Communicable Diseases Network Australia: National Arbovirus and Malaria Advisory Committee annual report 2004–05

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Abstract

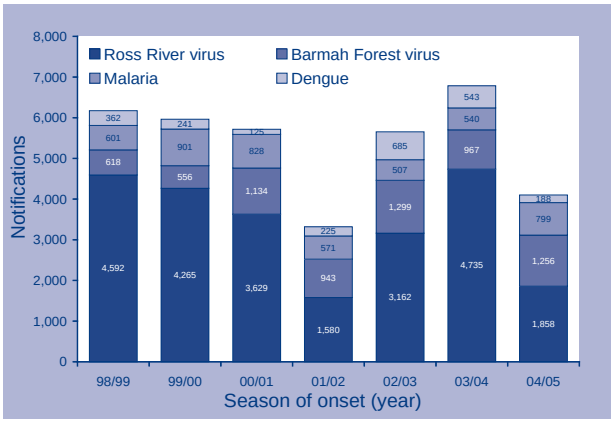
This report describes the epidemiology of mosquito-borne disease in Australia for the mosquito-borne disease season 1 July 2004 to 30 June 2005. Ross River virus (RRV) infections (45%), Barmah Forest virus (BFV) infections (30%) and malaria (19%) were the most common mosquito-borne diseases reported in 2004–05. The Northern Territory had the highest rate of RRV notifications and the peak notification rate (in February 2005) was 54 per cent less than the previous season. The Northern Territory also reported the highest BFV notification rate this season, peaking in April 2005, which was the second highest reported BFV notification rate since 1998. National RRV and BFV notification rates were highest in the 45–49 year age group. There were 799 notifications of malaria in 2004–05 of which none were reported as locally acquired. This was the third highest reporting season for malaria notifications since 1998. In contrast to previous years in which *Plasmodium vivax* was the predominant species, *Plasmodium falciparum* was reported as the infecting species in 57 per cent of the malaria notifications and *Plasmodium vivax* for 34 per cent of cases. Children in the 5–9 year age group had the highest number of cases compared to previous years in which the peak number of cases tended to be in young adult age groups. There were four cases of Kunjin virus (KUNV) and two cases of Murray Valley encephalitis virus (MVEV) reported in 2004–05. Sentinel chicken surveillance data for flaviviruses and sentinel pig surveillance data for Japanese encephalitis virus are reported. There were 188 notifications of dengue virus infection (DENV) in 2004–05, of which 46 per cent (n=86) were reported as having been acquired overseas. Dengue serotype 4 was the most frequently reported type, accounting for 32 per cent of cases (n=60). *Commun Dis Intell* 2005;29:341–357.

Notifications

Historical data from 1998 are also shown for comparison. Data were extracted by onset date from the National Notifiable Diseases Surveillance System (NNDSS) on 4 August 2005. During this reporting period, there were 4,127 notifications of mosquito-borne diseases (MBD) reported in Australia. Ross River virus infections accounted for 45 per cent (n=1,858) of these notifications (Appendix 1).

Figure 1 shows that the next two highest contributors to MBD notifications in 2004–05 were Barmah Forest virus infections (30% of total, n=1,256) and malaria (19%, n=799). Overall, total MBD notifications during 2004–05 were much lower than the 2002–03 and 2003–04 seasons, and were similar to the 2001–02 season.

Figure 1. Notifications of select mosquito-borne diseases, Australia, 1998 to 2005, by season of onset



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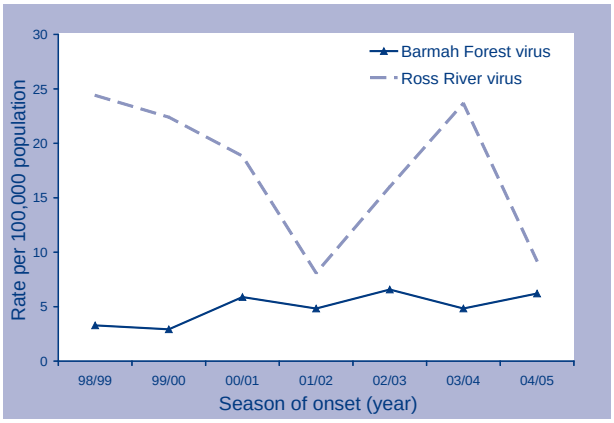
The national notification rates for RRV and BFV in 2004–05 were 9.2 cases per 100,000 population and 6.2 cases per 100,000 population, respectively (Appendix 1).

