Enhancing foodborne disease surveillance across Australia in 2001: the OzFoodNet Working Group

In alphabetical order: Rosie Ashbolt,[1] Rod Givney,[2] Joy E Gregory,[3] Gillian Hall,[4] Rebecca Hundy,[2] Martyn Kirk,[5] Ian McKay,[6] Lynn Meuleners,[7] Geoff Millard,[8] Jane Raupach,[2] Paul Roche,[6] Nittita Prasopa-Plaizier,[3] Mohinder K Sarna,[7] Russell Stafford,[9] Nola Tomaska,[4] Leanne Unicomb,[10] Craig Williams,[5] the OzFoodNet Working Group

Abstract

In 2000, the OzFoodNet network was established to enhance surveillance of foodborne diseases across Australia. OzFoodNet consists of 7 sites and covers 68 per cent of Australia's population. During 2001, sites reported 15,815 cases of campylobacteriosis, 6,607 cases of salmonellosis, 326 cases of shigellosis, 71 cases of yersiniosis, 61 cases of listeriosis, 47 cases of shiga-toxin producing *E. coli* and 5 cases of haemolytic uraemic syndrome. Sites reported 86 foodborne outbreaks affecting 1,768 people, of whom 4.0 per cent (70/1,768) were hospitalised and one person died. There was a wide range of foods implicated in these outbreaks and the most common agent was *S.* Typhimurium. Sites reported two international outbreaks; one of multi-drug resistant *S.* Typhimurium Definitive Type 104 due to helva imported from Turkey, and one of *S.* Stanley associated with dried peanuts from China. The National Centre for Epidemiology and Population Health conducted a national survey of gastroenteritis. Preliminary data from interviews of 2,417 people suggests that the incidence of foodborne illness is significantly higher than previously thought. OzFoodNet initiated case control studies into risk factors for *Campylobacter*, *Salmonella*, *Listeria*, and shiga-toxin producing *E. coli*. OzFoodNet developed a foodborne disease outbreak register for Australia; established a network of laboratories to type *Campylobacter*; prepared a survey of pathology laboratories; reviewed Australian data on listeriosis; and assessed the usefulness of sentinel surveillance for gastroenteritis. This program of enhanced surveillance has demonstrated its capacity to nationally investigate and determine the causes of foodborne disease. *Commun Dis Intell* 2002;26:375-406.

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1. Tasmanian Department of Health and Human Services, Hobart, TAS
2. South Australian Department of Human Services, Adelaide, SA
3. Victorian Department of Human Services, Melbourne, VIC
4. National Centre of Epidemiology and Population Health, Australian National University, Canberra, ACT
5. Food Standards Australia New Zealand, Canberra, ACT
6. Commonwealth Department of Health and Ageing, Canberra, ACT
7. Health Department of Western Australia, Perth, WA
8. ACT Department of Health and Community Care, Canberra, ACT
9. Queensland Department of Health, Brisbane, QLD
10. Hunter Health Area Public Health Unit, NSW

The OzFoodNet working group includes the authors and *(in alphabetical order)*: Robert Bell (Qld), Meredith Caelli (Hunter Health Area, NSW), Scott Crerar (FSANZ), Craig Dalton (Hunter Health Area, NSW), Brigid Hardy (AFFA), Geoff Hogg (MDU), Rebecca Hundy (SA), Karin Lalor (Vic), Vanessa Madden (Tas), Peter Markey (NT), Tony Merritt (Hunter Health Area, NSW), David Peacock (NT), Craig Shadbolt (DoHA), Jenny Williams (FSANZ).

Corresponding author: Mr Martyn Kirk, Coordinating Epidemiologist, OzFoodNet, c/o National Public Health Partnership, 589 Collins St, Melbourne 3000, Australia. Telephone: +61 3 9616 1522. Facsimile: +61 3 9616 1500. E-mail: martyn.kirk@dhs.vic.gov.au.

Introduction

In 2000, the Commonwealth Department of Health and Ageing (DoHA) established a collaborative network, coined OzFoodNet, to enhance the existing surveillance mechanisms for foodborne disease. This was one of a number of projects that the department established to build a strong base for national policy development in the area of food safety.[1]

The OzFoodNet initiative built upon the experience of an 18-month trial of active foodborne disease surveillance in the Hunter region of New South Wales.[2] This pilot was modelled on the FoodNet system of active surveillance in the United States of Amercia (USA), and provided much insight into establishing OzFoodNet (see http://www.cdc.gov/foodnet/).[3]

Mission and aims

The mission of OzFoodNet is to apply a concentrated effort at a national level to investigate and understand foodborne disease; to describe more effectively its epidemiology and to provide better evidence on how to minimise foodborne illness in Australia.

OzFoodNet aims to:

- estimate the incidence and cost of foodborne illness in Australia;
- improve our understanding of the epidemiology of foodborne disease, by enhancing surveillance and conducting special studies on foodborne pathogens;
- identify inappropriate practices in domestic and commercial settings which lead to food contamination and foodborne illness;
- assess the efficacy of current and proposed food hygiene standards and their enforcement by jurisdictions;
- provide data essential for future risk assessments and policy interventions; and
- train people to investigate foodborne illness.

The work of OzFoodNet will improve surveillance of foodborne disease across Australia, but many of these goals may only be realised in years to come.

Organisation

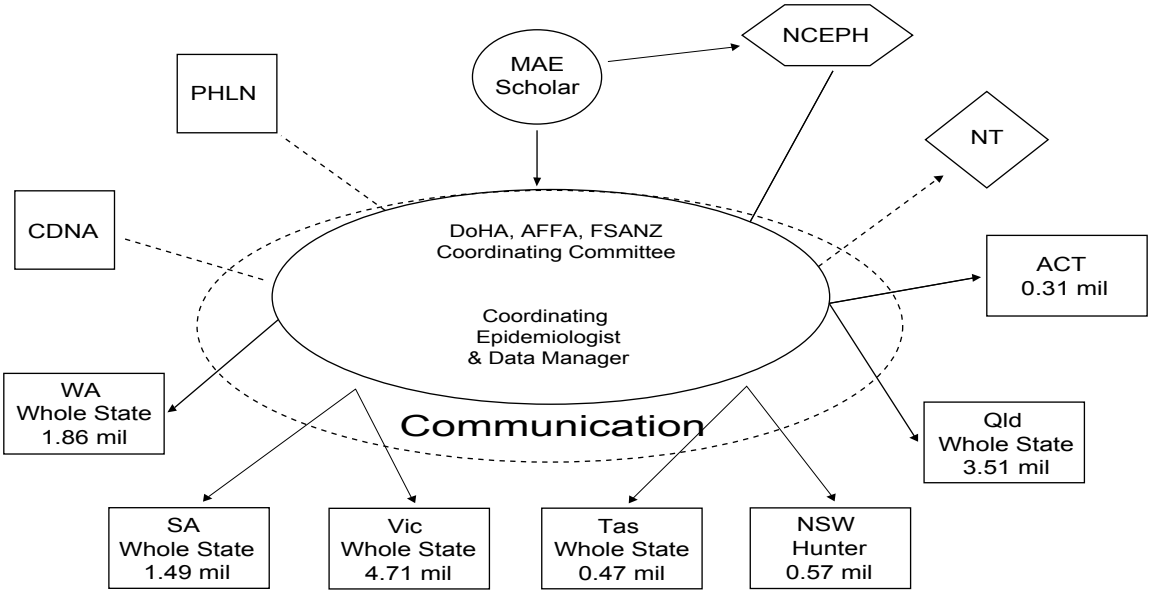
OzFoodNet involves many different agencies and has required a major collaborative effort to establish (Figure 1). The Commonwealth Department of Health and Ageing provides funding and strategic management for the OzFoodNet program of work. The department convenes a regular management group that includes senior managers from Food Standards Australia New Zealand (FSANZ) (formerly the Australian New Zealand Food Authority) and the Commonwealth Department of Agriculture, Fisheries and Forestry — Australia. Australia's peak body for communicable disease control, the Communicable Diseases Network Australia (CDNA), oversees the work of OzFoodNet.

In 2000, DoHA provided funding for the six Australian States and the Australian Capital Territory to participate in OzFoodNet. Each of the seven funded jurisdictions has employed one or more epidemiologists to participate in OzFoodNet. These epidemiologists report to the jurisdiction's manager of communicable disease surveillance. Each epidemiologist conducts work that is locally or nationally important for prevention of foodborne diseases. The work program includes a mixture of surveillance, outbreak investigation, and applied research.

A coordinating epidemiologist and a data manager were employed to ensure that the work is conducted efficiently and consistently. Site epidemiologists provide regular reports of foodborne disease incidence to the coordinating epidemiologist, who is the OzFoodNet representative on CDNA.

Every 3 months, the OzFoodNet epidemiologists and a wider group meet to discuss surveillance and control of foodborne diseases and the progress of applied research studies (Figure 2). This wider group forms the basis of the OzFoodNet Working Group, which includes partners from state and territory health departments, the National Centre for Epidemiology and Population Health (NCEPH), the Public Health Laboratory Network (PHLN), and federal government agencies. OzFoodNet also communicates regularly through monthly teleconferences, and a list server.

Figure 1. Outline of OzFoodNet sites showing population covered (in millions) and relationship to other bodies



NCEPH – National Centre for Epidemiology and Population Health
MAE – Master of Applied Epidemiology (Field Epidemiology Training Program)
PHLN – Public Health Laboratory Network
CDNA – Communicable Diseases Network Australia
DoHA – Department of Health and Ageing
FSANZ – Food Standards Australia New Zealand
AFFA – Department of Agriculture, Fisheries and Forestry — Australia

Figure 2. Participants at the OzFoodNet face-to-face meeting in Hobart, September 2001

Pictured from left: Gill Hall (NCEPH), Jane Raupach (SA), Donna Cassoni (DoHA), Martyn Kirk (FSANZ), Nittita Prasopa-Plaizier (Vic), Rebecca Hundy (SA), Leanne Unicomb (Hunter Health Area, NSW), Vanessa Madden (Tasmania), Luba Tomaska (FSANZ), Lynne Meuleners (WA), Russell Stafford (Qld), Geoff Millard (ACT), Joy Gregory (Vic)

OzFoodNet currently covers a population of 12.9 million people, or 68 per cent of Australia's population. The states of Queensland, Tasmania, South Australia, Victoria and Western Australia enhanced their surveillance for foodborne disease across the whole state. In New South Wales, the health department enhanced foodborne disease surveillance in the Newcastle region which is covered by the Hunter Health Area. The Australian Capital Territory joined the Network in July 2001 and the Northern Territory participated in OzFoodNet as an observer during 2001.

OzFoodNet reports to the management group on a quarterly basis. The Department of Health and Ageing uses the data and findings to feed into national committees formulating policy, such as the Food Regulation Standing Committee, the Development and Implementation Sub-Committee and the Technical Advisory Group.

Scope of this report

This first annual report for OzFoodNet synthesises the work and reports of all site epidemiologists for 2001. The report details:

- the incidence of foodborne disease across Australia;
- information on risk factors for foodborne illness;
- ways of improving surveillance for foodborne disease;
- the status of the OzFoodNet projects across Australia;
- outcomes from OzFoodNet activities during 2001; and
- recommendations arising from the work of OzFoodNet.

Incidence of foodborne disease

National foodborne disease incidence

This section documents trends in the incidence of enteric diseases in OzFoodNet sites. OzFoodNet epidemiologists provide regular summaries of foodborne disease incidence from notifiable disease datasets. The OzFoodNet data on sporadic disease are a subset of the information reported to the National Notifiable Diseases Surveillance System (NNDSS), but are more detailed and allow interpretation at the state, territory or public health unit level. NNDSS annual reports should be consulted for national notification rates of foodborne diseases. OzFoodNet provides a national picture by recording details of outbreaks and clusters occurring across jurisdictional boundaries. Improved communication and cross-jurisdictional investigations provide important information about the food handling practices that have led to food contamination and the causes of foodborne disease.

