Foodborne disease in Australia: incidence, notifications and outbreaks. Annual report of the OzFoodNet network, 2002

The OzFoodNet Working Group

Abstract

In 2002, OzFoodNet continued to enhance surveillance of foodborne diseases across Australia. The OzFoodNet network expanded to cover all Australian states and territories in 2002. The National Centre for Epidemiology and Population Health together with OzFoodNet concluded a national survey of gastroenteritis, which found that there were 17.2 (95% C.I. 14.5–19.9) million cases of gastroenteritis each year in Australia.The credible range of gastroenteritis that may be due to food each year is between 4.0–6.9 million cases with a mid-point of 5.4 million. During 2002, there were 23,434 notifications of eight bacterial diseases that may have been foodborne, which was a 7.7 per cent increase over the mean of the previous four years. There were 14,716 cases of campylobacteriosis, 7,917 cases of salmonellosis, 505 cases of shigellosis, 99 cases of yersiniosis, 64 cases of typhoid, 62 cases of listeriosis, 58 cases of shiga toxin producing *E. coli* and 13 cases of haemolytic uraemic syndrome. OzFoodNet sites reported 92 foodborne disease outbreaks affecting 1,819 persons, of whom 5.6 per cent (103/1,819) were hospitalised and two people died. There was a wide range of foods implicated in these outbreaks and the most common agent was *Salmonella* Typhimurium. Sites reported two outbreaks with potential for international spread involving contaminated tahini from Egypt resulting in an outbreak of *Salmonella* Montevideo infection and an outbreak of suspected norovirus infection associated with imported Japanese oysters. In addition, there were three outbreaks associated with animal petting zoos or poultry hatching programs and 318 outbreaks of suspected person-to-person transmission. Sites conducted 100 investigations into clusters of gastrointestinal illness where a source could not be identified, including three multi-state outbreaks of salmonellosis. OzFoodNet identified important risk factors for foodborne disease infection, including: *Salmonella* infections due to chicken and egg consumption, bakeries as a source of *Salmonella* infection, and problems associated with spit roast meals served by mobile caterers.There were marked improvements in surveillance during 2002, with all jurisdictions contributing to national cluster reports, increasing use of analytical studies to investigate outbreaks and 96.9 per cent of *Salmonella* notifications on state and territory surveillance databases recording complete information about serotype and phage type. During 2002, there were several investigations that showed the benefits of national collaboration to control foodborne disease. Sharing surveillance data from animals, humans and foods and rapid sharing of molecular typing information for human isolates of potentially foodborne organisms could further improve surveillance of foodborne disease in Australia. *Commun Dis Intell* 2003;27:209–243.

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

The OzFoodNet Working Group is: (in alphabetical order): Rosie Ashbolt (Tas), Robert Bell (Qld), Barry Combs (SA), Scott Crerar (FSANZ), Craig B Dalton (Hunter PHU), Karen Dempsey (NT), Rod Givney (SA), Joy Gregory (Vic), Gillian V Hall (NCEPH), Brigid Hardy (AFFA), Geoff Hogg (MDU), Rebecca Hundy (NCEPH), Martyn D Kirk (FSANZ), Karin Lalor (Vic), Janet Li (FSANZ), Peter Markey (NT), Tony Merritt (Hunter PHU), Ian McKay (DoHA), Geoff Millard (ACT), Lillian Mwanri (SA), Jennie Musto (NSW), Leonie Neville (NSW), Jane Raupach (SA), Paul Roche (DoHA), Mohinder Sarna (WA), Craig Shadbolt (DoHA), Russell Stafford (Qld), Nola Tomaska (NCEPH), Leanne Unicomb (Hunter PHU), Kefle Yohannes (DoHA), Craig Williams (FSANZ), Jenny Williams (FSANZ)

Corresponding author: Mr Martyn Kirk, Coordinating Epidemiologist, OzFoodNet, Food Safety and Surveillance, Department of Health and Ageing, Canberra ACT 2601. Telephone: +61 2 6289 1555. Facsimile: +61 2 6289 5100. Email: martyn.kirk@health.gov.au

Introduction

The World Health Organization recently developed a strategy to address the global issue of food safety.[1] The strategy highlighted that, 'surveillance is the basis for the formulation of national strategies to reduce food-related risks'. Many countries recognise the importance of improving foodborne disease surveillance due to high incidence and increasing spread of foodborne diseases, particularly in outbreaks.[2] While outbreaks may attract media attention and cause community concern, sporadic cases of foodborne disease far outweigh the number associated with outbreaks.[3] In addition, foodborne diseases have a major impact on communities and are increasingly affecting trade.[4]

In 2000, the Commonwealth Department of Health and Ageing (DoHA) established the OzFoodNet to enhance surveillance for foodborne disease.[5] OzFoodNet built upon an 18-month trial of active surveillance in the Hunter region of New South Wales and was modelled on the Centers for Disease Control and Prevention's FoodNet surveillance system (see http://www.cdc.gov/foodnet/).[6,7] The purpose of enhancing surveillance for foodborne disease in Australia was to investigate, describe and understand foodborne disease at the national level to provide better evidence of how to prevent foodborne illness.

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 (CDNA), which is Australia's peak body for communicable disease control. The Commonwealth Department of Health and Ageing funds OzFoodNet and convenes a committee to manage the Network.

This is the second annual report of OzFoodNet and covers data and activities for 2002.

Methods

Population under surveillance

In 2002, the coverage of the network included the entire Australian population, which was estimated to be 19,662,781 persons.[8]

During 2002, OzFoodNet coverage expanded to include the Northern Territory and all of New South Wales. Prior to this, New South Wales had enhanced surveillance only in the Hunter region.

In 2002, the Hunter site continued to operate as a sentinel for foodborne disease occurrence in New South Wales. The Hunter site conducts thorough local investigation and provides a baseline for foodborne disease incidence in New South Wales. In 2002, the population covered by the Hunter site was estimated to be 544,623 persons.

Data sources

Incidence of gastroenteritis

To determine the burden of gastroenteritis in Australia, the National Centre for Epidemiology and Population Health (NCEPH) conducted a cross-sectional survey between September 2001 and August 2002 on behalf of OzFoodNet. A research company used Computer Assisted Telephone Interviews to interview randomly selected individuals from each state and the Northern Territory. The Australian Capital Territory was included in the sample for New South Wales and there was an over sample in the Hunter region. Respondents were asked whether they had diarrhoea or vomiting in the past four weeks, and about the symptoms related to that episode. Interviewers asked people reporting gastroenteritis in the previous month whether they sought medical care, provided a specimen of faeces for testing, were unable to carry out normal daily activities, or missed paid work.

People were considered to have had 'infectious gastroenteritis' if they:

- experienced three or more loose stools and/or two or more vomits in a 24 hour period;
- experienced four or more loose stools and/or three or more vomits in a 24 hour period where they had concomitant respiratory symptoms of respiratory illness; and

- did not have any non-infectious causes, such as pregnancy, medications, chronic illness, or alcohol consumption as a cause for their illness.

The results were analysed using a generalised regression estimator method and jackknife approach to estimation of standard errors (P Bell, Household Surveys Facilities, Australian Bureau of Statistics). Data were weighted by state, age, sex, the number of phone lines in the house and household size.

Estimating the burden of foodborne disease

To estimate the burden of foodborne disease we used Australian data from various sources and adopted the approach taken by Mead, *et al*.[3] OzFoodNet considered 28 'known' bacterial, viral and parasitic pathogens that can cause infectious gastroenteritis. To estimate the community incidence of these pathogens in Australia, data from the National Notifiable Diseases Surveillance System and state surveillance systems, from outbreak investigations in Victoria (Joy Gregory, personal communication, November 2002), from laboratories and from published results of a longitudinal study of gastroenteritis in Australia were used.[9,10,11]

Using these data, the literature and a Delphi assessment of Australian foodborne disease specialists, OzFoodNet estimated the proportion of gastroenteritis that was foodborne for each pathogen.[12] It was assumed that the proportion of gastroenteritis due to foodborne transmission among the 'unknown' agents was the same as for 'known' agents. The estimate of the proportion of foodborne among all these known pathogens was then used as proxy for estimating the proportion of all infectious gastroenteritis that was foodborne.

To account for inherent uncertainty in the data the potential distribution of the estimates were simulated to give credible intervals, similar to Bayesian inferential techniques.[13] OzFoodNet calculated the credible interval of foodborne disease for a 'typical year in Australia–2000'.

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 disease to historical totals, OzFoodNet compared crude numbers and rates of notification to the mean of the previous four 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 jurisdiction for June 2002, or the specified year, were used.[8] 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 gastrointestinal and foodborne disease outbreaks that occurred in Australia during 2002. The reports collate summary information about the setting where the outbreak occurred, 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 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 2002 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 2002. The proportion of notifications with serotype and phage type information were compared with results for the previous two years.

Results

Incidence of gastroenteritis

During the 12 months between September 2001 and August 2002, 11.2 per cent (683/6,096) of respondents reported gastroenteritis in the previous month. The overall weighted incidence of gastroenteritis was 0.92 (95% C.I. 0.77–1.06) cases per person per year. This equated to 17.2 (95% C.I. 14.5–19.9) million cases each year. About a third of cases resulted in either the person with gastroenteritis, or a carer of the sick person missing some work. After weighting, this equates to approximately 6.5 million lost days of work due to gastroenteritis annually.

The crude incidence of gastroenteritis was similar in all jurisdictions, except for the Northern Territory where it was markedly higher (Table 1). The survey identified that children reported the highest incidence followed by 20–40-year-old adults. Older persons and teenagers reported less gastroenteritis. The median duration of an episode of illness was two days. Gastroenteritis accounted for about 45 million days of illness each year in Australia.

People with more severe gastroenteritis were more likely to seek treatment. Over 20 per cent of persons with gastroenteritis visited a doctor for treatment and 19 per cent of these persons provided a faecal specimen. After weighting, there were an estimated total of 4.6 million visits to a health facility and 3.7 million visits to a doctor in Australia in one year. About 40 per cent of cases reported taking at least one medication for their illness. Pain killers were the most common medication taken during illness. After weighting, OzFoodNet estimates that 7.0 million persons take at least one medication each year for gastroenteritis, which includes prescription and medications purchased over the counter at pharmacies.

Table 1.Crude incidence of gastroenteritis in Australia,September 2001 to August 2002, by state or territory

Jurisdiction	Number surveyed	Number with gastroenteritis	Crude incidence (%)
New South Wales	1,031	111	10.3
Northern Territory	862	137	16.3
Queensland	825	81	9.6
South Australia	781	91	11.3
Tasmania	843	88	10.2
Victoria	895	91	9.9
Western Australia	859	84	9.8
Total	**6,096**	**683**	**11.2**

Burden of foodborne disease

Of the 28 potentially foodborne pathogens considered only 20 were considered relevant in Australia. The other eight pathogens either did not cause gastroenteritis, or were not locally acquired or transmitted by food. OzFoodNet estimated that 'known' enteric pathogens cause approximately 5 million cases of gastroenteritis each year in Australia. After considering data for these 'known' pathogens from the literature, outbreaks and expert opinion, it was estimated that the credible interval for the proportion of episodes caused by enteric pathogens in food was between 24 per cent and 40 per cent (mid point 32%). From this, it is conservatively estimated that the number of cases of foodborne illness in Australia in a typical year is between 4–6.9 million cases (mid point 5.4 million cases). Among the 'known' pathogens, pathogenic *Escherichia coli*, noroviruses, *Campylobacter* and *Salmonella* contributed the largest number of cases of foodborne gastroenteritis each year.

Rates of notified infections

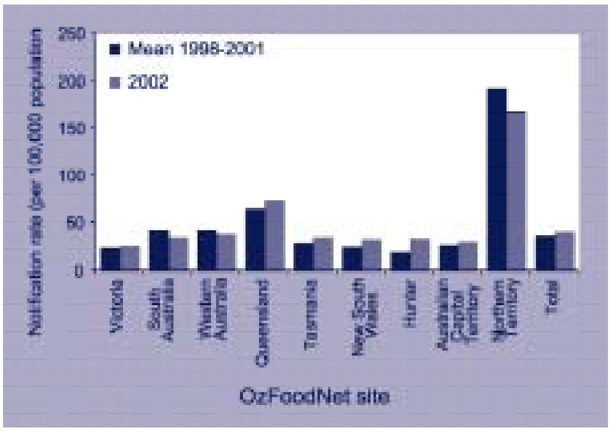
In 2002, OzFoodNet sites reported 23,434 notifications of eight diseases that were potentially foodborne. This was a 7.7 per cent increase from the mean of 21,761 notifications for the previous four years. Reports for these eight diseases make up almost a quarter of notifications to the National Notifiable Diseases Surveillance System.[14] A summary of the number and rates of notifications by OzFoodNet sites is shown in Appendix 1.

Salmonella *infections*

In 2002, OzFoodNet sites reported 7,917 cases of *Salmonella* infection, which equated to a rate of 40.3 cases per 100,000 population. This rate of notification represented an increase of 9.7 per cent over the mean rate for the previous four years (Figure 1). The rate of *Salmonella* notification in OzFoodNet sites ranged from 24.8 cases per 100,000 population in Victoria to 166.7 cases per 100,000 population in the Northern Territory.

Overall, notification rates of salmonellosis for 2002 were increased in the Hunter (62.2%), New South Wales (32.7%), Tasmania (21.5%), the Australian Capital Territory (15.1%), Queensland (12.4%) and Victoria (6.3%) compared to historical means. There were moderate declines in the notification rate of *Salmonella* in South Australia (–19.5%), the Northern Territory (–14.1%), and Western Australia (–10.3%).

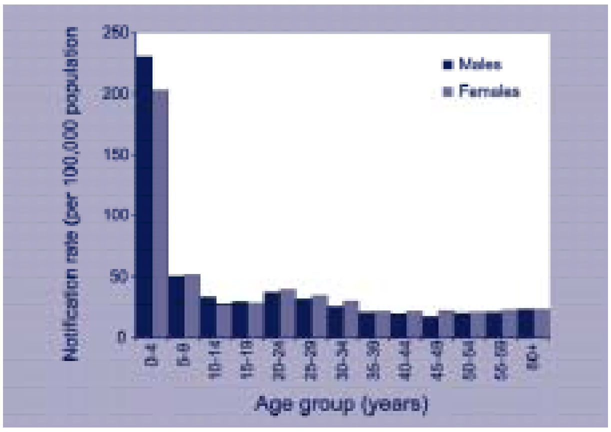
Figure 1. Notification rates of *Salmonella* infections for 2002 compared to mean rates for 1998–2001, by OzFoodNet site



OzFoodNet sites reported that the ratio of males to females was approximately 1:1, and ranged from 1.3:1 in the Northern Territory to 0.8:1 in the Hunter. The median age of cases ranged between 17and 26 years at all OzFoodNet sites, except for the Northern Territory and Queensland where the median ages were 1 and 7 years respectively. There were no major changes in the median ages of salmonellosis cases from 2001 to 2002.

