Reported foodborne illness and gastroenteritis in Australia: Annual report of the OzFoodNet network, 2004

The OzFoodNet Working Group

Abstract

In 2004, OzFoodNet sites recorded 24,313 notifications of eight potentially foodborne diseases, along with 118 outbreaks of foodborne disease. Overall, reports of both notifications and outbreaks were higher than previous years. The most common sporadic diseases were campylobacteriosis (15,640 cases) and salmonellosis (7,842 cases). Reports of sporadic cases of Shiga toxin-producing *Escherichia coli* were rare with only 46 cases, but there were two small clusters due to serotypes O157/O111 and O86. The 118 foodborne disease outbreaks affected 2,076 persons, of whom 5.6 per cent (116/2,076) were hospitalised and two people died. Foods prepared in restaurants and catering settings caused the most outbreaks and the most common agent was *Salmonella* Typhimurium. Outbreak investigations during 2004 implicated chicken, foods containing eggs, imported oysters and food handlers infected with norovirus. In addition to foodborne outbreaks, OzFoodNet sites reported 874 outbreaks that were spread from person-to-person affecting 25,363 people. Sites conducted 54 investigations into clusters of *Salmonella* and other pathogens where a source could not be identified. Surveillance of foodborne diseases continued to improve during 2004, with all jurisdictions contributing to national cluster reports and using analytical studies to investigate outbreaks. Ninety-eight per cent of *Salmonella* notifications on state and territory surveillance databases recorded complete information about serotype and phage type. Foodborne disease may cost Australia as much as $1.2 billion annually making it vital to intervene to prevent disease. *Commun Dis Intell* 2005;29:164–190.

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

Introduction

Foodborne disease is a major cause of morbidity and an occasional cause of mortality throughout the world.[1,2] Each year there are approximately 5.4 million cases (95% Credible Interval 4–6.9 million cases) of foodborne gastroenteritis in Australia, resulting in 80 deaths annually.[3] Approximately 32 per cent (95% Credible Interval 28%–38%) of all gastroenteritis in Australia is estimated to be foodborne.

Many countries conduct surveillance of potentially foodborne diseases to protect consumers and maintain a safe food supply.[4,5] The major aim of surveillance of diseases that arise from contaminated food is to detect outbreaks. Investigation of foodborne outbreaks have many clear public health benefits, as early intervention can remove contaminated product from the marketplace and contribute to policies to prevent further disease.[6] The public health benefits of surveillance and early outbreak detection have clear economic benefits.[7]

In addition, countries are increasingly using data from surveillance systems to support and monitor interventions in the food supply chain. One example is the use of the United States of America Centers for Disease Control and Prevention's FoodNet data to establish whether national disease targets set under the 'Healthy People 2010' initiative have been met (www.healthypeople.gov). FoodNet has been able to track the incidence of laboratory-diagnosed

The OzFoodNet Working Group is (in alphabetical order): Rosie Ashbolt (Tas), Jenny Barralet (Qld), Robert Bell (Qld), Andrew Black (ACT), Barry Combs (SA), Christine Carson (WA), Craig Dalton (Hunter PHU), Karen Dempsey (NT), Gerard Fitzsimmons (DoHA), Joy Gregory (Vic), Gillian Hall (NCEPH), Bridget Hardy (DAFF), Michelle Harlock (NT), Geoff Hogg (MDU), Melissa Irwin (NSW), Geetha Isaac-Toua (ACT), Martyn Kirk (DoHA), Karin Lalor (Vic), Deon Mahoney (FSANZ), Tony Merritt (Hunter PHU), Rosanne Muller (NT), Sally Munnoch (Hunter), Jennie Musto (NSW), Lillian Mwanri (SA), Chris Oxenford (DoHA, NCEPH), Rhonda Owen (DoHA), Jane Raupach (SA), Mohinder Sarna (WA), Cameron Sault (Tas), Russell Stafford (Qld), Barbara Telfer (NSW), Marshall Tuck (NSW), Leanne Unicomb (Hunter PHU), Hassan Vally (WA), 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

cases of foodborne disease that are not notifiable to State health departments.[8] Recent results from FoodNet indicate sustained declines in the incidence of several diseases, including salmonellosis and campylobacteriosis.[9] This is supported by findings in the United States of America meat industry that have recorded declining isolation of *Salmonella* and *Campylobacter* in meat processing plants.[10]

In 2000, the Australian Government Department of Health and Ageing (DoHA) established the OzFoodNet network to enhance surveillance for foodborne disease.[11] This built upon an 18-month trial of active surveillance in the Newcastle region of New South Wales that was modelled on the FoodNet surveillance system. The OzFoodNet network consists of epidemiologists specifically employed by each state and territory health department to conduct 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, which is Australia's peak body for communicable disease control.[12] The Australian Government Department of Health and Ageing funds OzFoodNet and convenes a committee to manage the Network, and a committee to review the scientific basis for various research projects.

This is the fourth annual report of OzFoodNet and covers data and activities for 2004.

Methods

Population under surveillance

In 2004, the coverage of OzFoodNet included all states and territories. The entire Australian population was estimated to be 20,111,297 persons in June 2004.[13] In addition, the Hunter Area Health Service had a separate OzFoodNet Site complementing 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 June 2004, the population covered by the Hunter site was estimated to be 549,846 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 by agreement. OzFoodNet aggregated and analysed data on patients notified with the following diseases or conditions, a proportion of which may be acquired from food:

- *Campylobacter* infections;
- *Salmonella* infections, including *Salmonella* Paratyphi A, B and C;
- *Listeria* infections;
- *Yersinia* infections;
- Shiga toxin-producing *Escherichia coli* infections and haemolytic uraemic syndrome;
- typhoid; and
- *Shigella* infections.

To compare disease to historical totals, OzFoodNet compared crude numbers and rates of notification to the mean of the previous six years. Where relevant, 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 jurisdiction for June 2004, or the specified year, were used.[13] Age specific rates for notified infections in each jurisdiction were calculated.

The date that notifications were received was used throughout this report to analyse notification data. These data are similar to those reported to the National Notifiable Diseases Surveillance System, but individual totals may vary with time and due to different approaches to analysis.

Gastrointestinal and foodborne disease outbreaks

OzFoodNet collected information on outbreaks of gastrointestinal disease, including foodborne illness, that occurred in Australia during 2004. An outbreak of foodborne disease was defined as an increase in the number of reports of a particular infection or illness associated with a common food or meal. The reports collate summary information about the setting where the outbreak occurred, where food was prepared, the month the outbreak occurred, the aetiological agent, the number of persons affected, the type of investigation conducted, the level of evidence obtained and the food vehicle responsible. To summarise the data, OzFoodNet categorised the outbreaks by aetiological agents, food vehicles and settings where the outbreak occurred. Data on outbreaks transmitted from infected persons, water, animals and cluster investigations were also summarised. The number of outbreaks and documented causes may vary from summaries published by different jurisdictions.

Risk factors for infection

To identify risk factors for foodborne infection in Australia, OzFoodNet reviewed summary data from outbreaks that occurred in 2004 and compared them to previous years. Data from several complementary OzFoodNet studies of foodborne illness in Australia were also examined.

Surveillance evaluation and enhancement

To identify areas where improvements to surveillance are critical, OzFoodNet compared the results of surveillance across different sites, including rates of reporting outbreaks, and investigation of clusters of *Salmonella*. To measure how well jurisdictions conducted surveillance for *Salmonella,* OzFoodNet examined the completeness of information contained on state and territory databases in 2004. The proportion of notifications with serotype and phage type information was compared with results for the previous three years.

Results

Rates of notified infections

In 2004, OzFoodNet sites reported 24,313 notifications of eight potentially foodborne diseases. This was a 9.0 per cent increase from the mean of 22,289 notifications for the previous six years. Reports for these eight diseases make up almost a quarter of notifications to the National Notifiable Diseases Surveillance System.[14] A summary of the number and rates of notifications by OzFoodNet sites is shown in Appendix 1.

Salmonella infections

In 2004, OzFoodNet sites reported 7,842 cases of *Salmonella* infection, which equated to a rate of 39.0 cases per 100,000 population. This rate of notifications represented an increase of 4.9 per cent over the mean rate for the previous six years (Figure 1). The rate of *Salmonella* notification in OzFoodNet sites ranged from 22.9 and 23.2 cases per 100,000 population in the Hunter and Victoria, respectively, to 195.1 cases per 100,000 population in the Northern Territory (Figure 2).

The notification rates of salmonellosis remained relatively constant over the last seven years. Overall, notification rates of salmonellosis for 2004 were increased in New South Wales (20.3%), the Australian Capital Territory (18.0%) and Queensland (9.9%) compared to historical means. Western Australia (-21.5%), Tasmania (-17.2%) and South Australia (-11.2%) recorded declines in the notification rate of *Salmonella*, with other jurisdictions recording similar rates to previous years (Figure 2).

OzFoodNet sites reported that the ratio of males to females was approximately 1:1.1. The highest age-specific rate of *Salmonella* infection was 221 cases per 100,000 population in males aged 0–4 years and 204 in females aged 0–4 years. Notification rates were also elevated in the 5–9 year age group with a secondary peak in the 20–29 year age range for males and females.

Rates of salmonellosis were highest in northern areas of Australia. The highest rate in Australia is consistently reported in the Kimberley region of Western Australia.[14] In the Northern Territory, the rate of *Salmonella* notifications was 283 per 100,000 population in Indigenous people compared to 137 per 100,000 population in non-Indigenous people.

During 2004, there were 629 notifications of *Salmonella* Typhimurium 170/108 and 585 notifications of *S.* Typhimurium 135 (including 135a) to OzFoodNet sites making these the most common *Salmonella* infections (Table 1). *S.* Typhimurium 170

Figure 1. Notifications and annual rates of *Salmonella* infections, Australia, 1998 to 2004

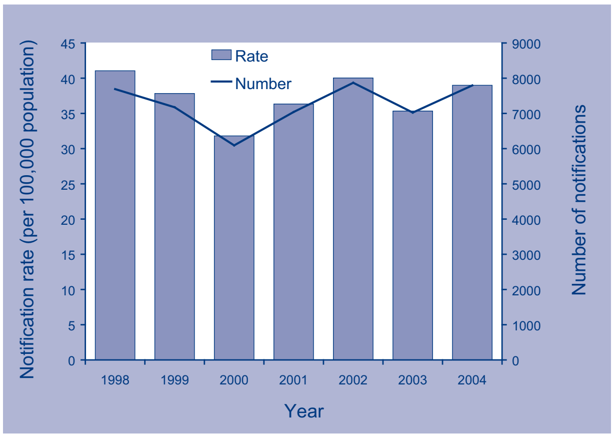
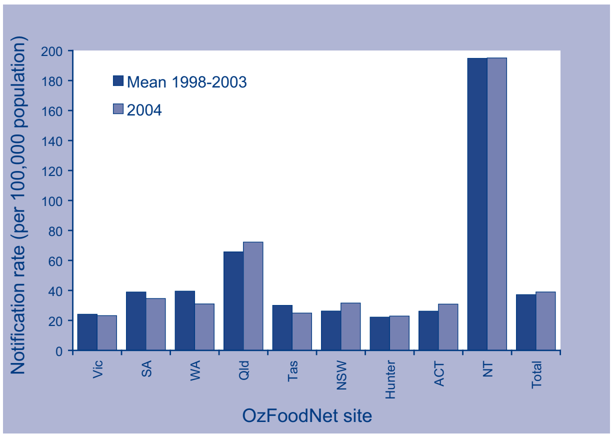


Figure 2. Notification rates of *Salmonella* infections for 2004 compared to mean rates for 1998 to 2003, by OzFoodNet site



and *S.* Typhimurium 108 are the same phage type and continued to emerge as a significant phage type around Australia, accounting for 10 outbreaks of foodborne disease during 2004. *S.* Typhimurium 197 emerged as a cause of significant disease, particularly in Queensland, where 56 per cent (141/251) of notifications of this phage type were reported. There were 383 cases of *S.* Saintpaul, making it the most common *Salmonella* serovar following *S.* Typhimurium.