Interpreting the data

It is important to recognise that subtle differences between the three sources of data used in this report, OzFoodnet, NNDSS and the National Enteric Pathogens Surveillance System (NEPSS) can make interpretation difficult. Some of the inherent limitations of the data include:

- Data in the surveillance systems may come from different information sources, e.g. the proportion of notifications received from medical practitioners varies from jurisdiction to jurisdiction.
- Each surveillance system will have different delays in receipt and processing of reports, which can affect the total number reported in any time period.
- Where the surveillance data are reported, the reporting date is often different, e.g. sometimes the 'date of onset of symptoms' is used, while at other times reports will relate to the 'date of specimen collection', or the 'date of receipt of notification'. In this report, the 'date of receipt of notification' is also used, except for historical comparisons where we use the 'date of onset'.

Managers of the various surveillance schemes may still be cleaning data at the time of reporting. This cleaning will involve checking for accuracy of information on the database, and removing duplicate entries.

The data reported usually reflect a complex mix of biases that are inherent in public health surveillance. One bias that particularly affects surveillance data is ascertainment bias, i.e. some groups of the population are more likely to be detected as cases by the surveillance system. In notifiable disease datasets it is common to have an over representation of younger children, people who are elderly or immunocompromised, and people who are severely affected by the illness. This is usually because these patients are more likely to seek medical attention, and doctors are more likely to conduct tests on these patients. The data are rarely representative of the true burden of infection in the community, or the gradient of symptoms associated with infection.

The states and territories have differing approaches to surveillance, which may be reflected in the data. This also impacts the way that different jurisdictions choose to report data, such as outbreaks or clusters.

Some diseases are not notifiable in certain jurisdictions, e.g. individual cases of *Campylobacter* infection are not notifiable in New South Wales.

OzFoodNet data

OzFoodNet reports surveillance data for several bacterial pathogens and summary information from outbreaks potentially related to food and water. In this report, data are reported by the date of receipt of notifications at the health agency, unless specified. Historical comparisons use date of onset of symptoms for comparative purposes. Summary data for OzFoodNet sites on notified cases are shown in Appendix 1.

The Hunter OzFoodNet site supplied data for all of New South Wales. These data were used where possible for reporting total figures. Data for the Northern Territory are not reported unless specified.

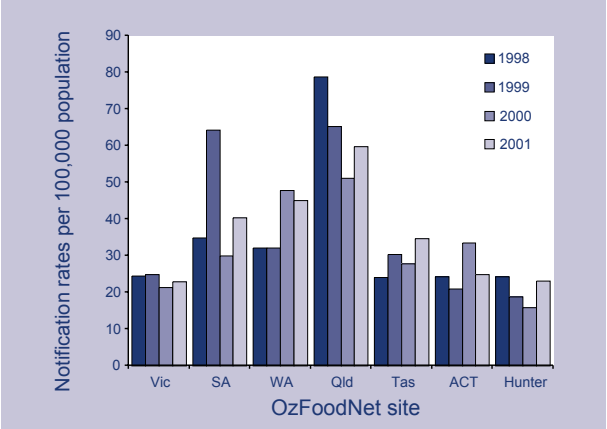
Rates were calculated using the Australian Bureau of Statistics estimated resident populations for 2001. Where appropriate, we directly standardised regional rates of disease within jurisdictions by age to estimated resident population for Australia, 2000.

Salmonella

In 2001, OzFoodNet sites reported 6,607 cases of *Salmonella* infection, which represented an increase of 2.1 per cent over the mean of the previous 3 years.* The overall rate of *Salmonella* notification in OzFoodNet sites was 34.1 cases per 100,000 population, and ranged from 23.1 cases per 100,000 population in the Hunter region to 59.8 cases per 100,000 population in Queensland (Figure 3).

Overall, notification rates of salmonellosis for 2001 were increased in the states of Tasmania (26.2%), Western Australia (20.7%) and the Hunter Health Area, New South Wales (17.1%) when compared with the 3-year mean rates for 1998–2000. There were moderate declines in the number of notifications of *Salmonella* in Queensland (-12.4%), South Australia (-6.3%), the Australian Capital Territory (-5.5%), and in Victoria (-2.8%) from the 3-year mean values.

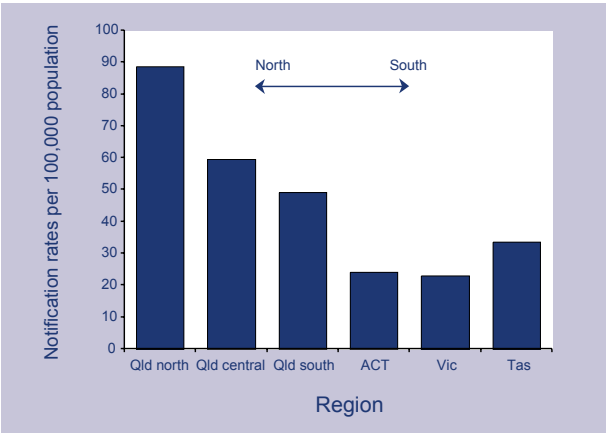
Figure 3. Crude notification rates of salmonellosis, 1998 to 2001, by site and year



OzFoodNet sites reported that the ratio of males to females was approximately 1:1, and ranged from 1.2:1 in Victoria to 0.9:1 in Tasmania. The median age of cases ranged between 18–21 years at all OzFoodNet sites, except for Queensland where the median age was 9 years. There were no major changes in the median ages of salmonellosis cases from 2001 to 2000.

Rates of salmonellosis are highest in northern areas of Australia, with the highest rates in the Kimberley region.[4] Western Australia reported that the Kimberly region had a rate of 559 cases per 100,000 population. OzFoodNet sites reported that notification rates increased from south to north along eastern Australia (Figure 4).

Figure 4. Standardised rates of *Salmonella* notifications in OzFoodNet regions in eastern Australia, 2001, 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 2000.

* In this report, historical comparisons use date of onset of patient's symtoms or nearest equivalent for analysis.

Table 1. Numbers, rates and proportions of top five *Salmonella* infections, 2000 to 2001, by site

OzFoodNet site	Top five *Salmonella* infections					
	***Salmonella* type (serovar & phage type)**	**2001**	**Rate 2001***	**Proportion (%)†**	**2000**	**Ratio‡**
ACT	Typhimurium 9	10	3.2	12.8	31	0.3
	Stanley	5	1.6	6.4	1	5.0
	Bovismorbificans 14	4	1.3	5.1	0	–
	Paratyphi B bv Java Dundee	2	0.6	2.6	1	2.0
	Enteritidis RDNC 11	2	0.6	2.6	0	
Hunter	Typhimurium 135	15	2.8	12.2	10	1.5
	Typhimurium 126	9	1.7	7.3	3	3.0
	Typhimurium 64	9	1.7	7.3	14	0.6
	Birkenhead	5	0.9	4.1	9	0.6
	Typhimurium U290	3	0.6	2.4	0	–
New South Wales	Typhimurium 135	202	3.1	11.9	115	1.8
	Typhimurium 9	133	2.0	7.8	138	1.0
	Typhimurium 126	98	1.5	5.8	56	1.8
	Birkenhead	87	1.3	5.1	73	1.2
	Infantis	41	0.6	2.4	25	1.6
Queensland	Virchow 8	177	4.9	8.2	189	0.9
	Saintpaul	164	4.5	7.6	184	0.9
	Typhimurium 135	137	3.8	6.3	118	1.2
	Birkenhead	130	3.6	6.0	102	1.3
	Aberdeen	81	2.2	3.7	52	1.6
South Australia	Typhimurium 126	110	7.3	18.0	5	22.0
	Typhimurium 9	49	3.3	8.0	26	1.9
	Typhimurium 108	31	2.1	5.1	11	2.8
	Typhimurium 64 var	21	1.4	3.4	0	–
	Infantis	19	1.3	3.1	8	2.4
Tasmania	Mississippi	98	20.8	59.0	73	1.3
	Typhimurium 9	11	2.3	6.6	22	0.5
	Typhimurium 135	5	1.0	3.0	5	1.0
	Infantis	3	0.6	1.8	4	0.8
	Saintpaul	2	0.4	1.2	2	1.0
Victoria	Typhimurium 9	127	2.6	11.4	186	0.7
	Typhimurium 135	96	2.0	8.6	70	1.4
	Typhimurium 4	79	1.6	7.1	37	2.1
	Typhimurium 170	73	1.5	6.5	36	2.0
	Virchow 34	35	0.7	3.1	60	0.6
Western Australia	Typhimurium 135	80	4.2	9.0	68	1.2
	Saintpaul	45	2.4	5.1	42	1.1
	Chester	31	1.6	3.5	12	2.6
	Muenchen	23	1.2	2.6	29	0.8
	Stanley	21	1.1	2.4	5	4.2

* Rate per 100,000 population

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

‡ Ratio of the number of reported cases in 2001 compared with 2000.

During 2001, there were 520 notifications of *Salmonella* Typhimurium phage type 135 to OzFoodNet sites (including New South Wales) making it the most common infection (Table 1). There were 330 notifications of *Salmonella* Typhimurium phage type 9, which has been a common phage type for many years. South Australia recorded the emergence of *Salmonella* Typhimurium phage type 126, which had previously been rare in this state. The incidence of this phage type also increased in other Australian jurisdictions during 2001, particularly New South Wales and Queensland.

Certain *Salmonella* serovars were localised to specific geographical areas in Australia. During 2001, *Salmonella* Birkenhead was the fourth most common serovar for both New South Wales and Queensland. This elevated notification rate relates to an endemic focus of *Salmonella* Birkenhead in northern New South Wales and south-eastern Queensland. In Tasmania, 59 per cent (98/166) of *Salmonella* reports were the Mississippi serovar, which is rarely reported anywhere else in Australia. The notification rate for *Salmonella* Mississippi in Tasmania was 20.8 cases per 100,000 population, which was the highest specific rate of any serovar in OzFoodNet sites.

During 2001, NEPSS recorded 6,912 cases of *Salmonella* and documented specific epidemiological changes. The most notable of these changes was the emergence of *Salmonella* Typhimurium 126 across Australia. NEPSS also detected increases in *Salmonella* Stanley, *Salmonella* Typhimurium 170, *Salmonella* Typhimurium DT 104, and other serovars. NEPSS collaborated with state and territory health departments and OzFoodNet on a regular basis and participated in several joint investigations and routine teleconferences. NEPSS is a valuable Australian resource due to the data they collect on human and non-human sources of *Salmonella* and other enteric pathogens.

The rates of salmonellosis in Australia are higher than in the United States of America, but lower than in New Zealand (personal communication, Michael Baker, ESR, New Zealand, 1 August 2002).[3] In 2001, the FoodNet active surveillance system in the United States of America reported an incidence of 15.1 cases per 100,000 population compared to 64.7 cases per 100,000 population in New Zealand. It is difficult to compare the true incidence between countries due to the different healthcare systems and cultural settings.

Campylobacter

In 2001, OzFoodNet sites reported 15,815 cases of *Campylobacter* infection, which equated to a rate of 125 cases per 100,000 population however, data was not available for New South Wales, and the Hunter Health Area, New South Wales. This notification rate represented a 20.6 per cent increase over the mean for the previous 3 years. The increase was consistently observed in each quarter of 2001, with the highest rates in spring.

Rates of campylobacteriosis increased in all sites, ranging from 3.4 per cent in Queensland to 63.2 per cent in Western Australia (Figure 5). The increased rate in Western Australia is partly attributable to the introduction of voluntary laboratory notifications in 2000 for the first time. Geographically, the rates of *Campylobacter* infection were higher in southern parts of Australia in contrast to the rates observed for *Salmonella* infections (Figure 6). The north south trend was less marked for *Campylobacter* infections, but this phenomenon has been observed in other countries.[5] The highest rate of *Campylobacter* infection was 174 notifications per 100,000 population in South Australia.