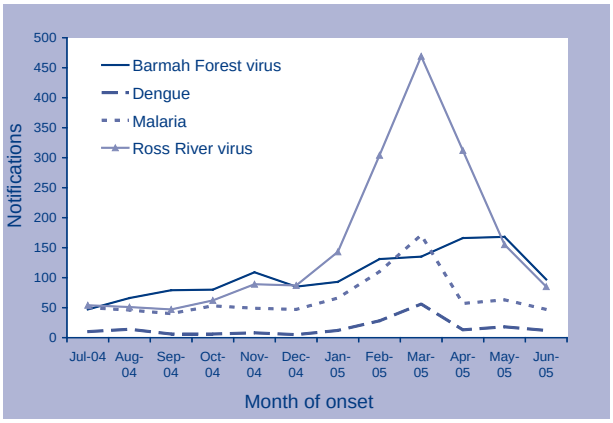
Figure 2 shows that there was a reduction in the rate of notifications for RRV infections in the 2004–05 season compared to last season and similar to the rate reported in 2001–02. The notification rate for BFV has remained relatively stable over the last six seasons.

Figure 2. Notification rate of select mosquito-borne diseases, Australia, 1998 to 2005, by season of onset



During the 2004–05 MBD season (1 July 2004 to 30 June 2005), the highest number of notifications for RRV, malaria and DENV were received in March (Appendix 2, Figure 3). BFV notifications rose steadily from July 2004 to reach the highest number of notifications for the season in April-May 2005.

Figure 3. Notifications of select mosquito-borne diseases, Australia, 1 July 2004 to 30 June 2005, by month of onset



Alphaviruses

During 2004–05, the Northern Territory had the highest rates of BFV notifications (21.4 cases per 100,000 population) and RRV notifications (89.1 cases per 100,000 population) (Table 1). Queensland reported the second highest notification rate for BFV (17.2 cases per 100,000 population) and RRV (25.9 cases per 100,000 population).

Ross River virus infection

The number of notifications of RRV infection began to rise in the Northern Territory during October 2004, peaking in February 2005. High rates of infection were reported, between two and eighteen times above the national rate (Figure 4). The Northern Territory peak notification rate in February 2005 (328.7 per 100,000 population) was 54 per cent less than the previous season, but similar to the 1998–99, 1999–00 and 2002–03 seasons.

Table 1. Number and crude annual rate of Barmah Forest virus and Ross River virus notifications, Australia, 1 July 2004 to 30 June 2005, by jurisdiction

Jurisdiction	Barmah Forest virus		Ross River virus	
	Notifications	Rate (per 100,000)	Notifications	Rate (per 100,000)
ACT	2	0.6	5	1.5
NSW	432	6.4	430	6.4
NT	43	21.4	179	89.1
Qld	675	17.2	1,014	25.9
SA	18	1.2	49	3.2
Tas	0	0.0	5	1.0
Vic	22	0.4	35	0.7
WA	64	3.2	141	7.1
Australia	1,256	6.2	1,858	9.2

Figure 4. Annualised notification rates for Ross River virus infection, select jurisdictions, July 1998 to June 2005, by month and season of onset

