Australia's notifiable disease status, 2014: Annual report of the National Notifiable Diseases Surveillance System

NNDSS Annual Report Working Group

Abstract

In 2014, 69 diseases and conditions were nationally notifiable in Australia. States and territories reported a total of 275,581 notifications of communicable diseases to the National Notifiable Diseases Surveillance System, an increase of 22% on the number of notifications in 2013. In 2014, the most frequently notified diseases were sexually transmissible infections (105,719 notifications, 38% of total notifications), vaccine preventable diseases (101,400 notifications, 37% of total notifications), and gastrointestinal diseases (40,367 notifications, 15% of total notifications). There were 17,411 notifications of bloodborne diseases; 8,125 notifications of vectorborne diseases; 1,942 notifications of other bacterial infections; 615 notifications of zoonoses and 2 notifications of quarantinable diseases. *Commun Dis Intell* 2016;40(1):E48–E145.

Keywords: Australia, communicable diseases, epidemiology, surveillance

Introduction

Australia's notifiable diseases status, 2014, is an annual surveillance report of nationally notifiable communicable diseases. Communicable disease surveillance in Australia operates at the national, jurisdictional and local levels. Primary responsibility for public health action lies with the state and territory health departments. The role of communicable disease surveillance at the national level includes:

- identifying national trends;
- providing guidance for policy development and resource allocation at the national level;
- monitoring the need for and impact of national disease control programs;
- informing the response to national or multi-jurisdictional outbreaks;
- describing the national epidemiology of communicable diseases;
- meeting international reporting requirements, such as providing disease statistics to the World Health Organization (WHO); and
- supporting quarantine activities, which are the responsibility of the Australian government.

Methods

Australia is a federation of 6 states (New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia) and 2 territories (the Australian Capital Territory and the Northern Territory).

State and territory health departments collect notifications of communicable diseases under their respective public health legislations. In September 2007, the *National Health Security Act 2007*[1] received royal assent. This Act provides a legislative basis for and authorises the exchange of health information, including personal information, between jurisdictions and the Australian Government. The Act provides for the establishment of the National Notifiable Diseases List,[2] which specifies the diseases about which personal information can be provided. The *National Health Security Agreement*,[3] which was signed by Health Ministers in April 2008, establishes the operational arrangements to formalise and enhance existing surveillance and reporting systems, an important objective of the Act. Under the Agreement, in 2014 states and territories forwarded de-identified notification data on 65 communicable diseases to the Australian Government Department of Health for the purposes of national communicable disease surveillance, although not all 65 diseases were notifiable in each jurisdiction. Data were electronically updated daily from states and territories. The system was complemented by other surveillance systems, which provided information on various diseases, including 4 that are not reported to the National Notifiable Diseases Surveillance System (NNDSS): human immunodeficiency virus (HIV), acquired immune deficiency syndrome (AIDS) and the classical and variant forms of Creutzfeldt-Jakob disease (CJD).

The NNDSS core dataset requires the following mandatory data fields: unique record reference number; notifying state or territory; disease code; confirmation status and the date when the jurisdictional health department was notified (notification received date). In addition, the following data fields were supplied where available: date of birth; age at onset; sex; Indigenous status; postcode of residence; disease onset date; date

when the pathology service authorised a report or a medical practitioner signed the notification form (notification date); death status; date of specimen collection; and outbreak reference number (to identify cases linked to an outbreak). Where relevant, information on the species, serogroups/subtypes and phage types of organisms isolated, and on the vaccination status of the case were collected and reported to NNDSS. Data quality was monitored by the Office of Health Protection and the National Surveillance Committee (NSC) and there was a continual process of improving the national consistency of communicable disease surveillance through the daily, fortnightly and quarterly review of these data.

While not included in the core national dataset, enhanced surveillance information for some diseases (invasive pneumococcal disease, hepatitis B, hepatitis C, tuberculosis, donovanosis, gonococcal infection and syphilis < 2 years duration) were reported from states and territories to NNDSS. With the exception of hepatitis B and hepatitis C these enhanced data are not included in this report. These data, along with influenza enhanced data, are reported in separate (disease-specific) annual reports. Additional information concerning mortality and specific health risk factors for some diseases were obtained from states and territories and included in this annual report.

Newly diagnosed HIV infection and AIDS were notifiable conditions in each state or territory health jurisdiction in 2014. These data were forwarded to the Kirby Institute for Infection and Immunity in Society (Kirby Institute). Further information can be found in the Kirby Institute's annual surveillance report.[4]

Surveillance for the classical and variant forms of CJD in Australia has been conducted through the Australian National Creutzfeldt-Jakob Disease Registry (ANCJDR) since its establishment in October 2003. CJD is a nationally notifiable disease and by June 2006, CJD was notifiable in all states and territories. Further surveillance information on CJD can be found in surveillance reports from the ANCJDR.[5]

Information on communicable disease surveillance is communicated through several avenues. The most up-to-date information on topics of interest is provided at the fortnightly teleconferences of the Communicable Diseases Network Australia (CDNA). A summary of these reports is available online from the CDNA web site (http://www.health.gov.au/internet/main/publishing.nsf/Content/cdnareport.htm).[6]

The *Communicable Diseases Intelligence* (CDI) quarterly journal publishes surveillance data, annual surveillance reports, short reports, and articles on the epidemiology and control of communicable diseases in Australia.

Notification rates for each notifiable disease were calculated using the estimated 2014 December resident population supplied by the Australian Bureau of Statistics (ABS) (Appendix 1 and Appendix 2).[7] Where diseases were not notifiable in a state or territory, national rates were adjusted by excluding the population of that jurisdiction from the denominator. For some diseases, age adjusted rates were calculated using the direct method of standardisation with 2011 census data as the standard population. All rates are represented as the rate per 100,000 population unless stated otherwise.

Direct age standardised notification rates, using the method described by the Australian Institute of Health and Welfare,[8] were calculated for Aboriginal and Torres Strait Islander and non-Indigenous notifications for relevant STIs for jurisdictions that had Indigenous status data completed for more than 50% of notifications over the period from 2007 to 2012. Where the Indigenous status of a notification was not completed, these notifications were counted as non-Indigenous in the analyses. These data, however, should be interpreted with caution, as STI screening may occur predominantly in specific high risk groups, including in remote Aboriginal and Torres Strait Islander populations. Recent studies have suggested that higher rates in Aboriginal and Torres Strait Islander populations may be attributable to higher prevalence and reinfection rates while others have suggested that they may be due to increased testing and contact tracing.[9]

In the national case definitions for chlamydial infection, gonococcal infection and syphilis the mode of transmission cannot be inferred from the site of infection. Infections in children may be acquired perinatally (e.g. congenital chlamydia).[10] As such, notifications of chlamydial, gonococcal and non-congenital syphilis infections were excluded from analysis of age and sex distribution where the case was aged less than 13 years and the infection was able to be determined as non-sexually acquired through enhanced surveillance data where available.

Notes on interpretation

This report is based on 2014 data from each state and territory, agreed upon in June 2015, and represents a snapshot of the year after duplicate records and incorrect or incomplete data were removed.

Totals in this report may vary slightly from the totals reported in CDI quarterly publications and state and territory reports.

Analyses in this report were based on the date of disease diagnosis in an attempt to estimate disease activity within the reporting period. The date of diagnosis is the onset date or where the onset date was not known, the earliest of the following dates: specimen collection date, the notification date, or the notification received date. In January 2014, the NSC redefined the diagnosis date methodology for hepatitis B (unspecified), hepatitis C (unspecified), leprosy, syphilis (unspecified) and tuberculosis. As considerable time can elapse between the initial infection, the onset of symptoms and the subsequent diagnosis, the diagnosis date for these 5 diseases is derived from the notification receive date.

When referring to NNDSS notification data throughout the report, the term 'cases' or 'notified cases' are used to identify individuals for whom 'notification' of a condition has been received by NNDSS. These notifications can only represent a proportion (the 'notified fraction') of the total incidence (Figure 1) and this has to be taken into account when interpreting NNDSS data. Moreover, the notified fraction varies by jurisdiction, over time and by disease. This caveat is particularly relevant to sexually transmissible infections (STIs), many or most of which are identified through screening programs (Figure 1 dashed line).

A survey of jurisdictional public health departments was conducted in 2014 to ascertain the source of each notification (Table 1). Whilst most jurisdictions have data on laboratory notifications, the percentage of notifications attributed to doctor only and laboratory and doctor for each state and territory are based on estimates deduced from the data that are available, noting that fields for these data may be incomplete.

Methods of surveillance vary between states and territories, each having different requirements for notification by medical practitioners, laboratories and hospitals. Although the National Notifiable Diseases List[2] was established, some diseases are not notifiable in all 8 jurisdictions (Table 2).

Table 1: Percentage of notified cases from different sources in each jurisdiction, 2014*

State or territory	Source of notifications		
	Laboratory only	Doctor only	Laboratory and doctor
ACT	95	<1	4
NSW	99	<1	<1
NT	98	1	1
Qld	100	<1	<1
SA	6	2	92
Tas.	100	<1	<1
Vic.	64	7	29
WA	35	1	64

* Not all percentages add up to 100% due to other sources of notifications and/or incomplete data for laboratory and medical notification fields.

Figure 1: Communicable diseases notifiable fraction

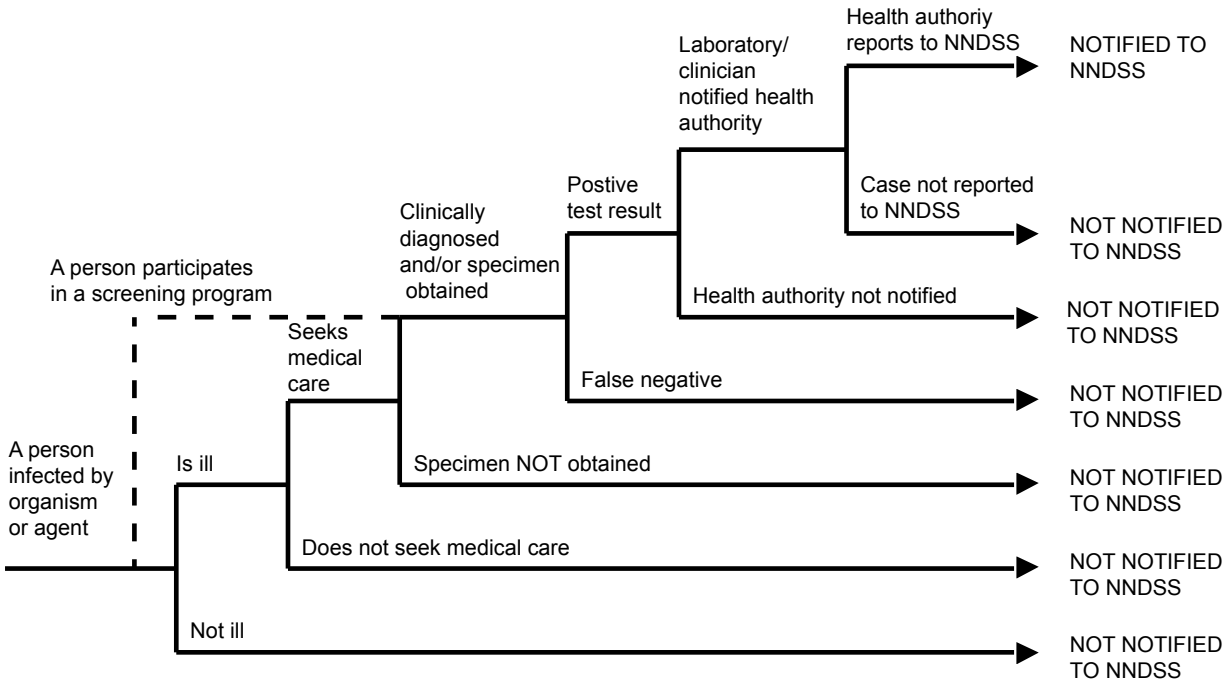


Table 2: Diseases notified to the National Notifiable Diseases Surveillance System, Australia 2014

Disease	Data received from
Bloodborne diseases	
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
Shiga toxin producing *Escherichia coli*	All jurisdictions
Typhoid fever	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 infections	All jurisdictions
Donovanosis	All jurisdictions
Gonococcal infection	All jurisdictions
Syphilis < 2 years duration	All jurisdictions
Syphilis > 2 years or unspecified duration	All jurisdictions
Syphilis – congenital	All jurisdictions
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

Table 2 *continued*: Diseases notified to the National Notifiable Diseases Surveillance System, Australia 2014

Disease	Data received from
Vaccine preventable diseases *cont'd*	
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 disease (invasive)	All jurisdictions
Tuberculosis	All jurisdictions

NEC Not elsewhere classified.

Changes in surveillance practices may have been introduced in some jurisdictions and not in others, and must be taken into consideration when comparing data between jurisdictions. In this report, some additional information was obtained from states and territories to assist in the interpretation of the 2014 data. These include changes in surveillance practices, screening practices, laboratory practices, and major disease control or prevention initiatives.

Postcode information reflects the residential location of the case, but this does not necessarily represent the place where the disease was acquired.

Data completeness was assessed for cases' Indigenous status and place of acquisition, and reported as the proportion of complete notifications. The completeness of data in this report is summarised in the Results.

The percentage of data completeness was defined as:

> Percentage of data completeness = (total notifications – missing or unknown) / total notifications x 100

The Indigenous status was defined by the following nationally accepted criteria:[11]

> 1=Indigenous – (Aboriginal but not Torres Strait Islander origin);
>
> 2=Indigenous – (Torres Strait Islander but not Aboriginal origin);
>
> 3=Indigenous – (Aboriginal and Torres Strait Islander origin);
>
> 4=Not Indigenous – (not Aboriginal or Torres Strait Islander origin);
>
> 9=Not stated.

For the purposes of this report, an Indigenous person includes responses 1, 2 or 3 with non-Indigenous including response 4 only.

Place of acquisition is where the disease is believed to have been acquired; either locally or overseas. The country of acquisition is determined by the Standard Australian Classification of Countries (SACC) from the ABS.[12] A notification is complete if a valid value from the SACC is entered.

For some diseases, changes in surveillance and testing practices should be taken into account when interpreting national trends.

In interpreting STI notification data it is important to note that changes in notifications over time may not solely reflect changes in disease prevalence as changes in screening programs,[13,14] the use of less invasive and more sensitive diagnostic tests[15] and periodic public awareness campaigns[16] may influence the number of notifications that occur over time. Rates for STIs are particularly susceptible to overall rates of testing, with low testing rates resulting in an underestimation of disease and increased testing potentially causing an increase in notifications.[17]

The differences in rates between females and males for STIs should be interpreted with caution, as rates of testing, symptom status, health care-seeking behaviours, and partner notification differ between the sexes.[18]

Notes on case definitions

Each notifiable disease is governed by a national surveillance case definition for reporting to the NNDSS. These case definitions were agreed by CDNA and implemented nationally in January 2004 and were used by all jurisdictions for the first time in 2005. These case definitions are reviewed by the Case Definitions Working Group (CDWG) as required.

The national surveillance case definitions and their review status are available from the Australian Government Department of Health web site (http://www.health.gov.au/casedefinitions).

Results

There were 275,581 communicable disease notifications received by NNDSS in 2014 (Table 3).

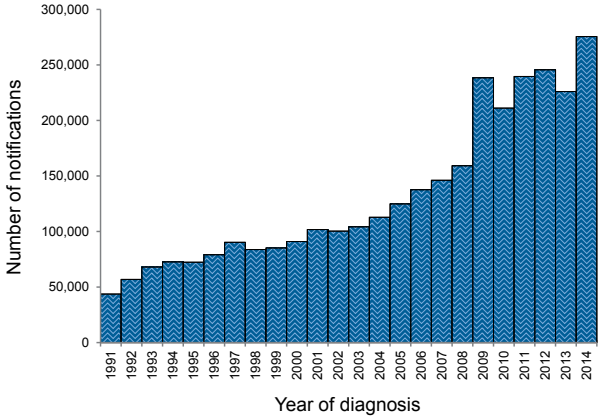
In 2014, the most frequently notified diseases were sexually transmissible infections (105,719 notifications, 38% of total notifications), vaccine preventable diseases (101,400 notifications, 37% of total notifications), and gastrointestinal diseases (40,367 notifications, 15% of total notifications).

Table 3: Notifications to the National Notifiable Diseases Surveillance System, Australia, 2014, by disease category rank order

Disease category	Number	%
Sexually transmitted infections	105,719	38
Vaccine preventable diseases	101,400	37
Gastrointestinal diseases	40,367	15
Bloodborne diseases	17,411	6
Vectorborne diseases	8,125	3
Other bacterial diseases	1,942	1
Zoonoses	615	0
Quarantinable diseases	2	0
Total	275,581	100

There was an increase of 22% compared with the total number of notifications in 2013 (226,041) (Figure 2). The increase can largely be attributed to the seasonal increase in influenza notifications for 2014, which reached a higher peak than in previous seasons.

Figure 2: Trends in notifications received by the National Notifiable Diseases Surveillance System, Australia, 1991 to 2014



Notifications and notification rates per 100,000 for each disease by state or territory in 2014, are shown in Table 4 and Table 5 respectively. Notifications and rates per 100,000 for the period 2009 to 2014 are shown in Table 6.

Table 4: Notified cases of communicable diseases, Australia, 2014, by state or territory

Disease	State or territory								
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aust.
Bloodborne diseases									
Hepatitis B (newly acquired)*	2	29	3	53	7	5	53	24	176
Hepatitis B (unspecified)†	95	2,514	150	988	323	55	1,741	628	6,494
Hepatitis C (newly acquired)*‡	11	26	2	NN	45	14	174	161	433
Hepatitis C (unspecified)†	164	3,555	178	2,648	449	217	2,048	990	10,249
Hepatitis D	0	19	1	13	9	0	14	3	59
Gastrointestinal diseases									
Botulism	0	0	0	1	0	0	0	0	1
Campylobacteriosis	505	NN	294	6,220	1,804	934	7,211	2,963	19,931
Cryptosporidiosis	30	418	87	668	225	30	637	310	2,405
Haemolytic uraemic syndrome	0	6	1	3	3	1	5	1	20
Hepatitis A	5	83	2	44	7	1	70	19	231
Hepatitis E	1	37	0	7	0	0	11	0	56
Listeriosis	1	23	2	17	6	4	22	5	80
Salmonellosis	225	4,314	457	4,937	1,220	249	3,695	1,261	16,358
Shiga toxin-producing *Escherichia coli*	0	30	0	28	45	0	10	2	115
Shigellosis	9	198	99	176	36	2	463	68	1,051
Typhoid fever	1	45	1	19	9	1	29	14	119
Quarantinable diseases									
Cholera	0	0	0	0	0	0	2	0	2
Highly pathogenic avian influenza in humans	0	0	0	0	0	0	0	0	0
Plague	0	0	0	0	0	0	0	0	0
Rabies	0	0	0	0	0	0	0	0	0
Severe acute respiratory syndrome	0	0	0	0	0	0	0	0	0
Smallpox	0	0	0	0	0	0	0	0	0
Viral haemorrhagic fever	0	0	0	0	0	0	0	0	0
Yellow fever	0	0	0	0	0	0	0	0	0
Sexually transmitted infections									
Chlamydial infection§‖	1,196	22,909	2,997	20,480	5,496	1,774	19,910	11,346	86,108
Donovanosis	0	0	0	0	0	0	0	1	1
Gonococcal infection‖	120	4,862	1,741	2,721	736	65	3,236	2,194	15,675
Syphilis – congenital‖	0	0	5	0	0	0	0	0	5
Syphilis < 2 years duration*‖¶	18	739	73	394	29	14	649	93	2,009
Syphilis > 2 years or unspecified duration†‖	26	536	73	279	123	19	801	64	1,921
Vaccine preventable diseases									
Diphtheria**	0	0	0	2	0	0	0	0	2
Haemophilus influenzae type b	0	6	1	9	1	0	3	1	21
Influenza (laboratory confirmed)	1,260	20,877	810	17,924	11,041	673	9,907	5,250	67,742
Measles	7	67	52	73	16	5	77	43	340
Mumps	2	79	1	49	19	5	12	23	190
Pertussis	233	3,131	83	1,392	503	68	4,702	1,751	11,863
Pneumococcal disease (invasive)	15	518	43	230	133	39	379	207	1,564
Poliomyelitis	0	0	0	0	0	0	0	0	0
Rubella	0	10	0	2	2	0	2	1	17
Rubella – congenital	0	0	0	0	0	0	0	0	0
Tetanus	0	1	0	1	0	0	0	1	3

Table 4 *continued*: Notified cases of communicable diseases, Australia, 2014, by state or territory

Disease	State or territory								
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aust.
Vaccine preventable diseases *cont'd*									
Varicella zoster (chickenpox)	63	NN	103	301	330	46	822	423	2,088
Varicella zoster (shingles)	92	NN	245	55	2,031	268	1,416	1,366	5,473
Varicella zoster (unspecified)	183	NN	8	5,544	146	141	4,810	1,265	12,097
Vectorborne diseases									
Arbovirus infection (NEC)	0	5	0	22	0	0	1	0	28
Barmah Forest virus infection	1	163	30	473	1	0	18	55	741
Dengue virus infection	16	377	62	393	72	17	329	450	1,716
Japanese encephalitis virus infection	0	0	0	0	1	0	0	0	1
Kunjin virus infection	0	0	0	0	0	0	1	0	1
Malaria	10	88	11	86	6	4	69	48	322
Murray Valley encephalitis virus infection	0	0	0	0	0	0	0	0	0
Ross River virus infection	5	682	412	2,344	75	18	208	1,572	5,316
Zoonoses									
Anthrax	0	0	0	0	0	0	0	0	0
Australia bat lyssavirus	0	0	0	0	0	0	0	0	0
Brucellosis	0	4	1	8	0	0	4	0	17
Leptospirosis	0	14	2	59	1	1	8	3	88
Lyssavirus (NEC)	0	0	0	0	0	0	0	0	0
Ornithosis	0	14	0	4	0	0	21	2	41
Q fever	1	179	1	240	10	0	33	5	469
Tularaemia	0	0	0	0	0	0	0	0	0
Other bacterial infections									
Legionellosis	2	70	7	94	40	8	87	116	424
Leprosy	0	1	0	1	1	0	1	5	9
Meningococcal infection††	2	38	3	40	34	2	33	18	170
Tuberculosis	30	472	28	165	48	9	448	139	1,339
Total	4,331	67,139	8,069	69,208	25,083	4,689	64,173	32,891	275,581

* Newly acquired hepatitis and syphilis < 2 years duration includes cases where the infection was determined to be acquired within 24 months prior to diagnosis.

† Unspecified hepatitis and syphilis includes cases where the duration of infection could not be determined or is greater than 24 months.

‡ In Queensland, includes newly acquired hepatitis C cases.

§ Includes *Chlamydia trachomatis* identified from cervical, rectal, urine, urethral and throat samples, except for South Australia, which reports only cervical, urine and urethral specimens. From 1 July 2013 case definition changed to exclude all ocular infections.

|| The national case definitions for chlamydial, gonococcal and syphilis diagnoses include infections that may be acquired through a non-sexual mode (especially in children – e.g. perinatal infections, epidemic gonococcal conjunctivitis).

¶ Data for all states and territories are reported by diagnosis date, except Queensland, which is reported by notification receive date.

** This number may underrepresent the number of diphtheria cases in Australia. For more details please see the 2014 summary of diphtheria in the Vaccine Preventable Diseases section.

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

NEC Not elsewhere classified.

NN Not notifiable.

Table 5: Notification rates per 100,000 of nationally notifiable communicable diseases, Australia, 2014, by state or territory

Disease	State or territory								Aust.
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	
Bloodborne diseases									
Hepatitis B (newly acquired)*	0.5	0.4	1.2	1.1	0.4	1.0	0.9	0.9	0.7
Hepatitis B (unspecified)†	24.6	33.4	61.3	20.9	19.2	10.7	29.8	24.5	27.7
Hepatitis C (newly acquired)*‡	2.9	0.3	0.8	NN	2.7	2.7	3.0	6.3	2.3
Hepatitis C (unspecified)†	42.5	47.3	72.8	56.1	26.6	42.2	35.1	38.6	43.7
Hepatitis D	–	0.3	0.4	0.3	0.5	–	0.2	0.1	0.3
Gastrointestinal diseases									
Botulism	–	–	–	<0.1	–	–	–	–	<0.1
Campylobacteriosis	131.0	NN	120.2	131.7	107.0	181.5	123.5	115.5	124.9
Cryptosporidiosis	7.8	5.6	35.6	14.1	13.3	5.8	10.9	12.1	10.2
Haemolytic uraemic syndrome	–	0.1	0.4	0.1	0.2	0.2	0.1	<0.1	0.1
Hepatitis A	1.3	1.1	0.8	0.9	0.4	0.2	1.2	0.7	1.0
Hepatitis E	0.3	0.5	–	0.1	–	–	0.2	–	0.2
Listeriosis	0.3	0.3	0.8	0.4	0.4	0.8	0.4	0.2	0.3
Salmonellosis	58.4	57.4	186.8	104.6	72.4	48.4	63.3	49.2	69.7
Shigellosis	2.3	2.6	40.5	3.7	2.1	0.4	7.9	2.7	4.5
Shiga toxin producing *Escherichia coli*	–	0.4	–	0.6	2.7	–	0.2	0.1	0.5
Typhoid fever	0.3	0.6	0.4	0.4	0.5	0.2	0.5	0.5	0.5
Quarantinable diseases									
Cholera	–	–	–	–	–	–	<0.1	–	<0.1
Highly pathogenic avian influenza in humans	–	–	–	–	–	–	–	–	–
Plague	–	–	–	–	–	–	–	–	–
Rabies	–	–	–	–	–	–	–	–	–
Severe acute respiratory syndrome	–	–	–	–	–	–	–	–	–
Smallpox	–	–	–	–	–	–	–	–	–
Viral haemorrhagic fever	–	–	–	–	–	–	–	–	–
Yellow fever	–	–	–	–	–	–	–	–	–
Sexually transmitted infections									
Chlamydial infection§‖	310.3	304.8	1225.2	433.8	326.1	344.7	341.0	442.3	366.8
Donovanosis	–	–	–	–	–	–	–	<0.1	<0.1
Gonococcal infection‖	31.1	64.7	711.7	57.6	43.7	12.6	55.4	85.5	66.8
Syphilis – congenital‖	–	–	2.0	–	–	–	–	–	<0.1
Syphilis < 2 years duration*‖¶	4.7	9.8	29.8	8.3	1.7	2.7	11.1	3.6	8.6
Syphilis > 2 years or unspecified duration†‖	6.7	7.1	29.8	5.9	7.3	3.7	13.7	2.5	8.2
Vaccine preventable diseases									
Diphtheria**	–	–	–	<0.1	–	–	–	–	<0.1
Haemophilus influenzae type b	–	0.1	0.4	0.2	0.1	–	0.1	<0.1	0.1
Influenza (laboratory confirmed)	326.9	277.8	331.1	379.6	655.1	130.8	169.7	204.6	288.6
Measles	1.8	0.9	21.3	1.5	0.9	1.0	1.3	1.7	1.4
Mumps	0.5	1.1	0.4	1.0	1.1	1.0	0.2	0.9	0.8
Pertussis	60.4	41.7	33.9	29.5	29.8	13.2	80.5	68.3	50.5
Pneumococcal disease (invasive)	3.9	6.9	17.6	4.9	7.9	7.6	6.5	8.1	6.7
Poliomyelitis	–	–	–	–	–	–	–	–	–
Rubella	–	0.1	–	<0.1	0.1	–	<0.1	<0.1	0.1
Rubella – congenital	–	–	–	–	–	–	–	–	–
Tetanus	–	<0.1	–	<0.1	–	–	–	<0.1	<0.1

Table 5 *continued*: Notification rates per 100,000 of nationally notifiable communicable diseases, Australia, 2014, by state or territory

Disease	State or territory								Aust.
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	
Vaccine preventable diseases *cont'd*									
Varicella zoster (chickenpox)	16.3	NN	42.1	6.4	19.6	8.9	14.1	16.5	13.1
Varicella zoster (shingles)	23.9	NN	100.2	1.2	120.5	52.1	24.2	53.2	34.3
Varicella zoster (unspecified)	47.5	NN	3.3	117.4	8.7	27.4	82.4	49.3	75.8
Vectorborne diseases									
Arbovirus infection (NEC)	–	0.1	–	0.5	–	–	<0.1	–	0.1
Barmah Forest virus infection	0.3	2.2	12.3	10.0	0.1	–	0.3	2.1	3.2
Dengue virus infection	4.2	5.0	25.3	8.3	4.3	3.3	5.7	17.5	7.3
Japanese encephalitis virus infection	–	–	–	–	0.1	–	–	–	<0.1
Kunjin virus infection	–	–	–	–	–	–	<0.1	–	<0.1
Malaria	2.6	1.2	4.5	1.8	0.4	0.8	1.2	1.9	1.4
Murray Valley encephalitis virus infection	–	–	–	–	–	–	–	–	–
Ross River virus infection	1.3	9.1	168.4	49.6	4.4	3.5	3.6	61.3	22.6
Zoonoses									
Anthrax	–	–	–	–	–	–	–	–	–
Australia bat lyssavirus	–	–	–	–	–	–	–	–	–
Brucellosis	–	0.1	0.4	0.2	–	–	0.1	–	0.1
Leptospirosis	–	0.2	0.8	1.2	0.1	0.2	0.1	0.1	0.4
Lyssavirus (NEC)	–	–	–	–	–	–	–	–	–
Ornithosis	–	0.2	–	0.1	–	–	0.4	0.1	0.2
Q fever	0.3	2.4	0.4	5.1	0.6	–	0.6	0.2	2.0
Tularaemia	–	–	–	–	–	–	–	–	–
Other bacterial infections									
Legionellosis	0.5	0.9	2.9	2.0	2.4	1.6	1.5	4.5	1.8
Leprosy	–	<0.1	–	<0.1	0.1	–	<0.1	0.2	<0.1
Meningococcal infection††	0.5	0.5	1.2	0.8	2.0	0.4	0.6	0.7	0.7
Tuberculosis	7.8	6.3	11.4	3.5	2.8	1.7	7.7	5.4	5.7

* Newly acquired hepatitis and syphilis < 2 years duration includes cases where the infection was determined to be acquired within 24 months prior to diagnosis.

† Unspecified hepatitis and syphilis includes cases where the duration of infection could not be determined or is greater than 24 months.

‡ In Queensland, includes newly acquired hepatitis C cases.

§ Includes *Chlamydia trachomatis* identified from cervical, rectal, urine, urethral and throat samples, except for South Australia, which reports only cervical, urine and urethral specimens. From 1 July 2013 case definition changed to exclude all ocular infections.

|| The national case definitions for chlamydial, gonococcal and syphilis diagnoses include infections that may be acquired through a non-sexual mode (especially in children – e.g. perinatal infections, epidemic gonococcal conjunctivitis).

¶ Data for all states and territories are reported by diagnosis date, except Queensland, which is reported by notification receive date.

** This number may underrepresent the number of diphtheria cases in Australia. For more details please see the 2014 summary of diphtheria in the Vaccine Preventable Diseases section.

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

NEC Not elsewhere classified.

NN Not notifiable.

Table 6: Notified cases and notification rate for communicable diseases, Australia, 2009 to 2014

Disease	Number of notified cases						5 year mean	Ratio (2014: 5 year mean)	Notification rate per 100,000					
	2009	2010	2011	2012	2013	2014			2009	2010	2011	2012	2013	2014
Bloodborne diseases														
Hepatitis B (newly acquired)*	253	231	192	196	175	176	209.4	0.8	1.2	1.0	0.9	0.9	0.8	0.7
Hepatitis B (unspecified)†	6,963	6,796	6,404	6,443	6,940	6,494	6,709.2	1.0	32.1	30.8	28.7	28.3	30.0	27.7
Hepatitis C (newly acquired)*‡	400	383	411	472	398	433	412.8	1.0	2.3	2.2	2.3	2.6	2.2	2.3
Hepatitis C (unspecified)†	11,066	11,062	9,912	9,662	10,339	10,249	10,408.2	1.0	51.0	50.2	44.4	42.5	44.7	43.7
Hepatitis D	51	44	47	36	61	59	47.8	1.2	0.2	0.2	0.2	0.2	0.3	0.3
Gastrointestinal diseases														
Botulism	1	0	2	0	4	1	1.4	0.7	<0.1	–	<0.1	–	<0.1	<0.1
Campylobacteriosis	16,104	16,993	17,726	15,668	14,692	19,931	16,236.6	1.2	110.0	114.1	117.2	101.6	93.5	124.9
Cryptosporidiosis	4,624	1,482	1,812	3,145	3,846	2,405	2,981.8	0.8	21.3	6.7	8.1	13.8	16.6	10.2
Haemolytic uraemic syndrome	13	9	13	20	15	20	14.0	1.4	0.1	<0.1	0.1	0.1	0.1	0.1
Hepatitis A	563	267	145	166	190	231	266.2	0.9	2.6	1.2	0.6	0.7	0.8	1.0
Hepatitis E	33	37	41	32	34	56	35.4	1.6	0.2	0.2	0.2	0.1	0.1	0.2
Listeriosis	92	71	70	93	76	80	80.4	1.0	0.4	0.3	0.3	0.4	0.3	0.3
Salmonellosis	9,501	11,912	12,275	11,251	12,785	16,358	11,544.8	1.4	43.8	54.1	54.9	49.5	55.3	69.7
Shigellosis	617	552	493	548	538	1,051	549.6	1.9	2.8	2.5	2.2	2.4	2.3	4.5
Shiga toxin-producing *Escherichia coli*	128	80	95	111	180	115	118.8	1.0	0.6	0.4	0.4	0.5	0.8	0.5
Typhoid fever	115	96	135	125	152	119	124.6	1.0	0.5	0.4	0.6	0.5	0.7	0.5
Quarantinable diseases														
Cholera	4	3	6	5	3	2	4.2	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Highly pathogenic avian influenza in humans	0	0	0	0	0	0	0.0	–	–	–	–	–	–	–
Plague	0	0	0	0	0	0	0.0	–	–	–	–	–	–	–
Rabies	0	0	0	0	0	0	0.0	–	–	–	–	–	–	–
Severe acute respiratory syndrome	0	0	0	0	0	0	0.0	–	–	–	–	–	–	–
Smallpox	0	0	0	0	0	0	0.0	–	–	–	–	–	–	–
Viral haemorrhagic fever	0	0	0	0	0	0	0.0	–	–	–	–	–	–	–
Yellow fever	0	0	2	0	0	0	0.4	–	–	–	<0.1	–	–	–

Table 6 *continued*: Notified cases and notification rate for communicable diseases, Australia, 2009 to 2014

Disease	Number of notified cases						5 year mean	Ratio (2014: 5 year mean)	Notification rate per 100,000					
	2009	2010	2011	2012	2013	2014			2009	2010	2011	2012	2013	2014
Sexually transmissible infections														
Chlamydial infection§‖	63,200	74,418	81,099	83,121	82,974	86,108	76,962.4	1.1	291.4	337.8	363.0	365.7	358.9	366.8
Donovanosis	1	1	0	1	0	1	0.6	1.7	<0.1	<0.1	–	<0.1	–	<0.1
Gonococcal infection‖	8,274	10,320	12,095	13,880	14,902	15,675	11,894.2	1.3	38.1	46.8	54.1	61.1	64.5	66.8
Syphilis – congenital‖	3	3	7	1	7	5	4.2	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Syphilis < 2 years duration*‖¶	1,293	1,118	1,280	1,556	1,768	2,009	1,403.0	1.4	6.0	5.1	5.7	6.8	7.6	8.6
Syphilis > 2 years or unspecified duration†‖	1,459	1,358	1,352	1,389	1,747	1,921	1,461.0	1.3	7.3	6.7	6.5	6.1	7.6	8.2
Vaccine preventable diseases														
Diphtheria**	0	0	4	0	2	2	1.2	1.7	–	–	<0.1	–	<0.1	<0.1
Haemophilus influenzae type b	19	24	13	16	20	21	18.4	1.1	0.1	0.1	0.1	0.1	0.1	0.1
Influenza (laboratory confirmed)	59,026	13,466	27,233	44,571	28,311	67,742	34,521.4	2.0	272.1	61.1	121.9	196.1	122.5	288.6
Measles	104	70	194	199	162	340	145.8	2.3	0.5	0.3	0.9	0.9	0.7	1.4
Mumps	166	98	155	200	218	190	167.4	1.1	0.8	0.4	0.7	0.9	0.9	0.8
Pertussis	30,192	34,845	38,750	24,101	12,362	11,863	28,050.0	0.4	139.2	158.2	173.5	106.0	53.5	50.5
Pneumococcal disease (invasive)	1,556	1,640	1,883	1,822	1,549	1,564	1,690.0	0.9	7.2	7.4	8.4	8.0	6.7	6.7
Poliomyelitis	0	0	0	0	0	0	0.0	–	–	–	–	–	–	–
Rubella	27	44	58	37	25	17	38.2	0.4	0.1	0.2	0.3	0.2	0.1	0.1
Rubella – congenital	0	0	0	1	2	0	0.6	–	–	–	–	<0.1	<0.1	–
Tetanus	3	2	3	7	4	3	3.8	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Varicella zoster (chickenpox)	1,796	1,793	2,100	1,983	2,127	2,088	1,959.8	1.1	12.3	12.0	13.9	12.9	13.5	13.1
Varicella zoster (shingles)	2,779	3,045	4,022	4,506	5,038	5,473	3,878.0	1.4	19.0	20.5	26.6	29.2	32.1	34.3
Varicella zoster (unspecified)	7,425	8,155	8,608	9,421	10,983	12,097	8,918.4	1.4	50.7	54.8	56.9	61.1	69.9	75.8
Vectorborne diseases														
Arbovirus infection (NEC)	5	14	16	6	19	28	12.0	2.3	<0.1	0.1	0.1	<0.1	0.1	0.1
Barmah Forest virus infection	1,473	1,470	1,863	1,730	4,239	741	2,155.0	0.3	6.8	6.7	8.3	7.6	18.3	3.2
Dengue virus infection	1,402	1,228	821	1,541	1,840	1,716	1,366.6	1.3	6.5	5.6	3.7	6.8	8.0	7.3
Japanese encephalitis virus infection	0	0	0	1	4	1	1.0	1.0	–	–	–	<0.1	<0.1	<0.1
Kunjin virus infection	2	2	2	0	2	1	1.6	0.6	<0.1	<0.1	<0.1	–	<0.1	<0.1
Malaria	504	405	418	344	416	322	418.2	0.8	2.3	1.8	1.9	1.5	1.8	1.4
Murray Valley encephalitis virus infection	4	0	16	1	1	0	4.4	<0.1	<0.1	–	0.1	<0.1	<0.1	–
Ross River virus infection	4,741	5,129	5,137	4,682	4,316	5,316	4,801.0	1.1	21.9	23.3	23.0	20.6	18.7	22.6

Disease	Number of notified cases						5 year mean	Ratio (2014: 5 year mean)	Notification rate per 100,000					
	2009	2010	2011	2012	2013	2014			2009	2010	2011	2012	2013	2014
Zoonoses														
Anthrax	0	1	0	0	0	0	0.2	–	–	<0.1	–	–	–	–
Australian bat lyssavirus	0	0	0	0	1	0	0.2	–	–	–	–	–	<0.1	–
Brucellosis	32	21	37	31	14	17	27.0	0.6	0.1	0.1	0.2	0.1	0.1	0.1
Leptospirosis	141	131	215	114	88	88	137.8	0.6	0.7	0.6	1.0	0.5	0.4	0.4
Lyssavirus (NEC)	0	0	0	0	0	0	0.0	–	–	–	–	–	–	–
Ornithosis	63	58	89	76	47	41	66.6	0.6	0.3	0.3	0.4	0.3	0.2	0.2
Q fever	314	338	359	369	487	469	373.4	1.3	1.4	1.5	1.6	1.6	2.1	2.0
Tularaemia	0	0	2	0	0	0	0.4	–	–	–	<0.1	–	–	–
Other bacterial infections														
Legionellosis	297	307	358	383	508	424	370.6	1.1	1.4	1.4	1.6	1.7	2.2	1.8
Leprosy	5	10	10	8	14	9	9.4	1.0	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Meningococcal infection††	260	228	242	223	149	170	220.4	0.8	1.2	1.0	1.1	1.0	0.6	0.7
Tuberculosis	1,307	1,364	1,389	1,316	1,263	1,339	1,327.8	1.0	6.0	6.2	6.2	5.8	5.5	5.7
Total	238,401	211,124	239,611	245,610	226,037	275,581								

* Newly acquired hepatitis and syphilis < 2 years duration includes cases where the infection was determined to be acquired within 24 months prior to diagnosis.

† Unspecified hepatitis and syphilis includes cases where the duration of infection could not be determined or is greater than 24 months.

‡ In Queensland, includes newly acquired hepatitis C cases.

§ Includes *Chlamydia trachomatis* identified from cervical, rectal, urine, urethral and throat samples, except for South Australia, which reports only cervical, urine and urethral specimens. From 1 July 2013 case definition changed to exclude all ocular infections.

|| The national case definitions for chlamydial, gonococcal and syphilis diagnoses include infections that may be acquired through a non-sexual mode (especially in children – e.g. perinatal infections, epidemic gonococcal conjunctivitis).

¶ Data for all states and territories are reported by diagnosis date, except Queensland, which is reported by notification receive date.

** This number may underrepresent the number of diphtheria cases in Australia. For more details please see the 2014 summary of diphtheria in the Vaccine Preventable Diseases section.

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

NEC Not elsewhere classified.

NN Not notifiable.

Data completeness

Indigenous status

Indigenous status is usually obtained from clinical notifications and completeness varies by disease and by state and territory. This reflects differences in notification requirements (i.e. depending on the jurisdiction, some diseases are primarily or completely notified by pathology laboratories rather than clinicians) and the fact that it is not possible to follow up all cases for diseases with a large volume of notifications and/or not requiring specific case-based public health action.

Indigenous status was complete in 45% of all notifications reported to NNDSS in 2014. Indigenous status was complete in 95% of data reported in the Northern Territory, 93% in Western Australia and 91% in South Australia. In the remaining jurisdictions, Indigenous status completeness ranged from 14% to 47% (Table 7).

Data completeness on Indigenous status also varied by disease as summarised in Appendix 3. In 2009, CDNA set target thresholds of 95% completeness for 18 priority diseases (17 notifiable to NNDSS and HIV, which are provided to the Kirby Institute) (Table 8) and 80% completeness for the remainder of the notifiable diseases as part of its 'Closing the Gap' strategy. Of all diseases notified to the NNDSS in 2014, 31 (62%) equalled or exceeded 80% completeness for Indigenous status and 15 (48%) were priority diseases.

In 2014, 11 of the 17 priority diseases notified to NNDSS had an Indigenous completeness that exceeded 95% (congenital syphilis, donovanosis, *Haemophilus influenzae* type b, hepatitis A, hepatitis C (newly acquired), measles, meningococcal infection, pneumococcal disease less than 5 years, pneumococcal disease ≥ 50 years, leprosy, and tuberculosis). This was an improvement on 2013 where 7 priority diseases exceeded 95% completeness. There has been a notable improvement in completeness of Indigenous status for hepatitis C (newly acquired) notifications from 88% in 2012 to 98% in 2014.

A review of the NNDSS priority diseases between 2004 and 2014 showed that meningococcal disease (invasive) and tuberculosis exceeded the 95% threshold for completeness of Indigenous status over the entire period. They ranged from 95%–97% and 98%–100% respectively.

Six of the priority diseases were consistently below the 95% threshold over the entire period (Figure 3):

- dengue virus infection (locally acquired)
- gonococcal infection
- hepatitis B (newly acquired)
- hepatitis C (newly acquired)
- pertussis less than 5 years
- shigellosis.

The completeness of the Indigenous status for 8 of the priority diseases has improved since 2004:

- congenital syphilis, increasing from 93% in 2004 to 100% in 2014;
- *Haemophilus influenzae* type b, increasing from 93% in 2004 to 100% in 2014
- hepatitis A, increasing from 90% in 2004 to 96% in 2014;
- hepatitis B (newly acquired), increasing from 81% in 2004 to 92% in 2014;
- hepatitis C (newly acquired), increasing from 85% in 2004 to 98% in 2014;
- pneumococcal disease less than 5 years, increasing from 89% in 2004 to 100% in 2014;
- pneumococcal disease 50 years or over, increasing from 90% in 2004 to 97% in 2014; and
- shigellosis, increasing from 72% in 2004 to 81% in 2014.

The completeness of Indigenous status for 2 diseases has not improved since 2004. Dengue virus infection (locally acquired), decreased from 86% in 2004 to 69% in 2014, and gonococcal infection, decreased from 69% in 2004 to 66% in 2014.

The completeness of Indigenous status for syphilis < 2 years was 92% in 2014 but has regularly exceeded the 95% threshold over the period.

Table 7: Indigenous status completeness of National Notifiable Diseases Surveillance System data, Australia, 2014, by state or territory

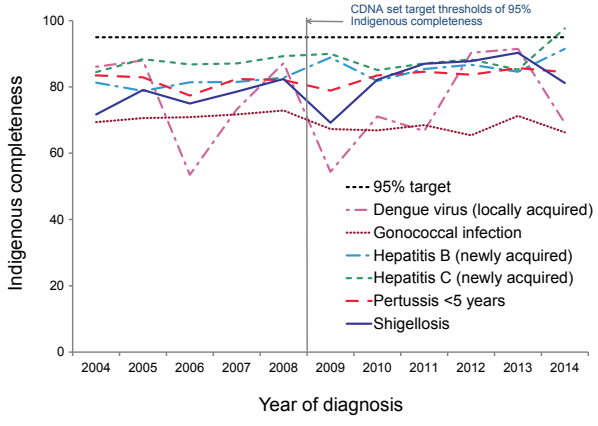
	State or territory								
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aust.
Total notifications	4,331	67,139	8,069	69,207	25,083	4,689	64,172	32,891	275,581
Indigenous status									
Unknown/ missing	2,284	57,507	437	39,027	2,191	3,066	43,940	2,232	150,684
Per cent complete	47	14	95	44	91	35	32	93	45

Table 8: Percentage completeness of priority diseases for Indigenous status completeness of National Notifiable Diseases Surveillance System data, Australia, 2014, by state or territory

Priority disease	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aust.
Congenital syphilis	No cases	No cases	100	No cases	No cases	No cases	No cases	No cases	100
Dengue virus (locally acquired)	No cases	100	No cases	69	100	No cases	67	100	69
Donovanosis	No cases	No cases	No cases	No cases	No cases	No cases	No cases	100	100
Gonococcal infection	100	45	99	59	99	94	55	100	66
Haemophilus influenzae type b	No cases	100	100	100	100	No cases	100	100	100
Hepatitis A	100	100	100	80	100	100	100	100	96
Hepatitis B (newly acquired)	100	100	100	74	100	100	98	100	92
Hepatitis C (newly acquired)	100	100	100	NN	100	100	95	99	98
Leprosy	No cases	100	No cases	100	100	No cases	100	100	100
Measles	100	88	98	97	100	100	97	100	96
Meningococcal disease (invasive)	100	100	100	100	100	100	94	100	99
Pertussis <5 years	100	91	100	65	100	100	81	97	85
Pneumococcal disease <5 years	100	100	100	100	100	100	100	100	100
Pneumococcal disease ≥50 years	100	99	100	98	100	100	91	100	97
Shigellosis	100	83	98	61	100	100	80	100	81
Syphilis < 2 years	100	90	100	95	100	100	89	100	92
Tuberculosis	100	100	100	100	100	100	100	100	100

NN Not notifiable.

Figure 3: Priority diseases consistently below the 95% threshold for Indigenous completeness, 2004 to 2014



Place of acquisition

The place of acquisition is where the disease is known to have been acquired, either locally or overseas and is usually obtained through public health follow-up. Follow-up and thus completeness varies by disease and by jurisdiction. It is not possible to follow-up all cases for diseases with a large volume of notifications. Place of acquisition is not usually completed for diseases unless overseas travel is known to be a risk factor.

Through the NSC, jurisdictions have agreed that completeness for place of acquisition should be 100% for the following 24 priority diseases:

- arbovirus infection (NEC)
- brucellosis
- cholera
- dengue virus infection
- hepatitis A
- highly pathogenic avian influenza in humans
- Japanese encephalitis virus infection
- Kunjin virus infection
- legionellosis
- leprosy
- malaria
- measles
- Murray Valley encephalitis virus infection
- plague

- poliomyelitis
- Q fever
- rabies
- rubella
- severe acute respiratory syndrome
- smallpox
- tularaemia
- typhoid fever
- viral haemorrhagic fever (NEC)
- yellow fever.