Certain *Salmonella* serovars traditionally occupy localised niches in specific geographical areas in Australia. During 2004, *Salmonella* Birkenhead infections were the fourth most common serovar in New South Wales and the fifth most common in Queensland. The total number of cases in these two States (244 cases) was 38 per cent higher in 2004 compared to 2003. This elevated notification rate reflects an endemic focus of *S.* Birkenhead in northern New South Wales and south-eastern Queensland. In Tasmania, 53 per cent of reported cases of salmonellosis were *S.* Mississippi infections, equating to a rate of 13.2 cases per 100,000 population. The highest serovar specific rate in Australia was *S.* Ball in the Northern Territory, with a rate of 25.2 cases per 100,000 population. Reported rates of *S.* Saintpaul in the Northern Territory were 23.2 cases per 100,000 population.

Salmonella *Enteritidis*

S. Enteritidis is a serotype that can infect the internal contents of eggs via the oviducts of infected chickens, predominantly with one strain: *S.* Enteritidis phage type 4. People may become infected with this serotype after eating undercooked eggs. This phage type has caused major problems in the Northern Hemisphere where it has become established in commercial egg laying flocks. Australia is largely free of *S.* Enteritidis phage type 4 except in people infected overseas. OzFoodNet is currently investigating other phage types of *S.* Enteritidis that are acquired locally in Australia to determine risk factors for infection.

Table 1. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2003 to 2004, by OzFoodNet site*

OzFoodNet site	*Salmonella* type (sero/phage type)	2004			2003		
		n	Rate†	Proportion (%)‡	n	Rate	Ratio§
Australian Capital Territory	Typhimurium 170	31	9.6	31.3	4	1.2	7.8
	Typhimurium 197	7	2.2	7.1	0	0.0	-
	Infantis	6	1.9	6.1	3	0.9	2.0
	Typhimurium 9	6	1.9	6.1	4	1.2	1.5
	Typhimurium 135	5	1.5	5.1	25	7.7	0.2
	Typhimurium 12	4	1.2	4.0	0	0.0	-
	Virchow 8	4	1.2	4.0	0	0.0	-
	Agona	3	0.9	3.0	0	0.0	-
	Chester	2	0.6	2.0	1	0.3	2.0
	Mbandaka	2	0.6	2.0	1	0.3	2.0
	Newport	2	0.6	2.0	0	0.0	-
	Stanley	2	0.6	2.0	0	0.0	-
	Subsp I ser 16:1,v:-	2	0.6	2.0	1	0.3	2.0
	Typhimurium 104L	2	0.6	2.0	2	0.6	1.0
	Typhimurium 12a	2	0.6	2.0	0	0.0	-
	Typhimurium U290	2	0.6	2.0	4	1.2	0.5
Hunter	Typhimurium 170	16	2.9	12.7	10	1.8	1.6
	Typhimurium 135	10	1.8	7.9	1	0.2	10.0
	Typhimurium 12	10	1.8	7.9	0	0.0	-
	Typhimurium 4	8	1.5	6.3	9	1.6	0.9
	Typhimurium 9	5	0.9	4.0	7	1.3	0.7
	Typhimurium U290	5	0.9	4.0	8	1.5	0.6
	Chester	5	0.9	4.0	3	0.5	1.7
	Potsdam	4	0.7	3.2	1	0.2	4.0
	Saintpaul	4	0.7	3.2	2	0.4	2.0
	Birkenhead	4	0.7	3.2	3	0.5	1.3

Table 1. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2003 to 2004, by OzFoodNet site,* *continued*

OzFoodNet site	*Salmonella* type (sero/phage type)	2004			2003		
		n	Rate†	Proportion (%)‡	n	Rate	Ratio§
New South Wales	Typhimurium 170	333	4.9	15.7	232	3.5	1.4
	Typhimurium 12	170	2.5	8.0	38	0.6	4.5
	Typhimurium 135	140	2.1	6.6	135	2.0	1.0
	Typhimurium 9	108	1.6	5.1	131	2.0	0.8
	Birkenhead	77	1.1	3.6	68	1.0	1.1
	Typhimurium 4	66	1.0	3.1	34	0.5	1.9
	Infantis	53	0.8	2.5	86	1.3	0.6
	Typhimurium u290	46	0.7	2.2	30	0.4	1.5
	Typhimurium 197	43	0.6	2.0	66	1.0	0.7
	Virchow 8	40	0.6	1.9	27	0.4	1.5
Northern Territory	Ball	50	25.0	13.1	44	22.2	1.1
	Saintpaul	47	23.5	12.3	28	14.1	1.7
	Litchfield	15	7.5	3.9	9	4.5	1.7
	Muenchen	14	7.0	3.7	14	7.1	1.0
	Havana	13	6.5	3.4	11	5.5	1.2
	Anatum	12	6.0	3.1	22	11.1	0.5
	Chester	12	6.0	3.1	16	8.1	0.8
	Senftenberg	8	4.0	2.1	7	3.5	1.1
	Wandsworth	8	4.0	2.1	3	1.5	2.7
	Weltevreden	8	4.0	2.1	10	5.0	0.8
Queensland	Virchow 8	241	6.2	8.6	165	4.3	1.5
	Saintpaul	223	5.7	8.0	167	4.4	1.3
	Typhimurium 135	176	4.5	6.3	155	4.1	1.1
	Birkenhead+	163	4.2	5.8	109	2.9	1.5
	Typhimurium 197	141	3.6	5.0	90	2.4	1.6
	Aberdeen	114	2.9	4.1	75	2.0	1.5
	Hvittingfoss	110	2.8	3.9	72	1.9	1.5
	Waycross	94	2.4	3.4	50	1.3	1.9
	Chester	84	2.2	3.0	98	2.6	0.9
	Typhimurium 12a	53	1.4	1.9	1	0.0	53.0
South Australia	Typhimurium 108	70	4.6	13.4	32	2.1	2.2
	Typhimurium 9	46	3.0	8.8	28	1.8	1.6
	Typhimurium 135a	25	1.6	4.8	18	1.2	1.4
	Chester	21	1.4	4.0	24	1.6	0.9
	Typhimurium RDNC	20	1.3	3.8	12	0.8	1.7
	Typhimurium 135	19	1.2	3.6	17	1.1	1.1
	Infantis	17	1.1	3.2	20	1.3	0.9
	Singapore	17	1.1	3.2	9	0.6	1.9
	Typhimurium 8	17	1.1	3.2	2	0.1	8.5
	Typhimurium 126 var	17	1.1	3.2	0	0.0	-

Table 1. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2003 to 2004, by OzFoodNet site,* *continued*

OzFoodNet site	*Salmonella* type (sero/phage type)	2004			2003		
		n	Rate†	Proportion (%)‡	n	Rate	Ratio§
Tasmania	Mississippi	63	13.1	52.5	70	14.7	0.9
	Typhimurium 9	4	0.8	3.3	7	1.5	0.6
	Typhimurium 12a	4	0.8	3.3	3	0.6	1.3
	Typhimurium 170	3	0.6	2.5	5	1.0	0.6
	Enteritidis 4b	2	0.4	1.7	0	0.0	-
	Enteritidis 6a	2	0.4	1.7	1	0.2	2.0
	Newport	2	0.4	1.7	2	0.4	1.0
	Paratyphi B bv Java Dundee	2	0.4	1.7	1	0.2	2.0
	Potsdam	2	0.4	1.7	0	0.0	-
	Saintpaul	2	0.4	1.7	5	1.0	0.4
	Typhimurium 135	2	0.4	1.7	6	1.3	0.3
	Typhimurium 141	2	0.4	1.7	0	0.0	-
	Typhimurium RDNC	2	0.4	1.7	0	0.0	-
	Virchow 6	2	0.4	1.7	0	0.0	-
Victoria	Typhimurium 9	145	2.9	12.8	159	3.2	0.9
	Typhimurium 170	137	2.8	12.1	125	2.5	1.1
	Typhimurium 135	88	1.8	7.8	233	4.7	0.4
	Typhimurium 197	59	1.2	5.2	21	0.4	2.8
	Infantis	43	0.9	3.8	54	1.1	0.8
	Typhimurium u290	36	0.7	3.2	88	1.8	0.4
	Typhimurium 126	28	0.6	2.5	18	0.4	1.6
	Virchow 8	26	0.5	2.3	9	0.2	2.9
	Typhimurium 12	23	0.5	2.0	19	0.4	1.2
	Stanley	21	0.4	1.9	19	0.4	1.1
	Typhimurium RDNC	21	0.4	1.9	11	0.2	1.9
Western Australia	Saintpaul	46	2.3	7.5	29	1.5	1.6
	Typhimurium 135a	45	2.3	7.3	42	2.2	1.1
	Typhimurium 135	29	1.5	4.7	30	1.5	1.0
	Chester	24	1.2	3.9	36	1.8	0.7
	Muenchen	23	1.2	3.7	28	1.4	0.8
	Enteritidis 6a	21	1.1	3.4	8	0.4	2.6
	Stanley	14	0.7	2.3	7	0.4	2.0
	Havana	13	0.7	2.1	10	0.5	1.3
	Senftenberg	13	0.7	2.1	15	0.8	0.9
	Typhimurium 9	13	0.7	2.1	20	1.0	0.7

* 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 2004.

§ Ratio of the number of reported cases in 2004 compared to the number reported in 2003.

RDNC = 'Reactive but Does Not Conform' and represents phage type patterns that are not yet assigned.

During 2004, OzFoodNet sites reported 422 cases of *Salmonella* Enteritidis, which was higher than for 2003. The majority of cases were related to travel overseas (69%) or were of unknown travel history (18%) (Table 2). Relevant travel histories are difficult to obtain, as people have often travelled to several countries before visiting Australia. Asian countries were commonly mentioned, which reflects the frequency of Asia as a travel destination for Australians (Table 3). In the Asian region, cases of *S.* Enteritidis infection most commonly reported travelling to Bali (38%). Fifteen per cent of people acquiring their infection overseas reported travelling to Europe.

Table 2. Numbers of *Salmonella* Enteritidis infections acquired overseas and in Australia in 2004, by OzFoodNet site

OzFoodNet site	Overseas travel			Total
	Yes	No	Unknown	
Australian Capital Territory	2	0	0	2
New South Wales	43	4	50	97
Northern Territory	1	2	2	5
Queensland	51	40	21	112
South Australia	27	5	0	32
Tasmania	8	1	0	9
Victoria	84	2	0	86
Western Australia	77	0	2	79
Total	293	54	75	422

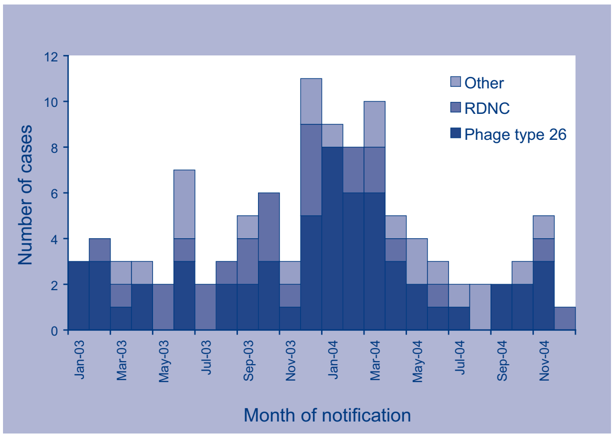
The most common phage types depended on the region that the person travelled to. For people travelling to Bali and Indonesia, the most common phage types were 6a, 5a, 4, and 4b. In Malaysia and Singapore the most common infecting phage types were 1 and 6a, with no phage type 4 reported. Thailand travellers were infected with the same phage types as Malaysian travellers, along with phage type 4. For travellers returning from Europe, phage types 1, 4, 5a and 6 were most common.

