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# Annual reports

# Annual report: surveillance of adverse events following immunisation in Australia, 2008

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## Abstract

This report summarises Australian passive surveillance data for adverse events following immunisation (AEFI) reported to the Therapeutic Goods Administration (TGA) for 2008, and describes reporting trends over the 9-year period 2000 to 2008. There were 1,542 AEFI records for vaccines administered in 2008. This was an annual AEFI reporting rate of 7.2 per 100,000 population, a 5% decrease compared with 2007. The majority of AEFI reports described non-serious events while 10% (n = 152) were classified as serious. Two deaths temporally associated with immunisation were reported; there was no evidence to suggest a causal association. The most commonly reported reactions were injection site reaction, allergic reaction, fever and headache. AEFI reporting rates in 2008 were 2.7 events per 100,000 administered doses of influenza vaccine for adults aged ≥18 years, 18.9 per 100,000 administered doses of pneumococcal polysaccharide vaccine for those aged ≥65 years, and 17.2 per 100,000 administered doses of scheduled vaccines for children aged < 7 years. Reports for infants increased in 2008, mainly related to gastrointestinal system events temporally associated with receipt of rotavirus vaccine in the 1st full year of the rotavirus immunisation program, while there was a substantial decrease in AEFI reports for human papillomavirus vaccine in adolescents compared with 2007 when the program commenced. Increases in reports in children and adults were also partly attributed to the implementation of enhanced passive surveillance in Victoria. The consistently low reporting rate of serious AEFI highlights the safety of vaccines in Australia and illustrates the value of the national TGA database as a surveillance tool for monitoring AEFIs nationally. *Commun Dis Intell* 2009;33(4):365–381.

Keywords: AEFI, adverse events, vaccines, surveillance, immunisation, vaccine safety

## Introduction

The aim of passive post-licensure surveillance of adverse events following immunisation (AEFI) is to monitor the vaccine and immunisation program safety. An 'adverse event following immunisation' is defined as any serious or unexpected adverse event that occurs *after* a vaccine has been given, which may be related to the vaccine itself or to its handling or administration. An AEFI can be *coincidentally* associated with the *timing* of immunisation without necessarily being caused by the vaccine or the immunisation process. Analysing trends in passive reports can identify signals or assist in generating hypotheses that can then be tested by more rigorous methods. This can lead to the detection of population-specific, rare, late-onset or unexpected adverse events that have not been identified in pre-licensure vaccine trials.[1,2]

Several important changes to vaccine funding and availability occurred in 2007 and 2008 that impact on the AEFI surveillance data presented in this report. These are:

- In March 2008, Queensland, South Australia and Victoria changed from using 2 combination vaccines (i.e. quadrivalent DTPa-IPV and Hib-HepB) to the single hexavalent DTPa-IPV-HepB-Hib vaccine for children at 2, 4 and 6 months of age,[3-6] due to an international shortage of some *Haemophilus influenzae* type b (Hib) vaccines (PedvaxHib® [monovalent] and Comvax® [Hib-HepB]).[7] The hexavalent vaccine has been used in all other jurisdictions since November 2005, except for all infants in the Northern Territory and Indigenous infants in Western Australia, who continue to receive pentavalent DTPa-IPV-HepB and monovalent Hib vaccines.
- The national rotavirus immunisation program commenced in July 2007, when rotavirus (RotaTeq® and Rotarix®) vaccines were added to the National Immunisation Program (NIP) for all infants in Australia.[8] This followed the earlier introduction in the Northern Territory in October 2006. Infants receive either a 2-dose schedule (Rotarix®) at 2 and 4 months of age, or a 3-dose schedule (RotaTeq®) at 2, 4 and 6 months of age.
- The national human papillomavirus (HPV) immunisation program commenced in April 2007 for all girls aged 12–18 years, and was extended to the 19–26 year age group in July 2007.[8] Two vaccines are funded—the quadrivalent vaccine (Gardasil®) and the bivalent vaccine (Cervarix®). Both vaccines are given as a 3-dose course.

Previous changes to the NIP schedule[8-10] also impact on the interpretation of trend data, and have been described in detail in previous reports published regularly since 2003.[11-21] These are: (i) in 2003, the commencement of the meningococcal C conjugate vaccine (MenCCV) immunisation program and the removal of the 18-month dose of DTPa vaccine; (ii) from 2004, the progressive introduction of a dose of dTpa for adolescents;[9] (iii) in January 2005, the commencement of the 7-valent pneumococcal conjugate vaccine (7vPCV) program for infants and the 23-valent polysaccharide vaccine (23vPPV) for adults aged ≥65 years;[7,8] and (iv) in November 2005, varicella for infants and at 12–13 years of age for those with no evidence of previous vaccination or varicella infection, and the replacement of oral poliovirus vaccine with inactivated poliovirus vaccine (IPV) for children. All IPV-containing vaccines include diphtheria-tetanus-acellular pertussis (DTPa) antigens (i.e. quadrivalent vaccines) and some also include hepatitis B (HepB) and/or *Haemophilus influenzae* type b (Hib) antigens (i.e. pentavalent and hexavalent vaccines). The specific combination vaccines administered at 2, 4, and 6 months of age vary between states and territories but all jurisdictions provide DTPa-IPV quadrivalent vaccine at 4 years of age.[10]

## Methods

AEFI are notified to the Therapeutic Goods Administration (TGA) by state and territory health departments, health professionals, vaccine manufacturers and members of the public.[9,10] All reports are assessed using internationally consistent criteria[22] and entered into the Australian Adverse Drug Reactions System (ADRS) database. All reports for vaccines and complementary medicines, plus all serious reports for drugs, are forwarded to the Adverse Drug Reactions Advisory Committee (ADRAC) for review at regular meetings. This is an expert committee of the TGA composed of independent medical experts who have expertise in areas of importance to the evaluation of medicine safety.

### Adverse events following immunisation data

De-identified information on AEFI reports from the ADRS database for vaccine adverse event notifications received to 28 February 2009, were released to the National Centre for Immunisation Research and Surveillance (NCIRS). Readers are referred to previous AEFI surveillance reports for a description of the surveillance system and methods used to evaluate reports to the TGA.[12,13] This report focuses on AEFI reported for vaccines administered during 2008 and trends in AEFI reporting for the 9-year period 2000 to 2008.

AEFI records* contained in the ADRS database were eligible for inclusion in the analysis if a vaccine was recorded as 'suspected'† of involvement in the reported adverse event and *either*

a. the vaccination occurred between 1 January 2000 and 31 December 2008 *or*
b. for records where the vaccination date was not recorded, the date of onset of symptoms or signs occurred between 1 January 2000 and 31 December 2008.

### Study definitions of adverse events following immunisation outcomes and reactions

AEFI were defined as 'serious' or 'non-serious' based on information recorded in the ADRS database and criteria similar to those used by the World Health Organization[22] and the US Vaccine Adverse Events Reporting System (VAERS).[23] In this report, an AEFI is defined as 'serious' if the record indicated that the person had recovered with sequelae, been admitted to a hospital, experienced a life-threatening event, or died.

The causality ratings of 'certain', 'probable' and 'possible' are assigned to individual AEFI records by the TGA and reviewed by ADRAC. They describe the likelihood that a suspected vaccine or vaccines was/were associated with the reported reaction at the level of the individual vaccine recipient. Factors that are considered in assigning causality ratings include the timing (minutes, hours etc) and the spatial correlation (for injection site reactions) of symptoms and signs in relation to vaccination, and whether one or more vaccines were administered, and are outlined in more detail elsewhere.[12] Because children in particular receive several vaccines at the same time, all administered vaccines are usually listed as 'suspected' of involvement in a systemic adverse event as it is usually not possible to attribute the AEFI to a single vaccine.

Typically, each AEFI record listed several symptoms, signs and diagnoses that had been re-coded by TGA staff from the reporter's description into standardised terms using the Medical Dictionary for Regulatory Activities (MedDRA®).[24] AEFI reports of suspected anaphylaxis and hypotonic-hyporesponsive episodes (HHE) were reviewed

* The term 'AEFI record' is used throughout this report because a single AEFI notification to the Medicine Safety Monitoring Unit can generate more than one record in the ADRS database. This may occur if there is a time sequence of separate adverse reactions in a single patient.

† Records are classified as 'suspected' if the report contains sufficient information to be valid and the relationship between reported reactions and drugs are not deemed as biologically implausible.

by ADRAC and classified using the Brighton Collaboration case definitions.[25,26] If an AEFI report met any level of the Brighton Collaboration case definition it was coded accordingly.

To analyse reported AEFI, we grouped MedDRA® coding terms to create a set of reaction categories. Firstly, reaction categories were created that were analogous to the AEFI listed and defined in *The Australian Immunisation Handbook* (9th edition). Additional categories were created for MedDRA® coding terms that were listed in more than 1% of AEFI records (e.g. headache, dizziness, change in heart or respiratory rate or rhythm). Reaction terms listed in less than 1% of records were grouped into broader categories based on the organ system where the reaction was manifested (e.g. gastrointestinal, neurological).

### Data analysis

All data analyses were performed using SAS software version 9.1.3.[27] The distribution of AEFI records was analysed by age, sex and jurisdiction. Average annual population-based reporting rates were calculated for each state and territory and by age group using population estimates obtained from the Australian Bureau of Statistics.

The frequency and age distribution of reported AEFI outcomes, reaction categories and vaccines were assessed. For each vaccine, the age distribution of vaccinees was calculated, as well as the proportion of records where (i) the vaccine was the only suspected vaccine or drug; (ii) the AEFI record was assigned a 'certain' or 'probable' causality rating; and (iii) the AEFI was defined as 'serious'.

AEFI reporting rates per 100,000 administered doses were estimated for influenza vaccine for adults aged ≥18 years; for 23vPPV for adults aged ≥65 years; and for 10 vaccines funded through the NIP for children aged < 7 years. The 2008 AEFI reporting rates were compared with those for 2007 and 2006.

Denominator data to estimate influenza and 23vPPV AEFI reporting rates were obtained from the national adult coverage survey conducted in 2006 (unpublished) for adults aged ≥65 years and 18–64 years (influenza only). The number of administered doses of each of the 10 childhood vaccines was calculated from the Australian Childhood Immunisation Register (ACIR), a national population-based register of approximately 99% of children aged < 7 years.[28]

Dose-based AEFI reporting rates could not be calculated for other vaccines and age groups as reliable denominator data for the number of vaccine doses distributed or administered were not available.

### Notes on interpretation

Caution is required when interpreting the AEFI data presented in this report. Due to reporting delays and late onset of some AEFI, the data are considered preliminary, particularly for the 4th quarter of 2008. Data published in previous reports for 2000–2007[11-21] differ to that presented in this report for the same period because the data have been updated to include AEFI notified to the TGA after original publication.

The information collated in the ADRS database is intended primarily for signal detection and hypothesis generation. While AEFI reporting rates can be estimated using appropriate denominators, such as the number of vaccine doses administered, they cannot be interpreted as incidence rates due to under-reporting and biased reporting of suspected AEFI, and the variable quality and completeness of information provided in individual AEFI notifications.[11–21,29]

It is important to note that this report is based on vaccine and reaction term information collated in the ADRS database and not on comprehensive clinical notes. Individual database records list symptoms, signs and diagnoses that were used to define a set of reaction categories based on the case definitions provided in the 9th edition of *The Australian Immunisation Handbook*.[10] These reaction categories are similar, but not identical, to the AEFI case definitions.

The reported symptoms, signs and diagnoses in each AEFI record in the ADRS database are temporally associated with vaccination but are not necessarily causally associated with a vaccine or vaccines. The causality ratings assigned to individual AEFI records describe the likelihood that a suspected vaccine or vaccines was/were associated with the reported reaction in an individual vaccine recipient.

## Results

### Summary of data

There was a total of 1,542 AEFI records in the ADRS database where the date of vaccination (or onset of an adverse event, if vaccination date was not reported) occurred between 1 January and 31 December 2008. This was 5% lower than in 2007. In 2008, approximately 2% of AEFI notifications resulted in more than 1 AEFI record in the database, usually an injection site reaction (ISR) and a systemic reaction.

Of the 1,542 AEFI records, 152 (10%) were defined as 'serious' (i.e. recovery with sequelae, requiring hospitalisation, experiencing a life-threatening event or death). A total of 440 (29%) AEFI records were assigned causality ratings of 'certain' (n = 380, 25%) or 'probable' (n = 60, 4%).

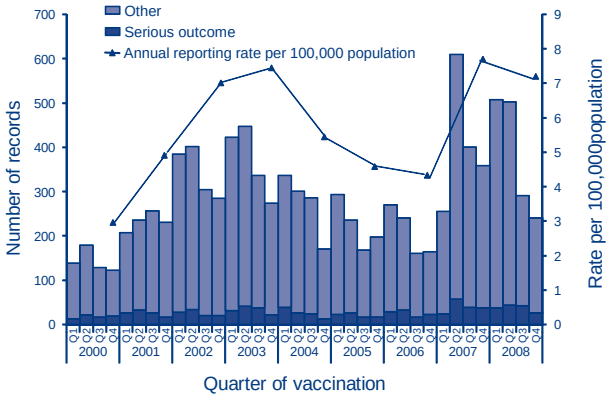
### Reporting trends

The AEFI reporting rate for 2008 was 7.2 per 100,000 population, compared with 7.7 per 100,000 population in 2007 (Figure 1). This is the third highest reporting rate for the period 2000 to 2008, and is similar to the peaks in 2003 and 2007 that coincided with the national MenCCV and HPV programs, respectively. The trends in AEFI notifications shown in Figure 1 are reflected in the trends in vaccines frequently suspected of involvement in reported AEFI (Figure 2), and in the types of reactions frequently reported (Figure 3).

Many of these changes correspond in time with changes in the funded NIP schedule. Most recently, the previously mentioned addition of HPV and rotavirus vaccines in 2007 and the change over for Queensland, South Australia and Victoria to the hexavalent DTPa-IPV-HepB-Hib vaccine for infants in March 2008. Previously, reporting rates increased then stabilised at lower rates following the introductions of 7vPCV in 2005 and MenCCV in 2003 (Figure 2). Following this trend, reports for HPV vaccine peaked in the year of that vaccine's introduction in 2007 and declined substantially in 2008 (Figure 2).

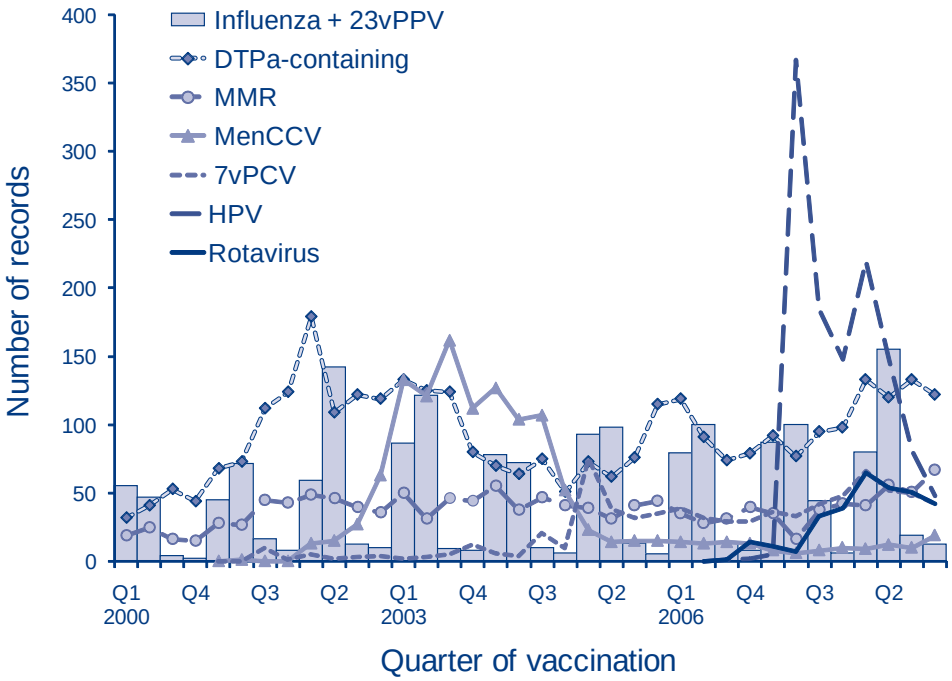
The usual seasonal pattern of AEFI reporting, with peaks in the first half of the year, was also apparent in 2008 (Figure 1). The seasonal peaks generally correspond to the months when more vaccinations are administered in Australia, particularly among 4– and 5-year-old children receiving MMR and DTPa-containing vaccines prior to commencing school in February and older Australians receiving 23vPPV and influenza vaccine during the autumn months (March to June) (Figure 2).

**Figure 1: Adverse events following immunisation, ADRS database, 2000 to 2008, by quarter of vaccination**



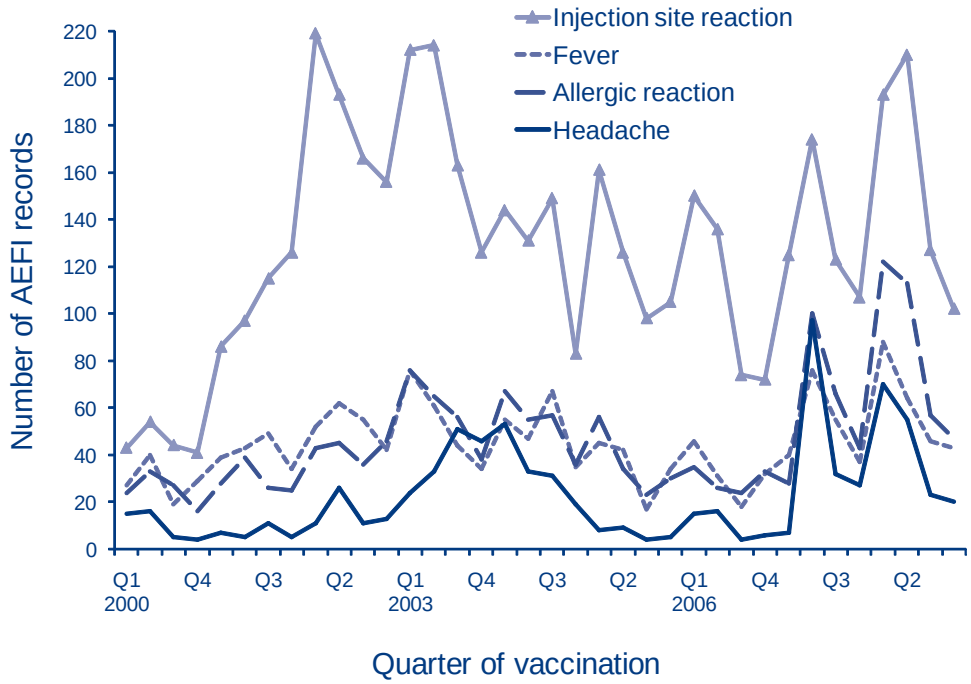

For reports where the date of vaccination was not recorded, the date of onset was used as a proxy for vaccination date.

**Figure 2: Frequently suspected vaccines, adverse events following immunisation, ADRS database, 2000 to 2008, by quarter of vaccination**




See appendix for abbreviations of vaccine names. DTPa-containing vaccines include DTPa, and the combination vaccines DTPa-HepB, DTPa-IPV, DTPa-IPV-HepB and DTPa-IPV-HepB-Hib.

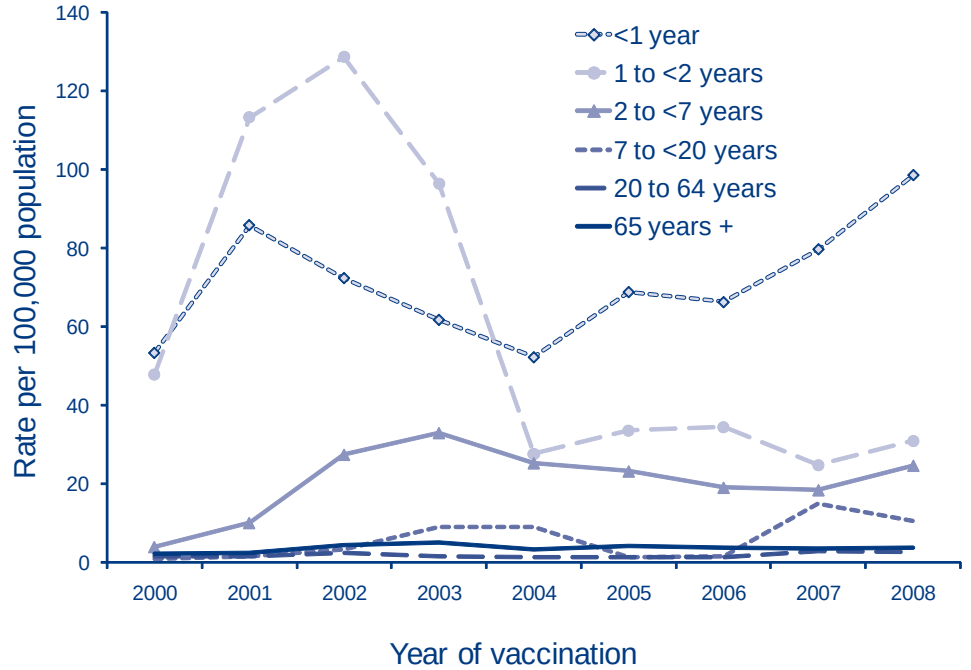
**Figure 3: Selected frequently reported adverse events following immunisation, ADRS database, 2000 to 2008, by quarter of vaccination**




### Age distribution

In 2008, the highest population-based AEFI reporting rate occurred in infants < 1 year of age, the age group that received the highest number of vaccines (Figure 4). Compared with 2007, AEFI reporting rates increased among the < 1 year age group (24% increase from 79.6 to 98.5 per 100,000 population), the 1 to < 2 year age group (25%, 24.7 to 30.8 per 100,000) and the 2 to < 7 year age group (34%, 18.4 to 24.6 per 100,000). Rates declined for older children and adolescents (30%, 14.8 to 10.4 per 100,000) and remained stable for adults (2.89 to 2.82 per 100,000).

**Figure 4: Reporting rates of adverse events following immunisation per 100,000 population, ADRS database, 2000 to 2008, by age group and year of vaccination**



### Geographical distribution

As reported previously,[12,13,16,18-20] AEFI reporting patterns varied between states and territories for vaccines received during 2008 (Table 1). The Northern Territory, the Australian Capital Territory and South Australia had the highest reporting rates (19.1, 17.1 and 15.3 per 100,000 population, respectively) while Western Australia and New South Wales had the lowest rates (4.7 per 100,000 population). AEFI reporting rates decreased in all jurisdictions in 2008 except Victoria and Tasmania. The increase in Victoria (from 3.7 per 100,000 in 2006 to 6.7 in 2007 and 8.9 in 2008) followed the implementation of a new AEFI reporting and evaluation system in that state in April 2007.[30]

### Outcomes

Sixty per cent of reported AEFI in 2008 were defined as 'non-serious' while 10% were defined as 'serious' (Table 2), similar to the proportions observed in previous years. Fewer 'serious' AEFI were assigned certain or probable causality ratings compared with 'non-serious' AEFI (12% versus 29%) (Table 2). Numbers of reported AEFI and AEFI with outcomes defined as 'serious' are shown in Table 3.

Two deaths were recorded as temporally associated with receipt of vaccines. One was a 22-month-old child who had received varicella vaccine 18 days prior to death. The cause of death was reported to be intracranial haemorrhage secondary to idiopathic thrombocytopenia (ITP), which was diagnosed 10 days after receipt of the vaccine. While temporally related to vaccine administration, no causal relationship has been established. The second reported death was a 1-year-old child who had received Hib, meningococcal C and MMR vaccines. The cause of death was reported to be cerebral oedema due to encephalitis 12 days after receipt of the vaccine, with onset of illness 10 days after vaccination. According to the treating neurologist and paediatrician it was unlikely to be vaccine related.

### Vaccines

The 1,542 AEFI records for 2008 listed 31 different vaccines as suspected of involvement in the reported AEFI (Table 3). The percentage of records where only 1 vaccine was reported differed by vaccine, as did the percentage assigned causality ratings of 'certain' or 'probable', and with outcomes defined as 'serious'. This is to be expected because vaccines are routinely co-administered at specific ages in the immunisation schedule.

The most frequently reported individual vaccine was HPV with 497 records (32%) (Table 3). Vaccines containing diphtheria, tetanus and acellular pertussis antigens (including combination vaccines and dTpa) were suspected in 547 (35%) records (Table 3),

**Table 1: Adverse events following immunisation (AEFI), ADRS database, 1 January to 31 December 2008, by state or territory**

| State or territory | AEFI records | | Annual reporting rate per 100,000 population* | | | |
|---|---|---|---|---|---|---|
| | n | % | Overall | 'Certain' or 'probable' causality rating† | 'Serious' outcome‡ | Aged <7 years |
| Australian Capital Territory | 59 | 4 | 17.1 | 3.8 | 0.6 | 95.0 |
| New South Wales | 325 | 21 | 4.7 | 1.4 | 0.5 | 10.6 |
| Northern Territory | 42 | 3 | 19.1 | 10.0 | 1.8 | 51.5 |
| Queensland | 222 | 14 | 5.2 | 1.9 | 0.6 | 19.8 |
| South Australia | 246 | 16 | 15.3 | 3.9 | 0.9 | 93.8 |
| Tasmania | 31 | 2 | 6.2 | 2.6 | 0.4 | 34.0 |
| Victoria | 472 | 31 | 8.9 | 2.3 | 0.7 | 65.7 |
| Western Australia | 103 | 7 | 4.7 | 1.1 | 0.7 | 28.4 |
| Other§ | 42 | 3 | na | na | na | na |
| Total | 1,542 | 100 | 7.2 | 2.1 | 0.7 | 36.7 |

* Average annual rates per 100,000 population calculated using mid-2008 population estimates (Australian Bureau of Statistics).

† See previous report[12] for criteria used to assign causality ratings.

‡ AEFI records defined as 'serious' (i.e. recovery with sequelae, hospitalisation, life-threatening or death – see Table 2).

§ Records where the jurisdiction in which the AEFI occurred was not reported or was unclear. AEFI records in this category were notified by pharmaceutical companies (n = 27), members of the public (11), and general practitioners (4).

## Table 2: Outcomes of adverse events following immunisation (AEFI), ADRS database, 2008

| Outcome | AEFI records | | 'Certain' or 'probable' causality rating* | | Age group† | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | <7 years | | ≥7 years | |
| | n | %‡ | n | %§ | n | %§ | n | %§ |
| Non-serious | 919 | 60 | 264 | 29 | 400 | 44 | 513 | 56 |
| Not recovered at time of report | 285 | 18 | 88 | 31 | 110 | 39 | 172 | 60 |
| Not known (missing data) | 186 | 12 | 70 | 38 | 93 | 50 | 89 | 48 |
| Serious | 152 | 10 | 18 | 12 | 96 | 63 | 55 | 36 |
| recovered with sequelae | 2 | | 0 | | 1 | | 1 | |
| hospital treatment – admission | 146 | | 18 | | 93 | | 53 | |
| life-threatening event | 2 | | 0 | | 0 | | 1 | |
| death (maybe drug) | 2 | | 0 | | 3 | | 0 | |
| Total | 1,542 | 100 | 440 | 29 | 699 | 45 | 829 | 54 |

* Causality ratings were assigned to AEFI records using criteria described previously.[12]

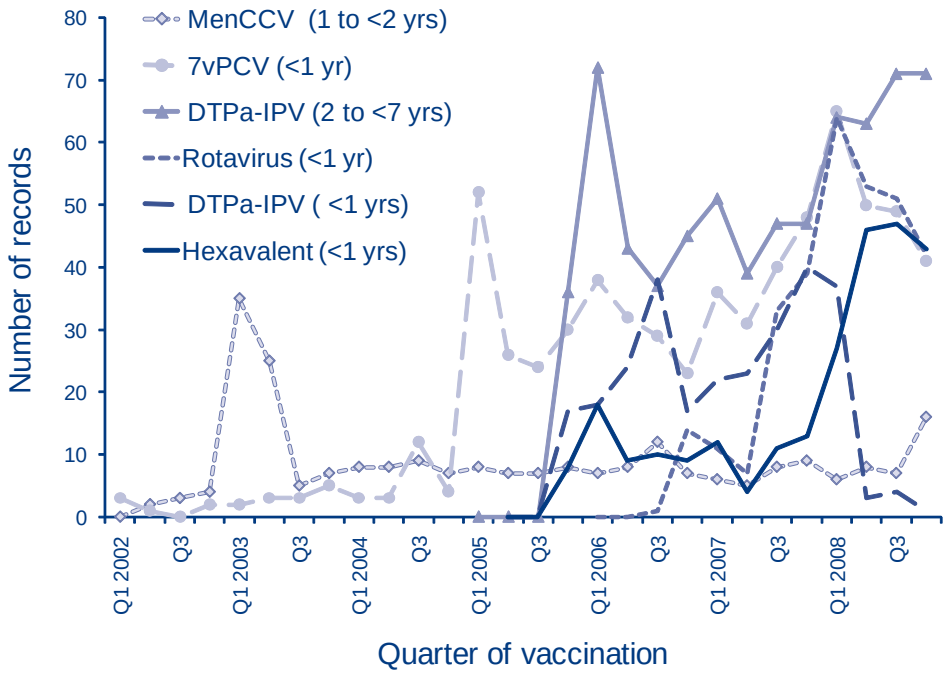
† AEFI records where both age and date of birth were not recorded are not shown (14 missing).

‡ Percentages relate to the total number of AEFI records (n = 1,542).

§ Percentages relate to the number of AEFI records with the specific outcome, e.g. of 919 AEFI records with a 'non-serious' outcome, 29% had causality ratings of 'certain' or 'probable' and 44% were for children aged <7 years.

with DTPa-IPV (320 records; 21%) and hexavalent DTPa-IPV-HepB-Hib (169 records; 11%) the most frequently reported vaccines in this group. In the < 1 year age group, reports that included DTPa-IPV decreased and reports of DTPa-IPV-HepB-Hib increased, in line with the changes in usage of those vaccines as outlined in the Introduction (Figure 5). The other frequently reported vaccines were MMR

## Figure 5: Reports of adverse events following immunisation, ADRS database, 2002 to 2008, for vaccines recently introduced into the funded National Immunisation Program,* by quarter of vaccination




* Meningococcal C conjugate vaccine (MenCCV) was introduced into the NIP on 1 January 2003, 7-valent pneumococcal conjugate vaccine (7vPCV) on 1 January 2005, both DTPa-IPV and hexavalent vaccines on 1 November 2005, and rotavirus vaccine on 1 July 2007.

## Table 3: Vaccine types listed as 'suspected' in records of adverse events following immunisation (AEFI), ADRS database, 2008

| Suspected vaccine type* | AEFI records | One suspected vaccine or drug only† | | 'Certain' or 'probable' causality rating‡ | | 'Serious' outcome§ | | Age group‖ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | < 7 years | | ≥ 7 years | |
| | n | n | %¶ | n | %¶ | n | %¶ | n | %¶ | n | %¶ |
| HPV** | 497 | 440 | 89 | 110 | 22 | 35 | 7 | 1 | 0.2 | 493 | 99 |
| DTPa-IPV | 320 | 149 | 47 | 137 | 43 | 18 | 6 | 314 | 98 | 2 | 1 |
| MMR | 215 | 32 | 14 | 22 | 10 | 15 | 7 | 205 | 95 | 8 | 4 |
| Rotavirus†† | 212 | 48 | 23 | 17 | 8 | 50 | 24 | 211 | 99 | 0 | – |
| 7vPCV | 210 | 6 | 3 | 5 | 2 | 39 | 19 | 209 | 99 | 0 | – |
| DTPa-IPV-HepB-Hib | 169 | 12 | 7 | 9 | 5 | 29 | 17 | 169 | 100 | 0 | – |
| Influenza | 160 | 119 | 74 | 30 | 19 | 12 | 8 | 22 | 14 | 135 | 84 |
| 23vPPV | 137 | 94 | 69 | 64 | 47 | 11 | 8 | 14 | 10 | 121 | 88 |
| Hepatitis B | 74 | 25 | 34 | 7 | 9 | 7 | 9 | 3 | 4 | 71 | 96 |
| Hib-Hepatitis B | 63 | 3 | 5 | 1 | 2 | 10 | 16 | 63 | 100 | 0 | – |
| Varicella | 57 | 37 | 65 | 11 | 19 | 11 | 19 | 37 | 65 | 20 | 35 |
| MenCCV | 50 | 2 | 4 | 3 | 6 | 6 | 12 | 49 | 98 | 1 | 2 |
| dTpa | 44 | 26 | 59 | 14 | 32 | 1 | 2 | 0 | – | 43 | 98 |
| Hib | 33 | 0 | – | 2 | 6 | 5 | 15 | 32 | 97 | 1 | 3 |
| dT | 15 | 11 | 73 | 6 | 40 | 0 | – | 0 | – | 15 | 100 |
| Hepatitis A | 15 | 2 | 13 | 1 | 7 | 3 | 20 | 10 | 67 | 5 | 33 |
| DTPa | 11 | 6 | 55 | 2 | 18 | 4 | 36 | 11 | 100 | 0 | – |
| Hepatitis A + B | 8 | 5 | 63 | 3 | 38 | 2 | 25 | 0 | – | 8 | 100 |
| Hepatitis A-Typhoid | 6 | 1 | 17 | 0 | – | 0 | – | 1 | 17 | 5 | 83 |
| IPV | 6 | 1 | 17 | 0 | – | 0 | – | 3 | 50 | 3 | 50 |
| Yellow fever | 6 | 3 | 50 | 0 | – | 0 | – | 0 | – | 6 | 100 |
| BCG | 4 | 4 | 100 | 4 | 100 | 0 | – | 3 | 75 | 1 | 25 |
| DTPa-IPV-HepB | 3 | 0 | – | 0 | – | 1 | 33 | 3 | 100 | 0 | – |
| Typhoid | 3 | 0 | – | 0 | – | 2 | 67 | 1 | 33 | 2 | 67 |
| Cholera | 2 | 2 | 100 | 0 | – | 1 | 50 | 0 | – | 2 | 100 |
| Rabies | 2 | 2 | 100 | 0 | – | 0 | – | 0 | – | 2 | 100 |
| Q fever | 2 | 1 | 50 | 1 | 50 | 0 | – | 0 | – | 2 | 100 |
| Japanese encephalitis | 1 | 1 | 100 | 0 | – | 0 | – | 0 | – | 1 | 100 |
| Tetanus | 1 | 1 | 100 | 0 | – | 1 | 100 | 0 | – | 1 | 100 |
| dTpa-IPV | 0 | 0 | – | 0 | – | 0 | – | 0 | – | 0 | – |
| Men4PV | 0 | 0 | – | 0 | – | 0 | – | 0 | – | 0 | – |
| Total‡‡ | 1,542 | 419 | 27 | 440 | 29 | 152 | 10 | 699 | 45 | 829 | 54 |

* See appendix for abbreviations of vaccine names.

† AEFI records where only one vaccine was suspected of involvement in a reported adverse event.

‡ Causality ratings were assigned to AEFI records using criteria described previously.[12]

§ 'Serious' outcomes are defined in the Methods section (see also Table 2).

‖ AEFI records are not shown if both age and date of birth were not reported.

¶ Percentages are calculated for the number of AEFI records where the vaccine was suspected of involvement in the AEFI, e.g. HPV was 'suspected' in 497 AEFI records; this was the only suspected vaccine in 89% of the 497 AEFI records, 22% had 'certain' or 'probable' causality ratings, 7% were defined as 'serious' and 99% were for those aged ≥7 years.

** Human papillomavirus vaccine was added to the National Immunisation Program schedule on 1 April 2007.[8]

†† Rotavirus vaccine was added to the National Immunisation Program schedule on 1 July 2007.[8]

‡‡ Total number of AEFI records analysed, not the total in each column as categories are not mutually exclusive and an AEFI record may list more than one vaccine.

(215 records; 14%), rotavirus (212 records; 14%) and 7vPCV (210 records; 14%).

AEFI reporting trends differed by vaccine. In 2008, compared with 2007, reports were substantially reduced for HPV (497 in 2008 vs 705 in 2007) and Hib-HepB (63 vs 118) vaccines, while reports increased for DTPa-IPV (320 vs 28), MMR (215 vs 131), 23vPPV (137 vs 118), DTPa-IPV-HepB-Hib (169 vs 139), 7vPCV (210 vs 159) and rotavirus (212 vs 90) (Figure 2). As previously reported there were peaks in AEFI reporting for individual vaccines soon after their introduction into the routine childhood immunisation schedule, followed by a reduction and stabilisation in reporting over time (Figure 2). This pattern was particularly evident for MenCCV in 2003, 7vPCV and DTPa-IPV containing vaccines in 2005, and HPV vaccine in 2007 (Figures 2 and 5), while a decrease in reports for rotavirus vaccine, which commenced later in 2007, was not evident.

Reports for rotavirus vaccines increased in total number as well as rate (41.0 per 100,000 doses in 2008 compared with 33.2 per 100,000 in 2007; Table 4). The majority of the cases (45.3%) were reported from Victoria. Thirty-six per cent of the total 212 rotavirus vaccine AEFI reports list rotavirus as the only vaccine suspected of involvement in the reported adverse event while the majority (64%) listed other vaccines as well, which is to be expected as most infants now receive rotavirus vaccine at the same time as other scheduled vaccines at 2, 4 and 6 months of age.

## Reactions

The distribution and frequency of reactions listed in AEFI records for 2008 are shown in Tables 5 and 6. In Table 5, only the reaction categories analogous to those listed in *The Australian Immunisation Handbook*[10] are shown. In Table 5, other reaction categories are listed in descending order of frequency.