In 2014, 14 of the 24 priority diseases had cases notified to NNDSS, the overall completeness for place of acquisition for these diseases was 96%. The completeness was 100% in 2014 for cholera, brucellosis, leprosy, Kunjin virus infection and Japanese encephalitis virus infection (Table 9).

Bloodborne diseases

In 2014, the bloodborne diseases reported to the NNDSS were hepatitis B, C, and D infections. Both hepatitis B and C infections were notified to the NNDSS as either 'newly acquired', where evidence was available that the infection was acquired in the 24 months prior to diagnosis; or 'greater than 2 years or unspecified' period of infection. These categories were reported from all states and territories except Queensland where all cases of hepatitis C infection, including newly acquired, were reported as being 'greater than 2 years or unspecified'.[19] Determination of a case as 'newly acquired' is reliant on public health follow-up, with the method and intensity of follow-up varying by jurisdiction and over time.

In interpreting these data it is important to note that changes in notified cases over time may not solely reflect changes in disease prevalence or incidence. National testing policies developed by the Australian Society for HIV Medicine and screening programs, including the preferential testing of high risk populations such as prisoners, injecting drug users and persons from countries with a high prevalence of hepatitis B or C infection, may contribute to these changes.[20,21]

Information on exposure factors relating to the most likely source(s) of or risk factors for infection for hepatitis B and C were reported in a subset of newly acquired infections. The collection of enhanced data is also dependent on the level of public health follow-up, which is variable by jurisdiction and over time.

Table 9: Percentage completeness of priority diseases* for place of acquisition completeness of National Notifiable Diseases Surveillance System data, Australia, 2014, by state or territory

Disease	2010	2011	2012	2013	2014
Cholera	100	100	100	100	100
Legionellosis	97	83	85	80	86
Murray Valley encephalitis virus infection	No cases	88	100	100	No cases
Tularaemia	No cases	100	No cases	No cases	No cases
Malaria	94	97	97	96	98
Dengue virus infection	>99	98	98	99	99
Yellow fever	No cases	100	No cases	No cases	No cases
Brucellosis	81	24	36	100	100
Hepatitis A	>99	100	94	95	99
Typhoid fever	100	98	94	98	97
Rubella	89	74	62	80	53
Leprosy	80	90	75	79	100
Measles	100	89	95	98	>99
Kunjin virus infection	50	100	No cases	100	100
Japanese encephalitis virus infection	No cases	No cases	100	100	100
Flavivirus unspecified	93	75	100	100	96
Q fever	81	57	78	89	89
Total	96	88	92	95	96

* Only includes priority diseases notified to the National Notifiable Diseases Surveillance System in 2010 to 2014 are included.

Notifications of HIV diagnoses were reported directly to the Kirby Institute, which maintains the National HIV Registry. Information on national HIV surveillance can be obtained from the Kirby Institute web site (http://www.kirby.unsw.edu.au/).

Hepatitis B

- In 2014, 6,670 cases of hepatitis B were notified to the NNDSS.
- Over the past 10 years, notifications of newly acquired hepatitis B have declined.

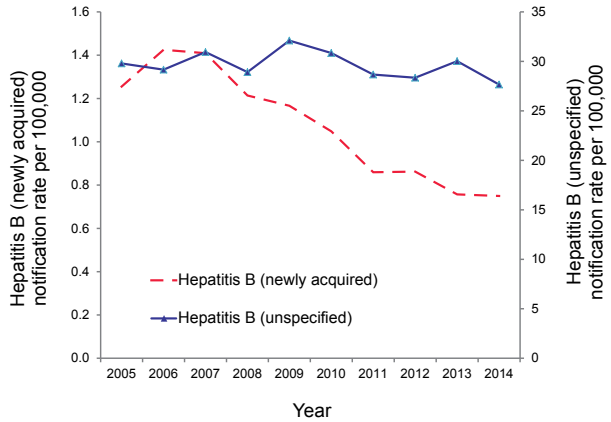
Hepatitis B is a potentially life-threatening liver infection caused by the hepatitis B virus. Major modes of transmission include unprotected sexual contact or needle sharing with an infected person, and perinatal transmission from mother to child. Symptoms of acute infection include abdominal pain, nausea and vomiting progressing to jaundice. Outcomes vary inversely with age; infected infants are more likely to progress to chronic infection whereas people who are infected as adults often clear the virus. Chronic infection can lead to a number of liver complications including cirrhosis, cancer and liver failure.[22]

Hepatitis B notifications are classified as being either 'newly acquired' (evidence that infection was acquired within the 24 months prior to diagnosis) or 'unspecified' (infection acquired more than 24 months prior to diagnosis or not able to be specified).

Epidemiological situation in 2014

In 2014, there were 6,670 notified cases of hepatitis B (both newly acquired and unspecified), representing a rate of 28.4 cases per 100,000 (Figure 4).

Figure 4: Notification rate for newly acquired hepatitis B and unspecified hepatitis B, Australia, 2005 to 2014, by year



Between 2005 and 2014, rates of newly acquired hepatitis B decreased by 40% from 1.3 to 0.7 per 100,000 (Figure 4). The decline in newly acquired hepatitis B notifications may be attributed to the hepatitis B vaccination program, which was introduced nationally for infants in 2000, and nationally funded adolescent hepatitis B vaccination programs, which were introduced from 1997 onwards, depending on the jurisdiction.[23] As at 30 June 2014, approximately 92% of children 12–15 months of age in Australia were assessed as being fully immunised for hepatitis B.[24] A 2007 study showed significant improvements in immunity to hepatitis B for the 12–17 years age group in jurisdictions with established school-based programs compared to those jurisdictions without such programs.[25]

From the 1980s, hepatitis B vaccination was also recommended for certain at-risk adults in Australia.[26] Some jurisdictions implemented vaccination programs to target identified at-risk adults in a variety of settings and at various times.[27] The full impact of Australian vaccination programs should be reflected in trends in chronic infection and reductions in hepatitis B related complications in the near future.[28]

Between 2005 and 2014, rates of unspecified hepatitis B have declined slightly by 7% from 29.8 to 27.7 per 100,000. It is important to note the significant impact of immigration on rates for unspecified hepatitis B. In 2014, Western Australia reported a decline in asylum seeker boat arrivals coinciding with a decline in unspecified hepatitis B notifications in the state, particularly in the Kimberley region (which includes the postcode for Christmas Island). In 2011, an Australian study estimated that more than 95% of new cases of chronic hepatitis B virus infection entered the population through migration.[29]

Newly acquired hepatitis B

- In 2014, 176 cases of newly acquired hepatitis B were notified to the NNDSS.
- The highest rate of notification was among males aged 35–39 years.

Epidemiological situation in 2014

In 2014, 176 cases of newly acquired hepatitis B infection were notified to the NNDSS, a rate of 0.7 per 100,000, which is similar to the 175 cases (0.8 per 100,000) reported in 2013 (Figure 4).

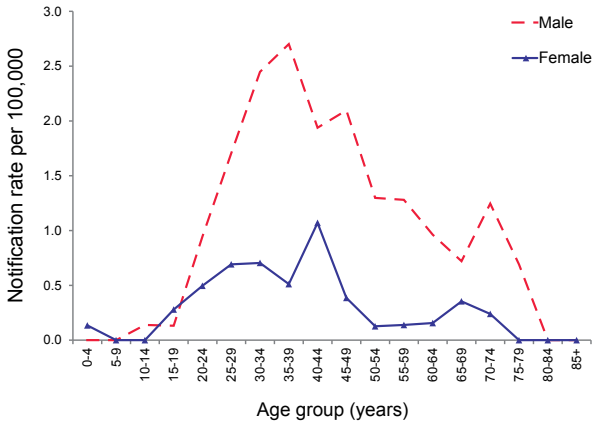
Geographical distribution

The highest rates were reported from the Northern Territory (1.2 per 100,000) and Queensland (1.1 per 100,000) (Table 5). This may be due to population differences between the jurisdictions, with hepatitis B disproportionately affecting a number of marginalised groups in Australia including migrant communities with origins in Asia, the Pacific and Africa; and Aboriginal and Torres Strait Islander people.[29–31]

Age and sex distribution

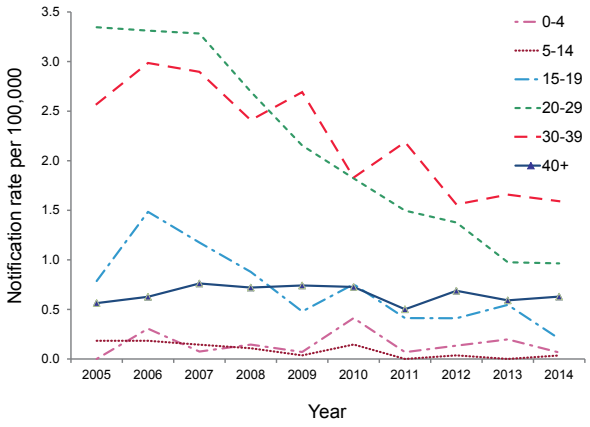
In 2014, males accounted for 77% of newly acquired hepatitis B notifications. In 2014, the highest rate of newly acquired hepatitis B infection was observed among males aged 35–39 years (2.7 per 100,000). For females, the highest rate was in those aged 40–44 years (1.1 per 100,000) (Figure 5). Exposure to hepatitis B may be more common in certain high risk groups, including immigrants from endemic regions; injecting drug users; prisoners; Aboriginal and Torres Strait Islander peoples; and men who have sex with men.[22,29] The greater representation of males in some of these groups may contribute to the higher notification rates among males.

Figure 5: Notification rate for newly acquired hepatitis B, Australia, 2014, by age group and sex



Between 2005 and 2014, most age group specific notification rates were low and remained stable or trended downwards. The most marked decreases occurred among those aged 15–39 years. During this period, notification rates declined by 74% for those aged 15–19 years (from 0.8 to 0.2 per 100,000), by 71% for those aged 20–29 years (from 3.3 to 1.0 per 100,000) and by 38% for those aged 30–39 years (from 2.6 to 1.6 per 100,000) (Figure 6). These declines are likely to be attributable to the hepatitis B vaccination program.[27]

Figure 6: Notification rate for newly acquired hepatitis B, Australia, 2005 to 2014, by year and selected age groups



Risk groups

Enhanced data on risk factors and country of birth were provided by the Australian Capital Territory, New South Wales, South Australia, Tasmania, Victoria and Western Australia* (Table 10). In 2014, 98 of 106 cases (92%) from these jurisdictions had at least 1 risk factor recorded, with a potential source of exposure not recorded or unable to be determined for the remainder. Sexual exposure was the most frequently reported potential source of infection (56/106, 53%), followed by injecting drug use (36/106, 34%). Of the 118 cases for which country of birth was reported, 91 were in Australian born persons (77%) and 27 cases were born overseas (10 from Asia, 8 from Europe, 4 from the Middle East, 4 from the Pacific, and 1 from South America).

Unspecified hepatitis B

- In 2014, 6,494 cases of unspecified hepatitis B were notified to the NNDSS.
- Notification rates peaked in females and males aged 30–34 years.

Epidemiological situation in 2014

In 2014, 6,494 cases of unspecified hepatitis B infection were notified to the NNDSS, representing a rate of 27.7 per 100,000, compared with 6,940 cases (30.0 per 100,000) reported in 2013 (Figure 4).

* Prior to 2009 enhanced hepatitis B surveillance data were reported to the Kirby Institute from health authorities in the states and territories.

Table 10: Enhanced risk factor data on notifications of newly acquired hepatitis B cases in selected jurisdictions,* 2014, by sex and risk factors†‡

Exposure category	Number of exposure factors reported			Percentage of total cases* (n=106)
	Male	Female	Total	
Sexual exposure	45	11	56	53
Sexual contact (hepatitis B partner status unknown) – opposite sex	16	6	22	21
Sexual contact (hepatitis B positive partner) – opposite sex	6	4	10	9
Sexual contact – not further classified	9	1	10	9
Sexual contact (hepatitis B partner status unknown) – same sex	10	0	10	9
Sexual contact (hepatitis B positive partner) – same sex	4	0	4	4
Injecting drug use	26	10	36	34
Skin penetration procedure	5	2	7	7
Tattoos	4	1	5	5
Ear or body piercing	0	1	1	1
Acupuncture	1	0	1	1
Undetermined	3	3	6	6
Imprisonment	5	0	5	5
Healthcare exposure	3	0	3	3
Major dental surgery work	2	0	2	2
Surgical work	1	0	1	1
Other	11	7	18	17
Other risk not elsewhere classified (≤24 months prior to diagnosis)	9	3	12	11
Non-IDU remote risk (>24 months prior to diagnosis)	1	2	3	3
Needlestick/biohazardous injury	1	1	2	2
Household contact	0	1	1	1
Unknown (not recorded)	2	0	2	
Total exposure factors reported	98	33	131	
Total number of cases	80	26	106	

* Cases from the Australian Capital Territory, New South Wales, South Australia, Tasmania, Victoria and Western Australia. While these 6 jurisdictions provided enhanced data on risk factors, not all cases had this information recorded.

† More than 1 exposure category for each case could be recorded.

‡ Analysis and categorisation of these exposures are subject to interpretation and may vary between reports.

§ The denominator used to calculate the percentage is based on the cases with recorded enhanced data from the Australian Capital Territory, New South Wales, South Australia, Tasmania, Victoria and Western Australia. As more than 1 exposure category for each notification could be recorded, the total percentage does not equate to 100%.

Geographical distribution

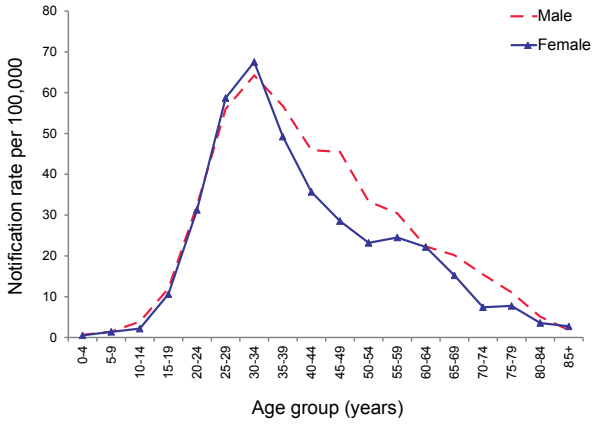
In 2014, the Northern Territory had the highest rate of unspecified hepatitis B infection (61.3 per 100,000) (Table 5).

Age and sex distribution

In 2014, males accounted for 53% (3,451/6,494) of unspecified hepatitis B notifications, with an overall rate of 29.5 per 100,000 for males and 25.5 per 100,000 for females. Notification rates were similar for males and females in most age groups. Notification rates in both males and females peaked in the 30–34 years age group (Figure 7).

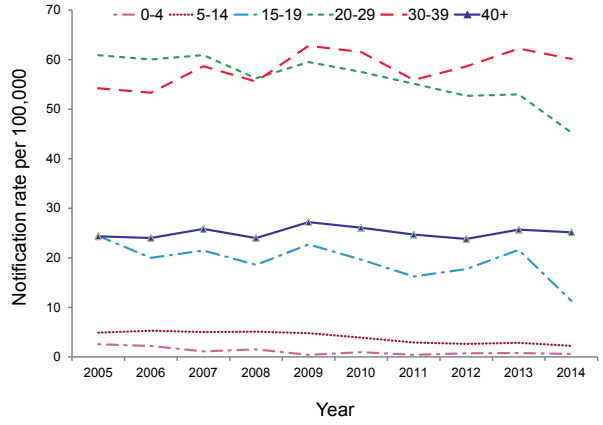
Between 2005 and 2014, notification rates for unspecified hepatitis B decreased overall in the age groups less than 30 years of age but slightly increased in those aged 30–39 years and remained relatively stable in those aged 40 years or over (Figure 8). The decrease in rates for the younger age groups is likely explained by the introduction of the infant and adolescent hepatitis B vaccination programs.[26] The adolescent vaccination program commenced in some jurisdictions from 1997 and the infant vaccination program commenced nationally from 2000.[32]

Figure 7: Notification rate for unspecified hepatitis B, Australia, 2014, by age group and sex*



* Excludes 36 cases where age and/or sex were not reported.

Figure 8: Notification rate for unspecified hepatitis B, Australia, 2005 and 2014, by year and selected age groups*



* Excludes 15 cases where age was not reported.

Hepatitis C

- In 2014, 10,682 cases of hepatitis C were notified to the NNDSS.
- Over the past 10 years, notifications of hepatitis C have declined by 12%.

Infection with hepatitis C virus causes inflammation of the liver. In more than 90% of cases, initial infection with hepatitis C virus is asymptomatic or mildly symptomatic. Approximately 50%–80% of cases go on to develop a chronic infection. Of those who develop a chronic infection, half will eventually develop cirrhosis or cancer of the liver.[22] There is no vaccine to prevent hepatitis C infection.

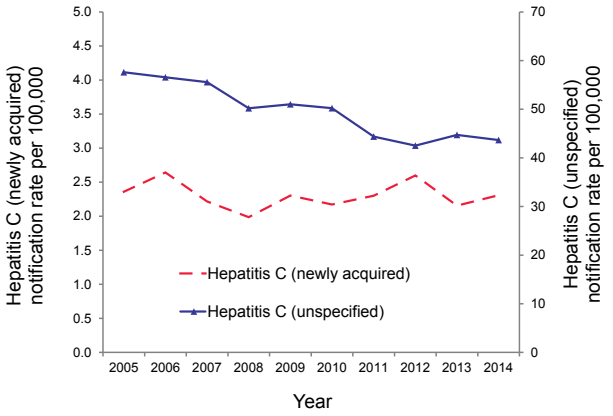
Hepatitis C notifications are classified as being either 'newly acquired' (evidence that infection was acquired within the 24 months prior to diagnosis) or 'unspecified' (infection acquired more than 24 months prior to diagnosis or not able to be specified).

Epidemiological situation in 2014

Of the 10,682 cases of hepatitis C notified in 2014, 4% (433/10,682) were identified as having been newly acquired infections. The proportion of hepatitis C notifications identified as newly acquired has remained reasonably stable since 2005 (range: 3%–5%).

Between 2005 and 2014, hepatitis C notifications (both newly acquired and unspecified) declined by 12% from 12,135 to 10,682. This was mainly due to a downward trend in unspecified hepatitis C notifications, while newly acquired hepatitis C notifications remained low and relatively stable (Figure 9).

Figure 9: Notification rate for hepatitis C (newly acquired* and unspecified†) infection, Australia, 2005 to 2014, by year



* Data from all states and territories except Queensland.

† Data provided from Queensland includes both newly acquired and unspecified hepatitis C cases.

Newly acquired hepatitis C

- In 2014, 433 cases of newly acquired hepatitis C were notified to the NNDSS.
- The majority of newly acquired cases had a history of injecting drug use.
- The highest notification rate was among males in the 20–24 years age group.

Epidemiological situation in 2014

Cases of newly acquired hepatitis C infection were reported from all states and territories except Queensland, where all cases of hepatitis C infection are reported as unspecified. Nationally, the notification rate in 2014 was 2.3 per 100,000 (n=433) compared with 2.2 per 100,000 (n=398) in 2013 (Figure 9).

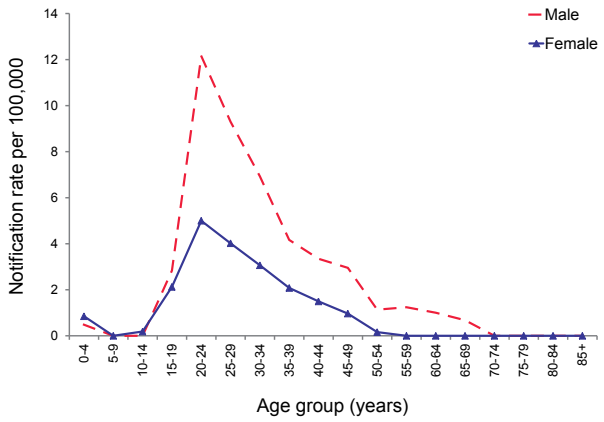
Geographical distribution

In 2014, Western Australia reported the highest jurisdiction-specific rate of newly acquired hepatitis C infection (6.3 per 100,000) (Table 5).

Age and sex distribution

In 2014, males accounted for 70% (304/433) of newly acquired hepatitis C notifications. In 2014, the highest notification rate for newly acquired hepatitis C infection was observed among males aged 20–24 years (12.2 per 100,000). For females, the highest notification rate was in those aged 20–24 years (5.0 per 100,000) (Figure 10).

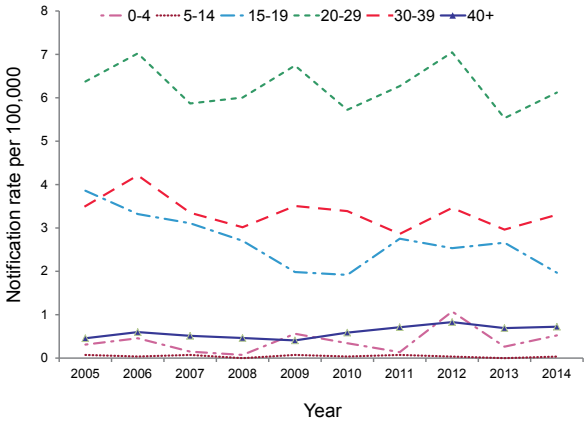
Figure 10: Notification rate for newly acquired hepatitis C* infection, Australia, 2014, by age group and sex



* Data from all states and territories except Queensland.

Between 2005 and 2014, notification rates for newly acquired hepatitis C infection have declined overall among those in the 15–39 years age groups. The largest decrease from 2005 to 2014 occurred in the 15–19 years age groups (from 3.9 to 2.1 per 100,000) (Figure 11). This may be partly explained by the findings of a recent survey, which suggested a decrease in the prevalence of injecting drug use among young people in Australia.[33]

Figure 11: Notification rate for newly acquired hepatitis C* infection, Australia, 2005 to 2014, by year and selected age groups†



* Data from all states and territories except Queensland.

† Excludes 1 case where age was not reported (2005).

Risk groups

Exposure histories for newly acquired hepatitis C cases reported in 2014 were analysed for all jurisdictions except Queensland (Table 11). In 2014, 99% (343/347) of cases with enhanced data had at least 1 risk factor recorded, with the potential source of exposure not recorded or unable to be determined for the remainder. Of the cases for which exposure history was reported, approximately 80% (279/347) had a history of injecting drug use and approximately 17% (59/347) reported possible sexual exposure.

Approximately 25% (n=86) of cases with exposure history had reported being imprisoned in the 24 months prior to diagnosis. Of these cases, approximately 87% (n=75) also reported a history of injecting drug use. However, it is important to note that screening rates are generally higher in the prison entry population than the general population. A screening survey of prison entrants conducted over a 2-week period found that the prevalence of hepatitis C infection, based on hepatitis C antibody detection, was 22% in 2012, a decrease from 35% in 2007.[34]

Unspecified hepatitis C

- In 2014, 10,249 cases of unspecified hepatitis C infection were notified to the NNDSS.
- The highest notification rates were among males in the 30–49 years age groups.

Table 11: Enhanced risk factor data on notifications of newly acquired hepatitis C infection in selected jurisdictions,* 2014, by sex and risk factors†‡

Exposure category	Number of exposure factors reported			Percentage of total cases§ (n=347)
	Male	Female	Total	
Injecting drug use	190	89	279	80
Imprisonment	77	9	86	25
Sexual contact	41	18	59	17
Sexual contact (hepatitis B positive partner) – opposite sex	19	17	36	10
Sexual contact (hepatitis B partner status unknown)	15	1	16	5
Sexual contact (hepatitis B positive partner) – same sex	7	0	7	2
Perinatal transmission	27	14	41	12
Other	21	15	36	11
Household contact	6	8	14	4
Other risk not elsewhere classified (≤24 months prior to diagnosis)	14	6	20	6
Needlestick/bio-hazardous injury	1	1	2	1
Skin penetration procedure	26	9	35	10
Tattoos	14	4	18	5
Ear or body piercing	5	4	9	3
Acupuncture	7	1	8	2
Healthcare exposure	7	3	10	3
Haemodialysis	4	2	6	2
Surgical work	2	1	3	1
Major dental surgery work	1	0	1	<1
Undetermined	3	6	9	3
Unknown (not recorded)	1	0	1	
Total exposure factors reported	389	157	546	
Total number of cases	233	114	347	

* Includes data from all states and territories except Queensland (not notified). While the 7 jurisdictions provided enhanced data on risk factors, not all cases had this information recorded.

† More than 1 exposure category for each notification could be recorded.

‡ Analysis and categorisation of these exposures are subject to interpretation and may vary between reports.

§ The denominator used to calculate the percentage is based on the total number of notified cases with recorded enhanced data, from all jurisdictions except Queensland (notified as unspecified hepatitis C). As more than 1 exposure category for each case could be recorded, the total percentage does not equate to 100%.

Epidemiological situation in 2014

In 2014, 10,249 cases of unspecified hepatitis C infections were notified to the NNDSS (43.7 per 100,000) compared with 10,339 cases in 2013 (44.7 per 100,000). Apart from slight rises from 2008–2009 and 2012–2013, notification rates have decreased annually since 2005. There was an overall decline of 24% between 2005 (57.6 per 100,000) and 2014 (43.7 per 100,000) (Figure 9).

Several factors may account for the decrease including changes in surveillance practices, removal of duplicate notifications and a gradual decline in the prevalent group of hepatitis C cases accumulated prior to the introduction of hepatitis C testing in the early 1990s.[25,35] The continuing decline in the notification rate may also be attributable to an apparent decrease in the prevalence of injecting drug use among young people in Australia.[33]

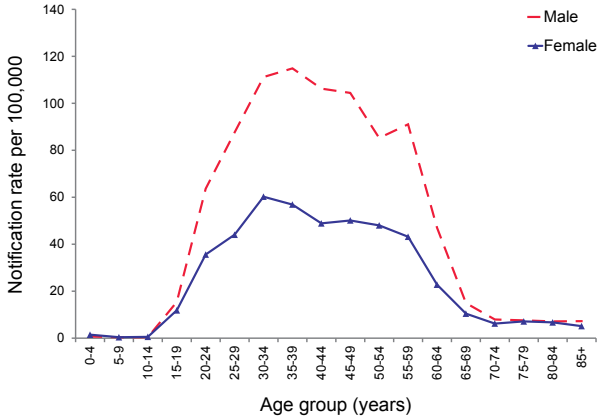
Geographical distribution

For the past 10 years, the Northern Territory has reported the highest jurisdiction-specific notification rate for unspecified hepatitis C. In 2014, the Northern Territory's notification rate was 72.8 per 100,000 (Table 5), which was 41% less than the 2005 rate of 123.6 per 100,000.

Age and sex distribution

Nationally in 2014, 66% (6,718/10,249) of unspecified hepatitis C notifications were in males (for cases where the sex was reported). The notification rate in males was 57.5 per 100,000 and in females 29.8 per 100,000; a male to female rate ratio of 1.9:1. Notification rates in males exceeded those in females across most age groups. The highest notification rates were among males in the 35–39 years (114.9 per 100,000) and 30–34 years (111.2 per 100,000) age groups. The highest notification rates among females were for those in the 30–34 years (60.2 per 100,000) and 35–39 years (56.9 per 100,000) age groups (Figure 12).

Figure 12: Notification rate for unspecified hepatitis C* infection, Australia, 2014, by age group and sex†



* Data provided from Queensland includes both newly acquired and unspecified hepatitis C cases.

† Excludes 29 cases where age and/or sex were missing or unknown.

Between 2005 and 2014, notification rates for unspecified hepatitis C infection have declined overall across all age groups, except for the 0–4 years age group for which rates remained relatively stable at 1.1 per 100,000 due to the low number of notifications. The largest decreases have occurred in the 20–29 years (from 111.6 to 58.3 per 100,000), the 30–39 years (117.8 to 86.2 per 100,000) and the 15–19 years (24.3 to 13.7 per 100,000) age groups (Figure 13).

Figure 13: Notification rate for unspecified hepatitis C* infection, Australia, 2005 to 2014, by year and selected age groups†

* Data provided from Queensland (2005–2014) includes both newly acquired and unspecified hepatitis C cases.

† Excludes 54 cases where age was not reported (2005–2007 and 2009–2014).

Hepatitis D

- In 2014, 59 cases of hepatitis D were notified to the NNDSS.
- Hepatitis D is always associated with hepatitis B co-infection.

Hepatitis D is a defective single-stranded RNA virus that replicates in the presence of the hepatitis B virus. Hepatitis D infection can occur as either an acute co-infection with hepatitis B or as a super-infection with chronic hepatitis B infection. The modes of hepatitis D transmission are similar to those for hepatitis B.[22]

Epidemiological situation in 2014

In Australia, the notification rate for hepatitis D infection remains low. In 2014, there were 59 notified cases of hepatitis D, representing a rate of 0.3 per 100,000 (Table 5). Over the preceding 9 years, notifications of hepatitis D remained relatively low with an average of almost 46 cases notified per year (range: 34 to 61).

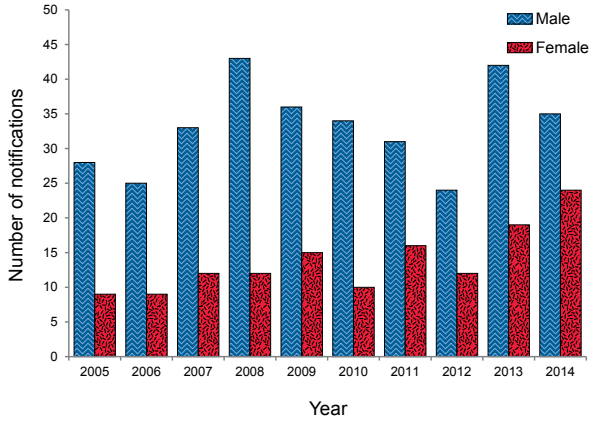
Geographical distribution

In 2014, New South Wales reported the highest number of cases (19) followed by Victoria (14), Queensland (13), South Australia (9), Western Australia (3) and the Northern Territory (1). No cases were reported from the Australian Capital Territory or Tasmania during this period.

Age and sex distribution

Hepatitis D notifications in males exceeded those in females each year from 2005 to 2014. In 2014, 59% (35/59) of notifications were in males. This represented a male to female notification ratio of 1.5:1. This was less than the average notification ratio of 2.7:1 over the preceding 9 years (Figure 14).

Figure 14: Notifications of hepatitis D infection, Australia, 2005 to 2014, by year and sex



Gastrointestinal diseases

Overview

In 2014, gastrointestinal diseases notified to NNDSS and discussed in this section were: botulism, campylobacteriosis, cryptosporidiosis, haemolytic uraemic syndrome (HUS), hepatitis A, hepatitis E, listeriosis, salmonellosis, shigellosis, Shiga toxin-producing *Escherichia coli* (STEC) infections and typhoid fever.

Overall notified cases of gastrointestinal diseases increased by 24%, from to 32,535 in 2013 to 40,367 in 2014. Notifications for campylobacteriosis, salmonellosis, and shigellosis were at the highest levels since NNDSS records began in 1991. It should be noted that nucleic acid-based testing methods were introduced by a number of diagnostic laboratories around the country from late 2013 onwards. Whilst these tests may have increased sensitivity compared with traditional techniques, such as culture, the effect on notifications has not been quantified.

Surveillance systems overview

The Australian Government established OzFoodNet—Australia's enhanced foodborne disease surveillance system—in 2000 as a collaborative network of epidemiologists and microbiologists who conduct enhanced surveillance, epidemiological outbreak investigations and applied research into foodborne disease across Australia. OzFoodNet's mission is to apply concentrated effort at the national level to investigate and understand foodborne disease, to describe its epidemiology more effectively and to identify ways to minimise foodborne illness in Australia. The data and results summarised in the following sections will be reported in more detail in the OzFoodNet annual report 2014.

Botulism

- In 2014, there was 1 case of botulism notified to NNDSS.

Botulism is a rare but extremely serious intoxication resulting from toxins produced by *Clostridium botulinum* (commonly toxin types A, B and E). Four forms of botulism are recognised; infant, foodborne, wound and adult intestinal toxaemia.[22]

Epidemiological situation in 2014

There was 1 case of infant botulism notified by Queensland in 2014. *C. botulinum* toxin type B gene was detected in the stools by polymerase chain reaction (PCR) and toxin type B was confirmed using a mouse bioassay. No source of infection was identified.

Campylobacteriosis

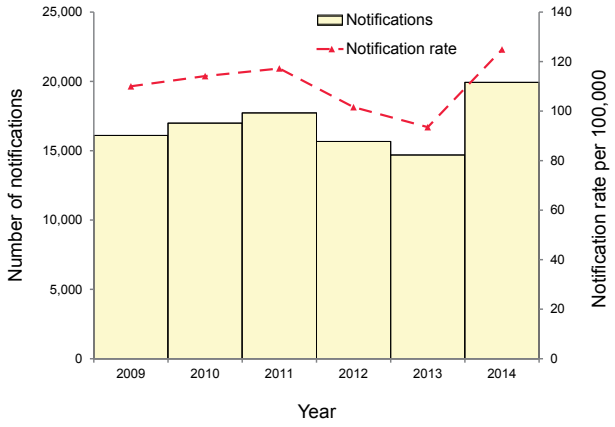
- In 2014, 19,931 cases of campylobacteriosis were notified to the NNDSS.
- Campylobacteriosis was the most frequently notified enteric infection in 2014.

The bacterium *Campylobacter* is a common cause of foodborne illness (campylobacteriosis) in humans. The severity of this illness varies and is characterised by diarrhoea (often bloody), abdominal pain, fever, nausea and or vomiting.[22] Campylobacteriosis is notifiable in all Australian states and territories except New South Wales.

Epidemiological situation in 2014

There were 19,931 notified cases of campylobacteriosis in 2014 making it the most frequently notified enteric infection (124.9 per 100,000 not including New South Wales). This was a 36% increase on the number of notifications received for 2013 (n=14,692) (Figure 15) and a 19% increase on the 5-year mean (n=16,237) (Table 6). The number of notified cases for 2014 was the highest recorded in NNDSS since 1991, and exceeded 2 standard deviations of the previous 5-year mean (2009 to 2013) by more than 1,300 notifications.

Figure 15: Notifications and notification rate for campylobacteriosis, Australia, 2009 to 2014, by year



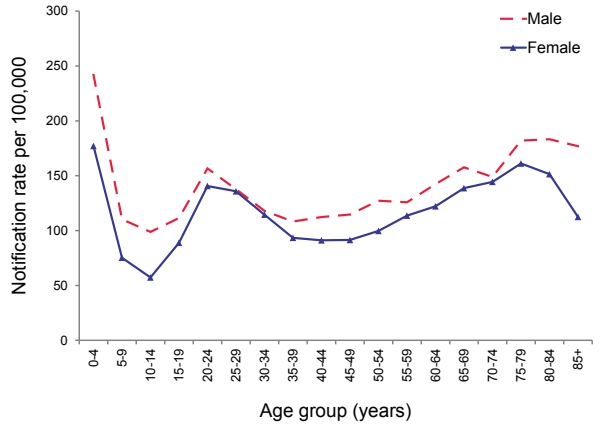
Geographical distribution

Notification rates ranged from 107.0 per 100,000 in South Australia to 181.5 per 100,000 in Tasmania; the Tasmanian rate was approximately 1.5 times higher than the national rate (124.9 per 100,000) (Table 5).

Age and sex distribution

Campylobacteriosis was most frequently notified among the 0–4 years age group for both males (241.9 per 100,000) and females (177.2 per 100,000). The median age of notified cases was 36 years (range 0 to 101 years) and 54% (10,811/19,896) where sex was known were male. Notification rates were highest among males in all age groups (Figure 16).

Figure 16: Notification rate for campylobacteriosis, Australia, 2014, by age group and sex (n=19.896)*



* Excludes notifications where age (n=12), sex (n=21) or both (n=2) were not reported.

Cryptosporidiosis

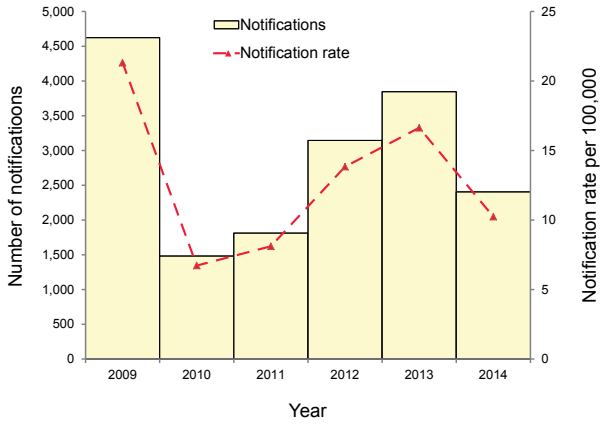
- In 2014, 2,405 cases of cryptosporidiosis were notified to the NNDSS.

Cryptosporidiosis is a parasitic infection characterised by abdominal cramping and usually large-volume watery diarrhoea. Ingesting contaminated water, typically from a recreational source like a community swimming pool or lake is a major risk factor for infection.[22]

Epidemiological situation in 2014

There were 2,405 notified cases of cryptosporidiosis in 2014 (10.2 per 100,000). This represents a 37% decrease on the number of notifications received for 2013 (n=3,846) and a 19% decrease on the 5-year mean (n=2,982) (Figure 17).

Figure 17: Notifications and notification rate for cryptosporidiosis, Australia, 2009 to 2014, by year



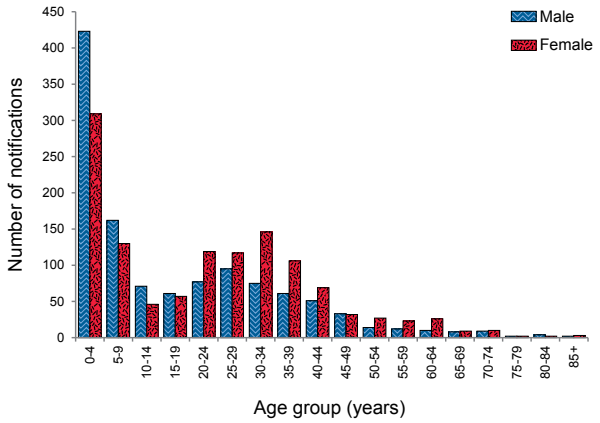
Geographical distribution

Notification rates ranged from 5.6 per 100,000 in New South Wales to 35.6 per 100,000 in the Northern Territory; the Northern Territory rate was 3.5 times higher than the national rate (10.2 per 100,000) (Table 5).

Age and sex distribution

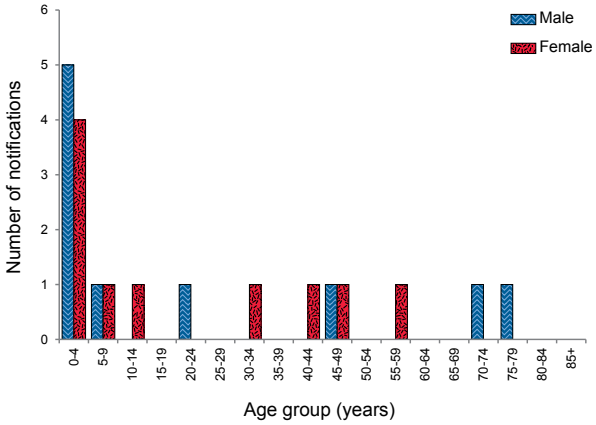
In 2014, notified cases for cryptosporidiosis, for which age was reported, were most frequent among the 0–4 years age group (31%, 732/2,403). The median age of notified cases was 18 years (range 0 to 92 years) and just over half (1,234/2,405) were female (Figure 18).

Figure 18: Notifications of cryptosporidiosis, Australia, 2014, by age group and sex



* Excludes notifications where age (n=2) was not reported.

Figure 19: Notifications of haemolytic uraemic syndrome, Australia, 2014, by age group and sex



Haemolytic uraemic syndrome

- In 2014, 20 cases of haemolytic uraemic syndrome notified to the NNDSS.
- Cases were most frequently notified among the 0–4 years age group.

HUS is a rare but serious illness that is characterised by acute renal impairment; with 50% of patients requiring dialysis and approximately 5% dying.[22] Not all diagnoses of HUS are related to enteric pathogens, but Australian cases are commonly associated with STEC infection.[36] In 2013, 68% (10/15) of notified HUS cases were positive for STEC.[37]

Epidemiological situation in 2014

There were 20 notified cases of HUS in 2014 compared with 15 in 2013 and a mean of 14 cases per year between 2009 and 2013.

Geographical distribution

Over half (55%, 11) of notifications were in residents from New South Wales (n=6) and Victoria (n=5).

Age and sex distribution

In 2014, HUS was most frequently notified among the 0–4 years age group (45%, 9) (Figure 19). Half of notified cases were in males (n=10).

Hepatitis A

- In 2014, 231 cases of hepatitis A infection notified to the NNDSS.
- Overseas travel was the primary risk factor for notified cases.

Hepatitis A is an acute viral infection primarily of the liver, characterised by fever, malaise, anorexia, nausea and abdominal discomfort followed by jaundice. The disease varies from a mild illness to a severely disabling disease lasting several months. Infection is usually spread from person to person via the faecal-oral route but can also be foodborne or waterborne.[22]

Epidemiological situation in 2014

There were 231 notified cases of hepatitis A infection in 2014 (1.0 per 100,000). This was a 22% increase on the number of notified cases in 2013 (n=190), and a 13% decrease on the 5-year mean (n=266). The historical mean reflects the impact of a 2009–2010 outbreak of hepatitis A associated with the consumption of semi-dried tomatoes (Figure 20).[38]

Geographical distribution

Two-thirds (66%, 153/231) of notifications were in residents from New South Wales (n=83) and Victoria (n=70).

Age and sex distribution

Hepatitis A infection was most frequently notified among the 5–9 years age group (14%, 32) in 2014 (Figure 21). The median age of notified cases was 23 years (range 1 to 76 years), and 58% (134) of all cases were male.

Indigenous status

Indigenous status was known for 96% (222) of notified cases of hepatitis A. Of these, 4 were identified as being Indigenous.

Figure 20: Notifications and notification rate for hepatitis A infection, Australia, 2009 to 2014, by year

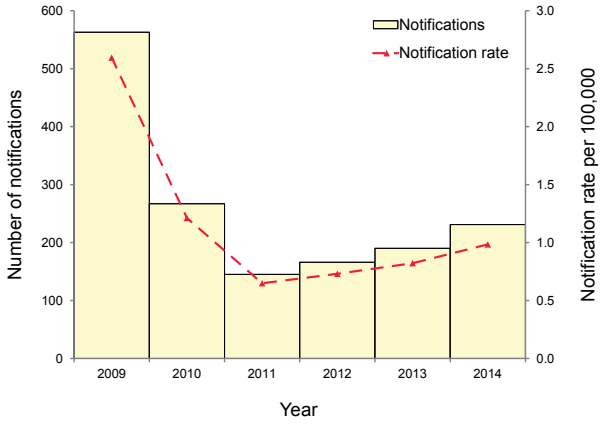
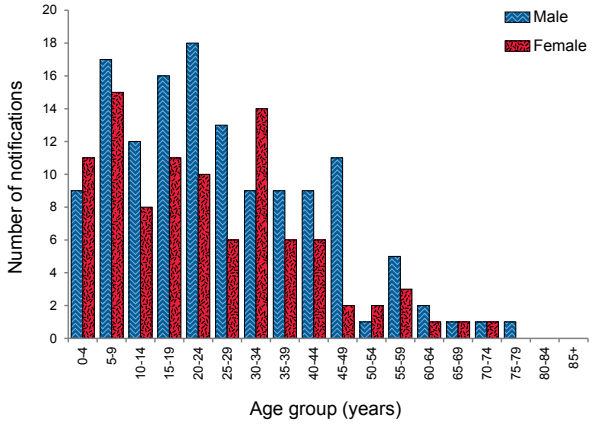


Figure 21: Notifications of hepatitis A infection, Australia, 2014, by age group and sex



Place of acquisition

Overseas travel was the primary risk factor for notified cases (Table 12). In 2014, 80% (184/231) reported overseas travel during their incubation period for hepatitis A infection and were considered to have been overseas acquired. The top 5 countries of acquisition were Fiji (n=30), the Philippines (n=24), India (n=22), Pakistan (n=18) and Indonesia (n=12).

In 2014, 19% (44) of notified cases were locally acquired. This was similar to 2012 where 24% (46/190) of notified cases were locally acquired (Table 12). A 2009–2010 outbreak associated with the consumption of semi-dried tomatoes contributed to an increase in locally acquired hepatitis A cases in those years.[38] Place of acquisition was unknown or not recorded for 3 notified cases.

Hepatitis E

- In 2014, 56 cases of hepatitis E infection notified to the NNDSS.

Hepatitis E infection is an acute viral infection primarily of the liver that is transmitted by the faecal-oral route, most often via food or water.[22] The infection is usually acquired overseas among travellers to endemic areas.

Epidemiological situation in 2014

There were 56 notified cases of hepatitis E infection in 2014 (0.2 per 100,000). This was a 65% increase on the number of notified cases in 2013 (n=34), and a 60% increase on the 5-year mean (n=35).

Geographical distribution

The majority of notifications were in residents from New South Wales (n=37).

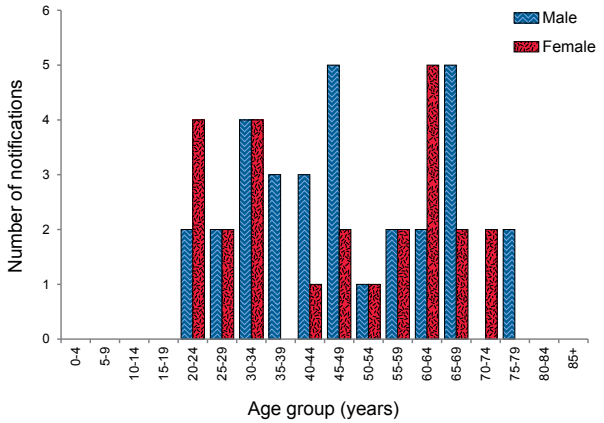
Table 12: Notifications of hepatitis A, Australia, 2009 to 2014, by place of acquisition

	Locally acquired		Overseas acquired		Unknown		
Year	n	%	n	%	n	%	Total
2009	373	66	139	25	51	9	563
2010	113	42	147	55	7	3	267
2011	41	28	103	71	1	1	145
2012	34	20	122	73	10	6	166
2013	46	24	134	71	10	5	190
2014	44	19	184	80	3	1	231

Age and sex distribution

Hepatitis E infection was most frequently notified among the 30–34 years age group (14%, 8) (Figure 22). In 2014, the median age of notified cases was 47 years (range 21 to 77 years), and 55% (31) were male.

Figure 22: Notifications of hepatitis E infection, Australia, 2014, by age group and sex



Place of acquisition

Hepatitis E in Australia has traditionally been associated with overseas travel. In 2014, 52% of cases (29) reported overseas travel during their incubation period and were considered to have been acquired overseas. Of these, 38% (11/29) reported travel to India. The place of acquisition was unknown for 6 notified cases.

In 2014, 38% (21) of cases were locally acquired, with the majority of these reported in New South Wales residents (n=20). The large number of notified cases among residents from New South Wales can be attributed to a cluster of hepatitis E infection associated with consumption of pork liver pâté at a specific restaurant in that state.[39] This was the first documented locally acquired outbreak of hepatitis E in Australia.

Listeriosis

- In 2014, 80 cases of listeriosis notified to the NNDSS.
- Notifications were highest in the 80+ year age group.

Invasive listeriosis is caused by a bacterial infection that commonly affects the elderly or immunocompromised, and typically occurs among people with serious underlying illnesses. Listeriosis can also affect pregnant women and infect their unborn baby.[40] Laboratory-confirmed infections in a mother and her unborn child or neonate are notified separately in the NNDSS.

Epidemiological situation in 2014

There were 80 notified cases of listeriosis in 2014 (0.3 per 100,000), which was a slight increase on the number of notified cases in 2013 (n=76) and the same as the 5-year mean (n=80).

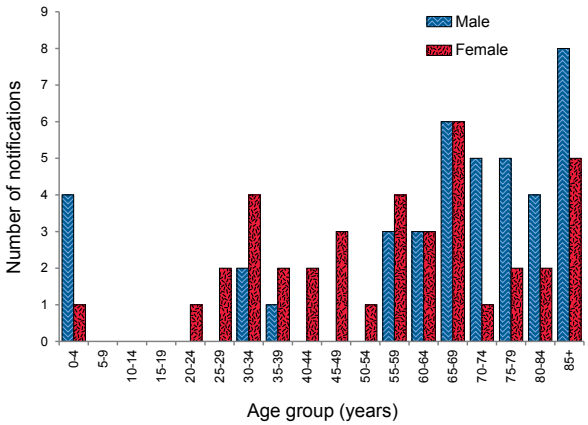
Geographical distribution

Over half (56%, 45) of notifications were in residents from New South Wales (n=23) and Victoria (n=22).