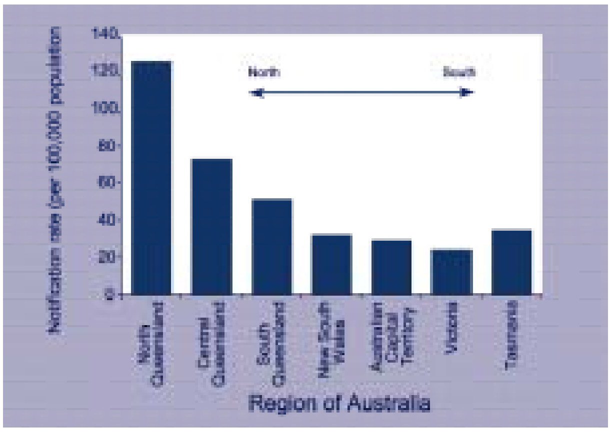
The highest rate of *Salmonella* infection was 230.4 cases per 100,000 population in 0–4-year-old males (Figure 2). The rate was highest in this age group for all sites and ranged from 83.4 cases per 100,000 population in Victoria to 1,421.8 cases per 100,000 population in the Northern Territory. Notification rates were elevated in the 5–9 year age group in all jurisdictions. In all jurisdictions there was also a secondary peak in notification rates in the 20–29 year age range for males and females, which was particularly noticeable in Tasmania.

Figure 2. Age specific notification rates of salmonellosis, Australia, 2002



Rates of salmonellosis were highest in northern areas of Australia, with the highest rate in the Kimberley region.[9,14] Western Australia reported that the Kimberley region had a rate of 332 cases per 100,000 population, which was a 40 per cent decline from the rate reported in 2001. Thirty-nine per cent (128/330) of *Salmonella* notifications in the Northern Territory were in persons of Aboriginal or Torres Strait Island origin. OzFoodNet sites reported that notification rates of salmonellosis increased from south to north along the eastern seaboard of Australia (Figure 3).

Figure 3. Rates of *Salmonella* notifications in selected regions of eastern Australia, 2002, by date of notification



Notifications were analysed by date of receipt at the health department. Rates were directly standardised to the Australian Bureau of Statistics estimated resident population for Australia in 2002. Estimated resident populations for Queensland were from the Australian Bureau of Statistics 2001 Australian Census.

During 2002, there were 704 notifications of *Salmonella* Typhimurium 135 (including 135a) to OzFoodNet sites making it the most common infection (Table 2). This compared to 636 notifications of this phage type last year. There were 604 notifications of *S*. Typhimurium 9, which has been a common phage type for many years. In 2002, Western Australia experienced a significant increase of *S*. Typhimurium 9 and had the highest total number of notifications for this phage type for all jurisdictions. *S*. Typhimurium 126 continued to emerge as a significant new phage type around Australia, which followed a large outbreak in South Australia in 2001. *S*. Typhimurium 170 also continued to increase in Queensland, New South Wales and Victoria. In 2002, there was a significant decrease in numbers of *S*. Typhimurium 64 from previous years. There were 382 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 2002, *Salmonella* Birkenhead was the third and fourth most common serovar in Queensland and New South Wales respectively. This elevated notification rate reflects an endemic focus of *Salmonella* Birkenhead in northern New South Wales and south-eastern Queensland. In Tasmania, *S*. Mississippi, which is rarely reported elsewhere in Australia, made up 48 per cent (79/165) of *Salmonella* notifications. The notification rate for *S*. Mississippi in Tasmania was 16.7 notifications per 100,000 population. Similarly, in the Northern Territory, S. Ball made up 14.8 per cent of *Salmonella* notifications with a rate of 24.7 cases per 100,000 population. This was the highest specific rate for a *Salmonella* subtype in any OzFoodNet site.

In total, OzFoodNet sites conducted 75 investigations into clusters and point source outbreaks of salmonellosis during 2002. A source of infection was identified for 40 per cent (30/75) of these investigations.

Table 2. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2001 to 2002, by OzFoodNet site*

OzFoodNet site	*Salmonella* type (serovar/phage type)	Top 10 infections					
		2002 n	2002 rate†	Proportion %‡	2001 n	2001 rate	Ratio§
Australian Capital Territory	Typhimurium 9	17	5.3	17.7	10	3.2	1.7
	Typhimurium 135	9	2.8	9.4	2	0.6	4.5
	Typhimurium 197	7	2.2	7.3	0	0.0	–
	Bovismorbificans 24	6	1.9	6.3	0	0.0	–
	Potsdam	4	1.2	4.2	0	0.0	–
	Typhimurium 170	4	1.2	4.2	0	0.0	–
	Typhimurium U290	3	0.9	3.1	0	0.0	–
	Typhimurium 64	3	0.9	3.1	2	0.6	1.5
	Stanley	3	0.9	3.1	5	1.6	0.6
	Adelaide	3	0.9	3.1	0	0.0	–
Hunter	Montevideo	22	4.0	12.3	1	0.2	22.0
	Typhimurium 9	14	2.6	7.8	3	0.6	4.7
	Typhimurium 135	13	2.4	7.3	15	2.8	0.9
	Agona	9	1.7	5.0	1	0.2	9.0
	Potsdam	9	1.7	5.0	2	0.4	4.5
	Typhimurium U290	8	1.5	4.5	3	0.6	2.7
	Typhimurium 170	7	1.3	3.9	6	1.1	1.2
	Virchow 34	5	0.9	2.8	0	0.0	–
	Typhimurium 64	5	0.9	2.8	9	1.7	0.6
	Chester	4	0.7	2.2	1	0.2	4.0
	Javiana	4	0.7	2.2	0	0.0	–
	Singapore	4	0.7	2.2	0	0.0	–
	Typhimurium 195	4	0.7	2.2	0	0.0	–
	Typhimurium 197	4	0.7	2.2	0	0.0	–
	Typhimurium U307	4	0.7	2.2	0	0	–
New South Wales	Typhimurium 9	262	3.9	12.2	132	2.0	2.0
	Typhimurium 135	196	3.0	9.1	201	3.1	1.0
	Typhimurium 170	151	2.3	7.0	35	0.5	4.3
	Birkenhead	89	1.3	4.1	89	1.4	1.0
	Typhimurium 126	64	1.0	3.0	97	1.5	0.7
	Typhimurium 197	61	0.9	2.8	1	0.0	61.0
	Montevideo	59	0.9	2.7	4	0.1	14.8
	Bovismorbificans 24	55	0.8	2.6	1	0.0	55.0
	Typhimurium 135a	50	0.8	2.3	41	0.6	1.2
	Potsdam	44	0.7	2.0	10	0.2	4.4

Table 2 continued. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2001 to 2002, by OzFoodNet site*

OzFoodNet site	*Salmonella* type (serovar/phage type)	Top 10 infections					
		2002 n	2002 rate†	Proportion %‡	2001 n	2001 rate	Ratio§
Northern Territory	Ball	49	24.7	14.9	30	15.2	1.6
	Saintpaul	18	9.1	5.5	17	8.6	1.1
	Chester	17	8.6	5.2	12	6.1	1.4
	Litchfield	16	8.1	4.9	8	4.0	2.0
	Anatum	13	6.6	4.0	9	4.6	1.4
	Muenchen	12	6.1	3.6	19	9.6	0.6
	Typhimurium 135	9	4.5	2.7	9	4.6	1.0
	Agona	6	3.0	1.8	0	0.0	–
	Hvittingfoss	6	3.0	1.8	1	0.5	6.0
	Reading	6	3.0	1.8	6	3.0	1.0
Queensland	Virchow 8	279	7.5	10.2	183	5.0	1.5
	Saintpaul	227	6.1	8.3	173	4.8	1.3
	Birkenhead	136	3.7	5.0	134	3.7	1.0
	Typhimurium 170	138	3.7	5.1	20	0.6	6.9
	Hvittingfoss	114	3.1	4.2	53	1.5	2.2
	Aberdeen	112	3.0	4.1	81	2.2	1.4
	Typhimurium 135	110	3.0	4.0	143	3.9	0.8
	Chester	84	2.3	3.1	68	1.9	1.2
	Typhimurium 9	80	2.2	2.9	50	1.4	1.6
	Waycross	68	1.8	2.5	34	0.9	2.0
South Australia	Typhimurium 8	56	3.7	13.6	3	0.2	18.7
	Typhimurium 126	40	2.6	9.7	110	7.3	0.4
	Typhimurium 99	26	1.7	6.3	4	0.3	6.5
	Typhimurium 108	25	1.6	6.1	31	2.1	0.8
	Typhimurium 9	24	1.6	5.8	49	3.3	0.5
	Typhimurium 145	19	1.2	4.6	0	0.0	–
	Typhimurium 126	17	1.1	4.1	15	1.0	1.1
	Typhimurium 12a	15	1.0	3.6	12	0.8	1.3
	Typhimurium 135a	15	1.0	3.6	13	0.9	1.2
	Typhimurium 135	13	0.9	3.2	24	1.6	0.5

Table 2 continued. Numbers, rates and proportions of the top 10 *Salmonella* infections, 2001 to 2002, by OzFoodNet site*

OzFoodNet site	*Salmonella* type (serovar/phage type)	Top 10 infections					
		2002 n	2002 rate†	Proportion %‡	2001 n	2001 rate	Ratio§
Tasmania	Mississippi	79	16.7	47.9	98	20.8	0.8
	Typhimurium 135	20	4.2	12.1	5	1.1	4.0
	Potsdam	14	3.0	8.5	0	0.0	–
	Typhimurium 9	11	2.3	6.7	11	2.3	1.0
	Typhimurium 126	4	0.8	2.4	1	0.2	4.0
	SaintPaul	3	0.6	1.8	2	0.4	1.5
	Newport	3	0.6	1.8	1	0.2	3.0
	Muenchen	3	0.6	1.8	1	0.2	3.0
	Agona	2	0.4	1.2	2	0.4	1.0
	Niarembe	2	0.4	1.2	0	0.0	–
	Typhimurium 197	2	0.4	1.2	0	0.0	–
	Typhimurium U290	2	0.4	1.2	1	0.2	2.0
Victoria	Typhimurium 135	177	3.6	21.2	92	1.9	1.9
	Typhimurium 170	162	3.3	19.4	72	1.5	2.3
	Typhimurium 9	152	3.1	18.2	127	2.6	1.2
	Typhimurium 126	61	1.3	7.3	16	0.3	3.8
	Saintpaul	43	0.9	5.2	10	0.2	4.3
	Typhimurium U290	39	0.8	4.7	4	0.1	9.8
	Typhimurium 4	21	0.4	2.5	80	1.7	0.3
	Infantis	21	0.4	2.5	27	0.6	0.8
	Potsdam	19	0.4	2.3	8	0.2	2.4
	Aberdeen	15	0.3	1.8	3	0.1	5.0
	Enteritidis 4b	15	0.3	1.2	2	0.0	7.5
Western Australia	Typhimurium 135	65	3.4	8.9	89	4.7	0.7
	Typhimurium 9	45	2.3	6.2	18	0.9	2.5
	Saintpaul	42	2.2	5.8	45	2.4	0.9
	Chester	34	1.8	4.7	31	1.6	1.1
	Enteritidis 4b	28	1.5	3.8	3	0.2	9.3
	Muenchen	27	1.4	3.7	26	1.4	1.0
	Typhimurium 135a	27	1.4	3.7	17	0.9	1.6
	Typhimurium 141	20	1.0	2.7	9	0.5	2.2
	Anatum	18	0.9	2.5	15	0.8	1.2
	Typhimurium U290	14	0.7	1.9	4	0.2	3.5
	Senftenberg	14	0.7	1.9	15	0.8	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.

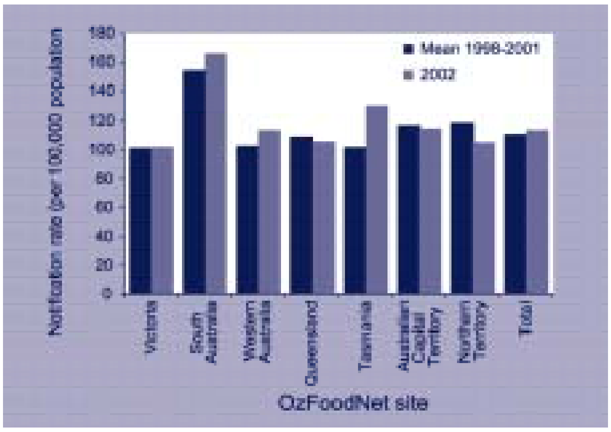
‡ Proportion of total *Salmonella* notified for this jurisdiction in 2002.

§ Ratio of the number of reported cases in 2002 compared to the number reported in 2001.

Campylobacter infections

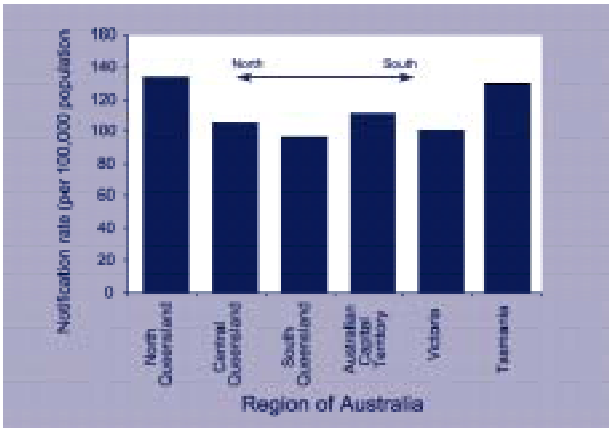
Data for campylobacteriosis were not available for New South Wales, including the Hunter Health Area. With this exception, in 2002 OzFoodNet sites reported 14,716 cases of *Campylobacter* infection, which equated to a rate of 113 cases per 100,000 population.[2] This rate represented a 5.8 per cent increase over the mean for the previous four years (Figure 4). The increase was consistently observed in each quarter of 2002, with the highest rates in spring.