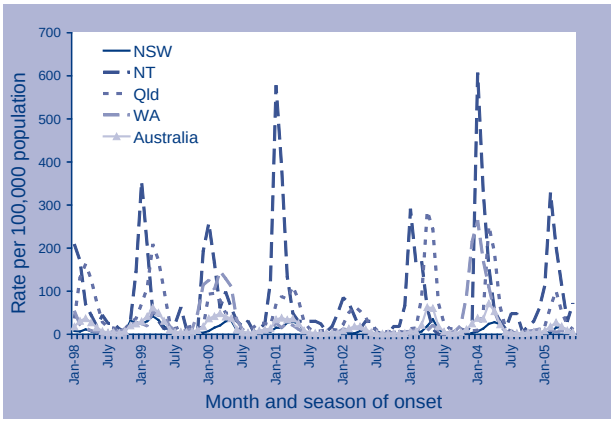
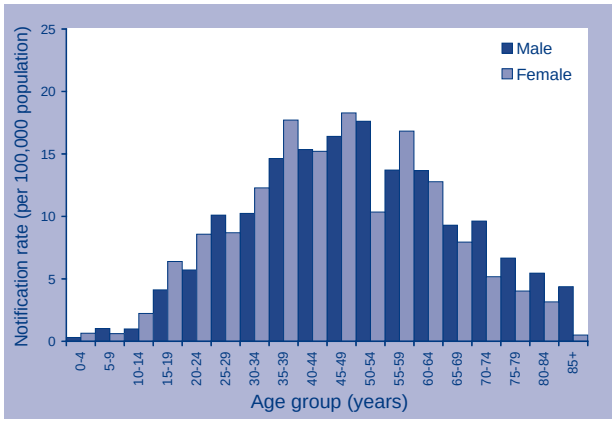


Figure 5. Notification rates for Ross River virus infections, Australia, 1 July 2004 to 30 June 2005, by age group and sex



Queensland reported a similar pattern but lower rates of RRV infection, with increases beginning in December 2004, peaking in March 2005 and subsiding in June 2005. Queensland's peak RRV rate was a 35–40 per cent decrease compared to the peak seasonal rates in April 2003, and March 2004.

In contrast to last season, the rate of RRV notifications in Western Australia remained around the national average throughout the reporting period.

The rate of national notifications for RRV was highest in the 45–49 age group (Figure 5). Females in the 45–49 and the 35–39 age groups, had the highest national notification rates (18.3 cases per 100,000 population and 17.7 cases per 100,000 population respectively, Appendix 3). The highest male national notification rate was reported in the 50–54 age group (17.6 cases per 100,000 population).

In general, state and territories showed similar age and sex distribution patterns, noting that small population sizes in older age groups in some jurisdictions can affect reporting rates (as small changes in the numerator lead to large changes in the overall rate).

Queensland, Western Australia and the Northern Territory reported higher age-specific RRV notification rates in females than in males (Appendix 3). New South Wales reported the highest notification rates in the 45–49 year age group (Figure 6), with males having higher notification rates than females in the same age group (14.8 and 11.7 cases per 100,000 population). The sex ratio for this age cohort was 99.3 males per 100 females.

In Queensland, the highest notification rates were reported in females in the 35–39 year age group (58 cases per 100,000 population) and in males in the 40–44 year age group (49.2 cases per 100,000 population) (Figure 7).

Figure 6. Notification rate for Ross River virus infections, New South Wales, 1 July 2004 to 30 June 2005, by age group and sex

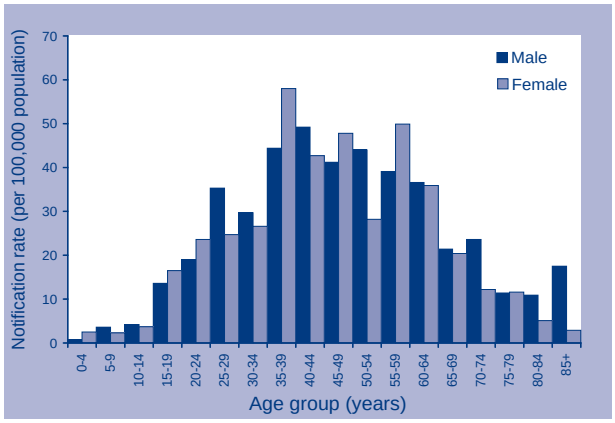
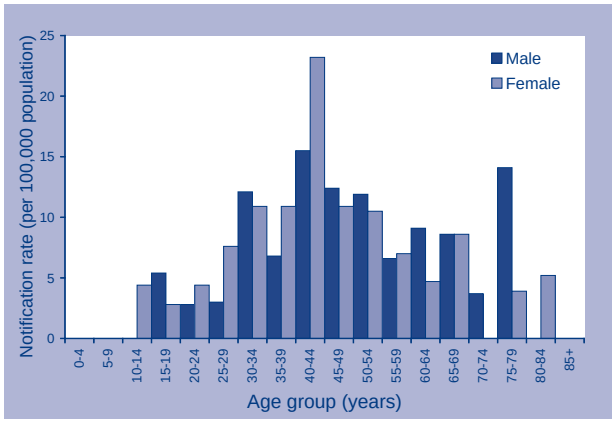