Age and sex distribution

Notifications of listeriosis were highest in the 80 years or over age group (16%, 13/80) (Figure 23), with just over half (51%, 41) of all notified cases being male.

Figure 23: Notifications of listeriosis, Australia, 2014, by age group and sex



Enhanced surveillance datasets

In 2010, OzFoodNet started collecting enhanced surveillance data on all notified cases of listeriosis in Australia. The information collected on cases includes laboratory data collected from the characterisation of *Listeria monocytogenes* isolates by molecular subtyping methods, and epidemiological data, which includes food consumption histories and clinical data. The overall aim of this enhanced surveillance is to enable timely detection of outbreaks and subsequent public health response.[41] Further information on OzFoodNet's National

Enhanced Listeriosis Surveillance System can be found in OzFoodNet annual reports (http://www.ozfoodnet.gov.au/internet/ozfoodnet/publishing.nsf/Content/reports-1).

Salmonellosis (non-typhoidal)

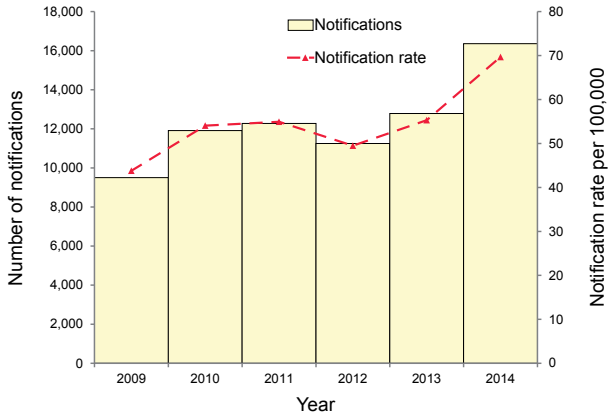
- In 2014, 16,358 cases of salmonellosis notified to the NNDSS.
- This was the highest number of notifications recorded in NNDSS since 1991.

Salmonellosis is a bacterial disease characterised by the rapid development of symptoms including abdominal pain, fever, diarrhoea, muscle pain, nausea and/or vomiting. People can become infected via faecal-oral transmission, ingesting contaminated food, through animal contact and from environmental exposures. The predominant mode of transmission is contaminated food, mainly of animal origin.[22]

Epidemiological situation in 2014

There were 16,358 notified cases of salmonellosis in 2014 (69.7 per 100,000). This was a 28% increase on the number of cases reported in 2013 (n=12,785) (Figure 24), and a 42% increase on the 5-year mean (n=11,545). The number of cases for 2014 was the highest recorded in NNDSS since 1991 when this disease became nationally notifiable, beating the previous record in 2013. Additionally, notified cases in 2014 exceeded 2 standard deviations of the previous 5-year mean (2009 to 2013) by more than 2,200 notifications.

Figure 24: Notifications and notification rate for salmonellosis, Australia, 2009 to 2014, by year



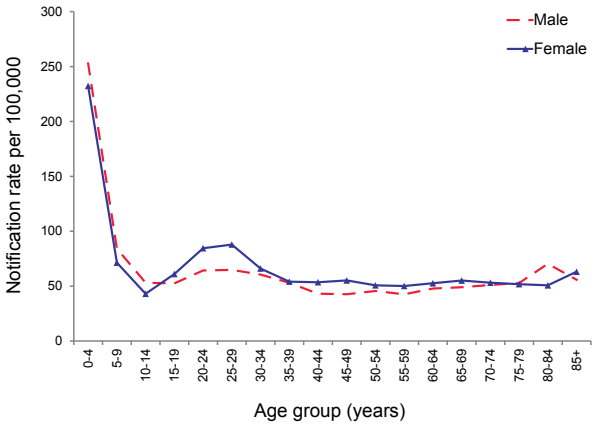
Geographical distribution

Notification rates ranged from 48.4 per 100,000 in Tasmania to 186.8 per 100,000 in the Northern Territory (Table 5).

Age and sex distribution

Salmonellosis was most frequently notified among the 0–4 years age group (23%, 3,709/16,355) (Figure 25) where age was recorded, with an age-specific rate of 210.4 per 100,000 population. The median age of notified cases was 27 years (range 0 to 102 years) and just over half (51%, 8,393/16,333) of cases where sex was recorded were female.

Figure 25: Notification rate for salmonellosis, Australia, 2014, by age group and sex (n=16,332)*



* Excludes notifications where age (n=1), sex (n=23) or both (n=2) were not reported.

Shigellosis

- In 2014, 1,051 notified cases of shigellosis to the NNDSS.
- Increase in notifications possibly associated with increased in culture-independent diagnostic testing.

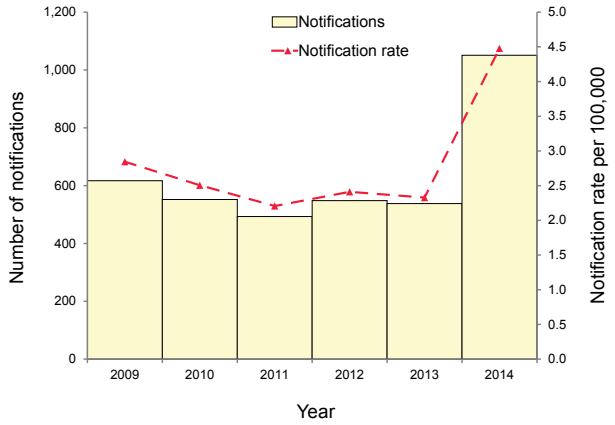
Shigellosis is a bacterial disease characterised by acute abdominal pain and fever, small-volume loose stools, vomiting and tenesmus. *Shigella* is transmitted via the faecal-oral route, either directly (such as male-to-male sexual contact) or indirectly through contaminated food or water.[22]

Epidemiological situation in 2014

There were 1,051 notified cases of shigellosis in 2014 (4.5 per 100,000). This was a 95% increase on

the number of cases in 2013 (n=538) (Figure 26), and a 91% increase on the 5-year mean (n=550). This increase may be associated with the increased use of culture-independent diagnostic testing (CIDT). The current CIDT methods are unable to differentiate between infection with *Shigella,* which is notifiable, and entero-invasive *Escherichia coli,* which is not.[42]

Figure 26: Notifications and notification rate for shigellosis, Australia, 2009 to 2014, by year



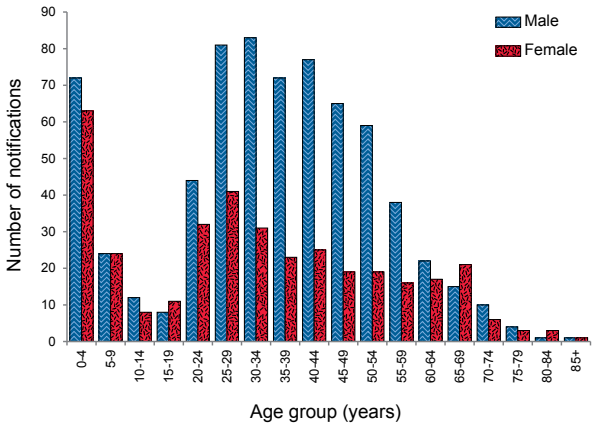
Geographical distribution

Notification rates ranged from 0.4 per 100,000 in Tasmania to 40.5 per 100,000 in the Northern Territory. State and territory rates for 2014 should be interpreted with caution as some jurisdictions require CIDT-positive samples to be confirmed by culture whilst others do not.

Age and sex distribution

Notifications for shigellosis were highest in the 0–4 year age group (13%, 135) (Figure 27). In 2014, the median age of notified cases was 34 years (range 0 to 94 years) and almost two-thirds (65%, 688) were male.

Figure 27: Notifications of shigellosis, Australia, 2014, by age group and sex



Indigenous status

Information on Indigenous status was available for 81% (853) of shigellosis cases. This proportion varied by state or territory, with Queensland being the only jurisdiction with less than 80% data completeness. Among states and territories with greater than or equal to 80% completeness, the proportion of notified cases who identified as being of Aboriginal and/or Torres Strait Islander origin was 11% (98/875).

Place of acquisition

Thirty-two per cent (333) of notified cases of shigellosis were reported as being acquired overseas. The top 5 countries of acquisition were Indonesia (n=86), India (n=54), Thailand (n=21), Vietnam (n=20) and Cambodia (n=17). The place of acquisition was inadequately described or unknown for half of notifications (51% 530) (Table 13).

Table 13: Notifications of shigellosis, Australia, 2009 to 2014, by place of acquisition

	Locally acquired		Overseas acquired		Unknown		
Year	n	%	n	%	n	%	Total
2009	227	37	83	13	307	50	617
2010	164	30	191	35	197	36	552
2011	152	31	133	27	208	42	493
2012	141	26	174	32	233	43	548
2013	137	25	209	39	192	36	538
2014	188	18	333	32	530	50	1,051

Shiga toxin-producing *Escherichia coli*

- In 2014, 116 notified cases of Shiga toxin-producing *Escherichia coli* infection to the NNDSS.

Shiga toxin-producing *Escherichia coli* is a common cause of diarrhoeal illness in humans. People can become infected via faecal-oral transmission, ingesting contaminated food, through animal contact and from environmental exposures. Severe illness can progress to HUS. Children under 5 years of age are most frequently diagnosed with infection and are at greatest risk of developing HUS.[22]

Epidemiological situation in 2014

There were 115 notified cases of STEC in 2014 (0.5 per 100,000). This was a 36% decrease on the number of cases in 2013 (n=180) and similar to the 5-year mean (n=119). A large outbreak (n=57) of STEC infection associated with a Queensland agricultural show contributed to the high number of notifications seen in 2013.[43]

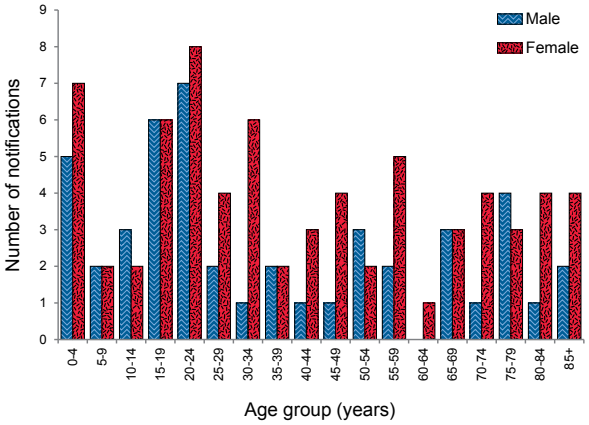
Geographical distribution

Detection of STEC infection is strongly influenced by jurisdictional practices regarding the screening of stool specimens.[41] South Australia continues to test all bloody stools for STEC using PCR and subsequently has the highest notification rate in the country; 2.7 cases per 100,000 compared with between 0.1 and 0.6 cases per 100,000 in other states and territories reporting cases. Additionally, South Australia ceased routinely culturing PCR positive STEC samples in 2014. The differences in testing practices among states and territories render comparison of notification data by jurisdiction and over time invalid.

Age and sex distribution

Notifications of STEC were highest in the 20–24 years age group (13%, 15/115) (Figure 28). In 2014, the median age of notified cases was 33 years (range 0 to 88 years) and 60% (69) of notified cases were female.

Figure 28: Number of notifications of Shiga toxin-producing *Escherichia coli* infection, Australia, 2014, by age group and sex



Typhoid fever

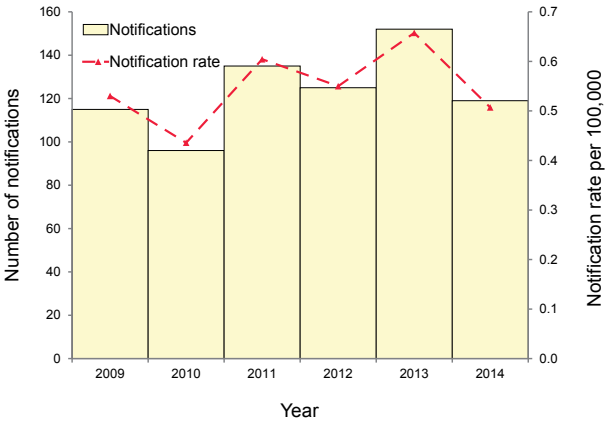
- In 2014, 119 notified cases of typhoid to the NNDSS.
- 92% of cases were acquired overseas.

Typhoid is a bacterial disease caused by *Salmonella enterica* serotype Typhi. Symptoms include sustained fever, marked headache, malaise and constipation more often than diarrhoea in adults. The transmission mode is the same as for salmonellosis, however, typhoid differs in that humans are the reservoir for the bacterium.[22]

Epidemiological situation in 2014

There were 119 notified cases of typhoid in 2014 (0.5 per 100,000). This was a 22% decrease on the number of cases in 2013 (n=152) (Figure 29) and similar to the 5-year mean (n=125).

Figure 29: Notifications and notification rate for typhoid, Australia, 2009 to 2014, by year



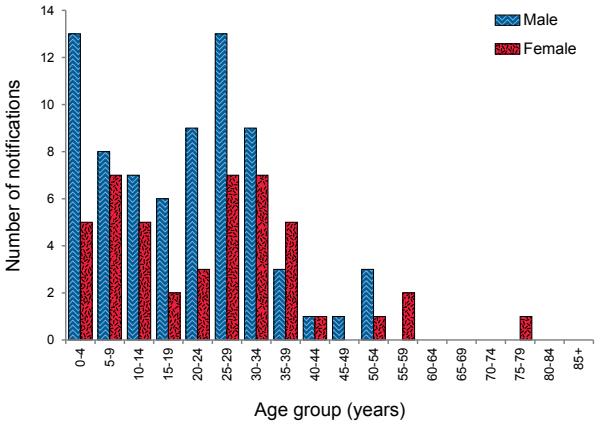
Geographical distribution

Almost two-thirds (62%, 74) of notifications were in residents from New South Wales (n=45) and Victoria (n=29).

Age and sex distribution

Typhoid was most frequently notified among the 20–24 years age group (17%, 20) (Figure 30). The median age of notified cases was 22 years (range 1 to 77 years), and 61% (73) were male.

Figure 30: Notifications of typhoid, Australia, 2014, by age group and sex



Place of acquisition

As in previous years, overseas travel was the primary risk factor for notified cases. In 2014, 92% (109) reported overseas travel during their exposure period and were considered overseas acquired. India continues to be the most frequently reported country of acquisition, accounting for 56% (61/109) of overseas-acquired cases in 2014. Six cases were listed as locally acquired and the place of acquisition was unknown for 4 cases (Table 14).

Quarantinable diseases

Human diseases covered by the *Quarantine Act 1908,* and notifiable in Australia and to the WHO in 2014 were cholera, plague, rabies, yellow fever, smallpox, highly pathogenic avian influenza in humans (HPAIH), severe acute respiratory syndrome (SARS) and 4 viral haemorrhagic fevers (Ebola, Marburg, Lassa and Crimean–Congo). These diseases are of international public health significance.

Travellers are advised to seek information on the risk of contracting these diseases at their destinations and to take appropriate measures. More information on quarantinable diseases and travel health can be found on the Travel Health Information web site (www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-strateg-quaranti-index.htm) and on the Smartraveller web site (www.smartraveller.gov.au/).

There were no cases of plague, rabies, smallpox, SARS, HPAIH or viral haemorrhagic fevers reported in Australia in 2014. While there were 2 cases of overseas-acquired cholera in 2014, Australia remains free of all the listed quarantinable diseases (Table 15).

Cholera

- In 2014, 2 cases of cholera notified to the NNDSS.

Cholera is an infection of the digestive tract (or gut) caused by certain strains of the bacterium *Vibrio cholerae* that produce toxins (poisons) and is most commonly acquired in parts of Africa, Asia, South America, the Middle East and the Pacific islands. *V. cholerae* is found in the faeces of infected people, and is spread by drinking contaminated water, eating food washed with contaminated water or prepared with soiled hands or eating fish or shellfish caught in contaminated water. Person-to-person spread of cholera is less common. Most people do not develop symptoms or have only mild illness but a small proportion of people will develop severe symptoms. Symptoms typically start between 2 hours and 5 days (usually 2 to 3 days) after ingesting the bacteria. Symptoms can include characteristic 'rice water' faeces (profuse, watery diarrhoea), nausea and vomiting, signs of dehydration, such as weakness, lethargy and muscle cramps. Only toxigenic *V. cholerae* o1 or o139 are notifiable in Australia.

Table 14: Notifications of typhoid, Australia, 2009 to 2014, by place of acquisition

	Locally acquired		Overseas acquired		Unknown		
Year	n	%	n	%	n	%	Total
2009	15	13	82	71	18	16	115
2010	2	2	92	96	2	2	96
2011	6	4	125	93	4	3	135
2012	9	7	109	87	7	6	125
2013	8	5	141	93	3	2	152
2014	6	5	109	92	4	3	119

Table 15: Australia's status for human quarantinable diseases, 2014

Disease	Status	Date of last record and notes
Cholera	Free	Small number of cases reported annually related to overseas travel. Very rare instances of local acquisition as described under the section 'Cholera'.
Plague	Free	Last case recorded in Australia in 1923[44]
Rabies	Free	Last case (overseas acquired) recorded in Australia in 1990[45]
Smallpox	Free	Last case recorded in Australia in 1938, last case world-wide in 1977, declared eradicated by the World Health Organization 1980[46,47]
Yellow fever	Free	Two cases in 2011 were the first recorded, related to overseas travel[37]
SARS	Free	Last case recorded in Australia in 2003[48]
HPAIH	Free	No cases recorded[49]
Viral haemorrhagic fevers		
Ebola	Free	No cases recorded
Marburg	Free	No cases recorded
Lassa	Free	No cases recorded
Crimean–Congo	Free	No cases recorded

Epidemiological situation in 2014

In 2014, there were 2 notifications of cholera in Australia. The following details are available about the relevant exposures or place of acquisition for the 2 cases in 2014:

- Case 1 was a 1-year-old female who acquired the infection whilst travelling in India;
- Case 2 was a 63-year-old female who was an international visitor and had acquired the infection in India;
- These cases both notified by Victoria, but were not known to have been linked.

There were 21 cases of cholera in total in Australia between 2009 and 2013. All cases of cholera reported since the commencement of the NNDSS in 1991 to 2013 have been acquired outside Australia except for 1 case of laboratory-acquired cholera in 1996,[50] 3 cases in 2006 linked to imported whitebait[51] and 1 laboratory-acquired case in 2013.[37]

Sexually transmissible infections

In 2014, the STIs reported to the NNDSS were chlamydial infection, donovanosis, gonococcal infection, and congenital and non-congenital syphilis. Other national surveillance systems that monitor STIs in Australia include the Australian Gonococcal Surveillance Programme (AGSP), which is a network of specialist laboratories monitoring antimicrobial susceptibility patterns of gonococcal infection; and the Kirby Institute.

Chlamydial infection

- In 2014, 86,108 cases of chlamydial infection were notified to the NNDSS.
- Notification rates have remained relatively stable from 2011.
- Almost 40% of notifications were among females aged 15–24 years.

Genital chlamydial infection is caused by the bacterium *Chlamydia trachomatis* serogroups D–K. Screening is important in detecting chlamydial infections, as a large proportion of infections are asymptomatic. Chlamydial infection is highly treatable, although reinfection is common.[52] If left untreated, complications such as epididymitis in males and infertility and pelvic inflammatory disease in females can arise.[22]

Epidemiological situation in 2014

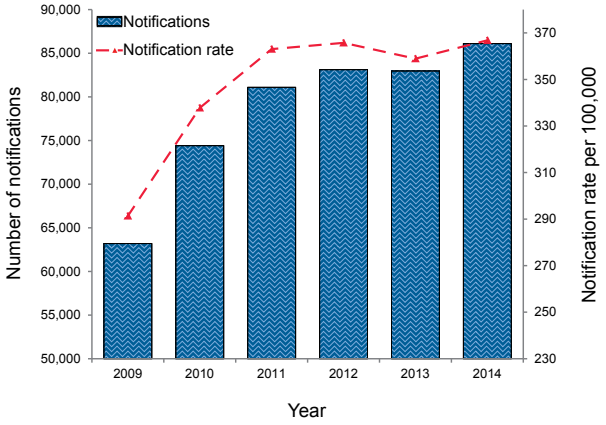
In 2014, chlamydial infection was the most frequently notified disease to the NNDSS, with 86,108 cases, representing 31% of all notifications reported to the NNDSS in 2014. Since 2011, notification rates have remained relatively stable, increasing marginally from 363.0 per 100,000 in 2011 to 366.8 per 100,000 in 2014. This follows a 25% increase in notification rates from 2009 to 2011 (291.4 to 363.0 per 100,000 respectively) (Figure 31).

Geographical distribution

In 2014, the notification rate for chlamydial infection was more than 3 times higher in the Northern Territory (1,225.2 per 100,000) than the overall

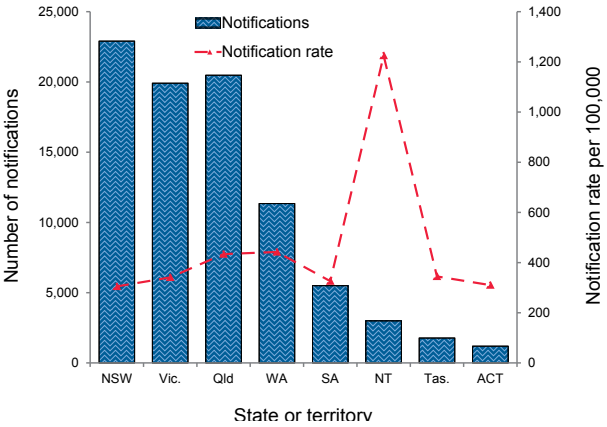
national rate (366.8 per 100,000) (Figure 32). This is mostly explained by the ongoing disproportion of young Aboriginal and Torres Strait Islander women affected by chlamydial infection, particularly those living in regional and remote areas (Table 5).[9]

Figure 31: Notifications and notification rate for chlamydial infection,* Australia, 2009 to 2014, by year



* Excludes notifications where the case was aged less than 13 years.

Figure 32: Notifications and notification rate for chlamydial infection, Australia, 2014, by state or territory

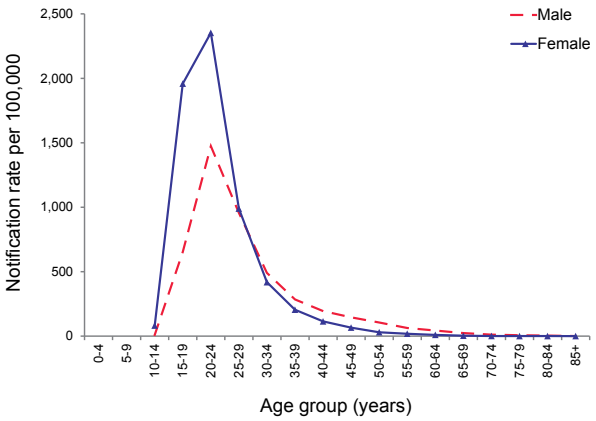


* Excludes notifications where the case was aged less than 13 years.

Age and sex distribution

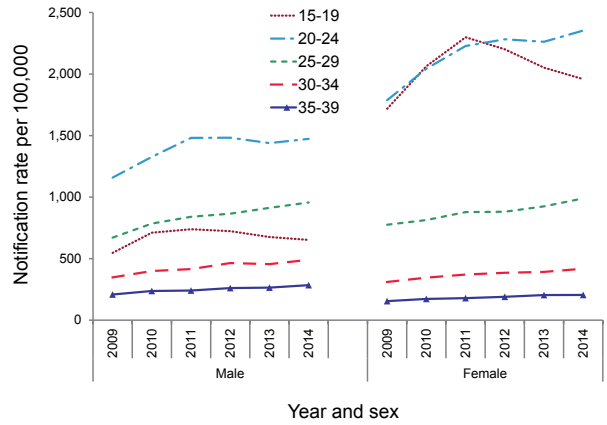
In 2014, chlamydial infection occurred predominately in females aged 15–24 years, accounting for 38% of all chlamydial infections (Figure 33). Similar to 2013, the national notification rate for chlamydial infection in 2014 was 314.8 per 100,000 in males and 417.5 per 100,000 in females. The overall higher rate among females may be partly attributable to preferential testing of women attending health services compared with men.[9,33] Notification rates for males and females increased overall from 2009 to 2014, by 31% (239.7 to 314.8) in males and 22% (340.9 to 417.5) in females, and across most age groups; however, rates decreased from 2011 and 2014 for females aged 15–19 years (Figure 34).

Figure 33: Notification rate for chlamydial infection, Australia, 2014, by age group and sex*



* Excludes notifications where age and/or sex were not reported and notifications where the case was aged less than 13 years.

Figure 34: Notification rate for chlamydial infection, Australia, 2009 to 2014, by year, sex* and selected age groups



* Excludes notifications where age and/or sex were not reported.

Indigenous status

The completeness of Indigenous status identification for chlamydial infection notification data var-

ies by year and by jurisdiction. Nationally in 2014, data on Indigenous status were complete for 37% (31,990) of chlamydial infection notifications, which was lower than the preceding 5-year average of 48% (range: 39%–51%). Four jurisdictions had greater than 50% completeness of the Indigenous status field in each year during the 2009–2014 period: the Northern Territory, Queensland, South Australia, and Western Australia. Among these jurisdictions, the combined age-standardised notification rate ratio between Indigenous and non-Indigenous populations in 2014 was 3.5:1, which was similar to the previous 5 years (range: 3.4–3.7).

Among the Indigenous population, the age-standardised notification rate declined from 1,378.8 per 100,000 in 2011 to 1,266.4 per 100,000 in 2014. This followed an increase from 1,112.4 per 100,000 in 2009 to 1,332.2 per 100,000 in 2011.

Age-standardised notification rates among the non-Indigenous population increased overall from 313.1 per 100,000 in 2009 to 369.9 per 100,000 in 2014. The rate increased each year except for a small decline from 358.5 per 100,000 in 2011 to 355.2 per 100,000 in 2012.

Between 2013 and 2014, age-standardised notification rates for chlamydial infection in the Indigenous population decreased by 7% in both Queensland (1,271.0 to 1,179.8) and Western Australia (1,433.8 to 1,327.8), and by 2% (1,906.6 to 1,863.6) in the Northern Territory. Conversely, rates increased in South Australia by 17% (871.4 to 1,020.6).

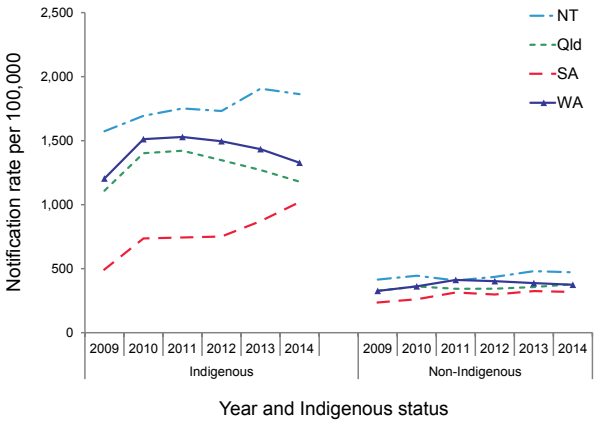
Between 2013 and 2014, age-standardised notification rates for chlamydial infection in the non-Indigenous population decreased by 3% (387.8 to 374.3) in Western Australia, and by 2% in both South Australia (325.1 to 318.5) and the Northern Territory (481.0 to 472.0). Conversely, rates increased in Queensland by 6% (356.8 to 378.7) (Figure 35).

Donovanosis

- In 2014, 1 case of donovanosis was notified to the NNDSS.
- This disease remains rare in Australia.

Donovanosis, caused by the bacterium *Klebsiella granulomatis*, is a chronic, progressively destructive infection that is primarily transmitted through sexual exposure. It affects the skin and mucous membranes of the external genitalia, inguinal and anal regions.[53] Once diagnosed, donovanosis is treated with a series of antibiotics.[54]

Figure 35: Age standardised notification rates for chlamydial infection, selected states and territories,* 2009 to 2014, by year and Indigenous status

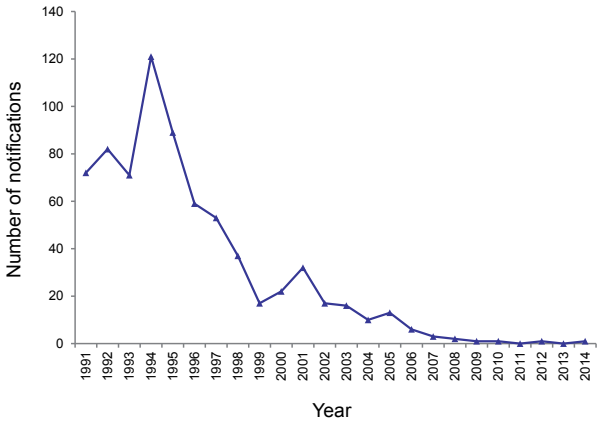


* Includes the states and territories where Indigenous status was reported for more than 50% of cases between 2009 and 2014: the Northern Territory, Queensland, South Australia and Western Australia.

All donovanosis notifications in Australia since 1991 were reported either in the Northern Territory, Western Australia or Queensland and have predominately occurred in Aboriginal and Torres Strait Islander people living in remote areas in northern and central Australia.

Donovanosis was targeted for elimination in Australia through the National Donovanosis Elimination Project 2001–2004.[55] It is now rare, with fewer than 17 cases notified each year since 2002, and fewer than 5 cases notified each year since 2007 (Figure 36).

Figure 36: Notified cases of donovanosis,* Australia, 1991 to 2014, by year



Epidemiological situation in 2014

In 2014, 1 case of donovanosis was notified in Australia, in an Indigenous female from Western Australia (Figure 36).

Gonococcal infection

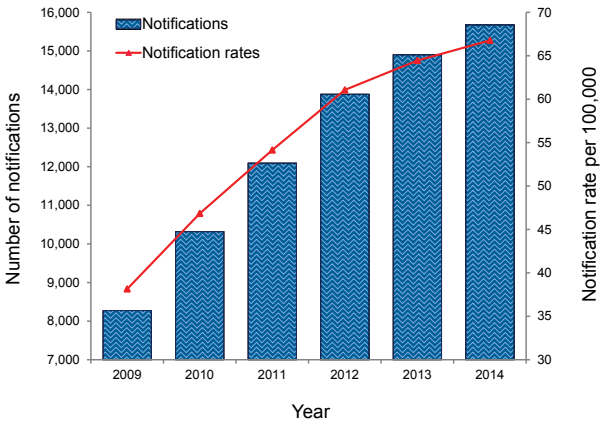
- In 2014, 15,675 cases of gonococcal infection were notified to the NNDSS.
- Notification rates for gonococcal infection continued to increase.
- Notifications occurred predominately in males aged 15–39 years and females aged 15–24 years.

Gonococcal infection is caused by the bacterium *Neisseria gonorrhoeae,* which affects the mucous membranes causing symptomatic and asymptomatic genital and extra-genital tract infections. The most common source of transmission is via unprotected sexual intercourse with an infected person.[22] If left untreated, it can lead to pelvic inflammatory disease in women and infertility in both men and women. Gonococcal infection also increases the risk of both acquisition and transmission of HIV. [53]

Epidemiological situation in 2014

In 2014, there were 15,675 cases of gonococcal infection reported to the NNDSS, a notification rate of 66.8 per 100,000. This was a 4% increase compared with the rate reported in 2013 (64.5 per 100,000). In the past 6 years, gonococcal infection notification rates increased, on average, 12% each year since 2009 (range: 4%–23%). Overall, gonococcal infection notification rates increased by 75% from 2009 (38.1 per 100,000) to 2014 (66.8 per 100,000) (Figure 37).

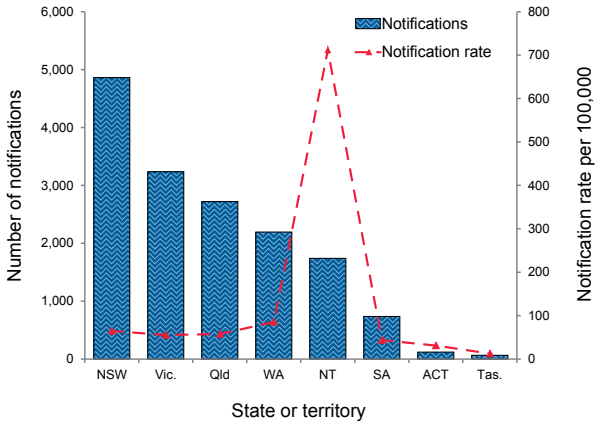
Figure 37: Notifications and notification rate for gonococcal infection, Australia, 2009 to 2014, by year



Geographical distribution

In 2014, the notification rate for gonococcal infection was almost 11 times higher in the Northern Territory (711.7 per 100,000) than the overall national rate (66.8 per 100,000) (Figure 38).

Figure 38: Notifications and notification rate for gonococcal infection, Australia, 2014, by state or territory



Age and sex distribution

Nationally in 2014, the notification rate for gonococcal infection was 97.9 per 100,000 in males and 35.3 per 100,000 in females. Notification rates in males increased by 8% and decreased in females by 7% when compared with 2013 (91.0 and 37.8 per 100,000 respectively). In 2014, 50% of notifications occurred in males in the 20–39 years age group. Notification rates in males exceeded those in females across all age groups above 20 years (Figure 39). This was consistent with previous years where, with the exception of Indigenous persons, notifications were largely reported in men who have sex with men (MSM).[56]

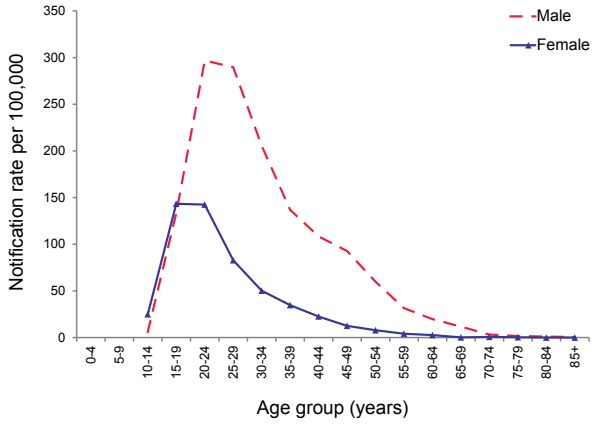
From 2009 to 2014, notification rates of gonococcal infection increased annually for males aged 20–39 and 45–49 years. The biggest overall increase was seen in the 45–49 years age group, with notification rates increasing by 171% (from 34.3 to 92.8 per 100,000), followed by the 30–34 years age group, with notification rates increasing by 131% (from 89.0 to 205.6 per 100,000). Compared with males, female rates were lower overall, peaking in 2011–12 in the 15–19 years age group, followed by a decline from 2012 to 2014 (Figure 40).

Indigenous status

The completeness of Indigenous status identification in the notification data varies by year and by

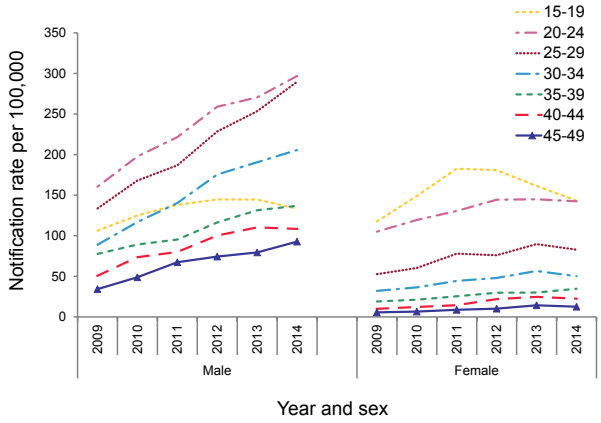
jurisdiction. Nationally in 2014, data on Indigenous status were complete for 66% of notifications, which was similar to the preceding 5-year mean of 68% (range: 66% to 72%). All states and territories except New South Wales had greater than 50% completeness of the Indigenous status field across the 2009 to 2014 period. Among the states and territories with greater than 50% completeness, the combined age-standardised notification rate ratio between Indigenous and non-Indigenous populations in 2014 was 26.5:1, increasing from 18.4:1 in 2013. Overall, the rate ratio has declined by 6% from 2009 to 2014 (from 28.1:1 to 26.5:1).

Figure 39: Notification rate for gonococcal infection, Australia, 2014, by age group and sex*



* Excludes notifications where age and/or sex were not reported and notifications where the case was aged less than 13 years and the infection was able to be determined as non-sexually acquired.

Figure 40: Notification rate for gonococcal infection, Australia, 2009 to 2014, by year, sex and selected age groups*



* Excludes notifications where age and/or sex were not reported.

Among the Indigenous population, the age-standardised notification rate decreased by 25% from 2013 to 2014 (from 770.3 to 577.3 per 100,000) and the age-standardised Indigenous rate in 2014 (577.3 per 100,000) was 12% lower than in 2009 (659.7 per 100,000).

Among the non-Indigenous population, the age-standardised notification rate has decreased by 6% from 2009 to 2014 (28.1 and 26.5 per 100,000 respectively).

From 2009 to 2014, notification rates decreased in all states and territories in which Indigenous status was more than 50% complete except Tasmania, (which stabilised following a brief increase, from 4.6 to 4.9 per 100,000) (Figure 41).

Microbiological trends

The AGSP is the national surveillance system for monitoring the antimicrobial resistance of *N. gonorrhoeae* isolates. These results are published in more detail in the AGSP annual report in CDI.[57]

In 2014, the AGSP reported that a total of 4,804 gonococcal isolates were referred for antibiotic susceptibility testing, representing 31% of gonococcal infections notified to the NNDSS. This was slightly lower than the proportion of NNDSS cases tested in 2013 (33%, 4,896/14,902).

Eighty-three per cent of the isolates (n=4,009) were from males and 17% (n=791) were from females (M:F, 5.1:1). There were 4 isolates for which gender was unknown. The proportion of gonococcal isolates from males and females tested by the AGSP has remained stable over recent years.

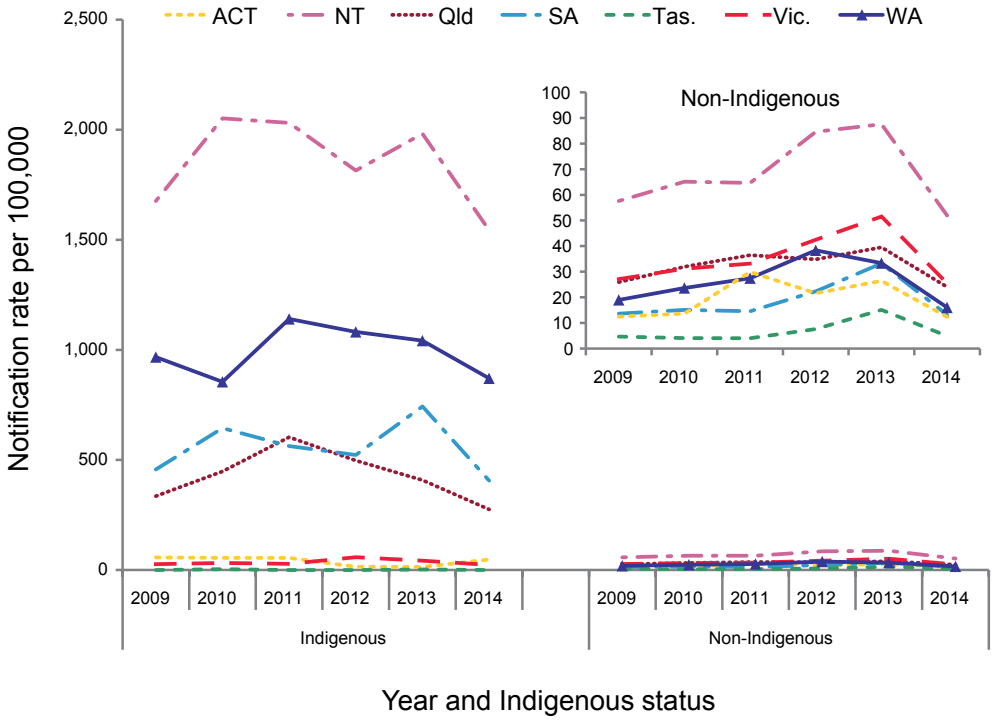
Syphilis (non-congenital categories)

- In 2014, 3,930 cases of syphilis (non-congenital categories) were notified to the NNDSS, a rate of 16.8 per 100,000.
- Cases of non-congenital syphilis were more frequently reported in MSM.

Syphilis is a sexually transmitted infection caused by the bacterium *Treponema palladium*. Infection is characterised by a primary lesion, a secondary eruption involving skin and mucous membranes, long periods of latency and late lesions of skin, bone, viscera, cardiovascular and nervous systems.[22]

In 2004, all jurisdictions except South Australia began reporting non-congenital syphilis infections to the NNDSS separately categorised as: infectious syphilis (primary, secondary or early latent) of less

Figure 41: Age-standardised notification rates for gonococcal infection, selected states and territories,* 2009 to 2014, by Indigenous status and year. Inset: Non-Indigenous notification rates



* Includes the states and territories where Indigenous status was reported for more than 50% of cases between 2009 and 2014: The Australian Capital Territory, the Northern Territory, Queensland, South Australia, Tasmania, Victoria, and Western Australia.

than 2 years duration; and syphilis of more than 2 years or unknown duration. From 2004 to 2011, South Australia reported only cases of infectious syphilis, and then commenced reporting syphilis of more than 2 years or unknown duration in 2012.

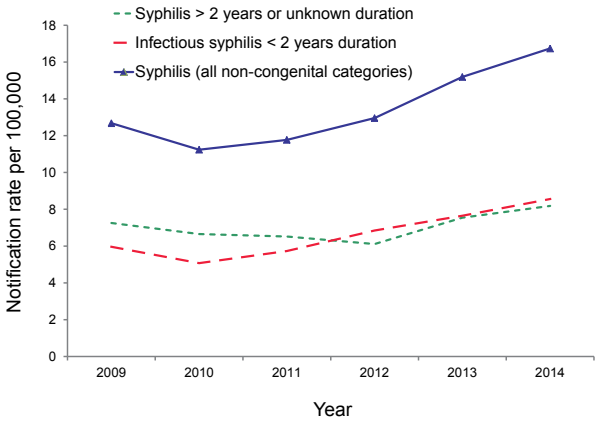
Epidemiological situation in 2014

In 2014, a total of 3,930 cases of syphilis (non-congenital) were reported to the NNDSS. This represented a rate of 16.8 per 100,000, an 11% increase compared with 2013 (15.2 per 100,000) (Figure 42). In 2014, 49% of syphilis notifications were categorised as greater than 2 years or unknown duration, and 51% of cases were categorised as infectious syphilis.

Syphilis – infectious (primary, secondary and early latent), less than 2 years duration

- In 2014, 2,009 cases of infectious syphilis were notified to the NNDSS.
- Of all notifications, 81% occurred in males aged 20–54 years.
- Cases of infectious syphilis were almost completely in MSM.

Figure 42: Notification rate for non-congenital syphilis infection (all categories),*† Australia, 2009 to 2014, by category and year



* Notifications were excluded where the case was aged less than 13 years and the infection was able to be determined as non-sexually acquired (8 notifications).

† For syphilis of more than 2 years or unknown duration, excludes South Australia from 2009–2011.

Epidemiological situation in 2014

In 2014, 2,009 notified cases of infectious syphilis <2 years duration were reported to the NNDSS, representing a rate of 8.6 per 100,000. This was a

13% increase compared with the rate reported in 2013 (7.6 per 100,000) and a 43% increase from 2009 (6.0 per 100,000) to 2014 (Table 6).

Geographical description

In 2014, notification rates for infectious syphilis were highest in the Northern Territory (29.8 per 100,000), Victoria (11.1 per 100,000) and New South Wales (9.8 per 100,000) (Table 16). This likely reflects the large proportions of at-risk individuals living in these jurisdictions; Indigenous persons in the Northern Territory and MSM in Victoria and New South Wales.[31,58] Increased screening in at-risk individuals may partly explain increased infection rates; however, the majority of the increase is likely to have been due to increased transmission.[59]

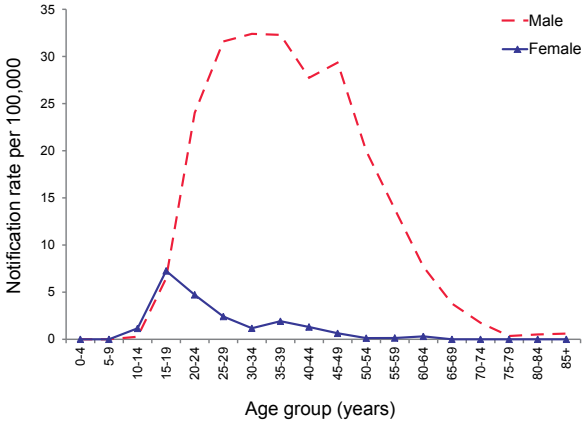
Age and sex distribution

Nationally in 2014, the notification rate for infectious syphilis was 15.8 per 100,000 in males and 1.4 per 100,000 in females, a male to female rate ratio of 11.3:1, which was consistent with previous years. In males, this was an increase of 13% when compared with the 2013 rate (14.0 per 100,000). The notification rate for females in 2014 did not markedly change from the rate seen in 2013 (1.3 per 100,000). In 2014, 81% (1,617/2008) of all notifications occurred in males aged 20–54 years (Figure 43). Similar to that seen in 2013, it is expected that diagnoses of infectious syphilis in 2014 were almost completely confined to MSM.[33]

Notification rates for males aged 15 years or over varied widely across age groups and increased overall from 2009 to 2014 for all age groups. For the majority of age groups, rates were at their lowest in 2010 after which rates steadily increased and reached maximum values for the period in 2014 (Figure 44).

In females aged 15 years or over, rates did not vary as noticeably across age groups as males (Figure 44). In females, notification rates over the 2009 to 2014 period averaged 2.1 per 100,000

Figure 43: Notification rate for infectious syphilis (primary, secondary and early latent), less than 2 years duration, Australia, 2014, by age group and sex*



* Excludes notifications where age and/or sex were not reported and notifications where the case was aged less than 13 years and the infection was able to be determined as non-sexually acquired (1 notification).

Table 16: Notifications and notification rate for infectious syphilis (less than 2 years duration),* Australia, 2014, by state or territory and sex

State or territory	Total*		Male		Female*	
	Notified cases	Notification rate‡	Notified cases	Notification rate‡	Notified cases	Notification rate‡
ACT	18	4.7	18	9.4	0	0.0
NSW	739	9.8	714	19.1	25	0.7
NT	72	29.8	40	30.9	32	28.6
Qld	394	8.3	317	13.5	77	3.2
SA	29	1.7	28	3.4	1	0.1
Tas.	14	2.7	12	4.7	2	0.8
Vic.	649	11.1	633	21.9	16	0.5
WA	93	3.6	82	6.3	11	0.9
Total	2,008	8.6	1,844	15.8	165	1.4

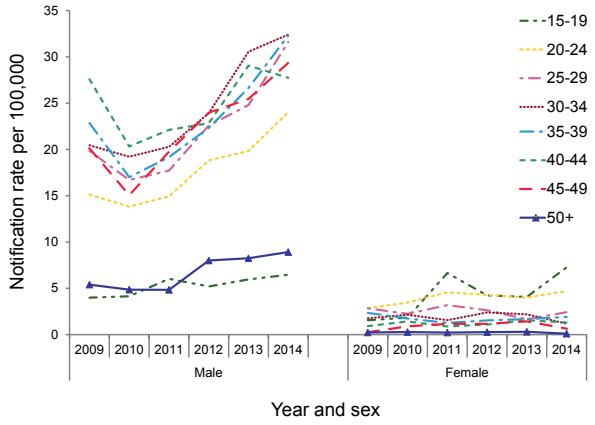
* Notifications were excluded where the case was aged less than 13 years and the infection was able to be determined as non-sexually acquired (1 notification).

† Includes notified cases where sex was not reported.

‡ Per 100,000 population.

(range: 0.1 to 7.3 per 100,000). Over the 6-year period, the notification rates remained low for females across all age groups.