Figure 4. Notification rates of *Campylobacter* infections for 2002 compared to mean rates for 1998-2001, by site excluding New South Wales



Rates of campylobacteriosis increased in Tasmania (27.1%), Western Australia (10.3%), and South Australia (7.5%). Rates were similar to historical means for Victoria, the Australian Capital Territory and Queensland. The Northern Territory experienced a 9.5 per cent decline from historical reports. Geographically, there was no trend in increasing or decreasing rates of notification of *Campylobacter* infection with latitude along the eastern seaboard, in contrast to the pattern observed for *Salmonella* infections (Figure 5). The highest rate of *Campylobacter* infection was 165.7 notifications per 100,000 population in South Australia and the lowest rate was 101.2 notifications per 100,000 population in Victoria.

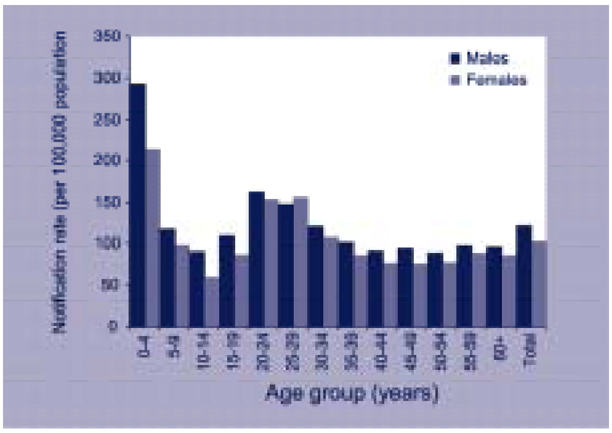
Figure 5. Rates of *Campylobacter* notifications in selected regions of eastern Australia, 2002, by date of notification



Notifications were analysed by date of receipt at the health department. Rates were directly standardised to the Australian Bureau of Statistics estimated resident population for Australia in 2002. Estimated resident populations for Queensland were from the Australian Bureau of Statistics 2001 Australian Census.

The overall ratio of male to females was 1.2:1. All sites, except Tasmania, reported a slight predominance of males amongst notified cases, with male to female ratios ranging from 1.1:1 in Queensland to 1.5:1 in the Northern Territory. The median ages of cases ranged from 17 to 30 years. 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 (Figure 6). The highest age specific rates were in males in the 0–4 year age group in the Northern Territory (518 cases per 100,000 population) and South Australia (473 cases per 100,000 population). The lowest rates in the 0–4 year age group was in Tasmanian female children (128 cases per 100,000 population).

Figure 6. Age specific notification rates of campylobacteriosis, Australia, 2002

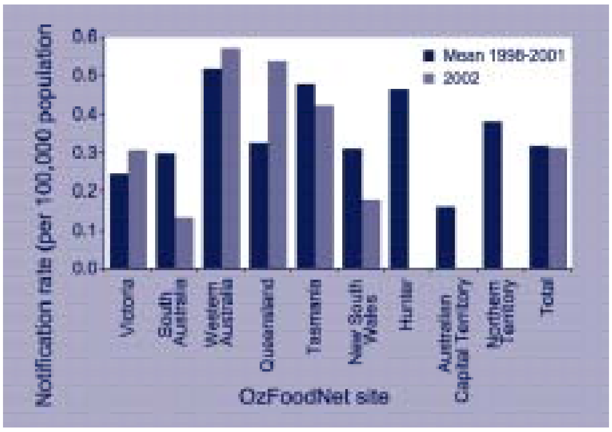


There was only one investigation of *Campylobacter* during 2002 where a source was identified, which occurred in a community-wide increase in Far North Queensland. Thirty-three per cent (68/208) of notified cases in the Northern Territory were in persons of Aboriginal or Torres Strait Island descent.

Listeria

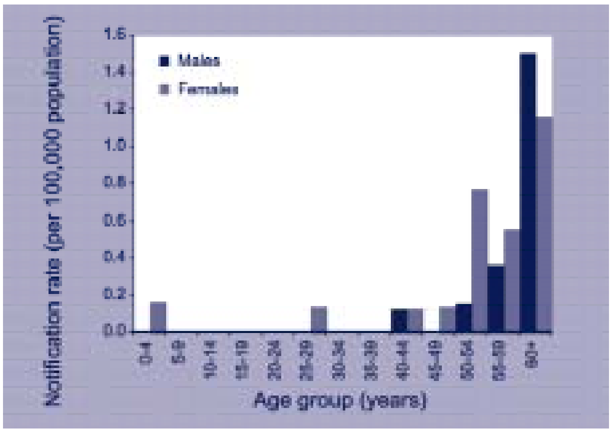
OzFoodNet sites reported 62 cases of listeriosis in 2002, which represents a notification rate of 0.3 cases per 100,000 population (Figure 7). This was a slight increase of 1.2 per cent in the same number of notifications compared to the historical mean. Western Australia (0.6 cases per 100,000 population) had the highest notification rate amongst OzFoodNet sites, which was followed by Queensland (0.5 cases per 100,000 population). There were no common source outbreaks of listeriosis detected during the period, although sites investigated several instances of temporal clustering of cases identified using Pulsed Field Gel Electrophoresis (PFGE).

Figure 7. Notification rates of *Listeria* infections for 2002 compared to mean rates for 1998–2001, by OzFoodNet site



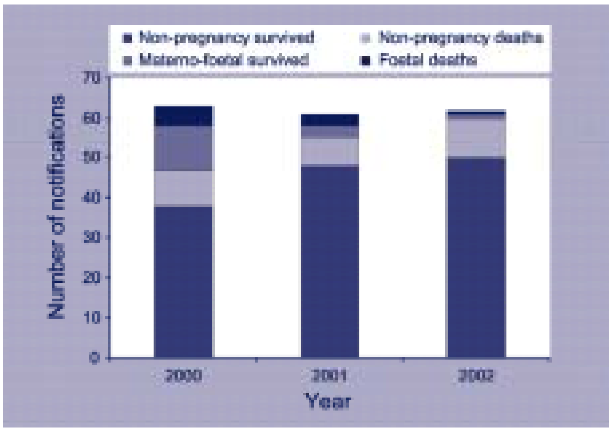
Ninety-seven per cent (60/62) of infections during 2002 were reported in persons who were either elderly and/or immunocompromised. More cases among females were notified during 2002, with the male to female ratio being 0.8:1. OzFoodNet sites reported that the median ages of non-pregnancy associated cases were between 60–86 years. The highest age specific rate of 1.5 cases per 100,000 population was in males over the age of 60 years (Figure 8). There was one notification of listeriosis in a 20-day-old female in Victoria and environmental transmission was suspected. Seventeen per cent (10/60) of non-pregnancy associated cases died.

Figure 8. Age specific notification rates of non-pregnancy associated listeriosis, Australia,2002



Sites reported two maternal foetal *Listeria* infections during 2002, which equated to a rate of 0.8 cases per 100,000 births.* The foetus or neonate died in one of these cases. There was a substantial decline in the number of materno-foetal infections in the three years between 2000 and 2002 (Figure 9).

Figure 9. Notifications of *Listeria* showing non-pregnancy related infections and deaths and materno-foetal infections and deaths, Australia, 2000 to 2002



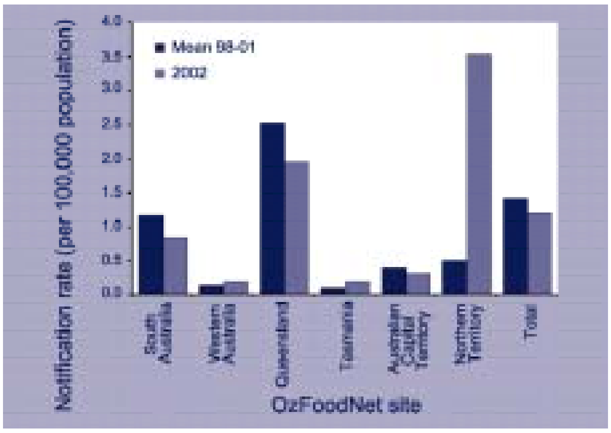
* Births data from the Australian Institute of Health and Welfare National Perinatal Statistics Unit for 1999 and includes live births and foetal deaths.[15]

Yersinia

The CDNA 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 2002, OzFoodNet sites reported 99 cases of yersiniosis, which equated to a rate of 1.2 notifications per 100,000 population (Figure 10). The overall rate declined 15.1 per cent from previous years, when adjusted for the absence of reporting from Victoria and New South Wales. The Northern Territory recorded seven cases of yersiniosis during 2002, giving a rate of 3.0 cases per 100,000 population. This was the highest rate nationally and considerably higher than historical levels in this jurisdiction. The reasons for the increase were unclear, although laboratory practices in the Territory did not change during 2002 (personal communication, Gary Lum, Royal Darwin Hospital, 21 May 2003).

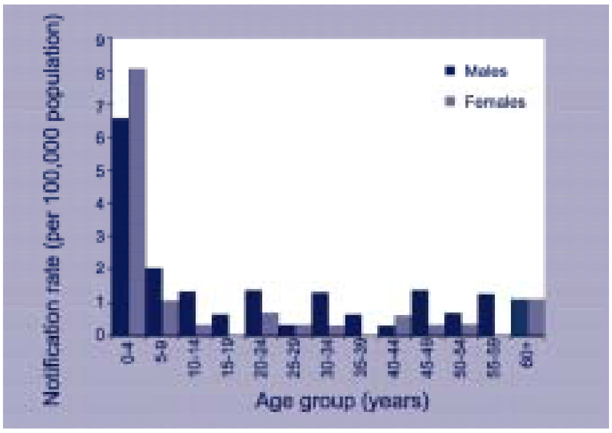
Figure 10. Notification rates of *Yersinia* infections for 2002 compared to mean rates for 1998–2001, Australia excluding Victoria and New South Wales, by OzFoodNet site



Queensland reported 74 per cent (73/99) of all cases, which equated to a rate of 2.0 cases per 100,000 population. The rates of yersiniosis were similar in all three Queensland health zones, and ranged from 1.6 to 2.5 notified cases per 100,000 population.

Overall there was a predominance of notifications in males, with the male to female ratio being 1.4:1. In the two jurisdictions with the majority of cases—South Australia and Queensland—infections in males were more common than in females, with male to female ratios of 2.3:1 and 1.4:1 respectively. Despite this, the highest age specific rate of notification (8.1 cases per 100,000 population) was in females in the 0–4 year age group (Figure 11). The Northern Territory (35.0 cases per 100,000 population) and Queensland (12.5 cases per 100,000 population) reported the highest rates in this age group of females.

Figure 11. Age specific notification rates of *Yersinia* infections, Australia excluding Victoria and New South Wales, 2002

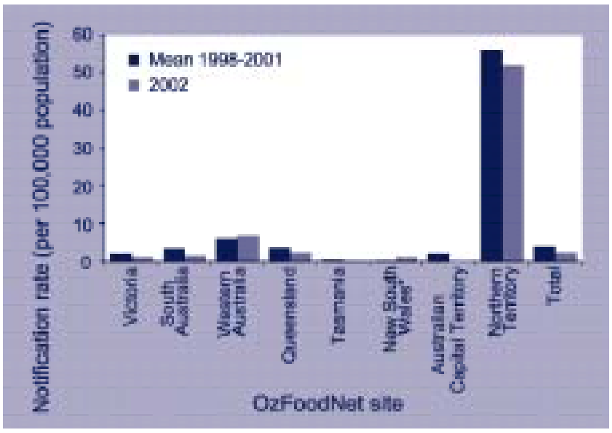


The decrease in *Yersinia* notifications has been occurring for several years and has been observed in other countries. They may be due to changes in laboratory testing practices or a true decline in incidence. Despite the low rates of this disease, it is important for health agencies to continue surveillance for yersiniosis due to its potential for foodborne spread and to monitor the effect of zoonotic control programs.

Shigella

OzFoodNet sites reported 505 cases of shigellosis during 2002, which equated to a notification rate of 2.6 cases per 100,000 population (Figure 12). This was a 38 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.

Figure 12. Notification rates of *Shigella* infections for 2002 compared to mean rates for 1998–2001, by OzFoodNetsite

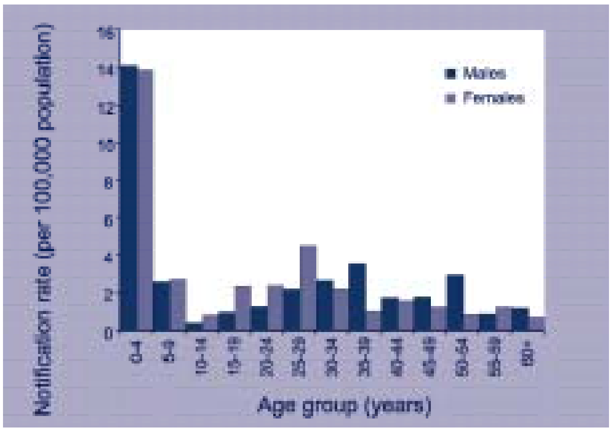


* Shigellosis became notifiable in New South Wales from 2001 onwards.

The highest rate of notification was in the Northern Territory (52 cases per 100,000 population), which was 20 times higher than the overall Australian rate. Eighty-seven per cent (90/103) of notifications in the Northern Territory were in persons of Aboriginal or Torres Strait Island origin. Only Western Australia observed an increased rate compared to the four years mean, the majority of which was related to an increase in cases in the fourth quarter of 2002 from remote areas of the state.

The male to female ratio of shigellosis cases was 1:1. The highest age specific rates were in males (14.1 cases per 100,000 population) and females (13.9 cases per 100,000 population) in the 0–4 year age group, with secondary smaller peaks in the 25–29 year age group for females and the 35–39 year age group for males (Figure 13). There were no reported outbreaks of shigellosis or confirmed links with food. In Australia, the majority of shigellosis infections are thought to be due to person-to-person transmission, or are acquired overseas.