Figure 5. Crude notification rates of *Campylobacter* infection, 1998 to 2001, by site and year

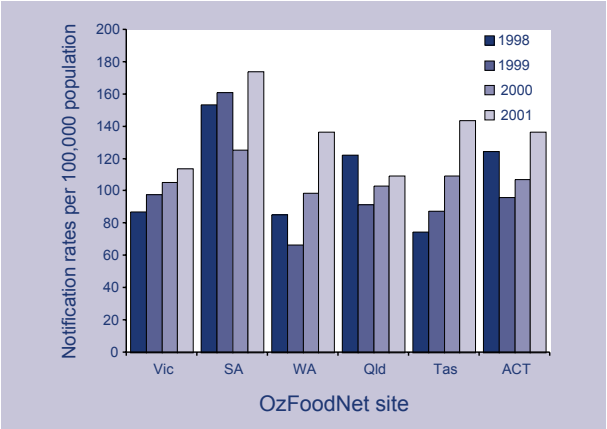
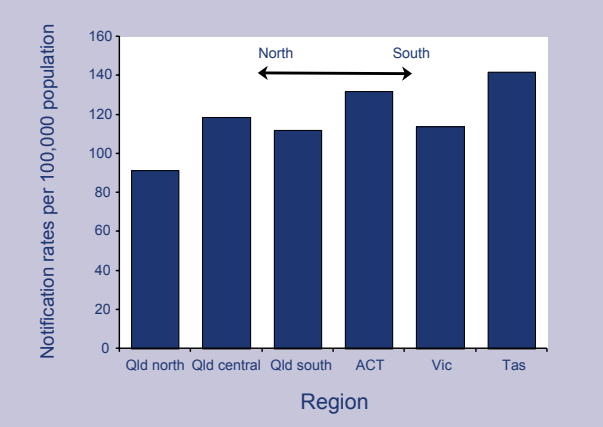


Figure 6. Standardised rates of *Campylobacter* notifications in OzFoodNet regions in eastern Australia, 2001, by date of notification*



* 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 2000.

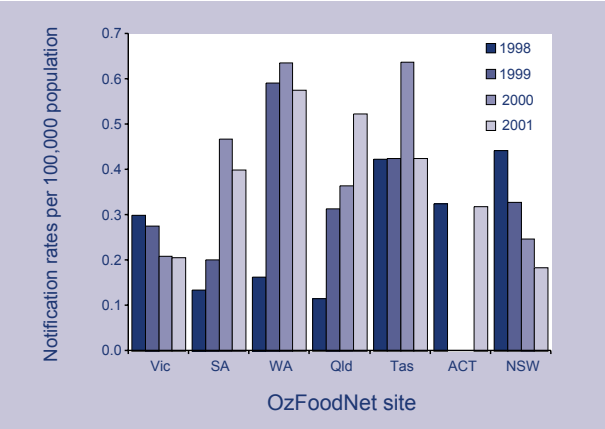
Sites reported a slight predominance of males (range of male to female ratio: 1:2–1.3:1) amongst notified cases. The median age of cases ranged from 26 to 32 years. Six outbreaks were reported due to *Campylobacter* in 2001. Apart from an overall increase in rates, OzFoodNet sites did not record any significant changes in the epidemiology of *Campylobacter* infections from 2001 to 2000.

There are substantial differences in rates of campylobacteriosis between countries. The rate in USA FoodNet sites is 13.8 cases per 100,000 population and 271.5 cases per 100,000 population in New Zealand (personal communication, Michael Baker, ESR, New Zealand, 1 August 2002).[3] It is difficult to determine whether these represent true differences in community incidence of the disease, or relate more to healthcare access, laboratory testing procedures and surveillance modalities.

Listeria

OzFoodNet sites reported 61 cases of listeriosis in 2001, which represents a notification rate of 0.3 cases per 100,000 population. This was an increase of 4 per cent compared to the mean of the previous 3 years. Western Australia had the highest notification rate amongst OzFoodNet sites and the incidence increased in Queensland over the last 3 years (Figure 7).

Figure 7. Crude notification rates of *Listeria* infections in OzFoodNet sites, 1998 to 2001, by site and year



The majority of cases during 2001 were reported in elderly people who were immunocompromised. OzFoodNet sites reported that the median age of non-pregnancy associated cases ranged from 60 to 86 years. Thirteen per cent (7/54) of non-pregnancy associated cases died. In Queensland, the outcome of 47 per cent (8/17) cases was unknown. Sites reported six maternal foetal infections during 2001, which equated to a rate of 2.3 cases per 100,000 births. (Births data from AIHW National Perinatal Statistics Unit for 1999 and includes live births and foetal deaths.[6]) The foetus or neonate died in three of these cases, giving a neonatal mortality rate of 50 per cent.

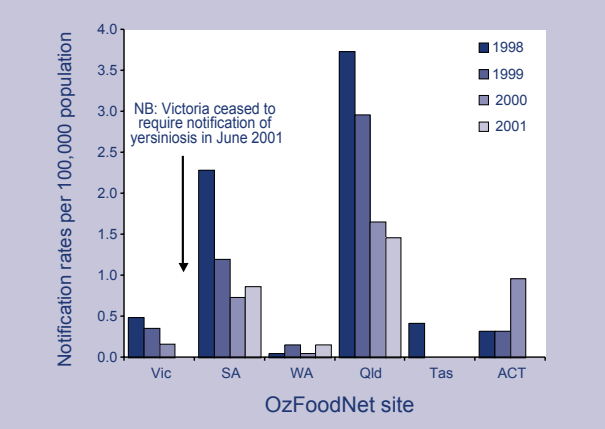
Yersinia

The CDNA agreed to stop reporting notifications of *Yersinia* infections to the NNDSS as of January 2001. The main reasons for this were the apparent decline in incidence and the absence 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. Currently, no other Australian jurisdiction has amended legislation to remove yersiniosis from lists of reportable conditions.

In 2001, OzFoodNet sites reported 71 cases of yersiniosis, which equated to a rate of 0.6 cases per 100,000 population. The overall rate was 50 per cent of the mean of the previous 3 years. The reasons for this decline in yersiniosis are unclear, but follow similar trends in other countries. Queensland reported 75 per cent (53/71) of all cases and had the highest rate of 1.5 cases per

100,000 population (Figure 8). The rates of yersiniosis were similar in all 3 Queensland Health zones, and ranged from 1.1 cases per 100,000 population in the Central zone to 1.9 cases per 100,000 population in the Northern zone.

Figure 8. Crude notification rates of yersiniosis, 1998 to 2001, by site and year



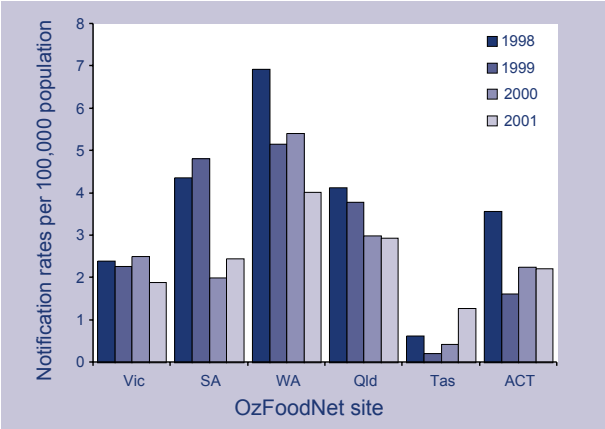
The median age of cases of yersiniosis ranged from 6 to 26 years in different sites. In the two jurisdictions with the majority of cases, South Australia and Queensland, males were more common than females with a male to female ratio of 1.8:1 and 1.5:1 respectively.

The decrease in *Yersinia* notifications may be due to changes in laboratory testing practices rather than a true decline in incidence. Despite the declining rates of this disease, it is important for health agencies to continue surveillance for yersiniosis. The rates of yersiniosis in neighbouring New Zealand are 11.5 per 100,000 population, which is significantly higher than Australia (personal communication, Michael Baker, ESR, New Zealand, 1 August 2002).

Shigella

OzFoodNet sites reported 326 cases of shigellosis during 2001, which equated to a notification rate of 2.6 cases per 100,000 population. The rate of notification decreased by 23 per cent from the mean of the previous 3 years and only Tasmania observed an increase in the 3-year period (Figure 9). The median ages ranged from 20–43 years. Males were more commonly reported from all sites, except for Tasmania and Western Australia. 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.

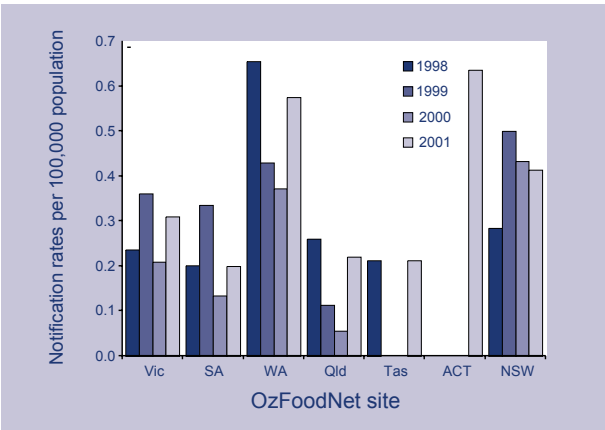
Figure 9. Crude notification rates of shigellosis, 1998 to 2001, by site and year



Typhoid

OzFoodNet sites reported 67 cases of typhoid infection during 2001. This represents an overall notification rate of 0.3 cases per 100,000 population, which was similar to previous years. The highest rates were reported in Western Australia (Figure 10). Where travel status was known, sites reported that 92.5 per cent (37/40) of cases of typhoid had recently travelled overseas. Fifty-five per cent (22/40) of these cases had recently returned from Indonesia.

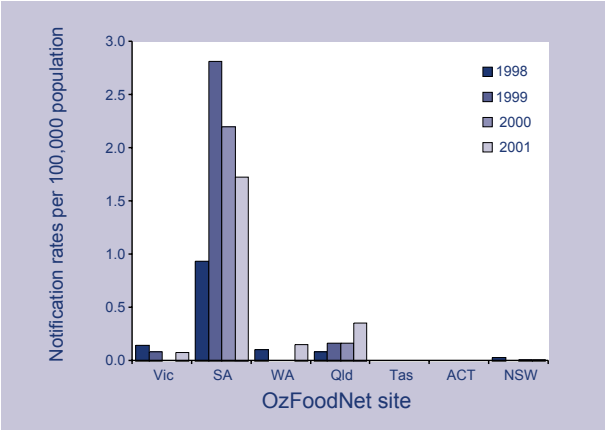
Figure 10. Crude notification rates of typhoid, 1998 to 2001, by site and year



Shiga-toxin producing *E. Coli*

OzFoodNet sites reported 47 cases of shiga-toxin producing *E. coli* (STEC) infection during 2001. The notification rate of 0.2 cases per 100,000 population was a 15 per cent increase over the mean rate for the previous 3 years (Figure 11). South Australia (26 cases) and Queensland (13 cases) reported the majority of cases. The median age of cases ranged from 10–28 years and females were more commonly infected than males in Queensland, South Australia and Victoria. All of the cases appeared to be sporadic.

Figure 11. Crude notification rates of shiga-toxin *E. coli*, 1998 to 2001, by site and year



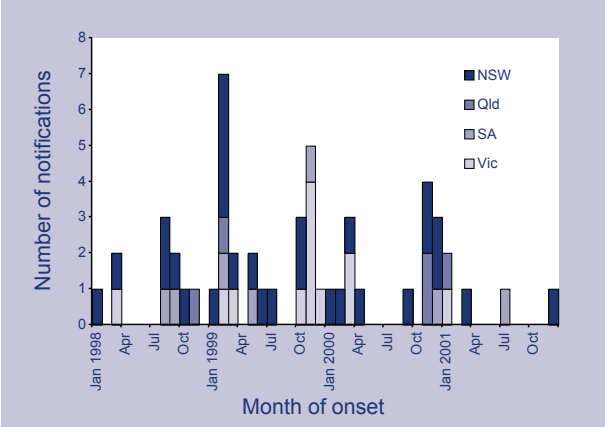
The highest rate of STEC infections was in South Australia, due to the specific testing of bloody stool (both microscopic and macroscopic) for the presence of shiga-toxin or the gene coding for production of the toxin. The majority of reports in South Australia were detected by polymerase chain reaction. Only 12 per cent (3/26) of cases in South Australia were reported to be due to *E. coli* O157. Victoria reported that two out of 4 cases were due to *E. coli* O157, while Queensland reported that four out of 10 cases were due to this serovar.