Figure 7. Notification rate for Ross River virus infections, Queensland, 1 July 2004 to 30 June 2005, by age group and sex



In Western Australia, the highest notification rates were reported from the 40–44 year age group for both sexes (males 15.5 cases per 100,000; females 23.2 cases per 100,000 population) (Figure 8). The Northern Territory reported the highest female notification rate in the 45–49 year age group (161.8 cases per 100,000 population) while the highest male notification rates (161.8 cases per 100,000 population) were reported in the same 40–44 year age group as Queensland and Western Australia (Figure 9). The overall higher notification rates in females were particularly striking given that the sex ratio in the Northern Territory was 111 males per 100 females.

Figure 8. Notification rate for Ross River virus infections, Western Australia, 1 July 2004 to 30 June 2005, by age group and sex

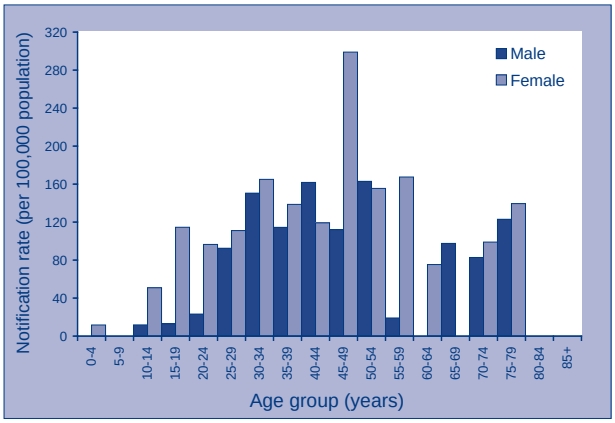
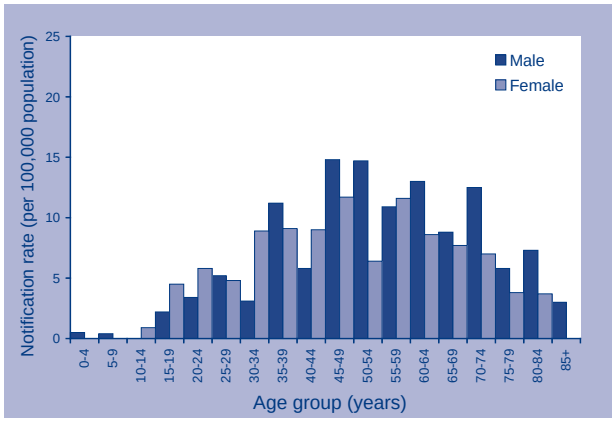


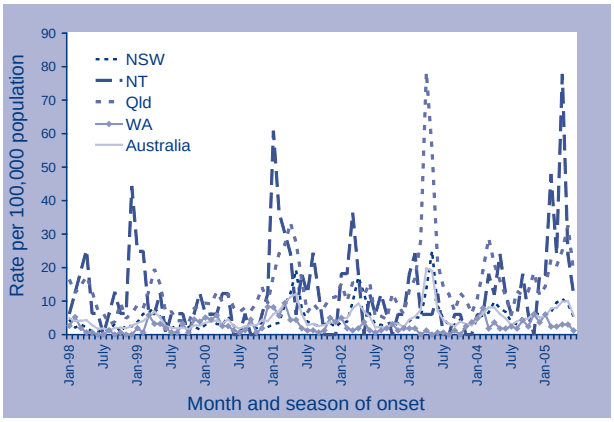
Figure 9. Notification rate for Ross River virus infections, Northern Territory, 1 July 2004 to 30 June 2005, by age group and sex