Overall, 13 per cent (54/422) of patients infected with *S.* Enteritidis acquired their infection in Australia (Figure 3). The median age of cases was 31 years (range 0–85 years) and the male to female ratio was 1.2:1. Thirty-six per cent (40/112) of *S.* Enteritidis infections in Queensland were locally acquired compared to Victoria where only two per cent (2/86) of infections were locally acquired. The majority of locally acquired infections in Queensland were due to phage type 26. There was a temporal clustering of cases of *S.* Enteritidis in December 2003—March 2004, although no common sources were identified. There were no locally acquired cases of *S.* Enteritidis in the Australian Capital Territory or Western Australia.

Salmonella *clustering*

In total, health departments conducted 81 investigations into clusters and point source outbreaks of salmonellosis during 2004. A source of infection was identified for 44 per cent (36/81) of these investigations.

Figure 3. Locally-acquired *Salmonella* Enteritidis infections, 2003 to 2004, by major phage type and month of notification



RDNC = 'Reactive but Does Not Conform' and represents phage type patterns that are not yet assigned.

Table 3. Numbers of *Salmonella* Enteritidis infections acquired overseas, 2004, by region of travel

Region of travel	Number of cases	Percentage
Africa	5	1.7
America	1	0.3
America/Europe	1	0.3
Asia/Americas	1	0.3
Asia/Europe	15	5.1
Asia-other	6	2.1
Bali	112	38.2
China	9	3.1
Europe	29	9.9
Hong Kong	9	3.1
Indian subcontinent	8	2.7
Indonesia	16	5.5
Malaysia	19	6.5
Middle East	8	2.7
Mixed Asia	9	3.1
Pacific	4	1.4
Phillipines	8	2.7
Singapore	16	5.5
Solomons	1	0.3
Thailand	13	4.4
Unknown	3	1.0
Total	293	100

Campylobacter *infections*

Campylobacteriosis is not notifiable in New South Wales, including the Hunter Health Area, and data for 2004 were unavailable. With this exception, in 2004 OzFoodNet sites reported 15,640 cases of *Campylobacter* infection, which equated to a rate of 117 cases per 100,000 population.

This rate represented a 4.6 per cent increase over the mean rate for the previous six years and represents a sustained increase in notifications (Figure 4). Notifications peaked in November with 1,666 reports, which was the highest for a single month in the previous six years. Victoria and Tasmania reported marked increases in the number of cases of 29 per cent and 17 per cent respectively, while South Australia (-18%) and the Northern Territory (-6%) reported decreases (Figure 5). All other jurisdictions reported minimal change from historical totals.

Figure 4. Notifications and annual rates of *Campylobacter* infections, Australia excluding New South Wales, 1998 to 2004

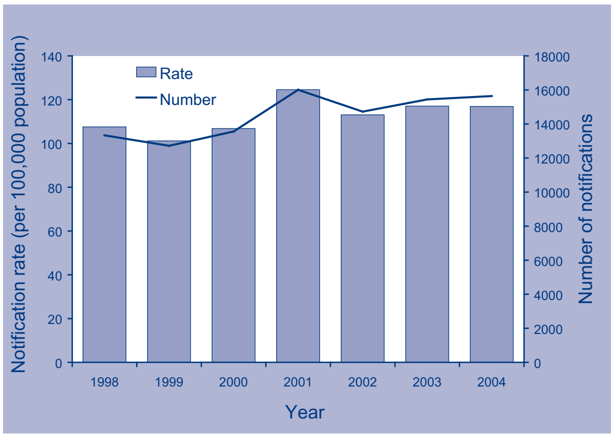
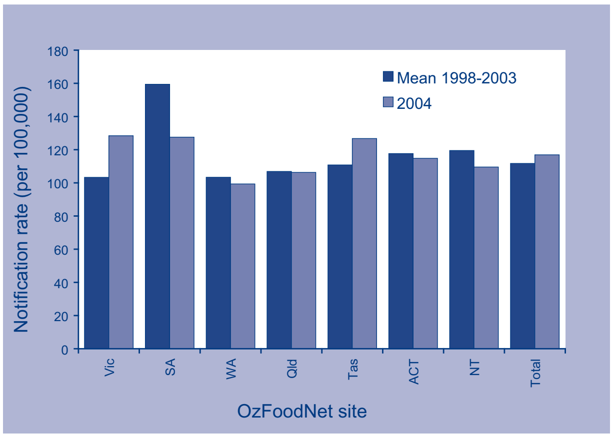


Figure 5. Notification rates of *Campylobacter* infections for 2004 compared to mean rates for 1998–2003, Australia excluding New South Wales, by OzFoodNet site



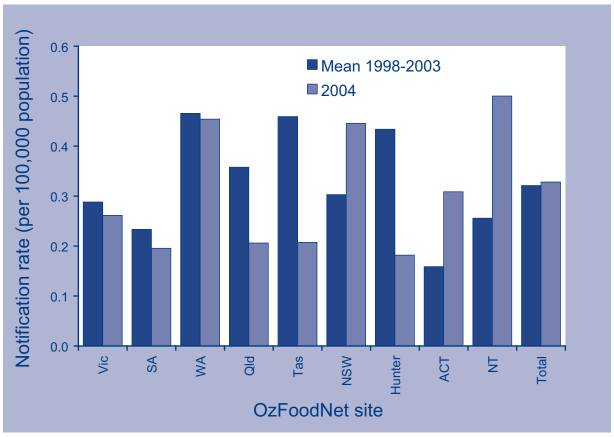
The overall ratio of infections in males and females was 1.2:1. The highest age specific rates were in children in the 0–4 year age group, with male and female children in this age group having rates of 261 and 188 per 100,000 population respectively. In the Northern Territory, the rate of campylobacteriosis in Indigenous peoples was 186 per 100,000 population compared to only 69 per 100,000 population in non-Indigenous persons.

During 2004, there were nine investigations of *Campylobacter* outbreaks affecting a total of 104 people. This was considerably higher than for 2003, where only one outbreak was investigated.

Listeria *infections*

OzFoodNet sites reported 66 cases of listeriosis in 2004, which represented a notification rate of 0.3 cases per 100,000 population (Figure 6). This was an increase of 6.5 per cent in the number of notifications compared to the historical mean. Western Australia and the Northern Territory both recorded 0.5 cases per 100,000 population. New South Wales recorded the greatest increase in notifications against historical averages with 30 notifications in 2004, which was 53 per cent higher than the six year mean. There was one small cluster of two cases in South Australia during 2004, although no source of infection was identified.

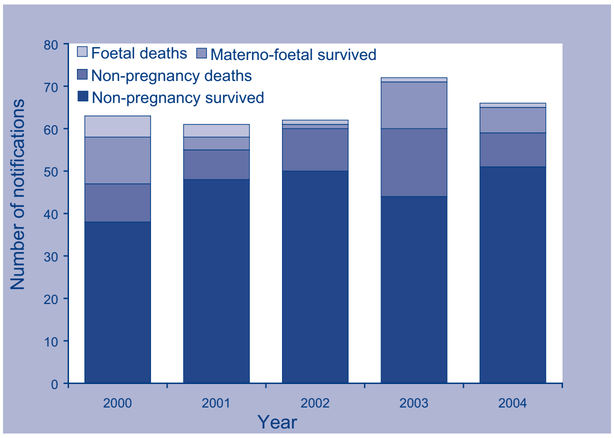
Figure 6. Notification rates of *Listeria* infections for 2004 compared to mean rates for 1998–2003, Australia, by OzFoodNet site



Eighty-nine per cent (59/66) of infections during 2004 were reported in persons who were either elderly and/or immunocompromised. Among cases of non-materno-foetal infections more males than females were notified, with the male to female ratio being 5.1:1. Sixty-one per cent (36/59) of cases were aged 65 years or greater. The highest age specific rate of 5.3 cases per 100,000 population was in males over the age of 65 years. Fourteen per cent (8/59) of non-pregnancy associated cases died.

There were seven materno-foetal infections with one foetal death recorded. This equates to a rate of 2.7 cases of *Listeria* infections per 100,000 births.[15] A substantial decline in the number of materno-foetal infections occurred between 2000 and 2002, but numbers of infections rose again in 2003 and 2004 (Figure 7).

Figure 7. Notifications of *Listeria* showing non-pregnancy related infections and deaths and materno-foetal infections and deaths, Australia, 2000 to 2004

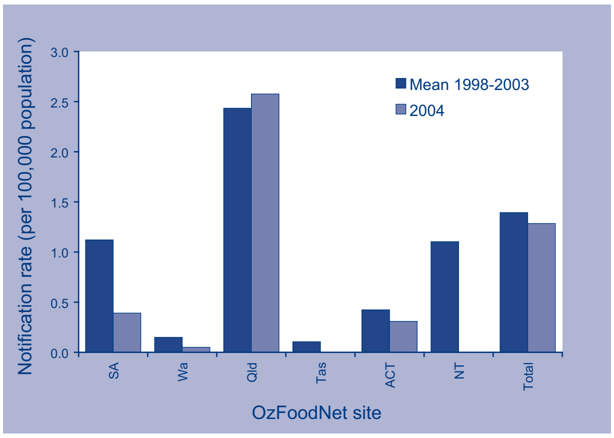


Yersinia *infections*

The Communicable Diseases Network Australia agreed to stop reporting notifications of *Yersinia* infections to the National Notifiable Diseases Surveillance System, as of January 2001. The main reason for this was the apparent decline in incidence and lack of identified outbreaks. In May 2001, the Victorian Government revised regulations governing reporting of infectious diseases, at which time they removed yersiniosis from the list of reportable conditions. *Yersinia* is also not notifiable in New South Wales. No other Australian jurisdictions have amended their legislation to remove yersiniosis from lists of reportable conditions.

In 2004, OzFoodNet sites reported 108 cases of yersiniosis, which equated to a rate of 1.3 notifications per 100,000 population (Figure 8). The overall rate declined 6.4 per cent from previous years, when adjusted for the absence of reporting from Victoria and New South Wales. Queensland reported 93 per cent (100/108) of all cases, which equated to a rate of 2.6 cases per 100,000 population. The rates of yersiniosis in Queensland decreased in the 1990s, but have steadily increased since 2002. In 2004 in Queensland, the median age of yersiniosis cases was 29 years (range <1–87 years) and notifications were similar in all three Queensland health zones. Biotype for *Yersinia enterocolitica* cases in Queensland was known for 96 cases, of which 48 per cent (46/96) were biotype 4 serotype O:3 and 25 per cent were biotype 1A serotype O:5. South Australia reported six cases of yersiniosis, while the Australian Capital Territory and Western Australia reported one case each.

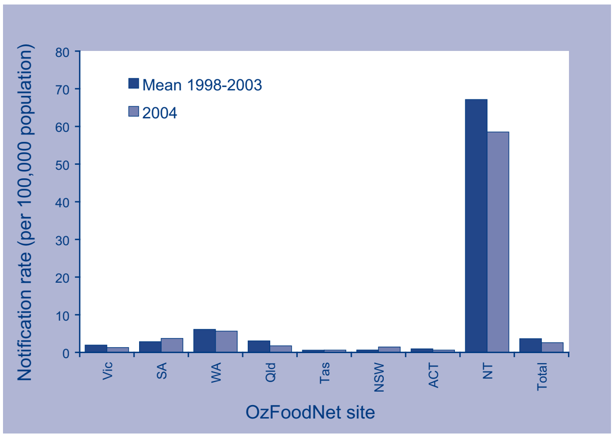
Figure 8. Notification rates of *Yersinia* infections for 2004 compared to mean rates for 1998–2003, Australia excluding Victoria and New South Wales, by OzFoodNet site



Shigella *infections*

OzFoodNet sites reported 520 cases of shigellosis during 2004, which equated to a notification rate of 2.6 cases per 100,000 population (Figure 9). This was a 29.1 per cent decrease in the notification rate compared with the six-year mean, after adjusting for the introduction of notifications from New South Wales in January 2001.