Haemolytic uraemic syndrome

There were 5 cases of haemolytic uraemic syndrome (HUS) reported during 2001, corresponding to an overall rate of 0.02 cases per 100,000 population. There were 2 cases reported in New South Wales, and one case reported in each of Victoria, South Australia and Queensland (Figure 12). The median age of cases was 16 years (range 2–53 years) and the male to female ratio was 1:1. One case, an 83-year-old male, died giving a case fatality rate of 20 per cent.

It is likely that there is substantial under-reporting of this serious disease. The Queensland site reported that there were 21 patients recorded in hospitalisation statistics for the financial year 2000/01, compared to only 3 cases for the same time period on the notification dataset. There is very little known about the notification fraction for diseases potentially due to food, and this is an area of future work for OzFoodNet.

Figure 12. Numbers of notifications of haemolytic uraemic syndrome, 1998 to 2001, by month of onset and site



Foodborne disease outbreaks

During 2001, several significant outbreaks occurred and some important themes emerged. This section discusses some of these outbreaks and summarises preliminary data. Common themes from these outbreaks are discussed in the section on 'Information on risk factors'. For a summary list of individual outbreaks associated with food or water reported by OzFoodNet sites see Appendix 2.

In 2001, OzFoodNet sites reported 86 outbreaks that were potentially related to food (Table 2). The 86 outbreaks affected approximately 1,768 people, of whom 4.0 per cent (70/1,768) were hospitalised and one person died. The majority of outbreaks occurred in summer and autumn, although there was a peak in December relating to pre-Christmas functions (Figure 13).

Figure 13. Foodborne disease outbreaks, 2001, by month and agent

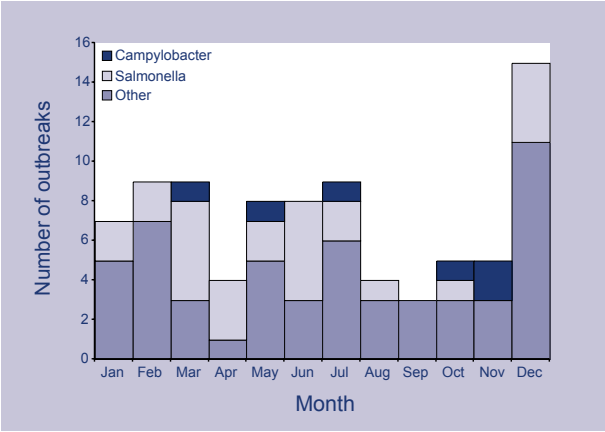


Table 2. Number of outbreaks and clusters, 2001, reported by OzFoodNet site and pathogen

OzFoodNet	Number of outbreaks, by pathogen type							Vehicles identified		Median number of cases per outbreak (range)	Analytical studies		Clusters investigated[||]
	Salmonella	*Campylobacter*	Parasites	Toxin	Viral	Unknown*	Total	Conf[†]	Susp[‡]		CCS[§]	Cohort	
ACT	0	0	0	0	0	6	6	0	6	46 (19–110)	0	0	3
Vic	7	2	0	3	4	7	23	9	5	22 (3–269)	2	11	26
Hunter	1	1	0	1	0	8	11	5	5	4 (2–20)	0	1	3
Qld	5	2	1	9	1	5	23	15	1	8 (2–87)	2	4	5
WA	3	0	0	0	2	5	10	3	3	20 (4–56)	0	7	1
SA	8	1	0	0	0	0	9	6	0	13 (2–90)	2	4	7
Tas	2	0	0	0	0	1	3	0	1	7 (6–9)	0	2	3
Aust	1	0	0	0	0	0	1	1	0	27	0	0	–
Total	**27**	**6**	**1**	**13**	**9**	**34**	**86**	**39**	**20**	**10 (2–269)**	**6**	**29**	**48m**

* Outbreaks where the aetiology was suspected, but not confirmed have been categorised as 'Unknown'.

† Confirmed vehicle, either microbiologically and/or epidemiologically.

‡ Suspected vehicle, from descriptive epidemiology and biological plausibility, and/or non-specific microbiological indicators.

§ Case control study.

|| The Australian Capital Territory and Tasmania reported investigating only clusters of non-salmonellosis, where Victoria, the Hunter and Queensland reported clusters of *Salmonella*, and South Australia reported additional investigation of suspected person-to-person transmission.

Thirty-one per cent (27/86) of outbreaks were due to *Salmonella*, while 37 per cent (32/86) were of unknown aetiology. OzFoodNet sites reported that a food vehicle was confirmed for 45 per cent (39/86) of outbreaks and suspected for a further 23 per cent (20/86) of outbreaks. To investigate these outbreaks, health departments conducted 29 cohort studies and 6 case control studies. In addition, sites reported details of 48 investigations into temporal or geographical increases of enteric pathogens, although this number is an underestimate as this information is poorly recorded.

Significant outbreaks

Australia participated in two international outbreak investigations during 2001. In the first, the Victorian Department of Human Services (DHS) investigated an outbreak of *Salmonella* Typhimurium Definitive Type 104 associated with helva imported from Turkey.[7] The Victorian DHS investigated this in conjunction with Sweden, Norway and other European countries. Eighty-seven per cent (20/23) of Australian cases occurred in Victoria, with 2 cases occurring in New South Wales and one in Queensland.

The second international outbreak was due to *Salmonella* Stanley associated with dried peanuts imported from China.[8] OzFoodNet coordinated the investigation into this outbreak at the request of CDNA. The investigation was unusual in that it involved small numbers of cases in several Australian jurisdictions. OzFoodNet epidemiologists and health department staff conducted hypothesis-generating interviews, which were collated centrally. The source of the outbreak became clear when the Victorian DHS and the Microbiological Diagnostic Unit, Public Health Laboratory tested dried peanuts nominated by 2 cases. The peanuts subsequently tested positive for three *Salmonella* serovars: Stanley, Newport and Lexington. This finding triggered an international product recall and assisted health agencies in Canada and the United Kingdom who were investigating similar outbreaks.

The largest community-wide outbreak in 2001 occurred in South Australia and was due to *Salmonella* Typhimurium phage type 126.[9] The outbreak lasted for several months, with cases emerging in other jurisdictions later in the epidemic. South Australian investigators conducted a case-control study showing that illness was associated with consumption of chicken. The department also identified corroborating evidence for this link, including descriptive epidemiology and microbiological evidence from samples of raw chicken. The South Australian DHS observed a decrease in human cases of this infection following interventions in the local chicken industry, at the breeder farm, hatchery and processing plant levels.

This outbreak raised again the question of the role that contaminated chicken products play in the epidemiology of *Salmonella* and *Campylobacter* in humans in Australia. Following the outbreak, a submission to the Food Regulation Standing Committee prompted an examination of this issue by a Development and Implementation Sub-Committee working group.

In June 2001, Queensland investigated a statewide increase in *Salmonella* Bovismorbificans phage type 32. Investigators suspected that the outbreak was linked to a food product purchased from a fast food restaurant, and conducted a case control study. The study implicated a product containing iceberg lettuce. Environmental investigations identified a mechanical slicer at the processing facility that was positive for *Salmonella* Bovismorbificans phage type 32.

Agents and vehicles

Thirty-one per cent (27/86) of outbreaks during 2001 were due to *Salmonella*, with S. Typhimurium causing 16 outbreaks (Table 3). The proportion of *Salmonella* outbreaks with good quality evidence for an implicated source was very high, with 52 per cent (14/27) having analytical and/or microbiological evidence. Despite *Campylobacter* being the most commonly notified pathogen to health authorities, only 6 outbreaks were recorded. Queensland recorded 83 per cent (5/6) of outbreaks of ciguatera poisoning due to fish that were locally caught and consumed. Consumption of fish caused 2 outbreaks of oily diarrhoea due to escolar wax esters and one of histamine poisoning. Norwalk-like viruses were responsible for 8 per cent (7/86) of outbreaks, although it is likely that many outbreaks of unknown aetiology could be caused by these viruses.

Outbreak settings

A summary of outbreaks by settings reveals that 29 per cent (25/86) of outbreaks were associated with restaurants, which affected an estimated 381 people (Table 4). Outbreaks at conferences and functions affected the most people (765 cases) and had the largest median outbreak size of 40.5 persons. The hospitalisation rate was very low in this outbreak setting. There were 5 outbreaks in aged care settings affecting 51 people, 10 of whom were hospitalised. Fast food and takeaway businesses were implicated in a smaller number of outbreaks. These outbreaks had a smaller median size of 3 persons.

Table 3. Number of outbreaks reported, 2001, by aetiological agent, and level of evidence

Agent category	A	A+M	D	D+M	M	Total
C. perfringens	1	1	2	-	-	**4**
Norwalk virus	3	-	4	-	-	**7**
Campylobacteriosis	1	-	4	1	-	**6**
Ciguatera	-	-	6	-	-	**6**
Cryptosporidiosis	-	1	-	-	-	**1**
Escolar wax esters	-	-	-	2	-	**2**
Salmonella other	-	1	7	1	-	**9**
Salmonella Typhimurium	3	6	6	1	-	**16**
Salmonella Virchow	-	-	1	-	1	**2**
Scombrotoxicosis	-	-	1	-	-	**1**
Suspected Norwalk virus	-	-	2	-	-	**2**
Suspected campylobacteriosis	-	-	1	-	-	**1**
Suspected salmonellosis	-	-	1	-	-	**1**
Suspected toxin	-	-	8	-	-	**8**
Unknown	2	-	18	-	-	**20**
Total	**10**	**9**	**61**	**5**	**1**	**86**

D Descriptive evidence implicating the suspected vehicle or suggesting foodborne transmission.

M Microbiological confirmation of agent in the suspect vehicle and cases.

A Analytical association between illness and one or more foods.

Table 4. Number of foodborne disease outbreaks, 2001, by settings

Setting	Outbreaks (n)	Affected (n)	Hospitalised (n)	Hospitalisation rate (%)	Median number affected (Range)
Aged care	5	51	10	19.6	14.5 (3–49)
Camp	6	207	2	1.0	30 (11–87)
Community	5	161	16	9.9	23 (6–88)
Conference/function	15	765	2	0.3	40.5 (2–269)
Home	13	81	24	29.6	7 (2–16)
Hotel	5	36	3	8.3	8 (6–22)
Nationwide	1	27	-	-	-
Restaurant	25	382	8	2.1	8.5 (2–95)
Takeaway	11	50	5	10.0	3 (2–10)
Total	**86**	**1,759**	**70**	**4.0**	**9 (2–269)**

It is important to consider when reviewing these data that the setting plays an important role in the recognition and investigation of an outbreak. An outbreak in a conference setting where many people eat common food is easily recognised because many people become ill. Outbreaks associated with takeaway food are difficult to detect. While the volume of food prepared might be very large, it is difficult to identify consumers of contaminated takeaway food as they may be widely dispersed in the community. Some of these outbreaks reported here may have resulted from food safety problems in settings other than those mentioned, as contributing factors have not been taken into account.

No food vehicle was identified in 31 per cent (27/86) of outbreaks in 2001 (Table 5). The most common categories were for meat and poultry, which were responsible for 14 per cent (12/86) and 13 per cent (11/86) of outbreaks respectively. There were 3 outbreaks that were associated with eggs. Fish or shellfish were responsible for, or suspected to have caused 11 outbreaks. The majority of seafood-associated investigations were descriptive, as they were small toxin-related outbreaks where diagnosis was made on clinical grounds. Desserts were responsible for 7 per cent (6/86) of outbreaks, while salads, vegetables or fruits were responsible for 3 per cent (4/86) of outbreaks.

There were 2 outbreaks associated with contaminated drinking water, although investigators only obtained descriptive epidemiological data. One of these was a camp water supply with a high coliform count, and the other was a remote mine site where bore water was suspected as the cause. During 2001, there were 2 outbreaks due to unpasteurised milk. One of these was a small outbreak of cryptosporidiosis associated with milk intended for animal consumption. The other outbreak was suspected to be caused by unpasteurised milk consumed while on a school camp.