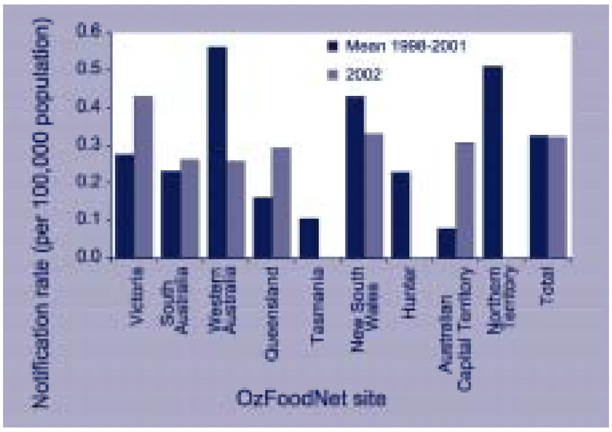
Figure 13. Age specific notification rates of shigellosis, Australia, 2002



Typhoid

OzFoodNet sites reported 64 cases of typhoid infection during 2001, equating to an overall notification rate of 0.3 cases per 100,000 population (Figure 14). The number of notifications was similar to previous years. The highest rate was reported in Victoria (0.4 cases per 100,000 population). Tasmania, the Northern Territory and the Hunter sites did not report any cases.

Figure 14. Notification rates of typhoid infections for 2002 compared to mean rates for 1998–2001, by OzFoodNet site



Where travel status was known, sites reported that 95 per cent (54/57) of cases of typhoid had recently travelled overseas (Table 3). Thirty-seven per cent (20/54) of these cases had recently travelled from Indonesia or Bali and the predominant phage types were D2 (6 cases) and E2 (4 cases). Nineteen cases had travelled to India or the subcontinent and the predominant phage type of *S. Typhi* was E1a (12 cases). The three non-travelling cases were either long-term carriers or infected by close contact with a known carrier. Travel status was unknown for seven cases. Information on phage type was reported for 66 per cent (42/64) of isolates.

Table 3. Travel status for typhoid cases, Australia, 2002

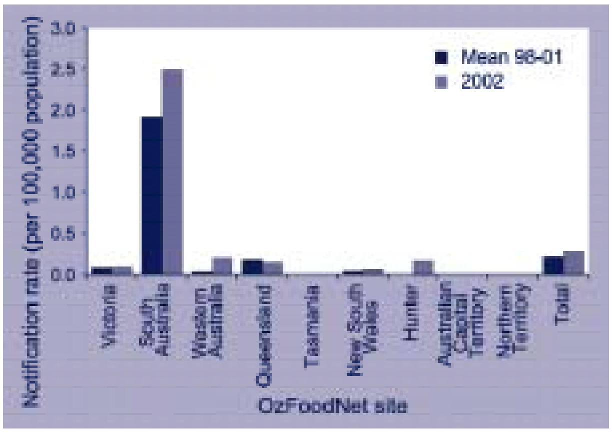
Country	Number of cases	Predominant phage types*
Indonesia	18	E2 (4), D2 (5)
Syria/Lebanon	2	
India	9	E1a (7)
Papua New Guinea	6	E4 (1), D2 (4)
Bangladesh	5	E1a (2)
Pakistan	5	E1a (3)
Kenya/Sudan	2	A (2)
Bali	2	D2 (1)
Samoa	1	E1a (1)
Philippines	1	
Malaysia	1	E4 (1)
Italy	1	
Carrier	1	
Infected by carrier	2	
Travel on ship to high risk areas	1	
Unknown	7	
Total	**64**	

* Numbers in parentheses represent number of cases infected by the phage type. Note that other phage types may have caused disease in returned travellers but are not shown here.

Shiga toxin producing E. coli *infections*

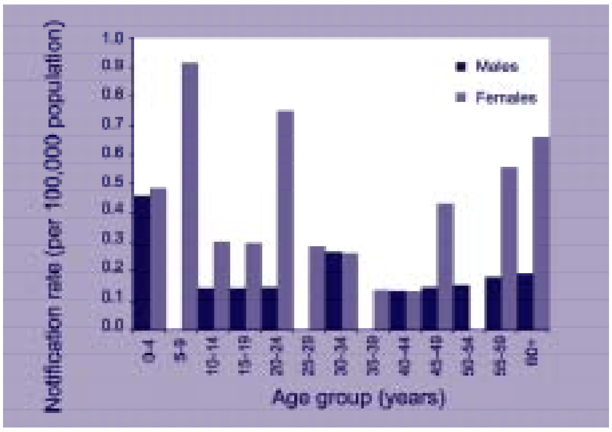
OzFoodNet sites reported 58 cases of shiga toxin producing *E. coli* (STEC) infection during 2002 (Figure 15). This number does not include cases of haemolytic uraemic syndrome where a toxigenic *E. coli* was isolated. The notification rate of 0.3 cases per 100,000 population was a 28 per cent increase over the mean rate for previous years. South Australia (38 cases) reported the majority of cases. All sites reporting cases had an increase in the number of cases notified, except for Queensland where there was a 14 per cent decrease from previous years. There were no cases reported from Tasmania, the Australian Capital Territory or the Northern Territory during 2002.

Figure 15. Notification rates of shiga toxin producing *E. coli* infections for 2002 compared to mean rates for 1998–2001, by OzFoodNet site



The male to female ratio of cases was 0.3:1 and the highest rates were in 4–9 and 20–24-year-old females (Figure 16). The reason for the strong predominance of females amongst notified cases is unknown. The highest rate was in South Australia, which reported 2.5 notifications per 100,000 population.

Figure 16. Age specific notification rates of shiga toxin producing *E. coli* infections, Australia, 2002



The majority of cases in South Australia were detected by polymerase chain reaction (PCR) and no typing details were available (Table 4). *E. coli* O157 was the most common serotype, making up 34 per cent of notifications. This represented an 82 per cent increase in reports of this serotype from the previous year. None of these *E. coli* O157 isolates were the H7 subtype, although H type was rarely reported. There were six notifications of *E. coli* O26 making it the second most common serotype. There were no cases of *E. coli* O111 notified during 2002.

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*. The different tests employed in reference laboratories account for the distribution of *E. coli* serotypes. Some laboratories predominantly use PCR testing and never culture, which means that a high proportion of notified cases are not definitively identified to the serotype level. South Australia has the most intensive testing regime and test bloody stool (both microscopic and macroscopic) for the presence of the genes coding for production of shiga toxin. Faecal specimens testing positive are then tested using specific PCR assays for virulence characteristics and specific *E. coli* serotypes. Queensland tests bloody faecal specimens using an enzyme linked immunosorbent assay test kit to detect the presence of shiga toxin. Positive faecal specimens are then tested for STEC using specific PCR tests. Laboratories in most other Australian jurisdictions only test for STEC on request from a doctor or in outbreak settings.

All of the cases appeared to be sporadic, except for one outbreak of *E. coli* O26 associated with animal contact in South Australia.

Table 4. Infecting subtypes of shiga toxin producing *E. coli* causing diarrhoea, Australia, 2001 to 2002

Organism type	Total 2002	Total 2001
O157	16	8
O26	6	5
O157:H–	3	1
Other *E. coli* serotype*	3	4
O113	2	1
O157 other H type	1	1
O157:H7	0	1
Untypable	1	2
Not typed†	23	20
Unspecified	3	6
Total	**58**	**49**

* Includes positive reports obtained by PCR that designated specimens as “non-O157 non-O111”.

† South Australia reported 96% (22/23) of not typed E. coli, which were PCR positive where no culture was obtained or serotyped.

Haemolytic uraemic syndrome

There were 13 cases of haemolytic uraemic syndrome reported during 2002, corresponding to an overall rate of 0.1 case per 100,000 population. New South Wales reported seven of these cases, three of which were notified in the Hunter. Victoria reported four cases, and Queensland and the Northern Territory both reported one case each (Figure 17).

The male to female ratio of cases was 0.7:1 and the highest rate of infection was in females in the 30–34 year age group (0.3 cases per 100,000 population). Sites reported that STEC were isolated for 46 per cent (5/13) of cases (Table 5). Three cases were due to the O157 serotype, making it the most common. There was one case of haemolytic uraemic syndrome due to *E. coli* O157:H7 during 2002.

Figure 17. Numbers of notifications of haemolytic uraemic syndrome, Australia, 1998 to 2002, by month of notification and OzFoodNet site

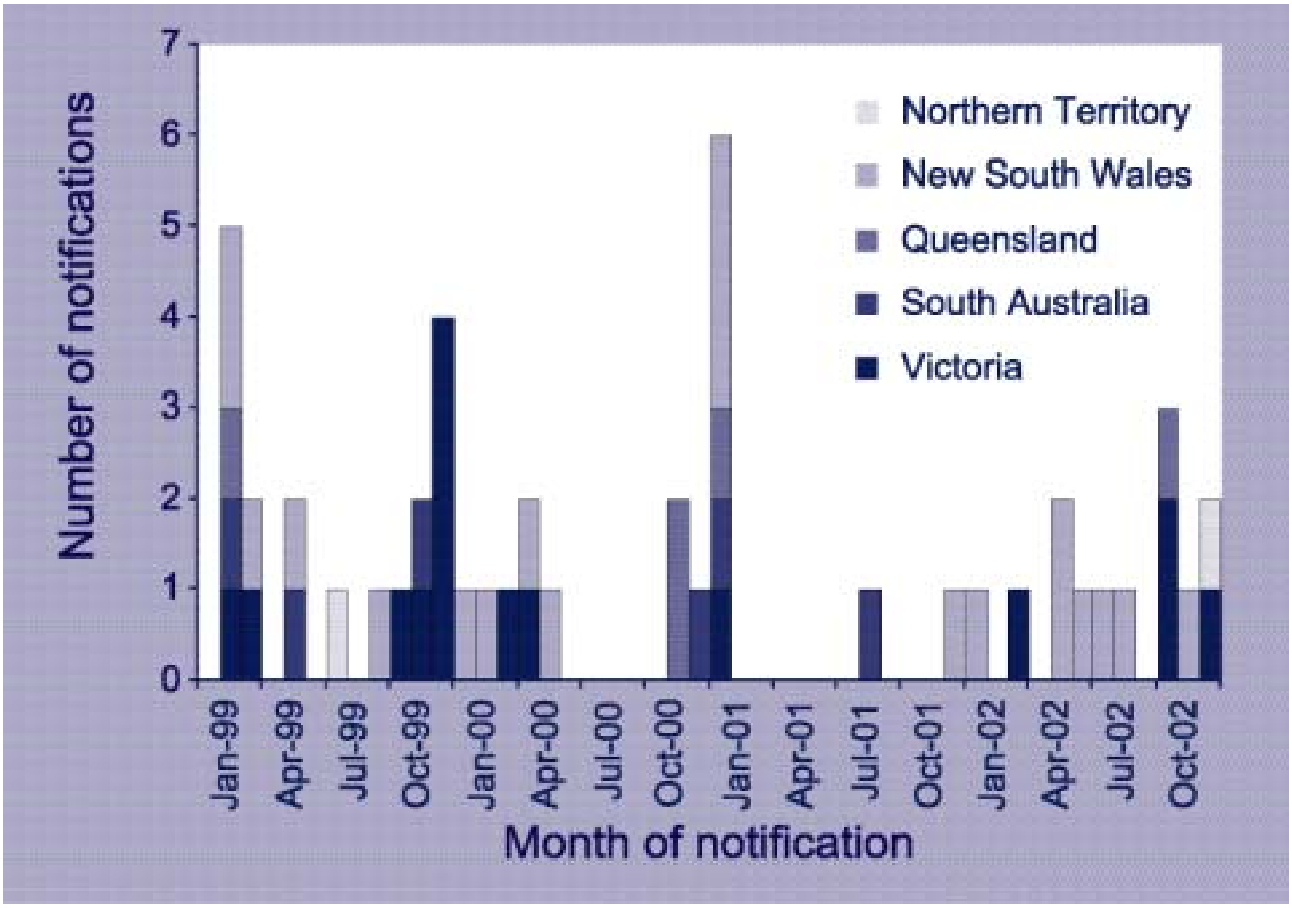


Table 5. Notifications of haemolytic uraemic syndrome and infecting subtypes of shiga toxin producing *E. coli*, Australia, 2001 to 2002

Organism type	Total 2002	Total 2001
O157	1	0
O157:H–	1	0
O157:H7	1	0
O157 other serotype	0	1
Other *E. coli* serotype	2	0
Untypable	0	2
Unspecified	7	5
No toxigenic *E. coli* – clinical diagnosis only	1	0
Total	**13**	**8**

Gastrointestinal and foodborne disease outbreaks

During 2002, OzFoodNet sites reported 513 outbreaks of gastrointestinal illness affecting 11,791 persons. Ninety-two of the outbreaks were due to transmission from contaminated food or water giving an overall rate of 4.7 outbreaks per million population. Three outbreaks were due to contact with infected animals.

The aetiology of the remaining outbreaks was either difficult to determine or were likely person-to-person transmission. Sites conducted 100 investigations into 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 318 outbreaks affecting 8,203 persons. The majority of these outbreaks occurred in aged care facilities and hospitals, and were due to norovirus.

Foodborne disease outbreaks

In 2002, 92 foodborne disease outbreaks affected 1,819 persons, hospitalised 103 persons and caused two deaths (Table 6). Appendix 2 shows a summary description of each outbreak.

Victoria reported the largest number of outbreaks (26/92, 28.3%), followed by New South Wales (23/92, 25%). The reporting rates of foodborne outbreaks for different OzFoodNet sites ranged from 1.5 per million persons in Western Australia to 31.2 per million persons in the Hunter. The Australian Capital Territory and the Northern Territory did not report any outbreaks with a foodborne mode of transmission during 2002. The majority of outbreaks occurred in summer and autumn (Figure 18). There was a peak in December relating to pre-Christmas functions, which was also observed in 2001.