Figure 9. Notification rates of *Shigella* infections for 2004 compared to mean rates for 1998–2003, by OzFoodNet site



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

The highest rate of notification was in the Northern Territory (59 cases per 100,000 population), which was 20 times higher than the overall Australian rate. Within the Northern Territory, shigellosis was most commonly reported in the drier central regions and the rate in Alice Springs was 196 cases per 100,000 population. Eighty-one per cent (95/117) of notifications in the Northern Territory were in persons of Aboriginal or Torres Strait Island origin, which equated to a rate of 167 cases per 100,000 population. Only South Australia and Tasmania observed an increased rate compared to the six-year mean.

The male to female ratio of shigellosis cases was 0.8:1. The highest age specific rates were in males (11.6 cases per 100,000 population) and females (14.4 cases per 100,000 population) in the 0–4 year age group, with a secondary smaller peak in the 25–29 year age group for females. There were three reported outbreaks of shigellosis all of which were suspected to be spread from person-to-person. There were two outbreaks of *Shigella flexneri* 2a in the Northern Territory and one outbreak of *Shigella sonnei* biotype g in South Australia. In Australia, the majority of *Shigella* infections are thought to be due to person-to-person transmission, or are acquired overseas.

Typhoid

OzFoodNet sites reported 74 cases of typhoid infection during 2001, equating to an overall notification rate of 0.4 cases per 100,000 population (Figure 10). The number of notifications was similar to previous years. The highest rate was reported in New South Wales (0.6 cases per 100,000 population). Tasmania, the Northern Territory and the Hunter sites did not report any cases during 2004.

Where travel status was known, sites reported that 81 per cent (55/68) of cases of typhoid had recently travelled overseas (Table 4). Forty-seven per cent (26/55) of these cases had travelled to the Indian subcontinent and the predominant phage types of *S.* Typhi were E1a (11 cases) and E9 (4 cases). Thirteen cases had recently travelled to Indonesia and the predominant phage types were E2 and E9 with two cases each. Five of the cases infected with typhoid reported recent travel to Samoa and the predominant phage type was E1a (3 cases).

Figure 10. Notification rates of typhoid infections for 2002 compared to mean rates for 1998–2001, by OzFoodNet site

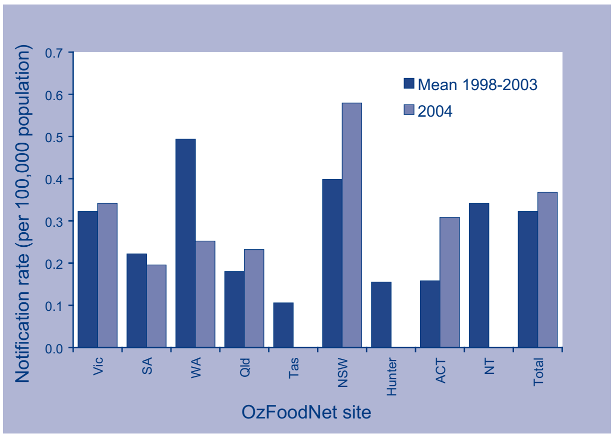


Table 4. Travel status and predominant phage types* for typhoid cases, Australia, 2004

Country	Number of cases	Predominant phage type (number of cases)
Albania	1	E9 (1)
Cambodia	4	E1a (2); E9 (1); Unknown (1)
China	1	O Variant (1)
El Salvador	1	A Degraded (1)
Indian Sub-continent	26	E1a (11); E9 (4); Degraded (3); O Variant (2); A degraded (1); Untypable (1); Unknown (4)
Indonesia	13	Untypable (3); E2 (2); E9 (2); E6 (1); D2 (1); Degraded (1); Unknown (3)
Jordan	1	Unknown (1)
Phillipines	2	Unknown (1); Degraded (1)
Samoa	5	E1a (3); E9 (1); E7 (1)
Sierra Leone	1	Unknown (1)
Locally acquired	13	E1a (5); E9 (2); Degraded (2); D2 (1); Untypable (1); Unknown (2)
Unknown	6	Unknown (5); Degraded (1)
Total	74	

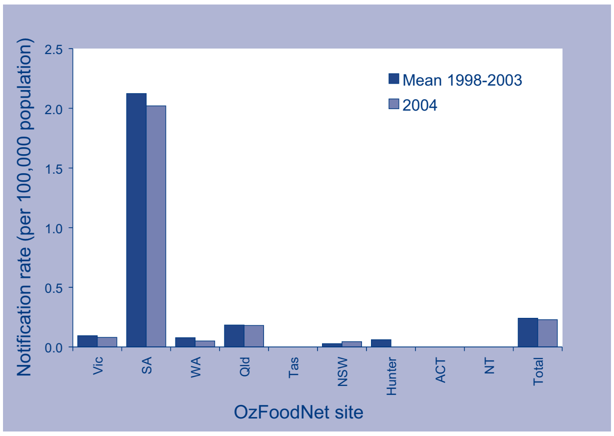
* Numbers in parentheses represent the number of cases infected by the phage type.

One of the locally acquired cases infected with phage type E1 reported that their brother had visited from Samoa. Eight of the locally-acquired cases were considered to be chronic carriers. There was one case of typhoid in a laboratory worker. Travel status was unknown for six cases.

Shiga toxin-producing Escherichia coli *infections*

OzFoodNet sites reported 46 cases of Shiga toxin-producing *E. coli* (STEC) infection during 2004 (Figure 11). This number does not include cases of haemolytic uraemic syndrome where a toxigenic *E. coli* was isolated. The notification rate of 0.2 cases per 100,000 population was a 0.5 per cent increase from the mean rate for the previous six years. South Australia (31 cases) reported the majority of cases, which represented a 3.1 per cent decrease over the historical mean for this State. The highest rate was in South Australia, which reported 2.0 notifications per 100,000 population (Table 5). The second highest number of cases was reported from Queensland, with 7 cases. There were no cases reported from Tasmania, the Hunter, the Australian Capital Territory or the Northern Territory during 2004.

Figure 11. Notification rates of Shiga toxin-producing *Esherichia coli* infections for 2004 compared to mean rates for 1998–2003, by OzFoodNet site



The male to female ratio of cases was 0.5:1 and the highest rates were in females aged between 5–9 years (0.8 cases per 100,000 population) and 20–24 years (0.7 cases per 100,000 population). The reason for the predominance of females amongst notified cases is unknown, but has been observed in previous years.

E. coli O157 was the most common serotype, accounting for 39 per cent of notifications. This serotype has been the most commonly reported for the last three years (Table 6). There were five cases of serotypes O111, four cases of serotype O26 and two cases of serotype O86. No serotype information was available for approximately one third of cases in South Australia due to the use of polymerase chain reaction (PCR) to diagnose infections.

Table 5. Infecting subtypes of Shiga toxin-producing *Escherichia coli,* Australia, 2004, by OzFoodNet site

State	Serotype						U/k	Total
	O111	O141	O157	O26	O5	O86		
NSW			1				2	3
Qld	1	1	1	1		2	1	7
SA	4		13*	2			12	31
Vic			2	1	1			4
WA			1					1
Total	5	1	18	4	1	2	14	46

* One case in South Australia was co-infected with *Escherichia coli* O113.

U/k Unknown.

Table 6. Infecting subtypes of Shiga toxin-producing *Escherichia coli*, Australia, 2002 to 2004

Organism type	2004	2003	2002
O111	5	8	0
O113	1*	0	2
O157	17	13	20
O26	4	0	6
O141	1	0	0
O5	1	1	0
O86	2	0	0
O128	0	0	1
O130	0	1	0
O28	0	1	1
O2	0	0	1
Unspecified	15	27	26
Untypeable	0	2	2
Total	46	53	59

* One case was co-infected with *Escherichia coli* O157.

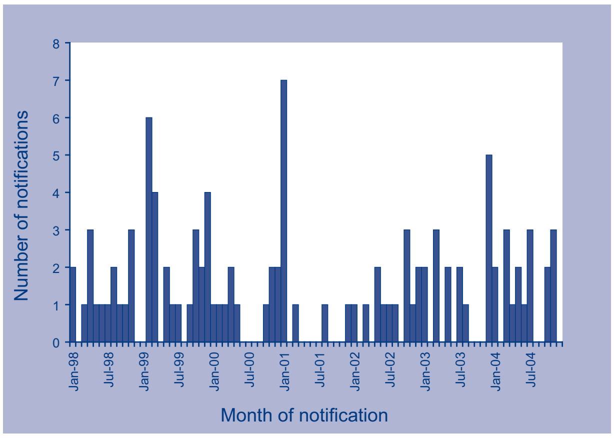
The marked difference in notification rates between states and territories is a result of the practices that pathology laboratories use to screen faecal specimens for toxin-producing *E. coli.* South Australia has the most intensive testing regime and test bloody stool for the presence of the genes coding for production of Shiga toxin. This is reflected in the higher notifications rates reported in South Australia.

All of the cases appeared to be sporadic, except for two small clusters in South Australia and Queensland. South Australia reported a cluster investigation into two cases of STEC; one with *E. coli* O111 and one with *E. coli* O157. Both cases had visited a common native animal petting zoo, however, stool samples of native animals were negative for STEC. Queensland reported an investigation into a cluster of cases of *E. coli* O86:H27 in a single town in January [see the report by A. Morgan, *et al* in this issue, pp 191–194]. There were four cases in total in two sets of siblings. Two children were diagnosed with haemolytic uraemic syndrome and are not included in this section. No source was identified for the Queensland cluster, although animal exposures were suspected as the cause.

Haemolytic uraemic syndrome

There were 17 cases of haemolytic uraemic syndrome reported during 2004, corresponding to an overall rate of 0.1 case per 100,000 population. New South Wales reported nine of these cases. Queensland reported three cases, South Australia two cases, while Victoria, Western Australia and the Northern Territory reported one case each (Figure 12). Cases occurred throughout the year and there was one investigation into a cluster of cases of *E. coli* O86 in Queensland, which involved two cases of haemolytic uraemic syndrome and two cases of Shiga toxin-producing *E. coli* [see pp191–194].

Figure 12. Numbers of notifications of haemolytic uraemic syndrome, Australia, 1998 to 2004, by month of notification

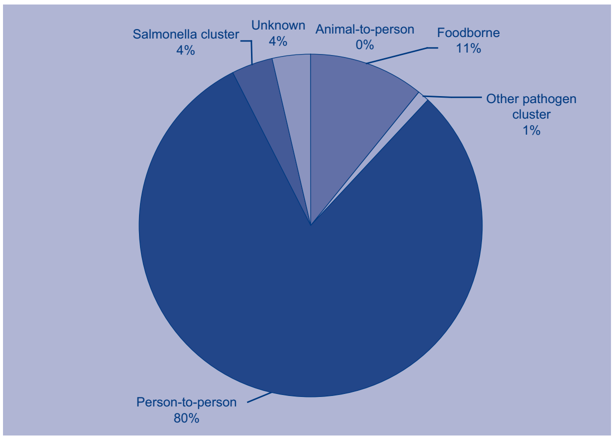


The male to female ratio was 0.4:1 and the highest rate of infection was in females in the 0–4 year age group (0.8 cases per 100,000 population). Details of specific toxigenic *E. coli* infections associated with haemolytic uraemic syndrome were not reported for 13 cases. Two cases were due to the O111 serotype and two were due to O86, while two cases had no STEC isolated.