Table 5. Outbreaks reported to OzFoodNet sites, 2001, by vehicle category and level of evidence

Vehicle category	Level of evidence					Total
	A	A+M	D	D+M	M	
Dessert*	2	4	-	-	-	**6**
Drinking water†	-	-	2	-	-	**2**
Eggs	-	1	-	-	-	**1**
Suspected eggs	-	-	2	-	-	**2**
Fish/shellfish/seafood	-	-	7	2	-	**9**
Suspected fish/shellfish	-	-	2	-	-	**2**
Milk‡	-	1	1	-	-	**2**
Miscellaneous	-	-	-	1	-	**1**
Mixed vehicles	2	-	-	-	1	**3**
Pizza	-	-	5	-	-	**5**
Poultry	-	1	2	1	-	**4**
Suspected poultry	1	-	6	-	-	**7**
Red meat/meat products	3	1	-	1	-	**5**
Suspected red meat/meat products	1	-	6	-	-	**7**
Salad/vegetable/fruit§	1	1	1	-	-	**3**
Unknown	-	-	27	-	-	**27**
Total	**10**	**9**	**61**	**5**	**1**	**86**

* One outbreak was suspected to be caused by the dessert based on mildly elevated relative risks.

† One outbreak was suspected to be due to drinking water contamination, based on circumstantial evidence.

‡ One outbreak was suspected to be due to unpasteurised milk based on circumstantial evidence, and descriptive epidemiology.

§ One outbreak was suspected to be caused by salads consumed at a barbecue.

D Descriptive evidence implicating the suspected vehicle or suggesting foodborne transmission.

M Microbiological confirmation of agent in the suspect vehicle and cases.

A Analytical association between illness and one or more foods.

The settings in which outbreaks occurred varied with the agent implicated (Table 6). Outbreaks due to salmonellosis occurred in many settings, compared to outbreaks due to *C. perfringens* where 75 per cent (3/4) of outbreaks occurred in restaurants. Conference or functions, or restaurants were the setting for all of the suspected toxin outbreaks, which would be explained by poor handling of foods. All ciguatera poisoning outbreaks reported in 2001 occurred in homes.

It is important to interpret these data cautiously, as we have only reported food vehicles and not sources of infection or cause of contamination (Box 1).

Box 1. Attributing source of *Salmonella* Typhimurium 64 outbreak

An outbreak in Western Australia of *Salmonella* Typhimurium 64 was epidemiologically linked to fried ice cream. Fried ice cream has been categorised as a dessert. The cause of this outbreak was related to several potential breaches in food safety, including:

- using raw eggs to make the batter;
- using bread crumbs that were also used for crumbing chicken and other meats; and
- inadequate cooking.

The original cause of contamination in this outbreak could have been either raw eggs or cross-contaminated bread crumbs.

Table 6. Agents responsible for foodborne disease outbreaks associated with different settings, OzFoodNet sites, 2001

	Aged care	Camp	Community wide	Conference/function	Home	Hotel	Nationwide	Restaurant	Takeaway	Total
C. perfringens	-	-	-	-	-	1	-	3	-	**4**
Norwalk virus	-	1	-	2	-	-	-	4	-	**7**
Campylobacteriosis	1	-	-	1	-	-	-	3	1	**6**
Ciguatera	-	-	-	-	6	-	-	-	-	**6**
Cryptosporidiosis	-	-	1	-	-	-	-	-	-	**1**
Escolar	-	-	-	1	-	-	-	1	-	**2**
Salmonella other	2	1	2	-	1	1	1	1	-	**9**
Salmonella Typhimurium	1	2	2	-	4	1	-	4	2	**16**
Salmonella Virchow	-	-	-	1	1	-	-	-	-	**2**
Scombrotoxicosis	-	-	-	-	-	-	-	1	-	**1**
Suspected Norwalk virus	-	-	-	2	-	-	-	-	-	**2**
Suspected campylobacteriosis	-	1	-	-	-	-	-	-	-	**1**
Suspected salmonellosis	-	-	-	-	-	-	-	-	1	**1**
Suspected toxin	-	-	-	5	-	-	-	3	-	**8**
Unknown	1	1	-	3	1	2	-	5	7	**20**
Total	**5**	**6**	**5**	**15**	**13**	**5**	**1**	**25**	**11**	**86**

Risk factors for foodborne illness

OzFoodNet sites identified some important risk factors for foodborne infections during 2001. Epidemiologists identified these by reviewing data on foodborne outbreaks and discussing the results of investigations. During 2001, OzFoodNet started a series of case control studies for common infections, which will further characterise risk factors for foodborne illness. The major risk factors for infection that OzFoodNet identified during 2001 are grouped in the following categories: imported foods; takeaway foods; seafood; and red meat and poultry.

Imported foods and *Salmonella* contamination

Like many other countries, Australia is importing increasing amounts of foods from overseas countries. In 2001, there were two major outbreaks in Australia associated with imported foods. The first of these was the outbreak of antibiotic resistant *Salmonella* Typhimurium Definitive Type 104 due to helva imported from Turkey.[7] The second outbreak was an outbreak of *Salmonella* Stanley due to dried peanuts imported from China.[8]

While both of these outbreaks were small in terms of numbers of cases (50 overall) they have important implications for Australia and the food industry. When foods contaminated by microorganisms are imported they can pose a serious risk for primary industry and the processed food sector. *Salmonella* Typhimurium DT 104 has the potential to be a serious threat to primary industry due to its virulence and antibiotic resistant characteristics.[10] *Salmonella* Enteriditis phage type 4 is another agent that could prove devastating to the egg producing industry if it becomes established in Australia. It is vital that health and agriculture agencies are able to rapidly recognise outbreaks and identify the source.

Outbreaks due to imported foods have important resource implications for health and other regulatory authorities. Identifying the source of the food vehicle is difficult, as these foods often have a wide distribution and cases may be widely and thinly spread. Small numbers of cases of *Salmonella* Stanley were identified in every Australian jurisdiction except Tasmania and the Northern Territory. This type of investigation requires a coordinated response from all jurisdictions. Although a food vehicle may be identified, it may be difficult to control future product importation. For example, testing all food products containing peanuts coming into Australia is virtually impossible due to the huge range of products containing these nuts.

These outbreaks have shown that there is an obvious need to strengthen networks between Australian and international investigators. Health Canada was trying to identify a source for a similar outbreak of *Salmonella* Stanley in British Columbia during September 2001. The OzFoodNet posting to international electronic mailing lists about contaminated peanuts assisted them to identify the source of their outbreak.

The Victorian DHS was only able to confirm the source for the outbreak of *Salmonella* Definitive Type 104 in Victoria after Turkish helva was confirmed as the source of a similar outbreak in Sweden. These two international investigations involved intensive liaison with health authorities in Canada, China, Turkey, the United Kingdom, Sweden, Norway and other European countries.

While investigators find it difficult to identify imported food vehicles, it is even more difficult to identify the original source of contamination in the source country. Both of these investigations tracked a specific product back to a country of origin, but were unable to identify how the product became contaminated. This is a cause for concern, as it makes prevention effort almost impossible. The concept of product traceability is currently under discussion in international forums, such as the Codex Alimentarius Commission.

Health agencies are increasingly identifying outbreaks associated with foods that are distributed internationally.[11,12,13] *Salmonella* is frequently recognised as causing international outbreaks, but other agents have also been implicated.[11] Imported foods are possibly responsible for many more cases of illness that currently go unrecognised by Australia's surveillance systems.

Takeaway foods

The increasing consumption and volume of takeaway food served in Australia means that we are recognising more outbreaks associated with this sector. In 2001, there were 10 outbreaks associated with fast foods and one community-wide outbreak associated with products served by fast food restaurants. Many of these outbreaks were relatively small, but occurred repetitively.

In 2001, there were 3 small clusters of *Salmonella* and *Campylobacter* infections associated with takeaway kebabs. The vertical spits used to cook these products may not allow adequate internal cooking during busy periods. A recent survey of kebabs in Victoria showed that in 41.1 per cent of instances meat did not reach a surface temperature of 75˚C, and 23 per cent of proprietors were cutting under-cooked meat off kebab spits.[14] There were several small outbreaks associated with takeaway chickens, where the cause of contamination could not be determined.

Pizza was suspected as the vehicle for 5 outbreaks, one of which was due to *S.* Typhimurium 126 and the remainder of unknown aetiology. These outbreaks were small, due to the nature of consumption of these products, i.e. generally in small groups, making outbreak recognition difficult. OzFoodNet sites reported that pizzas have historically been the cause of toxin related outbreaks, particularly due to *S. aureus*. These bacterial toxins have been due to poor storage of raw ingredients immediately prior to pizza preparation. Pizza is a food that may also be undercooked, particularly during busy periods when cooking times are reduced.

Knowledge of safe times and temperatures for cooking food is essential for food businesses to ensure safe food. Although a validated food safety program can greatly assist businesses ensure that their food is safe, one of the major *Salmonella* outbreaks in 2001 was associated with a supplier with a certified safety program.

Seafood related illness

During 2001, there were 10 outbreaks associated with seafood that indicate potential risks for consumers. These included:

- six outbreaks of ciguatera poisoning following reef fish consumption;
- two outbreaks of oily diarrhoea associated with escolar consumption;
- one outbreak of histamine poisoning after eating Mahi Mahi; and
- one outbreak of *Salmonella* Missisippi suspected to be associated with oysters.

Ciguatera poisoning is a commonly reported illness, particularly in Queensland, where the majority of outbreaks occurred in 2001. Ciguatera poisoning may cause serious illness. In one outbreak, 11 out of 14 people were hospitalised as a result of their illness. In another outbreak, all 3 people consuming fish were affected and one person died. All outbreaks occurred in a home setting. The fish species implicated in these outbreaks included coral trout (n=2), Spanish mackerel (n=2), spotted mackerel (n=1), and barracuda (n=1). These species are recognised as a high risk for ciguatera poisoning. There is an obvious need to increase the education of amateur fishermen about species likely to cause ciguatera poisoning and the location of high-risk reefs and fishing locations.

During 2001, there were 2 outbreaks of diarrhoea associated with consumption of escolar (*Lepidocybium flavobrunneum*) or oilfish (*Ruvettus pretiosus*). There have been several outbreaks of this diarrhoeal syndrome around Australia in recent years, particularly in South Australia, Victoria and New South Wales. The outbreaks in 2001 affected 42 per cent (20/47) of people attending a conference in Newcastle and 33 per cent (5/15) of people attending a restaurant in Melbourne.

The marketing names used for these species are confusing, as they may be called butterfish, rudderfish, oilfish or escolar. Escolar and oilfish are the only two species that have the potential to cause illness. These fish have a very high content of indigestible wax ester, which causes oily diarrhoea, nausea and vomiting. The two other outbreaks associated with seafood in 2001, were a small outbreak of histamine poisoning (4 cases) and one of salmonellosis associated with oysters (6 cases). Histamine poisoning is not commonly reported in Australia, compared to other countries.[15] The symptoms are short-lived and often affect small numbers of people. *Salmonella* outbreaks are not commonly associated with seafood, although oysters may be contaminated with human pathogens when grown in contaminated water.[16]

Red meat and poultry

Twenty-seven per cent (23/86) of outbreaks reported by OzFoodNet sites were attributed to poultry or red meat products (Table 7). Many of these outbreaks were related to contamination post-cooking. There were 2 outbreaks of *C. perfringens* associated with cooked red meats, and four suspected toxin-related outbreaks associated with spit roast meats. The outbreak of Norwalk-like virus occurred at a large function where it was suspected that dishes or platters containing chicken became contaminated.

Table 7. Outbreaks associated with poultry or red meat/meat products, 2001, by agent and vehicle

Agent category	Poultry	Red meat/ meat products	Suspected poultry	Suspected red red meat/ meat products	Total
C. perfringens	-	2	-	-	**2**
Norwalk virus	-	-	1	1	**2**
Campylobacteriosis	2	-	-	-	**2**
Salmonella Typhimurium	1	3	-	1	**5**
Salmonella Virchow	1	-	-	-	**1**
Suspected salmonellosis	-	-	-	1	**1**
Suspected toxin	-	-	-	4	**4**
Unknown	-	-	6	-	**6**
Total	**4**	**5**	**7**	**7**	**23**

Salmonella was responsible for 7 outbreaks associated with these foods, five of which were due to *Salmonella* Typhimurium serovar. The South Australian Department of Human Services investigated a large outbreak of *Salmonella* Typhimurium phage type 126. The department investigation demonstrated a strong association between illness and consuming locally produced chicken meat. They also identified concurrent epidemics of this *Salmonella* in local chicken flocks. The chicken industry instituted a range of interventions, which was likely to have resulted in a subsequent decrease in the number of human cases.