Figure 18. Outbreaks of foodborne disease, Australia, 2001 to 2002

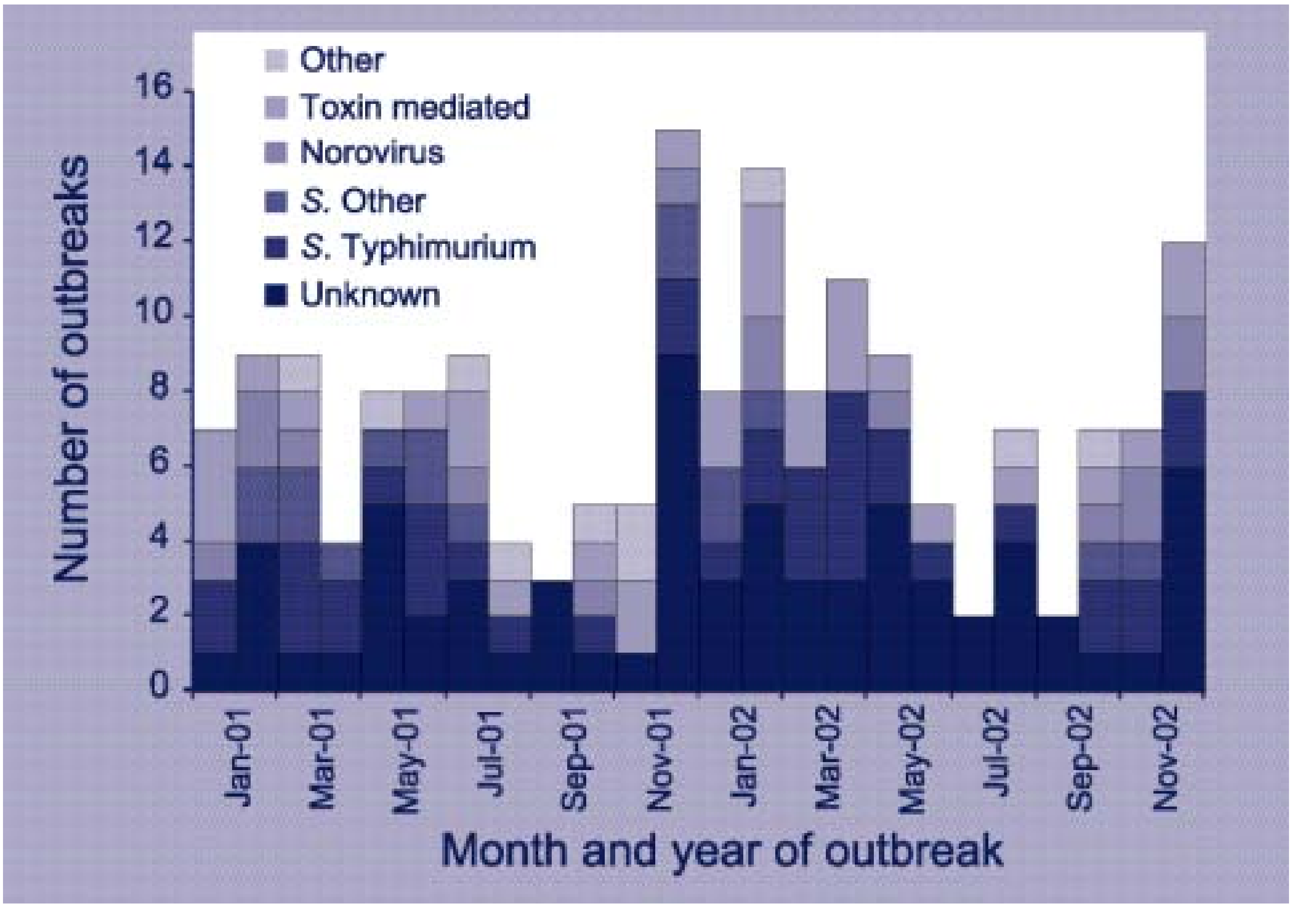


Table 6. Outbreaks of foodborne disease in Australia, 2002, by OzFoodNet site

State	Number of outbreaks	Number affected	Hospitalised	Deaths	Mean number of cases per outbreak
Hunter	17	143	8	0	8.4
New South Wales	23	404	21	0	17.6
Queensland	18	205	18	1	11.4
South Australia	4	113	22	1	28.3
Tasmania	1	5	3	0	5.0
Victoria	26	859	29	0	33.0
Western Australia	3	90	2	0	45.0
Total	**92**	**1,819**	**103**	**2**	**20.0**

Table 7. Aetiological agents responsible for foodborne disease outbreaks showing number of outbreaks and numbers of persons affected, Australia, 2002

Agent category	Number of outbreaks	Number affected	Hospitalised	Deaths
S. Typhimurium	21	471	61	2
C. perfringens	8	155	1	0
Norovirus	8	378	3	0
Salmonella other	5	72	7	0
Ciguatera	4	14	7	0
S. aureus	2	15	1	0
B. cereus	1	37	0	0
Campylobacter	1	24	6	0
Hepatitis A	1	8	0	0
Mixed toxins	1	272	13	0
Suspected wax esters	1	10	0	0
V. parahaemolyticus	1	2	0	0
Unknown	38	361	4	0
Total	**92**	**1,819**	**103**	**2**

Aetiological agents

The most common agent responsible for foodborne disease outbreaks was *Salmonella*, which was responsible for 28 per cent (26/92) of outbreaks (Table 7). These outbreaks affected a total of 543 persons with a hospitalisation rate of 13 per cent (68/543). *S.* Typhimurium was responsible for 81 per cent (21/26) of *Salmonella* outbreaks. Two fatalities were reported from two separate outbreaks of *S.* Typhimurium. There was only one outbreak of campylobacteriosis which affected 24 persons, and one small outbreak of *Vibrio parahaemolyticus*.

There were 16 outbreaks of toxin related illness during 2002. The most common was due to *Clostridium perfringens* (8 outbreaks). There were four outbreaks due to ciguatera fish poisoning, all of which were small (median of 3 persons). Ciguatera fish poisoning had the highest hospitalisation rate of 50 per cent (7/14). There were three outbreaks due to *Staphylococcus aureus*, one of which was a large outbreak in which *Bacillus cereus* was also identified. *B. cereus* was responsible for two outbreaks both involving rice meals.

There were nine outbreaks of known viral aetiology, eight of which were due to norovirus. These outbreaks of norovirus affected 378 persons, but only 0.8 per cent (3/378) were hospitalised. The other outbreak of viral illness was due to hepatitis A and affected eight persons.

There was one outbreak of gastroenteritis suspected to be due to wax esters from escolar or oilfish marketed under the name of rudderfish. Thirty-eight (41%) outbreaks were of unknown aetiology; these affected 361 persons and four cases were hospitalised.

Food vehicles

There was a wide variety of foods implicated in outbreaks of foodborne disease during 2002 (Table 8), although investigators could not identify a source for 34 per cent (31/92) of outbreaks. Fish, poultry and mixed foods were implicated in six outbreaks each. There were six outbreaks associated with red meat and a further six outbreaks associated with seafood. Five outbreaks were associated with eggs. There were two outbreaks associated with Vietnamese pork/beef rolls and two associated with kebabs.

Outbreaks involving cream filled cakes, egg dishes and fish had hospitalisation rates of 20 per cent or higher. Two outbreaks of salmonellosis, one associated with cream cakes and the other with a raw egg dish, resulted in two fatalities.

Table 8. Categories of food vehicles implicated in foodborne disease outbreaks, Australia, 2002

Vehicle category	Number of outbreaks	Number affected	Hospitalised	Deaths
Fish	6	26	7	0
Mixed foods	6	345	22	0
Poultry	6	57	8	0
Red meat/meat products	5	101	0	0
Dessert	4	71	2	0
Cream filled cake	3	61	12	1
Pizza	3	17	0	0
Rice dishes	3	46	1	0
Seafood	3	68	2	0
Suspected egg dishes	3	27	2	1
Suspected seafood	3	12	0	0
Egg dishes	2	23	8	0
Salad dishes	2	99	15	0
Sauces	2	38	0	0
Soup	2	23	0	0
Kebabs	2	49	5	0
Vietnamese rolls	2	52	8	0
Asian foods	1	12	1	0
Bean dish	1	132	1	0
Sandwiches	1	12	0	0
Suspected red meat/meat products	1	4	0	0
Unknown	31	544	9	0
Total	**92**	**1,819**	**103**	**2**

Outbreak settings

The most common setting for the occurrence of outbreaks was at restaurants (43%), followed by the home (13%), takeaway venues (11%), and events catered for by professional companies (8%) (Table 9). There were two outbreaks in community settings. Five outbreaks were due to foods purchased from bakeries, two of which were Asian bakeries. There were four small outbreaks (median size: 5 persons) associated with national franchised fast food outlets. There were two outbreaks each at schools, childcare centres, cruises and community fairs.

Investigative methods and levels of evidence

States and territories investigated 28 outbreaks using retrospective cohort studies and nine outbreaks using case control studies. Fifty per cent (14/28) of outbreak investigations using cohort studies were of unknown aetiology. Twenty-one per cent (6/28) of investigations using cohort studies were *Salmonella* outbreaks. Fifty per cent of *C. perfringens* outbreak investigations used cohort studies. Sixty-seven per cent (6/9) of outbreak investigations using case control studies were due to *Salmonella*. The remaining 55 outbreaks relied on descriptive information to attribute a foodborne cause or identify a food vehicle.

To attribute the cause of the outbreak to a specific food vehicle, investigators obtained analytical evidence from epidemiological studies for 12 outbreaks. Microbiological evidence of contaminated food was found in eight outbreaks, with a further eight outbreaks investigations obtaining both microbiological and analytical evidence. Investigators obtained analytical and/or microbiological evidence for 52 per cent (14/27) of *Salmonella* outbreaks. Seventy-two per cent (66/92) of outbreaks relied on descriptive evidence to implicate a food or foodborne transmission.

Table 9. Categories of settings for foodborne disease outbreaks, Australia, 2002

Setting category	Number of outbreaks	Number affected	Hospitalised	Deaths
Restaurant	40	736	23	0
Home	12	120	23	0
Takeaway	8	66	5	0
Commercial caterer	7	154	4	0
Bakery	5	113	20	1
Aged care facility	4	68	4	1
National franchised fast food	4	20	0	0
Fair/festival/mobile service	2	278	14	0
Child care	2	19	1	0
Community	2	29	6	0
Cruise/airline	2	21	1	0
School	2	180	2	0
Hospital	1	13	0	0
Institution	1	2	0	0
Total	**92**	**1,819**	**103**	**2**

Significant outbreaks

Six outbreaks affected 50 persons or more in 2002. Two were due to norovirus, two due to bacterial toxins, and two due to *Salmonella* Typhimurium. Four of these outbreaks occurred at restaurants, one at a school and one at a community festival. A variety of foods were implicated in these outbreaks, including: a bean dish, Caesar salad, seafood salad, lamb curry and a mixed meal of rice and meats.

The outbreak associated with the Caesar salad was due to *S*. Typhimurium 8, and occurred in South Australia. Seventy-eight cases were associated with this outbreak and 15 persons were hospitalised. Fifty-eight per cent (45/78) of cases were laboratory confirmed as *S*. Typhimurium 8. Several salad ingredients tested positive for *S*. Typhimurium 8 including the dressing, anchovies and parmesan cheese, with a very high organism count detected in the salad dressing (830,000 per gram). A meal of lamb, rice and potatoes contaminated with *S. aureus* and *B. cereus* caused an outbreak of gastrointestinal illness at a religious festival. Approximately 45 per cent of 600 persons attending the event became violently ill after eating food that was prepared with inadequate facilities for cold storage and preparation.

There were 20 outbreaks affecting between 20 and 50 persons. Cakes were implicated in four of these, two of which were caused by *Salmonella*. In one outbreak of *S*. Typhimurium 99 in South Australia, the bakery used the same piping bag to dispense both sausage meat, and cream for cakes. Two outbreaks were due to Vietnamese rolls containing pork and/or beef contaminated by *S*. Typhimurium 135 and *S*. Typhimurium 126.

Queensland reported an outbreak of *Campylobacter* infections from northern Queensland in August 2002. The public health unit, in conjunction with the Queensland site, interviewed 24 cases who identified chicken as a likely source and no other common exposures. The public health unit investigated a local poultry abattoir that was the main supplier of chickens for the region. Investigators collected samples of raw fresh chicken from the abattoir and from retail outlets representing three different chicken producers in Queensland. Sixty-seven per cent (29/43) of raw chicken samples were positive for the presence of *Campylobacter*. A specific *Campylobacter* subtype (Fla type 7) was the predominant subtype among human cases in northern Queensland and in chicken from two Queensland poultry manufacturers. PFGE typing of Fla type 7 isolates found that strains from human cases (Fla type 7; PFGE type P1) were indistinguishable from those obtained from the local abattoir. Fla type 7 *Campylobacter* isolates obtained from the other southern Queensland chicken manufacturers were distinct from these isolates by PFGE typing.

During February, the Hunter site investigated an outbreak of *C. perfringens* intoxication affecting 33 persons following a spit roast meal. The company had transported the meats to Newcastle from Sydney without proper temperature controls. At a national surveillance teleconference, it was reported that this outbreak was similar to four others in the Australian Capital Territory prior to Christmas. After investigation, it was identified that the same company supplied all five meals. All Australian jurisdictions reviewed their records to identify other similar incidents. The survey identified that the company had caused a total of 12 separate outbreaks affecting 332 persons in four jurisdictions in the previous five years.

There were two outbreaks associated with imported foods that could have international implications. One outbreak of *S*. Montevideo in the Hunter affected 47 persons and was linked to a local takeaway kebab shop. A further six associated cases were notified in 2003, which are not included in the outbreak total reported here. The investigation found several products in the kebab shop positive for *S*. Montevideo including tahini and hommus. Unopened jars of tahini originating from Egypt subsequently tested positive for *S*. Montevideo and *S*. Tennessee. This outbreak resulted in nationwide consumer and trade recalls, and an international alert to electronic list servers. Despite the potential for wider spread, New South Wales was the only site to report infections, although there were three cases in interstate visitors. There were no human infections reported overseas.

The other outbreak with potential for international spread occurred in Western Australia in August 2002. Delegates of a mining conference in Kalgoorlie became ill after consuming 'oyster shooters' served at a cocktail party. Over 1,000 persons attended the conference and the attack rate from a cohort study of 700 participants was

23 per cent. The oyster shooters were prepared using bulk oyster meat imported from Japan, and tomato juice. The label on the packet of oysters clearly stated, 'cook before consumption'. Norovirus was suspected as the cause of illness, although no virus was detected in faeces, or in a different batch of the same brand of oysters. There were three outbreaks of confirmed norovirus associated with Korean imported bulk oyster meat in New Zealand at the same time (Gail Greening, Institute of Environmental Science and Research, New Zealand, personal communication, April 2002).

Animal-to-person outbreaks

Sites reported three outbreaks that were transmitted from animal-to-person during 2002. Two of these were *Salmonella* outbreaks associated with poultry hatching programs in childcare centres. One was an outbreak of *S*. Agona affecting seven children in the Hunter region associated with ducklings. The other was an outbreak of *S*. Typhimurium 170 affecting six children in Queensland following hatching of chickens. A trace-back investigation in Queensland identified *S*. Typhimurium 170 and *S*. Typhimurium 12 in environmental samples from two poultry breeder sheds operated by the hatchery, which supplied eggs for the hatching program.

