	0	D	D	Unknown
	Feb	Aged care facility	S. Other	2	1	D	D	Unknown
	Feb	Restaurant	Unknown	7	0	D	D	Beef Burgundy
	Feb	Caterer	S. aureus	16	0	M	D	Pasta Salad
	Feb	Home	Ciguatera	7	0	D	D	Coral Trout

State	Month of outbreak	Setting Category	Agent category	Number affected	Hospitalised	Evidence *	Epidemiolgical study†	Responsible vehicles
Queensland *continued*	Mar	Home	Histamine poisoning	2	0	D	D	Tuna Patties
	Mar	Home	Ciguatera	3	0	D	D	Fish (Mooloolaba Bay)
	May	Restaurant	*S*. Other	21	2	D	CCS	Roast Pork
	May	Home	*C. perfringens*	19	0	AM	C	Curried Prawns Dish
	May	Childcare	Sorbic acid	23	0	M	N	Cheese
	May	Home	Ciguatera	2	0	D	D	Cod Fish Heads
	May	Home	Ciguatera	3	0	D	D	Giant Trevally Fish
	Jul	Restaurant	Norovirus	31	0	A	C	Trifle
	Aug	Home	Ciguatera	5	5	D	N	Barracuda (Sphyraena spp.)
	Sep	Camp/Excursion	Norovirus	11	0	D	D	Unknown
	Sep	Home	*S*. Typhimurium	7	0	D	D	Unknown
	Sep	Caterer	Norovirus	13	0	D	C	Unknown
	Oct	Restaurant	Ciguatera	15	0	D	D	Spanish mackerel
	Oct	Restaurant	Unknown	5	0	D	D	Unknown
	Nov	Home	Ciguatera	3	0	D	D	Fish head soup - Red Emperor
	Dec	Restaurant	Escolar	20	0	D	D	Escolar Fish
	Dec	Home	Ciguatera	4	0	D	D	Fish species unknown
	Dec	Aged care facility	*S*. Typhimurium	47	16	D	D	Suspect raw egg
	Dec	Restaurant	S. Typhimurium	18	3	D	CCS	Suspect sauces based on raw eggs
	Dec	Home	S. Typhimurium	6	1	D	D	Unknown
South Australia	Aug	Community	S. Typhimurium	6	1	A	CCS	Cold set Cheesecake
Tasmania	Jun	Camp/Excursion	Hepatitis A	22	2	A	C	Coleslaw
Victoria	Jan	Bakery	S. Typhimurium	213	22	M	D	Pork Rolls
	Feb	Restaurant	Escolar	3	0	D	D	Escolar Fish
	Feb	Camp/Excursion	Unknown	10	0	D	D	Unknown

State	Month of outbreak	Setting Category	Agent category	Number affected	Hospitalised	Evidence *	Epidemiolgical study†	Responsible vehicles
Victoria *continued*	Feb	Home	*S*. Typhimurium	4	1	D	C	Unknown
	Feb	Caterer	*S*. Typhimurium	20	0	AM	C	Roast Pork
	Feb	Caterer	*S*. Typhimurium	12	0	AM	C	Roast Pork
	Apr	Aged care facility	Unknown	14	0	D	D	Unknown
	Jun	Aged care facility	*C. perfringens*	12	0	D	D	Unknown
	Jul	Community	S. Other	6	0	D	D	Suspect cucumbers
	Jul	Aged care facility	Unknown	5	0	D	D	Unknown
	Jul	Caterer	Unknown	7	0	D	C	Unknown
	Aug	Community	*S*. Other	3	0	D	D	Tahini
	Sep	Aged care facility	*C. perfringens*	28	0	D	D	Unknown
	Sep	Aged care facility	*C. perfringens*	15	0	D	D	Unknown
	Sep	Restaurant	Unknown	14	0	D	D	Unknown
	Oct	Take away	Unknown	28	0	A	C	Vegetables and Chilli dish
	Nov	Camp/Excursion	*Campylobacter*	13	0	D	C	Unpasteurised milk/animal contact
	Dec	Restaurant	Norovirus	18	0	D	C	Unknown
	Dec	Restaurant	*S*. Typhimurium	52	4	A	C	Raw egg dishes
	Dec	Restaurant	Histamine poisoning	22	0	AM	C	Escolar Fish
Western Australia	Jan	Home	*S*. Typhimurium	8	1	D	D	Unknown
	Feb	Caterer	Unknown	17	0	A	C	Japanese IQF oysters
	Mar	Institution	*S*. Typhimurium	29	6	M	C	Mixed foods
	Jun	Caterer	Unknown	10	0	D	C	Sandwiches
	Sep	Aged care facility	C. perfringens	42	DK	A	C	Suspected gravy
	Nov	Caterer	Unknown	17	0	D	C	Club sandwiches
	Nov	Restaurant	Norovirus	35	0	A	C	Japanese IQF oysters
	Dec	Restaurant	Norovirus	24	0	D	C	Unknown

* 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.