During 2001, OzFoodNet sites investigated 38 clusters of *Salmonella* infections affecting 235 people. These included serovars commonly isolated from animal sources, such as Typhimurium, Virchow, and Bovismorbificans. Eleven of these clusters were various phage types of S. Typhimurium and accounted for 158 notified cases. Many of these clusters appeared to have links to red meat and/or poultry, either through human-animal contact or contaminated food.

Some of the reasons that investigators suspected that these clusters were related to these sources were:

- reports of isolation of these organisms from non-human sources in the NEPSS database;
- sporadic cases where the source of infection was known, e.g. a farmer infected with a certain type of *Salmonella* coincident with an outbreak in an animal herd;
- mixed infections with other organisms, such as *Campylobacter*, that are commonly associated with the suspected source;
- previous experience with outbreaks and sporadic cases of the specific *Salmonella* infection; and
- surveys of foods.

Identifying the source of these human infections is very difficult since poultry and red meats are very commonly consumed. While it is very difficult to identify sources, it is vital that public health agencies can compare data on *Salmonella* isolates from different sources to generate hypotheses.

State and territory health departments routinely consult NEPSS data on isolates from non-human sources to assist with investigations, although the underlying sampling distribution is unknown. It is often very difficult to obtain data from industry that are relevant to the investigation. To overcome these problems, jurisdictions could consider developing a long-term survey of *Salmonella* and *Campylobacter* in red meat and poultry at the retail level to monitor trends. If the sampling plan is well devised and the survey is conducted over a long period of time, investigators may be able to correlate these data with human infections. It is also vital for health agencies to improve liaison with industry and departments of agriculture.

Burden of disease

Foodborne disease imposes a substantial burden on the community and healthcare system.[17] One of the primary aims of OzFoodNet is to determine the incidence of foodborne disease in Australia. In 1999, the Australia New Zealand Food Authority estimated that there were approximately 4.2 million cases of foodborne disease each year, costing in excess of A$2.6 billion.[18]

NCEPH is conducting a National Gastroenteritis Survey on behalf of OzFoodNet to determine the incidence of gastroenteritis, which will be used to estimate the burden of foodborne disease. Two sites, Queensland and Victoria, also collected data about gastroenteritis through their state-based computer-assisted telephone interview (CATI) systems during 2001. This section reports on the progress of the National Gastroenteritis Survey and the preliminary results from the two state-based surveys.

Early estimates from the data collected in these three surveys indicate that the incidence of gastroenteritis is approximately one episode per person per year.[19] If we consider that roughly 35 per cent of gastrointestinal disease may be due to food, then there may be as many as 7 million cases of foodborne disease in Australia each year.[17] This is considerably higher than previous estimates.[18]

The National Gastroenteritis Survey

NCEPH started the OzFoodNet National Gastroenteritis Survey in September 2001. The main aim of this cross-sectional survey is to determine the incidence of gastroenteritis in Australia and to contribute to more reliable estimates of foodborne disease. The survey will also allow OzFoodNet to:

- identify regional or seasonal trends in gastroenteritis;
- determine the health seeking behaviours of persons with gastroenteritis; and
- determine the faecal testing patterns of medical practitioners who treat patients with gastroenteritis.

The National Gastroenteritis Survey uses the CATI technique to record people's experience of gastroenteritis in the previous month. The survey will run from September 2001 to August 2002 and will enrol approximately 6,000 people from all Australian states and territories. The results will be analysed by varying case definitions of gastroenteritis. This will range from the broadest possible, such as any acute episode of vomiting or diarrhoea in the last 4 weeks through to more stringent criteria, such as three or more loose stools or two episodes of vomiting in any 24-hour period. To ensure that the data are relevant to foodborne disease, OzFoodNet will exclude people attributing symptoms to non-infectious causes.

The preliminary data available in December 2001 covered the 4 months between September and December 2001 from 2,417 interviews of people across Australia. The unweighted results showed that approximately 12 per cent of respondents experienced symptoms of gastroenteritis in the previous 4 weeks. Preliminary analysis of the data suggests that there is variation by region, age and a medical history of chronic illness.[20] In the 4-month period there was modest variation across the jurisdictions with the highest level being recorded in the Northern Territory (Table 8). The Northern Territory recorded nearly twice the incidence of gastroenteritis of most other jurisdictions.

Table 8. Proportion of respondents with symptoms of gastroenteritis,* September to December 2001, by State and Territory

State	Proportion with gastroenteritis (%)
New South Wales†	10
Northern Territory	21
Queensland	11
South Australia	12
Tasmania	11
Victoria	11
Western Australia	10
Total	**12**

* Unweighted and all-inclusive definition of Gastroenteritis

† Includes the Australian Capital Territory, and an over sample in the Hunter Area Health Service

There was considerable difference in incidence by age, with younger children in the 0–4 year age group having the highest level of gastroenteritis. Approximately 20 per cent of this age group experienced gastroenteritis in the past 4 weeks compared with 5 per cent of older adults.

About 20 per cent of people with gastroenteritis visited their doctor or casualty department for treatment, but only about 3 per cent had a stool sample taken for testing. About a third took some form of medication, mostly painkillers. About a third of working people missed a day or more of work when they had gastroenteritis.

Victorian Population Health Survey

The Victorian Department of Human Services surveyed 7,494 persons aged 18 years or older as part of the Victorian Population Health Survey conducted between August and November 2001.

The survey used a CATI methodology to collect data about a range of health topics and demographic information. In the survey there were seven questions relating to gastroenteritis. The case definition for an episode of gastroenteritis was three or more loose stools, or two or more episodes of vomiting in a 24-hour period. Survey respondents were asked if they had experienced gastroenteritis in the previous 4 weeks. Persons with chronic conditions in which diarrhoea or vomiting were predominant symptoms were excluded from analysis.

The survey found that 10.1 per cent of adults had either diarrhoea or vomiting in the past 4 weeks when people with chronic gastrointestinal symptoms were excluded (Table 9). Twenty-one per cent of these people sought medical assistance for their illness, and 3.4 per cent had a faecal specimen tested.

Queensland Health 2001 Omnibus Survey

The Queensland Department of Health surveyed a total of 3,081 persons aged 18 years or older as part of the Queensland Health 2001 Omnibus Survey conducted between March and May in 2001. The Survey also collected data on children aged 7 months to 4 years from a nested survey of 386 parents or caregivers.

The survey used a CATI methodology to collect data about a range of health topics and demographic information. In the survey, there were 17 questions relating to gastroenteritis in adults and 13 addressed to carers of young children. The case definition for an episode of diarrhoea was three or more loose stools in a 24-hour period. Respondents were asked about episodes of diarrhoea during the preceding month. Persons with chronic conditions in which diarrhoea is a symptom were excluded from analysis.

The survey found that 13.6 per cent of adults and 18.9 per cent of children had acute diarrhoea in the preceding month (Table 10). Persons aged 18–39 years were almost twice as likely as those aged 40 years and older to report acute diarrhoea in the preceding month.

There was no significant difference for incidence of acute diarrhoea between persons living in a capital city or other major urban areas and persons living in rural and remote areas. There was no significant difference in the incidence of acute diarrhoea between lower and higher socio-economic groups as measured by the Australian Bureau of Statistics Socio-economic Indices for Areas, which is different to reports in the literature.[21]

Parents of young children with diarrhoea were more than twice as likely to seek medical care compared with adults (RR 2.5; 95% CI 1.8–3.5), although doctors requested stool specimens from similar proportions of presenting adults and young children.

Table 9. Self-reported gastroenteritis reported in the previous 4 weeks for adults over 18 years, Victorian Population Health Survey, August to December 2001

	Adults (n=7,494)	
	n	%
Gastroenteritis	760	10.1
Days off work/school/study/home duties	172	22.6*
Consulted doctor/nurse/medical person	157	20.7*
Stool tested	26	3.4*
Hospitalised	20	2.6*

* The denominator for proportions reporting days off work, consultation to doctor, stool testing and hospitalisation is the number of survey respondents reporting gastroenteritis (*n* = 760).

Table 10. Acute diarrhoea reported in the previous month, comparing adults and children aged between 7 months and 4 years, Queensland Health Omnibus Survey, March to May 2001

	Adults (n=3,081)		Children (n=386)	
	n	%	n	%
Acute diarrhoea	418	13.6	73	18.9
Consulted doctor	77	18.4*	34	46.6*
Stool collected	11	2.6*	6	8.2*

* The denominator for proportions reporting consultation to doctor and stool testing is the number of survey respondents reporting gastroenteritis (n = 418 for adults and n = 73 for children).

Improving surveillance

OzFoodNet aims to improve the investigation and reporting of foodborne disease throughout Australia. During 2001, OzFoodNet reviewed and evaluated surveillance of foodborne disease in different jurisdictions. These discussions highlighted that surveillance in different jurisdictions varies in sensitivity to detect and investigate outbreaks. OzFoodNet aims to ensure that each jurisdiction enhances the sensitivity of their surveillance system in a way that is sustainable in the longer term.

Communicating nationally

OzFoodNet has developed into the major forum vehicle for discussing foodborne disease incidence at the national level in Australia. OzFoodNet contributes to CDNA, which is Australia's peak body for surveillance and response to communicable diseases. CDNA meets each fortnight by teleconference to discuss issues about communicable diseases that are of national importance.[22] OzFoodNet is able to investigate clusters of foodborne disease that occur in more than one Australian jurisdiction.

During 2001, OzFoodNet started circulating a short summary report of outbreaks and clusters occurring at each site. These reports are circulated each fortnight and detail:

- the occurrence of point source outbreaks occurring in the site;
- results from current and previous investigations;
- any increases in enteric pathogens; and
- the current incidence of important foodborne diseases, such as: listeriosis, STEC and *Salmonella* Enteritidis infections.

OzFoodNet holds monthly teleconferences to update members about the occurrence of clusters of disease and discuss the progress of joint projects. If cluster investigations involve more than one jurisdiction more frequent teleconferences are conducted.

National outbreak coordination

In July 2001, CDNA requested that OzFoodNet coordinate the investigation into an outbreak of S. Stanley that was occurring in people with Asian surnames in several Australian jurisdictions. OzFoodNet convened teleconferences to discuss state and territory investigations of cases. All jurisdictions agreed to pool de-identified data into a spreadsheet for descriptive analysis and hypothesis generation.

This outbreak investigation was unusual in that very few cases were notified in each jurisdiction. Some jurisdictions only had one or 2 cases notified. It demonstrated the need for centralising data and coordinating investigations nationally. OzFoodNet also coordinated summaries of several smaller clusters of *Salmonella* infections occurring across different jurisdictions.

National case definitions

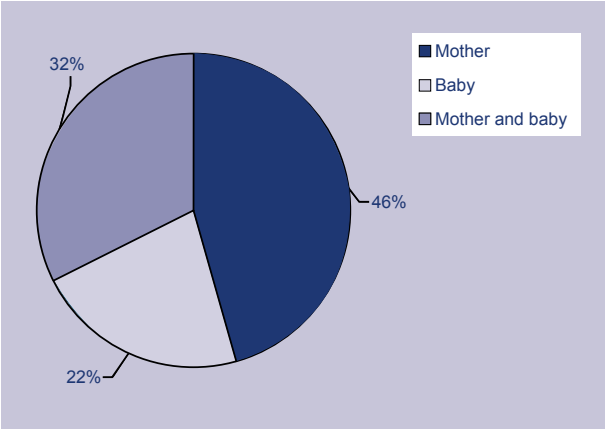
All contributors using the same case definitions and applying them consistently improve public health surveillance. During 2001, the CDNA revised the case definitions for national surveillance of communicable diseases. This review, which included input from OzFoodNet included several diseases potentially tranmitted via food.

Case series of listeriosis

The FSANZ requested that OzFoodNet compile data on human listeriosis for a risk assessment on *Listeria* in seafood. OzFoodNet obtained data from all states and territories on cases of listeriosis reported between 1998 and 2000.