**Table 4: Reporting rates of adverse events following immunisation (AEFI) per 100,000 vaccine doses,* children aged less than 7 years, ADRS database, 2008**

| | AEFI records‡ (n) | Vaccine doses* (n) | Reporting rate per 100,000 doses§ | | |
|---|---|---|---|---|---|
| | | | 2008 | 2007 | 2006 |
| **Vaccine†** | | | | | |
| DTPa-containing vaccines | 486 | 1,079,244 | 45.0 | 33.1 | 32.3 |
| DTPa-IPV | 314 | 342,757 | 91.6 | 45.3 | 43.0 |
| Pentavalent (DTPa-IPV-HepB) | 3 | 17,347 | 17.3 | 44.1 | 37.4 |
| Hexavalent (DTPa-IPV-HepB-Hib) | 169 | 719,140 | 23.5 | 10.7 | 12.9 |
| *Haemophilus influenzae* type b | 32 | 165,897 | 19.3 | 17.7 | 22.1 |
| *Haemophilus influenzae* type b-hepatitis B | 63 | 162,439 | 38.8 | 30.7 | 24.8 |
| Measles-mumps-rubella | 205 | 540,872 | 37.9 | 23.2 | 24.4 |
| Meningococcal C conjugate | 49 | 292,738 | 16.7 | 11.6 | 18.4 |
| Pneumococcal conjugate | 209 | 825,447 | 25.3 | 20.6 | 15.8 |
| Rotavirus vaccine | 211 | 514,659 | 41.0 | 45.0 | - |
| Varicella | 37 | 264,891 | 14.0 | 10.6 | 18.5 |
| **Age group** | | | | | |
| <1 year | 279 | 2,250,276 | 12.4 | 9.7 | 8.6 |
| 1 to <2 years | 79 | 1,022,447 | 7.7 | 6.2 | 9.3 |
| 2 to <7 years | 304 | 573,464 | 53.0 | 38.6 | 39.5 |
| **AEFI category†** | | | | | |
| Total | 662 | 3,846,187 | 17.2 | 13.3 | 13.9 |
| 'Certain' or 'probable' causality rating | 191 | 3,846,187 | 5.0 | 4.2 | 5.4 |
| 'Serious' outcome | 89 | 3,846,187 | 2.3 | 1.6 | 1.4 |

* Number of vaccine doses recorded on the Australian Childhood Immunisation Register (ACIR) and administered between 1 January and 31 December 2008.

† Records where at least one of the vaccines shown in the table was suspected of involvement in the reported adverse event. AEFI category includes all records (i.e. total), those assigned 'certain' or 'probable' causality ratings, and those with outcomes defined as 'serious'. Causality ratings were assigned using the criteria described previously.[12] A 'serious' outcome is defined as recovery with sequelae, hospitalisation, life-threatening event or death.[12]

‡ Number of AEFI records in which the vaccine was coded as 'suspected' of involvement in the reported adverse event and the vaccination was administered between 1 January and 31 December 2008. More than one vaccine may be coded as 'suspected' if several were administered at the same time.

§ The estimated AEFI reporting rate per 100,000 vaccine doses recorded on the ACIR.

## Table 5: Reaction categories of interest* mentioned in records of adverse events following immunisation (AEFI), ADRS database, 2008

| Reaction category* | AEFI records | Only reaction reported† | | 'Certain'/'probable' causality rating‡ | | Age group§ | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | <7 years | | ≥ 7 years | |
| | n | n | %‖ | n | %‖ | n | %‖ | n | %‖ |
| Injection site reaction | 632 | 170 | 27 | 322 | 51 | 325 | 51 | 301 | 48 |
| Allergic reaction¶ | 360 | 51 | 14 | 53 | 15 | 119 | 33 | 238 | 66 |
| Fever | 241 | 5 | 2 | 11 | 5 | 124 | 51 | 117 | 49 |
| Rash** | 131 | 39 | 30 | 18 | 14 | 72 | 55 | 56 | 43 |
| Syncope | 74 | 10 | 14 | 22 | 30 | 8 | 11 | 66 | 89 |
| Abnormal crying | 57 | 2 | 4 | 6 | 11 | 57 | 100 | - | |
| Convulsions | 43 | 7 | 16 | 10 | 23 | 24 | 56 | 19 | 44 |
| Arthralgia | 41 | 2 | 5 | 4 | 10 | - | | 40 | 98 |
| HHE†† | 39 | 14 | 36 | 1 | 3 | 39 | 100 | - | |
| Lymphadenopathy/itis‡‡ | 33 | 7 | 21 | 5 | 15 | 5 | 15 | 28 | 85 |
| Intussusception | 14 | 10 | 71 | 0 | | 14 | 100 | - | |
| Abscess | 10 | 5 | 50 | 7 | 70 | 9 | 90 | 1 | 10 |
| Anaphylactic reaction | 5 | - | | 1 | 20 | 2 | 40 | 3 | 60 |
| Guillain-Barré syndrome | 4 | 4 | 100 | 1 | 25 | 1 | 25 | 2 | 50 |
| Parotitis | 4 | 1 | 25 | - | | 1 | 25 | 3 | 75 |
| Thrombocytopenia | 4 | 1 | 25 | 1 | 25 | 2 | 50 | 2 | 50 |
| Arthritis | 3 | 1 | 33 | - | | - | | 3 | 100 |
| Brachial neuritis | 2 | - | | - | | - | | 2 | 100 |
| Death | 2 | - | | - | | 2 | 100 | - | |
| Encephalitis | 2 | - | | - | | 1 | 50 | 1 | 50 |
| Encephalopathy | 1 | - | | - | | 1 | 100 | - | |
| Acute flaccid paralysis | - | - | | - | | - | | - | |
| Meningitis | - | - | | - | | - | | - | |
| Orchitis | - | - | | - | | - | | - | |
| Osteitis | - | - | | - | | - | | - | |
| Osteomyelitis | - | - | | - | | - | | - | |
| Sepsis | - | - | | - | | - | | - | |
| SSPE§§ | - | - | | - | | - | | - | |
| Toxic shock syndrome | - | - | | - | | - | | - | |
| Total‖‖ | 1,542 | 419 | 27 | 440 | 29 | 699 | 45 | 829 | 54 |

* Reaction categories were created for the AEFI of interest listed and defined in *The Australian Immunisation Handbook,* (9th edition, p 58–65 and 360–3)[10] as described in Methods section.

† AEFI records where only one reaction was reported.

‡ Causality ratings were assigned to AEFI records using criteria described previously.[12]

§ Not shown if neither age nor date of birth were recorded.

‖ Percentages relate to the number of AEFI records in which the specific reaction term was listed, e.g. of 632 AEFI records listing injection site reaction, 27% listed only one type of reaction while 51% had a causality rating of 'certain' or 'probable' and 51% were for children aged <7 years.

¶ Allergic reaction includes skin reactions including pruritus, urticaria, periorbital oedema, facial oedema, erythema multiforme etc. and/or gastrointestinal (e.g. diarrhoea, vomiting) symptoms and signs but does not include other abdominal symptoms like abdominal pain, nausea, flatulence, abnormal faeces, hematochezia etc.[10]

** includes general terms of rash but does not include rash pruritic.

†† Hypotonic-hyporesponsive episode.

‡‡ Includes lymphadenitis following BCG vaccination and the more general term of 'lymphadenopathy'.

§§ Subacute sclerosing panencephalitis.

‖‖ Total number of AEFI records analysed, not the total in each column as categories are not mutually exclusive and an AEFI record may list more than one reaction term.

## Table 6: 'Other'* reaction terms listed in records of adverse events following immunisation (AEFI), ADRS database, 2008

| Reaction category* | AEFI records | Only reaction reported† | | 'Certain'/'probable' causality rating‡ | | Age group§ | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | <7 years | | ≥ 7 years | |
| | n | n | %‖ | n | %‖ | n | %‖ | n | %‖ |
| Headache | 168 | 4 | 2 | 23 | 14 | 5 | 3 | 162 | 96 |
| Malaise | 161 | 1 | 1 | 19 | 12 | 30 | 19 | 130 | 81 |
| Nausea | 130 | - | | 16 | 12 | 6 | 5 | 124 | 95 |
| Dizziness | 88 | - | | 17 | 19 | 1 | 1 | 87 | 99 |
| Gastrointestinal – RVV¶ | 66 | 11 | 17 | 10 | 15 | 66 | 100 | - | |
| Respiratory rate/rhythm change | 64 | 9 | 14 | 1 | 2 | 33 | 52 | 31 | 48 |
| Irritability | 63 | - | | 4 | 6 | 61 | 97 | 2 | 3 |
| Reduced sensation | 62 | 2 | 3 | 10 | 16 | - | | 62 | 100 |
| Myalgia | 59 | 1 | 2 | 2 | 3 | - | | 59 | 100 |
| Pain | 56 | 1 | 2 | 10 | 18 | 1 | 2 | 55 | 98 |
| Pallor | 48 | - | | 8 | 17 | 22 | 46 | 26 | 54 |
| Abdominal pain | 39 | - | | 4 | 10 | 10 | 26 | 29 | 74 |
| Somnolence | 36 | 1 | 3 | 5 | 14 | 20 | 56 | 16 | 44 |
| Erythema | 31 | 2 | 6 | 2 | 6 | 19 | 61 | 10 | 32 |
| Heart rate/rhythm change | 30 | - | - | 4 | 13 | 14 | 47 | 16 | 53 |
| Anorexia | 25 | 1 | 4 | 1 | 4 | 15 | 60 | 10 | 40 |
| Weakness | 25 | 1 | 4 | 4 | 16 | 2 | 8 | 23 | 92 |
| Oedema | 23 | - | - | 6 | 26 | 4 | 17 | 19 | 83 |
| Flushing | 21 | 1 | 5 | 5 | 24 | 5 | 24 | 16 | 76 |
| Increased sweating | 19 | - | | 4 | 21 | 4 | 21 | 15 | 79 |
| Tremor | 17 | - | | 2 | 12 | 2 | 12 | 15 | 88 |
| Other | 382 | 41 | 11 | 52 | 14 | 125 | 33 | 255 | 67 |
| eye or ear | 55 | 4 | 7 | 10 | 18 | 10 | 18 | 43 | 78 |
| neurological | 54 | 12 | 22 | 5 | 9 | 13 | 24 | 41 | 76 |
| respiratory | 47 | 3 | 6 | 6 | 13 | 14 | 30 | 33 | 70 |
| Gastrointestinal** | 41 | 7 | 17 | 6 | 15 | 21 | 51 | 20 | 49 |
| psychological | 34 | 3 | 9 | 5 | 15 | 9 | 26 | 25 | 74 |
| cardiovascular | 30 | 2 | 7 | 7 | 23 | 8 | 27 | 22 | 73 |
| general non-specific | 29 | 1 | 3 | 7 | 24 | 8 | 28 | 21 | 72 |
| Skin†† | 28 | 4 | 14 | 5 | 18 | 10 | 36 | 18 | 64 |
| musculoskeletal | 26 | 1 | 4 | 1 | 4 | 4 | 15 | 22 | 85 |
| infection | 22 | 2 | 9 | 2 | 9 | 6 | 27 | 16 | 73 |
| metabolic/endocrine | 17 | - | | - | | 8 | 47 | 9 | 53 |
| renal/urogenital | 16 | 3 | 19 | 3 | 19 | 2 | 12 | 14 | 88 |
| haematological | 10 | 1 | 10 | - | | 2 | 20 | 8 | 80 |
| miscellaneous | 3 | - | | 1 | 33 | 1 | 33 | 2 | 67 |
| pregnancy/congenital | 3 | 1 | 33 | 1 | 33 | 1 | 33 | 2 | 67 |

* Reaction terms not listed in *The Australian Immunisation Handbook*[10] but included in AEFI records in the ADRAC database. The top part of the table shows reaction terms included in 1% or more of AEFI records; the bottom part of the table shows reaction terms, grouped by organ system, that were included in less than 1% of AEFI records.

† AEFI records where only one reaction was reported.

‡ Causality ratings were assigned to AEFI records using criteria described previously.[12]

§ Not shown if neither age nor date of birth were recorded.

‖ Percentages relate to the number of AEFI records in which the specific reaction term was listed, e.g. of 632 AEFI records listing injection site reaction, 27% listed only one type of reaction while 51% had a causality rating of 'certain' or 'probable' and 51% were for children aged <7 years.

¶ Gastrointestinal – RVV includes all the GI reactions following rotavirus vaccination.

** Other, gastrointestinal does not include GI reactions and gastrointestinal – RVV signs and symptoms.

†† Other, skin includes purpura, petechie, blister, burning, dermatitis, dry skin etc, but does not include skin reactions.

The most frequently reported adverse events were injection site reaction (ISR; 41% of 1,542 AEFI records) followed by allergic reaction (23%), fever (16%), headache (11%), malaise (10%) rash (9%) and nausea (9%) (Tables 5 and 6). ISR was the most commonly reported individual adverse event following receipt of DTPa-IPV (81%; 259/320), 23vPPV (89%; 122/137), MMR (63%; 135/215), all DTPa-containing vaccines (55%; 301/547), and influenza vaccine (39%; 63/160), administered alone or in combination with other vaccines. Twenty-three per cent (113/497) of HPV vaccine-related AEFI records listed ISR.

More severe AEFI included reports of convulsion (n = 43), HHE (n = 39), anaphylactic reaction (n = 5), Guillain-Barré syndrome (GBS; n = 4), thrombocytopenia (n = 4), death (n = 2; described previously in this report) and encephalitis (n = 2).

There was a total of 43 reports of convulsion, including syncopal and febrile convulsions. Twenty-three were for children aged < 7 years and 40% of reports were from Victoria. The most commonly suspected vaccines were HPV (n = 13), 7vPCV (n = 8), rotavirus (n = 6) and MMR (n = 6). The majority (30/39) of HHE were notified by Victoria (22) and South Australia (8). DTPa-containing vaccines were listed as suspected in 38 reports, with hexavalent DTPa-IPV-HepB-Hib suspected in 23 reports and DTPa-IPV in 13 reports. 7vPCV (n = 33), rotavirus (n = 32) and Hib-HepB (n = 10) were also commonly suspected vaccines in HHE reports. Two of the 5 reports of anaphylaxis in 2008 occurred in adolescent girls following receipt of HPV vaccine,[31] while the other reports occurred following receipt of DTPa-IPV/MMR in a child, HepB in an adult, and DTPa-IPV-HepB-Hib /7vPCV in an infant. The 4 records coded as GBS included 3 reports in adults aged ≥60 years following influenza vaccine and 1 report following DTPa-IPV and MMR vaccine in a child.

Reactions shown in Table 6 include headache, malaise, nausea and dizziness. Many of the reaction terms shown in this table were reported for HPV and rotavirus vaccines.

Reactions mentioned in less than 1% of AEFI records in 2008 are shown in the lower portion of Table 6, grouped by organ system categories. The most commonly reported categories were coded as 'gastrointestinal and 'neurological'.

The trends in the most frequently reported types of reactions have changed over time (Figure 3). Reports of headache and allergic reactions peaked in 2003 and again in 2007, coinciding with the national school-based MenCCV immunisation program in 2003 and the HPV program in 2007. Much of the variation in reporting of ISR relates to specific changes in the immunisation schedules for vaccines that are known to have higher rates of ISR, including DTPa-containing vaccines, MenCCV, 23vPCV and HPV vaccine.[11-21,32,33] Increases in reports of fever in 2007 and 2008 are associated with both new vaccines added to the NIP in that period – rotavirus and HPV.

## Dose-based adverse events following immunisation reporting rates

### *Influenza vaccine and adults aged ≥ 18 years*

In 2008, influenza vaccine was suspected in 127 AEFI records for people aged ≥18 years. Using the 2006 estimate of the number of doses of vaccine administered to people aged ≥ 65 years, the AEFI reporting rate was 2.7 per 100,000 administered doses, slightly higher than the rate in 2006 and 2007 (Table 7). As seen in previous years, the overall AEFI reporting rates were higher for vaccinees aged 18–64 years than among older vaccinees. However, there was a drop in the serious AEFI reporting rate in the 18–64 year age group during 2008 (Table 7). The most frequently reported adverse events were ISR, allergic reaction, fever, malaise and nausea (1.2, 0.7, 0.5, 0.3 and 0.3 per 100,000 doses, respectively). Reporting rates for each of these reactions were higher in the 18–64 year age group. There were 4 reports of GBS following influenza vaccination in 2008 giving a reporting rate of 0.1 per 100,000 doses. This is higher than in recent years, when only 1 or 2 reports were received annually,[16,18] but well within the expected reporting rates.

### *Pneumococcal vaccine and adults aged ≥ 65 years*

There were 81 AEFI reports for older adults that included 23vPPV, with 5 reports coded as serious and 75 reports of ISR. Using the 2006 estimate of the number of doses of 23vPPV administered to people aged ≥ 65 years (n = 429,500), the AEFI reporting rate was 18.9 per 100,000 doses, with 1.2 serious and 17.5 ISR reports per 100,000 doses. This is similar to the rate reported for 2007 (18.6 per 100,000 doses with 1.4 serious).[20]

### *Scheduled vaccines for children aged < 7 years*

There was a total of 699 AEFI records for children aged < 7 years for vaccines administered in 2008. This was a 33% increase on the 526 AEFI records during 2007, which was the highest since 2003 when there were 485 AEFI records.

Of the total AEFI records in 2008, 662 records included one of the 10 vaccines for which ACIR data could be used to estimate AEFI reporting rates per 100,000 administered doses (Table 4). Vaccines for which reliable denominator data were not available included bacille Calmette-Guérin (n = 3), influenza (n = 22), 23vPPV (n = 14), hepatitis A (n = 10) and

**Table 7: Reporting rate of adverse events following immunisation (AEFI) per 100,000 doses of influenza vaccine,* 18 years and over, ADRS database, 2008**

| AEFI category† | Age group | AEFI records‡ (n) | Vaccine doses* (n) | Rate per 100,000 doses§ | | |
|---|---|---|---|---|---|---|
| | | | | 2008 | 2007 | 2006 |
| Overall | ≥18 years | 127 | 4,746,900 | 2.7 | 2.3 | 1.9 |
| | 18 to 64 years | 90 | 2,626,400 | 3.4 | 3.0 | 2.5 |
| | ≥65 years | 37 | 2,120,500 | 1.7 | 1.4 | 1.1 |
| Serious | ≥18 years | 9 | 4-,746,900 | 0.2 | 0.3 | 0.2 |
| | 18 to 64 years | 5 | 2,626,400 | 0.2 | 0.4 | 0.3 |
| | ≥65 years | 4 | 2,120,500 | 0.2 | 0.1 | 0.1 |

* Number of administered doses of influenza vaccine estimated from the 2006 national survey (unpublished).

† AEFI category includes all records, and those defined as 'serious' where influenza vaccine was suspected of involvement in the reported adverse event. The definition of a 'serious' outcome is given in the Methods section.

‡ Number of AEFI records in which influenza vaccine was 'suspected' and the vaccination was administered in 2008.

§ The estimated reporting rate of adverse events per 100,000 administered doses of influenza vaccine.

hepatitis B (n = 3) (Table 3). The overall reporting rate for the 10 NIP vaccines was 17.2 per 100,000 administered doses, while the reporting rate for serious AEFI was 2.3 per 100,000 doses (Table 4). AEFI reporting rates were higher than for the same period in 2007 for most age groups, reaction categories and vaccines (Table 4), while the rates of AEFI with certain or probable causality ratings remained stable.

The largest changes were for DTPa-IPV, hexavalent (DTPa-IPV-HepB-Hib), Hib-HepB and measles-mumps-rubella (MMR) vaccines. There was a substantial increase (42%) in the reporting in children aged < 7 years in Victoria, which predominantly included reports of non-serious events (60.2%). The main suspected vaccines included DTPa-IPV (n = 168), DTPa-IPV-HepB-Hib (n = 75), MMR (n = 102), 7vPCV (n = 20) and rotavirus (n = 96).

Reporting rates for the different DTPa-IPV combination vaccines varied by vaccine type and age group. The reporting rate for pentavalent DTPa-IPV-HepB vaccine is likely to be inaccurate due to the small number of reports and some under-reporting to the ACIR of doses administered.

The very high reporting rate for DTPa-IPV vaccine (91.6 per 100,000 doses) include both children aged < 1 year who were scheduled to receive the vaccine at 2, 4, and 6 months of age (53.1 per 100,000 doses) and the 2 to < 7 year age group (106 per 100,000 doses) (Table 4). The majority of the AEFI reports for the older age group following DTPa-IPV listed ISR (97 per 100,000 doses compared with 63 per 100,000 doses in 2007), and the increase from Victoria accounted for 83% of the national increase. This is the highest reporting rate for ISR following DTPa-containing vaccines since 2002.

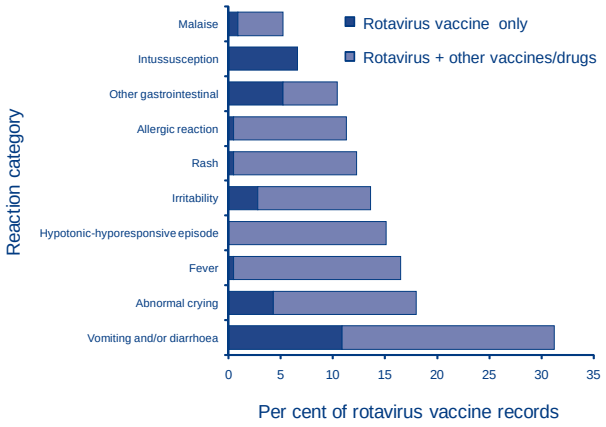
The overall AEFI reporting rate for children aged < 1 year was higher for quadrivalent DTPa-IPV compared with the hexavalent DTPa-IPV-HepB-Hib vaccine (53.1 vs 23.1 reports per 100,000 administered doses) (Table 4). The majority (73%) of the AEFI reports for quadrivalent DTPa-IPV for children aged < 1 year came from Victoria (reporting rate 79.6 per 100,000 doses), but within Victoria the reporting rate for DTPa_IPV was greater than for hexavalent DTPa-IPV-HepB-Hib vaccine (reporting rate 48.3 per 100,000 doses). Reporting rates among infants for most reaction categories were approximately 2 to 3 times higher for DTPa-IPV, except for HHE, which was 5-fold higher for DTPa-IPV (15.3 per 100,000 doses) compared with DTPa-IPV-HepB-Hib (3.3 per 100,000 doses).

The most commonly reported AEFIs following rotavirus vaccine were diarrhoea and vomiting (31%; n = 66) followed by abnormal crying (17.9%; n = 38), fever (17%; n = 35) and HHE (15%; n = 32). There were 14 (6.6%) reports of intussusception in 2008 (2.7 per 100,000 administered doses) compared with eight in 2007 (3.6 per 100,000 doses) (Figure 6).

## Discussion

The AEFI reporting rate in 2008 was the third highest in the period covered by this analysis (since 2000) and slightly lower than in 2007. The majority of AEFI reported to the TGA in 2008 were mild, transient and well-recognised vaccine side effects. The percentage of serious AEFI remained stable at 9%–10%. The main features of AEFI reporting in 2008, compared with previous years, were an overall increase in reports from Victoria, an increase in

**Figure 6: Most frequently reported adverse events following rotavirus immunisation,* ADRS database, 2008, by number of vaccines suspected of involvement in the reported adverse event**




* Percentage of 212 AEFI records where rotavirus vaccine was listed as suspected of involvement in the reported AEFI

children by 30%–40% and in adults by 10%–20%, and a reduction in AEFI reporting for HPV among adolescents.

The increases appear to be at least partly due to reporting from the first full year of enhanced passive surveillance in Victoria, as well as reports associated with rotavirus vaccine in the first full calendar year since its inclusion in the NIP. Nearly one in 3 AEFI reports (31%) during 2008 were received from a single jurisdiction, Victoria (n = 472), and the reporting rate in that jurisdiction increased 30% since 2007 and 140% since 2006. The jurisdiction with the next highest number of reports in 2008 was New South Wales (n = 325), followed by South Australia (n = 246) and Queensland (n = 222). This increase in reporting rate demonstrates the effectiveness of the methods used to enhance passive surveillance in Victoria, which could also be applied in jurisdictions with less sensitive reporting systems. At present, comparisons between jurisdictions to detect program errors or effects of different vaccines are complicated by the differences in the reporting methods. Developing and maintaining high rates of AEFI reporting from all states and territories is important for the integrity of a national database.

In children < 1 year of age the most commonly reported vaccines were rotavirus, hexavalent DTPa-IPV-HepB-Hib vaccine, 7vPCV and Hib-HepB and the reaction categories included diarrhoea and vomiting, abnormal crying, HHE and rash. The increase is likely to relate to the implementation of the rotavirus immunisation program in July 2007 as well as improvements in the sensitivity of surveillance in Victoria. Rotavirus vaccine is co-administered with 7-valent pneumococcal conjugate vaccine and combination vaccines containing DTPa, IPV, Hib and HepB antigens, and therefore increases in reports for one of these vaccines will be reflected in reports for the others as well.

The most commonly reported AEFI following rotavirus vaccine were gastrointestinal symptoms, predominantly diarrhoea and vomiting (31%) followed by fever (17%) and HHE (15%) and there were 14 reports of intussusception. The majority (10/14) of intussusception reports were infants after dose 1 (2–3 months age group) and 4 cases after dose 2 (4–5 months age group). No deaths occurred among reported intussusception cases. Of the 14 intussusception reports, 10 cases (71%) occurred in infants within 1–30 days after vaccination, including 7 cases (50%) that occurred within 1–7 days after vaccination. This is substantially lower than the 53 cases detected in a study by the Australian Paediatric Surveillance Unit (APSU) over a 10-month period and an estimated 256 cases of intussusception expected in Australian infants per year.[34] The cases reported to ADRAC equate to a rate of 2.7 per 100,000 doses of rotavirus vaccine, similar to the passive reporting rate of intussusception in the US VAERS of 2.3 per 100,000 administered doses, and the active reporting rate of intussusception in the US Vaccine Safety Datalink system of 2.7 per 100,000 doses.[35]

The rotavirus vaccines used in Australia (RotaTeq® and Rotarix®) underwent extensive pre-licensure clinical trials. RotaTeq® was tested in a large phase III trial in 11 countries and included more than 70,000 children. The risk of intussusception was evaluated for 42 days after each vaccine dose and the data didn't suggest any increased risk of intussusception in vaccine recipients relative to that for placebo.[36] Rotarix® was also tested in a large-scale trial of more than 63,000 infants enrolled in 11 Latin American countries and confirmed that during a 31-day period after each dose, there was no increase in intussusception among recipients of vaccine compared with placebo.[37] The major reason for these larger than usual clinical trials related to an association between intussusception within 21 days of receipt of a previously licensed rotavirus vaccine, RotaShield, which was licensed in the USA in 1998 and withdrawn soon afterwards.[38,39] In Australia, ongoing studies on rotavirus vaccine and intussusception are being conducted through the APSU and Paediatric Active Enhanced Disease Surveillance project.

The increase in the AEFI reporting rate for quadrivalent DTPa-IPV for children aged < 1 year was conjointly related to the implementation of the rotavirus vaccine in July 2007 and the changed surveillance practices in Victoria as both the vaccines are co-administered at 2, 4 and 6 months of age. The

increase in children aged 2 to < 7 years was mainly due to reporting of ISR and allergic reactions. ISR were predominantly higher among children aged 2 to < 7 years following the 4th dose of DTPa-IPV and 2nd dose of MMR. This increase was almost entirely due to an increase from Victoria. This AEFI, including extensive limb swelling, is known to be very common among children receiving a 4th and 5th dose of acellular pertussis-containing vaccine,[15,17,19,21] while the concomitantly administered MMR is likely to be included in these reports. It has been reported that 10% of children experience erythema > 5 cm with any pertussis containing vaccine including DTPa_IPV.[34] The reporting rate of ISR in this age group appeared to decline in recent years, as was expected following the removal of the dose due at 18 months of age from the NIP in September 2003. Children entering school in 2008 would have received their 4th dose of an acellular pertussis-containing vaccine at 4–5 years of age, whereas children in earlier birth cohorts would have received their 5th dose prior to school entry. It is likely that there is less under-reporting of ISR in Victoria and more in other jurisdictions, and that the incidence of this adverse event is higher than previously documented. There was a substantial decrease (497 records in 2008 compared with 705 records in 2007) in reports for HPV vaccine during 2008 and most were mild events that had been identified in pre-licensure clinical trials.[32,33] These included mainly milder allergic reactions and injection site reactions. A range of mild non-specific symptoms including headache, nausea, dizziness, malaise and weakness were also commonly reported (Table 6).[40,41]

## Conclusion

AEFI reports in 2008 showed a decrease in reports in adolescents during the second year of the national HPV program, an increase in reports in children associated with a continued high rate of reports associated with rotavirus vaccines, and increases in children and adults associated with improved sensitivity of surveillance in Victoria. The majority of AEFI reports were of mild, transient and well-recognised vaccine side-effects. When compared with the illness prevented by these vaccines, this report demonstrates again that the benefits of immunisation outweigh the risks.

While under-reporting is a known disadvantage of passive surveillance systems, the Australian national AEFI passive surveillance system is sufficiently sensitive to detect expected changes in AEFI reporting associated with changes in immunisation programs. Processes are in place to investigate signals and monitor trends in AEFI reporting.[31,40] The regular analysis and publication of national AEFI surveillance data collated in the ADRAC database remains an important aspect of Australia's immunisation program.

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## Abbreviations of vaccine types

| | |
|---|---|
| 7vPCV | 7-valent pneumococcal conjugate vaccine |
| 23vPPV | 23-valent pneumococcal polysaccharide vaccine |
| BCG | Bacille Calmette-Guérin (i.e. tuberculosis) |
| dT | diphtheria-tetanus – adolescent and adult formulation |
| DTPa | diphtheria-tetanus-pertussis (acellular) – paediatric formulation |
| dTpa | diphtheria-tetanus-pertussis (acellular) – adolescent and adult formulation |
| dTpa-IPV | combined dTpa and inactivated poliovirus |
| DTPa-HepB | combined diphtheria-tetanus-pertussis (acellular) and hepatitis B |
| DTPa-IPV | combined diphtheria-tetanus-pertussis (acellular) and inactivated poliovirus (quadrivalent) |
| DTPa-IPV-HepB | combined diphtheria-tetanus-pertussis (acellular), inactivated poliovirus and hepatitis B (pentavalent) |
| DTPa-IPV-HepB-Hib | combined diphtheria-tetanus-pertussis (acellular), inactivated poliovirus, hepatitis B and *Haemophilus influenzae* type b vaccine (hexavalent) |
| HepB | hepatitis B |
| Hib | *Haemophilus influenzae* type b |
| Hib-HepB | combined *Haemophilus influenzae* type b and hepatitis B |
| HPV | human papillomavirus |
| IPV | inactivated poliovirus vaccine |
| Men4PV | meningococcal polysaccharide tetravalent vaccine |
| MenCCV | meningococcal C conjugate vaccine |
| MMR | measles-mumps-rubella |

# Australian Rotavirus Surveillance Program annual report, 2008/2009

Carl D Kirkwood, Karen Boniface, Ruth F Bishop, Graeme L Barnes, and the Australian Rotavirus Surveillance Group

## Abstract

The Australian Rotavirus Surveillance Program together with collaborating laboratories Australia-wide, conducts a laboratory based rotavirus surveillance program. This report describes the genotypes of rotavirus strains responsible for the hospitalisation of children with acute gastroenteritis during the period 1 July 2008 to 30 June 2009, the second year of surveillance following introduction of rotavirus vaccine into the National Immunisation Program. Five hundred and ninety-two faecal samples from across Australia were examined for G and P genotype using hemi-nested multiplex reverse transcription-polymerase chain reaction assays. Of the 445 confirmed as rotavirus positive, genotype G2P[4] was the dominant type nationally, representing 50.3%, followed by genotype G1P[8] (22.5%). Genotypes G3P[8], G4P[8] and G9P[8] each represented less than 5% of circulating strains nationally. Uncommon rotavirus genotype combinations, including G1P[4] (n = 6), G4P[4] (n = 2) and single strains of G1P[6] and G3P[6] were identified during this study period. The national dominance of G2P[4] was associated with a large outbreak of severe gastroenteritis in Alice Springs in early 2009. This is the first report to describe G2P[4] as the dominant genotype nationally. Whether vaccine pressure has resulted in emergence of this genotype is not yet known. *Commun Dis Intell* 2009;33:382–388.

Keywords: Rotavirus, disease surveillance

## Introduction

Rotaviruses are the single most important cause of dehydration, hospitalisation and death due to severe gastroenteritis in young children worldwide.[1] In an effort to decrease the burden of rotavirus disease, 2 live oral rotavirus vaccines have been developed (Rotarix® [GlaxoSmithKline] and RotaTeq® [Merck]). Large-scale phase III clinical and efficacy trials, each involving over 60,000 children worldwide, have shown both vaccines to be safe and highly effective in prevention of severe diarrhoea and hospitalisation due to rotavirus infections.[2,3]

Rotavirus vaccine was introduced into the Australian National Immunisation Program for all young infants from 1 July 2007. This is aimed to decrease the huge social and economic burden of rotavirus disease in Australia, which accounts for up to 50% of childhood hospitalisations for diarrhoea in Australia, and which represents 10,000 children hospitalised each year,[4] costing an estimated $30 million in direct costs.[5]

In Australia, each state health department made independent decisions on which vaccine to use; Victoria, South Australia, and Queensland selected RotaTeq, while New South Wales, Western Australia (changed to RotaTeq from May 2009), the Northern Territory, Tasmania and the Australian Capital Territory selected Rotarix.

The national rotavirus surveillance program has been reporting the changing annual pattern of dominant serotypes in the Australian population since 1999. Over this period our results have highlighted the diversity of rotavirus strains capable of causing disease in children, and providing the baseline information of the changing pattern of circulating strains, prior to vaccine introduction.[6–8]

The impact of these 2 widely used vaccines on the natural pattern of circulating rotavirus strains is unknown and difficult to predict, given the different components of each vaccine. Continuing genotype surveillance should identify the effects that each vaccine program has on circulating strains – in particular, whether changes occur in genotype incidence and whether increased proportions of rare or uncommon types result.

In this report we describe the surveillance and characterisation of rotavirus strains causing the annual epidemics of severe diarrhoea in young children 5 years of age or younger in Australia for the period 1 July 2008 to 30 June 2009, the second year in which rotavirus vaccine has been included as part of the National Immunisation Program.

## Methods

Rotavirus positive specimens detected by enzyme immunoassay (EIA) or latex agglutination in collaborating laboratories were collected, stored frozen and forwarded to the National Rotavirus Reference Centre (NRRC) Melbourne, together with relevant age and sex details. Viral RNA was extracted from each specimen using a RNA extraction kit (Qiamp Viral mini extraction kit, Qiagen) according to the manufacturers instructions. Double stranded RNA was used to determine the G and P genotype of each specimen by

using a hemi-nested multiplex reverse transcription/polymerase chain reaction (RT-PCR) assay, using G or P specific oligonucleotide primers.[9,10]

## Results

### Number of isolates

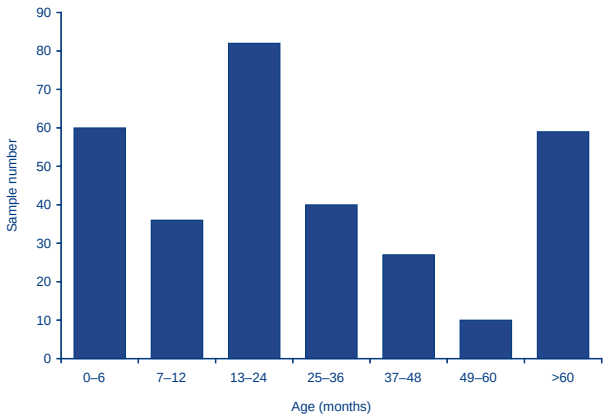
A total of 592 specimens were received for analysis from Melbourne, Victoria, and the collaborating centres in Western Australia, the Northern Territory, New South Wales, Queensland and Tasmania (Table 1). Samples were not obtained from South Australia or the Australian Capital Territory. Four hundred and forty-five specimens were confirmed as rotavirus positive using a combination of our in-house EIA and RT-PCR. The remaining 147 specimens contained either insufficient specimen for testing, or the specimens were not confirmed to be positive for rotavirus so were not analysed further.

### Age distribution

The overall age distribution of children with acute rotavirus gastroenteritis is depicted in Figure 1. In the reporting period, 31% of cases were from infants 0–12 months of age (19% from those less than 6 months of age, 12% from those 7–12 months of age), and 26% from patients 13–24 months of age. Overall, 81% of samples were from children aged 5 years or less.

During the study period, slightly more specimens from male than female children (n = 179 vs 172) were obtained for analysis.

**Figure 1: Distribution of rotavirus samples, Australia, 1 July 2008 to 30 June 2009, by age**




### Genotype distribution

The rotavirus genotypes identified in Australia from 1 July 2008 to 30 June 2009 are shown in Table 1.

G2P[4] and G1P[8] strains were the most common, representing 72.8% of all specimens nationally. Of all strains analysed 50.3% were G2P[4] and were identified in all collaborating centres except Hobart, but were the dominant type only in the Northern Territory and Western Australia. In the Northern Territory, the G2P[4] strain was responsible for a large outbreak of severe acute gastroenteritis between February and May 2009. This outbreak accounted for 74.6% of the G2P[4] samples submitted nationally. G1P[8] strains were the second most common type nationally, representing 22.5% of specimens. G1P[8] strains were identified in all states and was the dominant type in Sydney, Brisbane, Melbourne and Hobart.

G3P[8] strains were identified in Sydney and Melbourne, where they were the second most dominant type identified in these locations (26.3% and 29.6% respectively). In the Northern Territory, Brisbane and Perth, G3P[8] represented less than 2% of samples in each location. Overall, G3P[8] represented only 4.2% of strains nationally. Five G9P[8] strains, two each from Sydney and Melbourne, and one from Perth, comprised 1.1% of samples analysed. Four G4 strains were identified, two genotyped as G4P[8] in Melbourne and two as G4P[4] in Alice Springs and Brisbane.

A total of 12 (2.8%) uncommon strains were identified. A single G8 strain was identified in Darwin. One Brisbane strain was found to be VP7 G1 and VP6 Subgroup I. Ten were found to possess uncommon combinations of VP4 and VP7 genes, with 6 G1P[4] stains identified in Western Australia, and single G1P[6] and G3P[6] strains found in Brisbane and Melbourne, respectively, in addition to the 2 G4P[4] strains mentioned above. Seven (1.6%) rotavirus samples contained multiple types.

In 16.4% of samples either a G– or P-Type, or both, could not be assigned (Table 2). These samples may contain virus numbers below the detection limits of our typing assays or have inhibitors within extracted RNA that prevent the function of the enzymes used in RT and/or PCR steps.

The distribution of G & P genotypes between states using Rotarix (New South Wales, the Northern Territory, Western Australia and Tasmania) compared with RotaTeq states (Victoria, Queensland) appears to differ, as shown in Figure 2.