Gastrointestinal and foodborne disease outbreaks

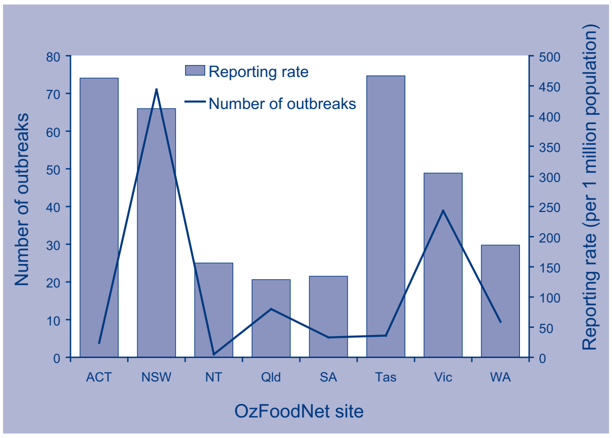
During 2004, OzFoodNet sites reported 1,085 outbreaks of gastrointestinal illness affecting 28,461 persons (Figure 13). One hundred and eighteen of the outbreaks were due to consumption of contaminated food or water giving an overall rate of 5.9 foodborne outbreaks per million population. During 2004, there was one outbreak of zoonotic origin that occurred throughout the year. This outbreak of antibiotic resistant *Salmonella* Paratyphi biovar Java was related to contact with tropical fish.

Figure 13. Foodborne and gastroenteritis outbreaks reported by OzFoodNet sites, Australia, 2004, by suspected mode of transmission (n=1,085 outbreaks)



The mode of transmission of the remaining outbreaks was either unknown or were most likely due to person-to-person transmission. Sites conducted 92 investigations into outbreaks or clusters where the mode of transmission was not determined, or a foodborne source was not identified. Person-to-person transmission was suspected as the cause of 874 outbreaks affecting 25,363 persons. The rates of non-foodborne outbreaks were reasonably consistent across different jurisdictions and ranged between 20.6 per million population in Queensland to 74.7 per million population in Tasmania (Figure 14). The majority of person-to-person outbreaks occurred in aged care facilities (593 outbreaks; 19,295 people affected) and hospitals (140 outbreaks;

Figure 14. Number and rates of non-foodborne gastroenteritis outbreaks,* Australia, 2004, by OzFoodNet site



* Includes outbreaks spread from person-to-person or of unknown mode of transmission and investigations of clusters of infections other than those caused by *Salmonella*, (*n*=924 outbreaks).

3,423 affected). Norovirus was confirmed as the aetiological agent for 398 outbreaks spread from person-to-person that affected 13,842 people.

Foodborne disease outbreaks

In 2004, 118 foodborne disease outbreaks affected 2,076 persons, resulting in 116 hospitalisations and two associated deaths (Table 7). A summary description of each outbreak is shown in Appendix 2.

New South Wales reported the largest number of outbreaks, which represented 36 per cent (43/118) of all outbreaks reported (Table 7). The reporting rates of foodborne outbreaks for different OzFoodNet sites ranged from 1.0 outbreaks per million population in Western Australia to 15.5 outbreaks per million population in the Australian Capital Territory. The majority of outbreaks occurred in summer and autumn (Figure 15).

Figure 15. Outbreaks of foodborne disease, Australia, 2001 to 2004, by selected aetiological agents

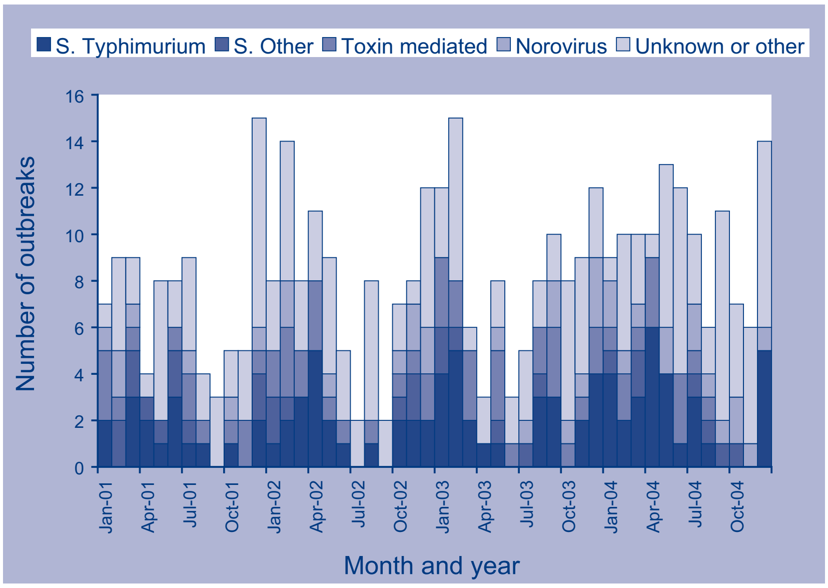


Table 7. Outbreaks of foodborne disease in Australia, 2004, by OzFoodNet site

State	Number of outbreaks	Outbreaks per million population	Mean number of cases per outbreak	Number affected	Hospitalised	Deaths
ACT	5	15.5	58.8	294	2	0
NSW	43	6.4	14.8	635	45	0
NT	2	10.1	7.0	14	2	0
Qld	27	7.1	9.4	254	20	0
SA	17	11.1	9.0	153	10	2
Tas	1	2.1	57.0	57	0	0
Vic	21	4.3	26.2	550	37	0
WA	2	1.0	59.5	119	0	0
Total	118	5.9	17.6	2,076	116	2

Aetiological agents

The most common agent responsible for foodborne disease outbreaks was *Salmonella*, which was responsible for 31 per cent (36/118) of outbreaks (Table 8). These outbreaks affected a total of 679 persons with a hospitalisation rate of 12 per cent (79/679). *S.* Typhimurium was responsible for 81 per cent (29/36) of *Salmonella* outbreaks. Norovirus caused 14 outbreaks of foodborne illness, with a low hospitalisation rate of only 0.4 per cent (2/500). There were eight outbreaks of 'suspected toxin' poisoning, which included seven outbreaks suspected to be due to *Clostridium pefringens* and one outbreak of suspected histamine poisoning due to 'butterfish' consumption.

In 2004, there were seven small outbreaks of ciguatera, all of which occurred in Queensland. There were five outbreaks of campylobacteriosis, which was more than in previous years. There were single outbreaks each of *Bacillus cereus*, rotavirus, mixed toxins from *B. cereus* and *Staphylococcus aureus* and *Listeria* infection. In an outbreak of listeriosis two cases died, although it is unclear whether *Listeria* infection was the major contributing factor to the deaths. Thirty-five per cent (41/118) of outbreaks were of unknown aetiology.

Food vehicles

There was a wide variety of foods implicated in outbreaks of foodborne disease during 2004 (Table 9), although investigators could not identify a vehicle for 47 per cent (55/118) of outbreaks. Contaminated fish was the most common food vehicle, seven of which caused ciguatera poisoning. Fish was responsible for nine per cent (10/118) of outbreaks, followed by seafood and mixed meat dishes each responsible for six outbreaks. Poultry, cakes, pizza, oysters and egg dishes were also common causes of outbreaks.

Outbreak settings

The most common settings where food was prepared was at restaurants and cafés (36%), followed by commercial caterers (14%), takeaway venues including nationally franchised fast food chains (13%), and private residences (11%) (Table 10). Contaminated primary produce was responsible for 7 (6%) outbreaks. Five outbreaks occurred in association with foods prepared in aged care facilities. Four outbreaks each were due to foods prepared in bakeries and in hospital settings. The settings where foods were consumed were similar to where it was prepared. Restaurants and cafés (36%) were the most common venues, followed by private residences (20%), catered functions (9%) and community settings (7%).

Investigative methods and levels of evidence

States and territories investigated 41 outbreaks using retrospective cohort studies and nine outbreaks using case control studies. Forty-four per cent (18/41) of outbreak investigations using cohort studies were of unknown aetiology. Twenty-four per cent (10/41) of investigations using cohort studies were *Salmonella* outbreaks. Fifty per cent of investigations of toxin and suspected toxin outbreaks used cohort studies. Fifty-six per cent (5/9) of outbreak investigations using case control studies were due to *Salmonella*. Sixty outbreaks relied on descriptive information to attribute a foodborne cause or identify a food vehicle, while investigators did not collect individual patient data for eight outbreaks.

Table 8. Aetiological agents responsible for foodborne disease outbreaks showing number of outbreaks and numbers of persons affected, Australia, 2004

Agent category	Number of outbreaks	Number of people affected	Number of people hospitalised	Mean size of outbreak
Bacillus cereus	1	6	0	6.0
Clostridium perfringens	3	128	1	42.7
Campylobacter	5	58	4	11.6
Ciguatoxin	7	24	3	3.4
Listeriosis	1	2	2	2.0
Norovirus	14	500	2	35.7
Rotavirus	1	14	0	14.0
Salmonella other	7	80	5	11.4
Salmonella Typhimurium	29	599	74	20.7
Suspected toxin	8	209	2	26.1
Mixed toxins	1	16	0	16.0
Unknown	41	440	23	10.7
Total	118	2,076	116	17.6

Table 9. Categories of food vehicles implicated in foodborne disease outbreaks, Australia, 2004

Food category	Number of outbreaks	Per cent	Number affected	Number hospitalised
Cakes	4	3.4	82	10
Custard	1	0.9	43	17
Dessert	1	0.9	4	0
Dips	1	0.9	14	0
Eggs	1	0.9	4	0
Fish	10	8.6	52	8
Mixed dish	5	4.3	63	1
Mixed meat dish	6	5.2	191	2
Oysters	4	3.4	35	1
Pizza	4	3.4	108	8
Pork	1	0.9	27	1
Poultry	6	5.1	188	3
Salad	1	0.9	28	3
Sandwiches	3	2.6	270	0
Seafood	6	5.2	45	10
Suspected eggs	2	1.7	19	6
Suspected poultry	2	1.7	24	2
Suspected red meat	1	0.9	5	5
Suspected water	1	0.9	7	0
Vegetable dish	1	0.9	6	0
Unknown	57	49.1	861	39
Total	118	100.0	2,076	116

Table 10. Categories of settings where food was prepared in association with foodborne disease outbreaks, Australia, 2004

Setting prepared	Number of outbreaks	Number affected	Number hospitalised
Aged care	5	75	4
Bakery	4	82	10
Café	2	17	3
Camp	1	5	0
Commercial caterer	16	683	15
Contaminated primary produce	7	58	9
Grocery store/delicatessen	2	30	0
Hospital	4	42	7
Institution	2	52	17
National franchised fast food	7	83	11
Private residence*	14	157	6
Restaurant	40	558	27
Takeaway	8	30	1
Other	1	27	1
Unknown	5	177	5
Total	118	2,076	116

* Includes one outbreak where food prepared included food prepared by takeaway stores.

To attribute the cause of the outbreak to a specific food vehicle, investigators obtained analytical evidence from epidemiological studies for 15 outbreaks. Sixty-six per cent (27/41) of cohort and 50 per cent (4/8) of case control studies did not identify a significant association between illness and a specific food vehicle. Microbiological evidence of contaminated food was found in 10 outbreaks, with a further four outbreak investigations obtaining both microbiological and analytical evidence. Investigators obtained analytical and/or microbiological evidence for 33 per cent (12/36) of *Salmonella* outbreaks (Appendix 2).