Figure 44: Notification rate for infectious syphilis (primary, secondary and early latent), less than 2 years duration, Australia, 2009 to 2014, by year, sex and selected age groups*



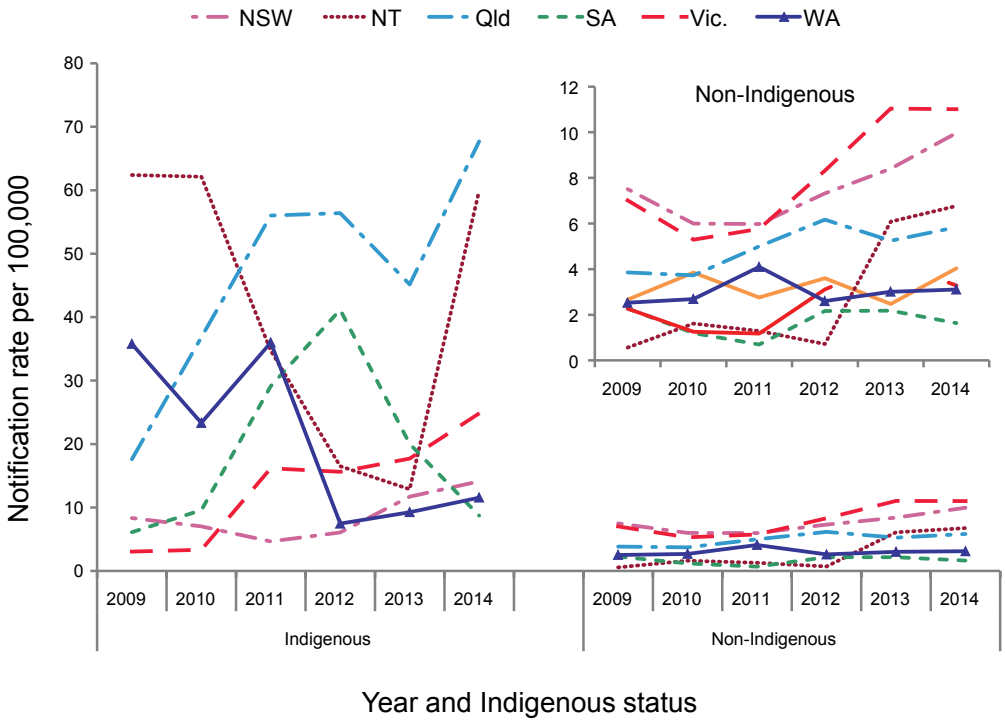
* Excludes notifications where age and/or sex were not reported and those less than 15 years of age (54 notifications).

Indigenous status

The completeness of Indigenous status identification in the notification data varies by year and by jurisdiction. Nationally in 2014, data on Indigenous status were complete for 92% of notifications of infectious syphilis, not changing from 2013, but lower than the preceding 5-year mean of 94% (range: 91% to 96%). All states and territories had greater than 50% completeness of the Indigenous status field across the 2009 to 2014 period.

In 2014, where rates were calculated for Indigenous and non-Indigenous persons, the age-standardised rates were higher for Indigenous persons than non-Indigenous persons in all jurisdictions (Figure 45). For all states and territories, the combined age standardised notification rate ratio between the Indigenous and non-Indigenous populations in 2014 was 4.4:1, which was the same as the preceding 5–year mean (range: 3.0 to 5.9). In 2014, for jurisdictions where cases were notified in both Indigenous and non-Indigenous persons, the age standardised notification rate ratio between Indigenous and non-Indigenous populations ranged from 1.4:1 in New South Wales to 11.6:1 in Queensland. Between 2013 and 2014, the largest increase in the difference between Indigenous and non-Indigenous age standardised notification rates

Figure 45: Age-standardised notification rate for infectious syphilis (primary, secondary and early latent), less than 2 years duration, selected states and territories,* 2009 to 2014, by Indigenous status and year. Inset: Non-Indigenous notification rates



* All states and territories reported Indigenous status for more than 50% of notifications between 2009 and 2014. The Australian Capital Territory and Tasmania were excluded due to low numbers of notifications.

was 318% in the Northern Territory (2.1 to 8.9 per 100,000). The only jurisdiction where the difference between Indigenous and non-Indigenous age standardised notification rates decreased from 2013 to 2014 was South Australia (a decrease of 42%).

An outbreak of infectious syphilis spanning northern areas of Queensland, the Northern Territory, and Western Australia and affecting largely young heterosexual Indigenous persons[5,12] was first detected in north-western Queensland in 2012 and in Central Australia in mid-2013,[60,61] continuing to 2014. Increased transmission along with targeted and opportunistic syphilis screening in each of these jurisdictions is likely to have contributed to an increase in Indigenous age-standardised rates for Queensland, the Northern Territory, and Western Australia between 2012–2014.[61]

Syphilis of more than 2 years or unknown duration

- In 2014, 1,921 cases of syphilis of more than 2 years or unknown duration were notified to the NNDSS.
- Notification rates decreased from 7.3 per 100,000 in 2009 to 6.1 per 100,000 in 2012 then increased to 8.2 per 100,000 in 2014.
- The notification rate among males (12.2 per 100,000) was nearly 3 times that in females (4.2 per 100,000) in 2014.

Epidemiological situation in 2014

In 2014, 1,921 cases of syphilis of more than 2 years or unknown duration were reported to the NNDSS. Notification rates increased by 12% between 2009 (7.3 per 100,000) and 2014 (8.2 per 100,000), and increased by 8% between 2013 (7.6 per 100,000) and 2014 (Table 6). This may have been due to increased testing in persons or populations with little previous testing history or it may have been due to an actual increase in the number of persons with non-infectious syphilis.

Geographical distribution

In 2014, notification rates for syphilis of more than 2 years or unknown duration were highest in the Northern Territory (29.8 per 100,000), followed by Victoria (13.7 per 100,000) (Table 17). Similar to infectious syphilis, this geographical distribution likely reflects the large proportions of at-risk individuals living in these jurisdictions (Indigenous persons in the Northern Territory and MSM in Victoria).[31,58]

Age and sex distribution

Nationally in 2014, the notification rate for syphilis of more than 2 years or unknown duration was 12.2 per 100,000 in males and 4.2 per 100,000 in females, a male to female rate ratio of 2.9:1. Between 2013 and 2014, the notification rate in males increased by 13% (10.8 to 12.2 per 100,000) and by 8% (3.9 to 4.2 per 100,000) in females. In 2014, approximately 73% (1404/1919) of all notifications for which sex was reported, occurred in males aged 20 years or over (Figure 46).

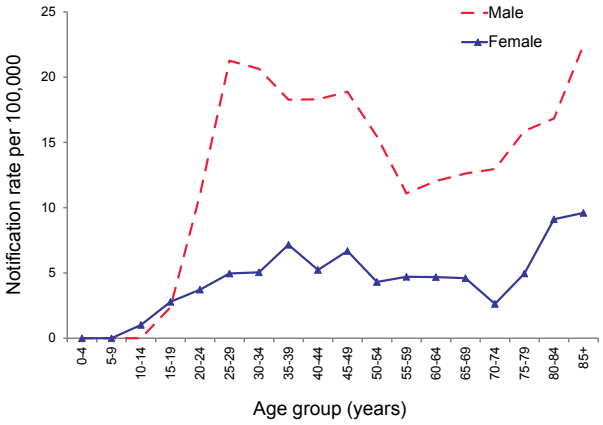
Table 17: Notifications and notification rate for syphilis (more than 2 years or unknown duration), Australia, 2014, by state or territory and sex

State or territory	Total*		Male		Female	
	Notified cases	Notification rate†	Notified cases	Notification rate†	Notified cases	Notification rate†
ACT	26	6.7	20	10.4	6	3.1
NSW	536	7.1	411	11.0	124	3.3
NT	73	29.8	40	30.9	33	28.6
Qld	279	5.9	182	7.7	97	4.1
SA	123	7.3	74	8.9	49	5.8
Tas.	19	3.7	14	5.5	5	1.9
Vic.	801	13.7	636	22.0	164	5.6
WA	64	2.5	45	3.5	19	1.5
Total	1,921	8.2	1,422	12.2	497	4.2

* Includes notified cases where sex was not reported.

† Per 100,000 population.

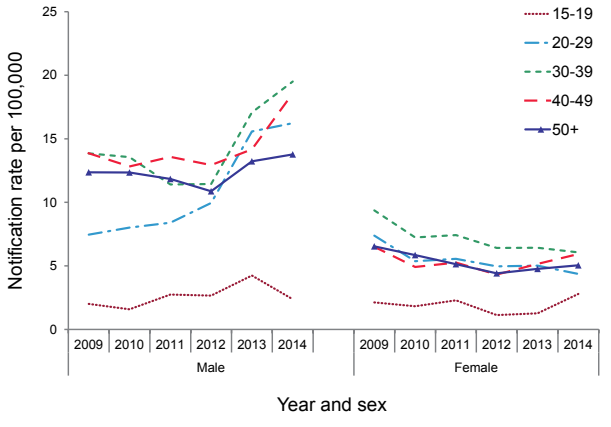
Figure 46: Notification rate for syphilis of more than 2 years or unknown duration,* Australia, 2014, by age group and sex



* Excludes notifications where age and/or sex were not reported and notifications where the case was aged less than 13 years (2 notifications).

Notification rates in males for all age groups except the 15–19 years age group increased overall from 2009 to 2014 (Figure 47). This increase is particularly prominent from 2012 to 2014. Notification rates in females for all age groups except the 15–19 years age group declined overall from 2009 to 2014 (Figure 47). Notification rates in males in the 15–19 years age group were lower than those of the other age groups and fluctuated across the time period. Notification rates in females in the 15–19 years age group were also lower than those of the other age groups with an increasing trend from 2012 to 2014 (Figure 47).

Figure 47: Notification rate for syphilis of more than 2 years or unknown duration, Australia,* 2009 to 2014, by year, sex and selected age groups†



* Data from all states and territories except South Australia in 2009–2011.

† Excludes notifications where age and/or sex were not reported and those aged less than 15 years (61 notifications).

Congenital syphilis

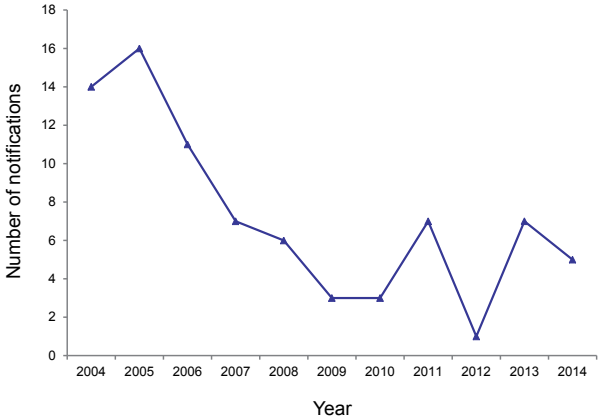
- In 2014, 5 cases of congenital syphilis were notified to the NNDSS.
- Congenital syphilis remains rare in Australia.

Congenital syphilis is caused by fetal infection with the bacterium *T. pallidum*. Syphilis is acquired by infants either in-utero or at birth from women with untreated early infection. Infections commonly result in abortion or stillbirth and may cause the death of a new-born infant. Congenital syphilis can be asymptomatic, especially in the first weeks of life.[22]

Epidemiological situation in 2014

There were 5 notifications of congenital syphilis in 2014, all occurring in Indigenous persons. This compared with 7 notifications of congenital syphilis in 2013. The preceding 5-year mean was 4.2 notifications (Table 6). Considering the previously mentioned syphilis outbreak in remote Indigenous communities, the increase in the number of cases seen in 2013 and 2014 (Figure 48) reflects the increased risk to neonates and mothers that outbreak situations pose.[62,63] Despite these peaks, case numbers remain low after a downward trend observed over the past decade (Figure 48). Routine antenatal screening for syphilis with follow-up and adequate treatment is considered to be a contributor to this overall decline.[64] Congenital syphilis, particularly in Indigenous persons, is targeted for elimination. This target is stated in the 4th National Aboriginal and Torres Strait Islander Blood-borne Viruses and Sexually Transmissible Infections Strategy and the third National Sexually Transmissible Infections Strategy, both for 2014–2017.[65,66]

Figure 48: Notifications of congenital syphilis, Australia, 2004 to 2014



Vaccine preventable diseases

This section summarises the national surveillance data for notifiable diseases targeted by the National Immunisation Program (NIP) in 2014. These include diphtheria, invasive *Haemophilus influenzae* type b (Hib) infection, laboratory confirmed influenza, measles, mumps, pertussis, invasive pneumococcal disease (IPD), poliomyelitis, rubella, tetanus and varicella zoster virus (VZV) infections (unspecified, chickenpox and shingles). Data on hepatitis B and invasive meningococcal disease, which are also targeted by the NIP, can be found in this report under 'Bloodborne diseases' and 'Other bacterial infections' respectively. Other vaccine preventable diseases (VPDs) presented in this report include hepatitis A and Q fever which can be found under the 'Gastrointestinal' and 'Zoonoses' sections respectively. For more detailed reports on historical data, including notifications, hospitalisations and deaths, readers are referred to the journal supplements 'Vaccine Preventable Diseases in Australia' and the 'Australian Vaccine Preventable Diseases Epidemiological Review Series' for additional analysis on individual diseases, which are published in CDI.

In 2014, there were 101,400 VPD notifications reported to the NNDSS, representing 37% of all reported cases and a 70% increase compared with 2013 (n=59,630). Influenza was the most commonly notified VPD with 67,742 cases (67%) reported, followed by pertussis (11,863, 12%). The number of notifications and notification rates for VPDs in Australia are shown in Table 4, Table 5 and Table 6.

Vaccination coverage is an important factor influencing the incidence of VPDs. Since the commencement of the Australian Childhood Immunisation Register in 1996, vaccination coverage in children has been high by international standards, although geographical pockets of lower coverage, in which there is an increased potential for VPD cases still remain. As no vaccine is 100% effective, infections with these diseases sometimes do occur in fully vaccinated people. However, evidence shows vaccines do provide a substantially lower chance of developing infection or can reduce the severity of disease. [67–71]

Information on a case's vaccination history was previously recorded in the NNDSS using the 'vaccination status' field (fully or partially vaccinated for age or not vaccinated), plus fields capturing the number of doses, the last vaccination date and how the vaccination information was validated. In January 2008 new, more detailed fields were incorporated for recording 'vaccine type', and 'vaccination date' for each dose of vaccine given. The new fields were intended to replace the old fields, with a transition period allowing either field to be utilised. In 2014, all jurisdictions, except the Australian Capital Territory, were using the new fields. In this report the vaccination status of a case is interpreted according to the data provided by the states and territories from the 2 different formats. A case is described as fully vaccinated if they have received all doses of the relevant vaccine according to the most recent edition of *The Australian Immunisation Handbook,*[32] and at least 14 days prior to disease onset.

Diphtheria

- In 2014, there were 2 imported cases of diphtheria notified to the NNDSS.
- Diphtheria is rare in Australia.

Diphtheria is an acute pharyngeal or cutaneous infection caused mainly by toxigenic strains of *Corynebacterium diphtheriae.* The exotoxin acts locally on the mucous membranes of the respiratory tract, and on damaged skin, although this is not as common. Disease is mainly due to local membranous inflammation, which for pharyngeal diphtheria can cause airway obstruction. Occasionally, systemic infections occur and cause damage to the myocardium, nervous system and kidneys. Diphtheria is spread by respiratory droplets or direct contact with nasopharyngeal secretions or skin lesions. While there are non-toxigenic strains of *C. diphtheriae,* they usually only cause mild throat or skin infection and are not nationally notifiable.[22]

Epidemiological situation in 2014

In 2014, there were 2 notifications† of diphtheria reported. Both cases were cutaneous, reported in Queensland and were imported from Tokelau and Cambodia. One case was reported as vaccinated and the other was of unknown vaccination status.

† This number may underrepresent the number of diphtheria cases in Australia due to a change in the national case definition for this disease. In mid-2013, the national case definition for diphtheria was revised, requiring clinical and laboratory evidence for confirmed cases. This change may have inadvertently excluded some notifications of cutaneous toxigenic diphtheria, as cutaneous presentations were not listed as clinical evidence in the revised definition.

Diphtheria is rare in Australia, with most cases associated with sporadic importations from countries in which the disease remains endemic. From 2001 to 2013, there were 7 cases of diphtheria reported to the NNDSS, including 1 case in 2001, a cluster of 3 cases and a sporadic case in 2011 and 2 cases in 2013. Of these, 5 were imported and 2 were linked to an imported case.

Influenza

- The seasonal increase in laboratory confirmed influenza notifications for 2014 was slightly earlier and reached a higher peak than recent years, excluding the 2009 influenza pandemic.
- Nationally, influenza A was the predominant influenza virus type. However, the distribution of influenza types and subtypes was variable between jurisdictions and changed as the season progressed. Unlike the rest of the country where influenza A(H1N1)pdm09 predominated throughout the season, New South Wales and the Australian Capital Territory saw influenza A(H3N2) circulating at higher levels.

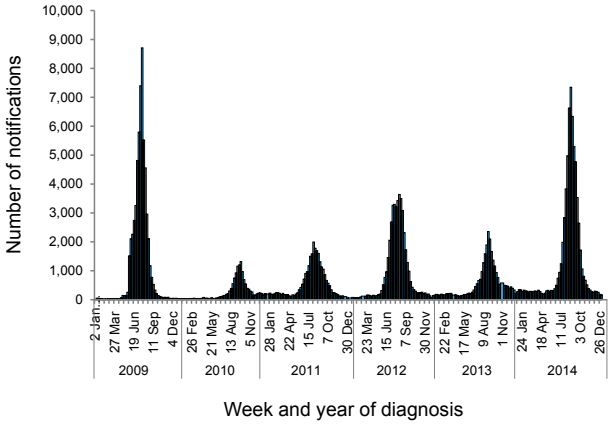
Influenza is a common, highly infectious acute respiratory disease caused by infection with influenza viruses. The virus is transmitted from person to person by airborne droplets of exhaled respiratory secretions, especially by coughing or sneezing.[72] The disease ranges from asymptomatic[73] through to mild upper respiratory tract illness, to severe complications including pneumonia. The severity of disease is determined by features intrinsic to the virus including its similarity to previous circulating and vaccine strains and by host factors including the age, level of immunity and presence of chronic medical conditions.[74,75]

Annual influenza vaccination is the primary means of preventing or attenuating influenza and its complications and is included in the NIP for individuals who are at increased risk of complications from influenza infection. In 2014, the NIP funded influenza vaccination for people aged 6 months and over with medical conditions placing them at risk of serious complications due to influenza, Aboriginal and Torres Strait Islander people aged 15 years or over, pregnant women and people aged 65 years or over.[32]

Epidemiological situation in 2014

In 2014, there were 67,742 notifications of laboratory confirmed influenza, which was almost 2.4 times the number of notified cases reported in 2013 (n=28,311) (Figure 49). The number of notifications recorded in 2014 is the highest on record and was 21% higher than 2009 (n=56,026), the year of the last influenza pandemic.

Figure 49: Notifications of laboratory confirmed influenza, Australia, 1 January 2009 to 31 December 2014, by week and year of diagnosis



Geographical distribution

Notification rates were highest in South Australia (655 per 100,000) and Queensland (380 per 100,000). Notifications rates in the Australian Capital Territory, New South Wales, and the Northern Territory were somewhat similar to the national notification rate of 289 per 100,000, while rates reported in Tasmania, Victoria and Western Australia were substantially lower than the national rate at 131, 170 and 205 per 100,000 respectively. New South Wales reported the highest number of influenza cases of any jurisdiction (n=20,877), comprising 31% of notifications nationally (Figure 50).

Age and sex distribution

The highest number of influenza notifications occurred in the 0–4 years and 5–9 years age groups (n=8,415 and 5,510, respectively), which together accounted for 21% of all notifications (Figure 51). Notification rates were highest in the 0–4 years and over 85 years age groups (551 and 547 notifications per 100,000 respectively) with an additional peak in the 35–39 years age group (312 notifications per 100,000) (Figure 51).

In seasons dominated by the influenza A(H1N1) pdm09 virus, such as 2009, 2010 and 2011, the age distribution of influenza notification rates showed a downward trend with increasing age (Figure 52). For comparison, in 2012, which was dominated by influenza A(H3N2), the age distribution of influ-

Figure 50: Notifications of laboratory confirmed influenza, Australia, 2014, by week and state or territory

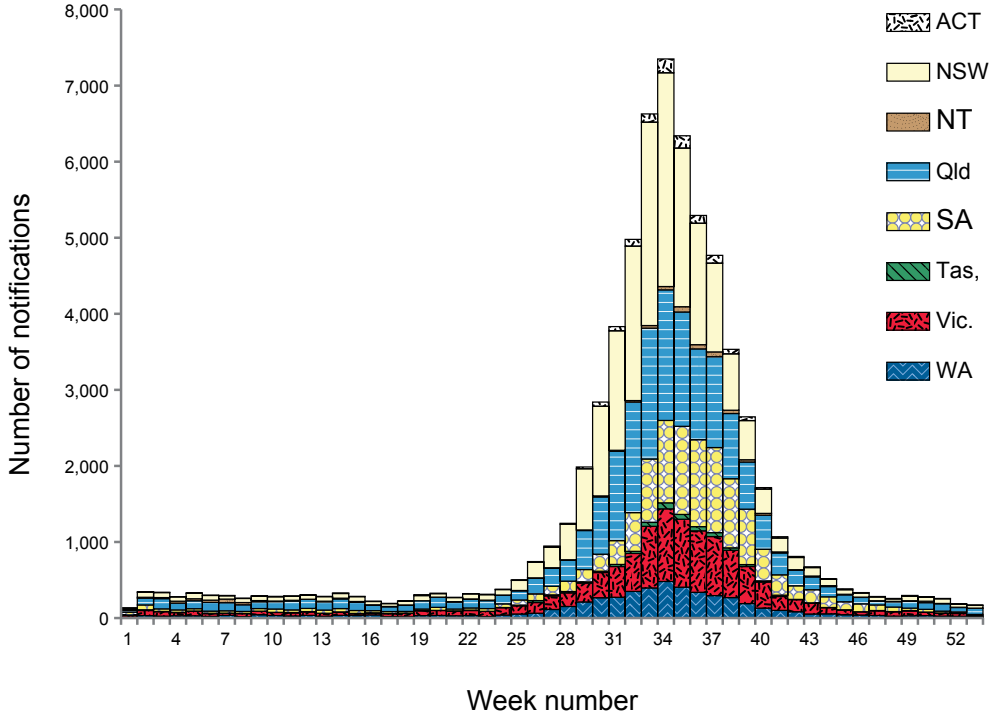


Figure 51: Notifications and notification rate for laboratory confirmed influenza, Australia, 2014, by age group and sex

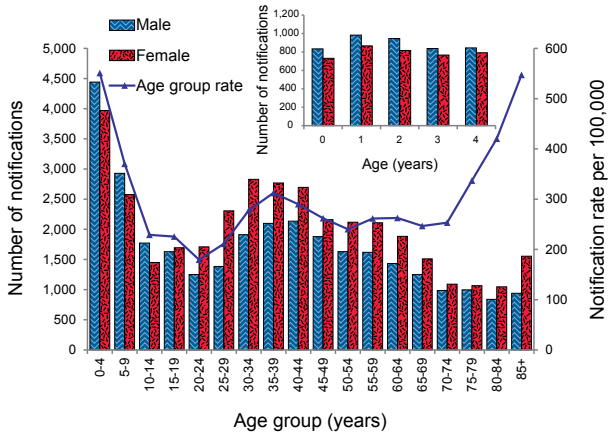
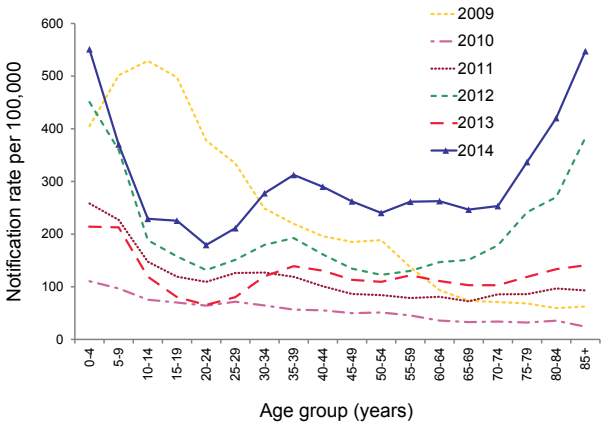


Figure 52: Notification rate for laboratory confirmed influenza, Australia, 2009 to 2014, by age group and year



enza notifications was bimodal with peaks in those aged under 10 years and in those aged 70 years or over. The 2014 influenza season was characterised by co-circulation of A(H1N1)pdm09 and influenza A(H3N2) with the proportion of influenza B viruses rising towards the end of the year. This broad strain distribution has seen the burden of disease carried across a breadth of age groups.

In 2014, females accounted for 54% (n=35,538) of the influenza notifications for which sex was reported. The age group-specific rate of influenza in males exceeded that in females in age groups less than 15 years and greater than 75 years.

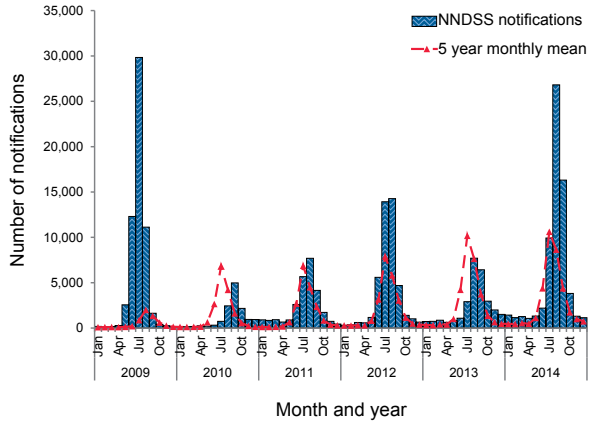
Seasonality

Influenza notifications during the 2013–14 inter-seasonal period were the highest on record with an average of 1,358 notifications per month. It is unclear whether this was a reflection of a higher prevalence of influenza circulating in the com-

munity at this time, an increased rate of testing or another factor. Queensland reported the largest number of inter-seasonal influenza notifications.

The seasonal increase of influenza notifications in 2014 started in June, rose sharply and peaked in August. This was slightly earlier than the seasonal patterns in the past 3 influenza seasons (Figure 53). The peak was higher than previous years, excluding the 2009 influenza pandemic. The majority of jurisdictions peaked in activity around late August, followed by a steady decline in influenza activity back to inter-seasonal levels by November.

Figure 53: Notifications of laboratory confirmed influenza, Australia, 2009 to 2014, by month and year



Indigenous status

Nationally in 2014, Indigenous status was reported in 40% (n=27,052) of laboratory confirmed notifications of influenza. Indigenous status completeness was greater than 50% in 3 jurisdictions: the Northern Territory (100%), South Australia (87%) and Western Australia (93%). Among these, the combined notification rate for influenza in Indigenous peoples was 584 per 100,000 and 371 per 100,000 among non-Indigenous population, representing a notification rate ratio of 1.6.

Mortality

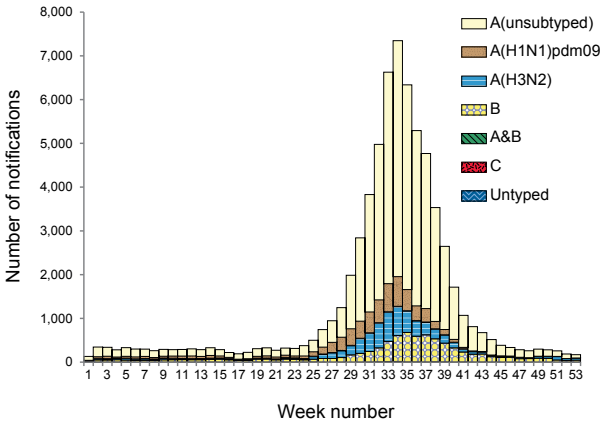
Nationally, there were 132 influenza-associated deaths notified to the NNDSS, with a median age of 75 years (range 1–103 years). The majority of deaths were associated with influenza A infections (n=126; 95%), and of these, 93 were associated with influenza A(unsubtyped) infections, 24 were A(H1N1)pdm09 and 9 were A(H3N2). Indigenous status was reported for 81% (n=107) of the influenza-associated deaths; and Indigenous peoples accounted for 6% (n=6) of these deaths. The number of influenza-associated deaths reported to the NNDSS is reliant on the follow-up of cases to determine the outcome of their infection and most likely underestimates the true mortality associated with this disease.

Microbiological trends

National Notifiable Diseases Surveillance System

In 2014, typing data were reported for all but 18 laboratory confirmed influenza notifications. Of notifications with typing information, 88% were due to influenza type A (n=59,563) and 12% were due to influenza type B (n=8,052). Whilst the majority of notifications of influenza A were reported as unsubtyped (69%, n=46,771), influenza A(H1N1)pdm09 and influenza A(H3N2) circulated in similar proportions (10%, n=6,922 and 9%, n=5,870 respectively). Mixed influenza type A and B infections accounted for less than 1% of notifications (n=96). There were 13 notifications of influenza type C (Figure 54).

Figure 54: Notifications of laboratory confirmed influenza, Australia, 2014, by week and subtype

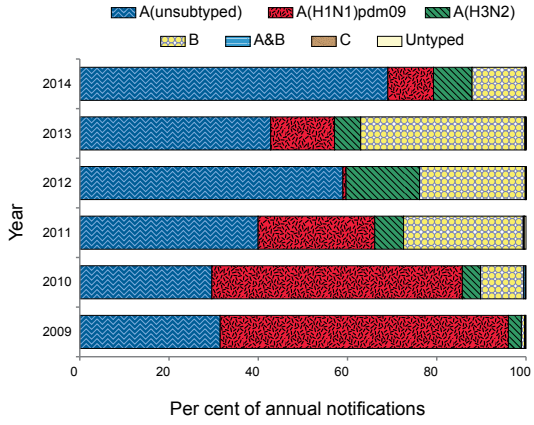


As in previous years, influenza A remained the predominant virus type in 2014 (Figure 55). Influenza A(H3N2) accounted for a larger burden of disease due to influenza A than has been seen in previous years, with the exception of 2012 where almost all disease due to influenza A was caused by influenza A(H3N2). Influenza B circulated at lower levels in 2014 when compared with the previous 3 years.

While influenza A(H1N1)pdm09 and influenza A(H3N2) circulated in similar proportions nationally, distribution varied between jurisdictions. Influenza A(H1N1)pdm09 predominated across most jurisdictions throughout the season. However,

influenza A(H3N2) was predominant in New South Wales and the Australian Capital Territory, with late season increases noted in Queensland, Western Australia, the Northern Territory and Tasmania.

Figure 55: Per cent of annual notifications of laboratory confirmed influenza, Australia, 2009 to 2014, by subtype

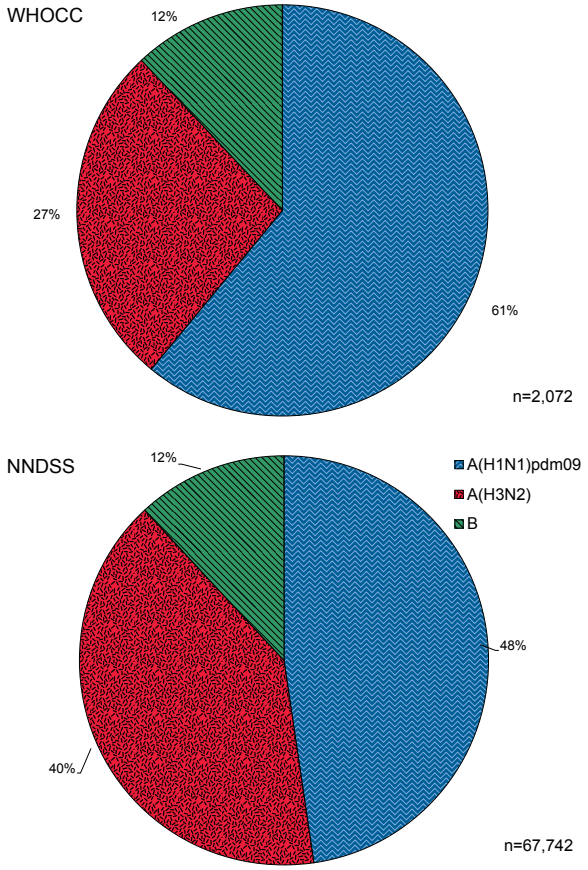


WHO Collaborating Centre for Reference and Research on Influenza

For 2014, the WHO Collaborating Centre for Reference and Research on Influenza (WHOCC) analysed 2,072 specimens from influenza cases identified in Australia. Specimens are submitted to the WHOCC from laboratories according to guidelines that aim for successful isolation of viruses and likelihood of obtaining a vaccine candidate. WHOCC specimens therefore do not constitute a representative sample of influenza infections, which most likely accounts for differences in virus subtype distribution between NNDSS and WHOCC.

The number of samples analysed by the WHOCC represented approximately 3% of the 67,742 laboratory confirmed cases reported to the NNDSS compared with 1,532 isolates in 2013 representing 5.4% of notifications. The majority of specimens were influenza A(H1N1)pdm09 (61%, n=1,263) with 27% influenza A(H3N2) (n=562) and 12% influenza B (n=247) (Figure 56). While the proportion of WHOCC isolates typed as influenza B was similar to that reported in laboratory confirmed notifications, the distribution of influenza A(H1N1)pdm09 and influenza A(H3N2) differed, assuming that the notifications to NNDSS of influenza A reported as unsubtyped were similarly distributed as the subtyped notifications.

Figure 56: Subtyped influenza virus samples WHO Collaborating Centre for Reference and Research on Influenza versus National Notifiable Diseases Surveillance System, Australia, 2014



The WHOCC assessed the antigenic similarity of circulating influenza virus isolates to reference strains included in the trivalent vaccine from recent years using the haemagglutination inhibition assay. The 2014 seasonal influenza vaccine contained 2 changes from 2013 and included an A/Texas/50/2012 (H3N2)-like virus and a B/Massachusetts/2/2012-like virus.

The majority of the A(H1N1)pdm09 isolates (1,257 of 1,263) were antigenically similar to the A(H1N1) component of the influenza vaccine, which has been used each year since 2010. The remaining 6 (0.5%) isolates were characterised as 'low reactors'. This suggests that the A(H1N1) viruses, which have been circulating since the 2009 pandemic continue to be genetically and antigenically stable. By comparison, approximately 6% (33/562) of A(H3N2) isolates were antigenically drifted from the A/Texas/50/2012 vaccine strain and, characterised as 'low reactors', the remainder of the A(H3N2) viruses were genetically distinct from A/Texas/50/2012.

Of the influenza B viruses tested (n=247), 83% (206) were from the B/Yamagata lineage, with the remainder from the B/Victoria lineage. A high proportion of B/Yamagata viruses (70%, 145/206) were low reactors to the B component of the 2014 vaccine (B/Massachusetts/2/2012-like) thus the vaccine was a poor match to the circulating lineages. Further studies determined that the majority (86%, 178/206) of B/Yamagata viruses circulating in 2014 were more antigenically similar to the 2013 trivalent influenza vaccine B component (B/Wisconsin/1/2010–like). B/Massachusetts/2/2012 and B/Wisconsin/1/2010 were both B/Yamagata viruses but sit within genetically-distinct clades in the influenza phylogenetic tree.

Viruses submitted to the WHOCC in 2014 were also tested for sensitivity to the neuraminidase inhibitor class of antiviral drugs. Neuraminidase inhibition assays were performed on 2,025 virus isolates consisting of 1,242 A(H1N1)pdm09, 551 A(H3N2) and 232 influenza B viruses. Reduced inhibition by oseltamivir was detected in 3 A(H1N1)pdm09 isolates and reduced inhibition by zanamivir was detected in a single A(H3N2) isolate. In recent years, resistance to oseltamivir in Australian-sourced isolates, has been mediated primarily through the well characterised H275Y mutation,[76] however, this was not the case in 2014 where none of the resistant isolates carried this mutation.

Due to the circulation of drifted A(H3N2) viruses and the predominance of a different B/Yamagata-lineage in Australia and elsewhere in the Southern Hemisphere, there were 2 updates recommended for the 2015 trivalent influenza vaccine for Australia, with the incorporation of an A/Switzerland9715293/2013-like A(H3N2) virus and a B/Phuket/3073/2013-like B/Yamagata virus (the latter virus being isolated at the WHOCC) being added to the existing A/California/7/2009-like A(H1N1)pdm09 virus.

Enhanced surveillance datasets

In addition to NNDSS data, a series of targeted influenza surveillance systems operated during 2014. Together these systems collected data, which were used to describe the season with respect to epidemiology, morbidity, mortality and virology and supported the conclusions drawn from analyses of NNDSS notification data. Enhanced influenza surveillance was based on the following additional sources of data:

- the number and proportion of calls to a national health call centre network for influenza or influenza-like illness (ILI);
- rates of ILI from a community survey;
- consultation rates for ILI identified by sentinel general practitioners;
- consultation rates for ILI identified by hospital emergency departments in Western Australia, New South Wales and the Northern Territory;
- hospitalised cases of influenza from 17 sentinel hospitals (adult and paediatric) across Australia;
- mortality data from the New South Wales Registry of Births, Deaths and Marriages; and
- typing and subtyping for influenza from sentinel laboratories in New South Wales, Victoria, Western Australia and Tasmania.

These data sources were used to inform the overall picture of influenza activity in Australia and comprehensive analysis of these data are provided in the fortnightly Australian Influenza Surveillance Report, which was published during the season, and in the annual National Influenza Surveillance Scheme report.

Discussion

In Australia, the 2014 influenza season was slightly earlier than in previous seasons with active transmission of influenza virus commencing in mid-June, sharply increasing in mid-July and peaking in mid-August. Influenza A predominated, accounting for 88% of cases, while influenza B made up 12% of notifications. While the majority of the influenza A cases were unsubtyped (69%), of those subtyped, A(H1N1)pdm09 (33%, 6,922/20,953) was predominant nationally throughout the season, with increasing proportions of A(H3N2) virus towards the end of the season.

Rates of influenza were highest among those in the less than 5 years, 30–44 years and ≥80 years age groups. The age distribution, especially in the younger and middle aged populations, is consistent with the observations of previous years associated with influenza A(H1N1)pdm09 virus, whereas infections in older age groups are typical of influenza A(H3N2).

Taking into account additional data from other targeted influenza surveillance systems monitored throughout the season, the severity of the 2014 influenza season was moderate across most jurisdictions. However, more severe activity was noted in New South Wales, where influenza A(H3N2) circulated at higher levels and affected people in older age groups, which led to a substantial number of outbreaks in residential care facilities.

Invasive *Haemophilus influenzae* type b

- In 2014, 21 cases of invasive Hib reported to the NNDSS.
- Of the cases reported 57% were male and 52% were under the age of 14 years.
- The 2014 notification rate of Hib remains low at 0.1 per 100,000 population.

Hib is a gram negative bacterium that causes disease with symptoms dependant on which part of the body is infected. Clinical categories of invasive disease caused by Hib include septicaemia (infection of the blood stream); meningitis (infection of the membranes around the brain and spinal cord); epiglottitis (severe swelling of the epiglottis at the back of the throat); and a range of other infections. Hib is mostly carried as a commensal (present without causing symptoms) in the nasopharynx of healthy individuals and is spread by respiratory secretions, including aerosol transmission or contact with articles soiled with discharges from the nose or throat.[77] The case fatality rate of Hib meningitis is at least 3% in developed countries, even with treatment. Approximately 15% to 30% of survivors have permanent neurological sequelae.[78]

Epidemiological situation in 2014

In 2014, there were 21 notifications of invasive Hib infection in Australia. This was similar to the number of cases notified in 2013 (n=20) and represented a ratio of 1.1 compared with the mean of the previous 5 years. The 2014 notification rate was 0.1 per 100,000 population, consistent with the very low rates seen since the introduction of the vaccine on the NIP in July 1993 (Figure 57). Cases occurred in 6 states or territories, with 9 cases reported in Queensland, 6 cases in New South Wales, 3 cases in Victoria and 1 case each reported in the Northern Territory, South Australia and Western Australia. Notification rates were consistent between states and territories, ranging from 0.1 per 100,000 in New South Wales, South Australia and Victoria to 0.4 per 100,000 in the Northern Territory. There was 1 Hib associated death in 2014 reported in a 2-month-old Indigenous female who was unvaccinated.

Age and sex distribution

Just over half of notified invasive Hib cases in 2014 were male (57%, n=12). Approximately half of the cases (52%, n=11) were in children aged less than 14 years, and 46% (n=5) of these were among infants less than 1 year of age (Figure 58). Consistent with previous years, the 0–4 years age group had the highest notification rate (0.5 per 100,000).

Figure 57: Notifications and notification rate for invasive *Haemophilus influenzae* type b infection, Australia, 1994 to 2014, by year

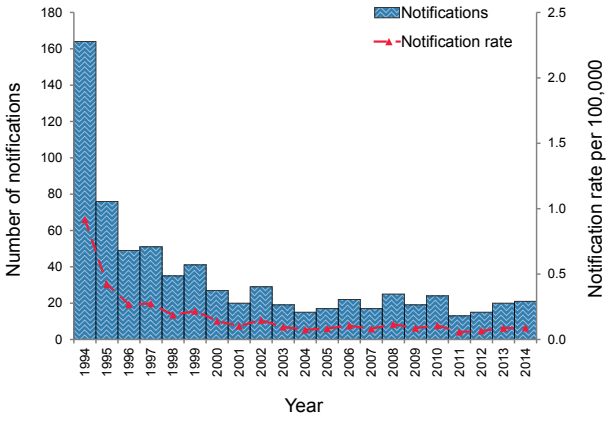
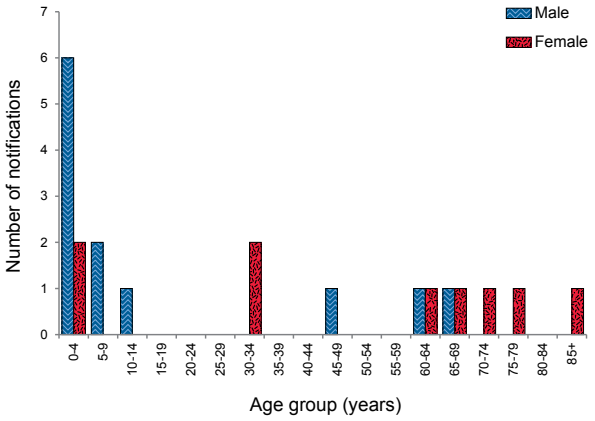


Figure 58: Notifications of invasive *Haemophilus influenzae* type b infection, Australia, 2014, by age group and sex



Indigenous status

Indigenous status was reported for all Hib cases in 2014. Five cases were reported as Indigenous Australians, representing a notification rate of 0.8 per 100,000. This was higher than the average of the previous 3 years (0.5 per 100,000) but lower than 2010 (1.4 per 100,000).

Vaccination status

In 2014, persons less than 22 years of age were eligible for Hib vaccination under the NIP during their infancy. Of the 21 Hib cases reported in 2014, 11 were eligible for vaccination. Six cases were 12 months of age or older, and therefore eligible for the full primary vaccine course and the booster. Of these, 4 were partially vaccinated, 1 was not vaccinated and 1 was of unknown vaccination status. Five cases were less than 12 months of age, of which 3 were reported as partially vaccinated (2 doses) and 2 were not vaccinated.

Invasive pneumococcal disease

- In 2014, 1,564 cases of invasive pneumococcal disease were notified to the NNDSS.
- Compared with 2013, the notification rate of invasive pneumococcal disease remains unchanged.

IPD is a disease in which *Streptococcus pneumoniae* is isolated from a normally sterile site such as blood, cerebrospinal fluid or pleural fluid. Transmission of the bacterium from person to person is usually via the inhalation of infected respiratory droplets. Many of the signs and symptoms of IPD are non-specific including fever, chills, headache, stiff neck and a general feeling of being 'out-of-sorts', severe symptoms can include seizures and occasionally coma.[22]

Epidemiological situation in 2014

There were 1,564 cases reported in 2014, representing a notification rate of 6.7 per 100,000. This notification rate was unchanged from the rate reported in 2013 and maintains the 20% rate reduction observed following the introduction of the 13-valent pneumococcal conjugate vaccine (13vPCV) to the NIP for infants in July 2011.

Geographic distribution

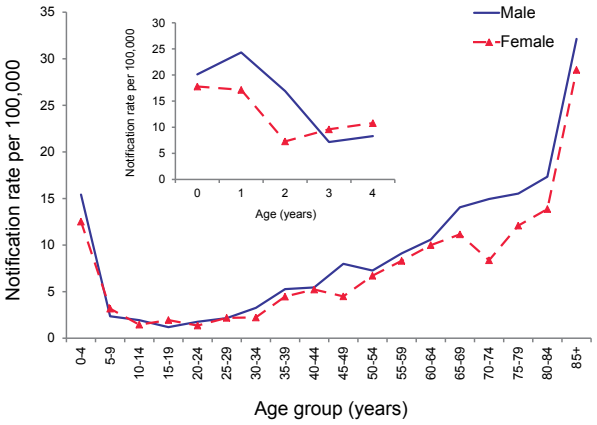
In 2014, the Australian Capital Territory, New South Wales, Tasmania, South Australia and Western Australia all reported an increase in the number of cases, with South Australia reporting the greatest increase on the previous year (20%, 111 to 133). The Northern Territory, Queensland and Victoria all reported a reduction in the number of cases, with the Northern Territory reporting the greatest reduction when compared with the previous year (26%, 58 to 43). Changes in notification rates in the jurisdictions reflected the changes in the number of cases, with rates ranging from 3.9 per 100,000 in the Australian Capital Territory to 17.6 per 100,000 in the Northern Territory.

Age and sex distribution

In 2014, males accounted for 53% (n=827) of cases of IPD. The rate of disease in males exceeded that in females in all age groups except for the 5–9 years, 15–19 years and 25–29 years age groups (Figure 59).

In 2014, the notification rate for IPD was highest in older Australians and in young children, with an age distribution similar to that seen in 2013.[37] In older Australians, the highest notification rate was

Figure 59: Notification rate for invasive pneumococcal disease, Australia, 2014, by age group and sex



in those aged 85 years or older (30.0 per 100,000), while the highest rate in children aged less than 5 years was in those aged 1 year (20.8 per 100,000) (Figure 59).

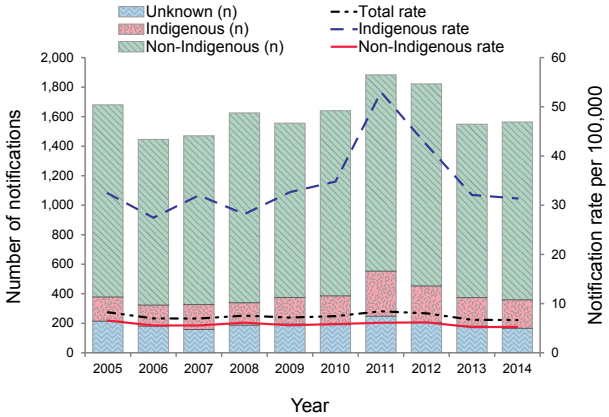
Seasonality

Many respiratory diseases, including IPD, are known to show a distinct seasonal trend that generally peaks during the winter months. In 2014, the seasonal trend of IPD peaked in July (n=213), 1 month earlier than the preceding 3 years.

Indigenous status

In 2014, 89% (n=1,398) of IPD cases were reported with a known Indigenous status. Of those with a known Indigenous status, 14% (n=193) were reported as Indigenous. The notification rate in the Indigenous population (31.4 per 100,000) was approximately 6 times the rate in non-Indigenous people (5.3 per 100,000) (Figure 60).

Figure 60: Notifications and notification rates of invasive pneumococcal disease, Australia, 2005 to 2014, by year and Indigenous status



Vaccination status

In Australia, pneumococcal vaccination is recommended as part of routine immunisation for the medically at risk, children under 5 years of age, Aboriginal and Torres Strait Islander peoples aged 50 years or over and other Australians aged 65 years or over. More information on the scheduling of the pneumococcal vaccination can be found in *The Australian Immunisation Handbook,* 10th edition.[32] The history of pneumococcal vaccination recommendations and practice is available through the National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases.[79]

Microbiological trends

Although there are over 90 *S. pneumoniae* serotypes, a relatively limited number cause the majority of IPD. Monitoring the profile of *S. pneumoniae* serotypes causing invasive pneumococcal disease in the community is critical for evaluating the impact of the NIP funded vaccines as well as for the early detection of emerging serotypes and serotype specific outbreaks. IPD serotypes were reported in 95% (n=1,487) of notified cases in 2014.

In 2014, 68% (1,005) of all notifications with a known serotype were a result of a serotype included in the 23vPPV, and 39% (586) were included in the 13vPCV. Across all ages, the most frequently reported serotypes were 3 (n=150), 19A (n=139), 7F (n=132), 22F (n=120), 19F (n=80) and 6C (n=66) with these 6 serotypes accounting for 46% (687) of all notifications with serotype information. Serotypes 3, 19A, 7F and 19F are included in both the 13vPCV and the 23vPPV. Serotype 22F is only included in the 23vPPV and 6C is not covered by a vaccine. The remaining 56% (n=800) of cases were distributed across 58 other different serotypes.

In Indigenous children aged under 5 years, there were 34 notifications, with serotype 23B (n=6) being the most frequently reported serotype. Serotype 23B is not included in the 13vPCV. In non-Indigenous children aged under 5 years, there were 180 notifications, with serotype 19A (n=30) being the most frequently reported serotype. Serotype 19A is included in the 13vPCV.