## Table 1: Rotavirus G and P genotypes, Australia, 1 July 2008 to 30 June 2009

| Centre | Total | G1P[8] | | G1P[4] | | G2P[4] | | G3P[8] | | G4P[8] | | G9P[8] | | Mix* | | NRI | | Other* | | Non-typeable | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n | % | n |
| **New South Wales** | | | | | | | | | | | | | | | | | | | | | |
| Sydney (POW) | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Sydney (Westmead) | 19 | 42.1 | 8 | 0.0 | 0 | 21.1 | 4 | 26.3 | 5 | 0.0 | 0 | 10.5 | 2 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| **Northern Territory** | | | | | | | | | | | | | | | | | | | | | |
| Alice Springs | 106 | 0.0 | 0 | 0.0 | 0 | 76.4 | 81 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.9 | 1 | 0.0 | 0 | 0.9 | 1 | 21.8 | 23 |
| Darwin | 57 | 1.8 | 1 | 0.0 | 0 | 84.1 | 48 | 3.5 | 2 | 0.0 | 0 | 0.0 | 0 | 1.8 | 1 | 0.0 | 0 | 0.0 | 0 | 8.8 | 5 |
| Western Diagnostic | 60 | 28.3 | 17 | 0.0 | 0 | 63.3 | 38 | 1.7 | 1 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 1.7 | 1 | 1.7 | 1 | 3.3 | 2 |
| **Queensland** | | | | | | | | | | | | | | | | | | | | | |
| Brisbane | 54 | 59.3 | 32 | 0.0 | 0 | 3.7 | 2 | 1.9 | 1 | 0.0 | 0 | 0.0 | 0 | 3.7 | 2 | 1.9 | 1 | 5.5 | 3 | 24.0 | 13 |
| **Victoria** | | | | | | | | | | | | | | | | | | | | | |
| Melbourne | 27 | 33.3 | 9 | 0.0 | 0 | 7.4 | 2 | 29.6 | 8 | 7.4 | 2 | 7.4 | 2 | 0.0 | 0 | 0.0 | 0 | 3.7 | 1 | 11.2 | 3 |
| **Western Australia** | | | | | | | | | | | | | | | | | | | | | |
| PathWest | 78 | 20.5 | 16 | 3.8 | 3 | 53.8 | 42 | 2.6 | 2 | 0.0 | 0 | 0.0 | 0 | 1.3 | 1 | 1.3 | 1 | 0.0 | 0 | 16.7 | 13 |
| Perth | 39 | 36.0 | 14 | 7.6 | 3 | 18.0 | 7 | 0.0 | 0 | 0.0 | 0 | 2.6 | 1 | 5.0 | 2 | 0.0 | 0 | 0.0 | 0 | 30.8 | 12 |
| **Tasmania** | | | | | | | | | | | | | | | | | | | | | |
| Hobart | 5 | 60.0 | 3 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 40.0 | 2 |
| Total | 445 | 22.5 | 100 | 1.3 | 6 | 50.3 | 224 | 4.2 | 19 | 0.5 | 2 | 1.1 | 5 | 1.6 | 7 | 0.7 | 3 | 1.4 | 6 | 16.4 | 73 |

* An additional 147 specimens were omitted from analysis due to insufficient sample or because the specimen was not confirmed to be rotavirus positive.

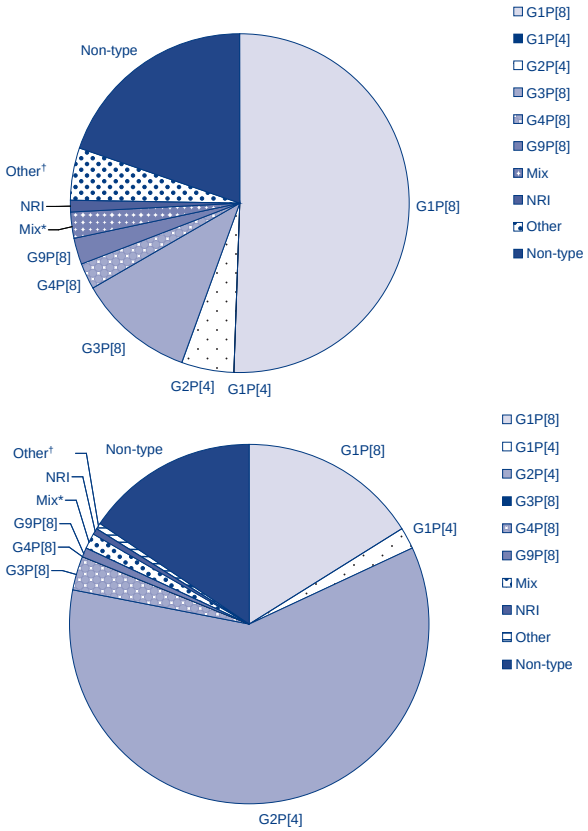
**Mix**

| | |
|---|---|
| Alice Springs | G9 P[4]/[9] |
| Darwin | G1/2 P[4] |
| Brisbane | G1/3/9 P[8], G1/3 P non-typeable |
| PathWest | G1 P[4]/[8] |
| Perth | G1/2 P[8], G1/2 P[4] |

**Other**

| | |
|---|---|
| Alice Springs | G4P[4] |
| Western Diagnostic | G8 P non-typeable |
| Brisbane | G1P[6], G4P[4], G1 + subgroup I |
| Melbourne | G3P[6] |

**Figure 2: Overall distribution of rotavirus G and P genotypes identified in Australian children based on vaccine usage for the period 1 July 2008 to 30 June 2009**




Analysis of fully G and P typeable samples revealed that in Rotarix states G2P[4] strains dominate (59%), whereas in RotaTeq states G1P[8] strains dominate (51%) and G2P[4] strains comprise only 5% of fully typed specimens. A slight increase in G3P[8] (11% vs 3%), G4P[8] (2% vs 0%) and G9P[8] (2% vs 1%) strains was observed in the states which introduced RotaTeq when compared with those using Rotarix. The majority of all samples analysed however, (364 of the 445 samples nationally) came from Rotarix states, with almost two-thirds originating from the high disease environment in the Northern Territory, and this discrepancy in sample number has to be considered when interpreting the data.

### Vaccine associated diarrhoea

Faecal specimens were received from 25 children who developed rotavirus diarrhoea after being vaccinated with RotaTeq in Victoria and Queensland. Vaccine virus was identified in five of these cases by RT-PCR and sequence analysis of the VP6 gene, while wild-type rotavirus was identified in 16 samples.

RotaTeq induced diarrhoea was confirmed in a child with severe combined immune deficiency. Serial stool samples were collected (n = 14) post immunisation, and RT-PCR and sequence analysis identified RotaTeq vaccine strain in all samples.[11]

**Table 2: G and P genotype assignments in non-typeable specimens**

| Centre | Total | P non-typeable | | | | G non-typeable | | G & P non-typeable |
|---|---|---|---|---|---|---|---|---|
| | | G1 | G2 | G4 | G9 | P[4] | P[8] | NT |
| **New South Wales** | | | | | | | | |
| Sydney (POW) | 0 | | | | | | | |
| Sydney (Westmead) | 0 | | | | | | | |
| **Northern Territory** | | | | | | | | |
| Alice Springs | 23 | | 5 | | 2 | 14 | | 2 |
| Darwin | 5 | | 3 | | | 1 | | 1 |
| Western Diagnostic | 2 | 1 | | | | 1 | | |
| **Queensland** | | | | | | | | |
| Brisbane | 13 | 12 | 1 | | | | | |
| **Victoria** | | | | | | | | |
| Melbourne | 3 | | | | | | 2 | 1 |
| **Western Australia** | | | | | | | | |
| PathWest | 13 | 1 | | | | 12 | | |
| Perth | 12 | 4 | | 1 | | 5 | 1 | 1 |
| **Tasmania** | | | | | | | | |
| Hobart | 2 | 2 | | | | | | |
| Total (%) | 73 | 20 (27.4) | 9 (12.3) | 1 (1.4) | 2 (2.7) | 33 (45.2) | 3 (4.1) | 5 (6.9) |

## Discussion

In this report covering the period 1 July 2008 to 30 June 2009, we describe the annual epidemics and geographic distribution of rotavirus genotypes causing disease in Australian children during the second year after the introduction of national rotavirus vaccination. The rotavirus surveillance program highlighted the emergence of genotype G2P[4] as the dominant genotype, nationally representing 50.2% of all strains. This large number corresponded with a large outbreak of acute gastroenteritis in Alice Springs during February to May 2009 and emergence as dominant type in Western Australia. Genotype G1P[8] was the second predominant type nationally, comprising 22.5% of all strains characterised. It was the dominant type along the eastern seaboard, in particular in Melbourne, Sydney and Brisbane. This survey continues to highlight the ongoing fluctuations in the dominant genotypes, and represented the second time in the past 5 years where G1P[8] was not the dominant genotype nationally. As the overall numbers of rotavirus gastroenteritis decrease in the post-vaccine era, the contribution of outbreaks to the analysis of circulating strains by the NRRC is likely to be increased.

Similar to other reports,[6–8] multiple common genotypes (G1P[8], G2P[4], G3P[8], G4P[8] and G9P[8]) continue to co-circulate within the Australian population causing significant disease with G1, G2 and G3 being identified in at least 5 states and territories. Unlike the first year of vaccine introduction where G1, G2, G3 and G9 were all identified in more than 10% of specimens, the proportion of G3, G4 and G9 strains were much less, each representing less than 5% of total isolates.

The prevalence of G2P[4] strains has increased during the past 2 surveys. During the 2005/06 period G2P[4] was identified in only 4 sites and represented less than 5% of the total number of strains nationally,[7] whereas during the 2007/08 survey, G2P[4] strains had become the second most common type nationally, being identified in 9 sites, and represented the dominant type in the Northern Territory.[8] G2P[4] have previously been responsible for 2 large outbreaks in the Northern Territory, both prior to vaccine introduction in 1997 and 2004. This outbreak represents the first emergence of G2P[4] since vaccine has been introduced.[12] The increased detection of G2P[4] strains has been restricted to 2 of 3 states using the monovalent vaccine, but this trend is of uncertain significance and will require ongoing investigation. The emergence of G2P[4] has also been reported in vaccinated populations in Brazil (Rotarix) and Nicaragua (RotaTeq),[13–15] but also to a lesser extent in non-vaccinated populations in Latin America.[16] In this setting, the proportion of rotavirus cases has significantly reduced since vaccine introduction, however G2P4 strains have virtually replaced all other strains as the cause of diarrhoea 1–2 years after vaccine introduction.[14]

In a comparison of rotavirus types identified, based on vaccine usage in the various states, differences in the prevalence rates of various genotypes were identified. G2P[4] strains were more prevalent in states using Rotarix, whereas G1P[8] and G3P[8] strains were more prevalent in states using RotaTeq. Not all the subjects from whom samples were obtained were eligible for vaccination, and the vaccination status of vaccine-eligible infants is unknown. Consequently, it is difficult to ascertain whether these differences are due to a lack of protection by either vaccine or by natural variation. G2P[4] strains have previously caused large outbreaks, but then their prevalence has generally declined in the following year. It will be important to determine whether G2P[4] continues to remain a common genotype causing disease in the Northern Territory and Western Australia. If G2P[4] strains decrease, then their emergence during the current study period is more likely due to the natural fluctuations in rotavirus genotypes, than to vaccine pressure.

Uncommon rotavirus types continue to be of worldwide interest because of the possible impact they could have on future rotavirus vaccine programs.[17] This year 2 unusual VP7/VP4 genotype combinations were identified; G1P[4] and G4P[4]. This follows the identification of a G2P8 strain in the 2007/08 survey.[8] A single G8 strain was identified in Darwin, continuing the ongoing observation of G8 strains in Perth, Brisbane and Darwin in the past 2 surveys.[7,8] Reports of uncommon strains continue to highlight their low level existence in Australian children.

In the second year of rotavirus vaccine usage we have observed a change in the age distribution of children admitted to hospital when compared with the previous 12 month period. Changes in 2 age groups were identified. An increase was observed in the 0–6 month group (23% vs 14%), while a decrease in the 7–12 month age group was observed (14% vs 24%). No differences in rates of hospital admissions were identified in children aged 1–2 and 2–3 years. The increase in the 0–6 month infants age group may be due to the presence of G2P[4] strains in Alice Springs and Western Australia where over 40% of infants in these locations were 0–6 months of age.

The second year of vaccine implementation has seen the emergence of G2P[4] as the dominant genotype. Interestingly, this was restricted to states using Rotarix, however, the differences in genotype distribution were potentially magnified by the large G2P[4] outbreak that occurred in Alice Springs.

These changes could therefore be the result of continual fluctuations in rotavirus genotypes, and the unpredictable nature of changes in the prevalence of rotavirus strains across Australia, rather than to vaccine pressure. Understanding the fluctuations in rotavirus genotypes, using multicentre national surveillance, is needed to evaluate vaccine efficacy in the long term.

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# Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet Network, 2008

The OzFoodNet Working Group

## Abstract

In 2008, OzFoodNet sites reported 25,260 notifications of 9 diseases or conditions that are commonly transmitted by food. The most frequently notified infections were *Campylobacter* (15,535 notifications) and *Salmonella* (8,310 notifications). Public health authorities provided complete serotype and phage type information on 94% of all *Salmonella* infections in 2008. The most common *Salmonella* serotype notified in Australia during 2008 was *Salmonella* Typhimurium, and the most common phage type was *S.* Typhimurium 135. During 2008, OzFoodNet sites reported 1,545 outbreaks of gastrointestinal illness; affecting 25,555 people and resulting in 691 people being hospitalised. There were 99 deaths during these outbreaks. The majority (83%, 1,276/1,545) of outbreaks were due to person-to-person spread, but 7% (104/1,545) were transmitted by contaminated food. Foodborne outbreaks affected 1,454 persons including 96 hospitalisations. Eleven deaths were reported during these outbreaks. For these foodborne outbreaks, *Salmonella* was the most common aetiological agent and restaurants were the most common setting where foods were prepared. Twenty of these foodborne outbreaks were related to the consumption of eggs; the majority (n = 18) of these outbreaks were due to various phage types of *S.* Typhimurium. This report summarises the incidence of disease potentially transmitted by food in Australia and details outbreaks associated with various food vehicles in 2008. These data assist agencies to identify emerging disease, develop food safety policies, and prevent foodborne illness. *Commun Dis Intell* 2009;33(4):389–413.

Keywords: foodborne disease, surveillance, disease outbreak

## Introduction

In Australia, an estimated 5.4 million cases of foodborne disease occur annually, costing an estimated $1.2 billion dollars per year.[1] Many of these illnesses are preventable by appropriate interventions and surveillance helps to identify control measures.[2] Health departments conduct surveillance for foodborne diseases and diseases potentially transmitted by food to monitor trends in illness, detect outbreaks, inform preventative measures and to evaluate the efficacy of intervention efforts.[3,4]

In Australia, state and territory health departments conduct surveillance for between 10 and 15 different diseases that may be transmitted through food. Most of these diseases are transmitted by the faecal–oral route and as such may also be transmitted by contact with infected animals or people, or through consumption of contaminated water. In addition, health departments collect summary data on all outbreaks of foodborne diseases, which provides robust surveillance information on contaminated foods causing illness in Australia.

Most foodborne diseases manifest as mild self-limiting gastroenteritis, with only around 20% of affected people seeking medical attention. Consequently, surveillance data collected by health departments underestimate the true burden of disease. In Australia, for every case of salmonellosis notified to a health department there are an estimated 7 infections that occur in the community, while there are approximately 10 and 8 cases in the community for every notified case of campylobacteriosis and infection with Shiga-toxin producing *Escherichia coli* (STEC), respectively.[5,6]

The Australian Government established OzFoodNet—Australia's enhanced foodborne disease surveillance system—in 2000 to improve national surveillance and conduct applied research into the causes of foodborne illness.[7] OzFoodNet aggregates and analyses national information on the incidence of diseases caused by pathogens commonly transmitted by food, as well as foodborne disease outbreaks. The OzFoodNet network includes collaborators from the National Centre for Epidemiology and Population Health at the Australian National University, the Public Health Laboratory Network, Food Standards Australia New Zealand (FSANZ), and the Department of Agriculture Fisheries and Forestry. OzFoodNet is a member of the Communicable Diseases Network Australia, which is Australia's peak body for communicable disease control.[8] This is the 8th annual

report for the OzFoodNet network and summarises 2008 surveillance data, which includes a comparison with data from previous years.

## Methods

### Population under surveillance

In 2008, the network covered the whole of the Australian population, which was estimated to be 21,373,998 persons.[9]

### Data sources

#### *Notified infections*

All Australian states and territories have public health legislation requiring doctors and pathology laboratories to notify cases of infectious diseases that are important to public health. State and territory health departments record details of notified patients on surveillance databases. These surveillance datasets are aggregated into a national database—the National Notifiable Diseases Surveillance System (NNDSS)—under the auspices of the *National Health Security Act 2007* and the National Health Securities Agreement 2008. OzFoodNet aggregated and analysed data from NNDSS and enhanced surveillance data from OzFoodNet sites on the following 9 diseases or conditions, a proportion of which are commonly transmitted by food:

- non-typhoidal *Salmonella* infections;
- *Campylobacter* infections (except in New South Wales);
- *Listeria* infections;
- *Shigella* infections;
- *Salmonella* Typhi;
- hepatitis A
- botulism
- STEC infections; and
- haemolytic uraemic syndrome (HUS).

Data for this report were extracted from NNDSS in July 2009 and were analysed by the date of diagnosis within the reporting period 1 January to 31 December 2008. Date of diagnosis was derived from the earliest date supplied from the date of onset of the case's illness, the date a specimen was collected or the date that a health department received the notification. Estimated resident populations for each state or territory as at June 2008 were used to calculate rates of notified infections.

#### *Enhanced surveillance*

OzFoodNet sites collected supplementary data on infections commonly transmitted by foods. Information on travel status was collected for cases of *Salmonella* Enteritidis, hepatitis A and typhoid. We compared the incidence of infection in returned travellers with the number of travellers to that region using customs data derived from incoming passenger cards.[10] The field 'country where you spent the most time abroad' was used as the numerator.

To examine the quality of surveillance data collected across Australia, OzFoodNet sites provided data on the completeness of serotype and phage type for *Salmonella* notifications. Data from Western Australia were excluded from the analysis, as isolates have not been routinely sent for phage typing since June 2007. To assess completeness, data were analysed using the date a notification was received by the health department.

OzFoodNet sites supplied data on listeriosis cases, which included whether a case was materno–foetal or not, and whether the case died. Many cases have severe chronic illnesses prior to their *Listeria* infection so it is difficult to determine if listeriosis is the cause of death for fatal cases, or one of many contributing factors. We did not validate deaths and all cases reported to have died were considered a listeriosis fatality. Materno-foetal pairs (mother and neonate) were counted as a single case with the mother being counted as the primary case. This affects age-specific notification rates for listeriosis and the proportion of reported cases that were female.

#### *Gastrointestinal and foodborne disease outbreaks*

OzFoodNet sites collected summary information on gastrointestinal and foodborne disease outbreaks that occurred in Australia during 2008. An outbreak of foodborne disease was defined as two or more people with a particular infection or illness whose common exposure was associated with a specific food or meal. A cluster was defined as an increase in infections that were epidemiologically related in time, place or person where investigators were unable to implicate a vehicle or determine a mode of transmission.

For foodborne and suspected foodborne outbreaks, the summary information collected on each outbreak included the setting where the outbreak occurred, where food was prepared, the month the outbreak occurred, the aetiological agent, the number of persons affected, the type of investigation conducted, the level of evidence obtained, and the food vehicle responsible for the outbreak. To summarise the data, outbreaks were categorised by aetiological agents, food vehicles and settings where the implicated food was prepared. Data on outbreaks due to waterborne transmission and data from clusters investigated by jurisdictional health departments were also summarised. The number of outbreaks and documented

causes reported here may vary from summaries previously published by individual jurisdictions as these can take time to finalise.

### *Data analysis*

We used Microsoft Excel and Stata version 10.1 for all analyses. Where appropriate we compared proportions using $\chi^2$ tests.

## Results

### Rates of notified infections

In 2008, OzFoodNet sites reported 25,260 notifications of 9 diseases or conditions that are commonly transmitted by food (Table 1), similar to the mean of 25,054 notifications per year for the previous 5 years (2003–2007). There were no cases of botulism in 2008.

### *Salmonella* infections

In 2008, OzFoodNet sites reported 8,310 cases of *Salmonella* infection, a rate of 39 cases per 100,000 population (Table 1). Notification rates among jurisdictions ranged from 31 cases per 100,000 population in Victoria to 226 cases per 100,000 population in the Northern Territory, which usually has the highest rate of salmonellosis. Approximately half (49%) of *Salmonella* notifications were in males. The highest age-specific rate of *Salmonella* infection was 300 cases per 100,000 population in children aged 0–4 years (Figure 1). The notification rate increased dramatically in children aged 2 years or under, with rates in children aged 3 or 4 years being similar to the 5–9 year age group.

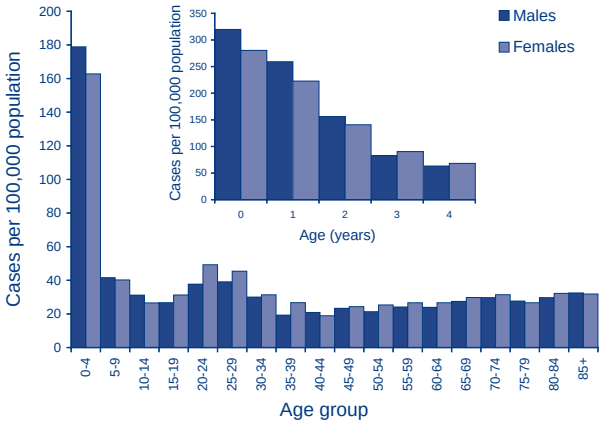
Nationally during 2008, the most commonly notified *Salmonella* serotype was *S.* Typhimurium, which was responsible for approximately 42% of all notified infections (Tables 2 and 3). During 2008, *S.* Typhimurium phage types 135, 44, 170/108 and

**Table 1: Number of notified cases, crude rate and 5-year mean (2003–2007) rate per 100,000 population of diseases or infections commonly transmitted by food, Australia, 2008, by disease and state or territory**

| Disease | | State or territory | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | Aust |
| *Salmonella* | Notified cases, 2008 | 132 | 2,261 | 497 | 2,047 | 661 | 206 | 1,651 | 855 | 8,310 |
| | Rate 2008 | 38.3 | 32.5 | 226.0 | 47.8 | 41.3 | 41.4 | 31.2 | 39.5 | 38.9 |
| | Mean rate, 2003–2007 | 31.2 | 31.9 | 200.3 | 63.4 | 38.6 | 40.4 | 28.3 | 37.8 | 40.1 |
| *Campylobacter** | Notified cases, 2008 | 381 | – | 257 | 4,821 | 1,992 | 475 | 5,780 | 1,829 | 15,535 |
| | Rate 2008 | 110.7 | – | 116.8 | 112.7 | 124.4 | 95.4 | 109.1 | 84.5 | 107.8 |
| | Mean rate, 2003–2007 | 121.3 | – | 125.3 | 103.9 | 153.3 | 136.4 | 119.2 | 102.9 | 116.9 |
| *Listeria* | Notified cases, 2008 | 1 | 34 | 0 | 12 | 1 | 1 | 11 | 8 | 68 |
| | Rate 2008 | 0.3 | 0.5 | 0.0 | 0.3 | 0.1 | 0.2 | 0.2 | 0.4 | 0.3 |
| | Mean rate, 2003–2007 | 0.4 | 0.4 | 0.1 | 0.2 | 0.3 | 0.2 | 0.3 | 0.3 | 0.3 |
| *Shigella* | Notified cases, 2008 | 3 | 109 | 175 | 97 | 137 | 4 | 134 | 169 | 828 |
| | Rate 2008 | 0.9 | 1.6 | 79.6 | 2.3 | 8.6 | 0.8 | 2.5 | 7.8 | 3.9 |
| | Mean rate, 2003–2007 | 0.9 | 1.3 | 71.9 | 1.9 | 3.1 | 0.7 | 1.6 | 6.0 | 2.8 |
| Typhoid | Notified cases, 2008 | 0 | 43 | 1 | 18 | 3 | 0 | 33 | 8 | 106 |
| | Rate 2008 | 0.0 | 0.6 | 0.5 | 0.4 | 0.2 | 0.0 | 0.6 | 0.4 | 0.5 |
| | Mean rate, 2003–2007 | 0.1 | 0.5 | 0.6 | 0.2 | 0.2 | 0.2 | 0.4 | 0.4 | 0.3 |
| Hepatitis A | Notified cases, 2008 | 5 | 69 | 3 | 71 | 20 | 1 | 85 | 22 | 276 |
| | Rate 2008 | 1.5 | 1.0 | 1.4 | 1.7 | 1.2 | 0.2 | 1.6 | 1.0 | 1.3 |
| | Mean rate, 2003–2007 | 0.7 | 1.5 | 15.3 | 0.9 | 0.6 | 1.0 | 1.2 | 2.9 | 1.5 |
| Shiga toxin-producing *Escherichia coli* | Notified cases, 2008 | 0 | 19 | 0 | 37 | 39 | 0 | 11 | 0 | 106 |
| | Rate 2008 | 0.0 | 0.3 | 0.0 | 0.9 | 2.4 | 0.0 | 0.2 | 0.0 | 0.5 |
| | Mean rate, 2003–2007 | 0.1 | 0.2 | 0.5 | 0.3 | 2.3 | 0.1 | 0.1 | 0.2 | 0.4 |
| Haemolytic uraemic syndrome | Notified cases, 2008 | 0 | 17 | 1 | 7 | 2 | 0 | 4 | 0 | 31 |
| | Rate 2008 | 0.00 | 0.24 | 0.45 | 0.16 | 0.12 | 0.00 | 0.08 | 0.00 | 0.15 |
| | Mean rate, 2003–2007 | 0.06 | 0.14 | 0.20 | 0.03 | 0.12 | 0.08 | 0.05 | 0.03 | 0.08 |

* *Campylobacter* is not a notifiable disease in New South Wales.

**Figure 1: Salmonellosis notifications, Australia, 2008, by age group and sex**




9 were commonly reported, representing four of the top 5 infections nationally. All serotypes in the Northern Territory exceeded 12 cases per 100,000 population, with *Salmonella* Ball being the highest at 20 cases per 100,000 population. Tasmania recorded a high rate for *S.* Mississippi notifications, which was 14.9 cases per 100,000 population. *S.* Mississippi is endemic in Tasmania and is thought to be transmitted from exposure to environments and drinking water that have been contaminated by native animals.[11]

### Salmonella *Enteritidis*

*Salmonella* Enteritidis is a globally important *Salmonella* serotype that can infect the internal contents of eggs, but is not endemic in Australian egg layer flocks. To monitor the emergence of this strain in Australia, OzFoodNet conducts enhanced surveillance of locally-acquired infections of *S.* Enteritidis. The majority of cases in Australia are associated with overseas travel.

During 2008, OzFoodNet sites reported 511 cases of *S.* Enteritidis infection (Table 4). Of those cases where travel status was reported, 83% (399/480) had travelled overseas and cases often reported visiting several countries. A travel history could not be obtained for 6% (31/511) of cases in 2008, compared with 18% of cases (73/396) in 2007 and 24% (72/305) of cases in 2006.

Of the cases that were known to have been acquired overseas, 80% (321/399) reported travel to South East Asia. This compares with only 13% (714,000 of 5,551,600) of returning travellers coming from South East Asia in 2008 (relative risk [RR] 28, 95% confidence interval [CI] 22–36).[10] Similar to previous years, the most common country of acquisition for overseas-acquired cases was Indonesia, with 43% (173/399) of cases reporting travel there, while comprising only 2% (94,000 of 5,551,600) of travel undertaken in 2008 (RR 44, 95% CI 36–54). Thailand was the 2nd most common country of acquisition with 16% (63/399) of all notifications that were known to have been acquired overseas, followed by Malaysia with 10% (40/399) and Singapore with 6% (25/399). The most common infecting phage types amongst overseas-acquired cases were 6a (17.5%) and 1 (11.3%) (Table 5).

All states and territories except the Australian Capital Territory reported locally acquired *S.* Enteritidis cases in 2008. In total, 16% (81/511) of *S.* Enteritidis infections were locally-acquired, which was higher than previous years. There was an average of 44 locally-acquired cases per year between 2003 and 2007. In 2008, 30% (24/81) of locally-acquired infections were due to *S.* Enteritidis 26, while 16% (13/81) were due to *S.* Enteritidis 6a. No phage type was recorded for 22% (18/81) of locally-acquired cases, the majority of which were reported from New South Wales. Queensland reported 90% (19/21) of *S.* Enteritidis 26 cases with infections occurring throughout the year, except during winter months. In contrast, *S.* Enteritidis 6a occurred mainly in the last half of 2008 and affected 3 jurisdictions; Queensland, New South Wales and Tasmania.

### *Completeness of* Salmonella *serotyping and phage typing*

Overall, 94% (6,983/7,464) of *Salmonella* notifications on state and territory databases contained information about serotype and/or phage type (excluding Western Australia). In Australia, 6 serotypes are routinely phage typed: Bovismorbificans; Enteritidis; Hadar; Heidelberg; Typhimurium; and Virchow. In 2008, phage typing was greater than 90% complete for serotypes Typhimurium, Virchow and Enteritidis (Table 6). There was an overall decline in the percentage of notifications with phage type reported in 2008 compared with previous years, with 94.1% containing complete information on phage type during 2008 (excluding Western Australia where routine phage typing ceased after June 2007).

## *Campylobacter* infections

In 2008, OzFoodNet sites (excluding New South Wales) reported 15,535 cases of *Campylobacter* infection; a rate of 108 cases per 100,000 population (Table 1). The lowest and highest rates of *Campylobacter* notification were in Western Australia (84.5 cases per 100,000 population) and in South Australia (124 cases per 100,000 population) respectively. Fifty-four per cent of notified cases were male, which is consistent with previous years. Notification rates were highest among males in nearly all age groups and particularly in males

## Table 2: Numbers, rates and proportions of the top 5 *Salmonella* infections, Australia (excluding Western Australia), 2007 to 2008,* by OzFoodNet site

| OzFoodNet site | Sero/phage type | 2008 | | Proportion | 2007 | | 2008/2007 ratio§ |
|---|---|---|---|---|---|---|---|
| | | n | Rate† | (%)‡ | n | Rate† | |
| Australian Capital Territory | *S.* Typhimurium 44 | 23 | 6.7 | 17 | 6 | 1.8 | 3.8 |
| | *S.* Typhimurium 9 | 19 | 5.5 | 14 | 6 | 1.8 | 3.2 |
| | *S.* Typhimurium 135 | 12 | 3.5 | 9 | 8 | 2.4 | 1.5 |
| | *S.* Typhimurium 170/108 | 11 | 3.2 | 8 | 5 | 1.5 | 2.2 |
| | *S.* Infantis | 5 | 1.5 | 4 | 3 | 0.9 | 1.7 |
| New South Wales | *S.* Typhimurium 135 | 256 | 3.7 | 11 | 232 | 3.4 | 1.1 |
| | *S.* Typhimurium 170/108 | 240 | 3.4 | 11 | 138 | 2.0 | 1.7 |
| | *S.* Typhimurium 9 | 146 | 2.1 | 6 | 363 | 5.3 | 0.4 |
| | *S.* Typhimurium 44 | 70 | 1.0 | 3 | 86 | 1.2 | 0.8 |
| | *S.* Birkenhead | 68 | 1.0 | 3 | 105 | 1.5 | 0.6 |
| Northern Territory | *S.* Ball | 44 | 20.0 | 9 | 38 | 17.7 | 1.2 |
| | *S.* Saintpaul | 38 | 17.3 | 8 | 32 | 14.9 | 1.2 |
| | *S.* Weltevreden | 31 | 14.1 | 6 | 16 | 7.4 | 1.9 |
| | *S.* Virchow 8 | 29 | 13.2 | 6 | 15 | 7.0 | 1.9 |
| | *S.* Lansing | 27 | 12.3 | 5 | 10 | 4.7 | 2.7 |
| Queensland | *S.* Typhimurium 135 | 159 | 3.7 | 8 | 154 | 3.7 | 1.0 |
| | *S.* Saintpaul | 155 | 3.6 | 8 | 219 | 5.2 | 0.7 |
| | *S.* Birkenhead | 119 | 2.8 | 6 | 116 | 2.8 | 1.0 |
| | *S.* Virchow 8 | 99 | 2.3 | 5 | 183 | 4.4 | 0.5 |
| | *S.* Aberdeen | 72 | 1.7 | 4 | 121 | 2.9 | 0.6 |
| South Australia | *S.* Typhimurium 135 | 93 | 5.8 | 14 | 66 | 4.2 | 1.4 |
| | *S.* Typhimurium 9 | 75 | 4.7 | 11 | 124 | 7.8 | 0.6 |
| | *S.* Infantis | 39 | 2.4 | 6 | 42 | 2.7 | 0.9 |
| | *S.* Typhimurium 29 | 36 | 2.2 | 5 | 77 | 4.9 | 0.5 |
| | *S.* Typhimurium 193 | 27 | 1.7 | 4 | 22 | 1.4 | 1.2 |
| Tasmania | *S.* Mississippi | 74 | 14.9 | 36 | 118 | 23.9 | 0.6 |
| | *S.* Typhimurium 135 | 58 | 11.6 | 28 | 43 | 8.7 | 1.3 |
| | *S.* Typhimurium 44 | 11 | 2.2 | 5 | 2 | 0.4 | 5.5 |
| | *S.* Virchow 8 | 5 | 1.0 | 2 | 2 | 0.4 | 2.5 |
| | *S.* Typhimurium 9 | 4 | 0.8 | 2 | 4 | 0.8 | 1.0 |
| | *S.* Enteritidis 6a | 4 | 0.8 | 2 | 0 | – | – |
| Victoria | *S.* Typhimurium 135 | 272 | 5.1 | 16 | 214 | 4.1 | 1.3 |
| | *S.* Typhimurium 44 | 196 | 3.7 | 12 | 283 | 5.4 | 0.7 |
| | *S.* Typhimurium 9 | 154 | 2.9 | 9 | 141 | 2.7 | 1.1 |
| | *S.* Typhimurium 170/108 | 130 | 2.5 | 8 | 112 | 2.2 | 1.2 |
| | *S.* Stanley | 40 | 0.8 | 2 | 44 | 0.8 | 0.9 |

* Where there were multiple 5th ranking *Salmonella* types all data have been shown; Western Australia data not included due to incomplete phage typing of *S.* Typhimurium, *S.* Enteritidis, and *S.* Virchow in 2008.

† Rate per 100,000 population.

‡ Proportion of total *Salmonella* notified for this jurisdiction in 2008.

§ Ratio of the number of cases in 2008 compared to the number in 2007.

### Table 3: Numbers, rates, and proportions of top 5 *Salmonella* infections, Western Australia, 2007 to 2008

| OzFoodNet site | Serotype | 2008 | | Proportion (%)† | 2007 | | 2008/2007 ratio‡ |
|---|---|---|---|---|---|---|---|
| | | n | Rate* | | n | Rate | |
| Western Australia | *S.* Typhimurium | 302 | 14.0 | 35 | 392 | 18.6 | 0.8 |
| | *S.* Enteritidis | 139 | 6.4 | 16 | 105 | 5.0 | 1.3 |
| | *S.* Saintpaul | 25 | 1.2 | 3 | 48 | 2.3 | 0.5 |
| | *S.* Chester | 24 | 1.1 | 3 | 26 | 1.2 | 0.9 |
| | *S.* Kiambu | 20 | 0.9 | 2 | 9 | 0.4 | 2.2 |
| | *S.* Muenchen | 20 | 0.9 | 2 | 23 | 1.1 | 0.9 |

* Rate per 100,000 population.

† Proportion of total *Salmonella* notified for this jurisdiction in 2008.

‡ Ratio of the number of cases in 2008 compared to the number in 2007.

### Table 4: Number of *Salmonella* Enteritidis infections, Australia, 2008, by travel history and state or territory

| State or territory | History of overseas travel | | | |
|---|---|---|---|---|
| | Yes | No | Unknown | Total |
| Australian Capital Territory | 8 | 0 | 1 | 9 |
| New South Wales | 72 | 29 | 0 | 101 |
| Northern Territory | 4 | 2 | 0 | 6 |
| Queensland | 59 | 37 | 19 | 115 |
| South Australia | 34 | 2 | 2 | 38 |
| Tasmania | 6 | 2 | 0 | 8 |
| Victoria | 89 | 1 | 5 | 95 |
| Western Australia | 127 | 8 | 4 | 139 |
| Total | 399 | 81 | 31 | 511 |

### Table 5: Number and percentage of each phage type for of overseas-acquired cases of *Salmonella* Enteritidis, Australia, 2008

| Phage type | Total | |
|---|---|---|
| | n | % |
| 6a | 70 | 17.5 |
| 1 | 45 | 11.3 |
| 4 | 20 | 5.0 |
| 1b | 19 | 4.8 |
| 21 | 19 | 4.8 |
| Reactions do not conform | 17 | 4.3 |
| Untypable | 10 | 2.5 |
| 21b var | 8 | 2.0 |
| 8 | 7 | 1.8 |
| 21c | 7 | 1.8 |
| 26 | 6 | 1.5 |
| Other phage types | 32 | 8.0 |
| No phage type was provided | 139 | 34.8 |
| Total | 399 | 100.0 |

* The number of overseas-acquired cases with no phage type available includes 123 cases from Western Australia, where phage typing ceased in June 2007.

aged less than 5 years and greater than 65 years. The highest age-specific rate of notifications was in 1-year-old infants for both males and females (233 and 180 cases per 100,000 population, respectively) with additional peaks in the 20–29 year age group (Figure 2).

### *Listeria* infections

OzFoodNet sites reported 65 cases of *Listeria monocytogenes* infection in 2008 representing a crude rate of 0.3 per 100,000 population; the same as the 5-year historical mean (Table 1).

Similar to previous years, 18% (12/65) of cases were pregnancy-associated infections. In 2008, 47% (25/53) of the non-pregnancy related cases were female. Fifty-one per cent (33/65) of notifications were in people aged 60 years or over. The highest age-specific notification rate was in people aged 85 years or over (1.9 cases per 100,000 population, 7 cases) (Figure 3). Eight per cent (1/12) of pregnancy related cases and 21% (11/53) of non-pregnancy associated cases in 2008 were fatal (Figure 4).