The other outbreak of animal-to-person gastroenteritis was due to shiga toxin producing *E. coli* in South Australia. Six persons were affected after either visiting or having contact with persons visiting a petting zoo located at a regional fair. The predominant *E. coli* serotype was O26, although some later cases were non-O26. Investigation of the petting zoo revealed a pig with same multiplex polymerase chain pattern for STEC which was negative for *E. coli* O26.

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 are a small number of point source outbreaks where the mode of transmission is indeterminate that have been classified as a cluster.

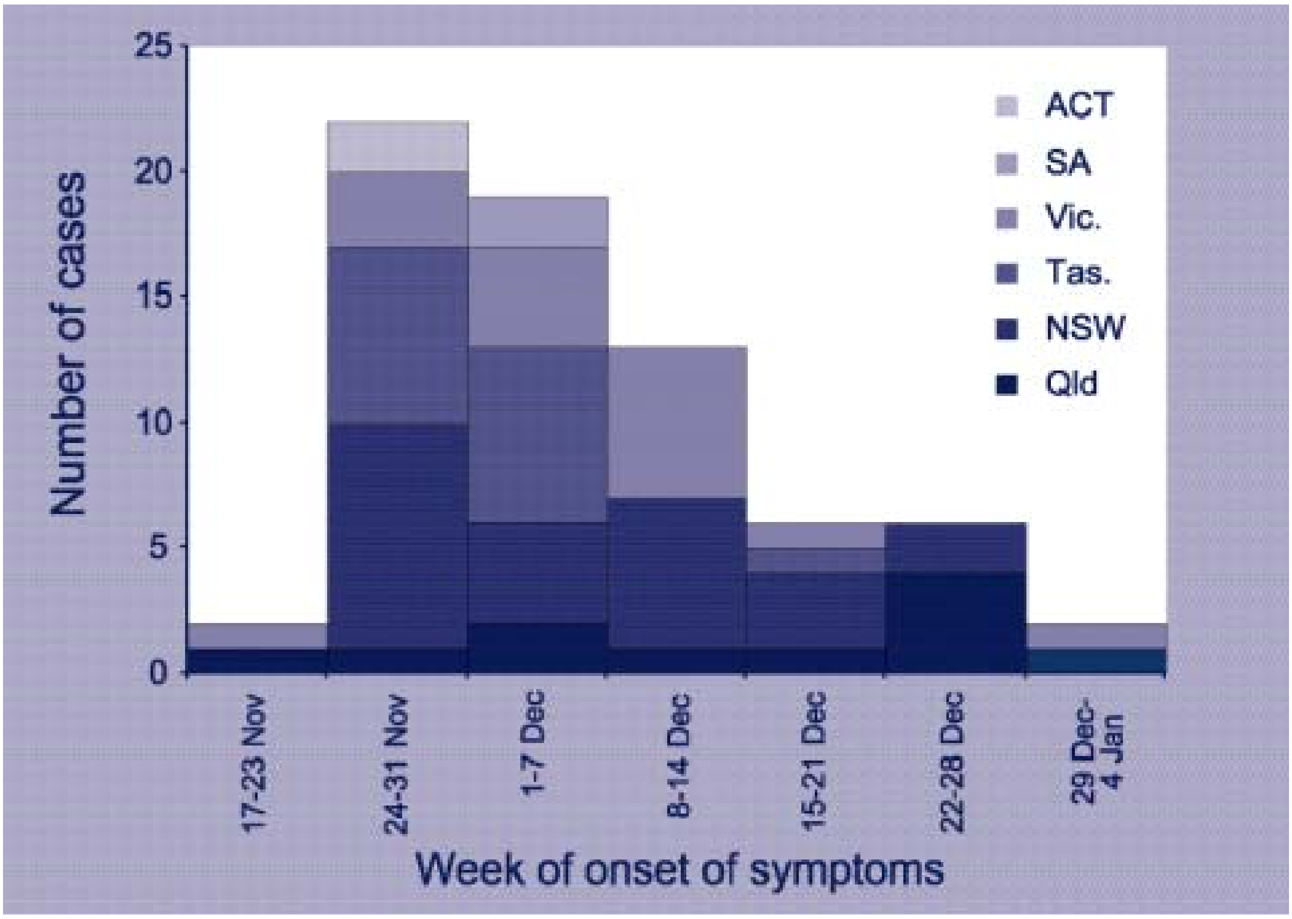
During 2002, states and territories conducted 100 cluster investigations, including three multi-state investigations. These clusters affected 1,751 persons with 65 cases hospitalised and one death. Forty-five per cent (45/100) of these investigations related to clusters of *Salmonella. Salmonella* clusters affected 601 persons with 53 cases hospitalised and one death. *S*. Typhimurium was responsible for 38 per cent (17/45) of cluster investigations. Of the remaining 28 investigations, there were 25 other different *Salmonella* serovars involved. Fifty-three per cent (53/100) of cluster investigations were of unknown aetiology.

There was one investigation of norovirus in a restaurant where the mode of transmission was unable to be determined. The Northern Territory reported a cluster of *Cryptosporidium* infections in the first six months of 2002. This community-wide increase was linked to infections acquired in a childcare centre and a local pool.

The first multi-state cluster investigation occurred in January 2002 and was related to *S*. Typhimurium 170.[16] Queensland, New South Wales and Victoria jointly investigated cases to generate hypotheses. Many cases were interviewed, although the source of infections was not identified.

The other two cluster investigations in November 2002 were of *S*. Kottbus and *S*. Potsdam. States and territories investigated less than 20 cases of *S*. Kottbus. The *S*. Kottbus cluster was spread across Australia and no common exposure was identified. The *S*. Potsdam cluster investigation involved New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania. Thirty-four per cent of S. Potsdam cases were New South Wales residents, although the rate in Tasmania (3.2 cases per 100,000 population) was tenfold higher than any other jurisdiction (Figure 19).

Figure 19. Cases of *Salmonella* Potsdam, Australia, November to December 2002, by date of onset



Sites interviewed 50 cases of *S.* Potsdam using hypothesis-generating questionnaires. Reliable food histories were available for 25 of these cases. The most commonly consumed foods in the three days prior to illness were fresh tomatoes (68%) and chicken (68%). Fifty-two per cent of cases ate tomatoes on the day before onset of illness. Investigators suspected that the source of infection was a type of fresh salad produce, although comparison with food histories from population-based controls indicated that it would be difficult to show this epidemiologically.

Collecting reliable food histories during the Christmas period complicated epidemiological investigations. Food safety agencies were involved in a complicated traceback investigation for produce and other foods. Despite these intensive efforts, no source of infection for the outbreak was identified.

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

Food

During 2002, 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 mayonnaise and salad dressings. These outbreaks can be large and serious, as highlighted by the outbreak of *S.* Typhimurium 8 in South Australia. There is a need to review the circumstances of egg-associated outbreaks in detail to identify potential interventions, and whether there is a need for better quality assurance in the industry. The restaurant and catering industries need to be made aware of the risks of using raw unpasteurised eggs in sauces and dressings.

Chicken and poultry

During 2002, OzFoodNet finalised a multi-state case control study into risk factors for *Campylobacter* infection. Preliminary results indicate that one of the major risk factors for illness is consumption of chicken. Chicken was the only vehicle implicated in *Campylobacter* outbreaks in 2002, despite it being the most common gastrointestinal disease notified to health departments in Australia. In 2002, outbreaks of poultry-associated salmonellosis continue to occur, including two animal-to-person outbreaks. Poultry is consumed by approximately 80 per cent of people each week. To make our food supply safer, Australia needs to consider ways to reduce the burden of infections due to this source of infection in the community.

Vietnamese pork rolls

There were two outbreaks of *Salmonella* infection associated with these ethnic specialty dishes during 2002. Health authorities have been aware of the health risks associated with Vietnamese pork rolls for several years. Large outbreaks associated with these rolls have occurred in at least three states due to poor preparation and handling.[17,18] The occurrence of two more outbreaks in 2002 show that they are a particularly high-risk food. Regulatory agencies and restaurants need to urgently improve the safety of these popular foods.

Red meats and meat products

There were several outbreaks associated with red meats during 2002. These were due to a mixture of pathogens and in a variety of settings. The investigation into the multi-state outbreak of *Salmonella* Typhimurium 170 did not identify a specific food vehicle, but suggested potential links to red meat and poultry consumption. From this investigation is clear that there is a need for better and more timely sharing of data from human, animal and food surveillance systems.

Imported foods

The two outbreaks associated with imported foods during 2002 showed the potential for the spread of foodborne disease internationally. Oysters are known to be at high risk of norovirus contamination. New Zealand reported similar outbreaks at the same time as outbreaks in Australia, although the source of oysters was different. Caterers should follow cooking instructions where provided to prevent foodborne disease. The outbreak of *S.* Montevideo associated with Egyptian tahini in the Hunter highlighted the potential for contamination of sesame-based products with *Salmonella*. In this outbreak, the level of contamination was very low (1–2 organisms per gram). However, *Salmonella* were able to rapidly multiply when the tahini was used to make hommus. Agencies investigating outbreaks of salmonellosis should consider tahini, helva and other sesame-based products as potential sources of contamination. It may help to increase the risk classification of these products and frequency of testing on importation into Australia

Settings

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

Bakeries

The five outbreaks occurring in bakeries in 2002 revealed the need for better assessment of food safety issues in these premises. Two of the outbreaks were related to Vietnamese pork rolls and the remaining three were associated with cakes filled with cream and/or custard. All outbreaks have been caused by *Salmonella* sp. 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. There is a need for research to determine what are the critical food safety problems in these facilities that result in foodborne disease.

Restaurants and catered events

Outbreaks due to this sector constituted 57 per cent (47/92) of outbreaks. A variety of pathogens caused these outbreaks, including *Salmonella, C. perfringens*, norovirus and *V. parahaemolyticus*. Outbreaks involving restaurants and commercial caterers are more readily recognised, as the meals are often served to large numbers of persons. Clearly there is a need to continue to monitor the causes of outbreaks in this sector to identify gaps in food safety practices. The outbreak of *C. perfringens* poisoning due to spit roasts highlighted the problems for regulatory agencies operating at the state level dealing with food businesses operating in more than one jurisdiction with poor food practices for preparing food.

Hospitals and aged care

People resident in aged care settings and hospital patients are at particular risk for foodborne disease, which is shown by the five outbreaks that occurred during 2002. Two were due to *C. perfringens* indicating problems with preparation and handling of foods for residents. The outcomes for patients in these settings are often more adverse, as these sub-populations more susceptible to serious gastrointestinal disease. During 2002, OzFoodNet reviewed listeriosis notifications in Australia, which identified that three out of five listeriosis outbreaks in the years between 1995 and 2000 had occurred in hospital settings. The food supplied to hospital patients and persons in institutions should be readily monitored. There is also a high potential for foodborne transmission of norovirus when food handlers become infected during the many person-to-person outbreaks that occur each year in these facilities.

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 surveillance conducted at different sites.

National information sharing

In 2002, 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 *S*. Typhimurium 170, and *S*. Potsdam. The cluster report was also important in identifying a single spit roast company as the cause of several outbreaks spread over time and several jurisdictions. The cluster report supplemented information sharing on a closed list server, teleconferences and at quarterly face-to-face meetings.

Outbreak reporting and investigation

During 2002, the Hunter site reported the highest reporting rate of outbreaks of foodborne disease (31.2 per 100,000 population) and foodborne salmonellosis (7.3 per 100,000 population). The rates of other sites reporting foodborne *Salmonella* outbreaks ranged between 1.3–2.1 outbreaks per 100,000 population. Victoria investigated the largest number of foodborne disease outbreaks (26 outbreaks; 5.4 per 100,000 population) and *Salmonella* clusters (26 clusters; 5.3 per 100,000 population).

States and territories conducted 52 analytical studies (cohort or case control studies) to investigate foodborne disease outbreaks or clusters of suspected foodborne illness. Investigators used analytical studies for 40 per cent (37/92) of foodborne disease outbreaks, which was similar to 2001. The Hunter had the highest rate for investigations of foodborne disease or potentially foodborne clusters using analytical studies, followed by South Australia. Queensland had one of the lowest rate of analytical investigation despite a high rate of reporting for foodborne outbreaks. This was mainly due to several outbreaks of ciguatera where only descriptive investigation was necessary.

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 2002 (Table 10). Overall 96.2 per cent (6,994/7,267) of *Salmonella* notification on databases contained either serotype or phage type, which was an increase of 4.3 per cent from 2000 and 1.7 per cent from 2001.

Only 89.1 per cent (49/55) of phage type information was reported for *S*. Hadar and 92.7 per cent (114/123) *S*. Heidelberg. Phage typing information was available for 95.0 per cent (307/323) of reports for *S*. Enteritidis in 2002. The largest increase in completeness between 2000 and 2002 was reported for *S*. Heidelberg (25.4%) and *S*. Bovismorbificans (16%).

South Australia had the highest proportion of complete *Salmonella* notification (100%), while four sites reported 98 per cent or higher. New South Wales reported the lowest rate of completeness, but recorded a 10.8 per cent improvement when compared to 2000 figures. Western Australia also reported an increase of 10.7 per cent, as a result of improved case notification to the health department.