In 2014, 37% (n=79) of notifications in children aged under 5 years were a result of a serotype included in the 13vPCV. This was similar to the 38% (n=72) of notifications reported in 2013 and maintains the large reduction in notifications in this age group observed following the introduction of the 13vPCV to the NIP.

In Indigenous adults aged 50 years or over, there were 54 notifications, with serotype 3 (n=6) being the most frequently reported serotype. In non-Indigenous adults aged 65 years or over, there were 502 notifications, with serotype 3 (n=51) and serotype 22F (n=51) being the most frequently reported. Both serotypes 3 and 22F are included in the 23vPPV.

In 2014, 57% (n=31) of notifications in Indigenous peoples aged 50 years or over, and 55% (n=278) of notifications in non-Indigenous Australians aged 65 years or over, were a result of a serotype included in 23vPPV. This continues a general downward trend observed in both these adult population groups in recent years. The 13 serotypes included in the 13vPCV are also included in the 23vPPV and the downward trend in notifications caused by serotypes included in the 23vPPV is likely to be a result of the herd immunity effect afforded to them by the vaccination of infants with 13vPCV.

Enhanced surveillance data sets

Enhanced data are available for IPD notifications. Further analyses, including risk factors and antibiotic susceptibilities can be found in annual and quarterly IPD surveillance report series published regularly in CDI. In addition, a subset of IPD notification data, including serotype, age, sex, Indigenous status, clinical categories and vaccination history are publicly available in the NNDSS IPD Public Dataset (http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-surveil-nndss-ipd-reports.htm).

Measles

- Measles is no longer endemic in Australia.
- In 2014, there were 340 notified cases of measles, representing a national notification rate of 1.4 per 100,000 population.
- Seventy-five per cent of cases were either imported or import-related.
- The largest outbreak of measles in 2014 consisted of 29 cases and lasted approximately 7 weeks.

Measles is a highly infectious acute viral illness, caused by the measles virus, which is spread by respiratory secretions, including aerosol transmission.[80] Initial symptoms last 2 to 4 days and are characterised by fever and malaise, followed by a cough, coryza and conjunctivitis. It is usually followed by a red blotchy rash, which typically begins on the face, and then becomes generalised. Measles is often a severe disease with complications more common in the chronically ill, including otitis media, pneumonia, diarrhoea and acute encepha-

litis.[81] Subacute sclerosing panencephalitis is a late, rare (approximately 1 in 100,000 cases) complication of measles caused by persistent infection and is always fatal.[32] Complications are more common in children under 5 years of age and in adults over 20 years of age.[82]

Epidemiological situation in 2014

In 2014, there were 340 notifications of measles. This represents a notification rate of 1.4 per 100,000 population, which was 2.3 times the mean of the previous 5 years (n=146) and an increase of 110% compared with 2013 (n=162) (Figure 61). In 2014, cases of measles occurred in all states and territories, with the 23% of cases occurring in Victoria (n=77) (Figure 62).

In temperate climates and where measles transmission remains endemic, the majority of cases usually occur in late winter to early spring.[83] In Australia, this seasonal pattern is no longer evident (Figure 62).

Age and sex distribution

The majority of notified measles cases were male (59%, n=199) in 2014. There was a wide variation in the male to female rate ratio across the age groups with the most notable difference in the 20–24 years and 30–34 years age groups, where there were 2 times as many males as females (Figure 63).

In 2014, age at diagnosis ranged from 0–64 years, with a median age of 19 years. Compared with 2013, notification rates increased in all age groups in 2014. Consistent with recent years, infants less than 1 year of age had the highest age specific rate (10.7 per 100,000). Rates have remained below 2.5 per 100,000 in all age groups between 2009 and 2014, with the exception of the less than 1 year age group in 2011, 2012 and 2014 and the 10–19 years age group in 2014 (Figure 64).

Forty-nine cases occurred in those born between 1978 and 1982 (32–36 years old in 2014), a cohort previously identified as susceptible to measles

Figure 61: Notifications and notification rate for measles, Australia, 1998 to 2014, by year

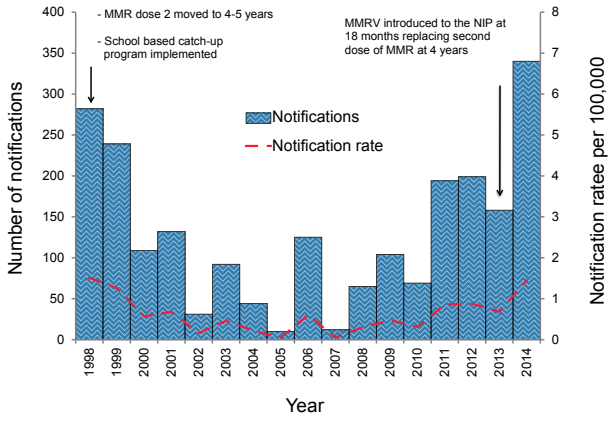
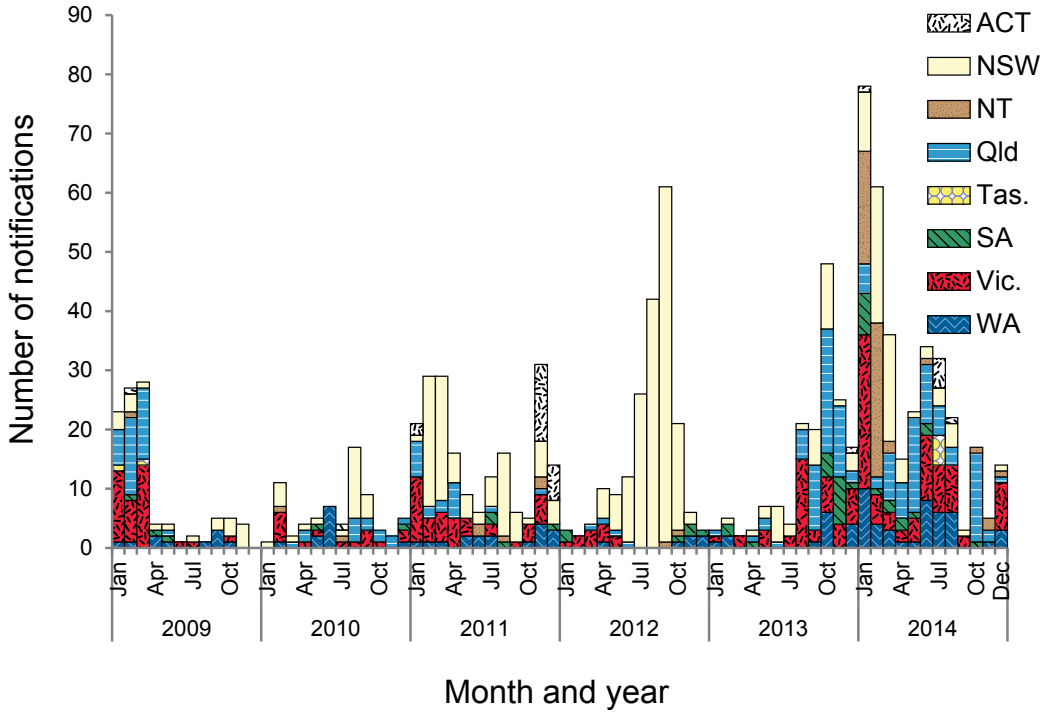


Figure 62: Notifications of measles, Australia, 2009 to 2014, by month, year and state or territory



infection.[84] Four cases were born before 1966, a cohort that is considered to have high levels of natural immunity.[85]

Figure 63: Notification rate for measles, Australia, 2014, by age group and sex

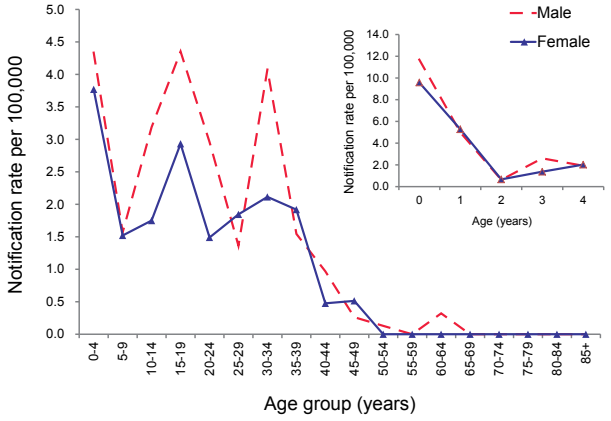
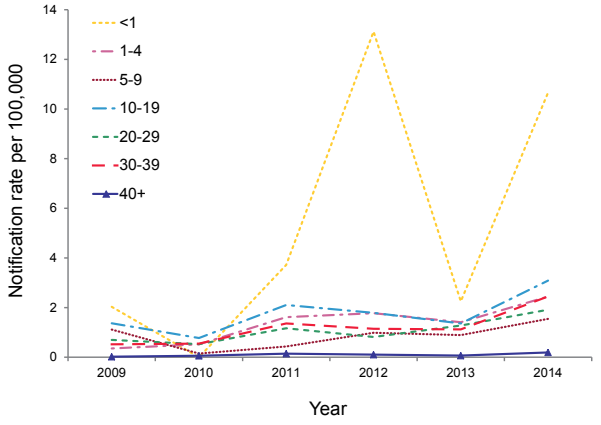


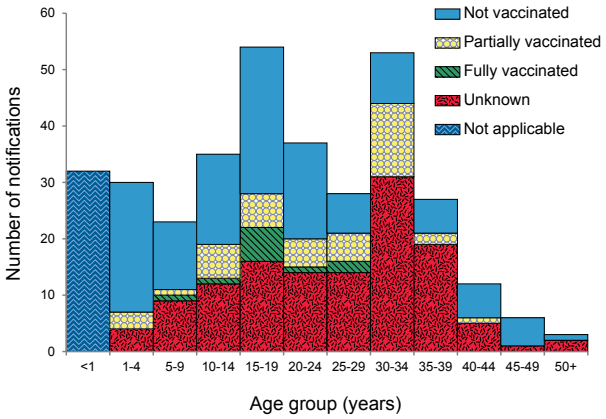
Figure 64: Notification rate for measles, Australia, 2009 to 2014, by year and selected age groups



Vaccination status

Two doses of the measles containing vaccine are recommended for all persons born during or after 1966. Of the 340 cases notified in 2014, 90% (n=305) were born after 1965 or were 12 months of age or older and therefore eligible for at least 1 dose of a measles-containing vaccine. Eighty-three per cent (n=252) of cases eligible for vaccination were either not vaccinated (42%, 127/305) or of unknown vaccination status (41%, 125/305). Of the remaining 17% (n=53) who were vaccinated, 11 had received the full course of 2 doses of a measles-containing vaccine and 42 were partially vaccinated with 1 dose (Figure 65). Young children and adolescents between 5 and 19 years of age accounted for 61% (77/127) of all unvaccinated cases. In 2014, 28% (25/88) of cases less than 15 years of age were reported as of unknown vaccination, in contrast to 46% (100/217) of cases 15 years or over (Figure 65).

Figure 65: Notifications of measles, Australia, 2014, by age group and vaccination status



The measles-mumps-rubella (MMR) vaccine induces long term measles immunity in 95% of recipients after a single dose and 99% of recipients after the second dose.[32]

Indigenous status

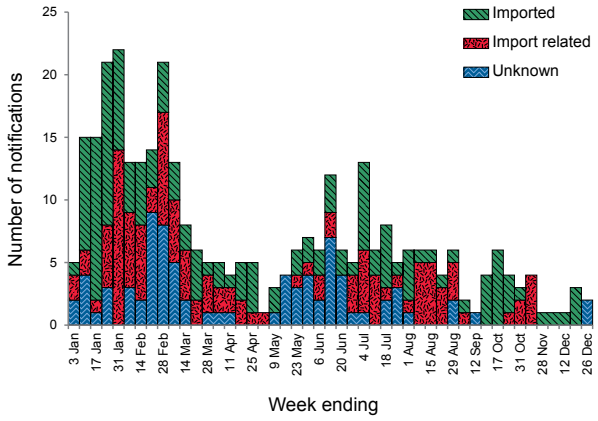
Indigenous status was completed for 96% of cases in 2014 (n=327), an increase in completeness compared with the 93% of cases in 2013. Of the cases reported in 2014, 3% (n=11) were reported as Indigenous.

Source of infection and outbreaks

Seventy-five per cent of cases in 2014 were either imported (n=140) or import-related (n=115) with the remaining 25% (n=85) of unknown source (Figure 66). Of the imported cases, 64% (90/140) were from the WHO Western Pacific Region, with the majority of cases imported from the Philippines (n=50) followed by Papua New Guinea (n=20) and Vietnam (n=13). Of the remaining imported cases, 43 were imported from the WHO South East Asia Region, 2 from the WHO European Region and 1 from the African Region.

There were 42 clusters of 2 or more epidemiologically linked cases (outbreaks) in 2014 accounting for 60% (n=204) of all cases. The remaining cases comprised sporadic imported cases (n=98) and sporadic cases acquired in Australia of unknown source (n=38). Seventy-eight per cent of clusters were import related (33/42). There were 9 clusters of locally acquired cases of unknown source, which occurred in 6 separate states or territories

Figure 66: Notifications of measles, Australia, 2014, by week and source of infection



including Western Australia, 1 cluster of 5 cases; New South Wales, 3 clusters – 1 of 2 cases, 1 of 3 cases and another of 7 cases; Queensland, 1 cluster of 8 cases; the Australian Capital Territory, 1 cluster of 4 cases; The Northern Territory, 1 cluster of 3 cases; Victoria, 1 cluster of 11 cases; and 1 cluster of 6 cases involving both Victoria and the Northern Territory.

Transmission was interrupted quickly in all outbreaks in 2014. The median outbreak duration was 14 days (range 0 to 72 days) between the onset of symptoms in the index and the last case. The median generations of transmission [86] was 1 (range 0 to 7). Thirty-nine of 42 clusters had fewer than 10 cases with a median of 3 cases (range 2 to 9). Of the 3 outbreaks with 10 or more cases, 2 were import related and all were genotyped as B3. The largest of these outbreaks comprised 29 cases and occurred principally in the Northern Territory (n=28), with 1 linked case in a resident of Western Australia. This outbreak commenced in mid-January, lasted approximately 7 weeks, included 5 generations of transmission and was associated with an imported case from Singapore.

Microbiological trends

Genotyping data were available for 41 clusters with 2 or more linked cases in 2014. Genotype B3 was associated with 22 separate clusters (n=126 cases), D8 with 11 clusters (n=47 cases), D9 with 4 clusters (n=14 cases) and H1 with 4 clusters (n=14 cases). Of the 136 sporadic cases 84% (n=114) were genotyped.

Imported genotypes varied by WHO region. In 2014, there was 1 B3 importation from the African Region and 2 separate D8 importations from the European Region. Multiple genotypes were imported from the South East Asia Region (B3, D8, D9, H1 and G3) and the Western Pacific Region (B3, D8, D9 and H1).

Discussion

The increasing prevalence of measles in some parts of the world, and the continued circulation of the virus in countries of close geographical proximity to Australia, will result in a continual source of imported virus in Australia. This was particularly the case in 2014 with 157 separate importations occurring. Despite this large number of importations in 2014, the majority were sporadic (n=98) and did not lead to local transmission.

Evidence suggests that endemic measles has been eliminated from Australia, since at least 2005,[83] and this was verified by the WHO in 2014.[87] In 2014, none of the outbreaks persisted for more than 12 months and there was no evidence of a single genotype continuously circulating. Ongoing evidence of high population immunity was demonstrated by the short duration and small number of cases in the majority of outbreaks.

Due to the highly infectious nature of measles, local transmission and outbreaks will continue to occur in Australia, mostly among susceptible contacts of non-immune travellers from countries where measles remains prevalent.

Mumps

- There were 190 cases of mumps reported in 2014.
- Since 2009, the notification rate of mumps has remained below 1.0 per 100,000 population.

Mumps is an acute viral illness caused by the mumps virus. Transmission is usually by respiratory secretions, including aerosol transmission, or by direct contact with saliva. Asymptomatic infections occur in one-third of cases. Symptomatic disease ranges from mild upper respiratory tract infections to systemic involvement. The characteristic bilateral, or occasionally unilateral, parotid swelling occurs in 60% to 70% of clinical cases, however, a high proportion have non-specific symptoms including fever, headache, malaise, myalgia and anorexia.[88] Mumps encephalitis has been estimated to occur in 1 to 2 per 10,000 cases, with a case fatality rate of around 1%.[22]

Epidemiological situation in 2014

In 2014, there were 190 notifications of mumps, which was a 13% decrease compared with the

218 cases reported in 2013 and a ratio of 1.1 compared with the 5-year mean (n=167). Since 2009, the national notification rate of mumps has remained below 1.0 per 100,000, ranging from 0.4 per 100,000 in 2010 to 0.9 per 100,000 in 2012 and 2013, and 0.8 per 100,000 in 2014. Cases of mumps were reported from all states and territories in 2014, with the highest rates occurring in South Australia and New South Wales (1.1 per 100,000 each) (Figure 67).

Place of acquisition was complete for 54% (n=102) of cases in 2014, of which 25% (25/102) were imported from overseas: 13 from Asia, 4 from Africa, 4 from the Americas, 2 from Europe and 1 each from the Middle East and New Zealand. The remaining 77 cases were reported as locally acquired in Australia.

Age and sex distribution

In 2014, just over half of all of notified mumps cases were reported in males (52%, n=98) and persons under the age of 40 years (67%, n=128) (Figure 68). The highest number of notifications for males occurred in the 0–4 years age group with 13 cases, while for females notifications were highest in the 35–39 years age group with 11 cases. Consistent with recent years, adults in the 30–39 years age group had the highest rates of infection (1.4 per 100,000) (Figure 69). Since 2010, there has been a steady increase in age-specific rates across all age groups. This is particularly evident in the 1–4 years age group rates, which have increased from 0.3 per 100,000 in 2010 to 1.1 per 100,000 in 2014.

Figure 68: Notifications of mumps, Australia, 2014, by age group and sex

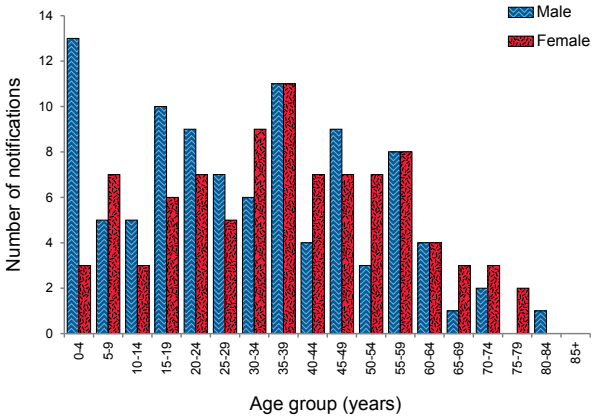


Figure 69: Notification rate for mumps, Australia, 2009 to 2014, by year and selected age groups

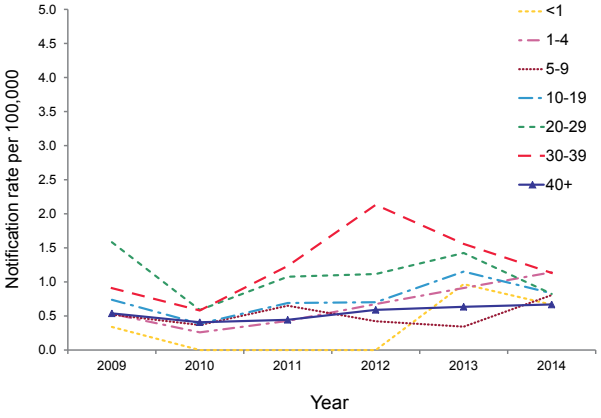
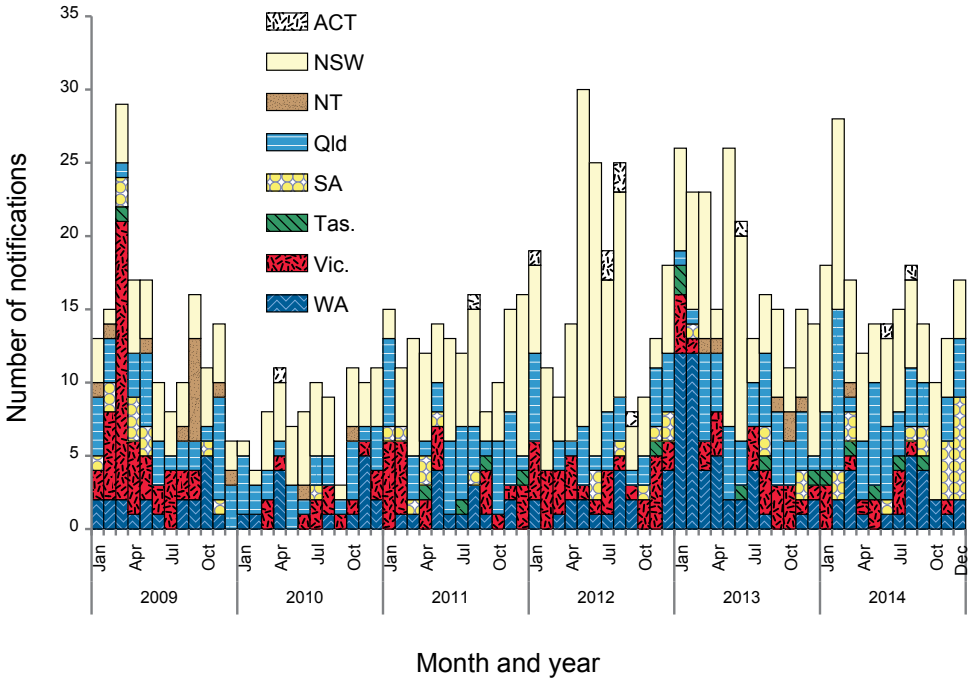


Figure 67: Notifications of mumps, Australia, 2009 to 2014, by month, year and state or territory



Indigenous status

Indigenous status was reported for 77% (n=147) of notified mumps cases in 2014. This is higher than the mean completeness of the previous 5 year period (64%, range 51% to 80%). Of the cases with a known Indigenous status, 3 (2%) were reported as Indigenous. The proportion of mumps notifications reported as Indigenous has remained below 5% since 2010.

Vaccination status

The mumps vaccine was first funded on the NIP schedule in 1982 for infants at 12 months of age, with people born after 1980 eligible for at least 1 dose of a mumps containing vaccine. Of the 190 cases notified in 2014, 49% (n=94) were eligible for at least 1 dose of a publicly funded mumps-containing vaccine. Of these, 17% (16/94) were unvaccinated and 38% (36/94) were of unknown vaccination status, 23% (22/94) were fully vaccinated, having received 2 doses of a mumps containing vaccine and 15% (14/94) were partially vaccinated with 1 dose of a mumps containing vaccine. Six cases were reported as vaccinated but had no dose information provided.

The mumps component of the MMR vaccine is considered to be the least effective of the 3 components with the reported 1 dose vaccine effectiveness varying between 60% and 90%.[89–91] While protection is greater in 2-dose vaccine recipients, recent outbreaks have been reported in 2-dose recipients, particularly young adults who received their vaccines more than 10 years previously.[92,93] Reduced effectiveness of the mumps vaccine over time may partially account for the proportion of vaccinated cases notified and contribute to mumps outbreaks in older vaccinated populations.[94]

Outbreaks

The outbreak reference field was completed for 6% (n=11) of cases in 2014. There were 3 outbreaks of 2 or more epidemiologically linked cases reported, of which, 2 were import related, 1 in Western Australia consisting of 3 cases, and 1 in South Australia consisting of 5 cases. The third outbreak comprised of 2 locally acquired cases in Western Australia.

Pertussis

- Pertussis remains highly prevalent in Australia.
- In 2014, there were 11,863 cases of pertussis reported to the NNDSS.
- National notifications continued to decline in 2014 and were the lowest level since 2007.
- In 2014, children under 15 years of age had a notification rate 2.4 times higher than those 15 years of age or over.

Pertussis, commonly known as whooping cough, is a highly infectious acute respiratory disease caused by the bacteria *Bordetella pertussis*. Spread by respiratory droplets, infection is often characterised by paroxysmal cough with inspiratory whoop, which is frequently seen among unvaccinated children but uncommon in individuals who have acquired some immunity through vaccination or infection.[95] The highest risk of infection and severe morbidity from pertussis occurs in infants who are too young to have received at least 2 doses of a pertussis-containing vaccine.[32] Complications include pneumonia, atelectasis, seizures, encephalopathy, and hernias, with pneumonia as the most common cause of death.[22]

Epidemiological situation in 2014

In 2014, pertussis notifications were at their lowest levels since 2007 and continued to display a downwards trend since reaching a peak in 2011, at the height of the most recent epidemic period, 2008 to 2012. There were 11,863 notifications of pertussis, which was a 4% decrease in notified cases compared with 2013 (n=12,362) and 51% less than in 2012 (n=24,101) (Figure 70). There were 2 pertussis related deaths reported. Both of these cases were reported as unvaccinated, with 1 case aged 7 months and the other 85 years.

In 2014, all jurisdictional specific rates had returned to pre-epidemic levels with rates remaining below 90 per 100,000 population. Compared with 2013, rates declined in all jurisdictions except New South Wales, Victoria and Western Australia (Figure 71). Rates in Victoria increased from 51 per 100,000 in 2013 to 81 per 100,000 in 2014, in New South Wales from 32 per 100,000 in 2013 to 42 per 100,000 in 2014 and in Western Australia from 65 per 100,000 in 2013 to 68 per 100,000 in 2014.

Age and sex distribution

Males accounted for 56% (n=6,657) of cases in 2014 and had higher rates across all age groups from 10 years of age (Figure 72). The highest noti-

Figure 70: Notifications of pertussis, Australia, 2009 to 2014, by month, year and state or territory

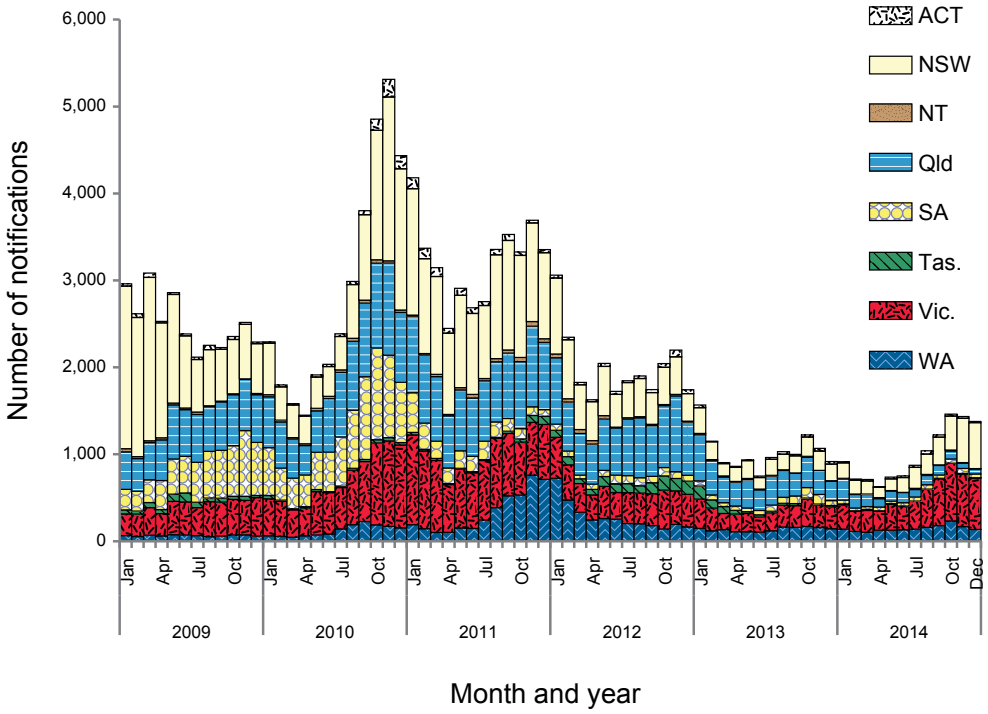


Figure 71: Notification rate for pertussis, Australia, 2009 to 2014, by year and state or territory

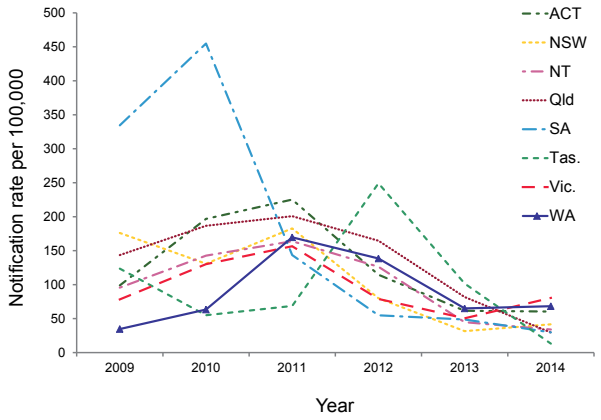
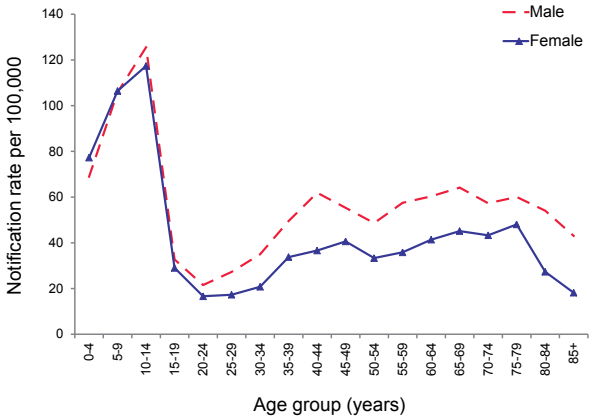


Figure 72: Notification rate for pertussis Australia, 2014, by age group* and sex†



* Excludes 16 cases reported without age.

† Excludes 5 cases reported without sex.

fication rate in both males and females occurred in the 10–14 years age group at 126 and 117 per 100,000 respectively.

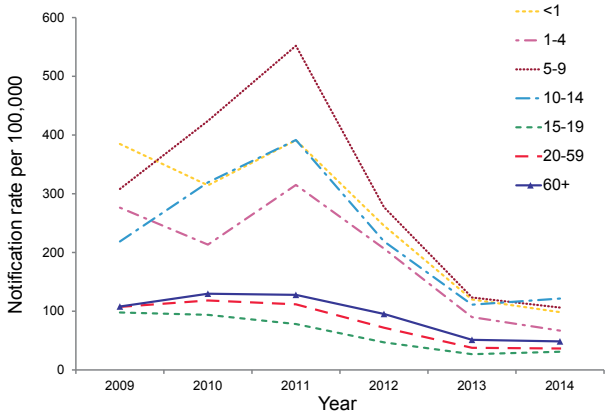
In 2014, children less than 15 years of age represented 37% (n=4,407) of notifications and had a notification rate (100 per 100,000) 2.6 times higher compared with those 15 years of age or over (36 per 100,000). After reaching a peak in 2011 rates in children less than 15 years of age have declined steeply, with the ratio of cases under 15 years compared with those over 15 years falling from 3.7 in 2011 to 2.7 in 2014. The highest age specific rates in 2014 occurred in the 10–14 years age group (122 per 100,000), which was higher than the rates reported in 2013 (111 per 100,000) (Figure 73).

Vaccination status

The NIP schedule in 2014 included a primary course of 3 doses of vaccine at 2, 4, and 6 months of age, with additional booster doses provided at 4 years of age and between 10 and 15 years of age.[32]

In order to determine the vaccination status of cases, public health follow-up is required. As per the pertussis national guidelines for public health units,[96] jurisdictions prioritise case follow-up to those less than 5 years of age. During 2014, those aged less than 5 years accounted for 9% (n=1,117) of all notified cases, of which information about vaccination status was available for 89% (n=992).

Figure 73: Notification rates for pertussis, Australia, 2009 to 2014, by year and selected age groups*



* Excludes 16 cases reported without age.

Of the children eligible to receive a pertussis-containing vaccine in 2014, 33% (n=255) of cases had received the full primary course of 3 doses and 22% (n=34) had received the full scheduled course of 4 doses (Table 18). Fifty-nine per cent (n=636) of eligible cases less than 5 years of age had received at least 2 doses of a pertussis-containing vaccine in 2014.

Pertussis vaccine effectiveness among Australian children has been estimated to range from 82% to 89% with the lower figure representing the cohort of children who would not have been eligible for the 18-month booster dose, which was removed from the NIP in 2003.[97] Immunity to disease decreases over time post-vaccination, with estimates of protection remaining for 4 to 12 years.[98–100] While pertussis can affect people of any age, infants are at highest risk of more severe disease as adequate immunity is not achieved through infant vaccination until receiving at least the second vaccine dose at 4 months of age.[101]

Discussion

Epidemics of pertussis have historically occurred at regular intervals of approximately 4 years on a background of endemic circulation in Australia, with the most recent epidemic peaking in 2011. In 2014, all jurisdictions reported pertussis activity consistent with pre-epidemic levels and national rates were at their lowest since 2007. However nationally, an increasing trend was evident from mid-2014, which was driven by a significant increase in pertussis activity in New South Wales and Victoria and a return to epidemic level activity in 2015 would not be unexpected.

All jurisdictions, except for the Northern Territory, ceased their respective cocooning programs in 2012, which included various combinations of providing free booster vaccinations to mothers and carers of infants.

Poliomyelitis

- There were no notifications of poliomyelitis in 2014.
- Australia, along with the Western Pacific Region, remains poliomyelitis free.

Table 18: Notifications of pertussis in children aged 0 to 5 years, Australia, 2014, by age group and number of vaccine doses

Age group	Number of vaccine doses					Unknown	Total
	0	1	2	3	4		
Less than 6 weeks of age (not eligible for vaccination)	25	0	0	0	0	14	39
6 weeks to <4 months (eligible for 1 dose of vaccine)	14	67	3	0	0	14	98
4 to < 6 months (eligible for 2 doses of vaccine)	3	23	27	0	0	3	56
6 months to < 4 years (eligible for 3 doses of vaccine)	61	125	250	255	5	73	769
4 to 5 years (eligible for 4 doses of vaccine)	18	20	51	11	34	21	155
Total	121	235	331	266	39	125	1,117

Poliomyelitis is an acute illness following gastrointestinal infection by 1 of the 3 types of poliovirus. Transmission occurs primarily from person-to-person via the faecal-oral route. In most cases poliovirus infection is not symptomatic but, in less than 1% of cases the virus may invade the nervous system and cause acute flaccid paralysis (AFP).[22]

Epidemiological situation in 2014

In 2014, there were no notifications of poliomyelitis. Australia, along with the Western Pacific Region, remains poliomyelitis free.

Poliovirus infection, both paralytic (poliomyelitis) and non-paralytic, is a notifiable disease in Australia. Clinical and laboratory investigation is conducted for cases involving patients of any age with a clinical suspicion of poliomyelitis, following the WHO protocol, which focuses on investigating cases of AFP in children under 15 years of age. The WHO target for AFP surveillance in a polio free country is 1 case of AFP per 100,000 children less than 15 years of age. Australia has achieved this surveillance target since 2008. However, the virological surveillance indicator of adequate stool specimen collection in 80% of AFP cases has never been met. More details can be found in the annual report series published in the CDI by the Australian Enterovirus Reference Laboratory who coordinate poliovirus surveillance activities in Australia.

Rubella and congenital rubella

- Rubella is a rare disease in Australia.
- Since 2003, rubella notifications have been less than 0.3 per 100,000.
- In 2014, there were 17 cases of rubella and no cases of congenital rubella syndrome reported.

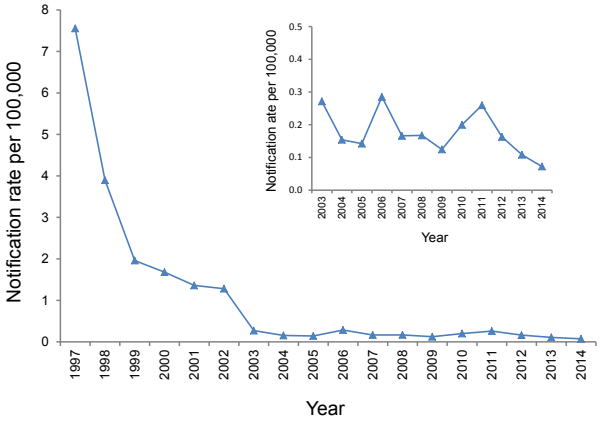
Rubella is generally a mild and self-limiting infectious disease caused by a rubella virus. It is spread from person-to-person through contact with respiratory secretions, including aerosol transmission. A rash, usually starting on the face before spreading across the body, may appear around 2 weeks after exposure to the virus and usually lasts for 3 days. Children usually show few or no constitutional symptoms of infection, but adults may experience 1 to 5 days of early low grade symptoms, such as fever, malaise, headaches and mild head colds.[22] Clinically, rubella can be difficult to distinguish from other diseases that also cause febrile rash, such as measles, and is asymptomatic in up to 50% of cases.

Rubella infection in the first trimester of pregnancy can result in miscarriages, foetal deaths or stillbirths, and a collection of birth defects known as congenital rubella syndrome (CRS) in over 90% of cases.[22,102] CRS can result in single or combined defects such as hearing impairment, eye abnormalities (including retinopathy, cataract and microphthalmia) congenital glaucoma, microcephaly, meningoencephalitis, development delay, purpura, jaundice radiolucent bone disease and congenital heart disease.

Epidemiological situation in 2014

In 2014, there were 17 cases of rubella reported, representing a rate of 0.1 per 100,000. While this was consistent with the low rates of this disease experienced since 2003, it was a marked decline from the peak rate of more than 7.5 per 100,000 in 1997 (Figure 74). Cases were reported from all states except Tasmania. No cases were reported from the Australian Capital Territory or the Northern Territory. There were no cases of CRS reported in 2014.

Figure 74: Notification rate for rubella, Australia, 1997 to 2014, by year



Age and sex distribution

In 2014, the majority of notified rubella cases were female (65%, n=11), of which 64% (7) were of child bearing age (15–44 years of age) (Figure 75). The median age of cases was 35 years, with a range of 7–56 years. Consistent with previous years, the majority of cases (82%, 14/17) occurred among adults over the age of 20 years (Figure 75), and age-specific rates remained below 0.7 per 100,000 across all age groups (Figure 76).

Vaccination status

Rubella vaccine is provided in the combined MMR or measles-mumps-rubella-varicella vaccine, and in 2014 was provided under the NIP schedule at

Figure 75: Notifications of rubella, Australia, 2014, by age group and sex

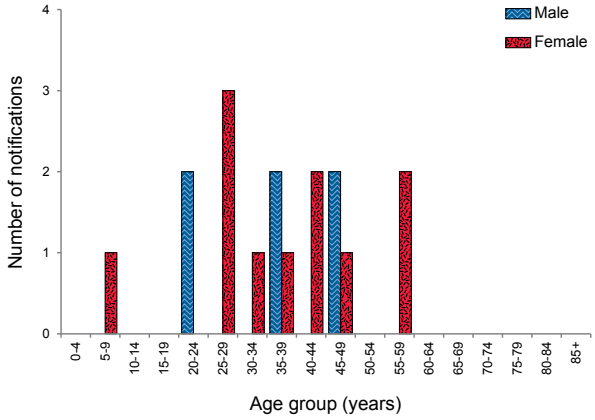
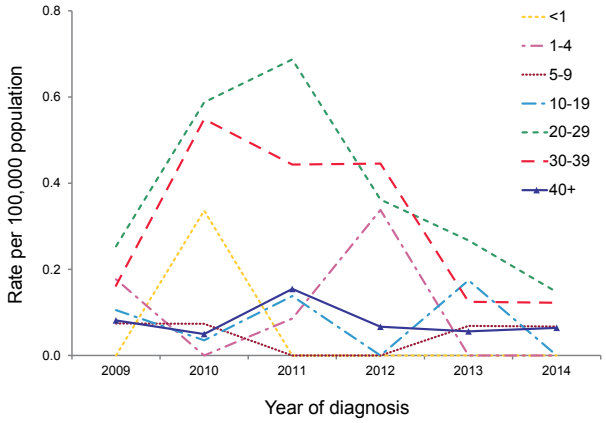


Figure 76: Notification rate for rubella, Australia, 2009 to 2014, by year and selected age groups



12 months and 18 months of age. A dose at 4 years of age was also recommended for those who did not receive the second dose at 18 months of age.[32]

Of the 17 cases notified in 2014, 4 were reported as vaccinated; 1 fully vaccinated, receiving 2 doses of a rubella-containing vaccine; 1 as partially vaccinated, receiving 1 dose; and 2 reported as vaccinated with no dose information provided. Two were reported as not vaccinated and the remaining 11 were of unknown vaccinations status.

The primary aim of immunisation against rubella is to prevent cases of CRS.[103] Two doses of a rubella-containing vaccine are recommended for all non-immune persons born during or since 1966 and who are greater than 18 months of age.

Discussion

Evidence suggests that endemic rubella is well controlled in Australia. A marked decline in rubella notifications since 2003 has seen rates in Australia remain well below the 1.0 per 100,000 population WHO goal indicative of rubella control.[104] The increasing trend in age of notifications likely reflects the declining rates of rubella among children since routine MMR immunisation was implemented and the subsequent achievement of high 2 dose coverage. Males, historically more susceptible as universal vaccination was not introduced until 1989, no longer appear to be at greater risk of infection compared with females.

CRS is rare in Australia and in recent years has mainly occurred among infants of women who were born overseas.[105]

Tetanus

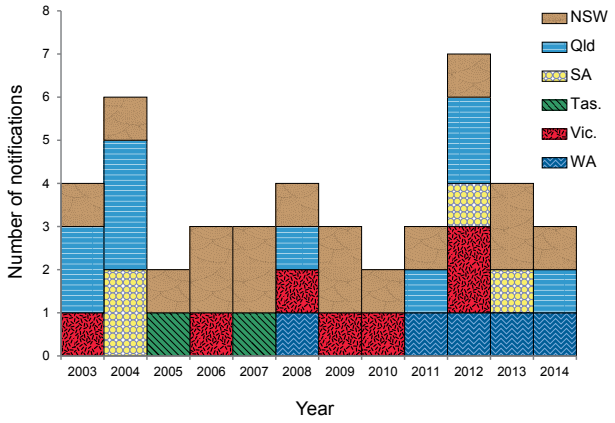
- Cases of tetanus are uncommon in Australia.
- Cases generally occur in older, unvaccinated people or in those who have not received a booster vaccination in the last 10 years.
- In 2014, there were 3 cases of tetanus and no deaths reported.

Tetanus is an acute, often fatal, disease caused by the toxin produced by the bacterium *Clostridium tetani*. *C. tetani* spores usually enter the body through contamination of a wound with manured soil. [22] The neurotoxin acts on the central nervous system to cause muscle rigidity with painful spasms. Generalised tetanus, the most common form of the disease, is characterised by increased muscle tone and generalised spasms. The disease usually occurs after an incubation period of 3 to 21 days (ranging from 1 day to several months), with a median time of onset at 10 days post injury. In Australia, tetanus is rare occurring primarily in older adults who have never been vaccinated or have not received a booster dose in the past 10 years. A high level of diagnostic awareness of tetanus is important in the elderly, as most deaths occur in people over 70 years of age, especially females, and may be associated with an apparent minor injury.[106]

Epidemiological situation in 2014

In 2014, there were 3 notifications of tetanus (Figure 77). This was consistent with the low number of this disease notified in recent years. All cases were adult males 30 years of age or over. Place of acquisition was reported for all cases, with 1 case reported to have acquired their infection in Italy and 2 in Australia. There were no reported deaths due to tetanus in 2014.

Figure 77: Notifications of tetanus, Australia, 2003 to 2014, by year and state or territory



Vaccination status

The NIP schedule in 2014 recommends a primary course of tetanus vaccination including 3 doses provided at 2, 4, and 6 months of age. Two booster doses are provided at 4 years and between 10 and 15 years delivered through school based programs. Booster doses are additionally recommended for all adults at the age of 50 years who have not received 1 in the previous 10 years.[32]

Of the 3 cases notified in 2014, 2 were reported as not vaccinated and 1 was of unknown vaccination status.

Complete immunisation induces protection that lasts throughout childhood but by middle age, 50% of vaccine recipients have low or undetectable levels of antibodies. Tetanus is however uncommon in people who have received 4 or more doses of a tetanus-containing vaccine, and in those who received their last dose within 10 years.[105]

Varicella zoster virus

- In 2014, there were 19,658 cases of varicella zoster virus infection reported, an increase of 16% from 2013.
- Of these, 62% were unspecified VZV infection, 28% were shingles and 11% were chickenpox.

The VZV is a highly contagious member of the herpesvirus family and causes 2 distinct illnesses; chickenpox as the primary infection, and shingles (herpes zoster), which occurs following reactivation, often many years later, of latent virus in approximately 20% to 30% of all chickenpox cases. Shingles occurs more frequently among older adults (most commonly after 50 years of age) and in immunocompromised people.[22]

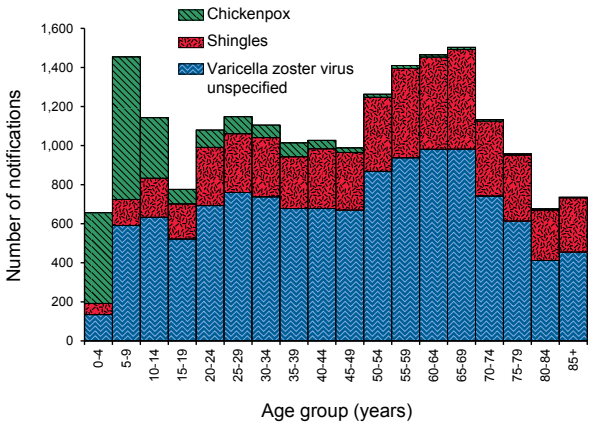
In 2006, the CDNA agreed 3 categories of VZV infection were nationally notifiable: chickenpox, shingles and varicella zoster virus unspecified. By 2009, all jurisdictions were notifying VZV infections to the NNDSS against these 3 categories, except New South Wales, where VZV is not a notifiable disease.

The ability to categorise a VZV infection as chickenpox or shingles depends on follow-up to determine the clinical presentation of the case. The majority of VZV infections are reported as unspecified as follow-up does not occur (Table 5). Notification rates for chickenpox, shingles and VZV unspecified, including any comparisons made between jurisdictions and age groups, should be interpreted with caution as they are affected by the varying levels of follow-up undertaken in each jurisdiction.

Epidemiological situation in 2014

In 2014, there were 19,658 VZV notifications from the 7 reporting jurisdictions. This was 16% more than the total cases notified in 2013 (n=16,986). Of the total VZV notifications in 2014, 62% (n=12,097) were reported as unspecified VZV infection, 28% (n=5,471) as shingles and 12% (n=2,088) as chickenpox (Figure 78).

Figure 78: Notifications of varicella zoster virus infection, 2014, Australia,* by age group†



* Excluding New South Wales.

† Age of onset missing for 123 notifications.

Varicella zoster virus (unspecified)

- In 2014, there were 12,097 cases of VZV unspecified reported, an increase of 10% from 2013.

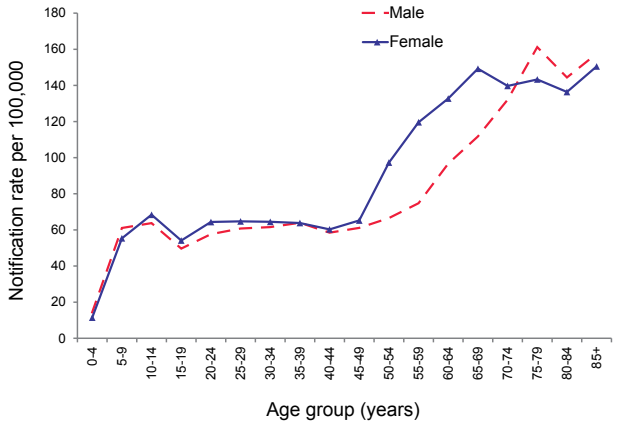
Epidemiological situation in 2014

In 2014, there were 12,097 cases of VZV unspecified infections reported, representing a notification rate of 76 per 100,000 population and a 10% increase in notifications compared with 2013 (n=10,983). The highest notification rate for VZV unspecified was reported from Queensland at 117 per 100,000 (n=5,544) and the lowest from the Northern Territory at 3 per 100,000 (n=8) (Table 5).

Age and sex distribution

In 2014, the majority of VZV unspecified cases were reported in females (54%, n=6,518). Overall, females have a higher notification rate (81 cases per 100,000) compared with males (70 per 100,000), which predominated across all ages except young children (under 10 years of age) and adults aged 75 years or over (Figure 79). The highest age-specific rates for females occurred in the 85 years or over age group (151 per 100,000) and for males in the 75–79 years age group (161 per 100,000). The lowest age-specific rates occurred in the 0–4 years age group for both males and females.