Large outbreaks (>50 persons affected)

Six outbreaks affected 50 persons or more in 2004. Two were due to norovirus, two due to *Salmonella*, one due to *C. perfringens,* and one due to suspected *C. perfringens* intoxication. The food for two of these outbreaks was prepared at commercial caterers, with a third using a mixture of food prepared at homes and takeaway food.

Outbreaks also resulted from the food prepared at a restaurant and a bakery. The sixth outbreak was a large community-wide outbreak of *Salmonella* Typhimurium 12 in New South Wales that was associated with chicken prepared in a variety of settings. A variety of foods were implicated in these large outbreaks, including: bakery products, chicken, sandwiches, and dishes containing chicken including pizza.

The two large outbreaks of norovirus were related to preparation of foods that required considerable handling. The food vehicles implicated in the two outbreaks were sandwiches containing salmon and egg fillings in one large outbreak involving a commercial caterer, and contaminated bakery products in the second outbreak. In both outbreaks, the investigation identified food handlers who had worked while ill with gastroenteritis.

One of the outbreaks of *Salmonella* was due to serotype Typhimurium phage type 9 at a pizza restaurant in Melbourne. Cases continued to occur after an initial cleaning of the facility. Several foods were positive for *S.* Typhimurium 9, along with swabs of food preparation areas. Cases occurring early in the outbreak were associated with pizza, whereas those occurring after the initial cleaning were associated with dishes containing chicken, including pasta, risotto and pizza. The cause of the outbreak was suspected to be due to cross contamination in the kitchen due to poor hygienic practices, including cooking chicken on trays in a pizza conveyor belt. After a second clean up of the restaurant there were no new cases or positive food samples.[16]

New South Wales conducted a major investigation into a state-wide increase of *Salmonella* Typhimurium 12 during February. A case series investigation of 40 cases interviewed with hypothesis generating questionnaires identified that cases reported a high consumption rate of fruit and vegetables when compared to previous studies. To examine this hypothesis, a case control study used community-based controls recruited randomly using the electronic white pages, and cases with other *Salmonella* Typhimurium phage types as controls. Forty-one cases—48 *S.* Typhimurium controls and 203 community controls—were recruited. Consuming chicken breast prepared in the home was identified as a risk factor for *S*. Typhimurium 12 infection (Odds Ratio 4.6, $p<0.1$). New South Wales reported 141 cases as part of this outbreak, making it the largest outbreak of salmonellosis during 2004.

Medium outbreaks (20–49 persons affected)

There were 22 outbreaks affecting between 20 and 49 persons. Seven of these outbreaks were due to *Salmonella,* including an outbreak of *Salmonella* Stanley in a school in Victoria. Food vehicles were only identified for three of these *Salmonella* outbreaks, which were custard, salad rolls containing red onion, and roast pork.

There were four outbreaks of norovirus, three of which occurred at restaurants and a fourth that occurred at a mass catered event. One norovirus outbreak in New South Wales affected 24 people following consumption of locally-grown oysters. No further illness was identified and norovirus was not detected in samples of oyster meat. There were two outbreaks of campylobacteriosis, one of which was suspected to be related to a barbecue meal at an aged care facility in Victoria, while the other was suspected to be due to a meal of chicken in New South Wales.

Victoria reported four outbreaks of suspected *C. perfringens* affecting between 20–49 people, only one of which could be confirmed by the presence of heavy growth of *C. perfringens* and the presence of toxin in stool samples. One of these outbreaks was in an aged care facility, while another was in a hospital. The other two suspected toxin related illnesses were associated with restaurants.

There were three outbreaks associated with imported foods with potential international implications. These outbreaks were all due to contaminated Individually Quick Frozen oysters. All outbreaks were small affecting a total of 11 people. Two occurred in Queensland and one in the Northern Territory. Investigations confirmed that these oysters from Japan were the same as those implicated in December 2003 in outbreaks in the Northern

Territory and Western Australia. Oysters from all outbreaks were tested but norovirus was not detected in any of these three batches. Investigation of the outbreak that occurred in Queensland in October 2004 implicated oyster meat from the same batch as the outbreak in the Northern Territory that occurred a year earlier, although it was a smaller size oyster.[17] This particular batch had reportedly been withdrawn from sale earlier in 2004, and had been shown by laboratory tests to be contaminated with norovirus.

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 vehicle or determine a mode of transmission for the increase. An example is a temporal or geographic increase in the number of cases of a certain type of *Salmonella* serovar or phage type. Another example is a community-wide increase of cryptosporidiosis that extends over some weeks or months. In this report, there were a small number of outbreaks of different pathogens where the mode of transmission was unknown, that have been classified as a cluster.

During 2004, states and territories conducted 54 cluster investigations. These clusters affected 622 persons with 51 cases hospitalised. Seventy-eight per cent (42/54) of these investigations related to clusters of *Salmonella*. *Salmonella* clusters affected 473 persons with 46 cases hospitalised. *S.* Typhimurium was responsible for 55 per cent (23/42) of cluster investigations, with phage types 135/a (6 investigations) and 170/108 (5) being the most common. Of the remaining 19 investigations, there were 18 other different *Salmonella* serovars involved. There were 11 clusters due to pathogens other than *Salmonella*, with *Campylobacter*, *Cryptosporidium,* Shiga toxin-producing *E. coli* and *Shigella* causing two each and one investigation into a cluster of hepatitis A. No aetiology was identified for three cluster investigations.

OzFoodNet sites compared investigations into concurrent increases in several *Salmonella* serotypes that occurred across multiple jurisdictions. These included *Salmonella* serotypes Singapore, Typhimurium 12a, Typhimurium 170/108, and Paratyphi B biovar Java.

The cluster investigation into cases of *Salmonella* Paratyphi B biovar Java was part of a national case series to investigate the association with tropical fish aquariums. Eighteen cases infected with this multi-drug resistant serotype were investigated. In the month prior to illness, 85 per cent (11/13) of cases with aquarium/tanks had contact with sick or dead fish.

The true number of clusters investigated is difficult to determine, as the figures do not include all cluster investigations conducted in Public Health Units or local government areas. Jurisdictions have different definitions of 'cluster' and triggers for investigating clusters to fit with staff resources and local priorities.

Risk factors for infection

During 2004, OzFoodNet identified several important risk factors for foodborne illness as a result of outbreak investigations and from preliminary results of case control studies. These included risks due to the following foods and settings for foodborne disease.

Eggs

Sites continue to report outbreaks associated with the consumption of egg-based products, such as eggs, salad dressings, cakes and desserts. There were three outbreaks suspected to be caused by eggs, and a further three associated with desserts and cakes where eggs were suspected as the source of *Salmonella.* In one outbreak of *Salmonella* Typhimurium 126 infections in Victoria, illness was associated with consumption of one brand of organic eggs. In several of these outbreaks, investigators were unable to trace implicated eggs back to a single farm. There is a need to identify potential interventions, and a review of quality assurance in the industry may be appropriate. The restaurant and catering industries need to be made aware of the potential risks of using raw unpasteurised eggs in sauces, dressings and desserts.

Chicken and poultry

During 2004, outbreaks of poultry-associated salmonellosis continued to occur, including a major outbreak of *Salmonella* Typhimurium 12 in New South Wales. Poultry is consumed by approximately 80 per cent of people each week. To make our food supply safer, it is important to consider ways to reduce the burden of infections in the community due to consumption of poultry.

Oysters and fish

The four outbreaks associated with oysters during 2004 showed their potential to cause outbreaks of human illness. Three of these outbreaks were due to contaminated imported oyster meat from a single estuary system in Japan. In 2004, the Australian Quarantine and Inspection Service restricted the importation of these products from this growing area. Importation from certain growing areas in Korea were also restricted, as oysters from this area had caused norovirus outbreaks in New Zealand.

There were 10 outbreaks due to fish during 2004, making it the most common food vehicle. The majority of these were small outbreaks of ciguatera poisoning in Queensland. Many outbreaks of ciguatera relate to fish caught by amateur fishermen, but one of these outbreaks was associated with coral trout eaten at a restaurant. Ciguatera can be a severe illness and there is a continuing need to educate amateur fishermen about ciguatera including the risks associated with fishing known ciguatera areas and consuming large warm ocean fish.

Settings

There were several settings where food was prepared or consumed that were identified as high risk for foodborne disease, which included:

Bakeries

The four outbreaks occurring in bakeries in 2004 revealed the need for assessment of food safety issues in these premises. Three of the outbreaks were associated with cakes, some of which were filled with cream or custard. Two of the outbreaks were caused by *Salmonella* Typhimurium, while one was unknown and another was due to norovirus. Epidemiological investigation of these outbreaks often does not uncover the real source of contamination, as there is a time lag between food consumption and the recognition of the outbreak. Food safety agencies may need to consider the development of hazard reduction plans for these facilities to prevent further outbreaks.

Restaurants and catered events

Outbreaks in this sector constituted 49 per cent (58/118) of outbreaks. A variety of pathogens caused these outbreaks, including *Salmonella, C. perfringens,* norovirus and ciguatera. Outbreaks involving restaurants and commercial caterers are more readily recognised, as the meals are often served to large numbers of persons. A wide range of food vehicles were responsible for outbreaks in this sector. Clearly there is a need to continue to monitor the causes of outbreaks in restaurant and catering settings to identify potential gaps in food safety practices.

Hospitals and aged care

People resident in aged care facilities and patients in hospital are at particular risk for foodborne disease, which is shown by the nine outbreaks that occurred during 2004. Four of the outbreaks were suspected or confirmed *Clostridium perfringens* outbreaks, while two were due to *Campylobacter* infection, one due to *Salmonella* Typhimurium 126var, one due to *Listeria monocytogenes* O1 and one unknown. The majority of these outbreaks indicate problems with preparation and handling of foods for residents. The outcomes for patients in these settings are often more adverse, as these sub-populations are more susceptible to serious foodborne disease. The food supplied to hospital patients and persons in institutions should be comprehensively monitored. In addition, there is a need to ensure that patients at risk for infection should not be fed high-risk foods in hospitals.

Surveillance evaluation and enhancement

Continuous improvement of surveillance is important to ensure that foodborne illness is investigated rapidly and effectively. To improve surveillance it is necessary to evaluate and compare practices conducted at different sites.

National information sharing

In 2004, all jurisdictions contributed to a fortnightly national cluster report to identify foodborne illness occurring across state and territory boundaries. The cluster report supplemented information sharing on a closed list server, teleconferences and at quarterly face-to-face meetings.

Outbreak reporting and investigation

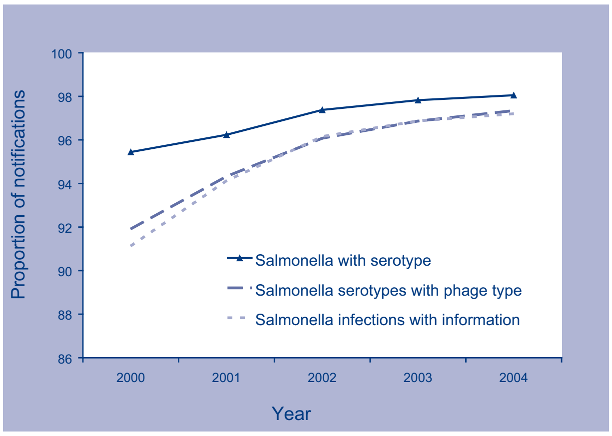
During 2004, the Australian Capital Territory site reported the highest rate of outbreaks of foodborne disease (15.5 outbreaks per 100,000 population). The rates of reporting foodborne *Salmonella* outbreaks ranged between 1.6–5.0 outbreaks per 100,000 population. New South Wales investigated the largest number of foodborne disease outbreaks (43 outbreaks; 6.4 per 100,000 population). Victoria and Queensland investigated 13 *Salmonella* clusters each, giving rates of 3.4 and 2.6 per million population respectively.