Table 10. Number of *Salmonella* infections notified and proportion of notifications with serotype and phage type information available, Australia, 2000 to 2002, by OzFoodNet site

Information required	Year	*Salmonella* notifications n	*Salmonella* with serotype %	*Salmonella* infections with phage typing information						*Salmonella* infections with information
				S. Bovis-morbificans %	*S.* Enteritidis %	*S.* Hadar %	*S.* Heidelberg %	*S.* Typhimurium %	*S.* Virchow %	
ACT	2000	102	96.1	–	100.0	0.0	0.0	100.0	100.0	95.1
	2001	78	98.7	100.0	100.0	100.0	–	100.0	100.0	98.7
	2002	96	97.9	100.0	100.0	–	–	91.1	100.0	93.8
Hunter	2000	86	94.2	100.0	50.0	66.7	100.0	97.4	0.0	87.2
	2001	117	97.4	85.7	50.0	–	50.0	97.1	100.0	92.3
	2002	179	95.5	100.0	100.0	–	0.0	95.1	100.0	92.7
NSW	2000	1,334	92.2	50.0	77.8	52.9	18.2	88.1	38.2	80.5
	2001	1,668	94.2	63.6	80.8	35.3	84.6	95.8	67.2	87.9
	2002	2,147	95.5	92.2	81.5	58.3	75.9	95.7	89.2	91.3
NT	2000	323	91.6	33.3	20.0	50.0	100.0	100.0	50.0	88.9
	2001	390	90.8	100.0	33.3	100.0	–	100.0	100.0	90.3
	2002	329	96.0	100.0	66.7	–	–	100.0	–	95.7
Qld	2000	1,818	97.2	100.0	94.8	100.0	90.6	93.1	97.4	97.7
	2001	2,169	97.0	100.0	91.8	73.3	91.8	95.8	95.0	97.8
	2002	2,722	97.5	100.0	100.0	100.0	97.6	98.1	98.9	99.4
SA	2000	452	99.6	100.0	100.0	100.0	–	100.0	100.0	99.6
	2001	613	99.8	100.0	100.0	100.0	–	100.0	100.0	99.8
	2002	520	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 10 continued. Number of *Salmonella* infections notified and proportion of notifications with serotype and phage type information available, Australia, 2000 to 2002, by OzFoodNet site

Information required	Year	*Salmonella* notifications n	*Salmonella* with serotype %	*Salmonella* infections with phage typing information						*Salmonella* infections with information
				S. Bovis-morbificans %	*S.* Enteritidis %	*S.* Hadar %	*S.* Heidelberg %	*S.* Typhimurium %	*S.* Virchow %	
Tas.	2000	127	96.9	100.0	100.0	–	0.0	100.0	100.0	96.1
	2001	159	98.7	100.0	100.0	–	–	96.3	–	98.1
	2002	165	99.4	100.0	100.0	100.0	–	100.0	100.0	99.4
Vic.	2000	1,005	97.9	96.3	100.0	90.0	75.0	99.8	99.1	97.4
	2001	1,090	97.7	100.0	100.0	100.0	100.0	99.8	100.0	97.6
	2002	1,207	99.2	90.9	100.0	88.9	100.0	100.0	100.0	99.0
WA	2000	936	92.4	100.0	93.1	85.0	0.0	91.4	80.0	87.7
	2001	858	95.8	85.7	95.7	85.7	0.0	97.0	66.7	93.8
	2002	730	98.6	100.0	100.0	100.0	–	99.2	100.0	98.4
OzFoodNet	2000	6,097	95.4	78.3	90.5	77.8	67.3	94.1	90.4	92.0
	2001	7,025	96.2	87.3	91.4	78.8	88.5	97.5	92.4	94.7
	2002	7,916	97.4	94.3	95.0	89.1	92.7	98.0	97.6	96.9

Discussion

Each year in Australia, it is estimated that 17.2 million persons experience infectious gastroenteritis and approximately 5.4 million (credible interval 4.0–6.9 million) of these may be due to contaminated food. These estimates are comparable to previous Australian and other international reports and clearly demonstrate the burden that foodborne disease has on Australian society.[3,19,20] The large burden justifies the attention given to foodborne disease surveillance and enhancing the safety of our food supply.

Gastrointestinal infections notified to health departments represent only a small proportion of cases occurring in the community, as most are mild and do not require medical attention. The gastroenteritis survey provides insight into the health seeking behaviour of Australians, with one in five persons with gastroenteritis visiting a doctor and one in 20 providing a faecal specimen. An intervention trial in Melbourne found that persons with acute gastroenteritis who submitted faecal specimens had pathogens identified in only 25 per cent of stools despite intensive testing, which demonstrates that there are many other gastrointestinal pathogens that are unrecognised.[21] Despite this, notifications of gastrointestinal infections to health departments provide a picture of illness that may potentially be due to food.

In 2002, notifications of selected gastrointestinal infections in Australia were 7.7 per cent higher than the historical mean, which may reflect a true increase in incidence, changing laboratory practices or improving surveillance. Certainly, the increased rates of STEC notification reflected changing patterns of testing faeces and diagnostic tests. This is likely to increase in future, as laboratories screen more specimens and diagnostic tests improve. The crude notification rate of *Salmonella* infections also increased, while *Campylobacter* and *Listeria* infection rates were stable. There were decreases observed for yersiniosis, shigellosis and haemolytic uraemic syndrome.

Australia has similar rates of notified gastrointestinal infections to some other developed countries including Canada, Norway, and the United Kingdom.[22,23,24] Australian rates are lower than rates in neighbouring New Zealand and higher than active surveillance data for salmonellosis in the United States of America (USA).[25,26] Notified *Salmonella* in the USA affects 16.1 cases per 100,000 population compared to 40.3 cases per 100,000 population in Australia. Even more startling is the difference in *Campylobacter* notification rates in the USA at 13.4 cases per 100,000 population compared to 110.1 cases per 100,000 population in Australia. The lower rates in the USA may be due to differences in access to healthcare, stool submission rates and testing regimes in laboratories.

The USA reports higher rates of toxigenic *E. coli* O157:H7 (1.7 cases per 100,000 population) than Australia.[26] This organism is easily isolated on routine pathology media and may reflect changes in testing procedures or a true difference in incidence. In 2002, Australian states and territories reported a doubling in the number of *E. coli* O157 infections, although the total numbers and rates remain small. H typing was not available for the majority of these, but it is likely that the majority are not the H7 subtype as laboratories have rarely isolated it in previous years. The increasing use of molecular detection methods often means that organisms are not cultured for faecal specimens for subsequent serotyping or profiling.

South Australia has conducted enhanced surveillance for STEC for several years, but had not identified any outbreaks until the outbreak at a petting zoo at a regional fair in 2002. Petting zoos have been commonly associated with outbreaks of STEC and other gastrointestinal diseases.[27,28,29] There were two other outbreaks of salmonellosis following poultry hatching programs in two different states. While some Australian states have prepared guidelines for petting zoos it is important that these cover poultry hatching programs and that all zoo operators are aware of the requirements to prevent infections.[30]

Salmonella caused the most foodborne outbreaks of any agent during 2002. Like many other countries, *Salmonella* infections are a serious problem for Australia.[31] Not only do they cause considerable morbidity, but investigations consume much public health effort and resources. For every two *Salmonella* outbreaks that are attributed to food, there are another three cluster investigations where no source is identified. In addition, there may be as many as 14 cases in the community for every case reported to Australian surveillance systems (OzFoodNet unpublished data). To identify causes of more of these outbreaks, we may need to critically evaluate our current methods of investigation. Investigations are becoming more complicated due to the increasing use of molecular methods for comparing isolates and regular trace back of foods consumed by cases to the source of food supply.[31,32]

OzFoodNet identified several risk factors for foodborne infections in 2002 based on the surveillance data and epidemiological studies. Many of these risk factors have been previously recognised, but need to be considered again. The risk posed by raw eggs used in dressings could be easily addressed by the use of pasteurised eggs. While Australia does not have endemic *S*. Enteritidis 4 that contaminates the internal contents of eggs, there are clearly other subtypes that are associated with eggs. Infections due to poultry, red meats and imported foods continued to occur in 2002. Food handling and preparation practices in bakeries need to be addressed to prevent outbreaks of salmonellosis, which are an increasing problem.[33,34,35]

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*. These organisms may be notified as the cause of outbreaks, but not individual cases of disease. There can also be considerable variation in assigning causes to outbreaks depending on investigators and circumstances.

There have been consistent improvements to surveillance in recent years, which is shown by the large number of analytical studies used in investigations of outbreaks. The success of national communication through OzFoodNet was highlighted by the identification of 12 separate incidents associated with a single spit roast company operating in several states. We observed a difference in the rate of reporting foodborne disease outbreaks that probably reflects sensitivity of surveillance and differing thresholds for investigation in different jurisdictions.[36] There was a significant improvement in the completeness of *Salmonella* typing information on state and territory databases, which reflects better quality surveillance data. In the future, OzFoodNet aims to regularly compare the timeliness of *Salmonella* typing reporting to review the effectiveness of data transmission for surveillance systems.

Despite these improvements to surveillance, we need to critically evaluate our efforts in order to prevent foodborne infections. In particular, there is a need to strengthen laboratory-based surveillance using standardised molecular methods for profiling organisms, such as *Listeria*, outbreak-associated *Salmonella* and shiga toxin producing *E. coli*. This information needs to be rapidly communicated to public health investigators to enable more timely investigation of widely spread clusters and prevention of outbreaks. Countries such as the United Kingdom routinely use PFGE as a successful adjunct to traditional *Salmonella* typing to assist with outbreak investigations.[37] Other potential improvements could include: standardised approaches to cluster investigation, and sharing surveillance information from animal and food testing data. None of these new initiatives will occur without appropriate resources, but the burden of diseases clearly requires that we improve to acquire better surveillance data to support control activities.

The burden of foodborne disease is a major concern to the community, industry and government. 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 assist with this task. OzFoodNet needs to consider what kinds of foodborne disease data are useful to evaluate the effect of interventions to make food safer. This will require closer working relationships with food safety professionals, microbiologists, veterinarians and industry. To ensure that control of foodborne disease remains a focus for government, it may be pertinent to set target goals for foodborne diseases similar to other national health priority areas.[26,38]

Acknowledgements

This report is based on the work of epidemiologists in each of the eight OzFoodNet sites during 2002: Rosie Ashbolt, Karen Dempsey, Joy Gregory, Karin Lalor, Geoff Millard, Jennie Musto, Leonie Neville, Jane Raupach, Mohinder Sarna, Russell Stafford, and Leanne Unicomb. It also represents the work of Gillian Hall, Nola Tomaska and Rebecca Hundy from the National Centre for Epidemiology and Population Health, Martyn Kirk, Janet Li and Craig Williams from OzFoodNet. Epidemiologists, project officers, interviewers and research assistants at each of the sites contributed to this report, including: Robert Bell, Barry Combs, Dot Little, Tony Merritt and Lillian Mwanri.

We would like to thank the many people who assisted OzFoodNet in our work during 2002, particularly our international colleagues from the United States of America, Canada, the United Kingdom, Ireland, New Zealand and the World Health Organization. We would also like to thank members of the Communicable Disease Network Australia, the Public Health Laboratory Network, and the Australian *Campylobacter* subtyping network.

We really appreciated the managerial assistance from staff of the Department of Health and Ageing, Food Standards Australia New Zealand, state and territory health departments and the National Public Health Partnership.

We also acknowledge the hard work of various public health professionals and laboratory staff around Australia who interviewed patients, tested specimens and investigated outbreaks. The high quality of their work is the foundation of this report.

References

1. World Health Organization. WHO Global Strategy for Food Safety. Geneva, 2002. Available from: http://www.who.int/fsf/Documents/fos_strategy_en.pdf. Accessed on 14 April 2003.
2. Käferstein FK, Motarjemi Y, Bettcher DW. Foodborne disease control: A transnational challenge. *Emerg Infect Dis* 1997;3:503–510.
3. Mead PS, Slutsker L, Dietz V, McCaig LF, Bresee JS, Shapiro C, *et al*. Food-related illness and death in the United States. *Emerg Infect Dis* 1999;5:840–842.
4. Käferstein FK, Abdussalam M. Food safety in the 21st century. *Bull World Health Organ* 1999;77: 347–351.
5. Ashbolt R, Givney R, Gregory JE, Hall G, Hundy R, Kirk M, *et al*. Enhancing foodborne disease surveillance across Australia in 2001: the OzFoodNet Working Group. *Commun Dis Intell* 2002;26:375–406.
6. Voetsch AC, Dalton CB, Crerar SK. Enhanced surveillance for foodborne disease in the Hunter. A model for national surveillance in Australia? *Food Australia* 2000;52: 97–99.
7. Centers for Disease Control and Prevention. Preliminary FoodNet data on the incidence of foodborne illnesses-selected sites, United States, 2001. *MMWR Morb Mortal Wkly Rep* 2002;51: 325–329.
8. Australian Bureau of Statistics. 3201.0 Population by age and sex, Australian states and territories, June 1971–June 2002. Canberra 2003.
9. Lin M, Roche P, Spencer J, Milton A, Wright P, Witteveen D, *et al*. Australia's notifiable diseases status, 2000: annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell* 2002;26:118–203.
10. Hellard, ME, Sinclair MI, Forbes AB, Fairley CK. A randomised, blinded, controlled trial investigating the gastrointestinal health effects of drinking water quality. *Env Health Pers* 2001;109:773–778.
11. Sinclair, MI, Hellard ME, Wolfe R, Fairley CK. Pathogens causing community gastroenteritis in Australia. (Poster) Australian Society for Infectious Disease Conference, Barossa, South Australia. 2002.
12. Henson S. Estimating the incidence of food-borne *Salmonella* and the effectiveness of alternative control measures using the Delphi method. *Int J Food Microbiol* 1997;35:195–204.
13. Cassin MH, Paoli GM, Lammerding AM. Simulation modelling for microbial risk assessment. *J Food Prot* 1998;61:1560–1566.
14. Blumer C, Roche P, Spencer J, Lin M, Milton A, Bunn C, *et al*. Australia's notifiable diseases status, 2001: annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell* 2003;27:1–77.
15. Nassar N, Sullivan E. Australia's mothers and babies 1999. Australian Institute of Health and Welfare, National Perinatal Statistics Unit, Perinatal Statistics Series Number 11, Sydney, 2001.
16. Ashbolt R, Bell R, Crerar S, Dalton C, Givney R, Gregory J, *et al*. OzFoodNet: enhancing foodborne disease surveillance across Australia: quarterly report, January to March 2002. *Commun Dis Intell* 2002;26:430–435.
17. Andrews R, Feldheim J, Givney R, Carman J, Murray C, Beers M, *et al*. Concurrent outbreaks of *Salmonella* Typhimurium in South Australia. *Commun Dis Intell*. 1997; 21:61–62.

18. Lester R, Carnie J, McClennan L, Lambert S, Kelsall H, Ferreira C, *et al. Salmonella* in Victoria, 1997: the story so far. *Commun Dis Intell* 1997;21: 190–192.

19. McKay I. Food safety standards costs and benefits. Australia New Zealand Food Authority. Canberra 1999.

20. Herikstad H, Yang S, Van Gilder TJ, Vugia D, Hadler J, Blake P, *et al.* A population-based estimate of the burden of diarrhoeal illness in the United States: FoodNet, 1996–7. *Epidemiol Infect* 2002;129:9–17.

21. Sinclair MI, Hellard ME, Wolfe R, Fairley CK. Pathogens causing community gastroenteritis in Australia. Australian Society for Infectious Diseases Annual Meeting, Barossa Valley, South Australia, 2001.