**Table 6: Percentage of *Salmonella* notifications for 6 serotypes notified to state and territory health departments with phage type information available, Australia,* 2003 to 2008**

| *Salmonella* serotype | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|
| *S.* Bovismorbificans | 94.7 | 95.9 | 95 | 96.9 | 97.4 | 83.5 |
| *S.* Enteritidis | 97.6 | 95.2 | 97.6 | 98.1 | 94.1 | 92.3 |
| *S.* Hadar | 100.0 | 90.0 | 87.0 | 100.0 | 90.0 | 81.3 |
| *S.* Heidelberg | 96.3 | 89.5 | 88.4 | 95.0 | 90.0 | 80.5 |
| *S.* Typhimurium | 98.8 | 98.7 | 98.6 | 98.3 | 98.3 | 94.8 |
| *S.* Virchow | 98.9 | 99.8 | 98.7 | 99.2 | 95.4 | 93.4 |

* 2007 to 2008 data excluding Western Australia, where phage typing ceased in June 2007.

**Figure 2: Campylobacteriosis notification rates and sex, Australia, 2008, by age group**

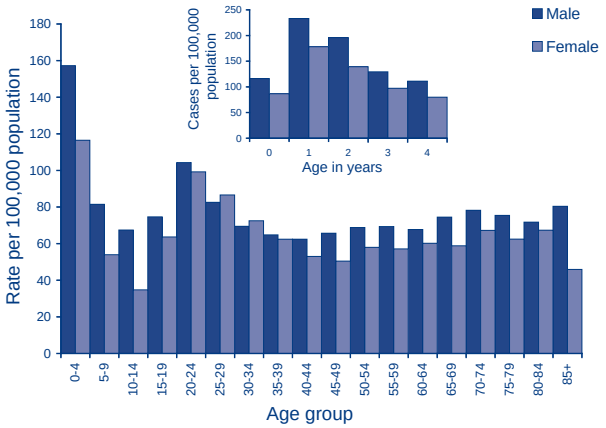
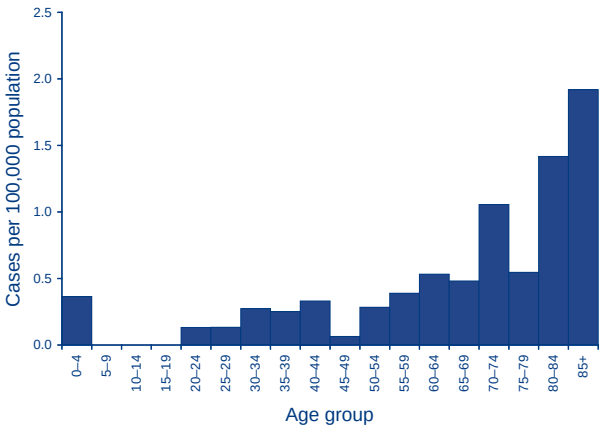



**Figure 3: Listeriosis notifications, Australia, 2008, by age group**

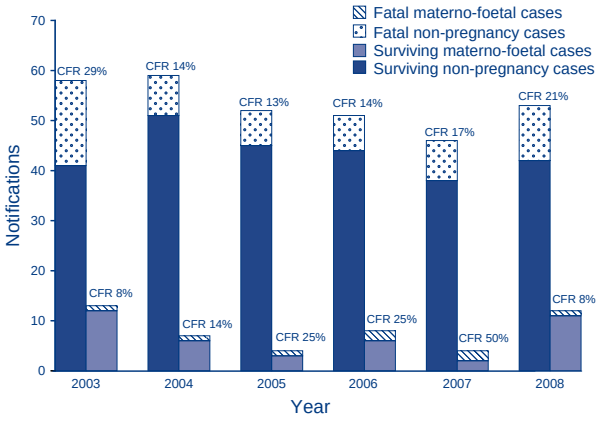



### *Shigella* infections

There were 828 notifications of shigellosis in Australia in 2008; a rate of 3.9 notifications per 100,000 population compared with a mean of 568 cases (2.8 notifications per 100,000 population) per year between 2003 and 2008 (Table 1). As in previous years, the Northern Territory reported the highest notification rate with 79.6 cases per 100,000 population compared with a mean of 71.9 cases per 100,000 population between the years 2003 and 2007.

The increased notification rate of shigellosis in 2008 compared with previous years is in part explained by an outbreak of *S. sonnei* biotype g with matching antibiotic resistance profiles amongst men who have sexual contact with other men (MSM), with cases in New South Wales (n = 12), Queensland (n = 4), Victoria (n = 29) and Western Australia (n = 2). Victoria also reported an outbreak of *S. sonnei* biotype g with matching antibiotic resistance profiles (different to the MSM cluster) amongst members of the Jewish community in Melbourne, with 12 cases and a further 2 cases from the same geographical area, although no source for the outbreak was identified. South Australia reported clusters of *S. flexneri* 6 with 3 cases and *S. sonnei* biotype a with 8 cases.

**Figure 4: Notifications and case fatality ratio (CFR %) for fatal and surviving listeriosis cases, Australia, 2003 to 2008, by pregnancy status**




In 2008, notification rates for shigellosis were highest in males and females aged 0–4 years, with

12.5 and 13.9 notifications per 100,000 population respectively. Secondary peaks were observed in children aged 5–9 years and in males aged 30–44 years (Figure 5). Amongst children aged less than 5 years, the highest notification rates were in children aged 1 year. In 2008, 50% of all shigellosis cases were male. In 2008, 38.4% (318/828) of infections occurred in people of Aboriginal or Torres Strait Island origin and this proportion varied by state or territory.

The most frequently reported *Shigella* biotype in 2008 was *S. sonnei* biotype a, followed by *S. sonnei* biotype g. Together these biotypes accounted for 50% of all *Shigella* infections reported in 2008 (Table 7).

### Typhoid

In Australia during 2008, there were 106 cases of typhoid due to *Salmonella* serotype Typhi infection. This equated to a rate of 0.5 cases per 100,000 population compared with a mean of 0.3 cases per 100,000 between 2003 and 2007 (Table 1). Cases were reported from all Australian states and territories except for the Australian Capital Territory and Tasmania.

Notification rates for typhoid in 2008 were highest in young adults, with 1.4 cases per 100,000 (21 cases) and 1.1 cases per 100,000 (16 cases) amongst the 20–24 year and 25–29 year age groups, respectively (Figure 6). Overseas travel was the primary risk factor for typhoid in Australia in 2008 with 92.5% (98/106) of cases known to have been acquired overseas. In 2008, 59.4% (63/106) of cases were male.

India was the most frequently reported country of travel for overseas-acquired cases of typhoid in 2008, with 50% (49/98) of cases, followed by Bangladesh, Indonesia, and Pakistan, each reported as a travel destination by 9% (9/98) of overseas-acquired cases (Table 8). The most common phage type of *S.* Typhi isolated from cases was E1 (36.8%, 39/106), and the majority of cases infected with E1 (79%, 30/39) reported travel to India (including cases who also reported travel to Bangladesh and Thailand). This was consistent with previous years, with approxi-

**Figure 5: Age and sex specific notification rates of shigellosis, Australia 2008**

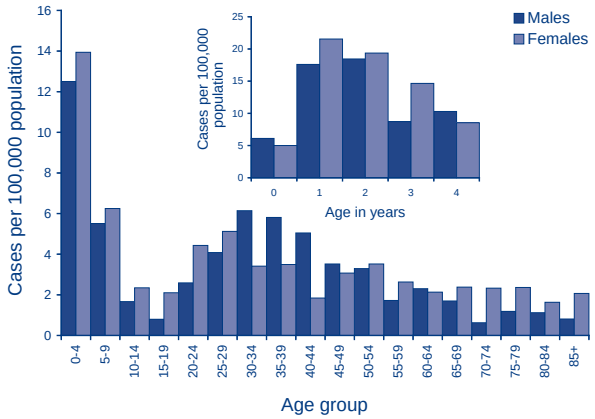



**Figure 6: Age specific notification rates for typhoid, Australia, 2008**

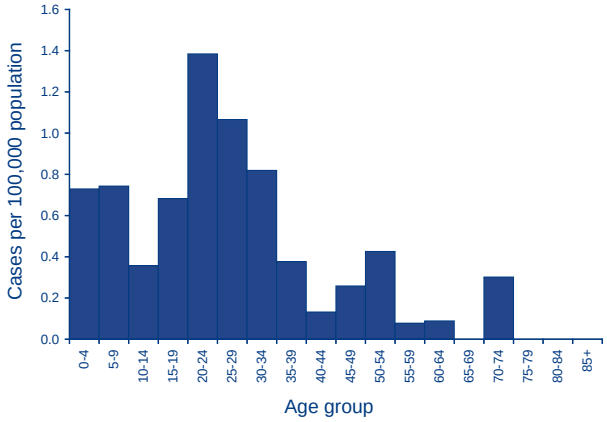



**Table 7: Number, percentage and ratio of the top 10 *Shigella* infections, Australia, 2006 to 2008**

| Biotype | 2006 | | 2007 | | 2008 | | 2008/2006 ratio* | 2008/2007 ratio* |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | | |
| *Shigella sonnei* biotype a | 80 | 14.7 | 134 | 22.3 | 232 | 28.0 | 1.9 | 1.3 |
| *Shigella sonnei* biotype g | 76 | 13.9 | 98 | 16.3 | 185 | 22.3 | 1.6 | 1.4 |
| *Shigella flexneri* 2a | 54 | 9.9 | 64 | 10.6 | 55 | 6.6 | 0.7 | 0.6 |
| *Shigella flexneri* 4a mannitol neg | 94 | 17.2 | 69 | 11.5 | 103 | 12.4 | 0.7 | 1.1 |
| *Shigella sonnei* untyped | 31 | 5.7 | 37 | 6.1 | 48 | 5.8 | 1.0 | 0.9 |
| *Shigella flexneri* 4 | 84 | 15.4 | 49 | 8.1 | 35 | 4.2 | 0.3 | 0.5 |
| *Shigella flexneri* untyped | 15 | 2.7 | 20 | 3.3 | 21 | 2.5 | 0.9 | 0.8 |
| *Shigella flexneri* 6 | 16 | 2.9 | 3 | 0.5 | 16 | 1.9 | 0.7 | 3.9 |
| *Shigella flexneri* 3a | 18 | 3.3 | 37 | 6.1 | 41 | 5.0 | 1.5 | 0.8 |
| *Shigella* | 22 | 4.0 | 21 | 3.5 | 27 | 3.3 | 0.8 | 0.9 |

**Table 8: *Salmonella* Typhi phage types isolated from cases (n = 106), Australia, 2008**

| Country where travelled | Phage type (n) | Number of cases |
|---|---|---|
| India | E1(29), 36(2), A (3), D2 (2), degraded (2), E9 (2) J1(5), untypeable (2) | 47 |
| Bangladesh | E7 (1), E9 (2), non-typeable(6) | 9 |
| Indonesia | D2 (2), degraded(1), E2(1), E2 var(1), M1(1), non-typeable (2), unknown(1) | 9 |
| Pakistan | E9 (6), T(1), non-typeable(1), 51(1) | 9 |
| Samoa | E1 (4), E7 (1)E9 (1) | 6 |
| Papua New Guinea | D2 (2), G3 (1) | 3 |
| Philippines | A (1), B1 var 1(1), degraded (1) | 3 |
| Thailand and Burma | O var (3) | 3 |
| Cambodia | E1 (1) | 1 |
| China and India | 36 (1) | 1 |
| India and Bangladesh | E1 (1) | 1 |
| India or Thailand | D2 (1) | 1 |
| Malaysia | E1 (1) | 1 |
| Malaysia and Thailand | D1 (1) | 1 |
| Nepal | E1 (1) | 1 |
| Sudan | Degraded (1) | 1 |
| Thailand and China | Untypeable (1) | 1 |
| No travel reported | E1 (2), untypeable (1), degraded (1), A (2), 40 (1), C4 (1) | 8 |

mately half of overseas-acquired cases in 2007 (51%, 42/83) reporting travel to India and 40% (19/48) being phage type E1.[12]

### Hepatitis A

Hepatitis A notifications declined in 2008, with 276 cases reported compared with a mean of 306 cases per year between 2003 and 2007 (Table 1 and Figure 7).[13] This decline may have been due to increased uptake of vaccine amongst high risk groups such as travellers, and targeted vaccination programs for Indigenous children.[13]

In 2008, the median age of notified cases was 24 years old (range 1–97 years) and 57% (158/276) of cases were male. Indigenous status was known for 88.8% of cases in 2008. The proportion of cases of hepatitis A among Indigenous persons declined from a mean of 14% (167/1,193) of cases for the years 2003 to 2006 to 1.2% (3/245) of cases in 2008. This marked decrease in the number and proportion of cases that were Indigenous may have been due to targeted vaccination programs for Indigenous children in Queensland commencing in 1999[14] as well as free vaccine for Indigenous children in South Australia, Western Australia and the Northern Territory from 2006.

Overseas travel was found to be the most frequently reported risk factor for infection amongst cases of hepatitis A in 2008, with 54.7% (151/276) reporting overseas travel (Table 9). The most commonly reported overseas travel destinations were India (29 cases), Indonesia (11 cases) and Pakistan (8 cases). Household contact with confirmed cases was identified as a risk factor for 4.3% (12/276) of cases, highlighting the importance of post-exposure prophylaxis for contacts. In 2008, 3.6% (10/276) of notified hepatitis A cases were suspected to be associated with foodborne transmission.

### Shiga toxin-producing *Escherichia coli* infections

In 2008, there were 106 notifications of STEC in Australia, equating to a rate of 0.5 cases per 100,000 population. This was an increase over a mean of 0.4 cases per 100,000 population between 2003 and 2007 (Table 1). Cases were reported from South Australia (39), Queensland (37), New South Wales (19) and Victoria (11). There were no cases in the Australian Capital Territory, the Northern Territory, Tasmania or Western Australia in 2008. Rates of STEC infection are strongly influenced by jurisdictional practices regarding the screening of stool specimens.[15] In particular, South Australia routinely tests all bloody stools by polymerase chain reaction (PCR) for gene coding for Shiga toxins and other virulence factors, making rates for this State the highest in the country.

In 2008, 51.9% of cases were female. The median age of cases was 24 years (range 0–89 years). Notification rates were highest in people aged 85 years or older, young people aged 10–14 years and children aged 4 years or under (Figure 8).

**Figure 7: Trends in notifications of hepatitis A, Australia, 1991 to 2008, by month of diagnosis and inset, notifications of hepatitis A, 2008, by month and state or territory**

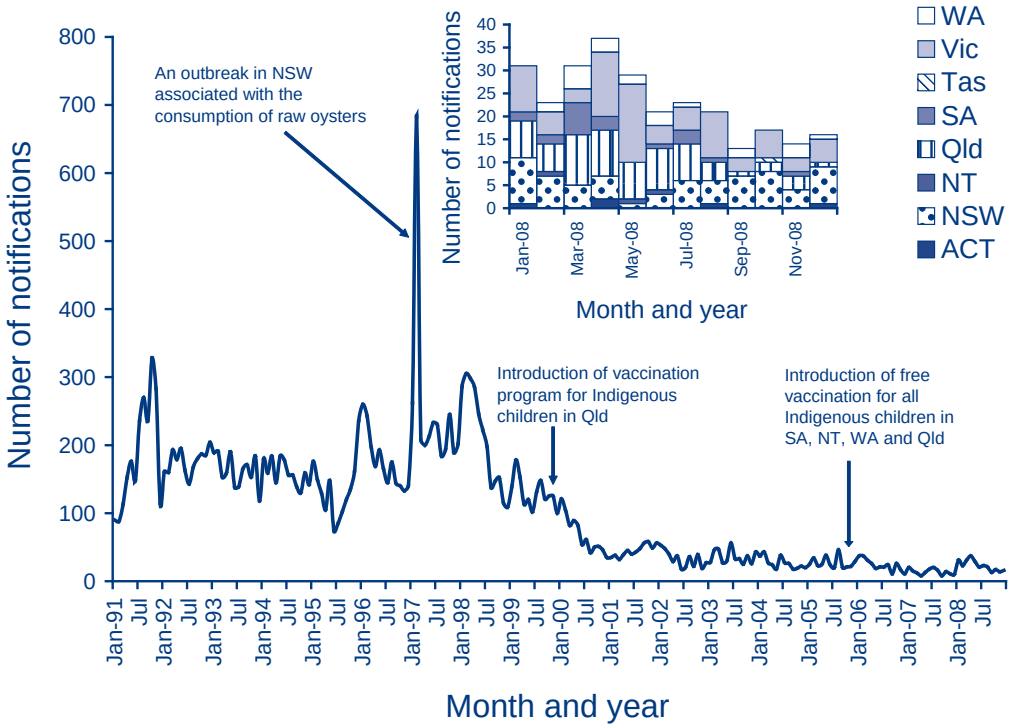



**Table 9: Risk factors identified for cases of hepatitis A, Australia, 2008**

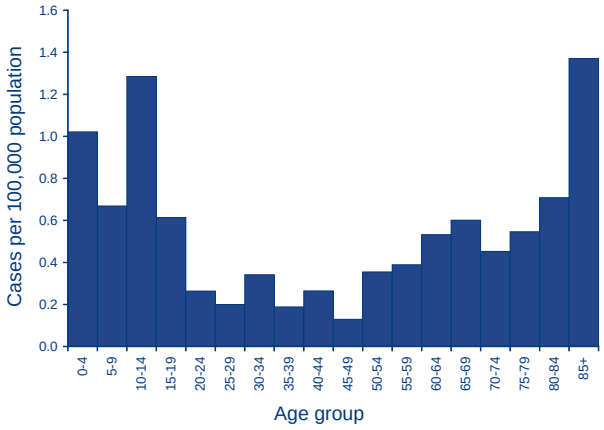
| Risk factor | Number of cases | Percentage of cases |
|---|---|---|
| Overseas travel | 151 | 54.7 |
| Household contact with confirmed cases | 12 | 4.3 |
| Associated with foodborne outbreak | 10 | 3.6 |
| Contact with confirmed cases | 3 | 1.1 |
| Overseas travel and contact with cases | 2 | 0.7 |
| Contact with injecting drug users | 1 | 0.4 |
| Contact with possible cases | 1 | 0.4 |
| Injecting drug use | 1 | 0.4 |
| Overseas travel and male-to-male sexual contact | 1 | 0.4 |
| Recent migrant from endemic area | 1 | 0.4 |
| No known risk factors | 73 | 26.4 |
| Unknown | 20 | 7.2 |
| Total | 276 | 100 |

The number of STEC notifications has increased over the past 5 years, from an average of 5 cases per month between 2003 and 2006 to 9 cases per month between 2007 and 2008 (Figure 9). Seven cases of STEC in 2008 were associated with an outbreak due to waterborne transmission at a camp in Queensland. STEC notifications have a seasonal association, tending to increase during the warmer months (November to April).

The most commonly identified serogroups* of STEC cases in 2008 were O157, with 27 cases (25.5%), followed by O111 (8 cases, 7.5%) and O26 (7 cases, 6.6%). No organism was isolated or the serogroup was reported for 33.0% (35/106) of cases.

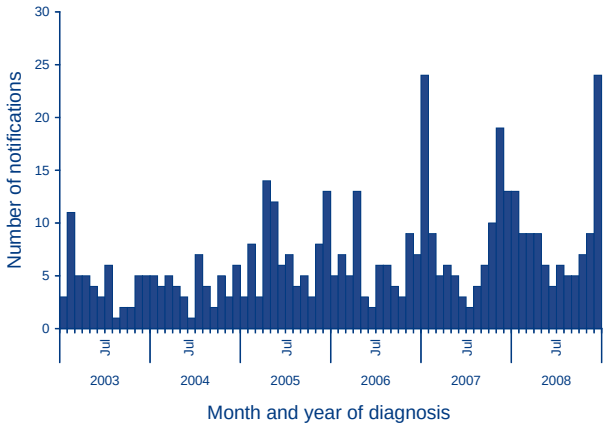
* Serotype reported may have been obtained by serotyping cultured isolates, or by polymerase chain reaction targeting serotype-specific genes.

### Figure 8: Age specific notification rates of Shiga toxin-producing *Escherichia coli*, Australia, 2008

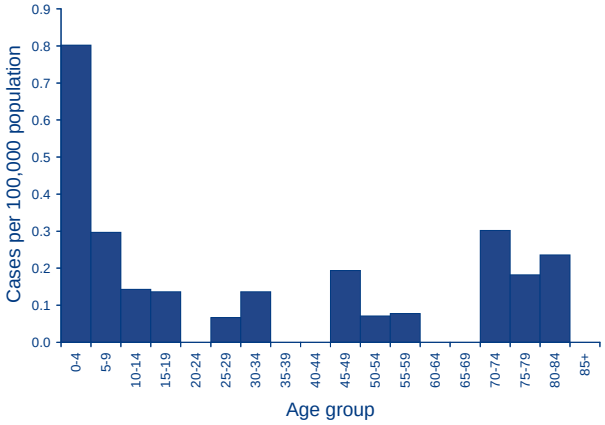



* Low case numbers make rates unstable and only age specific rates (not age and sex) have been calculated for Shiga toxin-producing *Escherichia coli*, with counts of less than 20 in all groups.

### Figure 9: Shiga toxin-producing *Escherichia coli* notifications, Australia, 2003 to 2008, by month and year of diagnosis




### Figure 10: Age specific notifications of haemolytic uraemic syndrome, Australia, 2008




reported for 56% (9/16) of these cases. *E. coli* O111 was reported in 5 instances, while serogroup O157 and O166 were reported for 1 case each. In 2008, 1 case of HUS was known to be due to a non-bacterial cause, 2 cases resulted from *Streptococcus pneumoniae* infection, and in the remaining 11 cases no aetiology was reported.

In Australia, HUS cases are more common during late spring and early summer,[12] with 37.4% (58/155) of cases occurring in the months of November, December or January for the years 2003 to 2008 (Figure 11). This was significantly more than expected ($P = 0.01$).

#### Gastrointestinal and foodborne disease outbreaks

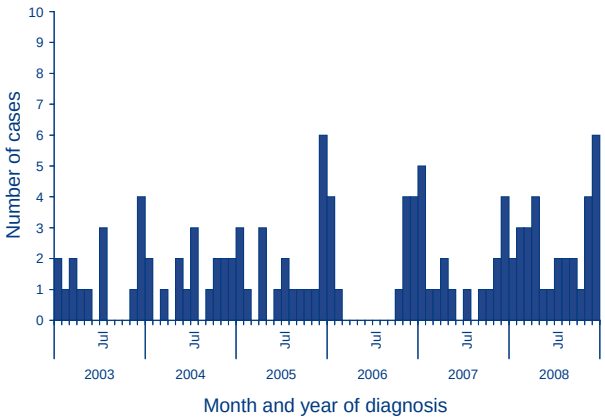
During 2008, OzFoodNet sites reported 1,545 outbreaks of gastroenteritis, including foodborne disease, which affected 25,555 people and hospitalised 691 (Table 10). There were 99 deaths during these

#### Haemolytic uraemic syndrome

In 2008, OzFoodNet sites reported 31 cases of HUS; a rate of 0.15 cases per 100,000 population (Table 1), compared with a mean of 0.08 cases per 100,000 population for the years 2003 to 2007. New South Wales reported the largest number of cases (17 cases), followed by Queensland (7 cases) and Victoria (4 cases). Similar to previous years, the highest notification rate in 2008 was in children aged 0–4 years (Figure 10), with 35.5% (11/31) of cases notified in this age group.

HUS may be due to causes other than Shiga toxin-producing *E. coli*, including other non-foodborne pathogens and genetic predisposition. In 2008, an antecedent STEC infection was reported for 52% (16/31) of cases, with serogroup information

### Figure 11: Notifications of haemolytic uraemic syndrome by month and year of diagnosis, Australia, 2003 to 2008



## Table 10: Outbreaks of gastroenteritis including foodborne disease reported to state and territory health departments, Australia, 2008

| Mode of transmission | Number of outbreaks | Number affected | Hospitalised | Fatalities |
|---|---|---|---|---|
| Foodborne | 104 | 1,454 | 96 | 11 |
| Person-to-person | 1,276 | 22,508 | 502 | 81 |
| Unknown mode (*Salmonella* cluster) | 22 | 309 | 46 | 0 |
| Unknown mode (other pathogen) | 22 | 157 | 19 | 1 |
| Unknown mode (unknown aetiology) | 118 | 1,085 | 26 | 6 |
| Waterborne | 1 | 7 | 1 | 0 |
| Total | 1,545 | 25,555 | 691 | 99 |

* Two outbreaks are included that commenced in December 2007, but were notified and investigated in 2008, one of them foodborne transmission and the other person-to-person.

outbreaks. This compares with 1,882 and 1,544 outbreaks reported across Australia in 2007 and 2006, respectively.

### Outbreaks due to person-to-person spread

In 2008, 83% (1,276/1,545) of all gastroenteritis outbreaks were due to person-to-person spread. There were 22,508 people affected in these outbreaks and 81 deaths. These outbreaks were most common in aged care homes, with 61% (784/1,276) of outbreaks occurring in this setting, followed by 17% (211/1,276) and 15% (189/1,276) in hospitals and child care centres respectively. Approximately 40% (513/1,276) of outbreaks spread from person-to-person were caused by norovirus,† followed by only 3% of outbreaks caused by rotavirus. Forty-two per cent (531/1,276) of outbreaks due to person-to-person spread were of unknown aetiology. Late winter and early spring were the peak seasons for person-to-person outbreaks, with 38% (487/1,276) of outbreaks reported in the months of August to October 2008.

### Waterborne outbreaks

There was 1 outbreak due to waterborne transmission; an outbreak of *E. coli* (multiple serotypes) associated with the consumption of tank water, affecting 7 people at a camp.

### Outbreaks with unknown mode of transmission

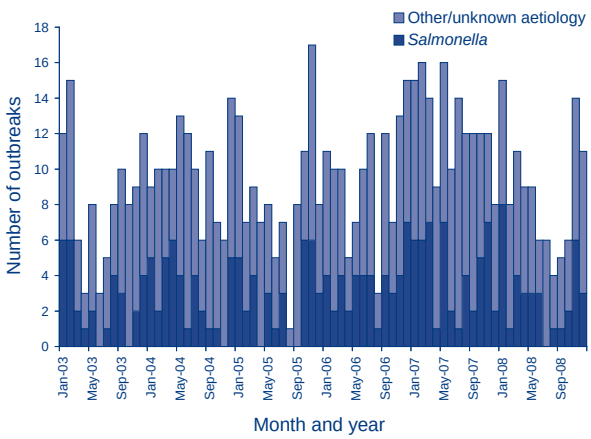
There were 162 outbreaks where the mode of transmission was not determined, affecting a total of 1,551 people. There were 22 investigations of *Salmonella* and 22 investigations of other pathogens that were clustered in time, place or person where investigators were unable to develop an adequate hypothesis for the source of illness. There were 118 outbreaks where investigators were unable to determine the mode of transmission or the aetiology.

### Foodborne outbreaks

In 2008, there were 104 outbreaks of foodborne disease affecting 1,454 people, compared with 149 and 115 foodborne outbreaks in 2007 and 2006, respectively (Appendix). There were 96 people hospitalised and 11 deaths reported during these outbreaks.

The overall rate of reported foodborne disease outbreaks for Australia was 4.9 outbreaks per million population in 2008 (Table 11). The highest rates of foodborne outbreak reporting were from the Northern Territory with 22.7 per million population and New South Wales with 7.6 per million population. Outbreaks were more common in warmer months (Figure 12).

## Figure 12: Outbreaks of foodborne *Salmonella* infections and other aetiological agents (n = 687) reported to state and territory health departments, Australia, 2003–2008, by month and year of outbreak




† This does not include a small number of outbreaks of mixed aetiology that included norovirus, or outbreaks where norovirus could not be confirmed as the aetiology of the outbreak.

*Aetiological agents*

The mostly commonly implicated aetiological agent in outbreaks of foodborne illness was *Salmonella*, which caused 34% (35/104) of outbreaks; 89% (31/35) of these being due to *S.* Typhimurium (Table 12).

Toxin-mediated outbreaks comprised 18% (19/104) of all foodborne outbreaks, with 32% (6/19) of these due to fish toxins (5 outbreaks of ciguatera fish poisoning, and 1 outbreak of histamine poisoning) and 68% (13/19) due to foodborne intoxications with *Bacillus cereus*, *Clostridium perfringens* or *Staphylococcus aureus*.

There were also 4 foodborne outbreaks of *Campylobacter*, and 8 outbreaks were caused by viral agents. In 2008, 37% (38/104) of foodborne outbreaks were of unknown aetiology compared with 38% in the previous year.

*Food vehicles*

A wide variety of food vehicles were implicated in outbreaks of foodborne disease in 2008. Investigators were unable to identify a food vehicle in 28% (29/104) of outbreaks (Table 13).

There were 20 outbreaks associated with eggs; these comprised 19% of all foodborne outbreaks and included all outbreaks that investigators considered to be egg-associated (Table 14). Nine of these outbreaks involved desserts that commonly contain raw egg (such as chocolate mousse and tiramisu), five were due to egg-based sauces or dressings (such as aioli or hollandaise sauce), three were due to eggs as a whole food and 1 outbreak each was due to mixed dishes, a dish containing eggs and suspected chicken and/or eggs. These outbreaks affected a total of 289 people and hospitalised 36 people.

Fifteen per cent (16/104) of outbreaks were due to mixed dishes, including buffets where a variety of dishes were served, and investigators were unable to implicate a particular ingredient (1 outbreak was suspected to be egg-associated). Nine per cent (9/104) of outbreaks were due to chicken or dishes containing chicken and 7% (7/104) were due to meat or dishes containing meat, 6% (6/104) due to fish and 6% (6/104) due to salads and/or sandwiches and 4% (4/104) due to molluscs. The remaining outbreaks were due to pasta dishes (3), vitamised foods (2), a rice-based dish (1) and a non-egg-based sauce or gravy (1).

**Table 11: Outbreaks of foodborne disease, Australia, 2008, by OzFoodNet site**

| State | Number of outbreaks | People affected | Mean size (persons) | Hospitalised | Outbreaks per million population |
|---|---|---|---|---|---|
| ACT | 1 | 24 | 24.0 | 2 | 2.9 |
| NSW | 53 | 632 | 11.9 | 31 | 7.6 |
| NT | 5 | 36 | 7.2 | 7 | 22.7 |
| Qld | 14 | 137 | 9.8 | 3 | 3.3 |
| SA | 4 | 66 | 16.5 | 14 | 2.5 |
| Tas | 2 | 81 | 40.5 | 9 | 4.0 |
| Vic | 21 | 328 | 15.6 | 27 | 4.0 |
| WA | 4 | 150 | 37.5 | 3 | 1.8 |
| Australia | 104 | 1454 | 14.0 | 96 | 4.9 |

**Table 12: Aetiological agents responsible for foodborne disease outbreaks, number of outbreaks and persons affected, Australia, 2008**

| Agent category | Number of outbreaks | People affected | Mean size (people) | Hospitalised |
|---|---|---|---|---|
| *Salmonella* Typhimurium | 31 | 443 | 14 | 67 |
| Foodborne intoxication | 13 | 348 | 27 | 6 |
| Viral | 8 | 238 | 30 | 4 |
| Ciguatera/histamine poisoning | 6 | 22 | 4 | 2 |
| *Campylobacter* | 4 | 16 | 4 | 0 |
| Other *Salmonella* serotypes | 4 | 43 | 11 | 4 |
| Unknown | 38 | 344 | 9 | 13 |
| Total | 104 | 1,454 | 14 | 96 |

## Table 13: Categories of food vehicles implicated in foodborne disease outbreaks, Australia, 2008

| Vehicle category | Number of outbreaks | Number affected | Mean size (persons) | Hospitalised |
|---|---|---|---|---|
| Mixed dishes | 17 | 300 | 6 | 8 |
| Egg-containing desserts | 9 | 98 | 9 | 10 |
| Chicken and chicken-containing dishes | 9 | 104 | 12 | 7 |
| Meat and meat-containing dishes | 7 | 90 | 13 | 2 |
| Fish | 6 | 22 | 4 | 2 |
| Salads and/or sandwiches | 6 | 68 | 11 | 6 |
| Molluscs | 4 | 19 | 5 | 0 |
| Egg-based sauces and dressings | 5 | 133 | 27 | 12 |
| Eggs | 3 | 26 | 9 | 8 |
| Pasta dish | 3 | 43 | 14 | 3 |
| Vitamised foods | 2 | 45 | 23 | 7 |
| Egg-containing dish | 1 | 3 | 3 | 1 |
| Rice based dish | 1 | 3 | 3 | 0 |
| Sauces and gravies | 1 | 31 | 31 | 0 |
| Suspected chicken and/or eggs | 1 | 14 | 14 | 2 |
| Unknown | 29 | 455 | 16 | 28 |
| Total | 104 | 1,454 | 14 | 96 |

## Table 14: Outbreaks of foodborne illness associated with egg-based dishes (n = 20), Australia, 2008

| State | Setting prepared | Agent responsible | Number affected | Evidence | Responsible vehicles |
|---|---|---|---|---|---|
| ACT | Restaurant | *S.* Typhimurium 44 | 24 | A | Hollandaise sauce and poached eggs |
| NSW | Private residence | *S.* Typhimurium | 20 | D | Eggs |
| | Private residence | *S.* Typhimurium 170 | 17 | D | Eggs used to make cake filling |
| | Restaurant | *S.* Typhimurium 126 | 3 | D | Chicken salad made with raw egg dressing |
| | Unknown | Unknown | 14 | D | Suspected chicken and/or eggs |
| | Aged care facility | *S.* Typhimurium 144 | 10 | M | Chocolate mousse with raw eggs |
| | Bakery | *S.* Typhimurium | 10 | A | Chocolate mousse cake |
| | Bakery | *S.* Typhimurium | 16 | D | Chocolate mousse cake |
| | Restaurant | *S.* Typhimurium 170 var | 24 | A | Raw eggs in Caesar salad dressing |
| | National franchised fast food | *S.* Typhimurium 44 | 3 | D | Bacon and egg sandwich |
| | Restaurant | Unknown | 5 | D | Aioli made with raw eggs |
| NT | Restaurant | *S.* Typhimurium 9 | 2 | D | Suspected raw egg mayonnaise/Caesar salad dressing |
| SA | Bakery | *S.* Typhimurium 9 | 15 | A | Sweet bakery products |
| Tas | Restaurant | *S.* Typhimurium 135a | 78 | AM | Aioli |
| | Private residence | *S.* Typhimurium 135a | 3 | D | Cake mix containing raw egg |
| Vic | Private residence | *S.* Typhimurium 135a | 7 | M | Ice cream cake made with raw eggs |
| | Private residence | *S.* Typhimurium 44 | 12 | D | Lemon dessert made with raw eggs |
| | Restaurant | Unknown | 4 | D | Desserts suspected |
| | Restaurant | *S.* Typhimurium 44 | 4 | D | Desserts suspected |
| | Restaurant | *S.* Typhimurium 170 | 4 | D | Tiramisu |

D Descriptive evidence implicating the vehicle

A Analytical epidemiological association between illness and vehicle

M Microbiological confirmation of aetiology in vehicle and cases.

*Settings where food was prepared*

In 2008, foods implicated in outbreaks were most commonly prepared in restaurants (43%, 45/104), by commercial caterers (12%, 12/104) or in private residences (12%, 12/104). Outbreaks were less frequently reported as being associated with foods prepared in aged care facilities (7%, 7/104), takeaway premises (6%, 6/104) or primary produce (5%, 5/104) (Table 15). In 2008 the only implicated foods that were contaminated in primary produce environments were fish involved in ciguatera fish poisoning outbreaks. The species of fish involved in these outbreaks included yellowtail kingfish, black kingfish, red throat emperor/reef snapper, yellow king/Samson fish and cod.

*Investigative methods and levels of evidence*

To investigate these foodborne outbreaks, state and territory investigators conducted 28 retrospective cohort studies and 4 case control studies. Descriptive case series were obtained for 62 outbreaks. No individual data were collected on patients in 10 outbreaks. An analytical association between illness and the implicated food as well as microbiological evidence of the aetiological agent in the implicated food was obtained for 3 outbreaks. Analytical evidence alone was obtained for 14 outbreaks and microbiological evidence alone for 9 outbreaks. These confirmed outbreaks comprised 25% (26/104) of all outbreaks compared with 46% in 2007 and 41% in 2006. Investigators relied on descriptive evidence implicating the food vehicle in 54 outbreaks, and there were no data available on the evidence obtained for 24 outbreaks (many of these were not attributed to a specific food vehicle).

## Significant outbreaks

In 2008 there were 8 outbreaks of foodborne illness affecting 40 or more people: 2 outbreaks of *C. perfringens;* 1 mixed outbreak of *C. perfringens* and *B. cereus;* 3 outbreaks of norovirus; one of *S.* Typhimurium 135a; and one of unknown aetiology. In total, these outbreaks affected 481 people, with a range of 41 to 78 people affected per outbreak. Nine people were hospitalised, all of them associated with a *Salmonella* outbreak.

Tasmania reported the largest of these outbreaks; an outbreak of *S.* Typhimurium 135a affecting 78 people who dined at the same restaurant over a 4-day period. A cohort study of 212 restaurant patrons showed a very strong association between the consumption of aioli and illness (odds ratio [OR] = 511, 95% CI 90–4,709), $P < 0.000$). *S.* Typhimurium 135a was isolated from 4 food items collected from the food premises; the aioli, 2 foods containing the aioli, and a guacamole, which was considered by the investigators likely to have been cross-contaminated. Eggs supplied to the food business were from the same producer who was implicated in outbreaks of this *Salmonella* strain in 2005 and 2007.[16,17]

**Table 15: Food preparation settings implicated in disease outbreaks, Australia, 2008**

| Setting prepared | Number of outbreaks | Proportion of all outbreaks (%)* | Number affected (persons) |
|---|---|---|---|
| Restaurant | 45 | 43 | 530 |
| Commercial caterer | 12 | 12 | 259 |
| Private residence | 12 | 12 | 107 |
| Aged care facility | 7 | 7 | 178 |
| Takeaway | 6 | 6 | 77 |
| Primary produce | 5 | 5 | 21 |
| Bakery | 4 | 4 | 42 |
| Institution | 4 | 4 | 101 |
| Camp | 2 | 2 | 29 |
| Grocery store/delicatessen | 1 | 1 | 2 |
| Institution – other | 1 | 1 | 15 |
| Military | 1 | 1 | 45 |
| National franchised fast food | 1 | 1 | 3 |
| School | 1 | 1 | 26 |
| Unknown | 2 | 2 | 19 |
| Total | 104 | | 1,454 |

* Percentages do not add up to 100% due to rounding.