States and territories conducted 50 analytical studies (cohort or case control studies) to investigate foodborne disease outbreaks or clusters of suspected foodborne illness. Investigators used analytical studies for 42 per cent (50/118) of foodborne disease outbreaks, which was similar to previous years. Queensland conducted four case control studies to investigate outbreaks of foodborne infections during 2004, which was the most for any jurisdiction. Every jurisdiction reported conducting at least one cohort study. New South Wales conducted 40 per cent of all cohort studies.

Completeness of Salmonella *serotype and phage type reports*

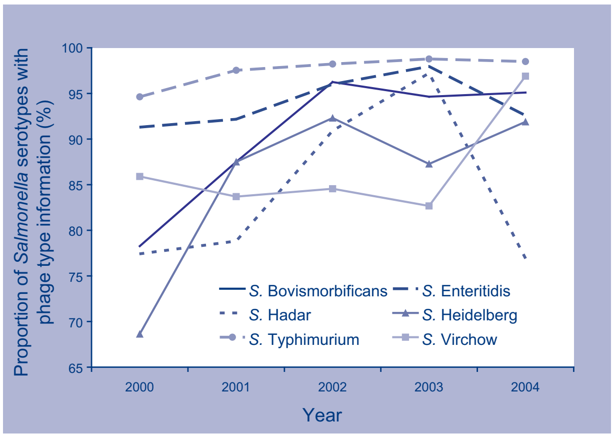
There was considerable improvement in the completeness of *Salmonella* available on state and territory surveillance databases between the years 2000 to 2004 (Figure 16). Overall 98.4 per cent (7,671/7,798) of *Salmonella* notifications on databases contained either serotype or phage type, which was an increase of 7.3 per cent from 2000 and 1.5 per cent from 2003.

Figure 16. Proportion of *Salmonella* infections notified to State and Territory health departments with serotype and phage type information available, Australia, 2000 to 2004



Only 76.9 per cent (39/48) of phage type information was reported for *S.* Hadar, which was a decline from the previous year (Figure 17). Phage typing information was available for 91.9 per cent (37/40) of *S.* Heidelberg and 92.6 per cent (418/449) of reports for *S.* Enteritidis in 2004. The largest increase in completeness between 2000 and 2004 was reported for *S.* Heidelberg (23.3%) and *S.* Bovismorbificans (17%).

Figure 17. Proportion of *Salmonella* infections for six serotypes notified to State and Territory health departments with phage type information available, Australia, 2000 to 2004



South Australia had the highest proportion of complete *Salmonella* notification (100%), while four sites reported 98 per cent or higher. Western Australia reported the lowest rate of completeness with 91.9 per cent. New South Wales reported the largest improvement with 19.1 per cent improvement, when compared to 2000 figures.

Discussion

This fourth annual report of OzFoodNet highlights the burden that foodborne illness places on the health system and community. The cost to Australia each year from foodborne disease may be as high as $AUD1.2 billion annually.[18] In recent years, Australia has experienced consistently increasing rates of notified infections, along with increasing numbers of foodborne outbreaks. In 2004, we observed a 28 per cent increase in reported foodborne outbreaks compared with 2003, which may be due in part to improved surveillance. However, there has not been any appreciable change in surveillance system for notifiable diseases. This is a concern, as there was a nine per cent increase in notifications of potentially foodborne diseases in this report when compared to historical averages.

The United States of America program—FoodNet—recently reported significant declines for 2004 in the incidence of human salmonellosis and campylobacteriosis, which were attributed to improvements in agricultural industry and reduction in isolation of *Salmonella* and *Campylobacter* in food processing plants.[9] Australia could consider gathering similar data on *Salmonella* and *Campylobacter* in animals and developing disease reduction targets to focus prevention efforts.

The major causes of foodborne disease in Australia during 2004 were similar to previous years, with fish, poultry, bakery products, seafood, and eggs being the major causes of outbreaks. While seafood and fish are responsible for large numbers of outbreaks they are usually small in size and are rarely associated with *Salmonella* and *Campylobacter* infections, which make up the majority of sporadic infections reported to health departments.[19] In contrast, poultry and eggs, are common causes of these sporadic infections. Risk of campylobacteriosis is strongly associated with consumption of under-cooked chicken in Australia and may be responsible for between 5–11 per cent of infections.[20] OzFoodNet sites reported several outbreaks associated with chicken during 2004.

The largest of these chicken-associated outbreaks was a community-wide outbreak of *Salmonella* Typhimurium 12 in New South Wales that affected 141 people. These community-wide increases occur commonly and are difficult to investigate due to poor patient recall of foods consumed and the high frequency of chicken consumption. Chicken meat is commonly contaminated with *Salmonella* and *Campylobacter* at retail sale.[21,22] While cooking readily kills these bacteria, reducing the concentration of bacteria on meat through control measures on farms or in processing plants could possibly lower the incidence of these diseases in the community. The *S.* Typhimurium 12 outbreak highlighted the potential of chicken as a vehicle of community outbreaks and the need to reduce contamination of raw meats through improved primary production and processing.

There were many outbreaks in 2004 where investigators were unable to confirm the aetiology. One reason for this is that surveillance of outbreaks is improving with smaller outbreaks being detected where it is difficult to confirm an aetiological agent. Another reason is the changing nature of laboratory tests. The availability of test kits for *C. perfringens* in Australia was limited in 2004, due to concerns about importation of *Clostridium* toxins. This made it difficult to confirm *Clostridium perfringens* as the cause of outbreaks, as traditional case definitions rely on confirming greater than 10^5 organisms in two or more faecal specimens or the demonstration of *C. perfringens* toxin.[23]

Similarly, epidemiologists were unable to identify a food vehicle in 63 per cent of outbreaks investigated using analytical epidemiological studies. In many of these outbreak investigations epidemiologists suspected a vehicle, but did not have the epidemiological, microbiological or traceback evidence to implicate a specific food. It can be difficult to effect and implement food recalls in these instances.

The outbreaks of norovirus associated with Individually Quick Frozen oyster meat were an example of where epidemiological and traceback evidence confirmed a food vehicle, but virological analysis was negative for norovirus. National discussions with food safety agencies identified the risks associated with these products, and Importers agreed to withdraw products from the marketplace. During 2004, the Northern Territory Health Services submitted oyster meat from an outbreak in the previous year to Environmental Science and Research in New Zealand, which confirmed contamination with norovirus (personal communication, Gail Greening, 3 May 2005). This positive test result, months after the initial investigation, vindicated various food safety agencies decisions to seek the withdrawal of these products. The small outbreak in Queensland in October several months after the original withdrawal showed how long-shelf life products can cause problems for public health agencies conducting food recalls. As a preventive measure, the Australian Quarantine and Inspection Service has implemented restrictions to imports of oyster meat from the specific harvest area where implicated oysters were harvested, and certain Korean oyster growing areas that have supplied products causing outbreaks in New Zealand.

Norovirus caused a considerable amount of gastroenteritis that was not foodborne in 2004. OzFoodNet sites reported a massive number of outbreaks spread from person-to-person, many of which occurred in aged care and hospital settings. Norovirus was responsible for 45 per cent of outbreaks spread from person-to-person and accounted for 13,739 cases. The genotype of these norovirus outbreaks was reported for very few of these outbreaks, as many were diagnosed using rapid enzyme-based detection test kits. It is likely that many of these outbreaks would have been due to the new variant of genotype II4 that affected Australia during 2004 and other countries internationally.[24] Epidemic clones of norovirus can affect multiple countries and cause widespread illness in community and institutional settings.[25] It is also likely that many of the person-to-person outbreaks of unknown aetiology would have been due to norovirus. The high burden of disease in the healthcare system is very costly and it is important for public health agencies to be able to identify interventions that are able to halt the spread of these outbreaks.[26]

OzFoodNet identified several risk factors for foodborne infections in 2004 based on the surveillance data and epidemiological studies. Many of these risk factors have been previously recognised, but may need to be considered again. Some of the risks require complex solutions, while others are far more simple, such as using pasteurised eggs in food service industries or avoiding consumption of shellfish and fish harvested from high-risk areas. While Australia does not have endemic *S.* Enteritidis 4 that contaminates the internal contents of eggs, there are clearly other subtypes of *Salmonella* that are associated with eggs. As noted in previous years, there is a need to identify the potential food safety failures in bakeries to prevent outbreaks of salmonellosis.[27]

It is important to recognise some of the many limitations of the data that OzFoodNet reports. 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. In some jurisdictions, the rates of disease are unstable due to small numbers of notifications and populations under surveillance. Importantly, some of the most common enteric pathogens are not notifiable, particularly norovirus, *Clostridium perfringens* and enteropathogenic *E. coli.* These organisms may be notified as the cause of outbreaks, but not as individual cases of disease. There can also be considerable variation in assigning causes to outbreaks depending on investigators and circumstances. States and territories are moving towards harmonising surveillance as much as possible to address some of these issues.

Surveillance of foodborne diseases in Australia has steadily improved in recent years, as shown by data on improving completeness of *Salmonella* subtyping on state and territory surveillance databases. OzFoodNet aims to continually improve surveillance and investigation practices regarding enteric and foodborne diseases. In 2004, the capacity of Australia to respond to multi-state foodborne disease outbreaks was examined in an external review. The review found that in recent years there had been significant improvements in capacity, but there was still room for improvement. Following the consultation, OzFoodNet conducted a trial of a web-based database for capturing individual patient data during multi-state outbreaks.[28] The trial was based on a mock outbreak of a fictitious *Salmonella* serotype—Mordor—amongst hobbits, wizards, ents and men after a hobbit's birthday party. The trial showed the benefits of using web-based databases for multi-site investigation of outbreaks. The issues highlighted in the review are common to many countries that investigate foodborne illness across multiple jurisdictions.[29]

The large burden of foodborne disease observed in 2004 is a concern for Australia. In future years, it may be appropriate to set targets for reducing foodborne disease in conjunction with other government agencies and industries. It is important that foodborne disease surveillance is able to assess whether food safety policies and campaigns are working. National surveillance of foodborne diseases has many benefits and provides long-term data to review causes of illness. Since OzFoodNet began surveillance in 2000, the network has collected information on the cause of approximately 400 outbreaks of foodborne disease. These data are becoming useful for reviewing less common, but important, causes of disease outbreaks. Ongoing efforts are needed to strengthen the robustness of these data and ensure that they continue to be useful to agencies developing food safety policy.

Acknowledgements

We would like to thank the many epidemiologists, project officers, interviewers and research assistants at each of the Sites who contributed to this report. We also acknowledge the work of various public health professionals and laboratory staff around Australia who interviewed patients, tested specimens, typed isolates and investigated outbreaks. The high quality of their work is the foundation of this report. OzFoodNet is an initiative of the Australian Government.

Appendix 1. Number of cases and rates per 100,000 population of potentially foodborne diseases reported to OzFoodNet sites, 2004

Infection or illness		ACT	Hunter	NSW	NT	Qld	SA	Tas	Vic	WA	Total
Campylobacter	cases	372	nn	nn	219	4,127	1,957	611	6,385	1,969	15,640
	rate	114.8	nn	nn	109.5	106.3	127.6	126.7	128.4	99.3	116.9
Haemolytic uraemic syndrome	cases	0	0	9	1	3	2	0	1	1	17
	rate	0.0	0.0	0.1	0.5	0.1	0.1	0.0	0.0	0.1	0.1
Listeria	cases	1	1	30	1	8	3	1	13	9	66
	rate	0.3	0.2	0.5	0.5	0.2	0.2	0.2	0.3	0.5	0.3
Salmonella†	cases	100	126	2,127	390	2,805	531	120	1,154	615	7,842
	rate	30.9	22.9	31.6	195.1	72.3	34.6	24.9	23.2	31.0	39.0
Shiga toxin producing *E. coli*	cases	0	0	3	0	7	31	0	4	1	46
	rate	0.0	0.0	0.0	0.0	0.3	2.0	0.0	0.1	0.1	0.2
Shigella	cases	2	–	97	117	68	57	3	64	112	520
	rate	0.6	–	1.4	58.5	1.8	3.7	0.6	1.3	5.7	2.6
Typhoid	cases	1	0	39	0	9	3	0	17	5	74
	rate	0.3	0.0	0.6	0.0	0.2	0.2	0.0	0.3	0.3	0.4
Yersinia	cases	1	nn	nn	0	100	6	0	nn	1	108
	rate	0.3	nn	nn	0.0	2.6	0.4	0.0	nn	0.1	1.3

nn not notifiable.