22. Notifiable Diseases Annual Summary 1999. *Can Commun Dis Rep* 2001;27 Suppl 6:1–147.

23. Hofshagen M, Aavitsland P, Kruse H, editors. Trends and sources of zoonotic agents in animals, feeding stuffs, food, and man in Norway 2001. The Norwegian Zoonoses Centre 2002. Available from: http://www.zoonose.no/Zoonoserapport01-eng.pdf. Accessed on 8 October 2002.

24. Prendiville P, Bishop L, Lamagni T, Dattani R, Duckworth G. Antimicrobial Resistance in 2000, England and Wales. Public Health Laboratory Service, London. Available from: http://www.phls.org.uk/topics_az/antimicrobial_resistance/amr.pdf. Accessed on 13 May 2003.

25. Crump JA, Murdoch DR, Baker MG. Emerging infectious diseases in an island ecosystem: the New Zealand perspective. *Emerg Infect Dis* 2001;7:767–772.

26. Centers for Disease Control and Prevention. Preliminary FoodNet data on the incidence of foodborne illnesses—selected sites, United States, 2002. *MMWR Morb Mortal Wkly Rep* 2003;52:340–343.

27. Payne CJI, Petrovic M, Roberts RJ, Paul A, Linnane E, Walker M, *et al.* Vero cytotoxin-producing *Escherichia coli* O157 gastroenteritis in farm visitors, North Wales. *Emerg Inf Di* 2003;9: 526–530.

28. Crump JA, Sulka AC, Langer AJ, Schaben C, Crielly AS, Gage R, *et al*. An outbreak of *Escherichia coli* O157:H7 infections among visitors to a dairy farm. *N Engl J Med* 2002;347:555-560.

29. Ashbolt RA, Coleman D, Misrachi A, Kirk MD. An outbreak of cryptosporidiosis associated with a petting zoo at a regional fair. *Commun Dis Intell* 2003; 27:244–249.

30. Petting zoo infection control guideline for petting zoo operators, education and childcare services, and environmental health officers. South Australian Department of Human Services, Adelaide, 2002. Available from: http://www.dhs.sa.gov.au/pehs/PDF-files/petting-zoos-guidelines.pdf. Accessed on 13 May 2003.

31. O'Brien SJ, de Valk H. *Salmonella*—'old organism', continued challenges! Euro Surv 2003;8:29–31.

32. Tauxe RV. Emerging foodborne diseases: an evolving public health challenge. *Emerg Infect Dis* 1997;3:425–434.

33. Evans MR, Tromans JP, Dexter EL, Ribeiro CD, Gardner D, *et al*. Consecutive outbreaks traced to the same bakery. *Epidemiol Infect* 1996;116: 161–167.

34. Ward B, Andrews R, Gregory J, Lightfoot D. The use of sequential studies in a salmonellosis outbreak linked to continental custard cakes. *Epidemiol Infect* 2002;129:287–293.

35. Wight JP, Cornell J, Rhodes P, Colley S, Webster S, Ridley AM, *et al*. Four outbreaks of *Salmonella* enteritidis phage type 4 food poisoning linked to a single baker. *Commun Dis Rep CDR Rev* 1996;6: R112–R115.

36. Lopman BA, Reacher MH, van Duijnhoven Y, Hanon FX, Brown D, Koopmans M, *et al*. Viral gastroenteritis outbreaks in Europe, 1995–2000. *Emerg Inf Dis* 2003;9:90–96.

37. Horby PW, O'Brien SJ, Adak GK, Graham C, Hawker JI, Hunter P, *et al*. A national outbreak of multi-resistant *Salmonella enterica* serovar Typhimurium definitive phage type (DT) 104 associated with consumption of lettuce. *Epidemiol Infect* 2003;130:169–178.

38. Adak GK, Long SM, O'Brien SJ. Trends in indigenous foodborne disease and deaths, England and Wales: 1992 to 2000. *Gut* 2002;51:832–841.

Appendix 1. Summary of gastrointestinal infections notified to OzFoodNet sites potentially due to food, 2002

		Australian Capital Territory	Hunter	New South Wales	Northern Territory	Queensland	South Australia	Tasmania	Victoria	Western	Total
Campylobacter	cases	367	nn	nn	208	3,905	2,519	610	4,932	2,175	14,716
	rate	114.0	nn	nn	105.0	105.3	165.7	129.0	101.2	112.9	113.0
Salmonella	cases	96	179	2,147	330	2,722	520	165	1,207	730	7,917
	rate	29.8	32.9	32.3	166.7	73.4	34.2	34.9	24.8	37.9	40.3
Yersinia	cases	1	nn	nn	7	73	13	1	nn	4	99
	rate	0.3	nn	nn	3.5	2.0	0.9	0.2	nn	0.2	1.2
STEC	cases	0	0	5	0	6	38	0	5	4	58
	rate	0.0	0.0	0.1	0.0	0.2	2.5	0.0	0.1	0.2	0.3
HUS	cases	0	3	7	1	1	0	0	4	0	13
	rate	0.0	0.6	0.1	0.5	0.0	0.0	0.0	0.1	0.0	0.1
Typhoid	cases	1	0	22	0	11	4	0	21	5	64
	rate	0.3	0.0	0.3	0.0	0.3	0.3	0.0	0.4	0.3	0.3
Shigella	cases	0	2	84	103	95	26	1	66	130	505
	rate	0.0	0.4	1.3	52.0	2.6	1.7	0.2	1.4	6.7	2.6
Listeria	cases	0	0	12	0	20	2	2	15	11	62
	rate	0.0	0.0	0.2	0.0	0.5	0.1	0.4	0.3	0.6	0.3

nn not notifiable

Appendix 2. Outbreak summary for OzFoodNet sites, 2002

State	Month of outbreak	Setting category	Agent responsible	Number exposed	Number affected	Evidence*	Epidemiological study†	Responsible vehicles
Hunter	Jan	Restaurant	*S.* Potsdam	Unknown	17	AM	C	Egg based dressings
	Feb	Restaurant	*V. parahaemolyticus*	Unknown	2	D	D	Unknown
	Feb	Commercial caterer	*C. perfringens*	33	16	AM	C	Spit roasted beef and/or pork
	Apr	National franchised fast food	Unknown	Unknown	5	D	C	Suspected seafood pizza
	May	Restaurant	Unknown	Unknown	3	D	D	Suspected seafood
	May	Restaurant	Unknown	Unknown	5	D	C	Unknown
	Jun	Restaurant	Unknown	Unknown	4	D	C	Suspected seafood
	Aug	Restaurant	Unknown	19	5	D	C	Unknown
	Aug	Takeaway	Unknown	Unknown	2	D	D	Suspected kebabs
	Nov	Home	Norovirus	Unknown	6	D	D	Unknown
	Nov	Restaurant	Unknown	Unknown	5	D	D	Unknown
	Nov	Takeaway	*S.* Montevideo	Unknown	47	M	D	Imported tahini
	Dec	Restaurant	Norovirus	Unknown	3	D	D	Unknown
	Dec	Restaurant	Unknown	Unknown	4	D	D	Unknown
	Dec	Restaurant	Unknown	Unknown	4	D	D	Suspected beef dish
	Dec	Restaurant	Unknown	Unknown	11	D	C	Unknown
	Dec	Restaurant	Unknown	Unknown	4	D	D	Unknown
NSW	Jan	National franchised fast food	*S.* Virchow	4	3	A	CCS	Chicken
	Jan	Takeaway	Unknown	Unknown	4	D	D	Mixed foods
	Jan	Takeaway	Unknown	2	2	D	D	Barbecue chicken
	Jan	Takeaway	Unknown	2	2	D	D	Special fried rice
	Feb	Restaurant	*S.* Typhimurium 9	Unknown	8	A	C	Deep fried ice cream
	Feb	School	*S.* Typhimurium 9	900	132	A	CCS	Baked beans/chilli con carne
	Mar	National franchised fast food	Unknown	4	4	D	D	Pizza
	Mar	Home	Ciguatera poisoning	Unknown	7	M	D	Spanish mackerel
	Apr	Home	Unknown	56	20	D	C	Suspected pasta
	Apr	Takeaway	Unknown	2	2	D	D	Fish
	Apr	Bakery	*S.* Typhimurium 126	Unknown	32	M	D	Vietnamese pork/chicken rolls
	May	Restaurant	Unknown	10	2	D	D	Beef curry
	Jun	Fair/festival/ mobile service	Unknown	Unknown	6	D	D	Cake
	Jun	Takeaway	Unknown	5	5	D	C	Pizza

Appendix 2 continued. Outbreak summary for OzFoodNet sites, 2002

State	Month of outbreak	Setting category	Agent responsible	Number exposed	Number affected	Evidence*	Epidemiological study†	Responsible vehicles
	Jul	Restaurant	Unknown	Unknown	4	D	D	Unknown
	Jul	Restaurant	Unknown	130	30	D	CCS	Unknown
	Sep	Cruise/airline	Unknown	3	3	D	D	Chicken casserole
	Sep	Restaurant	Unknown	5	4	D	D	Mixed foods
	Oct	Bakery	*S.* Typhimurium 135	Unknown	29	D	D	Cream filled cake
	Oct	Restaurant	Hepatitis A	Unknown	8	D	D	Yum cha
	Nov	Restaurant	*S.* Typhimurium 170 var	Unknown	6	D	C	Not identified
	Dec	Restaurant	*C. perfringens*	261	70	A	C	Lamb curry
	Dec	Restaurant	*S.* Typhimurium 126	1,200	21	A	CCS	Thai salad
Qld	Jan	Takeaway	Ciguatera	Unknown	2	D	D	Spanish mackerel
	Jan	Restaurant	*C. perfringens*	Unknown	2	D	D	Unknown
	Jan	Aged care facility	*S.* Typhimurium 102	53	12	D	C	Suspected egg-white dish
	Feb	Home	Ciguatera	2	2	D	D	Striped perch
	Feb	Institution	*S.* Potsdam	Unknown	2	D	D	Unknown
	Feb	National franchised fast food	*Staphylococcus aureus*	9	8	D	D	Pizza
	Feb	Restaurant	Unknown	7	6	D	D	Unknown
	Mar	Home	*S.* Typhimurium 135a	10	10	D	D	Salmon/egg/onion/rice patties
	Apr	Home	Ciguatera	5	3	D	D	Grunter bream
	May	Restaurant	Unknown	7	7	D	D	Unknown
	Jun	Commercial caterer	*Bacillus cereus*	250	37	AM	CCS	Rice
	Aug	Restaurant	Unknown	23	16	D	D	Unknown
	Aug	Community	*Campylobacter jejuni*	Unknown	24	M	D	Chicken
	Oct	Restaurant	*S.* Hadar 22	Unknown	3	D	D	Suspected egg dish
	Nov	Restaurant	*S.* Typhimurium 197	24	8	D	D	Unknown
	Dec	Home	*C. perfringens*	3	3	D	D	Unknown
	Dec	School	Norovirus	200	48	D	D	Unknown
	Dec	Child care	S. Typhimurium 135a	Unknown	12	D	D	Suspected egg sandwiches
SA	Apr	Restaurant	*S.* Typhimurium 8	Unknown	78	AM	CCS	Caesar salad
	May	Community	*S.* Typhimurium 43	Unknown	5	A	CCS	Sliced ham
	May	Home	*C. perfringens*	12	8	D	C	Potato and meat pie
	Oct	Bakery	*S.* Typhimurium 99	Unknown	22	AM	C	Cream and custard cakes

State	Month of outbreak	Setting category	Agent responsible	Number exposed	Number affected	Evidence*	Epidemiological study†	Responsible vehicles
Tas.	Mar	Restaurant	*S.* Typhimurium 135	Unknown	5	D	D	Unknown
Vic.	Feb	Commercial caterer	Unknown	90	32	A	C	Chocolate mud cake
	Feb	Restaurant	Norovirus	30	12	D	D	Unknown
	Feb	Restaurant	Unknown	23	18	D	C	Unknown
	Feb	Hospital	Unknown	13	13	D	D	Soup
	Mar	Restaurant	Unknown	15	8	D	C	Unknown
	Mar	Home	*S.* Typhimurium 135	67	19	A	C	Roast chicken
	Mar	Commercial caterer	Unknown	16	12	D	C	Suspected sandwiches
	Mar	Fair/festival/mobile service	*S. aureus, B. cereus*	600	272	M	D	Mixed foods
	Apr	Home	*S.* Typhimurium 135	9	6	M	D	Home barbequed chicken
	Apr	Aged care facility	*S.* Typhimurium 9	302	18	D	D	Unknown
	Apr	Home	*S.* Typhimurium 170	Unknown	6	M	D	Hedgehog — possibly eggs
	Apr	Child care	*S.* aureus	Unknown	7	M	D	Rice
	Apr	Cruise/airline	*C. perfringens*	34	18	D	C	Unknown
	May	Restaurant	Unknown	33	10	A	C	Pea and ham soup
	May	Restaurant	Norovirus	650	192	D	C	Unknown
	May	Bakery	*S.* Typhimurium U290	Unknown	10	A	CCS	Cream filled cakes/pastries
	Jun	Bakery	*S.* Typhimurium 135	Unknown	20	D	D	Vietnamese pork rolls
	Aug	Aged care facility	*C. perfringens*	69	15	D	D	Suspected gravy
	Aug	Restaurant	*S.* Typhimurium 135	Unknown	12	D	D	Suspected spring rolls
	Oct	Aged care facility	*C. perfringens*	64	23	D	D	Suspected gravy
	Oct	Commercial caterer	Norovirus	unknown	25	A	C	Suspected cheesecake
	Oct	Restaurant	Suspected viral	296	23	D	C	Mixed foods.
	Nov	Commercial caterer	Norovirus	140	32	D	C	Mixed foods.
	Nov	Restaurant	Suspected wax ester	15	10	D	D	Suspected rudderfish
	Dec	Restaurant	Unknown	20	5	D	D	Steak or sauce
	Dec	Restaurant	Unknown	77	41	D	C	Unknown
WA	Feb	Home	Unknown	100	30	D	D	Unknown
	Feb	Restaurant	Norovirus	230	60	AM	C	Seafood salad
	Aug	Commercial caterer	Unknown	1,100	Unknown	A	CCS	Oyster shooters
			7,234	1,819				

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

† C = cohort study; CCS=case control study; D=descriptive study.