New South Wales reported 3 outbreaks of foodborne intoxication affecting more than 40 people:

- an outbreak of gastrointestinal illness affecting all 75 guests of a birthday party where food had been supplied by an unregistered catering business. Several foods contained *C. perfringens* and *B. cereus* enterotoxins, and the proprietor was advised to cease preparing any foods for sale until the premises used for food preparation was brought up to a satisfactory standard.
- an outbreak of gastroenteritis affecting 45 of 100 people at an army training facility. A cohort study found an association between a curry meal and illness. Seven stool specimens were positive for *C. perfringens* enterotoxin type A. Temperature abuse of foods and inadequate equipment were considered by investigators to have been contributing factors in this outbreak.
- an outbreak of gastrointestinal illness affected 69 of 131 residents of an aged care facility over a 1 month period beginning in June. The outbreak may have involved two or more smaller peaks of illness accounting for the long time period of the outbreak. Seven out of 10 stool specimens were positive for *C. perfringens* enterotoxin type A. Consumption of vitamised or pureed diets and living in the high dependency unit were found to increase the risk of illness, although these 2 factors were not independent. Food handling and hygiene practices were found to be satisfactory.

A large outbreak of norovirus affected 56 of 138 attendees on a 5-day training course at a Brisbane academy in March. A retrospective cohort study identified an association between a cold meat and salad dish, provided by an outside caterer, and illness (RR = 2.0, 95% CI 1.5–2.7, $P = 0.004$). Eight stool specimens were positive for norovirus.[18]

An outbreak of norovirus gastroenteritis affected 75 of 366 people eating a buffet meal at a Western Australian restaurant. A Thai fish curry was the only food significantly associated with illness (RR = 1.30, $P < 0.05$), however this food was consumed by only 28% of cases. Six faecal specimens obtained were positive for norovirus. An inspection of the premises did not identify any major deficiencies and there were no reports of staff illness.[19]

An outbreak of norovirus at an aged care facility in Western Australia affected 42 people including residents and staff. The index case was a chef who had prepared food while he was ill with gastroenteritis. Other staff and residents subsequently became ill over a 24 hour period. No single food was identified as the vehicle in this outbreak, and some person-to-person spread may have been possible.

Victoria reported an outbreak of unknown aetiology affecting 41 people from 3 different groups who ate at a large buffet restaurant in October. While *C. perfringens* enterotoxin was suspected as the cause of this outbreak, it was detected in only one out of 13 stool specimens collected. Univariate analysis showed that illness was associated with consumption of lamb tenderloin (RR 4.0; 95% CI 2.3–7.0), chicken cacciatore (RR 2.0; 95% CI 1.4–2.8) and roast pork (RR 2.4; 95% CI 1.4–4.0).[20]

## Discussion

This report documents changes in the incidence of gastrointestinal diseases commonly transmitted by food in Australia. There was a decrease in the number of notifications of *Salmonella* and *Campylobacter* compared with previous years. Despite these declines, these 2 infections continue to be reported at higher rates than in other developed countries.[2,21] This is the first time hepatitis A has been included in the annual report. While the proportion of hepatitis A infections that may be foodborne is thought to be less than 10%, it is important to keep this infection under surveillance as it can cause large outbreaks of foodborne disease.[22,23]

Similar to 2007, higher rates of campylobacteriosis were observed in males than in females, particularly those over the age of 45 years.[12] The reasons for this were unclear, but may relate to higher susceptibility of males in this age group due to the use of acid suppressive medications.[24] In Australia, the primary source of *Campylobacter* infection is thought to be chicken consumption, causing an estimated 29.3% of all infections.[25] This is consistent with findings from other countries, although recent work in New Zealand highlights that the fraction of campylobacteriosis due to chicken meat consumption may be considerably higher.[26] The New Zealand Food Safety Authority recently announced that the poultry industry had successfully reduced the prevalence of *Campylobacter* on chicken meat, which had lead to a marked decline in human cases.[27]

In 2008, the proportion of *Salmonella* isolates that contained appropriate information on serotype and/or phage type decreased by 3% compared with 2007. Typing is vital for outbreak detection and monitoring trends. Western Australia ceased phage typing isolates in 2007 in favour of pulsed field gel electrophoresis, which is a discriminatory technique for typing *Salmonella* but not routinely used by other Australian laboratories.[28] Other jurisdictions used multi-locus variable number of tandem repeats analysis to compare strains during outbreaks, which proved rapid and very useful. The use of these different typing schemes caused some complexity dur-

ing multi-jurisdictional investigations. Despite this there is increasing harmonisation in typing schemes used by Australian laboratories.

Despite travel warnings and vaccine recommendations, travellers continue to acquire infections abroad, the risk being higher for long-term travellers and people who visit friends or relatives.[29] In this report, we summarised data on 3 infections that are commonly acquired overseas; typhoid (96% of cases), hepatitis A (54.7% of cases) and *S.* Enteritidis (83% of cases). A large proportion of hepatitis A infections are likely to be acquired while visiting friends or relatives, with a recent study in New South Wales showing travellers who were born in endemic areas were at higher risk of infection.[30] Travellers visiting friends or relatives may be less likely than other travellers to seek advice from a website such as the Department of Foreign Affairs' Smartraveller (http://www.smartraveller.gov.au), or from a travel clinic or general practitioner prior to travel, due to a perception of lower risk and lack of access to culturally and linguistically appropriate advice. It is important that prevention information is targeted at these groups. We compared the reported country and region of acquisition for *S.* Enteritidis infections with the proportion of all returning travellers who had nominated that place as their primary destination and observed that cases were more likely to have travelled to the South East Asian region.

In 2008, OzFoodNet sites reported 1,545 outbreaks of gastrointestinal disease, which was less than that reported in 2007.[12] Similar to previous years, the majority of outbreaks in 2008 were transmitted from person to person (83%), with 61% of these reported from aged care facilities, reflecting the frequency with which outbreaks of gastrointestinal illness occur, the ease of transmission in this setting and the improved reporting practices of these facilities. Outbreaks transmitted person-to-person were most frequently of unknown aetiology (42%) followed by norovirus (40%). Norovirus outbreaks peaked in late winter and early spring in 2008.

In 2008, OzFoodNet sites reported 104 foodborne or suspected foodborne outbreaks, a rate of 4.9 outbreaks per million people, with a mean outbreak size of 14 people affected per outbreak. This compares with 7.1 outbreaks per million in Australia in 2007, and an estimated 4.2 outbreaks per million in the United States in 2006.[31] *Salmonella* continues to be the leading cause of reported outbreaks of foodborne illness in Australia, with 34% of outbreaks due to this pathogen, the majority of them due to *S.* Typhimurium. In 2008, there were 8 large outbreaks of foodborne illness (affecting 40 or more people). The largest of these was due to *S.* Typhimurium 135a, which affected 78 people who dined at the same restaurant over a 4-day period. Eggs used at the restaurant were supplied by a producer who had been implicated in previous foodborne outbreaks.

Eggs were suspected as the cause of 27% (20/75) of foodborne outbreaks where investigators were able to identify a food vehicle. Eggs are a commonly consumed food, and as an ingredient of many dishes, and may be served raw or lightly cooked in dishes such as aioli, sauces and desserts. It is important that egg safety continues to be improved in Australia. During 2009, FSANZ continued developing a primary production and processing standard for eggs and egg products that is considering safety of the whole production chain from farm through to retail.[32]

Since the commencement of OzFoodNet in 2000, the network has successfully enhanced surveillance and conducted applied research into foodborne diseases in Australia. In 2008, OzFoodNet and the New South Wales Food Authority conducted the National Gastroenteritis Survey II (NGSII), which repeated the original survey in 2001–2002.[33] The NGSII survey was completed in early 2009 and is currently being analysed. OzFoodNet continues to be engaged in regional capacity building activities through the World Health Organization's Global Foodborne infections network, and has sent epidemiologists as trainers to 2 training workshops (held in Papua New Guinea and Thailand) in 2008.

It is important to recognise some of the limitations of the data used in this report. Where there are small numbers of notifications, caution must be used in comparisons between jurisdictions and over time. Some of the most common enteric pathogens are not notifiable, particularly norovirus and *C. perfringens*, which is why surveillance of outbreaks is so important. A limitation of the outbreak data provided by OzFoodNet sites for this report is the potential for variation in categorising features of outbreaks depending on investigator interpretation and circumstances. States and territories are working towards harmonising surveillance and outbreak data to address some of these issues.

Foodborne disease surveillance provides information to assist in not only immediate public health action and the prevention of these diseases, but also to the assessment of food safety policies and campaigns. A national program of surveillance for foodborne diseases and outbreak investigation has many benefits including identifying foods that cause human illness by identifying outbreaks that occur across state and territory borders. Continuing efforts to strengthen the quality of these data will ensure their use by agencies to develop food safety policy and thereby help prevent foodborne illness.

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## Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008

| State | Month of outbreak | Setting prepared | Aetiology | Number affected | Hospitalised | Fatalities | Evidence | Epidemiological study | Responsible vehicles | Food vehicle category |
|---|---|---|---|---|---|---|---|---|---|---|
| ACT | November | Restaurant | *Salmonella* Typhimurium 44 | 24 | 2 | 0 | A | CCS | Hollandaise sauce and poached eggs | Egg-based sauces and dressings |
| NSW | December | Aged care facility | *Salmonella* Typhimurium | 6 | 2 | 0 | | D | Unknown | Unknown |
| | February | Commercial caterer | *Bacillus cereus* and *Clostridium perfringens* | 75 | 0 | 0 | M | D | Curry pumpkin, curry chicken, rice with lamb | Mixed dishes |
| | June | Institution | Unknown | 14 | 0 | 0 | D | D | Lasagne | Pasta dish |
| | January | Institution | Unknown | 6 | 0 | 0 | | D | Unknown | Unknown |
| | January | Private residence | Unknown | 3 | 0 | 0 | | D | Mussels - fresh | Bivalves and molluscs |
| | March | Private residence | *Salmonella* Typhimurium 170 | 17 | 2 | 0 | D | D | Eggs used to make cake filling | Egg-containing desserts |
| | January | Private residence | *Salmonella* Typhimurium | 20 | 6 | 0 | D | D | Eggs | Eggs |
| | July | Restaurant | Unknown | 4 | 0 | 0 | D | D | Oysters | Bivalves and molluscs |
| | September | Restaurant | *Staphylococcus aureus* | 7 | 1 | 0 | M | D | Chicken | Chicken & chicken-containing dishes |
| | May | Restaurant | *Salmonella* Anatum | 11 | 0 | 0 | D | D | Chicken meal | Chicken & chicken-containing dishes |
| | December | Restaurant | Unknown | 5 | 0 | 0 | D | D | Aioli made with raw eggs | Egg-based sauces and dressings |
| | March | Restaurant | *Salmonella* Typhimurium 126 | 3 | 1 | 0 | | D | Chicken salad with raw egg dressing | Egg-containing dish |
| | January | Restaurant | Unknown | 2 | 0 | 0 | D | D | Suspected ham | Meat and meat-containing dishes |
| | April | Restaurant | *Salmonella* Typhimurium U290 | 7 | 0 | 0 | | D | Most likely chilli beef | Meat and meat-containing dishes |
| | April | Restaurant | *Salmonella* Typhimurium U290 | 4 | 1 | 0 | M | D | Variety of Chinese foods | Mixed dishes |
| | December | Restaurant | Unknown | 5 | 0 | 0 | | D | Unknown - suspected Indian takeaway food | Mixed dishes |
| | December | Restaurant | Unknown | 3 | 0 | 0 | | D | Rice, naan, butter chicken and lamb sabjwala | Mixed dishes |

## Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

| State | Month of outbreak | Setting prepared | Aetiology | Number affected | Hospitalised | Fatalities | Evidence | Epidemiological study | Responsible vehicles | Food vehicle category |
|---|---|---|---|---|---|---|---|---|---|---|
| NSW, *cont* | May | Restaurant | Unknown | 4 | 0 | 0 | | D | Stir fry beef with dried hot chilli and peanut | Mixed dishes |
| | April | Restaurant | Unknown | 7 | 0 | 0 | | D | Rice or salt and pepper prawn | Mixed dishes |
| | March | Restaurant | Unknown | 3 | 0 | 0 | D | D | Spring roll, suspected | Mixed dishes |
| | September | Restaurant | Unknown | 5 | 1 | 0 | | D | Barramundi, lamb, salad | Mixed dishes |
| | July | Restaurant | Unknown | 3 | 0 | 0 | | D | Fried rice | Rice based dish |
| | November | Restaurant | Unknown | 3 | 0 | 0 | | D | Unknown, possibly pizza | Unknown |
| | April | Restaurant | Unknown | 25 | 3 | 0 | | D | Unknown | Unknown |
| | December | Restaurant | Unknown | 3 | 0 | 0 | | D | Unknown | Unknown |
| | February | Restaurant | Unknown | 4 | 0 | 0 | | D | Unknown | Unknown |
| | January | Restaurant | Unknown | 7 | 0 | 0 | D | D | Unknown | Unknown |
| | November | Restaurant | Unknown | 6 | 0 | 0 | | D | Unknown | Unknown |
| | October | Restaurant | Unknown | 6 | 1 | 0 | | D | Unknown | Unknown |
| | September | Takeaway | Unknown | 5 | 0 | 0 | | D | Lamb kebab suspected | Meat and meat-containing dishes |
| | November | Takeaway | Unknown | 4 | 0 | 0 | | D | Pasta with tomato sauce (suspected) | Pasta dish |
| | December | Takeaway | Unknown | 25 | 1 | 0 | D | D | Unknown | Unknown |
| | January | Takeaway | Unknown | 3 | 0 | 0 | | D | Unknown | Unknown |
| | May | Unknown | Unknown | 14 | 2 | 0 | | D | Unknown but likely chicken and or eggs | Suspected chicken and/or eggs |
| | January | Bakery | Scombroid | 1 | 1 | 0 | D | N | Tuna from can used to prepare tuna salad roll in hot bread shop | Fish |
| | November | Camp | *Campylobacter* | 6 | 0 | 0 | | N | Unknown | Unknown |
| | November | Grocery store/ delicatessen | *Salmonella* Typhimurium | 2 | 1 | 0 | | N | Cabanossi and pepperoni sausages | Meat and meat-containing dishes |
| | December | National franchised fast food | *Salmonella* Typhimurium 44 | 3 | 2 | 0 | D | N | Bacon and egg sandwich - likely eggs | Eggs |
| | January | Private residence | Unknown | 2 | 0 | 0 | | N | Mussels - fresh | Bivalves and molluscs |

## Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

| State | Month of outbreak | Setting prepared | Aetiology | Number affected | Hospitalised | Fatalities | Evidence | Epidemiological study | Responsible vehicles | Food vehicle category |
|---|---|---|---|---|---|---|---|---|---|---|
| NSW, *cont* | November | Restaurant | *Salmonella* Typhimurium 170 var | 24 | 1 | 0 | A | N | Raw eggs in Caesar salad dressing | Egg-based sauces and dressings |
| | August | Aged care facility | *Salmonella* Typhimurium 144 | 10 | 0 | 0 | M | C | Chocolate mousse with raw eggs | Egg-containing desserts |
| | June | Aged care facility | *Clostridium perfringens* | 69 | 0 | 7 | AM | C | Unknown possibly pureed food | Unknown |
| | November | Bakery | *Salmonella* Typhimurium | 10 | 1 | 0 | A | C | Chocolate mousse cake | Egg-containing desserts |
| | November | Bakery | *Salmonella* Typhimurium | 16 | 0 | 0 | D | C | Chocolate mousse cake | Egg-containing desserts |
| | August | Commercial caterer | Viral | 8 | 0 | 0 | D | C | Mixed sandwiches | Salads and/or sandwiches |
| | April | Commercial caterer | *Clostridium perfringens* | 31 | 0 | 0 | A | C | Gravy | Sauces and gravies |
| | August | Institution | *Clostridium perfringens* | 25 | 3 | 0 | AM | C | Macaroni bolognaise | Pasta dish |
| | March | Military | *Clostridium perfringens* | 45 | 0 | 0 | D | C | Curry | Meat and meat-containing dishes |
| | July | Restaurant | Unknown | 10 | 0 | 0 | A | C | Oysters | Bivalves and molluscs |
| | May | Restaurant | Unknown | 17 | 0 | 0 | A | C | Fattouch salad | Salads and/or sandwiches |
| | November | Restaurant | Unknown | 4 | 0 | 0 | M | C | Unknown | Unknown |
| | October | Restaurant | Unknown | 5 | 0 | 0 | D | C | Unknown | Unknown |
| | December | Takeaway | Unknown | 25 | 1 | 0 | D | C | Unknown | Unknown |
| NT | November | Restaurant | *Salmonella* Typhimurium 9 | 2 | 0 | 0 | D | N | Suspect raw egg mayonnaise/ Caesar salad dressing | Egg-based sauces and dressings |
| | November | Restaurant | Unknown | 3 | 0 | 0 | D | N | Unknown | Unknown |
| | June | Takeaway | *Salmonella* Weltevreden | 15 | 3 | 0 | D | N | Unknown | Unknown |
| | January | unknown | *Salmonella* Typhimurium 182 | 5 | 1 | 0 | D | N | Unknown | Unknown |
| | March | Restaurant | Unknown | 11 | 3 | 0 | D | C | Steak and/ or fried rice | Mixed dishes |

## Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

| State | Month of outbreak | Setting prepared | Aetiology | Number affected | Hospitalised | Fatalities | Evidence | Epidemiological study | Responsible vehicles | Food vehicle category |
|---|---|---|---|---|---|---|---|---|---|---|
| Qld | March | Commercial caterer | Unknown | 6 | 0 | 0 | D | CCS | Unknown | Unknown |
| | October | Camp | *Staphylococcus aureus* | 23 | 2 | 0 | D | D | Roast chicken | Chicken & chicken-containing dishes |
| | December | Primary produce | Ciguatera fish Poisoning | 3 | 0 | 0 | D | D | Cod | Fish |
| | July | Primary produce | Ciguatera fish Poisoning | 4 | Unknown | 0 | D | D | 'Yellow king' - Samson fish | Fish |
| | July | Primary produce | Ciguatera fish Poisoning | 6 | 1 | 0 | D | D | Red throat emperor/ reef snapper | Fish |
| | March | Primary produce | Ciguatera fish Poisoning | 6 | Unknown | 0 | D | D | Black kingfish | Fish |
| | March | Primary produce | Ciguatera fish Poisoning | 2 | 0 | 0 | D | D | Yellowtail kingfish | Fish |
| | October | Private residence | *Salmonella* Virchow 8 | 3 | 0 | 0 | D | D | Chicken curry | Chicken & chicken-containing dishes |
| | February | Restaurant | *Campylobacter* | 4 | 0 | 0 | D | D | Chicken liver pate | Chicken & chicken-containing dishes |
| | February | Restaurant | *Campylobacter* | 2 | 0 | 0 | D | D | Chicken | Chicken & chicken-containing dishes |
| | April | Restaurant | *Clostridium perfringens* | 2 | 0 | 0 | M | D | Refried Mexican beans | Mixed dishes |
| | November | Restaurant | *Staphylococcus aureus* | 4 | 0 | 0 | D | D | Unknown | Unknown |
| | November | Commercial caterer | *Staphylococcus aureus* | 16 | Unknown | 0 | M | C | Multiple foods | Mixed dishes |
| | March | Institution | Norovirus | 56 | 0 | 0 | A | C | Deli meat & salad dish | Mixed dishes |
| SA | December | Bakery | *Salmonella* Typhimurium 9 | 15 | 3 | 0 | A | CCS | Sweet bakery products | Mixed dishes |
| | January | Private residence | *Salmonella* Typhimurium 9 | 15 | 6 | 0 | D | D | Unknown | Unknown |
| | June | Aged care facility | *Salmonella* Typhimurium 135 | 31 | 5 | 3 | A | C | Unspecified vitamised food | Vitamised foods |
| | September | Commercial caterer | Norovirus | 5 | 0 | 0 | D | C | No specific food identified | Unknown |

## Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

| State | Month of outbreak | Setting prepared | Aetiology | Number affected | Hospitalised | Fatalities | Evidence | Epidemiological study | Responsible vehicles | Food vehicle category |
|---|---|---|---|---|---|---|---|---|---|---|
| Tas | March | Private residence | *Salmonella* Typhimurium 135a | 3 | 0 | 0 | D | D | Raw egg | Eggs |
| | January | Restaurant | *Salmonella* Typhimurium 135a | 78 | 9 | 0 | AM | C | Aioli | Egg-based sauces and dressings |
| Vic | February | Aged care facility | *Clostridium perfringens* | 6 | 0 | 0 | D | D | Unknown | Unknown |
| | September | Aged care facility | *Salmonella* Typhimurium 44 | 14 | 2 | 1 | D | D | Vitamised food | Vitamised foods |
| | March | Commercial caterer | *Salmonella* Typhimurium 44 | 24 | 10 | 0 | D | D | Unknown | Unknown |
| | August | Institution – other | *Clostridium perfringens* | 15 | 0 | 0 | D | D | Savoury mince | Meat and meat-containing dishes |
| | January | Private residence | *Salmonella* Typhimurium 135a | 7 | 1 | 0 | M | D | Ice cream cake made with raw eggs | Egg-containing desserts |
| | June | Private residence | *Salmonella* Typhimurium 135a | 4 | 3 | 0 | D | D | Suspect egg/custard dessert | Egg-containing desserts |
| | April | Restaurant | *Salmonella* Typhimurium 44 | 4 | 1 | 0 | D | D | Desserts suspected | Egg-containing desserts |
| | October | Restaurant | *Salmonella* Typhimurium 170 | 18 | 1 | 0 | D | D | Tiramisu | Egg-containing desserts |
| | May | Restaurant | *Salmonella* Johannesburg | 14 | 1 | 0 | M | D | Roast pork | Meat and meat-containing dishes |
| | May | Restaurant | Norovirus | 14 | 0 | 0 | D | D | Breakfast meals | Mixed dishes |
| | June | Restaurant | Unknown | 9 | unknown | 0 | D | D | Ready to eat uncooked foods such as salads | Salads and/or sandwiches |
| | May | Restaurant | Hepatitis A | 12 | 4 | 0 | D | D | Ready to eat foods such as salads and sandwiches | Salads and/or sandwiches |
| | December | Restaurant | Norovirus | 26 | 0 | 0 | D | D | Unknown | Unknown |
| | May | Commercial caterer | Unknown | 21 | 1 | 0 | A | C | Chicken curry | Chicken & chicken-containing dishes |
| | February | Commercial caterer | Unknown | 21 | 0 | 0 | A | C | Continental custard cake | Mixed foods |
| | February | Commercial caterer | *Salmonella* Typhimurium 170 | 18 | 2 | 0 | A | C | Chicken and pasta salad and ham | Salads and/or sandwiches |

## Appendix: Foodborne outbreak summary for OzFoodNet sites, Australia, 2008, *continued*

| State | Month of outbreak | Setting prepared | Aetiology | Number affected | Hospitalised | Fatalities | Evidence | Epidemiological study | Responsible vehicles | Food vehicle category |
|---|---|---|---|---|---|---|---|---|---|---|
| Vic, *cont'd* | February | Commercial caterer | *Campylobacter* | 4 | 0 | 0 | A | C | Chicken and pasta salad | Salads and/or sandwiches |
| | January | Private residence | *Salmonella* Typhimurium 44 | 12 | 1 | 0 | D | C | Lemon dessert made with raw eggs | Egg-containing desserts |
| | January | Private residence | *Salmonella* Typhimurium 135a | 18 | 0 | 0 | D | C | Several foods had statistically significant associations with illness. | Mixed dishes |
| | October | Restaurant | Unknown | 41 | 0 | 0 | A | C | Lamb tenderloin and gravy or roast pork or chicken cacciatore | Mixed dishes |
| | May | School | *Salmonella* Typhimurium 44 | 26 | 0 | 0 | D | C | Unknown | Unknown |
| WA | July | Commercial caterer | *Clostridium perfringens* | 30 | 0 | 0 | D | CCS | BBQ Asian chicken | Chicken & chicken-containing dishes |
| | April | Aged care facility | Norovirus | 42 | 0 | 0 | D | D | Unknown | Unknown |
| | January | Private residence | *Salmonella* Typhimurium 9 | 3 | 3 | 0 | D | D | Chicken | Chicken & chicken-containing dishes |
| | April | Restaurant | Norovirus | 75 | 0 | 0 | D | C | Unknown | Unknown |

Evidence

D Descriptive evidence implicating the vehicle

A Analytical epidemiological association between illness and vehicle

M Microbiological confirmation of aetiology in vehicle and cases.

Epidemiological study

C Cohort study.

D Descriptive case series.

CCS Case-control study.

N Individual patient data not collected.

Peer-reviewed articles

# Outbreak of *Salmonella* Typhimurium 44 related to egg consumption

Amalie Dyda, Rebecca Hundy, Cameron RM Moffatt, Scott Cameron

## Abstract

ACT Health investigated an outbreak of gastroenteritis associated with a local restaurant in December 2008. The infecting agent was *Salmonella* serotype Typhimurium phage type 44. A case control study was conducted to identify the source of infection. A total of 22 cases and 9 controls were recruited to take part in the study. Both poached eggs (odds ratio [OR] 42.00) and hollandaise sauce (OR 19.00) had elevated odds ratios that were statistically significant. The major limitation of the study was the small sample size and small number of controls. Despite this, a strong association with illness and consumption of eggs and hollandaise sauce was detected and this was further supported by environmental evidence. The investigation concluded that the cause of the outbreak was putatively contaminated eggs, either on their own or as an ingredient used in hollandaise sauce. The investigation and control measures led to an improvement in hygiene practices at the restaurant and contributed to the voluntary recall of the contaminated batch of eggs from the Australian Capital Territory. The results of the study also build upon other evidence that egg-related salmonellosis is now common in Australia and attention to commercial practices at production and processing is overdue. *Commun Dis Intell* 2009;33(4):414–418.

Keywords: *Salmonella*, outbreak, eggs, hollandaise, case-control study

## Introduction

On 8 December 2008, a general practitioner notified the Health Protection Service, ACT Health of a case of salmonellosis, with a local restaurant being implicated as the possible source of infection. Further reports of illness linked to the restaurant were received from the general public. Numerous *Salmonella* notifications were received from local laboratories. Interviews following these notifications further implicated the restaurant. An outbreak was declared and an investigation was undertaken incorporating environmental, laboratory and epidemiological evidence. Approximately 1 week after the initial report was received the outbreak strain was identified as *Salmonella* serotype Typhimurium phage type 44 (STm44).

*Salmonella* Typhimurium infection commonly results in symptoms such as abdominal pain, diarrhoea, fever, nausea and vomiting. The organism is transmitted via ingestion, usually of food contaminated by the faeces of an infected person or animal. The incubation period of *Salmonella* can range between 6 and 72 hours but is more commonly between 12 and 36 hours.[1] There have also been instances of longer incubation periods of up to 16 days.[1]

*Salmonella* is one of the most frequently notified foodborne pathogens in Australia with 8,281 notifications in 2008.[2] Historically in Australia, *Salmonella* Typhimurium is the most frequently notified *Salmonella* serotype associated with foodborne outbreaks. During 2006, 16 egg-related outbreaks were identified, with over 80% due to various *Salmonella* Typhimurium phage types.[3] One of the most common phage types causing infection in Australia is STm44, with previous studies and outbreaks showing a common association with the consumption of raw eggs or pre-prepared dishes containing raw egg as an ingredient (OzFoodNet outbreak register, 2009, unpublished data).

## Methods

### Epidemiological investigation

Initial interviews with both confirmed and probable cases of *Salmonella* were conducted to allow the generation of hypotheses and to guide further investigations. Cases were interviewed using the OzFoodNet *Salmonella* questionnaire investigating exposures in the 7 days prior to onset of illness. This led to the hypothesis that the outbreak was linked to a local restaurant, affecting those who attended for breakfast. To test this hypothesis, a case control study was developed based upon the restaurant's breakfast menu.

A case was initially defined as 'any person who ate at the restaurant on 29 November 2008 and developed symptoms of gastroenteritis, defined as two or more gastrointestinal symptoms'. Probable cases were those who met this definition and confirmed cases were those who met the definition and had a faecal sample that was positive for *Salmonella*. The case definition

was later revised to include 'any person who ate breakfast at the restaurant during the period between the 29 November and 14 December 2008 and who developed symptoms of gastroenteritis after exposure'. This was altered as more cases were identified within this time period. For the purposes of analysis, all confirmed and probable cases were included.

As a booking list was not available from the restaurant, controls were selected via convenience sampling. This involved asking cases if they ate with any other people whilst at the restaurant. This resulted in the recruitment of 9 controls. Participants took part in a structured questionnaire examining clinical illness and 40 different food exposures from the breakfast menu.

Data were stored in an Epi Info database, before analysis of odds ratios (OR) and stratification to remove the effects of confounding between some menu items. Case control analysis and stratification were performed using Stata 9.

### Environmental investigation

Environmental Health Officers attended the restaurant on 9 December 2008. General hygiene practices, food storage and preparation procedures and fridge temperatures were all examined. Temperatures of the main storage fridge were tested using a data logger from 10 to 12 December 2008. Samples of hollandaise sauce, eggs and mint sauce were taken from the restaurant for testing and the egg supplier was contacted to explain egg sourcing and production procedures. The NSW Department of Health was also contacted to further the investigation into the practices of the New South Wales based egg supplier.

### Laboratory investigation

Food samples taken during the environmental investigation were provided to the Australian Capital Territory Government Analytical Laboratory (ACTGAL) for testing for detection of *Salmonella*. Faecal samples collected from 17 suspected cases were tested by the local public health laboratory and other private pathology providers for the presence of *Salmonella*, *Campylobacter* and *Shigella*.

ACTGAL also performed tests to identify the replication times of these *Salmonella* isolates in hollandaise sauce. The sauce was made by the restaurant's chef with lemon juice, raw eggs, butter and dill. Due to the acidic nature of hollandaise sauce, replication times may be longer than normal. The sauce taken from the restaurant, which was made approximately 2 days prior to the environmental health inspection, was inoculated with STm44 and incubated at 37° C. The test was carried out twice on 2 separate samples. Both samples were then examined at 0, 3, 6 and 24 hours.

## Results

### Epidemiological results

A total of 24 people were identified as cases after consuming food at the restaurant. Twenty-two subsequently agreed to participate in the case-control study. The age of cases ranged from 3–53 years, with 61% of those affected being female. Cases ate breakfast at the restaurant between 29 November and 9 December 2008. Illness onset ranged from 30 November to 10 December 2008. The average incubation period of STm44 infection in this instance was 22.6 hours (range 15 to 35.5 hours). The average length of illness was 7.5 days, with diarrhoea (100%), fever (77.3%) and nausea (77.3%) the most frequently reported signs and symptoms. Of those ill, 19 (86.4%) people consulted a doctor and two people (8.3%) were hospitalised.

Table 1 shows the odds ratios calculated for each item on the breakfast menu with confidence intervals (CI) and *P* values. These results suggest that the most likely source of *Salmonella* infection was poached eggs or hollandaise sauce with odds ratios of 42.00 (CI 2.80–2017.00) and 19.00 (CI 1.90–243.00) respectively. Despite having large confidence intervals both these results were statistically significant. Cases were asked if eggs consumed were runny or hard. The subjective nature of the question however, caused some confusion and a combined variable for all egg consumption was used. The odds ratios for tomatoes (OR 8.00), sour dough rye toast (OR 6.13) and hash browns (OR 4.57) were also elevated but not statistically significant. A total of 24 infrequently eaten foods (and hence with no suggestion of association with illness) have not been shown in Table 1.

Stratification of foods with elevated odds ratios was performed to adjust for possible confounding. As shown in Table 2, after stratification, the poached eggs and hollandaise sauce could not be separated. This was because almost all those who ate poached eggs also had hollandaise sauce. The odds ratio for poached eggs remained elevated and statistically significant when stratified with tomato (OR 30.00) and sourdough rye toast (OR 42.00).

Similarly, the odds ratios for hollandaise sauce remained high when stratified with tomato (OR 13.50) and sourdough rye toast (OR 18.00). All of the odds ratios had confidence intervals higher than one and were statistically significant at the 5% level.

Tomatoes (OR 2.22) had elevated odds ratios when stratified against hollandaise sauce but this was no

## Table 1: Univariate analysis of breakfast menu items

| Food Item | Exposed cases | Exposed controls | Odds ratio | Confidence interval | *P* value |
|---|---|---|---|---|---|
| Butter | 12 | 6 | 0.66 | 0.0–4.3 | 0.70 |
| Cheese | 2 | 1 | 0.80 | 0.0–53.0 | 1.00 |
| Tomato | 11 | 1 | 8.00 | 0.7–386.2 | 0.10 |
| Sourdough rye toast | 14 | 2 | 6.12 | 0.8–69.9 | 0.05 |
| Plain toast | 1 | 1 | 0.38 | 0.0–33.6 | 0.50 |
| Maple syrup | 2 | 2 | 0.35 | 0.0–5.9 | 0.56 |
| Bacon | 14 | 4 | 2.18 | 0.3–14.3 | 0.43 |
| Baby spinach | 8 | 2 | 2.00 | 0.2–23.8 | 0.67 |
| Hollandaise sauce | 19 | 3 | 19.00 | 1.8–243 | 0.003 |
| Poached eggs | 21 | 3 | 42.00 | 2.8–2017 | 0.0007 |
| Mushrooms | 6 | 2 | 1.40 | 0.1–17.4 | 1.00 |
| Hash brown | 8 | 1 | 4.57 | 0.4–227 | 0.22 |
| Zucchini | 4 | 2 | 0.77 | 0.0–10.5 | 1.00 |
| Coffee | 13 | 5 | 1.15 | 0.1–7.1 | 1.00 |
| Water | 17 | 4 | 4.00 | 0.5–28.4 | 0.11 |

## Table 2: Stratification analysis

| Poached eggs adjusted for: | Odds ratio | Confidence interval | *P* value |
|---|---|---|---|
| Tomato | 30.00 | 2.2–405 | 0.006 |
| Sourdough rye toast | 42.00 | 2.1–825 | 0.009 |
| **Hollandaise sauce adjusted for:** | | | |
| Tomato | 13.50 | 1.4–123 | 0.02 |
| Sourdough rye toast | 18.00 | 1.2–255 | 0.03 |
| **Tomatoes adjusted for:** | | | |
| Poached eggs | 2.20 | 0.1–28.1 | 0.50 |
| Hollandaise sauce | 2.22 | 0.1–28.8 | 0.50 |
| **Sourdough rye toast adjusted for:** | | | |
| Poached eggs | 1.00 | 0.0–13.0 | 0.72 |
| Hollandaise sauce | 1.08 | 0.0–14.4 | 0.70 |

longer significant statistically, as shown in Table 2. The odds ratio for tomatoes, when stratified with poached eggs remained elevated at 2.20 but was no longer statistically significant. Adjusting hash browns for poached eggs and hollandaise could not be performed. Sourdough rye toast no longer showed an association when adjusted for with poached eggs or hollandaise sauce.

### Environmental results

The possibility that raw eggs may have been the vehicle of infection was raised during the initial inspection of the restaurant. Environmental Health Officers advised of the dangers of serving raw egg dishes and provided information to reduce the risk. The restaurant subsequently ceased serving dishes containing raw eggs.

The data logger recorded an ineffective temperature range in the main storage fridge. The lowest reading during the duration of the test was 5.5° C, with the recommended temperature being 5° C or less. The highest temperature recorded during the 24 hour period was 10.3° C, with an average of 7° C. All food was labelled correctly with the date of preparation before storage, with the exception of the hollandaise sauce.

The process involving the storage and preparation of hollandaise sauce was identified as a possible problem. The dish was prepared with lemon juice, raw eggs, butter and dill and then stored in the

main refrigerator. The sauce was left under a heat lamp to soften before serving. The process for the preparation of poached eggs was also examined with all eggs cooked for approximately 2½ minutes, resulting in an egg that is almost completely cooked but not hard. However, this varies depending on customer preference.

Information from the egg supplier advised that they had investigated several other complaints, which had identified one batch of eggs that may have been responsible for the contamination. Their own investigation had identified that the eggs were not suitable for packing as first grade eggs and were supposed to be processed into liquid pulp eggs. However, a packing error resulted in the eggs being boxed and sold.

### Laboratory results

*Salmonella* was not isolated from any of the food samples taken during the environmental health investigation. Faecal samples taken from symptomatic diners yielded a total of 16 positive results for STm44, with only 1 person found to be negative for *Salmonella*.

The 2 samples of hollandaise sauce were found to have a pH of 4.01 and 4.05. The tests regarding the incubation period of *Salmonella* in the hollandaise sauce showed that the number of *Salmonella* did not increase at any time in a 24 hour period. It is likely that the incubation temperature of 37° C was higher than the temperature of the heat lamp at the restaurant.

### Public health action

After the initial environmental health investigation and hypothesis generating questionnaires, a letter was sent to the restaurant proprietor recommending the removal of dishes containing raw eggs. The restaurant subsequently ceased serving any dish containing raw egg. Improvements regarding a decrease in temperature of the main storage fridge were also advised to management of the restaurant. ACT Health was later informed via phone that the restaurant intended to remove all dishes from the menu that contain raw egg and temperature problems had been resolved. The restaurant also contacted their egg supplier who collected and replaced all eggs from the suspected batch. There were no further *Salmonella* infections related to the restaurant.

ACT Health liaised with the NSW Department of Health about the outbreak. It was found that several similar outbreaks associated with eggs had occurred in the region. ACT Health had not been aware of these outbreaks. This highlights the importance of communication between jurisdictions. The NSW Department of Health informed that a voluntary recall of the contaminated eggs was underway. Subsequently, notifications of STm44 infection in the Australian Capital Territory significantly reduced.

## Discussion

The results from the epidemiological investigation suggest that the most likely cause of this outbreak was contaminated eggs served at the restaurant. The most common cause of *Salmonella* contamination of eggs within Australia comes from contamination of the egg shells, specifically when they are soiled or damaged.[4] Infection can also occur during the development of the egg in the hen (trans-ovarian infection). This type of infection is most commonly associated with *Salmonella* Enteritidis and is not endemic in Australia.[4]

The infection may have been transmitted by the eggs when served on their own or via the hollandaise sauce, which contained raw egg as an ingredient. The odds ratios for both the eggs and the sauce were extremely high, indicating a strong association. The strength of association remained following adjustment for possible confounding. However, the 2 items on the breakfast menu are usually served together as 'eggs benedict' and could not be separated with stratification.

Though the 2 items could not be statistically separated, the environmental investigation suggested the hollandaise sauce provided a more plausible explanation for the outbreak. The procedure for serving hollandaise sauce may have provided an opportunity for *Salmonella* present on the shell of the eggs to contaminate the sauce. The sauce is served over multiple breakfast sittings. Due to lack of dates on the bottles it was also possible the sauce was kept for longer than is hygienically responsible. In comparison, the poached eggs, even if contaminated from the shell, could possibly be sterilised during the cooking process, depending on the length and temperature of cooking.