Figure 79: Notification rate for varicella zoster virus unspecified, Australia,* 2014, by age group and sex†



* Excluding New South Wales.

† Age of onset missing for 7 notifications and sex missing for 1 notification.

Chickenpox

- In 2014, there were 2,088 cases of chickenpox reported to the NNDSS, a 2% decrease from 2013 (n=2,127).
- Fifty-three per cent of notified chickenpox cases were male and 72% (n=1,501) occurred in children less than 14 years of age.

Chickenpox is a highly contagious infection spread by respiratory secretions, including aerosol transmission, or from the vesicle fluid of skin lesions from a patient with chickenpox or shingles infection. Chickenpox is usually a mild disease of childhood; however, complications occur in approximately 1% of cases. It is more severe in adults, and in persons of any age who are immunocompromised.[32]

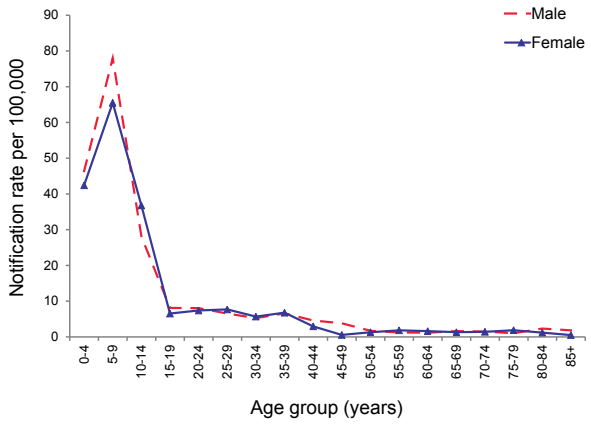
Epidemiological situation in 2014

In 2014, there were 2,088 cases of chickenpox reported, representing a notification rate of 13 per 100,000 population and a 2% decrease in the number of notifications compared with 2013 (n=2,127). The national notification rate of chickenpox has remained stable between 12 and 14 per 100,000 since 2009. The highest notification rate for chickenpox was reported in the Northern Territory (42 per 100,000) (Table 5).

Age and sex distribution

In 2014, 53% (n=1,103) of notified chickenpox cases were male and 72% (n=1,501) occurred in children less than 14 years of age (Figure 80). Consistent with recent years, children under the age of 10 years had the highest notification rates in 2014. Rates were highest in the 5–9 years age group at 72 per 100,000. Compared with 2013, age-group specific rates either declined or remained stable except for the 10–19 years age group which increased from 17 per 100,000 in 2013 to 20 per 100,000 in 2014 (Figure 81).

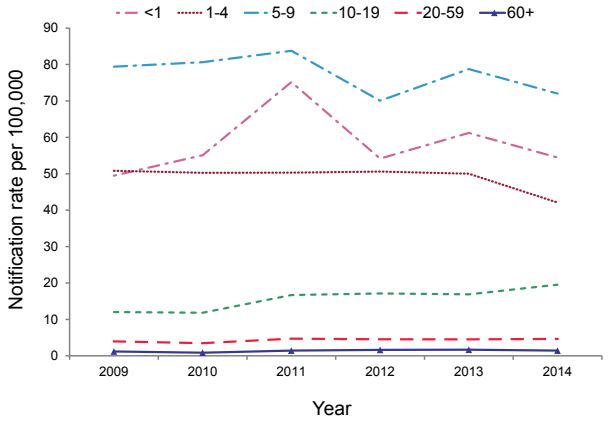
Figure 80: Notification rate for chickenpox, Australia,* 2014, by age group† and sex



* Excluding New South Wales.

† Age of onset missing for 57 notifications.

Figure 81: Notification rate for chickenpox, Australia,* 2009 to 2014, by year and selected age groups†



* Excluding New South Wales.

† Age of onset missing for 4 notifications in 2009, 10 notifications in 2010, 11 notifications in 2011, 22 notifications in 2012, 38 notifications in 2013 and 57 notifications in 2014.

Vaccination

Routine use of a varicella containing-vaccine in children was first recommended in Australia in 2003. In November 2005, the vaccine was funded under the NIP for all children at 18 months of age, with a school based catch-up program included for children 10 to 13 years of age with no history of disease or previous vaccination.

In 2014, the oldest cohort of children eligible for varicella vaccination at 18 months of age under the NIP would be 10 years of age. Of those eligible for vaccination (n=1,068), 41% (n=443) were vaccinated and 9% were unvaccinated (n=95) and the remaining 50% (n=530) were of unknown vaccinations status.

Shingles

- In 2014, there were 5,473 cases of shingles reported to the NNDSS, a 9% increase from 2013.
- Fifty-six per cent of notified shingles cases were female and rates were highest in the older age groups.

Shingles occurs most commonly with increasing age, impaired immunity, and a history of chickenpox in the first year of life.[32] Reactivation of VZV that causes shingles is thought to be due to a decline in cellular immunity to the virus. Shingles typically presents as a unilateral vesicular rash localised in a dermatomal distribution. Associated symptoms may include headache, photophobia, malaise, itching, tingling, or severe pain in the affected dermatome. In the majority of patients, shingles is an acute and self-limiting disease however, complications develop in approximately 30% of cases, the most common of which is chronic severe neuropathic pain or post herpetic neuralgia.[22]

A single dose of zoster vaccine is recommended for adults aged 60 years or over who have not previously received a dose of zoster vaccine. However, in 2014 this vaccination was not yet funded through the NIP. [32]

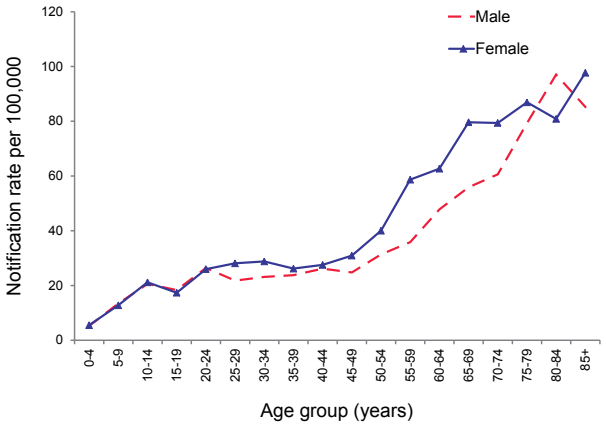
Epidemiological situation in 2014

In 2014, there were 5,473 cases of shingles reported, representing a notification rate of 34 per 100,000 and a 9% increase compared with 2013 (n=5,038). The highest rate of shingles occurred in South Australia, (121 per 100,000) followed by the Northern Territory, (100 per 100,000) (Table 5).

Age and sex distribution

In 2014, 56% (n=3,052) of notified shingles cases were female. As expected, notification rates increased with age, with the highest rates occurring in the 80 years or over age group across all reported years (Figure 82). Since 2009, rates in the adult age groups (greater than 20 years) have been rising, with the largest increase occurring in the 70–79 years age group with a 98% increase in rates between 2009 and 2014 (Figure 83). Rates among children and adolescents have been more stable, remaining below 20 per 100,000 since 2009.

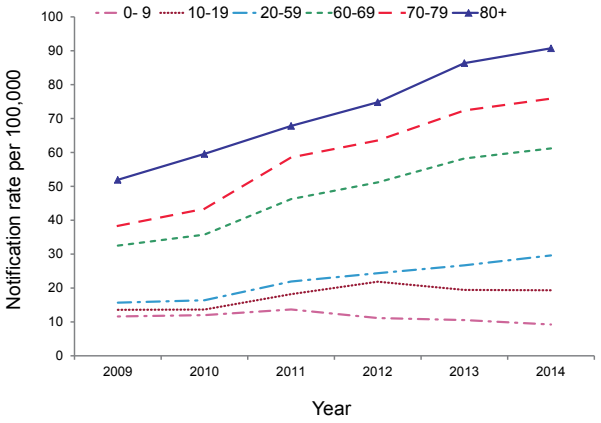
Figure 82: Notification rate for shingles, Australia,* 2014, by age group and sex†



* Excluding New South Wales.

† Age of onset missing for 59 notifications and sex missing for 1 notification.

Figure 83: Notification rate for shingles, Australia,* 2009 to 2014, by year and selected age groups†



* Excluding New South Wales

† Age of onset missing for 1 notification in 2009, 13 notifications in 2010, 18 notifications in 2011, 32 notifications in 2012, 59 notifications in 2013 and 59 notifications in 2014.

Vectorborne diseases

Vectorborne diseases are infections transmitted by arthropods such as mosquitoes and ticks. A vectorborne disease may involve a simple transfer via the arthropod, or may involve replication of the disease-causing organism in the vector.[22] Vectorborne diseases of public health importance in Australia listed in this chapter are: arbovirus not elsewhere classified (NEC); Barmah Forest virus (BFV) infection; dengue virus (DENV) infection; Japanese encephalitis virus (JEV) infection; infections with the Kunjin lineage of West Nile virus (KUNV, which is probably limited to the Australian mainland or possibly Papua New Guinea), and other lineages of West Nile virus (WNV), malaria, Murray Valley encephalitis virus (MVEV) infection and Ross River virus (RRV) infection. Some vectorborne diseases, including yellow fever virus infection, plague and certain viral haemorrhagic fevers, are listed under quarantinable diseases. The National Arbovirus and Malaria Advisory Committee (NAMAC) provides expert technical advice on vectorborne diseases to the Australian Health Principal Protection Committee through CDNA.

Alphaviruses

Viruses in the genus *Alphavirus* that are notifiable in Australia are BFV and RRV. These viruses are unique to the Australasian region.[107] Infection can cause a clinical illness, which is characterised by fever, rash and polyarthritis. The viruses are transmitted by numerous species of mosquito that breed in diverse environments.[108] The alphavirus chikungunya was not nationally notifiable in 2014, and thus not included in this annual report. However, it is notifiable in all states and territories except the Australian Capital Territory, and states and territories send information about cases to the Australian Government for national collation and analysis.[109,110] Chikungunya virus infection was made nationally notifiable in January 2015.

The national case definitions for RRV and BFV currently require only a single IgM positive test to 1 virus, in the absence of IgM to the other.[111] False positive IgM diagnoses for BFV in particular are a known issue, thus it is unclear what proportion of notifications represent true cases. Importantly, the case definitions were reviewed by the CDWG and endorsed by CDNA. The revised case definitions were implemented on 1 January 2016.

Barmah Forest virus infection

- The number of notifications and the notification rate decreased in 2014.
- Numbers and rates had previously increased in 2012 and 2013 due to false positive IgM diagnoses.

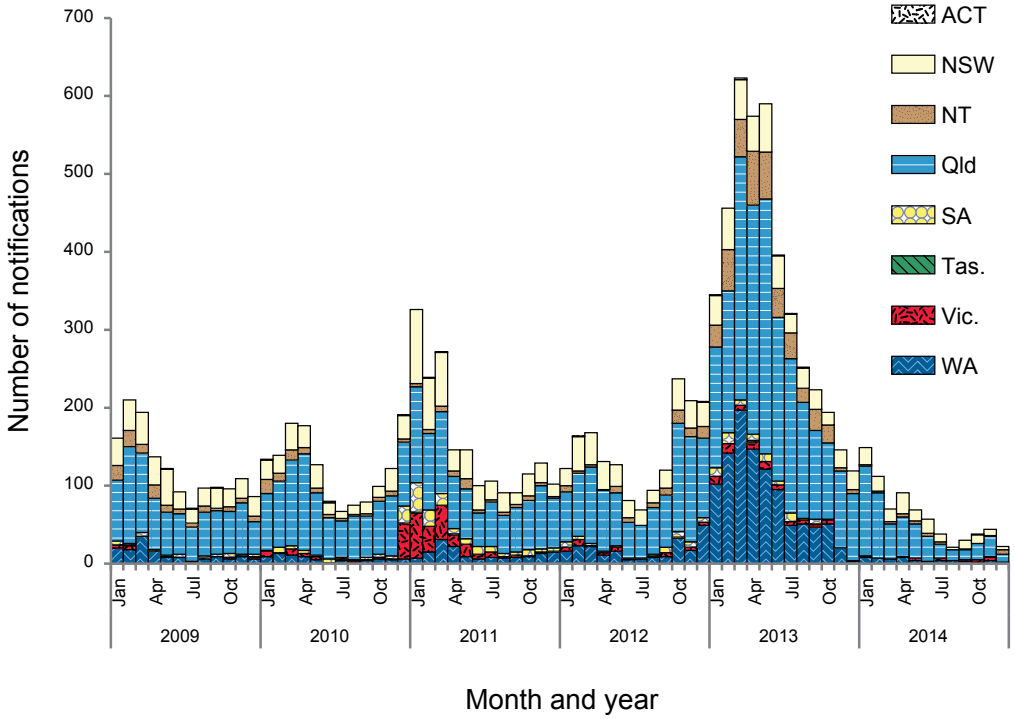
Epidemiological situation in 2014

In 2014, there were 741 notifications of BFV infection, representing a rate of 3.2 per 100,000. This compared with a 5-year mean of 2,155 notifications and a 5-year mean rate of 9.6 per 100,000. The number of notifications of BFV was dramatically decreased compared with 2013, when there were 4,239 notifications, representing a rate of 18.3 per 100,000 (Figure 84). This previous increase in 2013 was considered likely to have been due to a high rate of false positive IgM test results produced by a commercial test kit in private laboratories, and which resulted in a recall of the affected kits in September 2013.[112]

Geographic distribution

Comparisons between regions are likely to be influenced by the accuracy of case-ascertainment, which may vary between jurisdictions due to differences in reporting criteria and diagnostic tests used and seasonal trends vary between states and territories. More details are reported in the NAMAC annual reports.[110] More than half of all BFV notifications in 2014 were from Queensland (64%, 473) and population rates were highest in the Northern Territory (12.3 per 100,000) and Queensland (10.0 per 100,000). These rates were less than half the 5-year mean, with rate ratios of 0.2 and 0.5 respectively for the Northern Territory

Figure 84: Notifications of Barmah Forest virus infection, Australia, 2009 to 2014, by month and year and state or territory

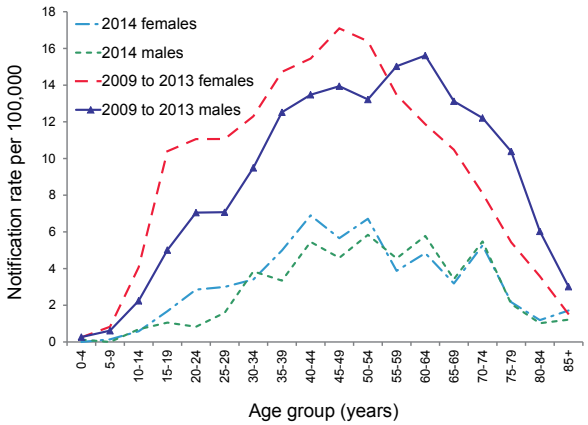


and Queensland for 2014 compared with the 5-year mean rate, noting that the 5-year mean rate is strongly affected by the increase between late 2012 and late 2013.

Age and sex distribution

In 2014, BFV infection was most frequently notified in people aged between 40 and 54 years (median 47 years, range 3 to 92 years). Age and sex specific rates were highest among females in the 40–44 and 50–54 years age groups (Figure 85). In 2014, 54% (403) of cases were female and rates were higher in females overall than in males (3.4 and 2.9 per 100,000 respectively).

Figure 85: Notification rates for Barmah Forest virus, 2014 and 2009 to 2013, by age group and sex



Seasonality

Peak incidence of BFV could be expected to occur during the warmer months (or during wetter months in northern areas of Australia) when mosquito numbers are high. However, seasonality of notifications is less marked than expected (Figure 84), and a high proportion of interseasonal notifications are thought to be due to false positive diagnoses. Peak notification of BFV in 2014 was between January and April, with 57% (422) of notifications being during this period, a stronger seasonality than observed between 2009 and 2012 (45%, 4,898/10,775) and 2013 (47% 1,998/4,239).

Discussion

The previously reported dramatic increase due to false positive IgM diagnoses declined in late 2013. In addition to the withdrawal of some affected batches of the test kit, the widely acknowledged unreliability of the IgM test kit may have led to a sustained decline in testing for BFV infection in private laboratories, which may not have an alternative diagnostic method to the IgM test kits. On recommendation from NAMAC, the CDWG undertook a review of the surveillance case definitions for BFV infection and for RRV infection. The CDNA surveillance case definition for BFV in 2014 allowed for confirmation based on a single positive IgM, in the absence of IgM to other alphaviruses. Under the revised case definition, a single IgM positive result will no longer constitute

laboratory evidence for infection, and where a single result is IgM and IgG positive, it may be notified as a probable case. A confirmed case will require IgG seroconversion or a significant increase in IgG antibody level (e.g. 4-fold or greater rise in titre). There is currently no plan to undertake a retrospective revision of notifications to apply the new case definitions because there is insufficient information on the diagnosis method information available in NNDSS. Therefore, the historical data prior to the upcoming change of case definition will continue to be considered unreliable. The new case definition was implemented from 1 January 2016.[111]

Ross River virus infection

- Notifications of RRV infections were similar to the 5-year mean.

Epidemiological situation in 2014

In 2014, there were 5,316 notifications of RRV, representing a rate of 22.6 per 100,000. This compares with a 5-year mean of 4801.0 cases and a 5-year mean rate of 21.5 per 100,000.

Geographic distribution

In 2014, similar to previous years, nearly half of all RRV infections were from Queensland (44%, 2,344), representing a rate of 49.6 per 100,000), but population rates were highest in the Northern Territory (168.4 per 100,000).

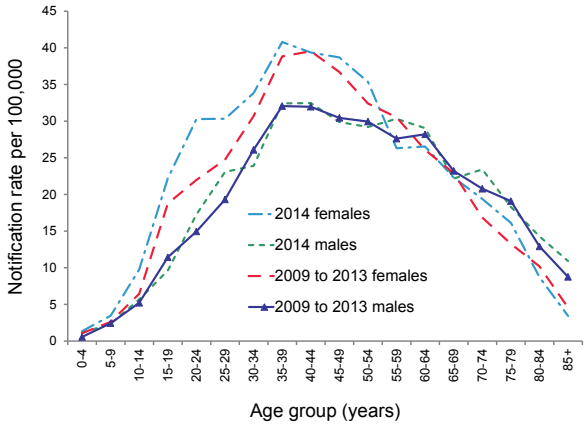
Age and sex distribution

RRV was most frequently reported in adults aged in their 30s or 40s (median 44 years, range 1 to 98 years), similar to previous years. Rates were similar in females and males (rates of 24.9 and 20.4 per 100,000 respectively for a rate ratio of 1.2), similar to previous years. In 2014, age specific rates were highest among females in the 35–49 years age group, and males in the 35–44 years age group (Figure 86).

Seasonality

The peak notification for RRV in 2014 was between January and April (Figure 87), and 39% (2,077) of cases were diagnosed during these months. Between 2009 and 2012, 58% (11,358/19,689) of notifications were between January and April, indicating that in 2014, similar to 2013,[37] the proportion of inter-seasonal notifications was higher than in previous years. It is important to note that seasonal trends vary between and within states and territories according to differences in mosquito vectors, hosts and climate. In addition, comparisons between regions are likely to be influenced by the accuracy of case-ascertainment, which may vary between jurisdictions because of some differences in reporting criteria and also quality of diagnostic tests used, with false positive IgMs a long term issue.[113,114]

Figure 86: Notification rates for Ross River virus, Australia, 2014, by age group and sex



Discussion

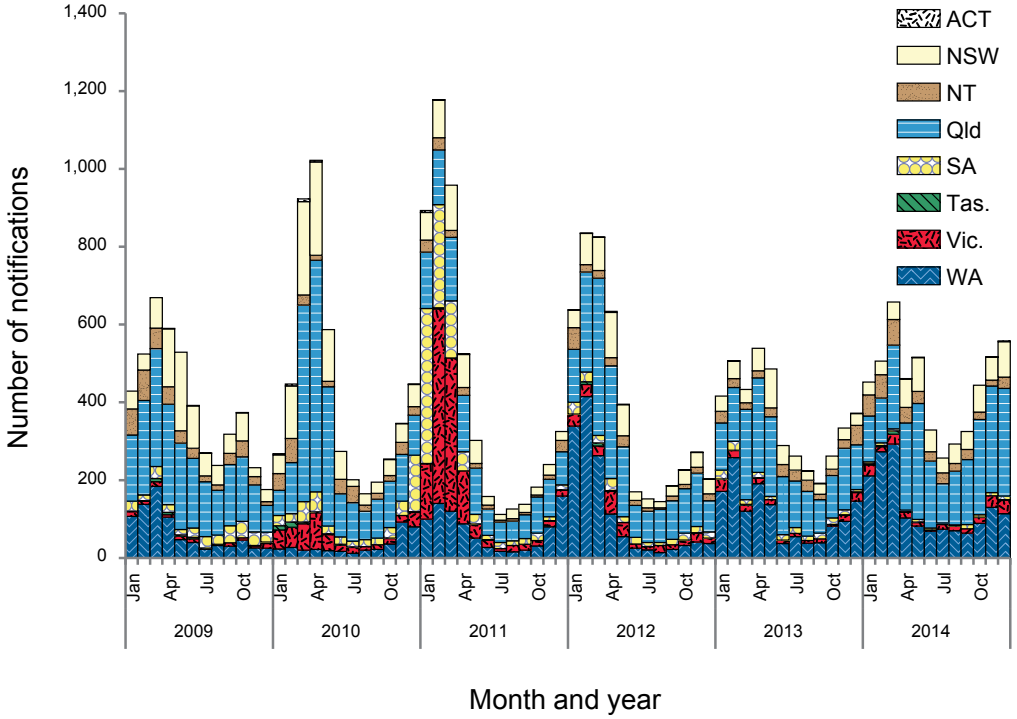
The CDNA surveillance case definition for RRV in 2014 allowed for confirmation based on a single positive IgM, in the absence of IgM to other alphaviruses, and there have been differences in laboratory and notification practices. Similar to BFV, there has been a widely acknowledged unreliability of diagnosis based on IgM-only, particularly during the off-season.[114] As mentioned under BFV, the case definition was reviewed by the CDWG. Under a revised definition a confirmed case requires IgG seroconversion or a significant increase in IgG antibody level (e.g. 4-fold or greater rise in titre). The revised definition was implemented on 1 January 2016.

Flaviviruses

No specific treatment is available for infections with the flaviviruses DENV, WNV/KUNV, MVEV or JEV and care is largely supportive. A vaccine is available to prevent JEV infection[32] and YFV infection, but there are no vaccines currently for DENV, MVEV or KUNV infection.

Infection with MVEV, KUNV or JEV is usually asymptomatic or produces a non-specific illness, but a small percentage of cases progress to encephalomyelitis of variable severity. *Culex annulirostris* is the major vector of MVEV, JEV and KUNV while *Aedes aegypti* is the major vector of DENV in Australia.

Figure 87: Notifications of Ross River virus, Australia, 2009 to 2014, by month and year and state or territory



The clinical illness for DENV infection illness is characterised by mild to severe febrile illness with fever, headache, muscle/joint pain and sometimes a rash. A minority of cases progress to severe dengue with haemorrhage and shock. DENV has 4 serotypes, each containing numerous genotypes. The serotypes isolated from returning travellers (and thus involved in local outbreaks) vary by year and geographical region. Infection with 1 serotype probably confers lifelong immunity to that serotype,[22] but subsequent infection with a different serotype is 1 factor thought to increase the risk of severe outcomes, along with the infecting serotype and genotype, and host factors.[22,115–117]

Arbovirus NEC /Flavivirus unspecified

- There were 28 of notifications arbovirus NEC in 2014.

Unspecified flavivirus infections are reported under arbovirus NEC. From 2015, arbovirus NEC has been renamed flavivirus unspecified.

Epidemiological situation in 2014

In 2014, there were 28 notifications of arbovirus NEC, compared with an average of 12.0 during the previous 5 years. Most notifications were from Queensland (22), with 5 from New South Wales and 1 from Victoria. These notifications comprised Kokobera (1 cases) and Zika virus (ZIKV) infection and probable ZIKV infection (16 cases) and 11 other notifications for which the infecting flavivirus could not be determined or was not supplied (Table 19). Of particular note were the 11 ZIKV and 1 probable ZIKV infections in March and April acquired in the Cook Islands and 1 in February acquired in Samoa. The first report of an outbreak of ZIKV in the South Pacific was through PacNet[118] in February 2013, and reported in the Cook Islands. Outbreaks were later reported in New Caledonia and French Polynesia and these continued to mid 2014.

Information about the country of acquisition was available for 93% of cases (26) and all of these were acquired overseas (Table 19).

The median age of cases was 39 years (range 18 to 79 years) and 46% of cases (13).

Dengue virus infection

- There was a continuing increase in the number of overseas acquired cases.
- There were 186 cases acquired in Australia in 2014, all of them acquired in North Queensland.

Local transmission of DENV in Australia is normally restricted to areas of northern Queensland where the key mosquito vector, *Ae. aegypti* is

Table 19: Notifications of arbovirus NEC, Australia, 2014, by country of acquisition and infecting species

Country of acquisition	Virus species				Total
	Kokobera	Zika	Zika (probable)*	Unspecified	
Australia	1	0	0	0	1
Central and West Africa, nfd	0	0	0	1	1
Cook Islands	0	10	1	1	12
Fiji	0	0	0	1	1
French Polynesia	0	1	0	0	1
Indonesia	0	0	0	2	2
Maldives	0	1	0	0	1
Papua New Guinea	0	0	0	2	2
Philippines	0	0	0	1	1
Samoa	0	1	0	0	1
Sub-Saharan Africa, nfd	0	0	0	1	1
Thailand	0	1	0	0	1
Vanuatu	0	0	0	1	1
Unknown	0	1	0	1	2
Total	1	15	1	11	28

nfd Not further defined.

* This case was a confirmed flavivirus infection, and there was some laboratory evidence of the infecting species being Zika virus, but this was not conclusive.

present.[119] DENV is not endemic in North Queensland, but local transmission can occur upon introduction of the virus to the mosquito vector by a viraemic tourist or a resident returning from a dengue-affected area overseas.[120]

Epidemiological situation in 2014

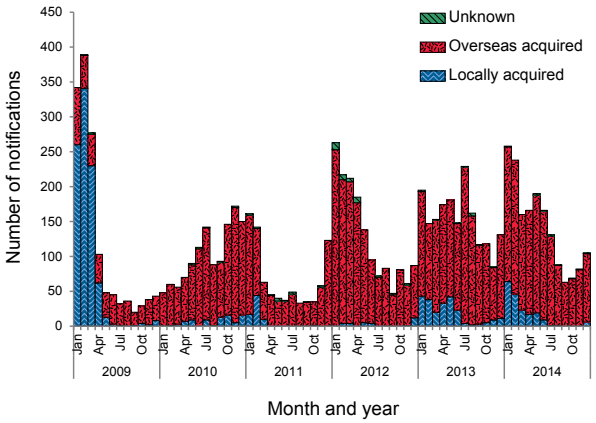
There were 1,716 notifications of DENV infection in 2014, which was 1.3 times the 5-year mean of 1,366.4 notifications. Most infections were known to have been acquired overseas (n=1,520) (Figure 88). There were 186 infections acquired in Australia. For 10 cases, no information was supplied on the place of acquisition.

Geographic distribution

More than 99% (1,706) of notifications in 2014 contained complete information on the place of acquisition. Overseas acquired infections comprised 89% of notifications (1,520) (Table 20). The number of overseas-acquired infections was slightly lower than in 2013 (n=1,596), which was the largest number ever reported (Table 21).

Cases acquired in Indonesia continue to account for the largest number and proportion of all notifications, accounting for 53% (811/1,520) of all overseas-acquired cases in 2014 (Table 21). This was similar to the percentage in 2012 and 2013. The serotype of DENV infections acquired in Indonesia, where known, was frequently serotype 2 or 3 although data completeness for serotype was very low. Other frequently reported source countries in 2014 included Thailand, Fiji and Malaysia.

Figure 88: Notifications of dengue virus infection, Australia, 2009 to 2014, by month and year and place of acquisition



In Queensland, a single case of locally acquired DENV infection is considered an outbreak. All of the of the 186 locally acquired cases in 2014 were reported in NNDSS to have been associated with 1 of the outbreaks of locally acquired infection in Queensland in 2014 and/or acquired in North Queensland and reported by other states or territories.

Table 20: Notified cases of dengue virus, Australia, 2014, by serotype and place of acquisition

Place of acquisition	Serotype						Unknown/ untyped	Total
	DENV 1	DENV 1 and 3	DENV1 And 4	DENV 2	DENV 3	DENV 4		
Locally-acquired								
Australia	130	0	0	0	1	0	55	186
Overseas-acquired								
Indonesia	267	2	0	70	52	21	399	811
Thailand	16	0	0	19	1	7	96	139
Fiji	2	0	0	9	25	0	70	106
Malaysia	8	0	0	16	2	2	53	81
Philippines	5	0	0	11	2	6	42	66
Sri Lanka	7	0	0	1	0	2	30	40
India	2	0	0	5	1	1	29	38
Timor-Leste	12	0	0	0	4	0	20	36
Vanuatu	1	0	1	0	12	1	18	33
Singapore	8	0	0	0	0	0	7	15
Tonga	0	0	0	0	3	0	12	15
Vietnam	1	0	0	4	0	1	9	15
Nauru	0	0	2	0	5	0	4	11
Papua New Guinea	0	0	0	3	4	0	4	11
Cambodia	0	0	0	1	0	1	8	10
French Polynesia	2	0	0	0	0	0	8	10
Other countries	6	0	2	9	2	0	61	80
Overseas-country unknown	0	0	0	0	0	0	3	3
Total overseas-acquired	337	2	5	148	113	42	873	1,520
Unknown								
Place of acquisition unknown	4	0	0	1	0	0	5	10
Total	471	2	5	149	114	42	933	1,716

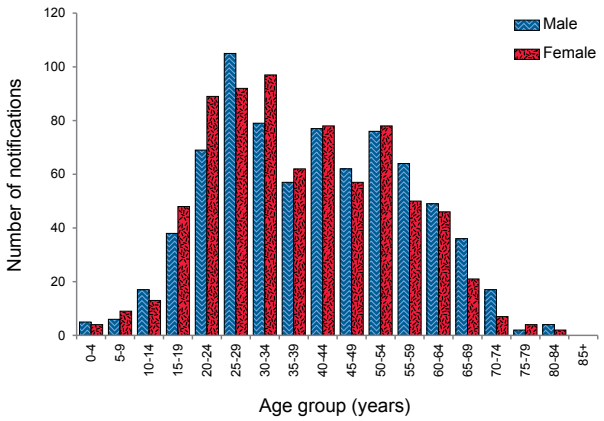
Table 21: Notifications of dengue virus infection acquired overseas, Australia, 2009 to 2014, by selected countries of acquisition

Country of acquisition	Year of diagnosis						Total
	2009	2010	2011	2012	2013	2014	
Indonesia	172	717	461	804	801	811	3,766
Thailand	25	124	84	279	269	139	920
Fiji	8	1	6	32	14	106	167
Malaysia	16	17	21	20	53	81	208
Philippines	9	42	24	55	63	66	259
Sri Lanka	0	4	12	26	28	40	110
India	15	43	31	60	58	38	245
Timor-Leste	25	37	12	52	49	36	211
Vanuatu	10	4	0	0	5	33	52
Singapore	1	4	5	3	18	15	46
Tonga	15	1	0	0	0	15	31
Vietnam	20	34	14	21	25	15	129
Papua New Guinea	13	21	15	16	35	11	111
Nauru	0	0	0	0	0	11	11
French Polynesia	3	0	0	0	5	10	18
Cambodia	5	11	6	31	31	10	94
Other/unknown countries	137	80	42	76	142	83	560
Total	474	1,140	733	1,475	1,596	1,520	6,939

Age and sex distribution

DENV infections acquired overseas in 2014 were most commonly reported among younger and middle aged adults (median 38 years, range 0 to 83 years), with a slight peak of notifications among females aged 25–34 years and males aged 25–29 years (Figure 89). Females comprised 50% (757) of overseas acquired cases.

Figure 89: Notifications of overseas-acquired dengue virus infection, 2014, by age group and sex (n=1,520)

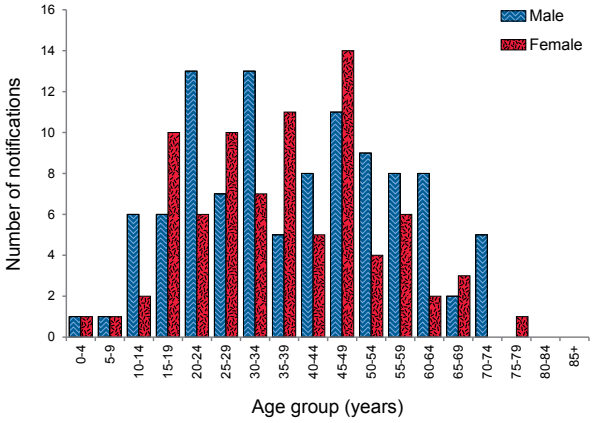


Locally acquired cases peaked in several adult age groups, but was less common among people aged less than 15 years or more than 64 years (Figure 90). The median age of locally-acquired cases was 38 years (range 1 to 75 years). Females comprised 45% (83/186) of locally-acquired cases.

Seasonality

In 2014, the largest number of overseas-acquired cases were diagnosed in January (193 cases) and the lowest number in September and October (63 and 68 cases respectively), but there is no consistent pattern of seasonality from year to year (Figure 88). For locally acquired cases, only 11 cases were reported between June and November demonstrating that there is no on-going local transmission of dengue during the cooler months and that DENV is not endemic in North Queensland.

Figure 90: Notifications of dengue virus infection acquired in Australia, 2014, by age group and sex (n=186)



Microbiological trends

In 2014, serotype information was available for 46% of notifications (783/1,716), which was a decrease compared with the 5-year mean of 53% (Table 22). In 2014, 60% (471/783) of cases with a known serotype were due to DENV 1, similar to 2013, but in contrast to 2012 when DENV2 was more frequently reported, noting the low completeness (Table 22).

Discussion

The number of overseas-acquired cases reported in Australia has tended to increase each year, although numbers in 2014 were lower than the previous year. In recent years, improved diagnostic techniques,

Table 22: Serotype of dengue virus infections, Australia, 2009 to 2014

Serotype	2009	2010	2011	2012	2013	2014
DENV1	82	190	140	138	507	471
DENV 1 and DENV 3	0	0	0	0	0	2
DENV 1 and DENV 4	0	0	0	1	0	5
DENV 2	54	255	159	477	179	149
DENV 3	771	106	78	113	142	114
DENV 4	43	47	43	16	55	42
Untyped/unknown	452	630	401	796	957	933
Total	1,402	1,228	821	1,541	1,840	1,716
% with a serotype supplied	68	49	51	48	48	46

in particular the availability of the rapid non-structural protein 1 (NS1) antigen detection kit, have improved detection and would have contributed to the observed increase in reported numbers of overseas-acquired dengue in Australia.[121] The dramatic re-emergence and geographical expansion of DENV overseas over the past 50 years with explosive outbreaks,[117] as well as increases in the number of Australians travelling overseas each year to DENV endemic countries, particularly tourist destinations such as Bali, Indonesia would also have contributed to this increase.

While local outbreaks of DENV infection occur during the warmer months in North Queensland, each outbreak since 2010 has been relatively small, and prompt and effective responses by public health authorities in Queensland have ensured that the disease has not become endemic.

The number of DENV infections that are serotyped continues to decline. The decreased reporting of a serotype may reflect the increasing use of NS1 antigen detection and/or other diagnostic methods, which do not provide a serotype.

Japanese encephalitis virus infection

- In 2014, there was 1 notification of JEV.

Epidemiological situation in 2014

There was 1 notification of JEV infection in 2014, which was reported to have been acquired in Indonesia. There were 4 notifications in 2013, all of which were acquired overseas. The last locally acquired case was in 1998.[122]

West Nile virus/Kunjin virus infection

- In 2014, there was 1 notification of WNV/KUNV.

Epidemiological situation in 2014

There was 1 notification of WNV/KUNV infection in 2014, which was reported to have been acquired in Indonesia. This overseas-acquired case was likely to be from a WNV lineage other than the KUNV lineage due to the limited range of KUNV. There were 2 notifications of WNV/KUNV infection in 2013 (previously published as 3 notifications[37] but this number has since been updated).

Murray Valley encephalitis virus infection

- In 2014, there was 1 notification of MVEV.
- MVEV is rare disease in Australia, but may also be acquired overseas in the region.

Epidemiological situation in 2014

There were no notifications of MVEV infection in 2014. MVEV is a rare disease in Australia with a 5-year mean of 4.4 cases.

The largest number of cases in recent years was in 2011, when 16 cases were reported, including an outbreak in south-east Australia, and these have been described elsewhere.[123–126]

Malaria

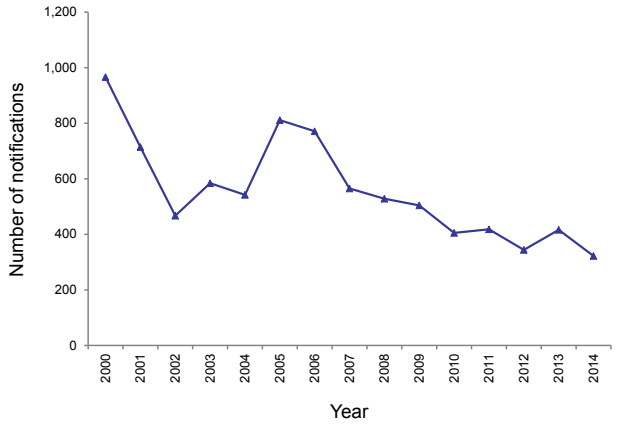
- There were 322 notifications of malaria in 2014, all were acquired overseas.
- The gradual decline observed since 2005 is continuing.

Malaria is caused by a protozoan parasite in the genus *Plasmodium*, and 5 species are known to infect humans; *Plasmodium vivax, P. falciparum, P. malariae, P. ovale* and *P. knowlesi*.[22,127] Malaria is a serious acute febrile illness that is transmitted from person-to-person via the bite of an infected mosquito of the genus *Anopheles*. Australia is free of endemic malaria as declared in 1981,[128] but suitable vectors are present in northern Australia, and the area remains malaria-receptive. Malaria is the most frequently reported cause of fever in returned travellers worldwide.[129] A case series in the Northern Territory showed that malaria cases were reported in travellers returning from endemic areas, but also reflected current events such as military operations and increased refugee arrivals from malaria endemic areas.[130] Malaria cases in Australia can be found either through testing of symptomatic persons with a compatible travel history, or through screening of refugees who may be asymptomatic, and people may be tested for other reasons.

Epidemiological situation in 2014

There were 322 cases of malaria notified in Australia in 2014, a 23% decrease compared with a 5-year mean of 417.4 cases, and continuing the trend of gradually decreasing notifications since 2005 (Figure 91). The largest number of cases was reported by Queensland (86 cases).

Figure 91: Notifications of malaria, Australia 2000 to 2014, by year

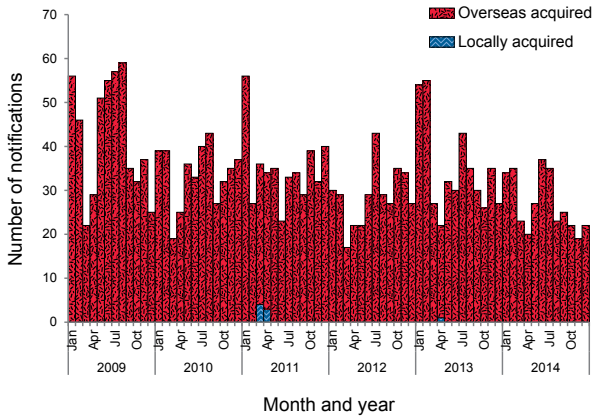


Geographic distribution

Malaria in Australia is a disease associated with residing or travelling overseas in areas with endemic transmission. The last cases acquired on mainland Australia were during an outbreak in North Queensland in 2002.[131] Limited transmission occurs occasionally in the Torres Strait following importation, with the most recent being a single case in 2013 acquired on Saibai Island in the Torres Strait and 7 locally acquired cases in the Torres Strait in 2011.

All cases of malaria notified in 2014 were known to have been acquired overseas; however, for 12 cases (4%) the country of acquisition information was incomplete or missing. The most frequent countries of acquisition for overseas acquired cases in 2014 were India (13%, 39/310 of cases with complete information) and Papua New Guinea (10%, 31/310) (Table 23) (Figure 92). Most cases acquired in Papua New Guinea were reported by Queensland (19/31 cases).

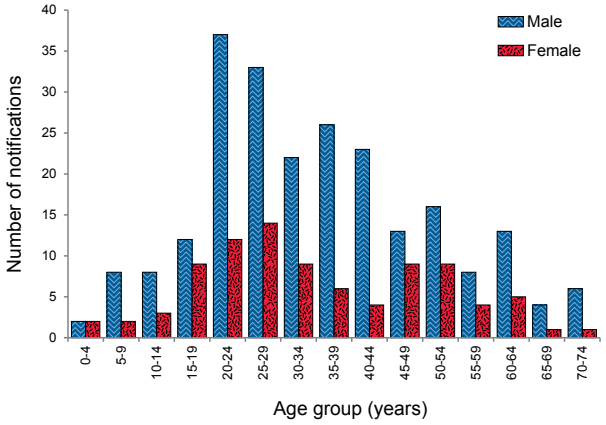
Figure 92: Notifications of malaria, Australia, 2009 to 2014, by month and year and place of acquisition



Age and sex distribution

In 2014, malaria was most commonly reported in males (72%, 232 cases) with a peak of notifications in males in the 25–29 years age group (Figure 93). The median age of cases was 32 years (range 2 to 72 years).

Figure 93: Notified cases of malaria, Australia, 2014, by age group and sex (n=321)*



* Age was not reported for 1 case and this case is excluded.

Seasonality

Increases in notifications or an observable pattern of seasonality in a predominantly overseas-acquired infection can relate to the seasonality of travel patterns, or to local disease epidemiology in the source countries. In 2014, while there were some fluctuations in monthly notifications, there was no clear pattern of seasonality, with notifications ranging between 19 and 37 per month.

Microbiological trends

The infecting species was supplied for 95% (307/322) of cases in 2014 (Table 23). The most frequent infecting species was *P. falciparum* (reported in 51% of cases with complete information). *P. vivax* was associated with Asia and the Pacific, whilst most cases acquired in African countries were *P. falciparum*.

Zoonoses

Overview

Zoonoses are those infectious diseases that are naturally transmitted between vertebrate animals and humans.[132] Approximately 60% to 70% of emerging

Table 23: Notified cases of malaria, Australia 2014, by infecting species and region and country of acquisition

Country	*P. falciparum*	*P. malariae*	*P. ovale*	*P. vivax*	*P.* species	Total
Oceania						
Papua New Guinea	7	1	0	22	1	31
Solomon Islands	0	0	0	4	1	5
North Africa and the Middle East						
Egypt	0	1	0	0	0	1
Sudan	23		3	2	1	29
Western Sahara	1	0	0	0	0	1
South Sudan	3	0	0	0	0	3
United Arab Emirates	1	0	0	0	0	1
South-east Asia						
Myanmar, The Republic of the Union of	0	0	0	1	0	1
Cambodia	0	0	0	4	0	4
Laos	0	0	0	1	0	1
Thailand	0	0	0	1	0	1
Brunei Darussalam	0	1				1
Indonesia	5	0	2	14	1	22
Malaysia	1	0	0	0	0	1
North-east Asia						
China (excludes SARs and Taiwan)	0	0	0	1	0	1
Korea, Republic of (South)		0	0	1	0	1
Southern and Central Asia						
India	0	0	0	35	4	39
Pakistan	0	0	0	12	2	14
Afghanistan	0	0	0	1	0	1
Peru	1	0	0	1	0	2
Sub-Saharan Africa						
Sub-Saharan Africa, nfd	5	2	0	0	1	8
Central and West Africa, nfd	1	0	0	0	0	1
Burkina Faso	0	0	1	0	0	1
Cameroon	1	0	0	0	0	1
Chad	1	0	0	0	0	1
Congo, Republic of	5	0	0	0	0	5
Congo, Democratic Republic of	1	0	0	0	0	1
Cote d'Ivoire	1	0	1	0	0	2
Gabon	1	0	0	0	0	1
Ghana	13	0	1	1	0	15
Guinea	1	0	0	0	0	1
Guinea–Bissau	1	0	0	0	0	1
Liberia	3	1	0	0	0	4
Mali	3	0	0	0	0	3
Nigeria	5	0	0	0	0	5
Sierra Leone	12	0	3	0		15
Togo	2	0	0	0	0	2

Table 23 *continued*: Notified cases of malaria, Australia 2014, by infecting species and region and country of acquisition

Country	*P. falciparum*	*P. malariae*	*P. ovale*	*P. vivax*	*P.* species	Total
Southern and East Africa						
Southern and East Africa, nfd	1	0	0	0	0	1
Burundi	1	0	0	0	0	1
Eritrea	0	0	2	1	0	3
Ethiopia	2	0	0	3	0	5
Kenya	12	2	2	0	1	17
Malawi	1	0	0	0	0	1
Mozambique	2	0	1	0	0	3
Rwanda	1	0	0	0	0	1
South Africa	2	0	0	0	0	2
Tanzania	11	0	0	0	1	12
Uganda	10	3	2	4	0	19
Zambia	7	0	3	0	0	10
Zimbabwe	3	0	0	0	0	3
Southern and East Africa, nec	4	0	0	0	1	5
Overseas acquired – country and region not stated						
Unknown/invalid	2	0	1	6	0	9
Overseas-country unknown	1	0	0	1	1	3
Total	158	11	22	116	15	322

nfd Not further defined.

human infectious diseases are zoonoses[133–135] and more than 70% of emerging zoonoses originate from wildlife.[134] An emerging zoonosis is defined by WHO as "a zoonosis that is newly recognised or newly evolved, or that has occurred previously but shows an increase in incidence or expansion in geographical, host or vector range".[136]

The zoonoses notifiable to the NNDSS included in this chapter are: anthrax, Australian bat lyssavirus (ABLV) or lyssavirus (unspecified) infection, brucellosis, leptospirosis, ornithosis, Q fever, and tularaemia.

Several zoonoses notifiable to the NNDSS are included under other headings in this report. For example, salmonellosis and campylobacteriosis are typically acquired from contaminated food and are listed under the gastrointestinal diseases section. Rabies is listed under Quarantinable diseases.

Anthrax

- There were no cases of anthrax notified in 2014.

Anthrax is caused by the bacterium *Bacillus anthracis* and most frequently causes cutaneous infection. However, it can also cause gastrointestinal and respiratory infections. Anthrax is primarily a disease of herbivores; humans and carnivores are incidental hosts. It can be an occupational hazard for veterinarians, and agriculture, wildlife and livestock workers who handle infected animals or by-products.

In Australia, the areas of anthrax risk are well defined and include the northern and north-eastern districts of Victoria and central New South Wales.[137] Anthrax occurs only sporadically in livestock in the at-risk areas. Rare or isolated incidents or cases in animals have historically occurred in Queensland, South Australia, Tasmania and Western Australia.[137]

Epidemiological situation in 2014

In 2014, there were no notified cases of anthrax in Australia. Over the previous 10 years, only 3 human cases of anthrax were reported in Australia in 2006, 2007 and 2010.[138–140] All had domestic farm or animal related exposures and all were cutaneous anthrax. Australia has never recorded a human case of inhalational or gastrointestinal anthrax.

There was 1 anthrax incident reported in livestock in Australia in 2014. It occurred on a property located within the known New South Wales anthrax endemic area.[137]

Australian bat lyssavirus and lyssavirus (unspecified)

- No cases of ABLV notified in 2014.

ABLV belongs to the genus lyssavirus, which also includes the rabies virus. Both invariably result in progressive, fatal encephalomyelitis in humans.[141] ABLV was first identified in Australia in 1996[142,143] and is present in several Australian species of bats (including flying foxes and microbats). Australia is free of terrestrial rabies.

The best way to prevent ABLV infection is to avoid contact with bats. For people whose occupation (including volunteer work) or recreational activities place them at increased risk of being exposed to ABLV, rabies virus vaccine is effective in preventing infection. Pre-exposure vaccination with rabies virus vaccine is recommended for bat handlers, veterinarians and laboratory personnel working with live lyssaviruses.[144] Post-exposure prophylaxis for ABLV consists of wound care and administration of a combination of rabies virus vaccine and human rabies virus immunoglobulin, depending on exposure category and prior vaccination or antibody status.[32,144]

Epidemiological situation in 2014

In 2014 there were no notified cases of ABLV or lyssavirus (unspecified) infection in Australia.