The data required considerable checking and interpretation, but yielded important insights into surveillance for listeriosis. An example of this was the inconsistencies in recording materno-foetal infections between states and territories. States and territories reported 49 listeriosis cases in pregnant women that corresponded to 37 distinct infections. For each pregnancy-associated infection, jurisdictions recorded either the mother or the baby as a single case, or they recorded both the mother and the baby on the dataset (Figure 14). This means that the numbers of listeriosis cases occurring in each jurisdiction are not comparable. The review also highlighted many information gaps on routine surveillance databases, such as information on risk factors and Indigenous status.

Figure 14. Notifications of listeriosis in pregnant women, 1998 to 2000, by method of State and Territory dataset entry (*n*=49 cases)



Timeliness and completeness of Salmonella reporting

Effective surveillance of *Salmonella* relies on data that are transmitted in a timely fashion and recorded systematically.[23] In 2001, OzFoodNet epidemiologists evaluated surveillance for foodborne diseases. These evaluations highlighted some deficiencies inherent in the system, which became obvious during multi-jurisdictional investigations.

OzFoodNet epidemiologists worked with local data providers and reference laboratories to improve the timeliness of surveillance data. Some examples of improvements are listed below.

- By changing the way data were reported from the reference laboratory, the OzFoodNet-Hunter site was able to decrease the median time delay between specimen collection to receipt of a serovar result from 21 days to 17 days.
- The OzFoodNet-Tasmania site was able to improve the timeliness of *Salmonella* reports by recording sero-groupings, as the predominant serovar. Mississippi is the only one belonging to the E/G group. S. Mississippi accounted for 59 per cent (96/166) of notifications in Tasmania during 2001. While not providing definitive results, this change will allow the Tasmanian Department of Health and Community Services to identify potential outbreaks of *Salmonella* Mississippi, and non-Mississippi serovars.
- The OzFoodNet-Western Australia site was able to liaise with the local reference laboratory to increase the frequency of sending *Salmonella* isolates requiring phage typing to reference laboratories in South Australia and Victoria. Minimising the time taken for batching isolates is vital for outbreak detection and control.

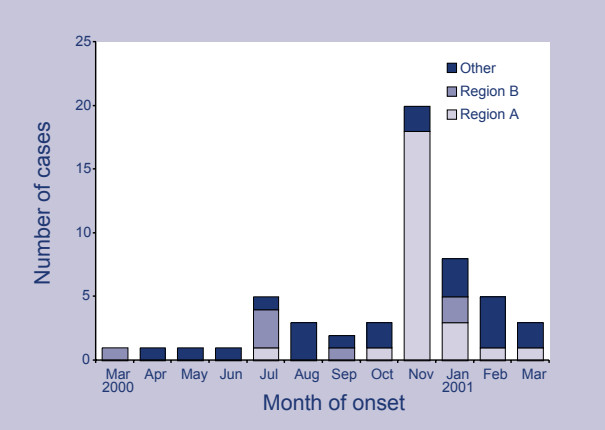
Despite these examples of improvements to *Salmonella* timeliness, there are still many gains yet to be made in this area. Timeliness should improve considerably with the introduction of electronic reporting from laboratories to health departments.

It is equally important for health agencies to accurately record reports of *Salmonella* on surveillance databases. The quality of datasets around the country can influence detection of clusters for investigation (Box 2).

Box 2. A psuedo outbreak due to data entry error

At a routine teleconference, an epidemiologist identified a recent increase in *Salmonella* Typhimurium phage type 4 in a neighbouring geographic region (Region A) of their state (Figure 15). An epidemiologist in another state reported a concurrent increase of *S.* Typhimurium 4 at the same time. Upon further investigation, the increase in the first state was found to be entirely due to a data entry error. This national discussion about this pseudo-outbreak again highlighted the importance of rigorous quality assurance in surveillance data collection.

Figure 15. Pseudo outbreak of *Salmonella* Typhimurium 4 due to data entry error in the neighbouring region to an OzFoodNet site



There was a marked improvement in completeness of *Salmonella* typing information on surveillance databases in jurisdiction between 2000 and 2001 (Table 11). There was a 5.3 per cent increase in salmonellosis cases on notification databases with appropriate typing data, up from 88.0 per cent in 2000 to 93.3 per cent in 2001. Importantly, the rates of completeness particularly improved in the states of Western Australia and New South Wales in these 2 years. Western Australia reported the largest improvement of 23.1 per cent from 2000 to 2001, which was due to the health department receiving voluntary laboratory notifications of communicable diseases at this time. South Australia had the highest rate of completeness with appropriate information for 99.8 per cent of all cases in 2001.

It is likely that the majority of salmonellas isolated at primary laboratories are typed due to a well-developed system of referral. The overall improvements observed in 2001 can be partly attributed to the interaction of OzFoodNet epidemiologists with surveillance systems. While there was an improvement in this area from 2000 to 2001, it is an area that OzFoodNet epidemiologists need to monitor and improve in the future.

Increasing OzFoodNet coverage

During 2001, the Northern Territory participated in OzFoodNet as observers. The Food Branch of the New South Wales Health Department also participated in several teleconferences and attended face-to-face meetings.

The Australian Capital Territory joined OzFoodNet as a fully funded member in August 2001. The OzFoodNet epidemiologist in the Australian Capital Territory is also assisting NCEPH with the estimation of the burden of foodborne disease in Australia. At the time of writing, contracts had recently been finalised which will see OzFoodNet coverage to include all of New South Wales and the Northern Territory.

Efficient surveillance of infectious diseases relies upon good liaison between health agencies and public health laboratories. OzFoodNet has continued to work collaboratively with laboratories in each jurisdiction and the PHLN and is undertaking several studies with strong laboratory involvement, which has associated benefits for surveillance.

International developments

In 2001, OzFoodNet established collaborative links with international agencies conducting surveillance and research into foodborne diseases. Several countries have conducted similar studies to OzFoodNet, which will yield important insights into the incidence and control of foodborne disease. These collaborations have included agencies, such as the USA Centers for Disease Control and Prevention, the Food Safety Authority of Ireland, Health Canada, the Institute of Environmental Science and Research New Zealand, the United Kingdom Public Health Laboratory Service, and the World Health Organization.

Table 11. Completeness of *Salmonella* typing data on State and Territory surveillance databases, 2000 and 2001

Information required	Per cent of notifications with appropriate typing information, by notification date															
	Tas		NSW		WA		ACT		Vic		Qld		SA		OzFoodNet sites	
	2000 (n=127)	2001 (n=166)	2000 (n=1,341)	2001 (n=1,670)	2000 (n=936)	2001 (n=898)	2000 (n=100)	2001 (n=76)	2000 (n=1,009)	2001 (n=1,091)	2000 (n=1,818)	2001 (n=2,169)	2000 (n=452)	2001 (n=613)	2000 (n=5,783)	2001 (n=6,683)
Salmonella serotype	96.9	98.2	92.8	94.1	92.2	95.2	96.0	98.7	97.7	97.7	97.2	97.0	99.6	99.8	95.5	96.5
S. Bovismorbificans phage type	100	100	50.0	39.4	62.5	57.1	–	100	96.3	96.7	100	100	100	100	76.4	83.2
S. Enteritidis phage type	100	100	78.2	80.8	34.5	85.5	100	100	100	100	94.8	90.2	100	100	78.3	89.4
S. Hadar phage type	–	–	52.9	38.9	80.0	85.7	0.0	100	81.8	100	100	73.3	100	100	75.8	77.8
S. Heidelberg phage type	0.0	–	18.2	84.6	0.0	0.0	100	100	75.0	100	90.6	91.8	–	–	68.6	88.6
S. Typhimurium phage type	97.0	96.4	88.1	95.7	55.2	87.8	100	100	99.8	99.7	93.1	95.8	100	100	87.7	96.4
S. Virchow phage type	100	–	38.2	67.2	80.0	66.7	100	100	99.1	100	97.4	95.0	100	100	90.7	92.5
Salmonella with information	**95.3**	**97.6**	**80.5**	**87.8**	**68.1**	**89.4**	**95.0**	**98.7**	**97.1**	**97.4**	**95.0**	**94.7**	**99.6**	**99.8**	**88.0**	**93.3**

OzFoodNet projects

During 2001, OzFoodNet collaborators initiated several projects to investigate and understand foodborne disease, some of which were national in scope. This section briefly details the nature of these projects and the current status of this work.

National projects

During September, NCEPH collected the first month's data for the national gastroenteritis survey. Starting this study was a major achievement and required considerable collaboration. NCEPH also prepared a report into future directions for OzFoodNet, which outlined research gaps in Australia for foodborne disease.

OzFoodNet developed national case control studies for *Campylobacter* and *Salmonella* Enteritidis to identify risk factors for infection. During 2001, sites in Tasmania, Victoria and Western Australia started the *Campylobacter* study and the remaining sites made preparations. In 2001, OzFoodNet developed a proposal for a listeriosis case control study and piloted the methodology. At the December face-to-face meeting, this was changed to a case series in all but two sites. OzFoodNet sites in the Hunter and Queensland will run the original protocol as a case control study. The results of this case series will provide important information nationally on the underlying risk factors for infection and high-risk foods.

OzFoodNet will conduct a case control study of STEC/HUS in South Australia, which has the highest rates of STEC notification in Australia due to intensive screening. Investigators continued to revise the protocol for the national laboratory survey. This survey will determine the faecal testing practices of laboratories around Australia, and will provide important information that will assist interpretation of notification data.

An outbreak register for Australia

Australia's lack of a systematic system of recording data on outbreaks of enteric disease has hampered our understanding of foodborne disease.[24] Summary data from outbreaks can provide useful information for the development of policy.[25]

Before OzFoodNet commenced, the Hunter Health Area, New South Wales initiated a retrospective survey of outbreak information from all states and territories between the years 1995 to 2000. This data collection, coined OzBreaks, contains detailed information on 208 outbreaks. OzBreaks is currently being analysed in collaboration with OzFoodNet epidemiologists.

To improve the quality of this information, OzFoodNet developed a register to provide a prospective record of Australian disease outbreaks associated with food and water. The OzFoodNet working group agreed to collect outbreak information from 1 January 2001 onwards. The OzFoodNet data manager developed a database and form, based on those used by the World Health Organization European regional office and the USA Centers for Disease Control and Prevention.

OzFoodNet epidemiologists have conducted a trial of the new register and made recommendations for improvement. The CDNA has requested that OzFoodNet expand the register to include outbreaks of intestinal illness not related to food. To ensure that the system for surveillance of outbreaks works properly, OzFoodNet is communicating with international investigators and formally evaluating the register in July 2002.

Development of a national *Campylobacter* typing network

The Hunter Health Area, New South Wales site conducted a case control study of *Campylobacter* infections that commenced prior to OzFoodNet. One hundred and eighty isolates from this study have been typed by several phenotypic and genotypic methods. The OzFoodNet-Hunter epidemiologist along with microbiologists will evaluate the testing methods for their epidemiological usefulness, cost, speed, simplicity and concordance. The outcome of this evaluation will assist the identification of suitable testing methods for *Campylobacter* isolates collected as part of the national case-control study.

This evaluation is unique in that the assessment of the different typing schemes is epidemiological in nature. Comparison of typing is quite common in microbiological research, but often lacks epidemiological input. In this instance, the case control study data for the most common subtypes from a range of typing schemes will be analysed.[26]

Another benefit of this typing network is that it may provide an opportunity to develop into a network for typing organisms associated with other disease outbreaks. This method of sharing microbiological data has provided many countries with an increased capacity to control foodborne disease.[27] Sharing pulsed field gel electrophoresis patterns using BioNumerics software is the basis of the successful PulseNet system.[28]

Projects in single sites

OzFoodNet epidemiologists or collaborators have developed several other studies within their jurisdictions. These include:

- a molecular typing project in Western Australia looking at automated ribotyping of bacterial foodborne pathogens, and development of a typing library using BioNumerics software;
- a pilot study looking at enhancing Environmental Health Officer reports of foodborne disease outbreaks in Victoria;
- case control studies for locally important *Salmonella* infections, including the following serovars and phage types:
  - S. Birkenhead in Queensland and northern New South Wales;
  - S. Mississippi in Tasmania;
  - S. Typhimurium 126 in South Australia; and
  - S. Typhimurium 135 in New South Wales, Victoria and Western Australia.