This conclusion is not supported by other laboratory evidence as *Salmonella* was not isolated from other food samples. However, the high turnover of food at the restaurant means it is unlikely that the food tested was from the same batch as the food that caused the illness. It is also possible that the hollandaise sample collected from the restaurant was more acidic than the sauce that likely caused the infection, thus mitigating against achieving *Salmonella* growth in the laboratory test.

There is a body of evidence that links outbreaks of STm44 with contaminated eggs and food containing raw eggs. An analysis of the OzFoodNet outbreak register data from January 2001 to December 2008

identified 12 outbreaks of STm44 associated with consumption of eggs or foods with eggs as a key ingredient.[3] Of these egg-associated outbreaks, the majority have occurred since 2006. Hollandaise sauce has been previously associated in outbreaks caused by a variety of *Salmonella* serotypes, including *S.* Hessarek and *S.* Typhimurium phage type 9 in Australia,[5,6] and *S.* Enteriditis in the United States of America.[7]

## Limitations

One of the major limitations of this study was the small sample size and disproportionate numbers of cases to controls. This may have affected the results leading to an erroneous exclusion of other foods as possible sources of the infection. However, this would seem less likely given the supporting environmental evidence and higher attack rates among persons eating poached eggs and hollandaise sauce. An association between illness and consumption of eggs was strong enough to be detected in this group of consumers.

As mentioned previously, there is strong evidence of confounding in these results. Both poached eggs and hollandaise sauce had high odds ratios but because the 2 items are usually served together they could not be separated with stratification. All people who became ill and who ate hollandaise sauce, also ate poached eggs as the sauce is served as a topping. Only 1 person who became ill ate poached eggs without hollandaise sauce while another could not recall. Hence epidemiological evidence was incorporated with environmental evidence to formulate conclusions.

The investigation concluded the most likely cause of this outbreak was consumption of undercooked eggs or raw egg containing sauce putatively contaminated by *Salmonella*. This evidence was then used by the restaurant's egg supplier to institute a voluntary recall of product from outlets in both the Australian Capital Territory and New South Wales. This action may have averted future infections, as well as increased general awareness about appropriate procedures for the distribution of uncontaminated eggs. The incident also led to improvements in hygiene and food storage procedures at the restaurant and serves to highlight the need for further education of food handlers in relation to the preparation of dishes containing raw eggs. In a wider context, this outbreak demonstrates the importance of exemplary hygiene and food storage practices in restaurant settings as a means of reducing the risk of egg-related salmonellosis. This adds to mounting evidence that contaminated eggs are a leading cause of outbreaks and often in restaurant settings. In addition to highlighting the importance of effective hygiene measures within commercial kitchen settings in Australia, this also suggests the need for more stringent regulation for the production of eggs. Health authorities should also consider prohibiting commercial outlets serving dishes containing raw eggs to further reduce the risk to the public of *Salmonella* infection.

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# Outbreaks of *Salmonella* Typhimurium phage type 197 of multiple genotypes linked to an egg producer

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## Abstract

This paper describes outbreaks of *Salmonella* Typhimurium phage type 197 (STm197) linked to eggs from the farm of a single egg producer. Epidemiological and microbiological investigations (genotyping by multiple locus variable number tandem repeats analysis [MLVA]) identified outbreaks of STm197 with the same or closely-related MLVA profiles in a series of restaurants across Brisbane over 2 months. Environmental health investigations revealed that these restaurants were supplied with eggs from the same egg producer and that cross-contamination may have contributed to the outbreak. Environmental swabs taken from restaurant kitchens and the farm of the egg producer identified a number of salmonellas including STm197, many with MLVA profiles matching or closely related to the human strains from outbreak cases. A case-to-case comparison study showed a significant association between illness with 1 MLVA type and attending a restaurant during the 5 days before onset of illness (odds ratio [OR] 8.1, 95% confidence interval [CI] 1.8, 35.4). MLVA has become a valuable tool for *S.* Typhimurium surveillance and outbreak investigation. This outbreak further justifies the Commonwealth Government's decision to develop a draft national primary production and processing standard for eggs and egg products to address food safety risks posed by cracked and dirty eggs. *Commun Dis Intell* 2009;33(4):419–425.

Keywords: eggs, *Salmonella* Typhimurium phage type 197, outbreak, genotyping, epidemiology, environmental health

## Introduction

In Australia, *Salmonella* Typhimurium (STm) is the most commonly notified serovar[1] of salmonellas causing gastrointestinal disease. For epidemiological purposes, isolates of STm have been differentiated by phage typing with more than 80 different phage types associated with infections in humans[2] in Australia. *S.* Typhimurium phage type 197 (STm197) was first reported in humans in Queensland in 2000. During 2003 to 2006, STm197 emerged as one of the 10 most commonly notified salmonellas in the State[3] with an average of 119 cases notified annually (personal communication, OzFoodNet Queensland).

Between 2002 and 2005 there were 4 reported STm197 outbreaks in Queensland.[3–5] Two of these outbreaks occurred in restaurants and one at a private residence with no food vehicle or source identified. The 4th was related to consumption of bakery products sourced from a manufacturer who used cracked and dirty eggs. Multiple small producers supplied the eggs and no trace-back was possible. Eggs have previously been implicated in STm outbreaks overseas,[6–10] throughout Australia[11–14] and in Queensland.[15]

Further rapid differentiation of salmonella isolates is often required in outbreak situations to identify additional cases and for source tracking. A variety of genotypic methods have been used to subtype STm including plasmid profiling, ribotyping, amplified fragment length polymorphism and pulsed-field gel electrophoresis.[16] A recently developed DNA fingerprinting technique, multiple locus variable number tandem repeats analysis (MLVA) has become very useful for this purpose. This polymerase chain reaction (PCR)-based technique, described by Lindstedt et al has been shown to have good discriminatory power between strains of STm.[17] Strain characterisation is based on differences in amplified DNA fragments at various loci in the salmonella genome, due to varying numbers of short-sequenced DNA tandem repeats (VNTR) at these sites.

In December 2006, contaminated eggs were the suspected source of a STm197 outbreak associated with 3 separate functions at a Brisbane restaurant (Restaurant A). Environmental sampling from the farm of the egg producer identified a matching STm197 genotype to the restaurant cases as well as several closely related MLVA genotypes. Surveillance in the following months identified further cases of STm197 with the same genotypic profiles. Case investigations led to the identification of outbreaks in 4 other restaurants (B1, B2, C, D).

This paper describes how MLVA typing, in combination with environmental and epidemiological investigations effectively linked this series of STm197 outbreaks of multiple related genotypes to

several restaurants in Brisbane and identified contaminated eggs from a single egg producer as the source of infection.

## Methods

### Microbiology

All human and environmental isolates of STm197 were typed by MLVA at the Public Health Microbiology Laboratory, Queensland Health. Five primer pairs were used to amplify the 5 VNTR targets and PCR products were sized by capillary electrophoresis. Fragment sizes were assigned a numerical code based on the coding system of Lindstedt et al,[17] e.g. 2-6-20-14-2 (corresponding to fragment sizes 171-330-312-369-489 for VNTRs STTR 9, STTR5, STTR6, STTR10 and STTR3). MLVA profiles which differ in size by one or 2 repeats at 1 locus are considered to be closely related and isolates with such closely related profiles should be viewed as possibly part of the same outbreak if epidemiological evidence is supportive.[17]

All STm isolates were sent to the Microbiological Diagnostic Unit in Melbourne for phage typing.

### Epidemiology

Notified cases of STm infection with closely related MLVA types were interviewed to obtain information on clinical presentation, food histories (including dining venues) for the 5 days prior to onset of illness, as well as other potential risk factors such as travel, exposure to other ill persons, activities associated with water, and domestic and wild animal exposure.

In the initial outbreak, retrospective cohort studies of patrons who attended two of the 3 functions at Restaurant A were conducted. A case was defined as any person who developed diarrhoea, vomiting and/or stomach cramps within 3 days after attending the restaurant. Both well and ill attendees were interviewed using a standard questionnaire, which included details of the food items consumed at the restaurant.

As more STm cases with closely-related MLVA profiles were identified, associations with other restaurants became evident. A case-to-case comparison study was undertaken to attempt to obtain epidemiological evidence demonstrating an association between illness and consumption of eggs.[18–20]

A case was defined as a person with STm 197 infection with the MLVA profile 2-6-20-14-2 notified after 27 January 2007 and residing in the Brisbane Statistical Division. The comparison group was randomly selected from all non-STm197 infections notified during the same period and residing in the Brisbane Statistical Division. They were frequency matched to cases by age group: 0–4 years, 5–19 years and 20+ years. Statistical analysis as an unmatched case-control study was conducted using Epi Info® version 3.3.2.[21]

### Environmental health

Restaurants identified following case investigation were inspected by Environmental Health Officers to assess compliance with the *Food Act 2006* and the Food Safety Standards. This also included environmental sampling. The egg producer provided a list of all restaurants that were directly supplied with eggs by the producer.

Restaurant A was reinspected in early January 2007 and samples of chicken and eggs were collected and a trace-back of their origin was conducted. Information about the egg and poultry producers was obtained from Safe Food Production Queensland (SFPQ). SFPQ is the Queensland arm of the network of food safety regulatory agencies across Australia responsible for safety and suitability of food for human or animal consumption from the primary production sector (meat, dairy, eggs, seafood, and plant products).

Inspections at the farm of the egg producer took place on 19 January and 19 February 2007. A variety of samples were taken and submitted to QH Public Health Laboratory for microbiological testing (Table 1).

## Results

### Microbiology

In December 2006, there were 3 laboratory-confirmed cases of STm infection related to Restaurant A (one from each function) (Figure 1). STm was also isolated from a tea-towel obtained as part of environmental sampling at the restaurant. All these isolates had the MLVA profile (2-7-20-14-2) (Figure 2) and were subsequently phage typed as STm197.

Between 28 January and 4 March 2007, there were a further 19 cases of STm197 associated with a further 4 restaurants and 14 cases for which no restaurant could be identified (Figure 1). The isolates displayed 6 different closely related genotypes (Figure 2), with only two having the same genotype as the outbreak strain from Restaurant A. One case had 2 MLVA profiles identified in their stool specimen.

Many of the environmental samples taken from the farm of the egg producer were positive for STm197 (Table 1). MLVA profiles included the strain from the cases from Restaurant A (MLVA 2-7-20-14-2 from sawdust) as well as 2 closely related strains

**Figure 1: Onset dates of cases in relation to eating at specific restaurants**

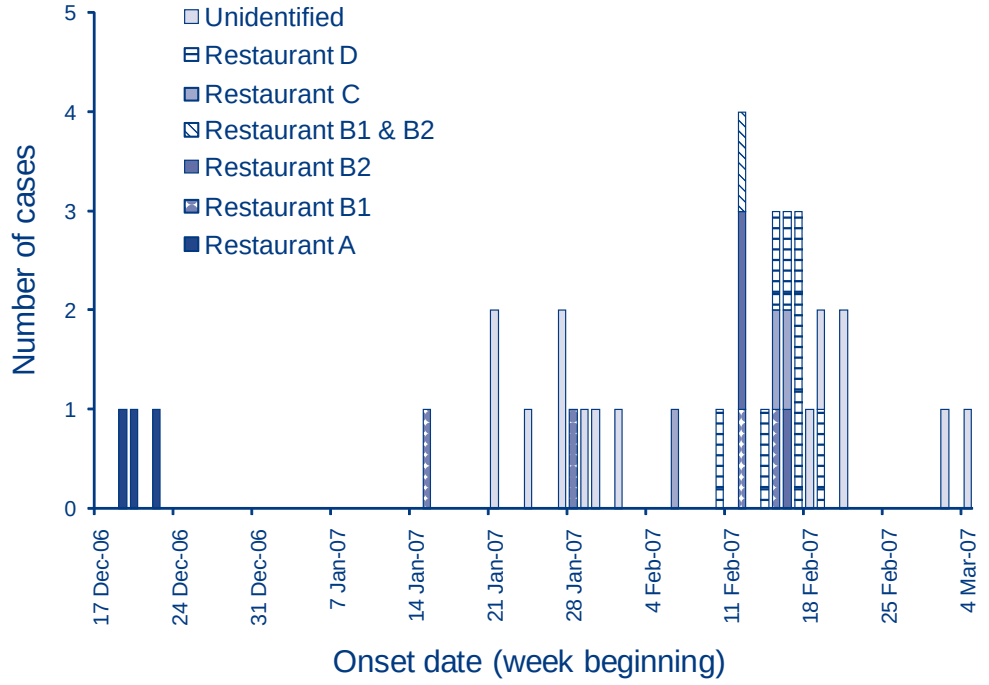
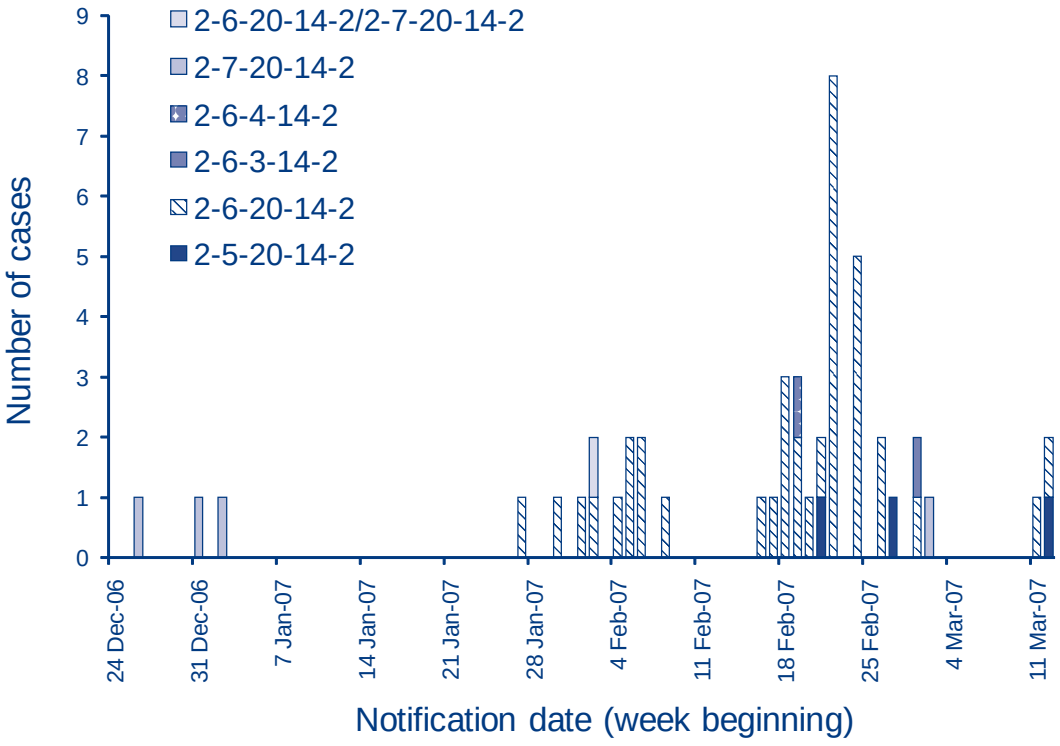



**Figure 2: Cases of implicated *Salmonella* Typhimurium infection, by notification date and multiple locus variable number tandem repeats analysis profile**




The legend refers to the multiple locus variable number tandem repeats analysis profiles.

(MLVA 2-6-20-14-2 from sawdust and drag swabs; MLVA 2-6-3-14-2 from sawdust, drag swabs and boot covers), which were detected in later cases. In addition, there were other serovars of *Salmonella* identified including Singapore, Tennessee and Zanzibar (Table 1).

### Epidemiology

In total, 45 people attended the 3 functions held in mid-December 2006 at Restaurant A. Of these, 29 were included in the retrospective cohort studies, with 16 meeting the case definition. No specific food vehicle of transmission was identified in these studies.

From late January 2007, detailed investigation of cases yielding STm isolates with MLVA profiles identical or closely related to strains identified from the outbreak or the farm was carried out. By mid March 2007, there were 44 further cases of these STm197 infections notified to QH. Thirty-six of these cases had MLVA 2-6-20-14-2, which was the major profile identified in isolates from the egg producer. There were 4 other strains among the remaining 8 cases with MLVA profiles that were closely related.

Thirty-three of the 44 cases (76%) were interviewed. Eleven cases refused or were not contactable. The median age of interviewed cases was 21 years (range < 1–54 years); 14 were male and 19 were female (male:female ratio 1:1.4). Dates of onset of illness for the 33 interviewed cases were between 15 January and 4 March 2007 (Figure 2) with 8 cases hospitalised.

Hypothesis-generating interviews identified outbreaks from another 4 restaurants (Restaurants B1, B2, C and D) in Brisbane (Figure 1), involving a total of 23 persons (19 laboratory-confirmed cases and 4 epidemiologically-linked cases). Two of the restaurants (B1 and B2) were in the same retail chain.

For the case-to-case comparison study, there were 25 cases and 22 comparisons recruited. Comparisons had a range of *Salmonella* serotypes including non-STm197 (n = 6), Virchow (3), Stanley (2), Birkenhead (2), Saintpaul (1), Reading (1), Infantis (1), Give (1), Chester (1), Chailey (1), Bovismorbificans (1), Aberdeen (1), and Muenchen (1).

Analysis of case-case comparison data showed cases were significantly more likely to have attended a restaurant during the 5 days before the onset of their illness compared with comparisons for the same period (OR = 8.1, 95% CI 1.8, 35.4, $P = 0.003$). Similarly, cases were significantly more likely to have eaten at a restaurant that was supplied eggs by the egg producer, compared with comparisons for the same 5 day period (OR undefined, $P < 0.001$) (Table 2).

### Environmental health

Environmental investigations revealed that all restaurants with identified outbreaks were supplied with eggs from the same egg producer. Trace-back of the restaurant's eggs found the egg producer had recently been investigated by SFPQ for selling cracked and dirty eggs.

Restaurant A was temporarily closed down by the local authority because of identified breaches of the *Food Act 2006*, which included issues with temperature control of food items and with cross-contamination, including problems with food storage, maintenance and cleaning, and staff practices.

**Table 1: Environmental samples taken from implicated egg farm (both visits)**

| Collection date | Description | Pathogen detected / Number of samples | Pathogen(s) | MLVA profiles |
|---|---|---|---|---|
| 19/1/2007 | Drag swab | 5/5 | *S.* Typhimurium 197 | 2-6-3-14-2<br>2-6-20-14-2 |
| 19/1/2007 | Sawdust | 5/5 | *S.* Typhimurium 197<br>*S.* Tennessee | 2-6-3-14-2<br>2-6-20-14-2<br>2-7-20-14-2 |
| 19/1/2007 | Boot covers | 4/5 | *S.* Typhimurium 197<br>*S.* Zanzibar | 2-6-3-14-2<br>2-6-20-14-2 |
| 19/1/2007 | Feed | 1/1 | *S.* Singapore | |
| 19/1/2007 | Faecal matter | 2/4 | *S.* Typhimurium 197 | 2-6-20-14-2 |
| 19/1/2007 | Sorting machine swab | 0/1 | – | – |
| 19/2/2007 | Water supply | 2/2 | *S.* Typhimurium 197 | 2-6-20-14-2 |
| 19/2/2007 | Eggs | 1/1 | *S.* Typhimurium 197 | 2-6-20-14-2 |

**Table 2: Odds ratios (OR) and 95% confidence intervals (CI) for STM 197 infection related to environmental exposures for cases and controls who ate outside the home**

| Exposure 5 days prior to illness | Cases exposed | | Controls exposed | | OR | 95% CI | *P* value |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | | | |
| Attended any restaurant | 22/25 | 88.0 | 10/21 | 48.0 | 8.1 | 1.8, 35.4 | 0.003 |
| Restaurant (sit down) | 20/24 | 83.3 | 6/21 | 28.6 | 12.5 | 2.98, 52.3 | <0.001 |
| Attended restaurant supplied by egg farm | 15/24 | 62.5 | 0/21 | 0.0 | Undefined | – | <0.001 |
| Ate a meal outside of home | 24/25 | 96.0 | 15/22 | 68.0 | 11.2 | 1.3, 100 | 0.015 |
| Bakery | 4/24 | 16.7 | 1/22 | 4.5 | 4.2 | 0.4, 40.9 | 0.20 |
| Fast food or takeaway restaurant | 14/22 | 64.0 | 10/22 | 46.0 | 2.1 | 0.6, 7 | 0.23 |
| Café | 7/24 | 29.2 | 4/22 | 18.2 | 1.9 | 0.4, 7.5 | 0.40 |
| Hotel or pub | 4/24 | 16.7 | 2/22 | 9.1 | 2.0 | 0.33, 12.2 | 0.38 |
| Travel | 0/17 | 0.0 | 0/22 | 0.0 | | | |
| Hospitalised | 7/25 | 28.0 | 5/22 | 22.7 | 1.3 | 0.35, 4.97 | 0.68 |
| Any other family members sick | 0/25 | 0.0 | 0/22 | 0.0 | | | |

There were also previous similar breaches of the Act identified by the local council with a cycle of enforcement followed by rectification.

Faecally-contaminated and cracked eggs were identified on the premises of Restaurant B1 on 15 February and environmental swabs (hand wash basin, chopping board, preparation bench and a display unit lid) from that restaurant identified 5 isolates of STm197 (MLVA 2-6-4-14-2), a profile found in only 1 case but closely related to the profiles of isolates from other cases. Samples from the other 3 restaurants were all negative.

At the time of the 2nd environmental health inspection of the farm of the egg producer (19 February 2007), the producer agreed to withdraw their eggs from sale. Attempts to identify the retailers and restaurants supplied by the egg producer were hindered by the producer's practice of distributing eggs from other producers co-mingled with their own stock. There was inadequate differentiation in the product traceability records to confirm the source of the eggs supplied to each restaurant as the producer's own stock or co-mingled stock from other producers. There were no further restaurant-associated cases detected with onset dates after 19 February 2007. There were no further outbreak strain cases notified to Queensland Health with an onset date after 4 March 2007.

Because of problems identified during audits of the establishment by SFPQ (including the supply of cracked and dirty eggs), SFPQ issued the egg producer with a Compliance Notice that all their eggs had to be washed and handled by another approved egg producer and were not to return to the farm before being sold in Queensland. This was to prevent possible co-mingling of these eggs with eggs supplied by other producers.

## Discussion

The source of this outbreak was identified by a combination of work by public health laboratory staff, epidemiologists and environmental health investigators including those outside the health sector. MLVA of STm has become a valuable tool for surveillance and outbreak investigation. Its value arises from its ability to rapidly produce a genotype profile for isolates and to differentiate within phage types. In this outbreak, the MLVA technique was able to differentiate STm197 from other phage types, and was also able to distinguish the closely related outbreak strains from non-outbreak STm197. In Queensland, at least 32 different MLVA profiles of STm197 have been identified. Closely related profiles may reflect genetic drift in the genome of the bacteria, however the coding system used by Lindstedt et al[17] may not always reflect these affiliations. There is now a move in Australia to use a coding system developed in New South Wales that can more easily identify closely related MLVA profiles.

In early January 2007, epidemiology related the first 3 cases with STm infection of the same MLVA type (2-7-20-14-2) to Restaurant A, though retrospective cohort studies conducted from those who attended separate functions in mid-December identified no specific food vehicle. However, environmental health investigation did identify food hygiene issues, which facilitated the cross-contamination of food and this was supported by the microbiological findings.

Detailed investigation of cases with related MLVA profiles following the inspection at the egg pro-

ducer's farm helped identify further outbreaks in restaurants. Environmental health investigation of these restaurants also identified food hygiene and potential cross-contamination issues. The cracked and faecally-contaminated eggs found at Restaurant B1 then provided further support for the link to the egg producer and the results of environmental swabs taken from the same restaurant found MLVA profiles closely linked to those found at the egg producer's farm.

In retrospect, an earlier Queensland outbreak of STm197 in 2006 may also be linked to this egg producer. Another restaurant in south Brisbane with identified cross-contamination issues was found to be the source of this previous outbreak. Again, no specific food vehicle was identified. The MLVA profile of this earlier outbreak was closely related (2-5-20-14-2) to the current one. There were 3 notifications of this MLVA profile identified in the outbreaks discussed. Records could not confirm whether this restaurant had received product from the egg producer.

The case-to-case comparison study also provided supporting evidence with a significant association between cases of STm infection with MLVA profile 2-6-20-14-2 (the most common profile found by surveillance of cases of STm infection with MLVA profiles found at the farm) and attending any restaurant or attending a restaurant supplied by the egg producer. Case-to-case comparison studies should reduce selection and recall bias.[19–21] However, some potential limitations with this study can be considered:

- Though reduced, selection bias may have occurred because not all cases could be contacted or consented to participate in the analytical study.
- As comparisons were not more precisely geographically matched to cases (other than the Brisbane Statistical Division), they may not have had the same chance of eating at a restaurant supplied by the egg producer.
- There may have been misclassification of exposure based on the producer's practice of co-mingling eggs from other producers and on-selling to restaurants. This may lead to an over-estimate of the measure of association.
- There was potential for misclassification of the cases and comparisons as other serovars of *Salmonella* were also identified at the farm of the egg producer. Though none of the comparisons had serovars that were identified from the farm there is still a possibility that some of these comparisons may still have acquired their infection from the egg producer. This would reduce the measure of association towards the null.
- Comparisons may have eaten at restaurants supplied by the egg producer. However, it would still not be known if the eggs were from the implicated farm because other producers' eggs were co-mingled.

The cross-contamination problems and breaches of the Food Safety Standards in restaurants played a contributory role in this outbreak where once again, cracked and dirty eggs were found to be the culprit. Outbreaks of STm197 in Queensland in previous years have been related to restaurants[4,5] and to a bakery[18] where the manufacturer used cracked and dirty eggs. The national Food Standards Code prohibits the sale of cracked and dirty eggs *for retail or catering*. However, this Standard does not appear to have adequately protected public health as it allowed the sale of potentially contaminated, cracked and dirty eggs to restaurants and bakeries where food handling practices may allow cross-contamination of food products and food contact surfaces. The evidence from this outbreak illustrates that this does occur.

SFPQ introduced the Queensland Egg Food Safety Scheme in July 2005 to manage these identified hazards posed by cracked and dirty eggs. This scheme also covers unpasteurised egg pulp. Under this Egg Food Safety Scheme individual eggs are required to be stamped to identify their source, to ensure product traceability and facilitate foodborne illness investigation. The egg producer had identified compliance issues and SFPQ were taking steps to ensure compliance. However, experience in Tasmania[11] and of other jurisdictions[12–14,22] justifies the need for a national standard to address the food safety risks posed by cracked and dirty eggs (and unpasteurised egg pulp supply) and to tackle inadequate traceability issues at a national level. Food Standards Australia and New Zealand are addressing this issue with a proposed national primary production and processing standard for eggs and egg products, which is currently in the late stages of development.

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Quarterly reports

# OzFoodNet quarterly report, 1 July to 30 September 2009

The OzFoodNet Working Group

## Introduction

The Australian Government Department of Health and Ageing established the OzFoodNet network in 2000 to collaborate nationally to investigate foodborne disease. OzFoodNet conducts studies on the burden of illness and coordinates national investigations into outbreaks of foodborne disease. This quarterly report documents investigations of outbreaks of gastrointestinal illness and clusters of disease potentially related to food, occurring in Australia from 1 July to 30 September 2009.

Data were received from OzFoodNet epidemiologists in all Australian states and territories. The data in this report are provisional and subject to change, as the results of outbreak investigations can take months to finalise.

During the 3rd quarter of 2009, OzFoodNet sites reported 606 outbreaks of enteric illness, including those transmitted by contaminated food. Outbreaks of gastroenteritis are often not reported to health agencies or the reports may be delayed, meaning that these figures under-represent the true burden of enteric illness. In total, these outbreaks affected 13,608 people, of whom 446 were hospitalised. There were 43* deaths reported during these outbreaks. The majority of outbreaks (67.5%, n = 409) were due to person-to-person transmission (Table 1).

## Foodborne disease outbreaks

There were 28 outbreaks during this quarter where consumption of contaminated food was suspected or confirmed as the primary mode of transmission (Table 2). These outbreaks affected 445 people and resulted in 26 hospitalisations. There were 3* reported deaths during these outbreaks. This compares with 17 outbreaks for the 3rd quarter of 2008[1] and 27 foodborne outbreaks for the 2nd quarter of 2009.[2]

*Salmonella* was responsible for 3 outbreaks during this quarter, with *Salmonella* Typhimurium being the most common serotype (n = 2). There was 1 outbreak due to *S.* Typhimurium phage type 193 var 1 and 1 outbreak of *S.* Typhimurium where phage typing was not reported. There was 1 outbreak due to *S.* Saintpaul.

Of the remaining 25 outbreaks, four were due to foodborne toxins, including 2 *Clostridium perfringens* outbreaks and 2 ciguatera fish poisoning outbreaks. There were 7 outbreaks due to norovirus and 2 outbreaks due to *Campylobacter* infection. One outbreak was each due to *Yersinia enterocolitica,* and *Listeria monocytogenes*. Ten outbreaks were of unknown aetiology.

Thirteen outbreaks (46%) reported in this quarter were associated with food prepared in restaurants, four (14%) each associated with aged care facilities and primary produce, three (11%) associated with commercial caterers, and two (6%) with takeaway establishments. An individual outbreak was associated with food prepared at a bakery. In 1 outbreak the setting in which the food was prepared was unknown.

To investigate these outbreaks, sites conducted 8 cohort studies, 1 case control study, 1 case–case analysis and collected descriptive case series data for 15 investigations. As evidence for the implicated food vehicle, investigators collected microbiological evidence in 2 outbreaks, analytical epidemiological evidence in 4 outbreaks, and both analytical epide-

**Table 1: Mode of transmission for outbreaks of gastrointestinal illness reported by OzFoodNet, 1 July to 30 September 2009**

| Transmission mode | Number of outbreaks | Percent of total |
|---|---|---|
| Foodborne | 28 | 4.6 |
| Person-to-person | 409 | 67.5 |
| *Salmonella* cluster | 10 | 1.7 |
| Suspected waterborne | 1 | 0.2 |
| Unknown – other pathogen cluster | 1 | 0.2 |
| Unknown | 157 | 25.9 |
| Total | 606 | 100 |

* Includes 3 foetal deaths associated with a multi-jurisdictional outbreak of *Listeria* infection. See section on multi-jurisdictional outbreaks.

## Table 2: Outbreaks of foodborne disease reported by OzFoodNet sites,* 1 July to 30 September 2009 (n = 28)

| State or territory | Month of outbreak | Setting prepared | Agent | Number affected | Hospitalised | Evidence | Responsible vehicles |
|---|---|---|---|---|---|---|---|
| ACT | July | Takeaway | *Yersinia enterocolitica* | 3 | 0 | D | Roast pork, BBQ pork |
| | July | Aged care facility | *Clostridium perfringens* | 50 | 0 | A | Sweet and sour pork |
| NSW | August | Commercial caterer | Norovirus | 31 | 0 | D | Unknown |
| | September | Restaurant | Norovirus | 13 | 0 | D | Unknown |
| | September | Restaurant | Unknown | 8 | 0 | D | Unknown |
| | July | Restaurant | Unknown | 6 | Unknown | D | Unknown |
| | July | Unknown | Unknown | 2 | 0 | D | Unknown |
| | September | Restaurant | Unknown | 3 | 0 | D | Unknown |
| | September | Aged care facility | *Salmonella* Typhimurium | 9 | 2 | D | Unknown |
| | August | Restaurant | Unknown | 2 | 0 | D | Unknown |
| Qld | August | Primary produce | Ciguatera | 2 | 2 | D | King snapper |
| | August | Restaurant | *C. perfringens* | 4 | 0 | D | Unknown |
| | July | Restaurant | Unknown | 2 | 0 | D | Unknown |
| | July | Bakery | Norovirus | 24 | Unknown | D | Sandwiches (various fillings) |
| | September | Restaurant | Unknown | 4 | 0 | D | Unknown |
| | July | Primary produce | Ciguatera | 2 | 0 | D | Reef cod |
| SA | August | Commercial caterer | Norovirus | 22 | 0 | D | Sandwiches and baguettes |
| Tas | September | Restaurant | *Campylobacter* | 35 | 0 | A | Chicken liver parfait |
| | September | Restaurant | *Campylobacter* | 9 | 0 | A | Chicken liver parfait |
| Vic | July | Aged care facility | Unknown | 4 | 0 | D | Unknown |
| | August | Restaurant | Norovirus | 87 | 0 | D | Unknown |
| | August | Restaurant | Unknown | 3 | 0 | D | Unknown |
| | September | Restaurant | Norovirus | 10 | 0 | D | Unknown |
| | September | Aged care facility | Unknown | 7 | 0 | D | Unknown |
| WA | July | Takeaway | *S.* Typhimurium 193 var 1 | 31 | 9 | M | Vietnamese pork roll |
| | August | Primary produce | *S.* Saintpaul | 17 | 3 | M | Paw paw |
| | September | Commercial caterer | Norovirus | 15 | 0 | A | Rice paper rolls |
| Multi-jurisdictional | July† | Commercially manufactured | *Listeria monocytogenes* | 40 | 10 | AM | Chicken meat |

* No foodborne outbreaks were reported by the Northern Territory during the quarter.

† Some cases associated with this outbreak had dates of onset prior to the 3rd quarter.

A Analytical epidemiological association between illness and one or more foods.

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

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

miological and microbiological evidence in 1 outbreak. Descriptive evidence only was obtained in 21 outbreaks.

The following jurisdictional summaries describe key outbreaks and public health actions that occurred in this quarter. The Northern Territory did not report any foodborne outbreaks during the quarter.

### Australian Capital Territory

The Australian Capital Territory reported 2 outbreaks of foodborne or suspected foodborne disease reported during the quarter.

In July, an outbreak occurred in a residential aged-care facility where *C. perfringens* enteritis affected 50 residents. A cohort study was undertaken, with a sweet and sour pork meal identified as the suspected food vehicle. No leftover food remained for microbiological testing.

The other was a cluster of yersiniosis that was investigated following a food complaint and confirmed infection in a 10-month-old child. Two other family members exhibited symptoms but returned negative stool samples. A takeaway meal including Asian style BBQ/roast pork and roast duck was nominated by the family as the suspected food vehicles, but no leftover food remained and samples of pork and duck collected from the restaurant tested negative for *Yersinia* and other bacterial pathogens.

### New South Wales

New South Wales reported 8 foodborne or suspected foodborne disease outbreaks in the 3rd quarter of 2009.

An outbreak of *Salmonella* occurred in an aged care facility with four confirmed cases of salmonellosis amongst 9 people with symptoms of gastroenteritis. Two of the cases were confirmed as *S.* Typhimurium multi-locus variable number of tandem repeats analysis (MLVA) 3-9-8-13-523. All 4 patients were categorised as high dependency, and all were on a pureed/soft diet. Approximately 30 out of 61 residents of the facility were on a pureed/soft diet and no other cases of salmonellosis were reported. A thorough investigation of the premises was conducted, including the collection of food and environmental samples for microbiological testing. Results were all negative, and the New South Wales Food Authority found no obvious problems or possible source of infection.

An outbreak of norovirus associated with a birthday party was investigated through a cohort study. Thirty-three people were interviewed, with 31 people reporting illness consistent with norovirus infection. One specimen was positive for norovirus. No foods were significantly associated with illness. The source of the infection remains unknown.

In September, an outbreak affecting 3 different groups and associated with a single food premises was reported. Illness onset times were between 25–35 hours after consumption of meals. The symptom profile was consistent with a viral infection, and norovirus was isolated from 3 stool specimens. Food items common to the cases was a side salad. It is likely that norovirus was transmitted to cases through consumption of salads, served as meal or as a side salad. No common ingredients could be identified between the salad types. The source of the outbreak remains unknown.

New South Wales reported a further 5 outbreaks of gastroenteritis of suspected foodborne origin, all of them of unknown aetiology.

New South Wales reported 2 confirmed cases of *L. monocytogenes* as part of a multi-jurisdictional outbreak that is detailed further in the section on multi-jurisdictional outbreak investigations.

### Queensland

Queensland investigated 6 outbreaks of foodborne or suspected foodborne illness during the 3rd quarter of 2009.

Two outbreaks of suspected ciguatera fish poisoning were reported during the quarter. In July, 2 cases consumed approximately 200 g of reef cod which was caught from a reef north east of Bundaberg (private catch). In August, 2 people consumed king snapper fillets that were purchased from a Brisbane seafood outlet. Traceback investigations identified that this fish was part of a 288 kg catch that was taken off Capel Bank (east of Brisbane).

In July, an outbreak of 24 cases of norovirus infection was reported among a cohort of 50 people. Illness was initially reported among staff members of an educational college following the consumption of sandwiches catered by a nearby café. The sandwiches were provided by the café during 2 separate events held in July. Onset of illness (with symptoms including vomiting, diarrhoea and stomach cramps) occurred between 12 and 36 hours after consuming the sandwiches. Environmental health investigations identified poor hygiene practices and food safety knowledge among café staff, and several staff had reported recent gastrointestinal illness. Norovirus was detected in one of 2 stool specimens from the college staff members.

In August, four people became ill with diarrhoea and stomach cramps after consuming a meal con-

sisting of roast beef and gravy at a Brisbane hotel restaurant. All 4 cases had incubation periods less than 11 hours and *C. perfringens* was detected at diagnostic levels in the stools of all 4 cases. No food samples were collected and no further cases of illness were reported.

Three cases of *L. monocytogenes* infection were reported by Queensland during this quarter, all were part of a multi-jurisdictional outbreak that occurred across 6 Australian states. All 3 cases were materno-foetal infections. Two cases had pre-term live births at 33 and 34 weeks gestation, while a foetal death occurred in the 3rd case at 20 weeks gestation. This investigation is detailed further in the section on multi-jurisdictional outbreak investigations.

### South Australia

South Australia reported 1 outbreak of foodborne or suspected foodborne disease during the 3rd quarter of 2009. The Communicable Disease Control Branch investigated an outbreak of 22 cases of gastroenteritis in people from 2 catered events in Adelaide in August 2009. Both events were served lunch consisting of sandwiches and baguettes that were prepared by the same caterer. An environmental inspection of the caterer found that 1 food handler had been sick on the premises the day the food was prepared. A second food handler also became ill 24–48 hours after the first.

Two outbreaks of unknown aetiology were reported in which investigators were unable to identify a food vehicle.