There have been 3 cases of ABLV infection recognised in humans in Australia, with single cases notified in each of 1996, 1998 and 2013. All 3 cases occurred following close contact with an infected bat in Queensland and all were fatal.[145–147] In 2013, the Queensland Department of Agriculture, Fisheries and Forestry confirmed the first known equine cases of ABLV infection in 2 horses on a Queensland property.[148,149]

The bat health focus group of Wildlife Health Australia (formerly the Australian Wildlife Health Network) gathers and collates information from a range of organisations on opportunistic testing of bats for ABLV. In 2014 there were 32 ABLV detections in bats compared with 14 detections during 2013.[150]

Brucellosis

- In 2014, 17 cases of brucellosis were notified to the NNDSS.

Brucellosis is characterised by a fever of variable duration with a range of other symptoms including headache, weakness, profuse sweating, chills, arthralgia, depression, weight loss and generalised aching.[22] *Brucella* species that can cause illness in humans include *Brucella melitensis* acquired from sheep and goats, *Brucella suis* from pigs and *Brucella abortus* from cattle. *B. abortus* was eradicated from Australian cattle herds in 1989 and *B. melitensis* has never been reported in Australian sheep or goats.[137] Therefore, all cases of *B. melitensis* or *B. abortus* in Australia are related to overseas travel. *B. suis* is confined to some areas of Queensland, where it is known to occur in feral pigs. Eales et al (2010)[151] found that feral pig hunting was the most common risk factor for brucellosis in Townsville during 1996 to 2009.

Internationally, brucellosis is mainly an occupational disease of farm workers, veterinarians, and abattoir workers who work with infected animals or their tissues.[22]

Epidemiological situation in 2014

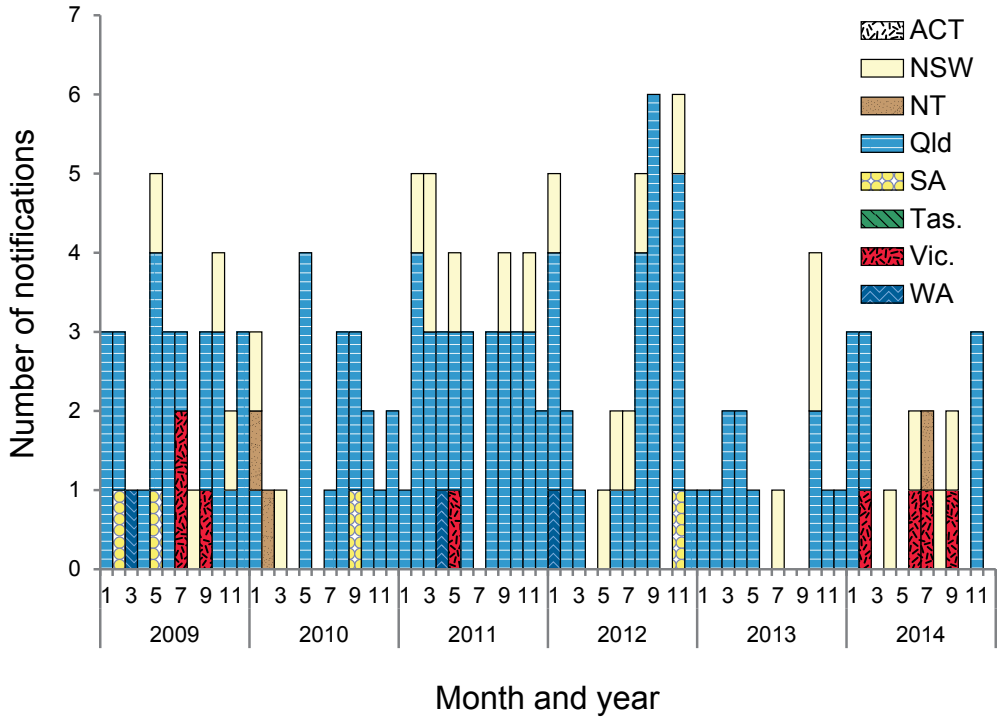
In 2014, there were 17 notified cases of brucellosis in Australia (0.1 per 100,000), representing a 37% decrease compared with the 5-year (2009 to 2013) mean (n=27).

Geographical distribution

Just under half of notified cases (47%, 8) were Queensland residents (Figure 94), with a state-specific notification rate of 0.2 per 100,000 and since 1991, 82% of notifications have been Queensland residents.

The species of the infecting organism was available for 71% (12/17) of notified cases in 2014. There were 3 cases of *B. suis,* all from Queensland, and all males aged between 30 and 46 years. There were 9 cases of *B. melitensis*, with the countries of acquisition listed as India (n=4), Iraq (n=2), Lebanon (n=1), Pakistan (n=1) and Sudan (n=1). The 5 remaining cases where the infecting organism was not specified, were all acquired in Australia.

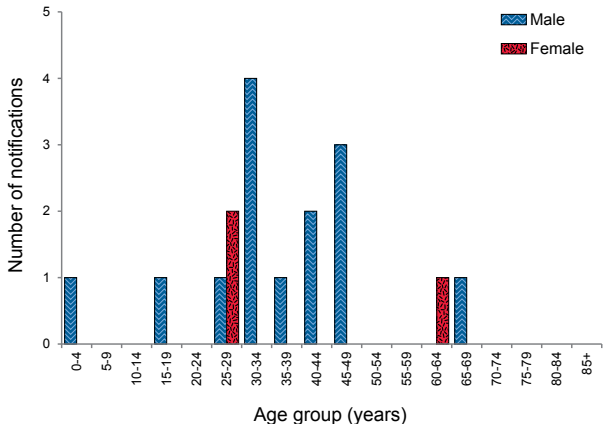
Figure 94: Notifications of brucellosis, Australia, 2009 to 2014, by month and year of diagnosis and state or territory



Age and sex distribution

The majority of notified cases (76%, 13/17) were aged between 25 and 49 years (Figure 95). In 2014, the median age of notified brucellosis cases was 34 years (range 3 to 66 years) and 82% (14) were male.

Figure 95: Notifications of brucellosis, Australia, 2014, by age group and sex



Leptospirosis

- In 2014, 88 cases of leptospirosis were notified to the NNDSS.

Leptospirosis can cause a variety of illnesses varying in severity from a mild influenza-like illness to Weil's syndrome, meningitis or pulmonary haemorrhage with respiratory failure possibly leading to death.[22] Leptospirosis is caused by spirochaetes of the genus *Leptospira,* which is found in the genital tract and renal tubules of domestic and wild animals. In affected areas, where there is exposure to infected urine of domestic and wild animals, this disease can be an occupational and recreational hazard (such as in certain agricultural sectors and swimming or wading in contaminated water).[152,153] The last reported death in Australia attributed to leptospirosis was in 2002.[154]

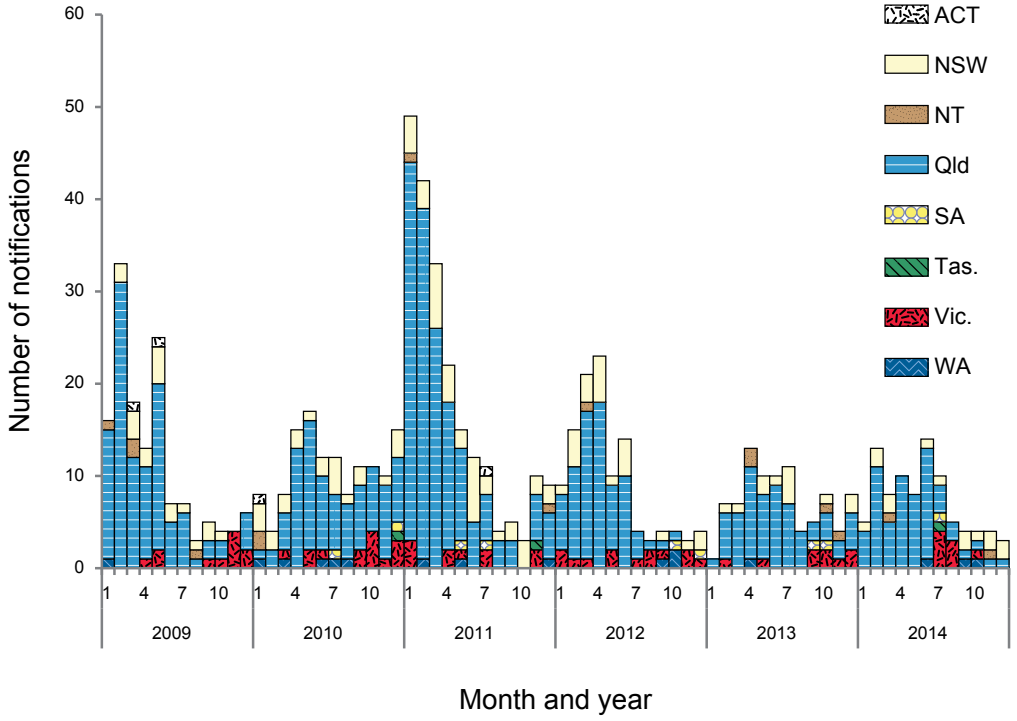
Epidemiological situation in 2014

In 2014, there were 88 notified cases of leptospirosis in Australia (0.4 per 100,000), which was a 36% decrease compared with the 5-year mean (2009 to 2013) (n=138).

Geographical distribution

Over two-thirds (67%, 59) of notified cases were Queensland residents (Figure 96), with a state-specific notification rate of 1.2 per 100,000.

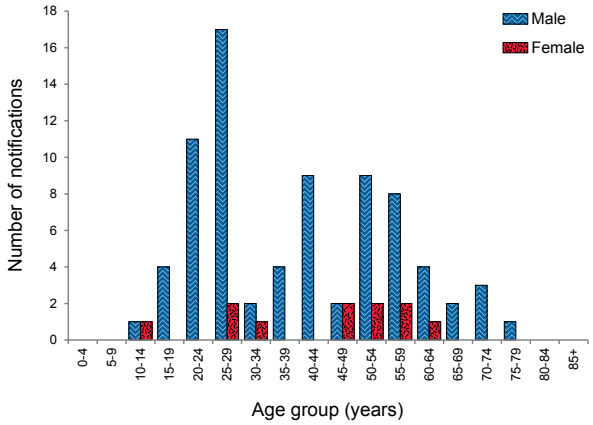
Figure 96: Notifications of leptospirosis, Australia, 2009 to 2014, by month and year of diagnosis and state or territory



Age and sex distribution

The highest counts were observed in males in the 25–29 years age group (n=17) (Figure 97). In 2014, the median age of notified leptospirosis cases was 40 years (range 13 to 78 years) and 82% (72) were male.

Figure 97: Notifications of leptospirosis, Australia, 2014, by age group and sex



Microbiological trends

The WHO/Food and Agriculture Organization/ World Organisation for Animal Health Collaborating Centre for Reference and Research on Leptospirosis (Leptospirosis Reference Laboratory, Queensland) routinely conducts PCR-based serotyping for leptospirosis cases from Queensland (from whence the majority of cases are reported), and collates national data that may be submitted to the laboratory from other states or territories. At the time of compiling this report, data for 2014 were not publicly available.

In Australia, serotyping is only conducted on pathogenic *Leptospira* species of which typing information was available for 72% (56/78) of these cases. The most frequently reported serovars were *L. interrogans* serovar Zanoni (23%, n=18), *L. borgpetersenii* serovar Arborea (15%, n=12) and *L. interrogans* serovar Australis (15%, n=12). In 2013, *L. interrogans* serovar Arborea was the most frequently reported serovar (13/78).

Ornithosis

- In 2014, 41 cases of ornithosis were notified to the NNDSS.

Ornithosis (or psittacosis) is a pneumonia-like illness caused by infection with the bacterium *Chlamydophila psittaci*.[22] It is transmitted to humans primarily from infected psittacines, but transmission to humans has also been known to occur from poultry and a range of other birds.[155]

Transmission to humans occurs via the inhalation of contaminated dried faeces, nasal or eye secretions and dust from the feathers. Individuals at risk of contracting ornithosis include bird owners and those with occupational exposure to birds.[156]

Epidemiological situation in 2014

In 2014 there were 41 notified cases of ornithosis in Australia (0.2 per 100,000), which was a 34% decrease compared with the 5-year mean (2009 to 2013) (n=62).

Geographical distribution

Similar to previous years, more than half of the 2014 notifications were Victorian residents (51%, 21) (Figure 98).

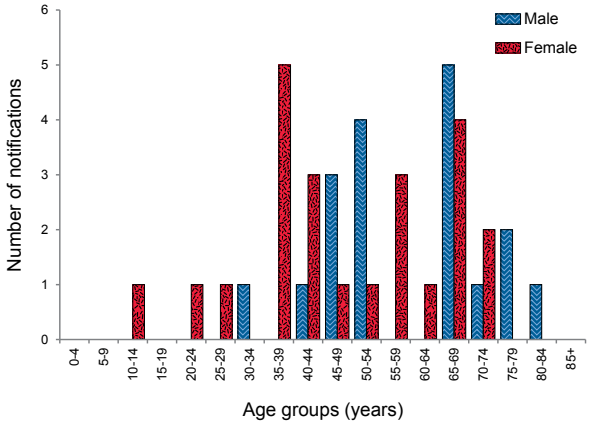
Age and sex distribution

In 2014, the median age of ornithosis notifications was 53 years (range 11 to 80 years) and 56% (23) were female (Figure 99).

Q fever

- In 2014, 469 cases of Q fever were notified to the NNDSS.
- 75% of notified cases were male.

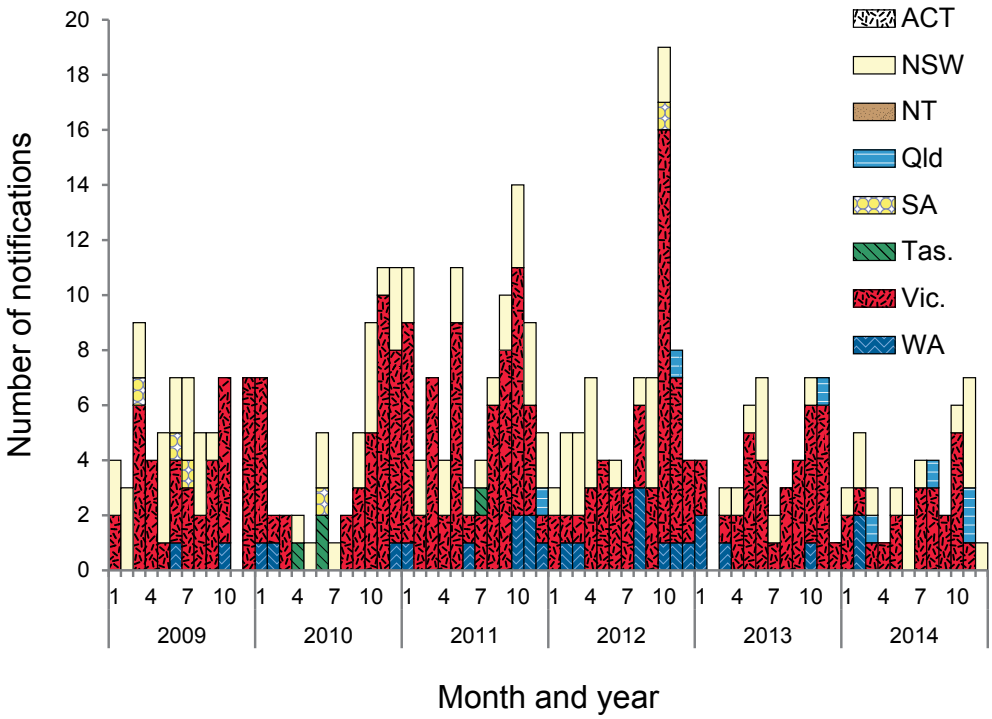
Figure 99: Notifications of ornithosis, Australia, 2014, by age group and sex



Q fever is caused by infection with the bacterium *Coxiella burnetii*. The primary reservoirs of these bacteria are cattle, sheep and goats. *C. burnetii* is resistant to environmental conditions and many common disinfectants.[157] Q fever is most commonly transmitted via the airborne route, where the organism is carried in dust contaminated with tissue, birth fluids or excreta from infected animals.[158] Prior to the commencement of vaccination programs in Australia, approximately half of all cases in New South Wales, Queensland and Victoria were among abattoir workers.[159,160]

The Australian Government funded the National Q Fever Management Program (NQFMP)

Figure 98: Notifications of ornithosis, Australia, 2009 to 2014, by month and year of diagnosis and state or territory



between 2001 and 2006 for states and territories to provide free vaccine to at-risk occupational groups (such as abattoir workers).[161]

Adults at risk of Q fever infection, including abattoir workers, farmers, veterinarians, stockyard workers, shearers and animal transporters should be considered for vaccination. The administration of the Q fever vaccine requires a pre-vaccination screening test to exclude those recipients with a previous (possibly unrecognised) exposure to the organism, including previous vaccination. A Q fever vaccine may cause an adverse reaction in a person who has already been exposed to the bacterium. Vaccination is not recommended for children under 15 years of age or pregnant females.[32]

Epidemiological situation in 2014

In 2014, there were 469 notified cases of Q fever in Australia (2.0 per 100,000), which was a 26% increase compared with the 5-year mean (2009 to 2013) (n=373).

Geographical distribution

Between 1991 and 2001, and prior to the introduction of the NQFMP, Q fever notification rates ranged between 2.5 and 4.9 cases per 100,000.[161] In 2014, the highest notification rate was in Queensland (5.1 per 100,000, n=240). Cases were reported in all jurisdictions except Tasmania (Figure 100).

'Hot spots' for Q fever occur in central Queensland and in the areas that border Queensland and New South Wales, with rates in those areas reaching as high as 142.2 per 100,000 (Figure 101).

Age and sex distribution

The median age of Q fever cases was 46 years (range 5 to 87 years) and 75% (352) were male. Almost a third (30%, 143) of notified cases were males aged between 40 to 59 years (Figure 102). This was consistent with a report that found higher rates of Q fever in men aged 50 to 59 years, and that agriculture-related occupations (including farming) are the most commonly reported occupation.[158]

Tularaemia

- There were no cases of tularaemia notified in 2014.

Tularaemia is a non-specific disease with diverse manifestations, often with an influenza-like onset, caused by infection with the bacterium *Francisella tularensis*.[22] The most common modes of transmission are through arthropod bites, handling infected animals, inhalation of infectious aerosols or exposure to contaminated food or water. Small mammals such as rodents, rabbits and hares are often the reservoir.[162]

Figure 100: Notifications of Q fever, Australia, 2009 to 2014, by month and year of diagnosis and state or territory

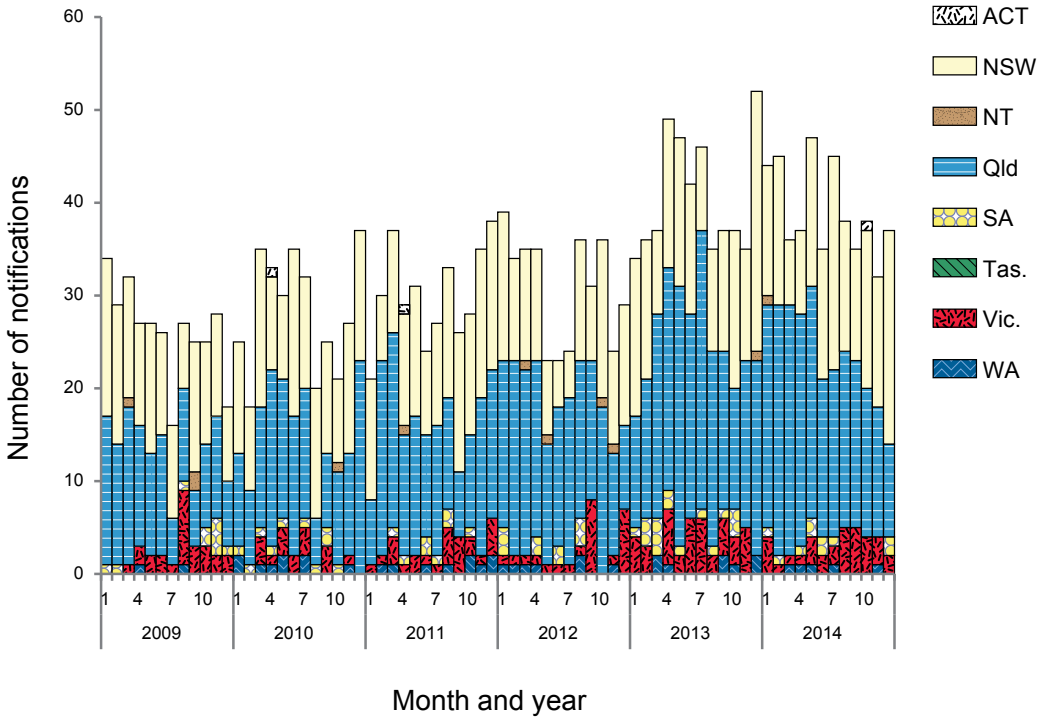


Figure 101: Notification rate for Q fever, Australia, 2014, by Statistical Area Level 3

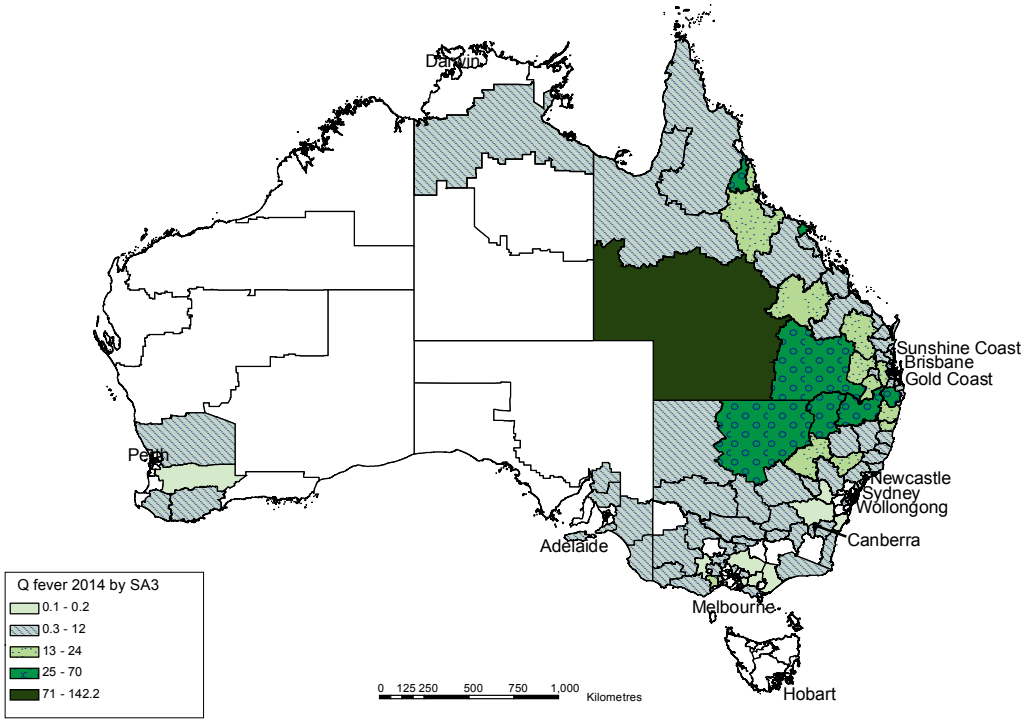
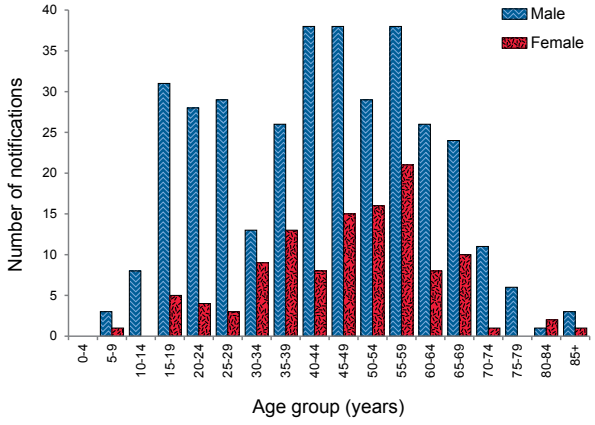


Figure 102: Notifications of Q fever, Australia, 2014, by age group and sex



Epidemiological situation in 2014

In 2014, there were no notified cases of tularaemia in Australia. Tularaemia was last notified in 2011, with 2 cases in Tasmanian residents. This was the first time that *F. tularensis* type B had been detected in the Southern Hemisphere.[163–165]

Other bacterial infections

Other bacterial diseases in the national notifiable disease list are legionellosis, leprosy, invasive meningococcal disease (IMD) and tuberculosis (TB). In 2014, there were 1,942 cases of other bacterial infections notified to the NNDSS, representing less than 1% of all reported cases and similar to the number notified in 2013 (n=1,932). Common objectives for the surveillance of diseases in this section are to monitor their epidemiology and to identify risk groups to accurately target control strategies.

Legionellosis

- In 2014, 424 cases of legionellosis were notified to the NNDSS.
- Compared with 2013, notifications of legionellosis declined by 17% in 2014.
- *Legionella pneumophila,* commonly associated with man-made water systems, was the most frequently reported causative species in 2014.

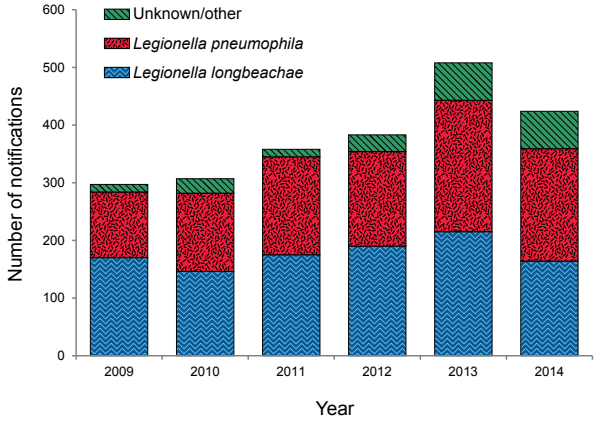
Legionellosis is an environmentally acquired pneumonia caused by the bacteria *Legionella*. It can take the form of either Legionnaires' disease, a severe form of infection of the lungs, or Pontiac fever, a milder influenza-like illness.[22] The species most commonly associated with human disease in Australia are *Legionella pneumophila* and *L. longbeachae*. *Legionella* bacteria are found naturally in low levels in the environment. In the absence of effective environmental treatments *Legionella* organisms can proliferate in air conditioning cooling towers, hot water systems, showerheads, spa pools, fountains, commercial potting

mix and other decomposing material such as bark and sawdust.[166–169] *Legionella* is generally transmitted to humans through contaminated water or dust aerosols.

Epidemiological situation in 2014

In 2014, there were 424 notifications of legionellosis, representing a rate of 1.8 per 100,000. Notifications declined by 17% following an outbreak-related peak in 2013 (n=508) (Figure 103).

Figure 103: Notifications of legionellosis, Australia, 2009 to 2014, by species and year



In 2014, data on the causative species were available for 85% (n=362) of notifications reported. Of those with a known causative, the most frequently reported causative species were *L. pneumophila* (54%, 195), followed by *L. longbeachae* (45%, 164). A single notification of *L. sainthelensi* and 2 notifications of *L. micdadei* were also reported (Table 24). Serogroup information was reported for 62% (120/195) of *L. pneumophila* notifications and 11% (18/164) of *L. longbeachae* notifications. Of these, 98% (117/120) of *L. pneumophila* notifications were typed to *L. pneumophila* serogroup 1, 1 notification was serogroup 2 and 2 were mixed. All *L. longbeachae* notifications were typed to *L. longbeachae* serogroup 1.

Over the period of 2009 to 2014, the number of notified cases of *L. pneumophila* ranged from 114 to 228 per year, whilst notified cases of *L. longbeachae* ranged from 144 to 215 per year (Figure 103). When compared with 2013, notifications of *L. pneumophila* declined by 14% and *L. longbeachae* by 24%.

In 2014, mortality data were available for 78% (n=329) of notifications. Of these, 4% (13/329) were reported to have died due to legionellosis and this was similar to the number of deaths reported in previous years. The majority of deaths were attributed to infection with *L. pneumophila* (46%, 6/13) (Table 24). Over the last 6 years (2009 to 2014) the mortality data of legionellosis notification has improved with the proportion of cases reported with death information increasing from 49% in 2009 to 78% in 2014.

Geographic distribution

In 2014, jurisdictional-specific rates of legionellosis varied from 0.5 per 100,000 in the Australian Capital Territory to 4.5 per 100,000 in Western Australia (Table 5).

In 2014, *L. pneumophila* was the most notified causative species in New South Wales, Queensland, South Australia and Victoria, while *L. longbeachae* was more frequently notified in the Northern Territory, Western Australian and Tasmania. The Australian Capital Territory reported and an equal number of notifications of both species. The most frequent species annually reported by each jurisdiction can vary between

Table 24: Notifications, notification rates and deaths for legionellosis, Australia, 2014, by species and state or territory

Species	State or territory									
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aust.	Deaths
L. longbeachae	1	17†	4	16	19	5	9	93*	164	5
L. pneumophila	1	41	3‡	45‡	20†	2	60	23†	195	6
L. micdadei	0	1‡	0	0	0	0	1	0	2	1
L. sainthelensi	0	0	0	0	1	0	0	0	1	0
Unknown species	0	11	0	33	0	1	17‡	0	62	1
Total	2	70	7	94	40	8	87	116	424	13

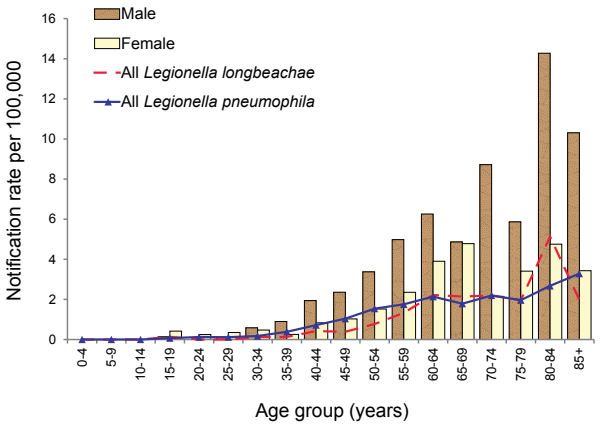
* 3 deaths.
† 2 deaths.
‡ 1 death.

L. pneumophila and *L. longbeachae*. However, generally Western Australia and Northern Territory tend to report more *L. longbeachae* notifications, while New South Wales, Queensland, South Australia and Victoria tend to report more *L. pneumophila* notifications. The Australian Capital Territory and Tasmania tend to report only a small number of notifications each year; therefore, they have no obvious trend in the most frequent causative species.

Age and sex distribution

In 2014, males accounted for the majority (65%) of the notifications resulting in a male to female ratio of 1.8:1. There were no notifications in people under the age of 15 years. In males, the highest notification rates were observed in those aged 80–84 years (14.3 per 100,000) and 85 years and over (10.3 per 100,000). While in females, the highest notification rates were observed in those aged 65–69 years and 80–84 years age groups (both 4.8 per 100,000) (Figure 104).

Figure 104: Notification rate for legionellosis, Australia, 2014, by age group, sex and species

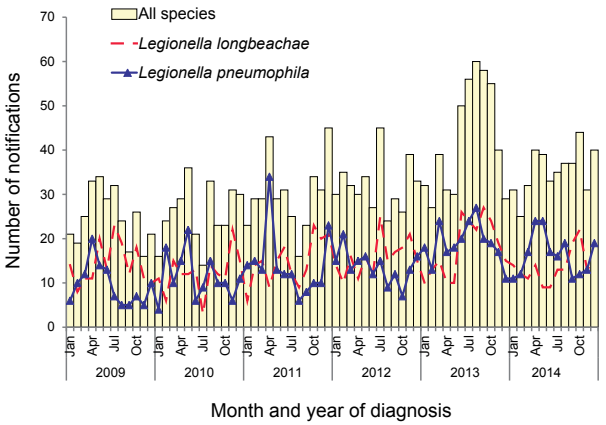


The ages of the 13 cases reported to have died due to legionellosis in 2014 ranged between 57 to 83 years (median 75 years); 12 deaths were male and 1 was female. In 2014, the demographic profile of legionellosis remained consistent with the recognised epidemiology of the disease.[22,170,171]

Seasonality

In 2014, diagnoses of legionellosis were highest in October, with 44 notified cases. The diagnosis of *L. pneumophila* peaked in April–May (24 cases each month), and the diagnosis of *L. longbeachae* peaked in October (n=22). From 2009 to 2013, the diagnosis of *L. pneumophila* commonly occurred in the autumn and summer months, except for 2013 when diagnoses peaked at the end of winter. In the same period, the diagnosis of *L. longbeachae* more commonly occurred in winter and spring. (Figure 105).

Figure 105: Notifications of legionellosis, Australia, 2009 to 2014, by month and year of diagnosis and species



Place of acquisition

In 2014, a place of acquisition was reported for 86% (n=363) of legionellosis notifications. Of these, 92% (334) were reported as acquired within Australia and 8% (29) were reported as acquired overseas. Of the overseas acquired notifications, Indonesia (17%, 5/29), the United States of America (10%, 3/29) and Thailand (10%, 3/29) were the most commonly reported places of acquisition.

Outbreaks

In 2014, there were 5 outbreaks of *L. pneumophila* reported to the NNDSS.

In South Australia, there was an outbreak of 6 cases of legionellosis caused by *L. pneumophila* serogroup 1. All cases lived or worked within the Adelaide central business district (CBD). During the environmental investigation several cooling towers in the Adelaide CBD were identified as reservoirs of *L. pneumophila* serogroup 1 and were subsequently decontaminated.

In Victoria, there were 4 outbreaks, involving a total of 17 cases. None of these outbreaks were linked to overseas sources and none of the cases linked to outbreaks died due to their infection.

One of the outbreaks involved a total of 10 cases and included 4 separate clusters. There were 3 environmental detections from cooling towers

associated with the outbreak; however, none of the environmental samples matched the *Legionella* strain isolated from the clinical samples.

Another outbreak involved 3 linked cases, all of whom had either visited or worked at the Melbourne Airport. Despite extensive sampling and testing, no environmental detections were found for this outbreak.

The remaining 2 outbreaks involved 2 cases in each outbreak. One of these outbreaks was associated with a common geographical link, but no environmental detections were found. The other outbreak was linked to a workplace at the port of Melbourne. An environmental detection was found in a cooling tower in the port of Melbourne area but this environmental sample did not contain the same *Legionella* strain as isolated from the clinical samples.

Leprosy

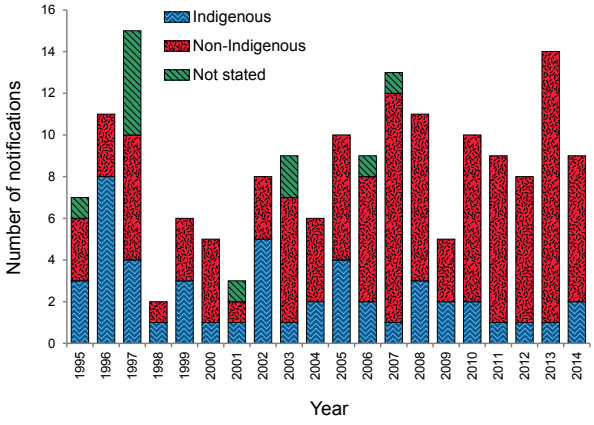
- A total of 9 cases of leprosy were notified in 2014, maintaining a notification rate of less than 0.1 per 100,000.
- Most cases of leprosy notified in 2014 were acquired overseas.

Leprosy is a chronic infection of the skin and peripheral nerves with the bacterium *Mycobacterium leprae*. Leprosy is an uncommon disease in Australia with the majority of cases occurring in migrants from leprosy-endemic countries and Indigenous populations. The incidence of leprosy worldwide is declining due to various factors including economic development, bacille Calmette Guérin (BCG) immunisation and high coverage with multi-drug therapy.[22] Leprosy is not a highly infectious disease and is typically slow to progress to a symptomatic stage. The incubation period for leprosy is about 5 years; however, it can take as long as 20 years for symptoms to appear.[172] People at-risk are generally in close and frequent contact with leprosy patients or living in countries where the disease is more common. Leprosy is curable and once a person with leprosy begins appropriate treatment, they quickly become non-infectious.

Epidemiological situation in 2014

In 2014, a total of 9 cases of leprosy were notified (4 female, 5 male), representing a rate of less than 0.1 per 100,000. There were 5 cases notified in Western Australia, and 1 each in Victoria, South Australia, Queensland and New South Wales. Cases ranged in age from 17 to 75 years, with a median age of 45 years. Two cases were reported as being Indigenous. The remaining 7 cases were reported as being non-Indigenous and as having acquired the infection overseas. Cases were reported as being from India (n=2), Sri Lanka (n=1), the Philippines (n=1), Samoa (n=1) and the overseas country of acquisition was unknown for 2 cases. Since 1995, annual notifications of leprosy have ranged from 2 to 15 cases per year (Figure 106).

Figure 106: Notifications of leprosy, Australia, 1995 to 2014, by year and Indigenous status



Meningococcal disease (invasive)

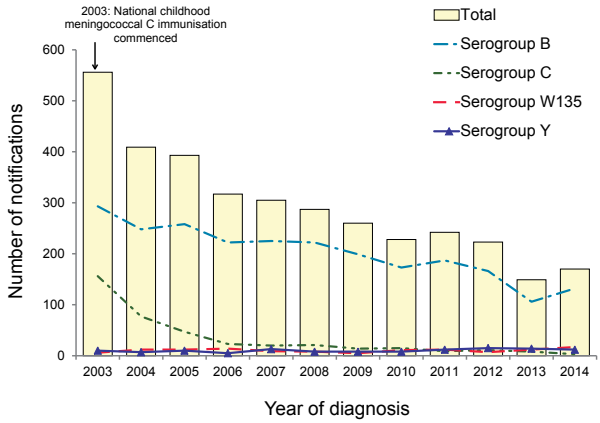
- There were 170 cases and 8 deaths related to IMD reported in 2014.
- The majority of IMD cases were caused by serogroup B organisms.
- Infections with serogroup Y account for a small but increasing proportion of IMD notifications.
- Seventy-two per cent of IMD cases reported in 2014 were less than 25 years of age.

IMD is caused when the bacterium *Neisseria meningitidis* enters a normally sterile site, usually the blood (septicaemia), cerebrospinal fluid (meningitis) or both. Asymptomatic respiratory tract carriage of meningococci is present in 5% to 10% of the population and prevalence may be higher when groups of people occupy small areas of any space.[22,32] The disease is transmitted via respiratory droplets and has an incubation period of between 2 and 10 days, commonly 3 to 4 days. [22,173] It occasionally causes a rapidly progressive serious illness, most commonly in previously healthy children and young adults. Globally, serogroups A, B, C, X, W135 and Y commonly cause invasive disease.[174] Historically, *N. meningitidis* serogroups B and C have been the major cause of IMD in Australia.

Epidemiological situation in 2014

In 2014, there were 170 cases of IMD reported to the NNDSS, representing a rate of 0.7 per 100,000 population. This was an increase of 14% compared with 2013 (n=149), but less than the number of cases notified between 2003 and 2012 (range 556 to 223 cases) (Figure 107). This rise in IMD cases was due to infections caused by serogroup B.

Figure 107: Notifications of invasive meningococcal disease, Australia, 2003 to 2014, by selected serogroup and year



The majority of cases notified in 2014 (99%, n=168) met the case definition as a confirmed case, being diagnosed based on laboratory definitive evidence, or laboratory suggestive evidence and clinical evidence.[173] A small number of cases (n=2) were reported as probable and diagnosed based on clinical evidence only.

In 2014, all states and territories reported cases of IMD (Table 1), with notification rates ranging from 0.4 per 100,000 in Tasmania to 2 per 100,000 in South Australia (Table 25). Mortality data were available for 74% (126/170) of cases. Of these, 8 cases were reported as having died from IMD, including 7 from infection with serogroup B organisms, and 1 from infection with serogroup Y organisms (Table 25). Six of the deaths associated with IMD infection caused by serogroup B organisms occurred in children less than 5 years of age and 1 in a teenager 17 years of age. The 1 death caused by a serogroup Y organism occurred in an adult over 85 years of age.

Age and sex distribution

More males (53%, n=90) than females (47%, n=80) were notified with IMD in 2014. Proportionally, 72% (n=122) of all cases reported were less than 25 years of age, of which half were children less than 5 years of age (n=61). The highest notification rate in 2014 for both males and females was in the 0–4 years age group (3.4 per 100,000) with a second peak in adolescents (15–19 years of age) (Figure 108).

Figure 108: Notification rate for invasive meningococcal disease, Australia, 2014, by age group and sex (n=170)

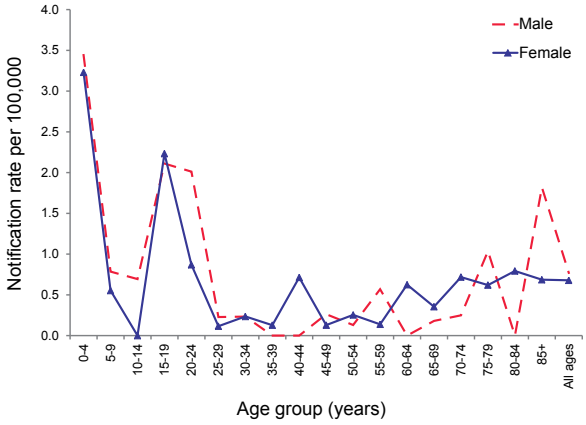


Table 25: Notifications of invasive meningococcal disease and deaths due to invasive meningococcal disease, Australia, 2014, by serogroup and state or territory

Serogroup	State or territory									
	ACT†	NSW†	NT	Qld	SA	Tas.	Vic.	WA	Aust.	Deaths
B	1	23	3	30	34	1	27	13	132	7
C	0	0	0	1	0	0	0	2	3	0
W135	0	7	0	3	0	1	4	2	17	0
Y	1	7	0	2	0	0	1	1	12	1
Unknown*	0	1	0	4	0	0	1	0	6	0
Total	2	38	3	40	34	2	33	18	170	8
Rate per 100,000	0.5	0.5	1.2	0.8	2.0	0.4	0.6	0.7	0.7	0

* Unknown includes notifications where serogroup was non-groupable or not grouped. Not grouped is when no serogroup is available and non-groupable is where the serogroup is reported by the reference laboratory as a non-groupable strain.

† Conjunctival IMD cases are also reported under the local case definition, and reported to the national dataset by the jurisdiction. Conjunctival cases cannot be distinguished from invasive cases in the national dataset.

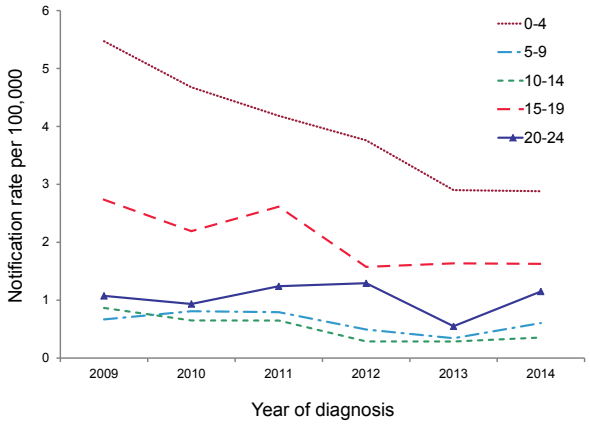
Serogroup analysis

Data on serogroup were available for 96% (n=164) of cases in 2014, of which 80% (132) were caused by serogroup B organisms, 10% (17) by serogroup W135, 7% (12/164) by serogroup Y and 2% (3) by serogroup C (Table 25). Cases caused by serogroup Y (n=12) were slightly lower compared with 2013 (n=14), but were higher than the average of 10 cases seen in the previous 10 years (2004–2013). Notifications of IMD caused by serogroup C organisms continue to decrease with 3 cases notified in 2014 compared with 8 in 2013 (Table 25) and representing a 98% decrease since the introduction of the meningococcal C vaccine on the NIP in 2003.

All 3 cases of IMD due to serogroup C organisms notified in 2014 were under the age of 25 years. Two cases were in the 0–4 years age group, and 1 was in the 20–24 years age group. Age-specific rates of serogroup C infections have remained below 0.2 cases per 100,000 since 2010.

Serogroup B accounted for the majority of cases across all age groups including those aged less than 25 years. Compared with 2013, serogroup B rates were relatively stable in all age groups except the 5–9 years and 20–24 years age groups, which displayed a 2-fold and 2.4-fold increase respectively (Figure 109).

Figure 109: Notification rate for serogroup B invasive meningococcal disease, Australia, 2009 to 2014, by year and selected age groups



An increase in notifications of serogroup W135 was evident in 2014 (n=17) with notifications nearly 2 times higher than the annual average of the previous 5 years. There were 17 cases of W135 reported in 2014 compared with 12 cases in 2013 and 7 cases in 2012.

Vaccination status

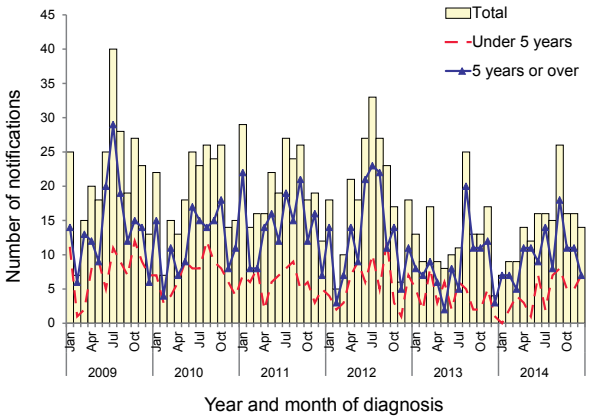
From 2003, the meningococcal C vaccine has been available for infants aged 12 months as a part of the childhood immunisation schedule funded under the NIP. A catch-up program provided access to the meningococcal C vaccine for children and adolescents born between 1984 and 2001.

Of the 3 cases of IMD caused by serogroup C organisms reported in 2014, 2 were less than 12 months of age and therefore not eligible for vaccination, and 1 was eligible for vaccination (21 years) but was reported with an unknown vaccination status.

Seasonality

In 2014, an average of 14 cases of IMD were reported monthly, with a range of 7 to 26 cases. A clear seasonal pattern was apparent in 2014, with the highest number of notifications reported in spring. The 2014 season peaked in September with 26 cases reported and was later than the seasonal pattern displayed in the previous 5 years (2009 to 2013), in which notifications peaked in mid to late winter (Figure 110). Consistent with the previous 5 years, the 2014 seasonal trend was more obvious in cases 5 years of age or over compared with those less than 5 years of age.

Figure 110: Notifications of invasive meningococcal disease, Australia, 2009 to 2014, by month and year and age group



Susceptibility

The Australian Meningococcal Surveillance Program (AMSP) was established in 1994 for the purpose of monitoring and analysing isolates of *N. meningitidis* from cases of IMD in Australia. The program is undertaken by a network of reference laboratories in each state and territory, using

standardised methodology to determine the phenotype (serogroup, serotype and serosubtype) and the susceptibility of *N. meningitidis* to a core group of antibiotics.

Annual reports of the AMSP are published in CDI, with the most recent report published for 2014.[175] The latest data from AMSP show that 12% of isolates tested were fully sensitive and 88% demonstrated decreased susceptibility to the penicillin group of antibiotics. No isolates tested in 2014 exhibited resistance to penicillin. All tested IMD isolates were susceptible to ceftriaxone and ciprofloxacin, and 2 isolates were resistant to rifampicin.

Discussion

In Australia, IMD has remained at its lowest levels since the national notification commenced in 1991. The reduction has been seen most considerably in disease caused by serogroup C, but declines in disease caused by serogroup B are also evident.

Tuberculosis

- A total of 1,339 cases of TB were notified in 2014.
- In 2014, the notification rate of TB increased slightly from 5.5 per 100,000 in 2013 to 5.9 per 100,000.