Two sites, Queensland and Victoria, attempted to establish sentinel surveillance for gastroenteritis in general practice. Despite intensive liaison with divisions of general practice, both sites found it difficult to recruit recorders for the scheme. OzFoodNet has decided not to proceed with sentinel GP surveillance at this stage, particularly when other groups such as the Royal Australian College of General Practice already collect such data.

Conclusion and recommendations

OzFoodNet is much more than a data gathering exercise. OzFoodNet has demonstrated its capacity to investigate and respond to outbreaks at the national level and can potentially provide an early-warning capacity for bioterrorism events associated with food.

In time, OzFoodNet will be able to assess the efficacy of current and proposed food hygiene standards and their enforcement by jurisdictions. OzFoodNet represents a significant investment in applied research into foodborne disease. It is important for the results of this work to become incorporated into policy formulation. The results of analytical studies initiated in 2001 will provide a useful insight into the occurrences of foodborne disease in Australia.

Recommendations regarding common risk factors

As a result of recurring outbreaks associated with commonly eaten foods, OzFoodNet recommends that Australian regulatory authorities:

1. consider developing guidelines for the safe preparation of takeaway kebabs and pizza;
2. educate amateur fishermen about the dangers of eating reef fish from areas affected by ciguatera poisoning;
3. provide effective guidelines to aged care facilities aimed at preventing foodborne disease outbreaks; and
4. monitor, with OzFoodNet, the incidence of escolar-associated outbreaks, following national efforts to prevent these outbreaks.

Recommendations regarding improving foodborne disease surveillance

To improve national surveillance of foodborne disease, OzFoodNet recommends that:

5. Health and food safety agencies should continue to improve international liaison regarding food safety alerts and disease outbreaks about widely distributed foods.
6. Health, food safety agencies and agricultural agencies should consider developing a long-term survey of retail meats across Australia to determine the prevalence of specific *Salmonella* types and *Campylobacter* to aid communicable disease investigations.
7. Health, food safety, industry and agricultural agencies should develop closer links to share information about the occurrence of foodborne pathogens.
8. OzFoodNet should develop short guidelines on investigating national clusters to outline responsibilities and expectations of all parties.
10. The Commonwealth Department of Health and Ageing in conjunction with CDNA should consider building on the *Campylobacter* typing network coordinated by OzFoodNet-Hunter to enable rapid sharing of molecular typing data on bacterial pathogens.
11. OzFoodNet epidemiologists should develop standard reporting practices for pregnancy-associated listeriosis.

12. State and territory health departments should continue to conduct rigorous checks on the quality of surveillance data maintained on surveillance databases.
13. State and territory health departments should consider using completeness and timeliness of *Salmonella* reporting as a potential performance indicator of surveillance and capacity to control disease.
15. OzFoodNet should review the under-reporting of haemolytic uraemic syndrome to state and territory health departments.

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Appendices

Appendix 1. Notification summary of infections potentially due to food for OzFoodNet sites, 2001, by date of onset

		ACT	NSW	Hunter	Qld	SA	Tas	Vic	WA	Total
Campylobacter	n	429	NN	NN	3,969	2,617	676	5,515	2,609	**1,5815**
	rate	136.5	NN	NN	109.4	174.2	143.7	114.2	136.6	**125.0**
Salmonella	n	78	1,619	125	2,171	607	163	1,107	862	**6,607**
	rate	24.8	24.8	23.1	59.8	40.4	34.7	22.9	45.1	**34.4**
Yersinia	n	0	NN	NN	53	13	0	2	3	**71**
	rate	0.0	NN	NN	1.5	0.9	0.0	0.0	0.2	**0.6**
STEC	n	0	1	0	13	26	0	4	3	**47**
	rate	0.0	0.0	0.0	0.4	1.7	0.0	0.1	0.2	**0.2**
HUS	n	0	2	0	1	1	0	1	0	**5**
	rate	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	**0.03**
Typhoid	n	2	27	3	8	3	1	15	11	**67**
	rate	0.6	0.4	0.6	0.2	0.2	0.2	0.3	0.6	**0.3**
Shigella	n	7	NN	NN	107	37	6	92	77	**326**
	rate	2.2	NN	NN	2.9	2.5	1.3	1.9	4.0	**2.6**
Listeria	n	1	12	2	19	6	2	10	11	**61**
	rate	0.3	0.2	0.4	0.5	0.4	0.4	0.2	0.6	**0.3**

NN Not notifiable.

Rate = Rate per 100,000 population

Appendix 2. Outbreak summary for OzFoodNet sites, 2001

State	Month of outbreak	Setting category	Agent responsible	Number affected	Hospitalised	Evidence study	Responsible vehicles
Australia	July	Nationwide	S. Stanley	27		D+M	Imported dried peanuts
ACT	December	Conference/ function	Suspected toxin	22	0	D	Suspected spit roast meal
	December	Conference/ function	Suspected toxin	110	0	D	Suspected spit roast meal
	December	Conference/ function	Suspected toxin	68	0	D	Suspected spit roast meal
	December	Conference/ function	Suspected toxin	31	0	D	Suspected spit roast meal
	September	Conference/ function	Suspected viral	61	0	D	Suspected salad at barbecue
	December	Restaurant	Suspected toxin	19	0	D	Suspected Turkish banquet
Hunter	October	Conference/ function	Escolar wax esters	20	0	D+M	Escolar
	June	Takeaway	Unknown	4	0	D	Pizza
	May	Takeaway	Unknown	8	0	D	Pizza
	May	Takeaway	Unknown	4	0	D	Pizza
	October	Takeaway	S. Typhimurium 126	2	1	D	Chicken pizza
	April	Restaurant	Unknown	6	0	D	Suspected seafood sauce
	July	Restaurant	Unknown	10	0	D	Suspected honey chicken
	July	Takeaway	Unknown	2	0	D	Suspected takeaway chicken
	May	Takeaway	Unknown	2	0	D	Suspected chicken kebab
	May	Takeaway	Unknown	3	0	D	Suspected BBQ chicken
	November	Restaurant	*Campylobacter*	2	0	D	Unknown
Qld	January	Camp	Unknown	87	0	D	Drinking water
	January	Home	Ciguatera poisoning	14	11	D	Spanish mackerel
	January	Home	Ciguatera poisoning	2	0	D	Spotted mackerel
	June	Home	Ciguatera poisoning	3	3	D	Barracuda (Sphyraena jello)
	November	Home	Ciguatera poisoning	4	0	D	Coral trout
	November	Home	Ciguatera poisoning	9	0	D	Spanish mackerel
	February	Restaurant	Histamine fish poisoning	4	0	D	Mahi Mahi
	August	Community	Cryptosporidiosis	8	3	A+M	Unpasteurised pets milk (cow)
	July	Conference/ function	Norwalk virus	56	0	A	Salads, steak sandwiches
	March	Conference/ function	S. Virchow PT 8	2	0	D	Chicken
	July	Restaurant	*Campylobacter*	2	0	D+M	Duck liver
	March	Takeaway	*C. jejuni*	3	0	D	Chicken kebabs
	January	Restaurant	*C. perfringens*	9	0	A+M	Reef & beef meal

Appendix 2 (continued). Outbreak summary for OzFoodNet sites, 2001

State	Month of outbreak	Setting category	Agent responsible	Number affected	Hospitalised	Evidence study	Responsible vehicles
Qld	July	Restaurant	*C. perfringens*	8	0	A	Beef curry
cont	May	Community	S. Bovismorbificans 32	36	6	A+M	Chicken salad in pita bread
	February	Aged care	S. Heidelberg PT 1	12	6	D	Suspected eggs
	February	Aged care	Unknown	19	0	D	Unknown
	March	Aged care	S. Muenchen	3	0	D	Unknown
	February	Conference/ function	Unknown	6	0	D	Unknown
	June	Conference/ function	Suspected viral	10	1	D	Unknown
	December	Hotel	Unknown	6	0	D	Unknown
	June	Hotel	S. Montevideo	8	1	D	Unknown
	July	Restaurant	*C. perfringens*	7	0	D	Unknown
SA	December	Home	S. Typhimurium 135a	11	4	A+M	Tiramisu dessert
	December	Restaurant	S. Typhimurium 64var	28	0	A+M	Mango pudding
	March	Takeaway	S. Typhimurium 126	9	3	A	Custard tart with strawberries and a jelly glaze
	March	Aged care	S. Typhimurium 135	17	3	A+M	Raw egg (mince & potato pie & rice pudding)
	May	Community	S. Typhimurium 126	88		A+M	Chicken
	June	Home	S. Typhimurium 135a	2	0	D+M	Homemade italian sausage
	January	Restaurant	S. Typhimurium 29	8	1	D	Unknown
	June	Restaurant	S. Zanzibar	2	0	D	Unknown
	May	Restaurant	*C. jejuni*	10	1	D	Unknown
Tas	April	Home	S. Typhimurium 9	6	1	D	Suspected duck egg whites
	April	Home	S. Mississippi	7	0	D	Unknown
	February	Home	Unknown	9	0	D	Unknown
Vic	June	Community	S. Typhimurium 104	23	7	A+M	Turkish Helva
	March	Home	Ciguatera poisoning	16	0	D	Coral trout
	August	Restaurant	Wax ester (butterfish diarrhoea)	5	0	D+M	Butterfish
	December	Home	S. Virchow 34	11	2	M	Barbequed chicken or beef
	March	Hotel	Unknown	15	0	A	Combination cheese platter, mushroom risotto, Thai prawns
	February	Restaurant	Unknown	5	0	D	Suspected pizza
	July	Hotel	S. Typhimurium 99	22	2	A	Lamb's fry
	August	Restaurant	S. Typhimurium 99	95	1	A	Eye fillet meal
	October	Conference/ function	*Campylobacter*	50	0	A	Tomato and cucumber salad

Appendix 2 (continued). Outbreak summary for OzFoodNet sites, 2001

State	Month of outbreak	Setting category	Agent responsible	Number affected	Hospitalised	Evidence study	Responsible vehicles
Vic	December	Community	S. Mississippi	6	0	D	Suspected oysters
cont	August	Camp	Suspected *Campylobacter* (1 +ve)	12	0	D	Suspected unpasteurised milk
	January	Home	S. Typhimurium 170	14	3	D	Unknown
	February	Restaurant	Norwalk virus	65	0	A	Suspected sausages
	May	Takeaway	Unknown (1 positive *Salmonella*)	3	1	D	Suspected kebabs
	November	Aged care	*Campylobacter*	49	1	D	Unknown
	April	Camp	S. Typhimurium 9	30	1	D	Unknown
	December	Conference/ function	Unknown (suspected toxin)	269	0	D	Suspected soup or roast beef
	December	Hotel	*C. perfringens*	9	0	D	Suspected potato and bacon soup
	December	Restaurant	Unknown (suspected toxin)	33	1	D	Unknown
	February	Restaurant	Norwalk virus	31	0	D	Unknown
	January	Restaurant	Norwalk virus	9	0	D	Unknown
	March	Restaurant	Norwalk virus	16	0	D	Unknown
	September	Restaurant	Unknown (suspected toxin)	7	0	D	Unknown
WA	October	Conference/ function	Unknown	50	1	A	Cranachan (dessert)
	June	Restaurant	S. Typhimurium 64	36	4	A+M	Fried ice cream
	March	Camp	S. Typhimurium 135 var	29	0	D	Suspected bore water supply
	December	Conference/ function	Norwalk virus	56	0	A	Suspected chicken
	July	Restaurant	Unknown	6	0	D	Possible undercooked turkey
	November	Takeaway	Unknown	10	0	D	Suspected chicken
	February	Camp	S. Wandsworth	50	0	D	Unknown
	October	Camp	Norwalk virus	11	1	D	Unknown
	December	Conference/ function	Unknown	4	0	D	Unknown
	September	Restaurant	Unknown	7	0	D	Unknown

D Descriptive evidence implicating the suspected vehicle or suggesting food or waterborne transmission.

A Statistical association between illness and one or more foods determined from a formal epidemiological study.

M Microbiological confirmation of agent in the suspect vehicle and cases.

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