One confirmed case of *L. monocytogenes* was reported by South Australia as part of the multi-jurisdictional outbreak. This investigation is detailed further in the section on multi-jurisdictional outbreak investigations.

### Tasmania

There were 2 outbreaks of foodborne disease reported by Tasmania this quarter affecting 2 groups attending separate functions at the same hotel and consuming an identical set menu. In the 1st outbreak 35 of the 83 attendees interviewed reported gastroenteritis after eating at the function. *Campylobacter* was detected in the faecal specimens of 7 cases. In the 2nd cohort nine of 21 attendees reported gastroenteritis after eating at the function. A combined cohort investigation was undertaken and analysis of the questionnaire data revealed that consumption of a chicken liver parfait was significantly associated with gastroenteric illness. While water and food samples, including the chicken liver parfait, tested negative for *Campylobacter,* it is suspected that inadequate cooking of the chicken livers was the main contributing factor to the outbreaks.

Tasmania reported 1 confirmed case of *L. monocytogenes* linked to the multi-jurisdictional outbreak described in further detail in the section on multi-jurisdictional outbreak investigations.

### Victoria

Victoria reported 5 outbreaks that were considered to be due to foodborne or suspected foodborne transmission this quarter. These outbreaks affected 111 people.

Norovirus was identified as the aetiology of two of the outbreaks. The 1st outbreak occurred in a hotel restaurant where a total of 87 people from 8 separate groups who dined on one of 3 consecutive days, reported illness. The food service was self-serve smorgasbord style and there was a selection of hot and cold foods. The 2nd outbreak affected 10 people in a group of 18 who dined at a café for lunch.

There were 2 suspected *C. perfringens*† outbreaks in aged care facilities, affecting four and 7 people respectively, during this quarter. A 3rd suspected *C. perfringens* outbreak was reported, which affected 3 people after sharing a meal at a restaurant. Investigators were unable to identify the vehicle responsible for infection in any of the outbreaks.

Thirty-two cases of hepatitis A were notified in Victoria this quarter and 21 cases of which were locally acquired. Fifteen of these locally-acquired cases had consumed semi-dried tomatoes within a likely window of exposure. Two cases were food handlers. The median age for these locally-acquired cases was 42 years (range 9–79 years) and there were approximately equal numbers of males and females. This increase in locally-acquired cases was considered to be related to the multi-jurisdictional outbreak between March and May,[2] not a new outbreak. A 2nd case control study to investigate this outbreak commenced in early October and cases were eligible for enrolment if they had an onset on or after 1 September 2009.

Victoria reported three cases of *Listeria* infection linked to the multi-jurisdictional outbreak, of which only one was notified in this quarter. Further information is provided in the section describing multi-jurisdictional outbreak investigations.

† The aetiology of these outbreaks was unable to be confirmed by investigators and is listed as unknown in Table 2.

### Western Australia

Western Australia investigated 3 outbreaks of foodborne disease or suspected foodborne disease in the 3rd quarter of 2009.

In July, 28 cases of *S.* Typhimurium Pulsed Field Gel Electrophoresis (PFGE) type 0279 (phage type 193) were notified, plus an additional 3 cases with symptoms of gastroenteritis linked to these cases. This PFGE type had not previously been reported in Western Australia. Sixteen of the 31 cases reported eating Vietnamese pork rolls that were prepared by a lunch bar for distribution to other food outlets. One of the cases was a secondary case, 5 cases had poor recall of food eaten, 4 cases could not be followed up and 5 cases reported eating at a restaurant and had not eaten pork rolls. The pork rolls consisted of cooked pork, raw egg mayonnaise, cucumber, carrots and coriander. *S.* Typhimurium with an indistinguishable PFGE pattern from the human cases was isolated from pork rolls sampled from a retail outlet. The source of the *Salmonella* contamination of the pork rolls could not be identified. No link was found between the cases that ate the pork rolls and the 5 cases that ate at a restaurant. The pork rolls were removed from sale.

An investigation was commenced in September into an increase in the number of *S.* Saintpaul notifications. Four of 5 locally-acquired cases in August reported eating paw paw, which is above expected consumption frequencies. Paw paw from one Western Australian grower was found to be contaminated with *S.* Saintpaul and subsequently withdrawn from sale. Investigations revealed that the likely source of contamination was from the washing process used to treat the paw paw with fungicide. A total of 17 *S.* Saintpaul cases were associated with this foodborne outbreak and three of the cases were hospitalised.

In September, a suspected foodborne outbreak of norovirus was reported amongst guests of a wake at a private home, with the incubation period, symptoms and duration of illness consistent with norovirus infection. While norovirus was detected in 1 specimen from an affected person, a 2nd specimen collected from the same person was positive for norovirus and rotavirus. A case control study was conducted with 15 cases and 15 controls. Illness was found to be significantly associated with the consumption of rice paper rolls (odds ratio [OR] 12.0, 95% confidence intervals [CI]: 1.9, 76). Food was supplied by a catering company, and no staff illness was reported. Contamination of the rice paper rolls by an infected food handler was the suspected source of infection.

Western Australia also reported a single case of listeriosis linked to the multi-jurisdictional outbreak investigation described in the section on multi-jurisdictional outbreak investigations.

### Multi-jurisdictional outbreak investigation

#### *Listeria monocytogenes*

In late July, Queensland reported a cluster of 4 cases of listeriosis who had been infected with the same strain of *L. monocytogenes* (serotype 1/2c, binary gene type 82), a strain not frequently detected in Queensland. However, this particular strain of *Listeria* had been detected in several food and environmental samples taken intermittently between January and July 2009 from a food manufacturer in Brisbane. Further investigation and case ascertainment identified additional cases in other jurisdictions.

During a multi-jurisdictional investigation into the outbreak, case ascertainment identified additional cases in other jurisdictions and a total of 13 laboratory confirmed cases with the outbreak strain were identified. Cases were from Queensland (5), Victoria (3), New South Wales (2), South Australia (1), Western Australia (1) and Tasmania (1). There were also 27 epidemiologically-linked cases associated with this outbreak, 26 with clinical symptoms of gastroenteritis only. Onset dates for all 40 cases ranged between January and July 2009. The median incubation period among the 26 clinical cases with gastroenteritis was 21 hours (range: 5–38 hours). Eight of the 13 laboratory-confirmed cases were perinatal infections with three foetal deaths at 15, 20 and 40 weeks gestation.

Eight of the 13 laboratory-confirmed cases and 21 of 27 clinical cases reported consuming chicken wraps on a particular domestic airline. Laboratory-confirmed cases infected with the outbreak strain ($n = 13$) were more likely to have flown on a domestic airline in the 3 months before onset of illness (OR 30.0, 95% CI: 2.3, 885.7, $P < 0.001$) and more likely to have consumed chicken wraps (OR 27.2, 95% CI: 2.2, 758.5, $P = 0.001$), when compared to sporadic cases of *Listeria monocytogenes* infected with other strains ($n = 40$).

Traceback investigation subsequently led to the isolation of the outbreak strain of *Listeria* from pre-packaged chicken sandwiches and wraps prepared by a food manufacturer in Queensland and from cooked chicken meat from a wholesaler in New South Wales that supplied chicken to the Queensland manufacturer. The Queensland food manufacturer supplied chicken wraps to the domestic airline and several other food businesses

in Queensland. An environmental investigation identified deficiencies in the food safety program for the production of chicken meat. The facility ceased the manufacture of the meat in response to the environmental investigation.

### Cluster investigations

During the 3rd quarter of 2009, OzFoodNet sites investigated a number of clusters across 7 jurisdictions and the majority were due to *Salmonella*. The Australian Capital Territory investigated a cluster of 2 cases of *S.* Rubislaw during the period. Both cases were young children. This was the first time this serotype has been reported by the Australian Capital Territory. One child was hospitalised with bloody diarrhoea and a pet lizard was identified as a possible source of the child's infection, with environmental sampling including lizard faeces, a vacuum cleaner filter and swabs from the terrarium in which it was housed testing positive for *S.* Rubislaw. The other clusters investigated included *Listeria*, *Shigella sonnei* biotype A *Campylobacter*, *S.* Typhi *S.* Enteritidis 6A, *S.* Typhimurium phage types 141, 170/108, 60, 3, 9 and *S.* Havana and *S.* Anatum.

## Comments

There was a higher number of foodborne outbreaks (n = 28) during the 3rd quarter of 2009 compared with the same quarter in 2008 (n = 17),[1] but a similar number to the previous quarter (2nd quarter 2009) (n = 27).[2] A limitation of the outbreak data provided by OzFoodNet sites for this report is the potential for variation in categorisation of the features of outbreaks depending on investigator interpretation and circumstances. Changes in the incidence of foodborne outbreaks should be interpreted with caution due to the small numbers each quarter.

Of particular interest this quarter was the multi-jurisdictional outbreak investigation into cases of listeriosis linked to the consumption of cooked chicken meat in pre-packaged sandwiches and wraps served during flights on a domestic airline. Cooperation between the jurisdictions and the companies involved in the supply chain in the investigation of these cases, facilitated traceback and appropriate public health actions, including recall of the affected food. Serotyping in combination with genotyping was critical for enhanced case-finding and source attribution in this investigation. This outbreak provides a timely reminder to public health investigators that foods containing high levels of *Listeria* are capable of causing outbreaks of both invasive and/or non-invasive (gastrointestinal) illness, occurring among both immunocompromised and healthy immunocompetent persons. Small outbreaks of *Listeria* infection have previously occurred in Australia,[3] including a cluster of cases in South Australia in 1996 linked to sandwiches prepared in a hospital with diced chicken meat from a commercial supplier.[4] The multi-jurisdictional outbreak described here is the first outbreak of listeriosis in Australia that has been linked to consumption of pre-packaged food on an airline and involved a higher than usual proportion of materno-foetal cases and foetal deaths. Communication of the risks to vulnerable populations, such as pregnant women and immunocompromised people is important for the prevention of cases. Food Standards Australia New Zealand (FSANZ) is planning an education campaign using OzFoodNet data.

Also of interest this quarter is the outbreak of *S.* Saintpaul in Western Australia associated with the consumption of paw paw. This is the 2nd outbreak of *Salmonella* linked to the consumption of paw paw/papaya produce. An outbreak of *S.* Litchfield infection in Queensland and Western Australia in late 2006 and early 2007 was shown to be associated with the consumption of papaya, with untreated water used to wash the fruit with fungicide being the likely source of contamination.[5] In addition, a multi-state outbreak of *S.* Saintpaul occurred in Australia in 2006 in which consumption of rockmelon was strongly associated with illness.[6] Together, these outbreaks show that there is a need for care in the preparation of fresh produce such as paw paw/papaya and rockmelon, with particular care to sourcing safe water for washing the fruit.

During this quarter, Victoria reported an increase in locally acquired cases of hepatitis A associated with consumption of semi-dried tomatoes, subsequent to the quarter, the multi-jurisdictional outbreak investigation was re-opened on 2 November 2009. All jurisdictions were asked to follow-up locally acquired cases and request genotyping on all isolates to determine whether they matched the strain linked to the multi-jurisdictional outbreak investigation conducted in the 2nd quarter. Between 1 July and 30 September, 14 locally acquired hepatitis A cases were reported by jurisdictions outside Victoria, including South Australia (7 cases), New South Wales (3 cases), Queensland (3 cases) and Western Australia (1 case). The investigation is continuing and outcomes of the investigation will be reported in the 4th quarterly report.

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# Communicable diseases surveillance

## Tables

### National Notifiable Diseases Surveillance System

A summary of diseases currently being reported by each jurisdiction is provided in Table 1. There were 73,994 notifications to the National Notifiable Diseases Surveillance System (NNDSS) with a notification received date between 1 July and 30 September 2009 (Table 2). The notification rate of diseases per 100,000 population for each state or territory is presented in Table 3.

**Table 1: Reporting of notifiable diseases by jurisdiction**

| Disease | Data received from: |
|---|---|
| **Bloodborne diseases** | |
| Hepatitis (NEC) | All jurisdictions |
| Hepatitis B (newly acquired) | All jurisdictions |
| Hepatitis B (unspecified) | All jurisdictions |
| Hepatitis C (newly acquired) | All jurisdictions except Queensland |
| Hepatitis C (unspecified) | All jurisdictions |
| Hepatitis D | All jurisdictions |
| **Gastrointestinal diseases** | |
| Botulism | All jurisdictions |
| Campylobacteriosis | All jurisdictions except New South Wales |
| Cryptosporidiosis | All jurisdictions |
| Haemolytic uraemic syndrome | All jurisdictions |
| Hepatitis A | All jurisdictions |
| Hepatitis E | All jurisdictions |
| Listeriosis | All jurisdictions |
| Salmonellosis | All jurisdictions |
| Shigellosis | All jurisdictions |
| STEC, VTEC | All jurisdictions |
| Typhoid | All jurisdictions |
| **Quarantinable diseases** | |
| Cholera | All jurisdictions |
| Highly pathogenic avian influenza in humans | All jurisdictions |
| Plague | All jurisdictions |
| Rabies | All jurisdictions |
| Severe acute respiratory syndrome | All jurisdictions |
| Smallpox | All jurisdictions |
| Viral haemorrhagic fever | All jurisdictions |
| Yellow fever | All jurisdictions |
| **Sexually transmissible infections** | |
| Chlamydial infection | All jurisdictions |
| Donovanosis | All jurisdictions |
| Gonococcal infection | All jurisdictions |
| Syphilis <2 years duration | All jurisdictions |
| Syphilis >2 years or unspecified duration | All jurisdictions except South Australia where data is not collected. |
| Syphilis - congenital | All jurisdictions |

## Table 1: Reporting of notifiable diseases by jurisdiction, *continued*

| Disease | Data received from: |
|---|---|
| **Vaccine preventable diseases** | |
| Diphtheria | All jurisdictions |
| *Haemophilus influenzae* type b | All jurisdictions |
| Influenza (laboratory confirmed)* | All jurisdictions |
| Measles | All jurisdictions |
| Mumps | All jurisdictions |
| Pertussis | All jurisdictions |
| Pneumococcal disease (invasive) | All jurisdictions |
| Poliomyelitis | All jurisdictions |
| Rubella | All jurisdictions |
| Rubella - congenital | All jurisdictions |
| Tetanus | All jurisdictions |
| Varicella zoster (chickenpox) | All jurisdictions except New South Wales |
| Varicella zoster (shingles) | All jurisdictions except New South Wales |
| Varicella zoster (unspecified) | All jurisdictions except New South Wales |
| **Vectorborne diseases** | |
| Arbovirus infection (NEC)† | All jurisdictions |
| Barmah Forest virus infection | All jurisdictions |
| Dengue virus infection | All jurisdictions |
| Japanese encephalitis virus infection | All jurisdictions |
| Kunjin virus infection | All jurisdictions |
| Malaria | All jurisdictions |
| Murray Valley encephalitis virus infection | All jurisdictions |
| Ross River virus infection | All jurisdictions |
| **Zoonoses** | |
| Anthrax | All jurisdictions |
| Australian bat lyssavirus | All jurisdictions |
| Brucellosis | All jurisdictions |
| Leptospirosis | All jurisdictions |
| Lyssavirus (NEC) | All jurisdictions |
| Ornithosis | All jurisdictions |
| Q fever | All jurisdictions |
| Tularaemia | All jurisdictions |
| **Other bacterial infections** | |
| Legionellosis | All jurisdictions |
| Leprosy | All jurisdictions |
| Meningococcal infection | All jurisdictions |
| Tuberculosis | All jurisdictions |

* Notifiable in South Australia as of 1 May 2008.

† Flavivirus (NEC) replaced Arbovirus (NEC) from 1 January 2004. Arbovirus (NEC) replaced Flavivirus (NEC) from 2008.

NEC Not elsewhere classified.

## Table 2: Notifications of diseases received by state and territory health authorities in the period 1 July to 30 September 2009, by date of diagnosis*

| Disease | State or territory | | | | | | | | Total 3rd quarter 2009† | Total 2nd quarter 2009 | Total 3rd quarter 2008 | Last 5 years mean 3rd quarter | Year to date 2009 | Last 5 years YTD mean | Ratio‡ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | | | | | | | |
| **Bloodborne diseases** | | | | | | | | | | | | | | | |
| Hepatitis (NEC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.4 | 0.0 |
| Hepatitis B (newly acquired) | 1 | 20 | 0 | 11 | 1 | 0 | 25 | 0 | 58 | 56 | 73 | 68.4 | 154 | 209.8 | 0.8 |
| Hepatitis B (unspecified) | 28 | 906 | 31 | 262 | 86 | 20 | 473 | 199 | 2,005 | 1,904 | 1,751 | 1,655.2 | 5,925 | 4,782.4 | 1.2 |
| Hepatitis C (newly acquired) | 1 | 8 | 0 | NN | 12 | 4 | 37 | 0 | 62 | 63 | 99 | 98.0 | 192 | 285.8 | 0.6 |
| Hepatitis C (unspecified) | 45 | 1,461 | 32 | 644 | 128 | 62 | 626 | 276 | 3,274 | 3,211 | 2,710 | 2,973.2 | 9,705 | 8,971.8 | 1.1 |
| Hepatitis D | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 4 | 11 | 10 | 11.2 | 25 | 27.8 | 0.4 |
| **Gastrointestinal diseases** | | | | | | | | | | | | | | | |
| Botulism | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 1 | 1.0 | 0.0 |
| Campylobacteriosis§ | 50 | NN | 42 | 1,116 | 412 | 177 | 1,359 | 657 | 3,813 | 3,798 | 3,383 | 3,679.0 | 11,641 | 11,464.4 | 1.0 |
| Cryptosporidiosis | 3 | 62 | 10 | 43 | 17 | 17 | 74 | 28 | 254 | 1,135 | 315 | 293.6 | 4,250 | 1,989.2 | 0.9 |
| Haemolytic uraemic syndrome | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 6 | 3.2 | 7 | 11.8 | 0.0 |
| Hepatitis A | 3 | 22 | 0 | 13 | 9 | 0 | 34 | 4 | 85 | 166 | 57 | 62.8 | 320 | 219.8 | 1.4 |
| Hepatitis E | 0 | 3 | 0 | 1 | 0 | 0 | 1 | 2 | 7 | 10 | 10 | 5.4 | 33 | 23.6 | 1.3 |
| Listeriosis | 0 | 7 | 0 | 6 | 0 | 0 | 5 | 4 | 22 | 19 | 17 | 13.4 | 70 | 45.8 | 1.6 |
| STEC, VTEC‖ | 0 | 2 | 0 | 12 | 6 | 0 | 3 | 0 | 23 | 27 | 17 | 14.8 | 103 | 55.8 | 1.6 |
| Salmonellosis | 25 | 329 | 86 | 290 | 130 | 26 | 363 | 261 | 1,510 | 2,225 | 1,327 | 1,310.2 | 7,124 | 6,307.0 | 1.2 |
| Shigellosis | 0 | 24 | 16 | 36 | 13 | 0 | 22 | 14 | 125 | 168 | 199 | 141.0 | 510 | 487.8 | 0.9 |
| Typhoid | 0 | 9 | 0 | 5 | 0 | 0 | 8 | 3 | 25 | 19 | 19 | 16.0 | 81 | 63.4 | 1.6 |
| **Quarantinable diseases** | | | | | | | | | | | | | | | |
| Cholera | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0.4 | 4 | 2.0 | 2.5 |
| Highly pathogenic avian influenza in humans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Plague | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Rabies | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Severe acute respiratory syndrome | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Smallpox | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Viral haemorrhagic fever | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Yellow fever | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |

## Table 2: Notifications of diseases received by state and territory health authorities in the period 1 July to 30 September 2009, by date of diagnosis,* *continued*

| Disease | State or territory | | | | | | | | Total 3rd quarter 2009† | Total 2nd quarter 2009 | Total 3rd quarter 2008 | Last 5 years mean 3rd quarter | Year to date 2009 | Last 5 years YTD mean | Ratio‡ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | | | | | | | |
| **Sexually transmissible infections** | | | | | | | | | | | | | | | |
| Chlamydial infection¶ | 225 | 3,692 | 420 | 3,987 | 885 | 372 | 3,352 | 2,084 | 15,017 | 16,751 | 14,659 | 11,596.8 | 47,383 | 35,517.0 | 1.3 |
| Donovanosis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1.6 | 1 | 5.2 | 0.0 |
| Gonococcal infection | 20 | 358 | 292 | 305 | 61 | 12 | 354 | 280 | 1,682 | 2,229 | 1,751 | 1,802.0 | 6,159 | 5,973.0 | 0.9 |
| Syphilis (all) | 17 | 360 | 28 | 128 | 16 | 12 | 213 | 41 | 815 | 819 | 835 | 703.2 | 2,437 | 2,034.6 | 1.2 |
| Syphilis < 2 years duration | 4 | 97 | 11 | 59 | 16 | 5 | 85 | 18 | 295 | 312 | 326 | 247.2 | 932 | 733 | 1.2 |
| Syphilis >2 years or unspecified duration | 13 | 263 | 17 | 69 | 0 | 7 | 128 | 23 | 520 | 507 | 509 | 456 | 1,505 | 1,301.6 | 1.1 |
| Syphilis - congenital | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 1.4 | 5 | 8.6 | 1.4 |
| **Vaccine preventable diseases** | | | | | | | | | | | | | | | |
| Diphtheria | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| *Haemophilus influenzae* type b | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 8 | 4 | 6.0 | 18 | 14.2 | 0.3 |
| Influenza (laboratory confirmed) | 902 | 442 | 1,397 | 15,218 | 9,093 | 1,068 | 1,029 | 4,694 | 33,843 | 9,906 | 6,433 | 4,313.8 | 44,221 | 5,132.6 | 7.8 |
| Measles | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 4 | 8 | 9 | 5 | 4.4 | 95 | 45.2 | 1.8 |
| Mumps | 0 | 9 | 8 | 5 | 0 | 0 | 8 | 4 | 34 | 43 | 55 | 79.0 | 133 | 207.2 | 0.4 |
| Pertussis | 98 | 1,820 | 45 | 1,578 | 1,332 | 143 | 1,004 | 162 | 6,182 | 7,460 | 3,526 | 3,249.4 | 22,154 | 6,889.4 | 1.9 |
| Pneumococcal disease (invasive) | 9 | 168 | 34 | 113 | 60 | 18 | 147 | 61 | 610 | 402 | 642 | 679.2 | 1,217 | 1,382.8 | 0.9 |
| Poliomyelitis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0.2 | 0.0 |
| Rubella | 0 | 2 | 0 | 0 | 2 | 0 | 2 | 2 | 8 | 7 | 13 | 11.2 | 23 | 30.6 | 0.7 |
| Rubella - congenital | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0.8 | 0.0 |
| Tetanus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.4 | 3 | 2.4 | 0.0 |
| Varicella zoster (chickenpox) | 0 | NN | 24 | 43 | 138 | 2 | 28 | 83 | 318 | 348 | 468 | 365.5 | 985 | 1,005.3 | 0.9 |
| Varicella zoster (shingles) | 1 | NN | 35 | 58 | 244 | 19 | 126 | 89 | 572 | 842 | 503 | 233.4 | 2,079 | 683.4 | 2.5 |
| Varicella zoster (unspecified) | 15 | NN | 0 | 939 | 97 | 31 | 439 | 202 | 1,723 | 1,516 | 1,119 | 642.8 | 4,975 | 1,779.2 | 2.7 |
| **Vectorborne diseases** | | | | | | | | | | | | | | | |
| Arbovirus infection (NEC) | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 5 | 5 | 6 | 5.2 | 24 | 28.0 | 1.0 |
| Barmah Forest virus infection | 2 | 66 | 15 | 157 | 6 | 0 | 2 | 18 | 266 | 360 | 373 | 295.0 | 1,195 | 1,327.4 | 0.9 |
| Dengue virus infection | 2 | 30 | 3 | 15 | 3 | 0 | 12 | 19 | 84 | 192 | 96 | 53.2 | 1,289 | 248.8 | 1.6 |
| Japanese encephalitis virus infection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 | 0 | 0.4 | 0.0 |
| Kunjin virus infection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 | 2 | 1.8 | 0.0 |
| Malaria | 1 | 25 | 4 | 45 | 10 | 0 | 44 | 24 | 153 | 151 | 153 | 154.0 | 439 | 505.0 | 1.0 |
| Murray Valley encephalitis virus infection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0.0 | 4 | 1.2 | 0.0 |
| Ross River virus infection | 0 | 159 | 58 | 411 | 90 | 1 | 14 | 91 | 824 | 1,522 | 779 | 457.0 | 3,988 | 3,698.4 | 1.8 |

## Table 2: Notifications of diseases received by state and territory health authorities in the period 1 July to 30 September 2009, by date of diagnosis,* *continued*

| Disease | State or territory | | | | | | | | Total 3rd quarter 2009† | Total 2nd quarter 2009 | Total 3rd quarter 2008 | Last 5 years mean 3rd quarter | Year to date 2009 | Last 5 years YTD mean | Ratio‡ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | | | | | | | |
| **Zoonoses** | | | | | | | | | | | | | | | |
| Anthrax | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.4 | 0.0 |
| Australian bat lyssavirus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Brucellosis | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 4 | 9 | 14 | 11.0 | 22 | 29.4 | 0.4 |
| Leptospirosis | 0 | 4 | 0 | 11 | 0 | 0 | 1 | 0 | 16 | 48 | 15 | 19.8 | 130 | 111.2 | 0.8 |
| Lyssavirus (NEC) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| Ornithosis | 0 | 6 | 0 | 0 | 1 | 0 | 9 | 0 | 16 | 14 | 27 | 36.6 | 46 | 118.8 | 0.4 |
| Q fever | 0 | 25 | 2 | 18 | 0 | 0 | 11 | 1 | 57 | 81 | 92 | 104.0 | 236 | 307.6 | 0.5 |
| Tularaemia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| **Other bacterial infections** | | | | | | | | | | | | | | | |
| Legionellosis | 0 | 22 | 2 | 10 | 11 | 0 | 9 | 17 | 71 | 102 | 59 | 65.8 | 237 | 229.0 | 1.1 |
| Leprosy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2.0 | 2 | 7.6 | 0.0 |
| Meningococcal infection** | 0 | 34 | 3 | 21 | 5 | 1 | 13 | 11 | 88 | 63 | 115 | 120.8 | 198 | 262.6 | 0.7 |
| Tuberculosis | 3 | 96 | 5 | 78 | 13 | 1 | 105 | 25 | 326 | 271 | 292 | 288.2 | 906 | 812.6 | 1.1 |
| Total | 1,451 | 10,175 | 2,593 | 25,588 | 12,881 | 1,986 | 9,959 | 9,361 | 73,994 | 55,980 | 42,033 | 36,219.3 | 181,694 | 104,192.0 | 2.1 |

* Date of diagnosis = true onset date, or where not available, the earliest of (i) specimen date, (ii) notification date, or (iii) notification receive date. Hepatitis B and C unspecified were analysed by the notification receive date.

† Totals comprise data from all states and territories. Cumulative figures are subject to retrospective revision so there may be discrepancies between the number of new notifications and the increment in the cumulative figure from the previous period.

‡ Ratio = ratio of current quarter total to the mean of last 5 years for the same quarter. Note: Ratios for syphilis <2 years; syphilis >2 years or unspecified duration are based on 5 years of data

§ Not reported for New South Wales where it is only notifiable as 'foodborne disease' or 'gastroenteritis in an institution'.

|| Infections with Shiga-like toxin (verotoxin) producing *Escherichia coli* (STEC/VTEC).

¶ Includes *Chlamydia trachomatis* identified from cervical, rectal, urine, urethral, throat and eye samples, except for South Australia, which reports only genital tract specimens; the Northern Territory and Queensland, which exclude ocular specimens; and Western Australia, which excludes ocular and perinatal infections.

** Ratio = ratio of current quarter total to the mean of last 5 years for the same quarter. Note: Ratios for varicella zoster (chickenpox), varicella zoster (shingles) and varicella zoster (unspecified) are based on 2 years of data

†† Only invasive meningococcal disease is nationally notifiable. However, New South Wales, the Australian Capital Territory and South Australia also report conjunctival cases.

NN Not notifiable.

NEC Not elsewhere classified.

NDP No data provided.

## Table 3: Notification rates of diseases, 1 July to 30 September 2009, by state or territory. (Annualised rate per 100,000 population)

| Disease* | State or territory | | | | | | | | Aust |
|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | |
| **Bloodborne diseases** | | | | | | | | | |
| Hepatitis (NEC) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Hepatitis B (newly acquired) | 1.2 | 1.1 | 0.0 | 1.0 | 0.2 | 0.0 | 1.9 | 0.0 | 1.1 |
| Hepatitis B (unspecified) | 32.5 | 52.0 | 56.4 | 24.5 | 21.5 | 16.1 | 35.7 | 36.8 | 37.5 |
| Hepatitis C (newly acquired) | 1.2 | 0.5 | 0.0 | NN | 3.0 | 3.2 | 2.8 | 0.0 | 1.2 |
| Hepatitis C (unspecified) | 52.3 | 83.9 | 58.2 | 60.2 | 32.0 | 49.8 | 47.3 | 51.0 | 61.3 |
| Hepatitis D | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 | 0.1 |
| **Gastrointestinal diseases** | | | | | | | | | |
| Botulism | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Campylobacteriosis† | 58.1 | NN | 76.4 | 104.3 | 102.9 | 142.1 | 102.6 | 121.5 | 71.4 |
| Cryptosporidiosis | 3.5 | 3.6 | 18.2 | 4.0 | 4.2 | 13.7 | 5.6 | 5.2 | 4.8 |
| Haemolytic uraemic syndrome | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Hepatitis A | 3.5 | 1.3 | 0.0 | 1.2 | 2.2 | 0.0 | 2.6 | 0.7 | 1.6 |
| Hepatitis E | 0.0 | 0.2 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.4 | 0.1 |
| Listeriosis | 0.0 | 0.4 | 0.0 | 0.6 | 0.0 | 0.0 | 0.4 | 0.7 | 0.4 |
| STEC, VTEC‡ | 0.0 | 0.1 | 0.0 | 1.1 | 1.5 | 0.0 | 0.2 | 0.0 | 0.4 |
| Salmonellosis | 29.0 | 18.9 | 156.4 | 27.1 | 32.5 | 20.9 | 27.4 | 48.3 | 28.3 |
| Shigellosis | 0.0 | 1.4 | 29.1 | 3.4 | 3.2 | 0.0 | 1.7 | 2.6 | 2.3 |
| Typhoid | 0.0 | 0.5 | 0.0 | 0.5 | 0.0 | 0.0 | 0.6 | 0.6 | 0.5 |
| **Quarantinable diseases** | | | | | | | | | |
| Cholera | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| Highly pathogenic avian influenza in humans | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Plague | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rabies | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Severe acute respiratory syndrome | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Smallpox | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Viral haemorrhagic fever | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Yellow fever | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Sexually transmissible infections** | | | | | | | | | |
| Chlamydial infection§ | 261.4 | 212.0 | 763.8 | 372.7 | 221.0 | 298.7 | 253.1 | 385.3 | 281.1 |
| Donovanosis | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Gonococcal infection | 23.2 | 20.6 | 531.0 | 28.5 | 15.2 | 9.6 | 26.7 | 51.8 | 31.5 |
| Syphilis (all) | 19.4 | 20.3 | 49.8 | 11.6 | 3.9 | 9.5 | 15.7 | 7.3 | 14.9 |
| Syphilis <2 years duration | 4.6 | 5.6 | 20.0 | 5.5 | 4.0 | 4.0 | 6.4 | 3.3 | 5.5 |
| Syphilis >2 years or unspecified duration | 15.1 | 15.1 | 30.9 | 6.4 | NDP | 5.6 | 9.7 | 4.3 | 9.7 |
| Syphilis - congenital | 0.0 | 0.0 | 1.8 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Vaccine preventable diseases** | | | | | | | | | |
| Diphtheria | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *Haemophilus influenzae* type b | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 |
| Influenza (laboratory confirmed) | 1,048.1 | 25.4 | 2,540.6 | 1,422.4 | 2,270.7 | 857.6 | 77.7 | 868.0 | 633.4 |
| Measles | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.7 | 0.1 |
| Mumps | 0.0 | 0.5 | 14.5 | 0.5 | 0.0 | 0.0 | 0.6 | 0.7 | 0.6 |
| Pertussis | 113.9 | 104.5 | 81.8 | 147.5 | 332.6 | 114.8 | 75.8 | 30.0 | 115.7 |
| Pneumococcal disease (invasive) | 10.5 | 9.6 | 61.8 | 10.6 | 15.0 | 14.5 | 11.1 | 11.3 | 11.4 |

## Table 3: Notification rates of diseases, 1 July to 30 September 2009, by state or territory. (Annualised rate per 100,000 population), *continued*

| Disease* | State or territory | | | | | | | | Aust |
|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | |
| **Vaccine preventable diseases, continued** | | | | | | | | | |
| Poliomyelitis | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rubella | 0.0 | 0.1 | 0.0 | 0.0 | 0.5 | 0.0 | 0.2 | 0.4 | 0.1 |
| Rubella - congenital | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tetanus | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Varicella zoster (chickenpox) | 0.0 | NN | 43.6 | 4.0 | 34.5 | 1.6 | 2.1 | 15.3 | 6.0 |
| Varicella zoster (shingles) | 1.2 | NN | 63.7 | 5.4 | 60.9 | 15.3 | 9.5 | 16.5 | 10.7 |
| Varicella zoster (unspecified) | 17.4 | NN | 0.0 | 87.8 | 24.2 | 24.9 | 33.1 | 37.4 | 32.2 |
| **Vectorborne diseases** | | | | | | | | | |
| Arbovirus infection (NEC) | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 0.0 | 0.1 |
| Barmah Forest virus infection | 2.3 | 3.8 | 27.3 | 14.7 | 1.5 | 0.0 | 0.2 | 3.3 | 5.0 |
| Dengue virus infection | 2.3 | 1.7 | 5.5 | 1.4 | 0.7 | 0.0 | 0.9 | 3.5 | 1.6 |
| Japanese encephalitis virus infection | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Kunjin virus infection | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Malaria | 1.2 | 1.4 | 7.3 | 4.2 | 2.5 | 0.0 | 3.3 | 4.4 | 2.9 |
| Murray Valley encephalitis virus infection | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ross River virus infection | 0.0 | 9.1 | 105.5 | 38.4 | 22.5 | 0.8 | 1.1 | 16.8 | 15.4 |
| **Zoonoses** | | | | | | | | | |
| Anthrax | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Australian bat lyssavirus | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Brucellosis | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 |
| Leptospirosis | 0.0 | 0.2 | 0.0 | 1.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.3 |
| Lyssavirus (NEC) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ornithosis | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 0.0 | 0.7 | 0.0 | 0.3 |
| Q fever | 0.0 | 1.4 | 3.6 | 1.7 | 0.0 | 0.0 | 0.8 | 0.2 | 1.1 |
| Tularaemia | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Other bacterial infections** | | | | | | | | | |
| Legionellosis | 0.0 | 1.3 | 3.6 | 0.9 | 2.7 | 0.0 | 0.7 | 3.1 | 1.3 |
| Leprosy | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Meningococcal infection‖ | 0.0 | 2.0 | 5.5 | 2.0 | 1.2 | 0.8 | 1.0 | 2.0 | 1.6 |
| Tuberculosis | 3.5 | 5.5 | 9.1 | 7.3 | 3.2 | 0.8 | 7.9 | 4.6 | 6.1 |

* Rates are subject to retrospective revision.

† Not reported for New South Wales where it is only notifiable as 'foodborne disease' or 'gastroenteritis in an institution'.

‡ Infections with Shiga-like toxin (verotoxin) producing *Escherichia coli* (STEC/VTEC).

§ Includes *Chlamydia trachomatis* identified from cervical, rectal, urine, urethral, throat and eye samples, except for South Australia, which reports only genital tract specimens; the Northern Territory and Queensland, which exclude ocular specimens; and Western Australia, which excludes ocular and perinatal infections.

‖ Only invasive meningococcal disease is nationally notifiable. However, New South Wales, the Australian Capital Territory and South Australia also report conjunctival cases.

NN Not notifiable.

NEC Not elsewhere classified.

NDP No data provided.

# Laboratory Virology and Serology Reporting Scheme

There were 9,118 reports received by the Virology and Serology Laboratory Reporting Scheme (LabVISE) in the reporting period, 1 July to 30 September 2009 (Tables 4 and 5).