TB is an infection caused by the bacterium *Mycobacterium tuberculosis*. TB is transmitted by airborne droplets produced by people with pulmonary or respiratory tract TB when coughing or sneezing. While Australia has one of the lowest rates of TB in the world, the disease remains a public health issue, particularly in Australia's overseas-born and Indigenous communities. [176]

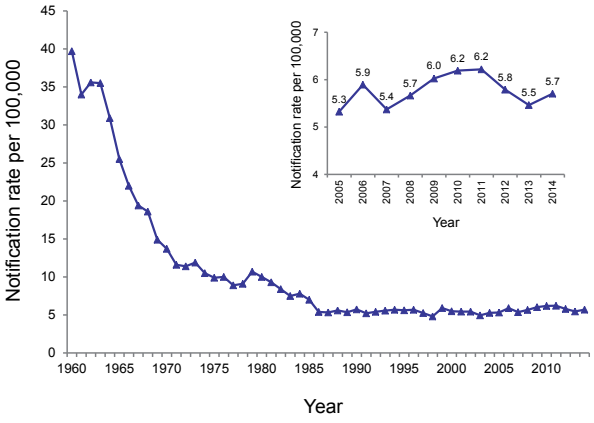
Epidemiological situation in 2014

In 2014, a total of 1,339 cases of TB were notified to the NNDSS representing a rate of 5.7 per 100,000. This was an increase on the rate of 5.5 per 100,000 (n=1,263) reported in 2013, but less than the preceding 5-year mean (2009 to 2013) of 5.9 per 100,000. Australia has achieved good TB control and has maintained low rates of TB since the mid 1980s (Figure 111).

Geographic distribution

New South Wales (n=472), Victoria (n=448), Queensland (n=165) and Western Australia (n=139) accounted for 91% of all cases of TB diagnosed in Australia. The Northern Territory (11.4 per 100,000), the Australian Capital Territory (7.8 per 100,000), Victoria (7.7 per 100,000) and New South Wales (6.3 per 100,000) all reported a rate higher than the national notification rate. In 2014, the Northern Territory, South Australia and Western Australia reported lower notification rates than the previous year. All the other states and territories reported an increase on the previous year. Notifications and rates of TB by state or territory are presented in Table 6.

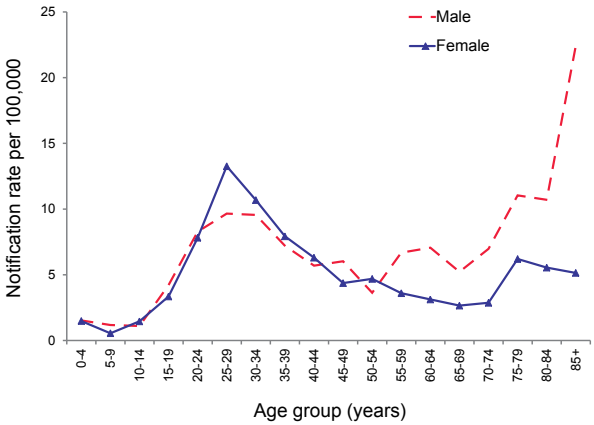
Figure 111: Notification rate for tuberculosis, Australia, 1960 to 2014, by year



Age and sex distribution

Overall, the age groups with the highest notification rates were in the 25–29 years and 85 years or over age groups (both 11.4 per 100,000), followed by the 30–34 years age group (10.1 per 100,000). The highest age and sex specific rates were observed in men in the 85 years or over (22.4 per 100,000) and women in the 25–29 years age groups (13.3 per 100,000) (Figure 112). Males accounted for 53% of the TB notifications in 2014.

Figure 112: Notification rate for tuberculosis, Australia, 2014, by age group and sex



Vaccination

The BCG vaccine was first introduced for protection against tuberculosis in the 1920s and despite variable evidence on the efficacy of the vaccine, it remains the only vaccine in use for TB today.[177,178]

According to national guidelines developed by Australia's National Tuberculosis Advisory Committee, BCG vaccination is recommended for Aboriginal and Torres Strait Islander neonates in communities with a high incidence of TB; neonates and children under 5 years of age who will be travelling to or living in countries or areas with a high prevalence of TB for extended periods; and neonates born to parents with leprosy or a family history of leprosy.

BCG vaccination is not recommended for general use in the Australian population or for most health care workers. It is contraindicated in HIV infected persons.[179] Note that BCG immunisation practices may vary between states and territories due to differences in jurisdiction specific TB vaccination policies and population demographics.

Enhanced surveillance data sets

Enhanced data are collected on all cases of TB. Further analyses, including identification of risk groups and reporting on treatment outcomes, can be found in the TB annual report series also published in CDI.

Appendices

Appendix 1: Estimate of Australian population, 2014, by state or territory

	State or territory								
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aus.
Males	191,566	3,729,091	129,421	2,351,996	835,151	256,418	2,888,381	1,296,737	11,680,860
Females	193,923	3,786,643	115,191	2,369,352	850,245	258,268	2,951,115	1,268,640	11,794,489
Total	385,489	7,515,734	244,612	4,721,348	1,685,396	514,686	5,839,496	2,565,377	23,475,349

Source: Australian Bureau of Statistics. Table 4, Estimated Resident Population, State and Territories. Australian Demographic Statistics. ABS Cat no. 3101.0 December 2014.

Appendix 2: Estimate of Australian population, 2014, by state or territory and age

Age group	State or territory								
	ACT	NSW	NT	Qld	SA	Tas.	Vic.	WA	Aus.
00–04	26,825	485,831	19,179	316,933	100,794	30,989	375,099	171,492	1,527,302
05–09	23,775	474,199	17,945	316,945	99,415	32,173	357,939	165,313	1,487,862
10–14	21,457	448,958	16,958	301,045	97,089	31,458	336,342	153,899	1,407,390
15–19	22,954	467,371	16,413	309,790	104,763	33,795	357,934	161,287	1,474,485
20–24	32,204	513,569	19,302	335,799	114,429	31,345	419,758	184,276	1,650,869
25–29	33,893	539,032	23,785	340,992	115,376	29,452	450,175	214,047	1,747,148
30–34	32,434	541,359	22,198	331,559	111,195	29,222	439,588	201,368	1,709,344
35–39	28,162	498,014	18,647	309,359	102,734	28,963	395,440	177,602	1,559,166
40–44	28,217	526,430	18,554	340,344	114,318	34,190	417,742	186,103	1,666,157
45–49	25,063	482,577	16,170	310,804	112,827	33,873	386,969	172,605	1,541,092
50–54	24,574	502,417	15,456	313,943	116,159	37,637	380,927	168,373	1,559,707
55–59	21,718	462,858	13,497	281,596	108,960	36,354	348,782	151,016	1,424,956
60–64	18,847	410,371	10,504	251,970	99,624	33,753	307,662	130,589	1,263,524
65–69	15,987	368,229	7,340	224,623	90,102	30,363	273,184	109,827	1,119,751
70–74	10,668	273,615	4,316	162,073	65,641	22,361	202,085	78,516	819,339
75–79	7,755	207,728	2,231	114,086	51,096	16,084	155,090	58,137	612,237
80–84	5,358	153,937	1,243	80,148	38,736	11,702	116,447	40,879	448,467
85+	5,598	159,239	874	79,339	42,138	10,972	118,333	40,048	456,553
Total	385,489	7,515,734	244,612	4,721,348	1,685,396	514,686	5,839,496	2,565,377	23,475,349

Source: Australian Bureau of Statistics. Estimated Resident Population, State and Territories. Australian Demographic Statistics. ABS Cat no. 3101.0 December 2014.

Appendix 3: Indigenous status, National Notifiable Diseases Surveillance System, Australia, 2014, by notifiable disease*

Disease name	Aboriginal but not TSI origin	TSI but not Aboriginal origin	Aboriginal and TSI origin	Not Indigenous	Not stated	Blank/ missing	Total	% complete	Number complete	Number incomplete
Arbovirus (NEC)	0	0	0	16	12	0	28	57	16	12
Barmah Forest virus infection	15	2	0	173	417	134	741	26	190	551
Botulism	0	0	0	1	0	0	1	100	1	0
Brucellosis	0	0	0	16	1	0	17	94	16	1
Campylobacteriosis	291	9	16	9,579	9,507	529	19,931	50	9,895	10,036
Chlamydial infection	5,508	757	354	25,371	31,682	22,436	86,108	37	31,990	54,118
Cholera	0	0	0	2	0	0	2	100	2	0
Cryptosporidiosis	148	3	4	1,153	971	126	2,405	54	1,308	1,097
Dengue virus infection	24	8	6	1,289	357	32	1,716	77	1,327	389
Diphtheria	0	0	0	2	0	0	2	100	2	0
Donovanosis	1	0	0	0	0	0	1	100	1	0
Gonococcal infection	3,233	194	95	6,875	3,694	1,584	15,675	66	10,397	5,278
Haemolytic uraemic syndrome	2	0	0	15	2	1	20	85	17	3
Haemophilus influenzae type b	5	0	0	16	0	0	21	100	21	0
Hepatitis A	3	1	0	218	9	0	231	96	222	9
Hepatitis B (newly acquired)	12	1	0	148	15	0	176	92	161	15
Hepatitis B (unspecified)	132	15	5	2,114	1,877	2,351	6,494	35	2,266	4,228
Hepatitis C (newly acquired)	117	1	0	305	10	0	433	98	423	10
Hepatitis C (unspecified)	745	8	18	3,085	3,386	3,007	10,249	38	3,856	6,393
Hepatitis D	0	0	0	39	9	11	59	66	39	20
Hepatitis E	0	0	0	53	3	0	56	95	53	3
Influenza (laboratory confirmed)	1,818	108	79	25,047	19,212	21,478	67,742	40	27,052	40,690
Japanese encephalitis virus infection	0	0	0	1	0	0	1	100	1	0
Kunjin virus infection	0	0	0	1	0	0	1	100	1	0
Legionellosis	7	0	0	390	23	4	424	94	397	27
Leprosy	2	0	0	7	0	0	9	100	9	0
Leptospirosis	0	0	0	70	18	0	88	80	70	18
Listeriosis	0	1	0	71	7	1	80	90	72	8
Malaria	2	0	0	272	48	0	322	85	274	48
Measles	11	0	0	316	11	2	340	96	327	13

Appendix 3 *continued*: Indigenous status, National Notifiable Diseases Surveillance System, Australia, 2014, by notifiable disease*

Disease name	Aboriginal but not TSI origin	TSI but not Aboriginal origin	Aboriginal and TSI origin	Not Indigenous	Not stated	Blank/ missing	Total	% complete	Number complete	Number incomplete
Meningococcal disease (invasive)	21	0	0	147	2	0	170	99	168	2
Mumps	2	1	0	144	33	10	190	77	147	43
Ornithosis	0	0	0	35	5	1	41	85	35	6
Pertussis	212	8	9	6,335	3,864	1,435	11,863	55	6,564	5,299
Pneumococcal disease (invasive)	179	7	7	1,205	131	35	1,564	89	1,398	166
Q fever	14	0	0	395	55	5	469	87	409	60
Ross River virus infection	129	15	6	2,466	1,990	710	5,316	49	2,616	2,700
Rubella	0	0	0	13	2	2	17	77	13	4
Shiga toxin-producing *Escherichia coli*	1	0	0	99	11	4	115	87	100	15
Salmonellosis	403	20	19	7,572	5,085	3,259	16,358	49	8,014	8,344
Shigellosis	138	3	3	709	178	20	1,051	81	853	198
Syphilis – congenital	5	0	0	0	0	0	5	100	5	0
Syphilis < 2 years	227	5	6	1,601	160	10	2,009	92	1,839	170
Syphilis > 2 years or unspecified duration	212	15	2	1,119	469	104	1,921	70	1,348	573
Tetanus	0	0	0	2	1	0	3	67	2	1
Tuberculosis	25	15	1	1,298	0	0	1,339	100	1,339	0
Typhoid fever	0	0	0	116	3	0	119	98	116	3
Varicella zoster (chickenpox)	99	3	6	1,771	180	29	2,088	90	1,879	209
Varicella zoster (shingles)	137	1	6	4,828	421	80	5,473	91	4,972	501
Varicella zoster (unspecified)	140	28	7	2,500	9,065	357	12,097	22	2,675	9,422
Total	14,020	1,229	649	109,001	92,927	57,757	275,581	45	124,899	150,682

* Indigenous status is usually obtained from medical notification and completeness varies by disease and by state and territory. This reflects differences in notification requirements (i.e. depending on the jurisdiction, some diseases are primarily or completely notified by pathology laboratories rather than clinicians) and the fact that it is not possible to follow-up all cases for diseases with a large volume of notifications and/or not requiring specific case-based public health action.

TSI Torres Strait Islander.

Abbreviations

13vPCV	13 valent pneumococcal conjugate vaccine
23vPPV	23 valent pneumococcal polysaccharide vaccine
ABLV	Australian bat lyssavirus
AFP	acute flaccid paralysis
AGSP	Australian Gonococcal Surveillance Programme
AIDS	acquired immune deficiency syndrome
AMSP	Australian Meningococcal Surveillance Programme
ANCJDR	Australian National Creutzfeldt-Jakob Disease Registry
BCG	bacille Calmette–Guérin
BFV	Barmah Forest virus
CDI	Communicable Diseases Intelligence
CDNA	Communicable Diseases Network Australia
CDWG	Case Definitions Working Group
CIDT	culture-independent diagnostic testing
CJD	Creutzfeldt-Jakob disease
CRS	congenital rubella syndrome
DENV	dengue virus
Hib	*Haemophilus influenzae* type b
HIV	human immunodeficiency virus
HPAIH	highly pathogenic avian influenza in humans
HUS	haemolytic uraemic syndrome
ILI	influenza like illness
IMD	invasive meningococcal disease
IPD	invasive pneumococcal disease
JEV	Japanese encephalitis virus
KUNV	Kunjin virus
MMR	measles-mumps-rubella
MVEV	Murray Valley encephalitis virus
NAMAC	National Arbovirus and Malaria Advisory Committee
NDP	no data provided
NEC	not elsewhere classified
NIP	National Immunisation Program
NN	not notifiable
NNDSS	National Notifiable Diseases Surveillance System
NQFMP	National Q fever Management Program
NSC	National Surveillance Committee
NS1	non-structural protein 1
PCR	polymerase chain reaction
RRV	Ross River virus
SACC	Standard Australian Classification of Countries
SARS	severe acute respiratory syndrome
STEC	Shiga toxin-producing *Escherichia coli*
STI(s)	sexually transmissible infections(s)
TB	tuberculosis
VPD(s)	vaccine preventable disease(s)
VZV	varicella zoster virus
WHO	World Health Organization
WHOCC	World Health Organization Collaborating Centre for Reference and Research on Influenza
ZIKV	Zika virus

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References

1. *National Health Security Act, 2007*. Accessed March 2015. Available from: http://www.comlaw.gov.au/Details/C2007A00174
2. National Health Security (National Notifiable Disease List) Instrument 2008. Accessed March 2015. Available from: http://www.comlaw.gov.au/ComLaw/legislation/LegislativeInstrument1.nsf/0/7162D634C6DD1BAACA25740B0079D6B8?OpenDocument
3. National Health Security Agreement 2008. Accessed March 2015. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-nhs-agreement.htm
4. The Kirby Institute. *HIV, viral hepatitis and sexually transmissible infections in Australia. Annual Surveillance Report 2015*. UNSW Australia, Sydney NSW: The Kirby Institute; 2015.
5. Klug GM, Boyd A, Sarros S, Stehmann C, Simpson M, McLean CA, et al. Creutzfeldt-Jakob disease surveillance in Australia, update to December 2013. *Commun Dis Intell* 2014;38(4):E348–355.
6. Communicable Diseases Network Australia. National Notifiable Diseases Surveillance System. 2015. Accessed March 2015. Available from: www.health.gov.au/nndssdata
7. Australian Bureau of Statistics. Australian Demographic Statistics, December 2014. Canberra: Australian Bureau of Statistics; 2015. Report No.: ABS Catalogue: 3101.0.
8. Australian Institute of Health and Welfare. Age-standardised rate – Identifying and definitional attributes. 2005. Accessed on 17 March 2015. Available from: http://meteor.aihw.gov.au/content/index.phtml/itemId/327276
9. Graham S, Guy RJ, Donovan B, McManus H, El-Hayek C, Kwan K, et al. Epidemiology of chlamydia and gonorrhea among Indigenous and non-Indigenous Australians, 2000–2009. *Med J Aust* 2012;197(11):642–646.
10. Hammerschlag M. Sexually transmitted diseases in sexually abused children: medical and legal implications. *Sex Transm Infect* 1998;74(3):167–174.
11. Australian Institute of Health and Welfare. National Health Data Dictionary 13.3; 2008.
12. Australian Bureau of Statistics. Standard Australian Classification of Countries (SACC). Canberra: Australian Bureau of Statistics; 2011. Report No.: 1269.0.
13. Chen MY, Fairley CK, Donovan B. Nowhere near the point of diminishing returns: correlations between chlamydia testing and notification rates in New South Wales. *Aust N Z J Public Health* 2005;29(3):249–253.
14. Hocking J, Fairley C, Counahan M, Crofts N. The pattern of notification and testing for genital *Chlamydia trachomatis* infection in Victoria, 1998–2000: an ecological analysis. *Aust N Z J Public Health* 2003;27(4):405–408.
15. Burckhardt F, Warner P, Young H. What is the impact of change in diagnostic test method on surveillance data trends in *Chlamydia trachomatis* infection? *Sex Transm Infect* 2006;82(1):24–30.
16. Chen MY, Karvelas M, Sundararajan V, Hocking JS, Fairley CK. Evidence for the effectiveness of a chlamydia awareness campaign: increased population rates of chlamydia testing and detection. *Int J STD AIDS* 2007;18(4):239–243.
17. Hammad A, Guy RJ, Fairley C, Wand H, Chen MY, Dickson B, et al. Understanding trends in genital *Chlamydia trachomatis* can benefit from enhanced surveillance: findings from Australia. *Sex Transm Infect* 2012;88(7):552–557.
18. Stephens N, O'Sullivan M, Coleman D, Shaw K. *Chlamydia trachomatis* in Tasmania 2001–2007: rising notification trends. *Aust N Z J Public Health* 2010;34(2):120–125.
19. Communicable Diseases Network Australia. Australian national notifiable diseases case definitions. 2014. Accessed on 5 September 2014. Available from: http://www.health.gov.au/casedefinitions
20. National HBV Testing Policy Expert Reference Committee. *National hepatitis B testing policy 2012 v1.1*. Australasian Society for HIV, Viral Hepatitis and Sexual Health Medicine, Darlinghurst, NSW: Commonwealth of Australia; 2012.
21. National HCV Testing Policy Expert Reference Committee. *National hepatitis C testing policy 2012 v1.1*. Australasian Society for HIV, Viral Hepatitis and Sexual Health Medicine, Darlinghurst, NSW: Commonwealth of Australia; 2012.
22. Heymann DL. *Control of Communicable Diseases Manual*. 19th edn. Washington: American Public Health Association, USA; 2008.
23. National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases. Hepatitis B Vaccines for Australians: Information for Immunisation Providers. In; 2015.
24. Medicare Australia. Australian Childhood Immunisation Register – Statistics. 2014. Accessed March 2015. Available from: http://www.medicareaustralia.gov.au/provider/patients/acir/statistics.jsp
25. Gidding HF, Warlow M, MacIntyre CR, Backhouse J, Gilbert GL, Quinn HE, et al. The impact of a new universal infant and school-based adolescent hepatitis B vaccination program in Australia. *Vaccine* 2007;25(51):8637–8641.
26. National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases. Significant events in hepatitis B vaccination practice in Australia. 2014. Accessed July 2014. Available from: http://ncirs.edu.au/immunisation/history/Hepatitis-B-history-July-2014.pdf
27. National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases. Hepatitis vaccines for Australians, NCIRS fact sheet: June 2012. 2012. Accessed March 2015. Available from: http://www.ncirs.edu.au/immunisation/fact-sheets/hepatitis-B-fact-sheet.pdf
28. Chiu C, Dey A, Wang H, Menzies R, Deeks S, Mahajan D, et al. Vaccine preventable diseases in Australia, 2005 to 2007. *Commun Dis Intell* 2010;34(Suppl):S1–S172.
29. Maclachlan JH, Towell T, Cowie BC. The burden of chronic hepatitis B virus infection in Australia, 2011. *Aust N Z J Public Health* 2013;37(5):416–422.

30. Naidu L, Chiu C, Habig A, Lowbridge C, Jayasinghe S, Wang H, et al. Vaccine preventable diseases and vaccination coverage in Aboriginal and Torres Strait Islander people, Australia 2006–2010. *Commun Dis Intell* 2013;37(Suppl):S1–S95.

31. Australian Bureau of Statistics. Census of Population and Housing: Characteristics of Aboriginal and Torres Strait Islander Australians, 2011, ABS. cat no 2076.0. Canberra: ABS; 2011.

32. Australian Technical Advisory Group on Immunisation. *The Australian Immunisation Handbook*. 10th edn. Canberra, Australia: National Health and Medical Research Council and the Department of Health; 2013.

33. The Kirby Institute. *HIV, viral hepatitis and sexually transmissible infections in Australia Annual Surveillance Report 2014*; 2014.

34. Butler T, Lim D, Callander D. National Prison Entrants' Bloodborne Virus and Risk Behaviour Survey Report 2004, 2007 and 2010. Prevalence of HIV, hepatitis C, hepatitis B, sexually transmissible infections, and risk behaviours among Australian prison entrants; 2011.

35. Razali K, Thein HH, Bell J, Cooper-Stanbury M, Dolan K, Dore G, et al. Modelling the hepatitis C virus epidemic in Australia. *Drug Alcohol Depend* 2007;91(2–3):228–235.

36. OzFoodNet Working Group. Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet network, 2011. *Commun Dis Intell* 2015;39(2):E236–264.

37. NNDSS Annual Report Writing Group. Australia's notifiable disease status, 2013: Annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell* 2015;39(3):E387–E477.

38. Donnan EJ, Fielding JE, Gregory JE, Lalor K, Rowe S, Goldsmith P, et al. A multistate outbreak of hepatitis A associated with semidried tomatoes in Australia, 2009. *Clin Infect Dis* 2012;54(6):775–781.

39. New South Wales Ministry of Health. Health Protection Report, NSW – 2014. Accessed on 8 October 2015. Available from: http://www.health.nsw.gov.au/hpr/Pages/201502-diseases.aspx

40. Lamont RF, Sobel J, Mazaki-Tovi S, Kusanovic JP, Vaisbuch E, Kim SK, et al. Listeriosis in human pregnancy: a systematic review. *J Perinat Med* 2011;39(3):227–236.

41. OzFoodNet Working Group. Monitoring the incidence and causes of diseases potentially transmitted by food in Australia: Annual report of the OzFoodNet Network, 2010. *Commun Dis Intell* 2012;36(3):E213–E241.

42. van den Beld MJ, Reubsaet FA. Differentiation between Shigella, enteroinvasive *Escherichia coli* (EIEC) and noninvasive *Escherichia coli*. (1435–4373 (Electronic)).

43. Queensland Health. Statewide Weekly Communicable Diseases Surveillance Report 30 September 2013,. 2013. Accessed on 7 October 2015. Available from: https://www.health.qld.gov.au/ph/documents/cdb/weeklyrprt-130930.pdf

44. Cumpston JHL. *Health and disease in Australia*. Canberra: Australian Government Publishing Service; 1989.

45. Grattan-Smith PJ O'Regan WJ, Ellis PS, O'Flaherty SJ, McIntyre PB, Barnes CJ. Rabies. A second Australian case with a long incubation period. *Med J Aust* 1992;156(9):651–654.

46. Fenner F, Henderson D, Arita I, Jezek Z, Ladnyi I. Smallpox and its eradication. Geneva, Switzerland; 1988.

47. Australian Government Department of Health and Ageing. Guidelines for smallpox outbreak, preparedness, response and management. 2004. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/FD73F6A81331E729CA256F190004427D/$File/smallpox.pdf

48. Miller M, Roche P, Yohannes K, Spencer J, Bartlett M, Brotherton J, et al. Australia's notifiable diseases status, 2003: Annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell* 2005;29(1):1–61.

49. World Health Organization. Cumulative number of confirmed human cases of avian influenza A(H5N1) reported to WHO. 2013. Available from: http://www.who.int/influenza/human_animal_interface/H5N1_cumulative_table_archives/en/index.html

50. Curran M, Harvey B, Crerar S. Annual report of the National Notifiable Diseases Surveillance System, 1996. *Commun Dis Intell* 1997;21:281–307.

51. Forssman B, Mannes T, Musto J, Gottlieb T, Robertson G, Natoli JD, et al. *Vibrio cholerae* O1 El Tor cluster in Sydney linked to imported whitebait. *Med J Aust* 2007;187(6):345–347.

52. Geisler W, Lensing S, Press C, Hook EW, 3rd. Spontaneous resolution of genital *Chlamydia trachomatis* infection in women and protection from reinfection. *J Infect Dis* 2013;207(12):1850–1856.

53. Victoria Department of Health. Blue book: Guidelines for the control of infectious diseases. 2009. Accessed on 3 April 2014. Available from: http://ideas.health.vic.gov.au/bluebook/

54. Australasian Society for HIV Medicine. *HIV, viral hepatitis and STIs: a guide for primary care providers*. Darlinghurst: Australasian Society for HIV Medicine; 2014.

55. Bowden FJ, on behalf of the National Donovanosis Eradication Advisory Committee. Donovanosis in Australia: going, going... *Sex Transm Infect* 2005;81(5):365–366.

56. Roberts-Witteveen A, Pennington K, Higgins N, Lang C, Lahra M, Waddell R, et al. Epidemiology of gonorrhoea notifications in Australia, 2007–12. *Sex Health* 2014;11(4):324–331.

57. Lahra M. Australian Gonococcal Surveillance Programme annual report, 2014. *Commun Dis Intell* 2015;39(3):E347–E354.

58. Prestage G, Ferris J, Grierson J, Thorpe R, Zablotska I, Imrie J, et al. Homosexual men in Australia: population, distribution and HIV prevalence. *Sex Health* 2008;5(2):97–102.

59. Allen K, Guy R, Leslie D, Goller J, Medland N, Roth N, et al. The rise of infectious syphilis in Victoria and the impact of enhanced clinical testing. *Aust N Z J Public Health* 2008;32(1):38–42.

60. Australian Broadcasting Corporation. Mount Isa health unit battles rise in syphilis rates. 2014. Accessed on 27 July 2015. Available from: http://www.abc.net.au/news/2014–12–03/mount-isa-health-unit-not-expecting-short-term/5936434

61. Centre for Disease Control Northern Territory. Syphilis outbreak in the NT: 2015 update. *The Northern Territory Disease Control Bulletin* 2015;22(1):1–30.

62. Oaten J. Syphilis outbreak among Northern Territory Indigenous youth prompts fears for unborn children. 2015. Accessed on 28 July 2015. Available from: http://www.abc.net.au/news/2015–07–12/syphilis-outbreak-nt-indigenous-youth-prompts-fears-for-unborn/6613514

63. Baskin B. Queensland remote area health staff are struggling with a syphilis outbreak. *The Daily Telegraph* 7 August 2012.

64. Ward J, Guy RJ, Akre S, Middleton M, Giele C, Su J, et al. Epidemiology of syphilis in Australia: moving toward elimination of infectious syphilis from Aboriginal and Torres Strait Islander communities? *Med J Aust* 2011;194(10):525–529.

65. Australian Government Department of Health. *Fourth National Aboriginal and Torres Strait Islander Blood-borne Viruses and Sexually Transmissible Infections Strategy, 2014–2014*. Canberra: Australian Government Department of Health; 2014.

66. Australian Government Department of Health. *Third National Sexually Transmissible Infections Strategy 2014–2017*. Canberra: Australian Government Department of Health; 2014.

67. Impact of vaccines universally recommended for children. 1900–1998. *MMWR Morb Mortal Wkly Rep* 1999;48(12):243–248.

68. Andre FE, Booy R, Bock HL, Clemens J, Datta SK, John TJ, et al. Vaccination greatly reduces disease, disability, death and inequity worldwide. *Bull World Health Organ* 2008;86(2):81–60.

69. Ehreth J. The global value of vaccination. *Vaccine* 2003;21(7–8):596–600.

70. Préziosi M, Halloran ME. Effects of pertussis vaccination on disease: Vaccine efficacy in reducing clinical severity. *Clin Infect Dis* 2003;37(6):772–779.

71. Schlenker TL, Bain C, Baughman AL, Hadler SC. Measles herd immunity: the association of attack rates with immunization rates in preschool children. *JAMA* 1992;267(6):823–826.

72. Punpanich W, Chotpitayasunondh T. A review on the clinical spectrum and natural history of human influenza. *Int J Infect Dis* 2012;16(10):e714–e723.

73. Carrat F, Vergu E, Ferguson NM, Lemaitre M, Cauchemez S, Leach S, et al. Time lines of infection and disease in human influenza: a review of volunteer challenge studies. *Am J Epidemiol* 2008;167:775–785.

74. Mauskopf J, Klesse M, Lee S, Herrera-Taracena G. The burden of influenza complications in different high-risk groups: a targeted literature review. *J Med Econ* 2013;16(2):264–277.

75. Bennett JE, Dolin R, Blaser MJ. *Principles and Practice of Infectious Diseases*. 8th edn: Elsevier Health Sciences; 2014.

76. de Jong MD, Thanh TT, Khanh TH, Hien VM, Smith GJD, Chau NV, et al. Oseltamivir resistance during treatment of influenza A (H5N1) infection. *N Engl J Med* 2005;353(25):2667–2672.

77. National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases. *Haemophilus influenzae* type b (Hib) vaccines for Australian children, NCIRS Fact sheet: October 2009. Sydney: National Centre for Immunisation Research and Surveillance for Vaccine Preventable Diseases; 2009.

78. Chandran A, Watt J, Santosham M. *Haemophilus influenzae*. In: Plotkin SA, Orenstein WA, Offit PA, editors. *Vaccines*. Philadelphia, PA, USA: Saunders Elsevier; 2008.

79. National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases. Significant events in pneumococcal vaccination practice in Australia. 2015. Accessed on 26 May 2015. Available from: http://ncirs.edu.au/immunisation/history/Pneumococcal-history-March-2015.pdf

80. Centers for Disease Control and Prevention. Measles. In: Atkinson W, Wolfe C, Hamborsky J, eds. *Epidemiology and prevention of vaccine preventable diseases*. 12th edn. Washington, D.C.: Public Health Foundation; 2011.

81. World Health Organization. Measles Fact Sheet Fact sheet N°286. Updated November 2015. Accessed November 2015. Available from: http://www.who.int/mediacentre/factsheets/fs286/en/

82. Strebel P, Papania M, Dayan G, Halsey N. Vaccines. In: Plotkin SA, Orenstein WA, Offit PA, editors. Philadelphia: Saunders Elsevier; 2008.

83. Heywood AE, Gidding HF, Riddell MA, McIntyre PB, MacIntyre CR, Kelly HA. Elimination of endemic measles transmission in Australia. *Bull World Health Organ* 2009;87(1):64–71.

84. Gidding H, Wood J, MacIntyre CR, Kelly H, Lambert SB, Gilbert GL, et al. Sustained measles elimination in Australia and priorities for long-term maintenance. *Vaccine* 2007;25(18):3574–3580.

85. Gidding HF, Gilbert GL. Measles immunity in young Australian adults. *Commun Dis Intell* 2001;25(3):133–136.

86. de Serres G, Gay NJ, Farrington CP. Epidemiology of transmissible diseases after elimination. *Am J Epidemiol* 2000;151(11):1039–1048.

87. World Health Organization. Four Western Pacific countries and areas are the first in their Region to be measles-free. 2014. Available from: http://www.wpro.who.int/mediacentre/releases/2014/20140320/en/

88. Plotkin SA, Rubin S. *Mumps vaccine*. 5th edn. Philadelphia, PA: Saunders Elsevier; 2008.

89. Deeks S, Lim G, Simpson M, Gagné L, Kristjanson E, Fung C, et al. An assessment of mumps vaccine effectiveness by dose during an outbreak in Canada. *Can Med Assoc J* 2011;183(9):1014–1020.

90. Demicheli V, Rivetti A, Debalini M, Di Pietrantonj C. Vaccines for measles, mumps and rubella in children. *Cochrane Database Sys Rev* 2012;2:CD004407.

91. Gupta R, Best J, MacMahon E. Mumps and the UK epidemic 2005. *BMJ* 2005;330:1132–1135.

92. Dayan GH, Quinlisk MP, Parker AA, Barskey AE, Harris ML, Schwartz JM, et al. Recent resurgence of mumps in the United States. *N Engl J Med* 2008;358(15):1580–1589.

93. Whelan J, Van Binnendijk R, Greenland K, Fanoy E, Kharqi M, Yap K, et al. Ongoing mumps outbreak in a student population with high vaccination coverage, Netherlands. *Euro Surveill* 2010;15(17):pii:19554.

94. Cohen C, White JM, Savage EJ, Glynn JR, Choi Y, Andrews N, et al. Vaccine effectiveness estimates, 2004–2005 mumps outbreak, England. *Emerg Infect Dis* 2007;13(1):12–17.

95. Pertussis. In: Atkinson W, Wolfe C, Hamborsky J, editors. *Epidemiology and prevention of vaccine preventable diseases*. 12th edn. Washington, DC: Public Health Foundation, Centers for Disease Control and Prevention; 2011.

96. Communicable Diseases Network Australia. Series of National Guidelines – Pertussis. 2013. Accessed March 2015. Available from: https://www.health.gov.au/internet/main/publishing.nsf/Content/cdna-song-pertussis.htm

97. Quinn H, McIntyre PB. Impact of removal of the 18 month DTPa dose on pertussis vaccine effectiveness. *12th National Immunisation Conference*. Adelaide, South Australia; 2010.

98. Quinn HE, Snelling TL, Macartney KK, McIntyre PB. Duration of protection after first dose of acellular pertussis vaccine in infants. *Pediatrics* 2014;133(3):e513–e519.

99. Sheridan SL, McCall BJ, Davis CA, Robson JM, Hull BP, Selvey CE, et al. Acellular pertussis vaccine effectiveness for children during the 2009–2010 pertussis epidemic in Queensland. *Med J Aust* 2014;200(6):334–338.

100. Wendelboe AM, van Rie A, Salmaso S, Englund JA. Duration of immunity against pertussis after natural infection or vaccination. *Pediatr Infect Dis J* 2005;24(5 Suppl):S58–S61.

101. Munoz FM. Pertussis in infants, children, and adolescents: diagnosis, treatment, and prevention. *Semin Pediatr Infect Dis* 2006;17(1):14–19.

102. McLean H, Redd S, Abernathy E, Icenogle J, Wallace G. Chapter 15: Congenital rubella syndrome. In: *Manual for the Surveillance of Vaccine-Preventable Diseases*. Atlanta: Centers for Disease Control and Prevention; 2012.

103. Song N, Gao Z, Wood J, Hueston L, Gilbert C, MacIntyre R, et al. Current epidemiology of rubella and congenital rubella syndrome in Australia: Progress towards elimination. *Vaccine* 2012;30(27):4073–4078.

104. Western Pacific Regional Office. *Rubella and congenital rubella syndrome* Geneva: World Health Organization; 2012.

105. Khandaker G, Zyrynski Y, Jones C. Surveillance for congenital rubella syndrome in Australia since 1993: cases reported between 2004 and 2013. *Vaccine* 2014;32(50):6746–6751.

106. Quinn H, McIntyre P. Tetanus in the elderly – An important preventable disease in Australia. *Vaccine* 2007;25(7):1304–1309.

107. Mackenzie JS, Lindsay MD, Coelen RJ, Broom AK, Hall RA, Smith DW. Arboviruses causing human disease in the Australasian zoogeographic region. *Arch Virol* 1994;136(3–4):447–467.

108. Russell RC, Dwyer DE. Arboviruses associated with human disease in Australia. *Microbes Infect* 2000;2(14):1693–1704.

109. Viennet E, Knope K, Faddy H, Williams C, Harley D. Assessing the threat of chikungunya emergence in Australia. *Commun Dis Intell* 2013;37(2):E136–E143.

110. Knope K, Kurucz N, Doggett S, Muller M, Johansen C, Feldman R, et al. Arboviral diseases and malaria in Australia, 2012–13: annual report of the National Arbovirus and Malaria Advisory Committee. *Commun Dis Intell* 2016;40(1):E17–E47.

111. Communicable Diseases Network Australia. Australian National Notifiable Diseases case definitions. 2014. Accessed on 5 September 2015. Available from: http://www.health.gov.au/casedefinitions

112. Therapeutic Goods Administration. Product recall, Panbio Barmah Forest virus IgM ELISA. An *in vitro* diagnostic medical device (IVD). Recall no. RC-2013-RN-00967-1,13/09/2013. 2013. Accessed on 6 May 2014. Available from: http://www.tga.gov.au/SARA/arn-detail.aspx?k=RC-2013-RN-00967-1

113. Rich G, McKechnie J, McPhan I, Richards B. Laboratory diagnosis of Ross River virus infection. *Commun Dis Intell* 1993;17(10):208–209.

114. Selvey LA, Donnelly JA, Lindsay MD, Pottumarthy Boddu S, D'Abrera VC, Smith DW. Ross River virus infection surveillance in the Greater Perth Metropolitan Area – has there been an increase in cases in the winter months? *Commun Dis Intell* 2014;38(2):E114–E122.

115. Guzman MG, Kouri G, Martinez E, Bravo J, Riveron R, Soler M, et al. Clinical and serologic study of Cuban children with dengue hemorrhagic fever/dengue shock syndrome (DHF/DSS). *Bull Pan Am Health Organ* 1987;21(3):270–279.

116. Vaughn DW, Green S, Kalayanarooj S, Innis BL, Nimmannitya S, Suntayakorn S, et al. Dengue viremia titer, antibody response pattern, and virus serotype correlate with disease severity. *J Infect Dis* 2000;181(1):2–9.

117. Mackenzie JS, Gubler DJ, Petersen LR. Emerging flaviviruses: the spread and resurgence of Japanese encephalitis, West Nile and dengue viruses. *Nat Med* 2004;10(12 Suppl):S98–S109.

118. Souarès Y, Pacific Public Health Surveillance Network. Telehealth and outbreak prevention and control: the foundations and advances of the Pacific Public Health Surveillance Network. *Pac Health Dialog* 2000;7(2):11–28.

119. Hanna JN, Ritchie SA, Richards AR, Humphreys JL, Montgomery BL, Ehlers GJ, et al. Dengue in north Queensland, 2005–2008. *Commun Dis Intell* 2009;33(2):198–203.

120. Queensland Health. *Queensland Dengue Management Plan 2010–2015, 2011*. Queensland: Queensland Health.

121. Knope K, National Arbovirus and Malaria Advisory Committee, Giele C. Increasing notifications of dengue related to overseas travel, 1991 to 2012. *Commun Dis Intell* 2013;37(1):E55–E59.

122. Hanna JN, Ritchie SA, Phillips DA, Lee JM, Hills SL, van den Hurk AF, et al. Japanese encephalitis in north Queensland, Australia, 1998. *Med J Aust* 1999;170(11):533–536.

123. Knope K, Whelan P, Smith D, Johansen C, Moran R, Doggett S, et al. Arboviral diseases and malaria in Australia, 2010–11: annual report of the National Arbovirus and Malaria Advisory Committee. *Commun Dis Intell* 2013;37(1):E1–E20.

124. Knox J, Cowan R, Doyle J, Ligtermoet M, Archer J, Burrow J, et al. Murray Valley encephalitis: a review of clinical features, diagnosis and treatment. *Med J Aust* 2012;196(5):322–326.

125. Roche S, Wicks R, Garner M, East IJ, Paskin R, Moloney BJ, et al. Descriptive overview of the 2011 epidemic of arboviral disease in horses in Australia. *Aust Vet J* 2013;91(1–2):5–13.

126. Frost MJ, Zhang J, Edmonds JH, Prow NA, Gu X, Davis R, et al. Characterization of virulent West Nile virus Kunjin strain, Australia, 2011. *Emerg Infect Dis* 2012;18(5):792–800.

127. *Plasmodium knowlesi* malaria in humans is widely distributed and potentially life threatening. *Clin Infect Dis* 2008;46(2):165–171. doi: 110.1086/524888.

128. World Health Organization. Synopsis of the world malaria situation in 1981. *Wkly Epidemiol Rec* 1983;58(26):197–199.

129. Leder K, Torresi J, Brownstein JS, Wilson ME, Keystone JS, Barnett E, et al. Travel-associated illness trends and clusters, 2000–2010. *Emerg Infect Dis* 2013;19(7):1049–1073.

130. Gray TJ, Trauer JM, Fairley M, Krause VL, Markey PG. Imported malaria in the Northern Territory, Australia—428 consecutive cases. *Commun Dis Intell* 2012;36(1):107–113.

131. Hanna JN, Ritchie SA, Eisen DP, Cooper RD, Brookes DL, Montgomery BL. An outbreak of *Plasmodium vivax* malaria in Far North Queensland, 2002. *Med J Aust* 2004;180(1):24–28.

132. World Health Organization. Zoonoses. Technical report series no. 169. Geneva, Switzerland: World Health Organization; 1959.

133. Taylor LH, Latham SM, Woolhouse ME. Risk factors for human disease emergence. *Philos Trans R Soc Lond B Biol Sci* 2001;356(1411):983–989.

134. Jones KE, Patel NG, Levy MA. Global trends in emerging infectious diseases. *Nature* 2008(451):990–994.

135. Woolhouse MEJ, Gowtage-Sequeria S. Host range and emerging and re-emerging pathogens. *Emerg Infect Dis* 2005;11(12):1842–1847.

136. World Health Organization. Report of the WHO/FAO/OIE joint consultation on emerging zoonotic diseases. Geneva, Switzerland: World Health Organization; 2004.

137. Animal Health Australia. Animal Health in Australia, 2014. Canberra: Animal Health Australia; 2015.

138. Kolbe A, Yuen M, Doyle B. A case of human cutaneous anthrax. *Med J Aust* 2006;185(5):281–282.

139. Fielding J. Zoonoses: Anthrax. *Victorian Infectious Diseases Bulletin* 2007;10(2):47.

140. NSW Department of Health. Communicable Diseases Report, NSW, January and February 2010. *N S W Public Health Bull* 2010;21(3–4):103–107.

141. Calisher CH, Ellison JA. The other rabies viruses: The emergence and importance of lyssaviruses from bats and other vertebrates. *Travel Med Infect Dis* 2012;10(2):69–79.

142. Fraser GC, Hooper PT, Lunt RA, Gould AR, Gleeson LJ, Hyatt AD, et al. Encephalitis caused by a lyssavirus in fruit bats in Australia. *Emerg Infect Dis* 1996;2(4):327–331.

143. Hooper PT, Lunt RA, Gould AR, Samaratunga H, Hyatt AD, Gleeson LJ, et al. A new lyssavirus — the first endemic rabies-related virus recognized in Australia. *Bulletin de l'Institut Pasteur* 1997;95(4):209–218.

144. Communicable Diseases Network Australia. Series of National Guidelines: Rabies virus and other lyssavirus including Australian bat lyssavirus) exposures and infections. 2013. Accessed on 7 June 2015. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/cdna-song-abvl-rabies.htm

145. Allworth A, Murray K, Morgan J. A human case of encephalitis due to a lyssavirus recently identified in fruit bats. *Commun Dis Intell* 1996;20(24):504.

146. Hanna JN, Carney IK, Smith GA, Tannenberg AEG, Deverill JE, Botha JA, et al. Australian bat lyssavirus infection: a second human case, with long incubation period. *Med J Aust* 2000;172(12):597–599.

147. Francis JR, Nourse C, Vaska VL, Calvert S, Northill JA, McCall B, et al. Australian bat lyssavirus in a child: The first reported case. *Pediatrics* 2014;133(4):e1063–1067.

148. Queensland Department of Agriculture. Australian bat lyssavirus overview. In: *Animal Health and Diseases*: Queensland Government; 2013.

149. Crook A. Australian bat lyssavirus communiqué. Department of Agriculture, Fisheries and Forestry; 2013.

150. Bat Health Focus Group. ABLV Bat Stats, Australian Bat Lyssavirus report – December 2014. *Wildlife Health Australia* 2015.

151. Eales KM, Norton RE, Ketheesan N. Brucellosis in northern Australia. *Am J Trop Med Hyg* 2010;83(4):876–878.

152. Levett PN. Leptospirosis. *Clin Microbiol Rev* 2001;14(2):296–326.

153. World Health Organization, Society IL. Human Leptospirosis: Guidance for Diagnosis, Surveillance and Control; 2003.

154. O'Leary FM, Hunjan JS, Bradbury R, Thanakrishnan G. Fatal leptospirosis presenting as musculoskeletal chest pain. *Med J Aust* 2004;180(1):29–31.

155. Beeckman DS, Vanrompay DC. Zoonotic *Chlamydophila psittaci* infections from a clinical perspective. *Clin Microbiol Infect* 2009;15(1):11–17.

156. Deschuyffeleer TP, Tyberghien LF, Dickx VL, Geens T, Saelen JM, Vanrompay DC, et al. Risk assessment and management of *Chlamydia psittaci* in poultry processing plants. *Ann Occup Hyg* 2012;56(3):340–349.

157. McCaul TF, Williams JC. Developmental cycle of *Coxiella burnetii:* structure and morphogenesis of vegetative and sporogenic differentiations. *J Bacteriol* 1981;147(3):1063–1076.

158. Lowbridge CP, Tobin S, Seale H, Ferson MJ. Notifications of Q fever in NSW, 2001–2010. *N S W Public Health Bull* 2012;23(1–2):31–35.

159. Bell M, Patel M, Sheridan J. Q fever vaccination in Queensland abattoirs. *Commun Dis Intell* 1997;21(3):29–31.

160. Lin M, Delpech V, McAnulty J, Campbell-Lloyd S. Notifications of Q fever in New South Wales, 1991–2000: EpiReview. *N S W Public Health Bull* 2001;12(6):172–175.

161. Gidding HF, Wallace C, Lawrence GL, McIntyre PB. Australia's National Q Fever Vaccination Program. *Vaccine* 2009;27(14):2037–2041.

162. Ellis J, Oyston PC, Green M, Titball RW. Tularemia. *Clin Microbiol Rev* 2002;15(4):631–646.

163. Jackson J, McGregor A, Cooley L, Ng J, Brown M, Ong CW, et al. *Francisella tularensis* subspecies holarctica, Tasmania, Australia, 2011. *Emerg Infect Dis* 2012;18(9):1484–1486.

164. Veitch M. The public health response to tularaemia in Tasmania. *Communicable Disease Control Conference 2013*. Canberra, Australia; 2013.

165. NNDSS Annual Report Writing Group. Australia's notifiable disease status, 2011: Annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell* 2013;37(4):E313–E393.

166. de Jong B. *Legionella,* springtime and potting soils. *Euro Surveill* 2010;15(8):19497.

167. O'Connor BA, Carman J, Eckert K, Tucker G, Givney R, Cameron S. Does potting mix make you sick? Results for a *Legionella longbeachae* case–control study in South Australia. *Epidemiol Infect* 2007;135(1):34–39.

168. Pravinkumar SJ, Edwards G, Lindsay D, Redmond S, Stirling J, House R, et al. A cluster of Legionnaires' disease caused by *Legionella longbeachae* linked to potting compost in Scotland, 2008–2009. *Euro Surveill* 2010;15(8):19496.

169. Whiley H, Bentham R. *Legionella longbeachae* and legionellosis. *Emerg Infect Dis* 2011;17(4):579–583.

170. Li J, O'Brien ED, Guest C. A review of national legionellosis surveillance in Australia, 1991 to 2000. *Commun Dis Intell* 2002;26:462–470.

171. Rota MC, Caporal MG, Bella A, Ricci ML, Napoli C. Legionnaires disease in Italy: results of the epidemiological surveillance from 2000 to 2011. *Euro Surveill* 2013;18(23).

172. World Health Organization. Leprosy – Fact Sheet No. 101. 2015. Accessed on 19 June 2015. Available from: http://www.who.int/mediacentre/factsheets/fs101/en/

173. Communicable Diseases Network Australia. Meningococcal disease (invasive) surveillance case definition – V1.4. 2009. Accessed on 6 July 2015. Available from: http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-surveil-nndss-case-defs-cd_mening.htm

174. Jafri RZ, Ali A, Messonnier NE, Tevi-Benissan C, Durrheim D, Eskola J, et al. Global Epidemiology of invasive meningococcal disease. *Population Health Metrics* 2013;11(17).

175. Lahra MM, Enriquez R. Annual Report of the Australian Meningococcal Surveillance Programme, 2014. *Commun Dis Intell* 2015:In press.

176. Bareja C, Waring J, Stapledon R, National Tuberculosis Advisory Committee for the Communicable Diseases Network Australia. Tuberculosis notifications in Australia, 2010. *Commun Dis Intell* 2014;38(1):E36–E48.

177. Luca S, Mihaescu T. History of BCG Vaccine. *Maedica (Burchar)* 2013;8(1):53–58.

178. Public Health England. Tuberculosis: the green book, chapter 32. In: *Immunisation against infectious disease* London: Department of Health; 2013. p. 394.

179. National Tuberculosis Advisory Committee. The BCG vaccine: Information and recommendations for use in Australia. *Commun Dis Intell* 2013;37(1):E65–E72.