Barmah Forest virus infections

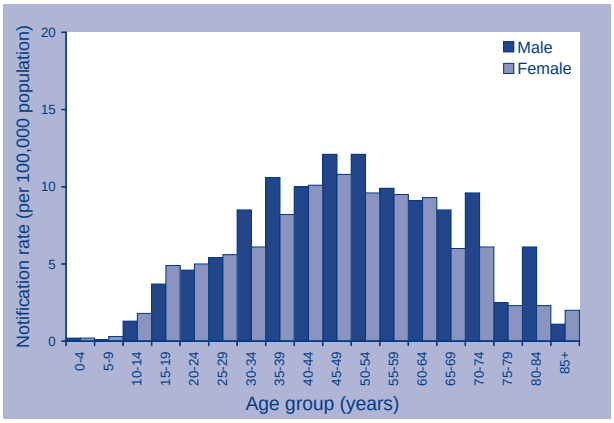
Queensland reported the highest number of BFV notifications (n=675) for this period whereas the Northern Territory had the highest crude annual rate of BFV infection (21.4 cases per 100,000 population) (Table 1). The monthly annualised BFV notification rate for the Northern Territory increased gradually from August 2004 and peaked in April 2005 (Table 1, Figure 10), to a rate of 77.7 cases per 100,000 population. This was the second highest reported BFV notification rate since 1998, with Queensland reporting the highest monthly annualised BFV notification rate in April 2003 (78.4 cases per 100,000 population).

Figure 10. Annualised notification rates for Barmah Forest virus infections, select jurisdictions, July 1998 to June 2005, by month and season of onset



The age group and sex distribution of BFV cases is similar to that of RRV with the majority reported in adults. The national rate of notifications for BFV was highest amongst the 45–49 year age group (11.4 cases per 100,000 population), with males and females in this age group having the highest national age specific rates (Figure 11, Appendix 4). High rates of national BFV notifications were also recorded for the 50–54 year age group in males (12.1 cases per 100,000 population).

Figure 11. Notification rate for Barmah Forest virus infections, Australia, 1 July 2004 to 30 June 2005, by age group and sex



New South Wales, Queensland and Western Australia reported the highest age-specific BFV notification rates as being in males (Figures 12, 13, and 14, Appendix 4). In Western Australia, the highest notification rate was reported in males in the 70–74 year age group while in the Northern Territory, the highest rate was observed in both males and females (Figure 15).

Figure 12. Notification rate for Barmah Forest virus infections, New South Wales, 1 July 2004 to 30 June 2005, by age group and sex

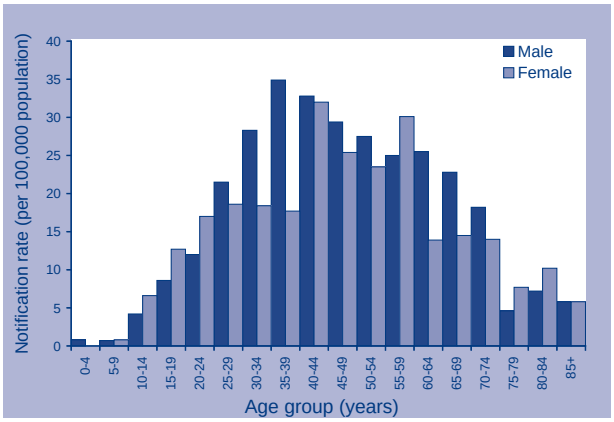
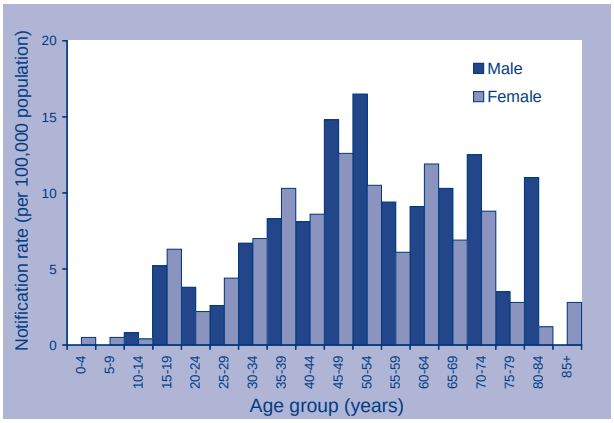