## Table 4: Virology and serology laboratory reports by state or territory* for the reporting period 1 July to 30 September 2009, and total reports for the year†

| | State or territory | | | | | | | | This period 2009 | This period 2008 | Year to date 2009 | Year to date 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | | | | |
| **Measles, mumps, rubella** | | | | | | | | | | | | |
| Measles virus | – | 1 | – | 2 | – | – | – | – | 3 | 6 | 47 | 30 |
| Mumps virus | – | – | – | 4 | – | – | 4 | 1 | 9 | 5 | 39 | 39 |
| Rubella virus | – | – | – | 1 | – | – | 3 | – | 4 | 3 | 13 | 12 |
| **Hepatitis viruses** | | | | | | | | | | | | |
| Hepatitis A virus | – | 1 | – | 10 | – | – | – | – | 11 | 9 | 39 | 44 |
| Hepatitis E virus | – | 1 | – | 1 | – | – | – | – | 2 | 2 | 5 | 8 |
| **Arboviruses** | | | | | | | | | | | | |
| Ross River virus | – | 8 | 5 | 126 | – | 1 | 1 | 2 | 143 | 207 | 837 | 1,264 |
| Barmah Forest virus | – | 1 | – | 29 | – | – | – | – | 30 | 106 | 179 | 483 |
| Flavivirus (unspecified) | 1 | 6 | – | 23 | 1 | – | 5 | – | 36 | 13 | 207 | 55 |
| **Adenoviruses** | | | | | | | | | | | | |
| Adenovirus not typed/ pending | – | 119 | – | 169 | – | 3 | 7 | 1 | 299 | 584 | 1,161 | 1,299 |
| **Herpesviruses** | | | | | | | | | | | | |
| Herpes virus type 6 | – | – | – | – | – | – | 1 | – | 1 | – | 2 | 1 |
| Cytomegalovirus | 4 | 64 | – | 114 | – | 4 | 11 | – | 197 | 348 | 832 | 968 |
| Varicella-zoster virus | – | 63 | – | 456 | – | 4 | 18 | – | 541 | 889 | 1,924 | 2,211 |
| Epstein-Barr virus | – | 12 | 15 | 363 | – | 1 | 5 | 28 | 424 | 617 | 1,583 | 1,836 |
| **Other DNA viruses** | | | | | | | | | | | | |
| Parvovirus | – | 3 | – | 33 | – | – | 10 | 1 | 47 | 84 | 168 | 207 |
| **Picornavirus family** | | | | | | | | | | | | |
| Rhinovirus (all types) | – | 39 | – | – | – | – | – | – | 39 | 47 | 104 | 138 |
| Enterovirus not typed/ pending | 1 | 7 | – | 11 | – | 1 | – | – | 20 | 24 | 72 | 158 |
| Picornavirus not typed | – | – | – | – | – | 6 | – | – | 6 | 2 | 11 | 9 |
| **Ortho/paramyxoviruses** | | | | | | | | | | | | |
| Influenza A virus | 39 | 1,628 | 1 | 1,181 | 13 | 17 | 79 | – | 2,958 | 509 | 6,178 | 647 |
| Influenza A virus H1N1 | – | 4 | – | 1 | – | 84 | 1 | – | 90 | – | 96 | – |
| Influenza A virus H3N2 | – | 3 | – | – | – | – | – | – | 3 | – | 4 | – |
| Influenza B virus | 4 | 41 | – | 75 | – | – | 6 | – | 126 | 777 | 268 | 869 |
| Influenza virus - typing pending | – | 1 | – | – | – | – | – | – | 1 | – | 6 | – |
| Parainfluenza virus type 1 | – | 9 | – | 3 | – | – | – | – | 12 | 32 | 23 | 181 |
| Parainfluenza virus type 2 | – | 6 | – | 6 | – | – | – | – | 12 | 5 | 81 | 25 |
| Parainfluenza virus type 3 | 4 | 97 | – | 51 | 1 | – | 3 | – | 156 | 174 | 319 | 198 |
| Parainfluenza virus typing pending | – | – | – | – | – | 1 | – | – | 1 | – | 2 | – |
| Respiratory syncytial virus | 6 | 301 | – | 196 | – | 37 | 25 | 1 | 566 | 846 | 2,510 | 1,790 |
| **Other RNA viruses** | | | | | | | | | | | | |
| Rotavirus | – | 25 | – | – | – | 2 | 7 | – | 34 | 78 | 185 | 275 |
| Norwalk agent | – | 46 | – | – | – | – | – | – | 46 | 46 | 78 | 74 |

## Table 4: Virology and serology laboratory reports by state or territory* for the reporting period 1 July to 30 September 2009, and total reports for the year,† *continued*

| | State or territory | | | | | | | | This period 2009 | This period 2008 | Year to date 2009 | Year to date 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | | | | |
| **Other** | | | | | | | | | | | | |
| *Chlamydia trachomatis* not typed | 4 | 308 | 1 | 1,477 | – | 14 | 10 | – | 1,814 | 2,190 | 6,373 | 6,586 |
| *Chlamydia pneumoniae* | – | – | – | 1 | – | – | 2 | – | 3 | 1 | 9 | 2 |
| *Chlamydia psittaci* | – | 1 | – | 3 | – | 2 | 11 | – | 17 | 24 | 56 | 79 |
| *Chlamydia* spp typing pending | – | 10 | – | – | – | – | – | – | 10 | – | 16 | – |
| *Chlamydia* species | – | – | – | – | – | – | 1 | – | 1 | 1 | 8 | 3 |
| *Mycoplasma pneumoniae* | – | 9 | 5 | 132 | 1 | 7 | 90 | 5 | 249 | 305 | 823 | 729 |
| *Mycoplasma hominis* | – | 5 | – | – | – | – | – | – | 5 | 3 | 9 | 7 |
| *Coxiella burnetii* (Q fever) | – | 4 | – | 13 | – | – | 11 | – | 28 | 81 | 143 | 234 |
| *Rickettsia* - spotted fever group | – | 2 | – | 11 | – | 1 | 2 | – | 16 | 47 | 91 | 138 |
| *Streptococcus* group A | – | 7 | – | 156 | – | – | 1 | – | 164 | 317 | 479 | 767 |
| *Yersinia enterocolitica* | – | – | – | 1 | – | – | – | – | 1 | 5 | 1 | 10 |
| *Brucella* species | – | – | – | 2 | – | – | – | – | 2 | 11 | 11 | 28 |
| *Bordetella pertussis* | 1 | 195 | – | 419 | – | 1 | 4 | – | 620 | 591 | 3,553 | 1,035 |
| *Legionella pneumophila* | – | – | – | 1 | – | 1 | 4 | – | 6 | 1 | 26 | 12 |
| *Legionella longbeachae* | – | – | – | – | – | – | 1 | – | 1 | 4 | 11 | 9 |
| *Legionella* species | – | 2 | – | 6 | – | – | 1 | – | 9 | – | 22 | 1 |
| *Cryptococcus* species | – | 2 | – | 5 | – | – | – | – | 7 | 8 | 28 | 23 |
| *Leptospira* species | – | – | – | 8 | – | – | – | – | 8 | 16 | 33 | 70 |
| *Treponema pallidum* | 2 | 69 | – | 259 | – | – | 1 | – | 331 | 510 | 1,293 | 1,618 |
| *Entamoeba histolytica* | – | – | – | 3 | – | – | 2 | – | 5 | 4 | 6 | 8 |
| *Toxoplasma gondii* | – | – | – | 1 | – | 3 | – | – | 4 | 6 | 15 | 12 |
| Total | 66 | 3,100 | 27 | 5,353 | 16 | 190 | 327 | 39 | 9,118 | 9,538 | 29,979 | 24,192 |

* State or territory of postcode, if reported, otherwise state or territory of reporting laboratory.

† Data presented are for reports with reports dates in the current period.

– No data received this period.

## Table 5: Virology and serology reports by laboratories for the reporting period 1 July to 30 September 2009*

| State or territory | Laboratory | July 2009 | August 2009 | September 2009 | Total this period |
|---|---|---|---|---|---|
| Australian Capital Territory | The Canberra Hospital | – | – | – | – |
| New South Wales | Institute of Clinical Pathology and Medical Research, Westmead | 1,182 | 358 | 158 | 1,698 |
| | New Children's Hospital, Westmead | 323 | 119 | 124 | 566 |
| | Repatriation General Hospital, Concord | – | – | – | – |
| | Royal Prince Alfred Hospital, Camperdown | 38 | 40 | 5 | 83 |
| | South West Area Pathology Service, Liverpool | 228 | 94 | 95 | 417 |
| Queensland | Queensland Medical Laboratory, West End | 2,684 | 1,481 | 1,624 | 5,789 |
| | Townsville General Hospital | – | – | – | – |
| South Australia | Institute of Medical and Veterinary Science, Adelaide | – | – | – | – |
| Tasmania | Northern Tasmanian Pathology Service, Launceston | 98 | 46 | 29 | 173 |
| | Royal Hobart Hospital, Hobart | – | – | – | – |
| Victoria | Australian Rickettsial Reference Laboratory | 13 | 1 | – | 14 |
| | Monash Medical Centre, Melbourne | 53 | 10 | – | 63 |
| | Royal Children's Hospital, Melbourne | – | – | – | – |
| | Victorian Infectious Diseases Reference Laboratory, Fairfield | 89 | 94 | 73 | 256 |
| Western Australia | PathWest Virology, Perth | – | – | – | – |
| | Princess Margaret Hospital, Perth | – | – | – | – |
| | Western Diagnostic Pathology | – | – | 59 | 59 |
| Total | | 4,708 | 2,243 | 2,167 | 9,118 |

* The complete list of laboratories reporting for the 12 months, January to December 2009, will appear in every report regardless of whether reports were received in this reporting period. Reports are not always received from all laboratories.

– No data received this period.

# Additional reports

## Australian childhood immunisation coverage

*Tables 1, 2 and 3 provide the latest quarterly report on childhood immunisation coverage from the Australian Childhood Immunisation Register (ACIR).*

*The data show the percentage of children fully immunised at 12 months of age for the cohort born between 1 April and 30 June 2008, at 24 months of age for the cohort born between 1 April and 30 June 2007, and at 5 years of age for the cohort born between 1 April and 30 June 2004 according to the National Immunisation Program Schedule. However from March 2002 to December 2007, coverage for vaccines due at 4 years of age was assessed at the 6-year milestone age.*

*For information about the Australian Childhood Immunisation Register see Surveillance systems reported in* CDI, *published in* Commun Dis Intell *2008;32:134–135 and for a full description of the methodology used by the Register see* Commun Dis Intell *1998;22:36-37.*

*Commentary on the trends in ACIR data is provided by the National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases (NCIRS). For further information please contact the NCIRS at telephone: +61 2 9845 1435, Email: brynleyh@chw.edu.au*

'Fully immunised' at 12 months of age is defined as a child having a record on the ACIR of 3 doses of a diphtheria (D), tetanus (T) and pertussis-containing (P) vaccine, 3 doses of polio vaccine, 2 or 3 doses of *Haemophilus influenzae* type b (Hib) vaccine, and 2 or 3 doses of hepatitis B vaccine. 'Fully immunised' at 24 months of age is defined as a child having a record on the ACIR of 3 or 4 doses of a DTP-containing vaccine, 3 doses of polio vaccine, 3 or 4 doses of Hib vaccine, 2 or 3 doses of hepatitis B vaccine and one dose of a measles, mumps and rubella-containing (MMR) vaccine. 'Fully immunised' at 5 years of age is defined as a child having a record on the ACIR of 4 or 5 doses of a DTP-containing vaccine, 4 doses of polio vaccine, and 2 doses of an MMR-containing vaccine.

Immunisation coverage for children 'fully immunised' at 12 months of age for Australia increased slightly by 0.7 of a percentage point to 92.0% (Table 1). There were no important changes in coverage for any individual vaccines due at 12 months of age or by jurisdiction.

Immunisation coverage for children 'fully immunised' at 24 months of age for Australia decreased slightly by 0.2 of a percentage point to 92.7 (Table 2). There were no important changes in coverage for any individual vaccines due at 24 months of age or by jurisdiction.

Immunisation coverage for 'fully immunised' at 5 years of age for Australia is currently at 82.1% (Table 3). In the Northern Territory, South Australia and Western Australia it is below 80% at 79.3%, 78.4% and 79.2% respectively. The only important changes in coverage for individual vaccines due at 5 years of age were seen in the Northern Territory (a decrease in all vaccines by around 5 percentage points) and in Tasmania (an increase in all vaccines by around 5–6 percentage points).

Figure 1 shows the trends in vaccination coverage from the first ACIR-derived published coverage estimates in 1997 to the current estimates. There is a clear trend of increasing vaccination coverage over time for children aged 12 months, 24 months and 6 years (5 years from March 2008), although coverage for vaccines due at 4 years decreases significantly due to the change in assessment age from 6 to 5 years. It should also be noted that, currently, coverage for the vaccines added to the NIP since 2003 (varicella at 18 months, meningococcal C conjugate at 12 months and pneumococcal conjugate at 2, 4, and 6 months) are not included in the 12 or 24 months coverage data, respectively.

**Figure 1: Trends in vaccination coverage, Australia, 1997 to 30 June 2009, by age cohorts**

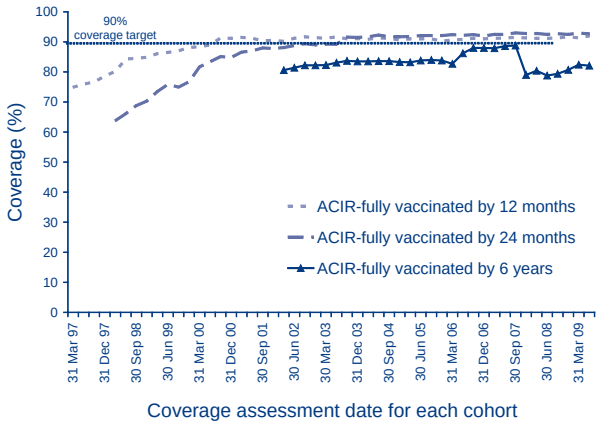


**Table 1: Percentage of children immunised at 1 year of age, preliminary results by disease and state or territory for the birth cohort 1 April to 30 June 2008; assessment date 30 September 2009**

| Vaccine | State or territory | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | Aust |
| Total number of children | 1,140 | 23,639 | 980 | 15,482 | 4,758 | 1,554 | 17,001 | 7,646 | 72,200 |
| Diphtheria, tetanus, pertussis (%) | 94.8 | 92.5 | 93.0 | 92.2 | 91.9 | 92.9 | 93.0 | 90.9 | 92.4 |
| Poliomyelitis (%) | 94.8 | 92.5 | 93.0 | 92.2 | 91.9 | 92.9 | 93.0 | 90.8 | 92.4 |
| *Haemophilus influenzae* type b (%) | 95.9 | 95.1 | 95.1 | 94.7 | 94.5 | 95.6 | 95.3 | 93.9 | 94.9 |
| Hepatitis B (%) | 95.6 | 95.0 | 96.5 | 94.5 | 94.3 | 95.6 | 95.2 | 93.7 | 94.8 |
| Fully immunised (%) | 94.4 | 92.2 | 91.8 | 91.9 | 91.7 | 92.9 | 92.6 | 90.4 | 92.0 |
| Change in fully immunised since last quarter (%) | +0.8 | +0.2 | +1.6 | +1.0 | +0.2 | +2.6 | +0.7 | +1.4 | +0.7 |

**Table 2: Percentage of children immunised at 2 years of age, preliminary results by disease and state or territory for the birth cohort 1 April to 30 June 2007; assessment date 30 September 2009***

| Vaccine | State or territory | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | Aust |
| Total number of children | 1,144 | 24,466 | 978 | 15,512 | 4,772 | 1,547 | 17,291 | 7,556 | 73,266 |
| Diphtheria, tetanus, pertussis (%) | 96.6 | 94.8 | 95.7 | 94.2 | 94.9 | 96.3 | 95.9 | 94.4 | 95.0 |
| Poliomyelitis (%) | 96.5 | 94.8 | 95.7 | 94.2 | 94.8 | 96.2 | 95.8 | 94.4 | 94.9 |
| *Haemophilus influenzae* type b (%) | 96.2 | 95.2 | 94.4 | 93.6 | 93.9 | 96.1 | 95.0 | 94.5 | 94.7 |
| Measles, mumps, rubella (%) | 95.4 | 93.6 | 95.8 | 93.4 | 94.2 | 95.5 | 94.9 | 93.3 | 94.0 |
| Hepatitis B (%) | 96.9 | 95.7 | 96.8 | 95.1 | 95.4 | 96.8 | 96.4 | 95.1 | 95.7 |
| Fully immunised (%) | 94.3 | 92.4 | 93.9 | 92.1 | 92.7 | 94.7 | 93.8 | 91.8 | 92.7 |
| Change in fully immunised since last quarter (%) | +0.7 | -0.3 | -0.8 | -0.1 | -0.5 | +1.7 | -0.1 | +0.0 | -0.1 |

* The 12 months age data for this cohort were published in *Commun Dis Intell* 2008;32:489.

**Table 3: Percentage of children immunised at 5 years of age, preliminary results by disease and state or territory for the birth cohort 1 April to 30 June 2004; assessment date 30 September 2009**

| Vaccine | State or territory | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | Aust |
| Total number of children | 1,041 | 21,386 | 864 | 13,865 | 4,376 | 1,359 | 15,634 | 6,996 | 65,521 |
| Diphtheria, tetanus, pertussis (%) | 87.7 | 82.1 | 80.0 | 84.1 | 78.9 | 85.1 | 85.0 | 80.3 | 82.9 |
| Poliomyelitis (%) | 87.7 | 82.0 | 79.9 | 83.9 | 78.9 | 85.3 | 85.0 | 80.2 | 82.9 |
| Measles, mumps, rubella (%) | 87.3 | 81.8 | 80.0 | 83.7 | 78.8 | 85.4 | 84.6 | 80.1 | 82.6 |
| Fully immunised (%) | 87.0 | 81.3 | 79.3 | 83.2 | 78.4 | 84.4 | 84.3 | 79.2 | 82.1 |
| Change in fully immunised since last quarter (%) | +2.6 | -0.6 | -5.5 | +0.7 | +2.7 | +5.8 | -1.5 | -1.1 | -0.3 |

## Australian gonococcal surveillance

*John Tapsall, The Prince of Wales Hospital, Randwick NSW 2031 for the Australian Gonococcal Surveillance Programme*

*The Australian Gonococcal Surveillance Programme (AGSP) reference laboratories in the various states and territories report data on sensitivity to an agreed 'core' group of antimicrobial agents quarterly. The antibiotics currently routinely surveyed are penicillin, ceftriaxone, ciprofloxacin and spectinomycin, all of which are administered as single dose regimens and currently used in Australia to treat gonorrhoea. When in vitro resistance to a recommended agent is demonstrated in 5% or more of isolates from a general population, it is usual*

*to remove that agent from the list of recommended treatment.*[1] *Additional data are also provided on other antibiotics from time to time. At present all laboratories also test isolates for the presence of high level (plasmid-mediated) resistance to the tetracyclines, known as TRNG. Tetracyclines are however, not a recommended therapy for gonorrhoea in Australia. Comparability of data is achieved by means of a standardised system of testing and a program-specific quality assurance process. Because of the substantial geographic differences in susceptibility patterns in Australia, regional as well as aggregated data are presented. For more information see* Commun Dis Intell *2008;32:134.*

**Reporting period 1 April to 30 June 2009**

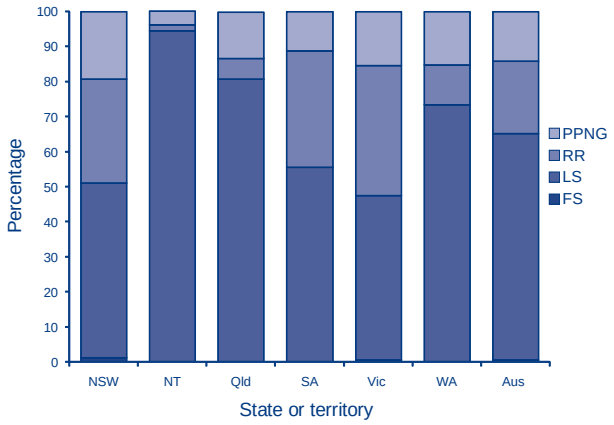
The AGSP laboratories received a total of 796 isolates in this quarter, a decrease from the 854 seen in the corresponding period in 2008. Of these, 782 remained viable for susceptibility testing. About 28% of this total was from New South Wales, 23% from Victoria, 17% from Queensland, 16% from the Northern Territory, 11% from Western Australia and 3.4% from South Australia. There were 7 isolates from the Australian Capital Territory and a single isolate from Tasmania. The number of isolates examined in Victoria, Queensland and the Northern Territory increased, while those from New South Wales were similar. There was a decline in numbers examined in Western and South Australia, with a marked decrease in South Australia.

## Penicillins

In this quarter, 272 (34.8%) of all isolates examined were penicillin resistant by one or more mechanisms, a 33% decline from the 402 reported in the same quarter in 2008. One hundred and ten (14.1%) isolates were penicillinase-producing *Neisseria gonorrhoeae* (PPNG) and 162 (20.7%) were resistant by chromosomal mechanisms, (CMRP). The decease in numbers in CMRP from the 304 recorded in this quarter in 2008 was especially marked, whereas PPNG increased slightly from the 98 (11%) seen in 2008. The proportion of all strains resistant to the penicillins by any mechanism ranged from 5.4% in the Northern Territory to 52.5% in Victoria. High rates of penicillin resistance were also found in New South Wales (49%), South Australia (44%), Western Australia (26%) and Queensland (19%).

Figure 2 shows the proportions of gonococci fully sensitive (MIC ≤ 0.03 mg/L), less sensitive (MIC 0.06–0.5 mg/L), relatively resistant (MIC ≤ 1 mg/L) or else PPNG, aggregated for Australia and by state or territory. A high proportion of those strains classified as PPNG or CMRP fail to respond to treatment with penicillins (penicillin, amoxycillin, ampicillin) and early generation cephalosporins.

**Figure 2: Categorisation of gonococci isolated in Australia, 1 April to 30 June 2009, by penicillin susceptibility and state or territory**




| | |
|---|---|
| FS | Fully sensitive to penicillin, MIC ≤0.03 mg/L. |
| LS | Less sensitive to penicillin, MIC 0.06–0.5 mg/L. |
| RR | Relatively resistant to penicillin, MIC ≥1 mg/L. |
| PPNG | Penicillinase producing *Neisseria gonorrhoeae*. |

In Victoria, New South Wales and South Australia most of the penicillin resistance was due to CMRP. In Victoria, 67 (37%) were CMRP and 28 (15%) PPNG. In New South Wales 66, (30%) isolates were CMRP with 43 (19%) PPNG and in South Australia 9 (33%) isolates were CMRP and 3 (11%) were PPNG. In Queensland, PPNG were more prominent (13%, 18 isolates) with 6% CMRP. Similarly in Western Australia PPNG were more prominent (15%, 12 isolates) with 11% CMRP. Five PPNG and 2 CMRP were detected in the Northern Territory. One isolate from the Australian Capital Territory was chromosomally resistant and the single isolate from Tasmania was PPNG.

## Ceftriaxone

Thirteen isolates with decreased susceptibility to ceftriaxone (MIC range 0.06–0.12 mg/L) were detected: five in New South Wales, four in Western Australia, two in South Australia and one each in Queensland and Victoria.

## Spectinomycin

All isolates were susceptible to this injectable agent.

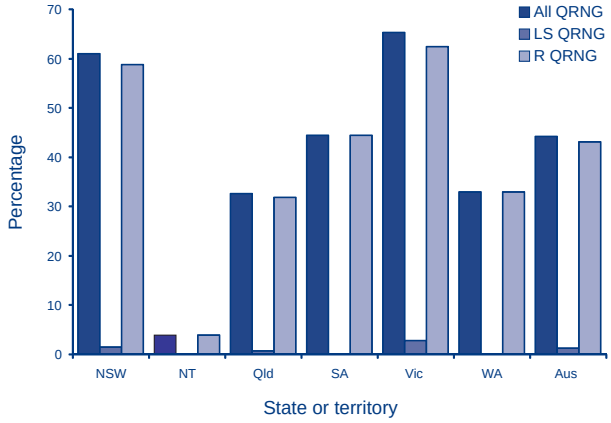
## Quinolone antibiotics

Quinolone resistant *N. gonorrhoeae* (QRNG) are defined as those isolates with an MIC to ciprofloxacin equal to or greater than 0.06 mg/L. QRNG are further subdivided into less sensitive (ciprofloxacin MICs 0.06–0.5 mg/L) or resistant (MIC ≤ 1 mg/L) groups.

A total of 346 QRNG was present in this quarter and represented 44.3% of all gonococci tested nationally. This was a decrease in the proportion of QRNG when compared with the 58.5% in this quarter in 2008, and the 44.5% in 2007. The majority of QRNG in the current period continued to exhibit higher-level resistance (ciprofloxacin MICs 1 mg/L or more).

QRNG were detected in all states and territories. The highest proportion of QRNG was present in Victoria where 118 QRNG were 65.2% of all isolates. A high number (134) and proportion (60%) of QRNG were found in New South Wales, Queensland (44 QRNG, 33%), Western Australia (26 QRNG, 33%) and South Australia (12 QRNG 45%) (Figure 3). Six isolates from the Australian Capital Territory, five from the Northern Territory and a single strain from Tasmania were QRNG.

**Figure 3: The distribution of quinolone resistant isolates of *Neisseria gonorrhoeae* in Australia, 1 April to 30 June 2009, by state or territory**




LS QRNG Ciprofloxacin MICs 0.06–0.5 mg/L.

R QRNG Ciprofloxacin MICs ≥1 mg/L.

## High level tetracycline resistance

There were 165 isolates with high level tetracycline resistance (TRNG) detected, which was more than the 146 found in this quarter in 2008 and represented 21.1% of all isolates. The highest proportion of TRNG in any jurisdiction was in Western Australia with 34% and the highest number was in New South Wales with 68 isolates. TRNG were present in all states and territories except the Australian Capital Territory

### Reference

1. Management of sexually transmitted diseases. World Health Organization 1997; Document WHO/GPA/TEM94.1 Rev.1 p 37.

## Australian Sentinel Practice Research Network

*The Australian Sentinel Practices Research Network (ASPREN) is a national surveillance system that is owned and operated by the Royal Australian College of General Practitioners and directed through the Discipline of General Practice at the University of Adelaide.*

*The network consists of general practitioners who report presentations on a number of defined medical conditions each week. ASPREN was established in 1991 to provide a rapid monitoring scheme for infectious diseases that can alert public health officials of epidemics in their early stages as well as play a role in the evaluation of public health campaigns and research of conditions commonly seen in general practice. Electronic data collection was established in 2006 and currently, further development of ASPREN is in progress to create an automatic reporting system.*

*The list of conditions is reviewed annually by the ASPREN management committee and an annual report is published. In 2009, four conditions are being monitored. They include influenza-like (ILI) illness, gastroenteritis and varicella infections (chickenpox and shingles). Definitions of these conditions are described in Surveillance systems reported in* CDI, *published in* Commun Dis Intell *2008;32:135.*

*Data on influenza-like illness, gastroenteritis, chickenpox and shingles from 1 July to 30 September 2009 compared with 2008, are shown as the rate per 1,000 consultations in Figures 4, 5, 6 and 7, respectively.*

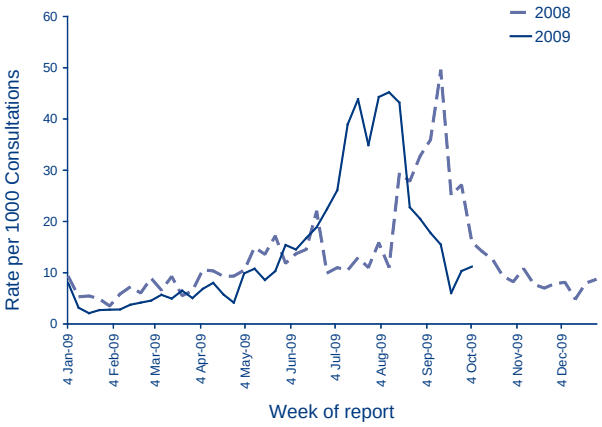
### Reporting period 1 July to 30 September 2009

Sentinel practices contributing to ASPREN were located in all jurisdictions other than the Northern Territory. A total of 91 general practitioners contributed data to ASPREN in the 3rd quarter of 2009. Each week an average of 56 general practitioners provided information to ASPREN at an average of 8,016 (range 5,899–9,417) consultations per week and an average of 294 (range 144–475) notifications per week.

ILI rates reported from 1 July to 30 September 2009 were 9–61 cases per 1,000 consultations. The reported rates in July and August 2009 were significantly higher (22–44 cases per 1,000 consultations and 21–45 cases per 1,000 consultations, respectively) compared with the same reporting period in 2008 (10–13 cases per 1,000 consultations and 11–33 cases per 1,000 consultations, respectively). ILI rates reported in September 2009 (6–18 cases

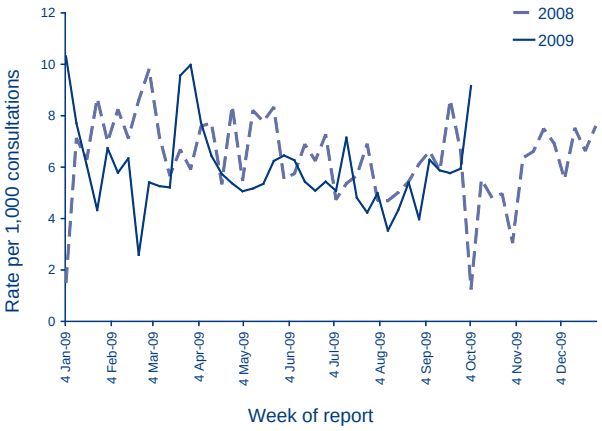
per 1,000 consultations) were significantly lower than rates recorded in September 2008 (16–50 cases per 1,000 consultations) (Figure 4).

**Figure 4: Consultation rates for influenza-like illness, ASPREN, 1 January 2008 to 30 September 2009, by week of report**



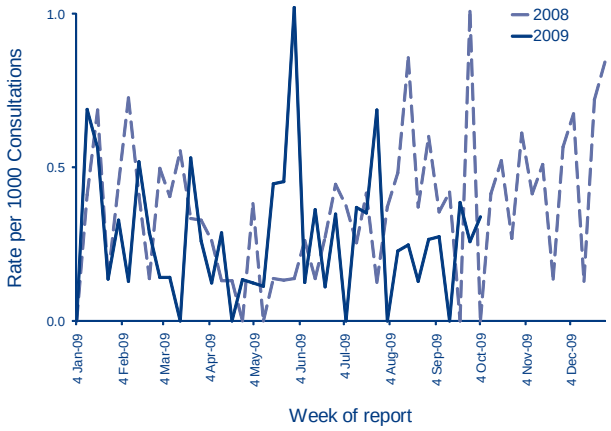

During this reporting period, consultation rates for gastroenteritis ranged from 4 to 9 cases per 1000 (Figure 5).

**Figure 5: Consultation rates for gastroenteritis, ASPREN, 1 January 2008 to 30 September 2009, by week of report**



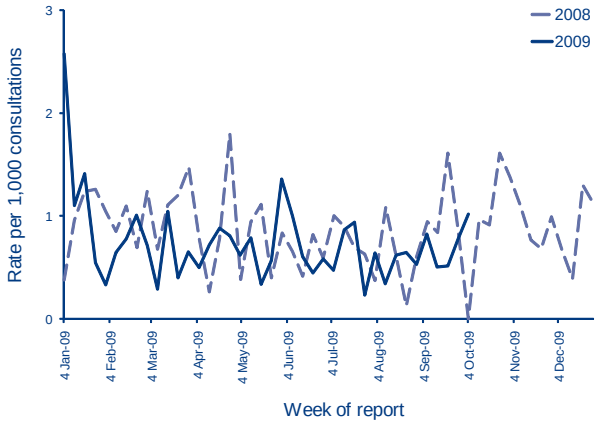

Varicella infections were reported at a slightly lower rate for the 3rd quarter of 2009 compared with the same period in 2008. From 1 July to 30 September 2009 recorded rates for chickenpox were between 0 and 0.7 cases per 1,000 consultations (Figure 6).

**Figure 6: Consultation rates for chickenpox, ASPREN, 1 January 2008 to 30 September 2009, by week of report**




In the 3rd quarter of 2009, reported rates for shingles were between 0.2 to 1 case per 1,000 consultations (Figure 7).

**Figure 7: Consultation rates for shingles, ASPREN, 1 January 2008 to 30 September 2009, by week of report**



## Australian meningococcal surveillance

*John Tapsall, The Prince of Wales Hospital, Randwick, NSW, 2031 for the Australian Meningococcal Surveillance Programme.*

*The reference laboratories of the Australian Meningococcal Surveillance Programme report data on the number of laboratory confirmed cases confirmed either by culture or by non-culture based techniques. Culture positive cases, where a Neisseria meningitidis is grown from a normally sterile site or skin, and non-culture based diagnoses, derived from results of nucleic acid amplification assays and serological techniques, are defined as invasive meningococcal disease (IMD) according to Public Health Laboratory Network definitions. Data contained in the quarterly reports are restricted to a description of the number of cases per jurisdiction, and serogroup, where known. A full analysis of laboratory confirmed cases of IMD is contained in the annual reports of the Programme, published in Communicable Diseases Intelligence. For more information see* Commun Dis Intell *2009;33:82.*

*Laboratory confirmed cases of invasive meningococcal disease for the period 1 July to 30 September 2009, are included in this issue of* Communicable Diseases Intelligence *(Table 4).*

**Table 4: Number of laboratory confirmed cases of invasive meningococcal disease, Australia, 1 July to 30 September 2009, by serogroup and state or territory**

| State or territory | Year | Serogroup | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | | B | | C | | Y | | W135 | | ND | | All | |
| | | Q3 | YTD | Q3 | YTD | Q3 | YTD | Q3 | YTD | Q3 | YTD | Q3 | YTD | Q3 | YTD |
| Australian Capital Territory | 09 | | | 0 | 3 | | | | | | | | | 0 | 3 |
| | 08 | | | 0 | 2 | 1 | 1 | | | | | | | 1 | 3 |
| New South Wales | 09 | | | 24 | 49 | 3 | 7 | 2 | 3 | 2 | 4 | 0 | 3 | 31 | 66 |
| | 08 | | | 14 | 27 | 1 | 4 | 1 | 3 | 1 | 2 | | | 17 | 36 |
| Northern Territory | 09 | | | 0 | 3 | 0 | 1 | | | | | | | 0 | 4 |
| | 08 | | | 3 | 3 | 0 | 2 | | | | | | | 3 | 5 |
| Queensland | 09 | | | 19 | 36 | 0 | 0 | 1 | 1 | | | 2 | 2 | 22 | 39 |
| | 08 | | | 11 | 52 | 2 | 4 | | | 0 | 0 | 11 | 11 | 24 | 67 |
| South Australia | 09 | | | 4 | 15 | | | 1 | 2 | | | | | 5 | 17 |
| | 08 | | | 5 | 12 | | | | | 1 | 1 | | | 6 | 13 |
| Tasmania | 09 | | | 0 | 1 | | | | | | | | | 0 | 1 |
| | 08 | | | 0 | 0 | | | | | | | | | 0 | 0 |
| Victoria | 09 | | | 13 | 23 | 0 | 1 | | | | | 1 | 3 | 14 | 27 |
| | 08 | | | 20 | 44 | 1 | 1 | 0 | 1 | | | 3 | 6 | 24 | 52 |
| Western Australia | 09 | | | 6 | 16 | 0 | 2 | 1 | 1 | | | | | 7 | 19 |
| | 08 | | | 8 | 16 | | | | | | | 0 | 1 | 8 | 17 |
| Total | 09 | | | 66 | 146 | 3 | 11 | 5 | 7 | 2 | 4 | 3 | 8 | 79 | 176 |
| | 08 | | | 61 | 156 | 5 | 12 | 1 | 4 | 2 | 3 | 14 | 18 | 83 | 193 |

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## HIV and AIDS surveillance

*National surveillance for HIV disease is coordinated by the National Centre in HIV Epidemiology and Clinical Research (NCHECR), in collaboration with State and Territory health authorities and the Commonwealth of Australia. Cases of HIV infection are notified to the National HIV Database on the first occasion of diagnosis in Australia, by either the diagnosing laboratory (Australian Capital Territory, New South Wales, Tasmania, Victoria) or by a combination of laboratory and doctor sources (Northern Territory, Queensland, South Australia, Western Australia). Cases of AIDS are notified through the State and Territory health authorities to the National AIDS Registry. Diagnoses of both HIV infection and AIDS are notified with the person's date of birth and name code, to minimise duplicate notifications while maintaining confidentiality.*

*Tabulations of diagnoses of HIV infection and AIDS are based on data available three months after the end of the reporting interval indicated, to allow for reporting delay and to incorporate newly available information. More detailed information on diagnoses of HIV infection and AIDS is published in the quarterly Australian HIV Surveillance Report, and annually in 'HIV/AIDS, viral hepatitis and sexually transmissible infections in Australia, annual surveillance report'. The reports are available from the National Centre in HIV Epidemiology and Clinical Research, 376 Victoria Street, Darlinghurst NSW 2010. Internet: http://www.med.unsw.edu.au/nchecr. Telephone: +61 2 9385 0900. Facsimile: +61 2 9385 0920. For more information see* Commun Dis Intell *2009;33:83.*

*HIV and AIDS diagnoses and deaths following AIDS reported for 1 January to 31 March 2009, as reported to 30 June 2009, are included in this issue of* Communicable Diseases Intelligence *(Tables 5 and 6).*

## Table 5: New diagnoses of HIV infection, new diagnoses of AIDS and deaths following AIDS occurring in the period 1 January to 31 March 2009, by sex and state or territory of diagnosis

| | Sex | State or territory | | | | | | | | Totals for Australia | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | This period 2009 | This period 2008 | YTD 2009 | YTD 2008 |
| HIV diagnoses | Female | 0 | 2 | 2 | 10 | 3 | 0 | 10 | 0 | 27 | 28 | 27 | 28 |
| | Male | 3 | 45 | 2 | 35 | 11 | 0 | 50 | 1 | 147 | 237 | 147 | 237 |
| | Not reported | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| | Total* | 3 | 48 | 4 | 45 | 14 | 0 | 60 | 1 | 175 | 265 | 175 | 265 |
| AIDS diagnoses | Female | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 4 | 1 | 4 | 1 |
| | Male | 0 | 0 | 0 | 2 | 0 | 0 | 12 | 0 | 14 | 29 | 14 | 29 |
| | Total* | 0 | 0 | 1 | 3 | 0 | 0 | 14 | 0 | 18 | 30 | 18 | 30 |
| AIDS deaths | Female | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Male | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 4 | 2 | 4 |
| | Total* | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 4 | 2 | 4 |

* Totals include people whose sex was reported as transgender.

## Table 6: Number of new diagnoses of HIV infection since the introduction of HIV antibody testing in 1985, and number of new diagnoses of AIDS and deaths following AIDS since 1981, cumulative to 31 March 2009, as reported to 30 June 2009, by sex and state or territory

| | Sex | State or territory | | | | | | | | Australia |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ACT | NSW | NT | Qld | SA | Tas | Vic | WA | |
| HIV diagnoses | Female | 35 | 967 | 27 | 339 | 119 | 13 | 445 | 240 | 2,185 |
| | Male | 276 | 14,191 | 148 | 3,104 | 1,033 | 115 | 5,800 | 1,332 | 25,999 |
| | Not reported | 0 | 229 | 0 | 0 | 0 | 0 | 22 | 0 | 251 |
| | Total* | 311 | 15,417 | 175 | 3,452 | 1,153 | 128 | 6,289 | 1,579 | 28,504 |
| AIDS diagnoses | Female | 10 | 265 | 5 | 74 | 32 | 4 | 123 | 45 | 558 |
| | Male | 94 | 5,513 | 47 | 1,082 | 418 | 55 | 2,114 | 448 | 9,771 |
| | Total* | 104 | 5,796 | 52 | 1,158 | 451 | 59 | 2,250 | 495 | 10,365 |
| AIDS deaths | Female | 7 | 138 | 1 | 43 | 20 | 2 | 64 | 29 | 304 |
| | Male | 73 | 3,597 | 32 | 679 | 280 | 34 | 1,444 | 299 | 6,438 |
| | Total* | 80 | 3,746 | 33 | 724 | 300 | 36 | 1,517 | 329 | 6,765 |

* Totals include people whose sex was reported as transgender.

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# Reviewers for *Communicable Diseases Intelligence* in 2009

The *Communicable Diseases Intelligence* staff wish to thank the following reviewers for their valued assistance throughout the year.

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