† Includes cases of *Salmonella* Paratyphi.

Appendix 2. Outbreak summary for OzFoodNet sites, 2004

State	Month of outbreak	Setting prepared	Agent category	Number affected	Hospitalised	Evidence*	Epidemiolgical study†	Food vehicle
ACT	April	Restaurant	Unknown	16	0	A	CCS	Suspected calamari
	April	Restaurant	*Salmonella* Typhimurium 197	12	2	M	C	Ling fish
	May	Commercial caterer	Norovirus	247	Unknown	A	C	Salmon and egg sandwiches
	May	Bakery	Unknown	7	0	D	D	Chocolate cake
	July	Grocery store/delicatessen	Unknown	12	0	D	D	Unknown
NSW	January	Hospital	Unknown	5	5	D	N	Suspected beef curry
	January	Takeaway	*Salmonella* Typhimurium 170	3	1	D	D	Suspected chicken
	January	Takeaway	Unknown	3	0	D	N	Unknown
	January	Restaurant	*Salmonella* Typhimurium 170	2	0	D	N	Tartare sauce, fish and chips
	February	Restaurant	Norovirus	32	0	D	C	Unknown
	February	Restaurant	Unknown	20	0	A	C	Bacon and mushroom dish
	February	Restaurant	Unknown	7	6	D	D	Fried rice, pippis
	February	Unknown	Unknown	6	0	D	C	Unknown
	February	Unknown	*Salmonella* Typhimurium 12	141	Unknown	A	CCS	Chicken
	March	Restaurant	*Salmonella* Typhimurium 170	17	1	M	D	Chinese food
	March	Private residence	Unknown	14	0	D	N	Unknown
	March	National franchised fast food	*Salmonella* Typhimurium U290	3	0	D	D	Fish cakes
	April	Restaurant	*Salmonella* Typhimurium 170	13	3	D	D	Chicken
	May	Institution	*Salmonella* Typhimurium 135	43	17	AM	C	Custard
	May	Other	*Salmonella* Typhimurium 170, RDNC	27	1	AM	CCS	Roast pork
	May	Grocery store/delicatessen	Unknown	18	0	D	D	Sandwiches
	May	National franchised fast food	Unknown	5	1	D	D	Suspected BBQ meat pizza
	May	Takeaway	Unknown	5	0	D	N	Takeaway chicken
	May	Restaurant	Unknown	3	0	D	C	Unknown
	June	Restaurant	Rotavirus	14	0	D	D	Dips (salsa, bean/guacamole)
	June	Restaurant	Unknown	8	0	D	N	Unknown
	June	Restaurant	Unknown	6	0	D	C	Unknown
	June	Restaurant	Unknown	6	0	D	N	Unknown
	June	Restaurant	Unknown	3	0	D	N	Chinese food
	July	Contaminated primary produce	Norovirus	24	1	A	C	Oysters
	August	Private residence	*Salmonella* Typhimurium U290	3	2	D	D	Chinese style minced fish balls
	September	Restaurant	Unknown	13	0	D	C	Unknown
	September	unknown	Unknown	12	3	D	C	Unknown
	September	Restaurant	Unknown	11	0	D	C	Unknown
	September	Restaurant	Unknown	4	0	D	D	Unknown
	September	Takeaway	Unknown	4	0	D	D	Unknown
	October	Restaurant	Unknown	7	0	D	C	Cold chicken sandwiches
	October	Private residence	Unknown	5	0	D	D	Unknown
	October	Restaurant	*Salmonella* Chester	3	1	D	D	Unknown
	November	Commercial caterer	Unknown	33	0	D	C	Unknown
	November	Restaurant	Unknown	7	0	D	D	Unknown

Appendix 2. Outbreak summary for OzFoodNet sites, 2004, *continued*

State	Month of outbreak	Setting prepared	Agent category	Number affected	Hospitalised	Evidence*	Epidemiolgical study†	Food vehicle
NSW cont'd	December	Commercial caterer	Unknown	42	0	D	C	Unknown
	December	Restaurant	*Campylobacter*	21	1	M	C	Suspected chicken
	December	Restaurant	Unknown	13	0	D	C	Unknown
	December	Restaurant	Unknown	12	0	D	C	Suspected bacon and ham
	December	Commercial caterer	Unknown	8	0	D	D	Unknown
	December	Takeaway	Unknown	6	0	D	D	Unknown
	December	Restaurant	*Salmonella* Typhimurium 135	3	2	M	D	Crab
NT	January	Café	*Salmonella* Typhimurium 108	9	2	D	D	Unknown
	May	Contaminated primary produce	Unknown	5	0	D	C	Oysters (frozen)
Qld	January	Contaminated primary produce	Norovirus	4	0	D	D	Oysters (frozen)
	January	Private residence	Ciguatoxin	2	2	D	D	Golden spotted trevally fish
	February	National franchised fast food	*Bacillus cereus*	6	0	M	D	Potato and gravy
	February	Restaurant	Ciguatoxin	4	1	D	D	Coral trout
	March	Restaurant	*Salmonella* Singapore	13	0	A	CCS	Sushi rolls
	March	Commercial caterer	Norovirus	8	0	D	C	Unknown
	March	Restaurant	Unknown	5	0	D	D	Sandwiches
	March	Restaurant	*Salmonella* Zanzibar Var 15+	5	0	D	D	Unknown
	March	Private residence	Ciguatoxin	2	0	D	D	Fish species unknown
	April	National franchised fast food	*Salmonella* Typhimurium 12a	41	10	D	CCS	Unknown
	April	Restaurant	Mixed toxins	16	0	M	D	Japanese rice balls,/omelette, chicken, fish
	April	Contaminated primary produce	Ciguatoxin	5	Unknown	D	D	Spanish mackerel/trevally
	June	Restaurant	Unknown	25	0	D	C	Buffet meal with cold salad
	June	Takeaway	Ciguatoxin	4	0	D	D	Grey mackerel
	June	Private residence	Ciguatoxin	3	0	D	D	Trevally
	July	Commercial caterer	Norovirus	26	0	D	CCS	Unknown
	July	Bakery	*Salmonella* Typhimurium 135a	5	5	D	D	Custard fruit tarts
	July	Private residence	Ciguatoxin	4	0	D	D	Grey mackerel
	August	National franchised fast food	Norovirus	7	0	D	D	Pizza
	August	National franchised fast food	*Clostridium perfringens*	6	0	M	D	Meat pizza
	August	Camp	Salmonella Virchow 8	5	0	D	D	Unknown
	September	Private residence	*Salmonella* Enteritidis 26	17	0	D	C	Unknown
	September	Restaurant	Norovirus	16	0	D	D	Unknown
	September	Takeaway	*Campylobacter*	2	0	D	D	Chicken kebab
	October	Private residence	Norovirus	13	1	D	CCS	Unknown
	October	Commercial caterer	Unknown	8	1	D	D	Unknown
	October	Contaminated primary produce	Norovirus	2	Unknown	D	D	Oysters (frozen)
SA	January	Private residence	*Salmonella* Saintpaul	4	0	A	C	Boiled eggs
	March	Bakery	*Salmonella* Typhimurium 108	13	5	AM	CCS	Cream cakes
	April	Restaurant	*Salmonella* Typhimurium 108	9	2	D	C	Unknown
	April	Private residence	*Salmonella* Typhimurium 108	8	Unknown	A	C	Lemon meringue & potato bake
	June	Restaurant	Unknown	9	Unknown	D	D	Unknown

Appendix 2. Outbreak summary for OzFoodNet sites, 2004, *continued*

State	Month of outbreak	Setting prepared	Agent category	Number affected	Hospitalised	Evidence*	Epidemiolgical study†	Food vehicle
SA, *cont'd*	June	Takeaway	*Salmonella* Typhimurium 35	3	Unknown	D	D	Unknown
	July	Private residence	*Salmonella* Typhimurium 9	4	0	D	D	Home made icecream
	July	Restaurant	Unknown	4	0	D	C	Unknown
	July	Restaurant	*Campylobacter*	4	1	D	CCS	Unknown
	August	Restaurant	Unknown	8	0	D	C	Unknown
	September	National franchised fast food	Unknown	15	0	D	C	Pizza
	September	Hospital	Listeriosis	2	2	D	D	Unknown
	November	Institution	Norovirus II	9	0	D	C	Unknown
	December	Restaurant	Norovirus II	36	0	D	C	Unknown
	December	Aged care	*Salmonella* Typhimurium 126 var	13	0	D	D	Unknown
	December	Unknown	*Salmonella* Typhimurium 8	9	0	D	D	Unknown
	December	Private residence	*Salmonella* Typhimurium 126 var	3	0	D	D	Unknown
Tas	May	Bakery	Norovirus	57	0	D	C	Bakery products
Vic	January	Restaurant	*Salmonella* Typhimurium 9	90	7	M	D	Pizza, risotto and pasta
	February	Hospital	Suspected toxin	14	Unknown	D	D	Unknown
	February	Contaminated primary produce	*Salmonella* Typhimurium 126	11	5	D	D	Suspected eggs
	March	Restaurant	Suspected toxin	16	0	A	C	Suspected spaghetti bolognaise
	April	Unknown	*Salmonella* Typhimurium 9	9	2	D	D	Unknown
	May	Commercial caterer	*Salmonella* Typhimurium 12a	28	3	AM	C	Gourmet rolls/red onion
	May	Hospital	Suspected toxin	21	Unknown	D	D	Unknown
	May	Cafe	*Salmonella* Typhimurium 9	8	1	D	D	Suspected sauce - raw eggs
	June	Aged care	*Clostridium perfringens*	22	1	D	D	Unknown
	June	Aged care	Suspected toxin	9	1	D	D	Unknown
	July	Commercial caterer	*Salmonella* Stanley	33	4	D	C	Unknown
	July	Commercial caterer	*Salmonella* Typhimurium 126	21	1	D	C	Unknown
	August	Restaurant	Suspected toxin	45	0	D	C	Unknown
	September	Aged care	*Campylobacter*	24	2	D	D	Suspected barbecue
	October	Commercial caterer	Unknown	33	4	D	C	Unknown
	November	Commercial caterer	Suspected toxin	20	0	A	C	Chicken vol au vents
	November	Commercial caterer	Suspected toxin	9	0	D	D	"Butterfish" (rudderfish)
	November	Contaminated primary produce	Unknown	7	3	D	D	Redfin
	December	Private residence/takeaway	Suspected toxin	75	1	D	C	Unknown
	December	Commercial caterer	*Salmonella* Typhimurium 170	48	2	D	C	Unknown
	December	Aged care	*Campylobacter*	7	0	D	D	Suspected drinking water
WA	January	Commercial caterer	Norovirus	19	0	A	C	Prawns and cold meats
	April	Commercial caterer	*Clostridium perfringens*	100	0	M	D	Pasta meat sauce
Total				2,076	116			

* 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.

RDNC = 'Reactive but Does Not Conform' and represents phage type patterns that are not yet assigned.

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