Figure 13. Notification rate for Barmah Forest virus infections, Queensland, 1 July 2004 to 30 June 2005, by age group and sex



Flaviviruses

The Sentinel Chicken Surveillance Programme is a network involving New South Wales, Queensland, the Northern Territory, Victoria and Western Australia, and is designed to detect flavivirus activity (including the endemic arboviruses MVEV and KUNV).[1]

Figure 14. Notification rate for Barmah Forest virus infections, Western Australia, 1 July 2004 to 30 June 2005, by age group and sex

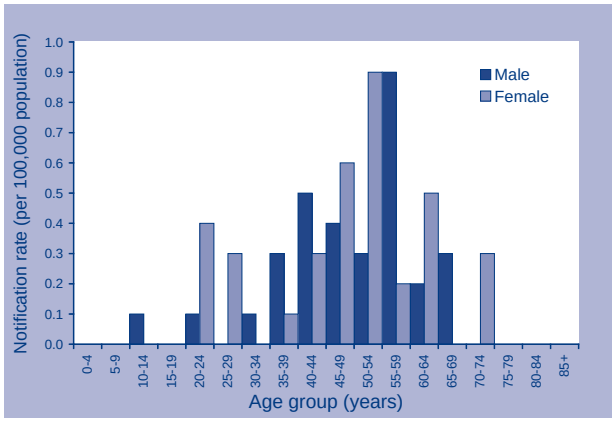
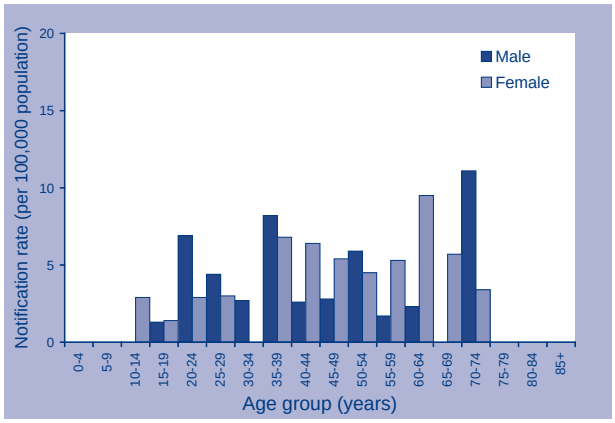


Figure 15. Notification rate for Barmah Forest virus infections, Northern Territory, 1 July 2004 to 30 June 2005, by age group and sex



Northern Territory

The sentinel chicken program in the Northern Territory commenced in January 1992 and replaced an earlier program run by the Australian Quarantine and Inspection Service (AQIS). Sentinel chicken flocks in the Northern Territory are maintained, bled and analysed for flavivirus in a combined program between the Northern Territory Department of Health and Community Services, the University of Western Australia, the Health Department of Western Australia, the Northern Territory Department of Business Industry and Resource Development (DBIRD), and volunteers.

The Map shows the sentinel chicken flocks are presently at Darwin urban (Leanyer), Darwin rural (Howard Springs), Adelaide River (Coastal Plains Research Station), Kakadu (Jabiru), Katherine, Nhulunbuy, Tennant Creek and Alice Springs (Ilparpa and Arid Zone research station). DBIRD officers or volunteers usually bleed flocks once a month and the samples are sent to the University of Western Australia for specific testing for MVEV and KUNV. Sometimes for operational reasons, chickens are not bled during a scheduled month and hence seroconversion shown in the next bleed could have occurred in the previous month. When chickens from a flock show new antibodies to MVEV during a prime risk period, a media warning is issued for the region for the risk period. These warnings advise residents of the need to take added precautions to avoid mosquito bites.

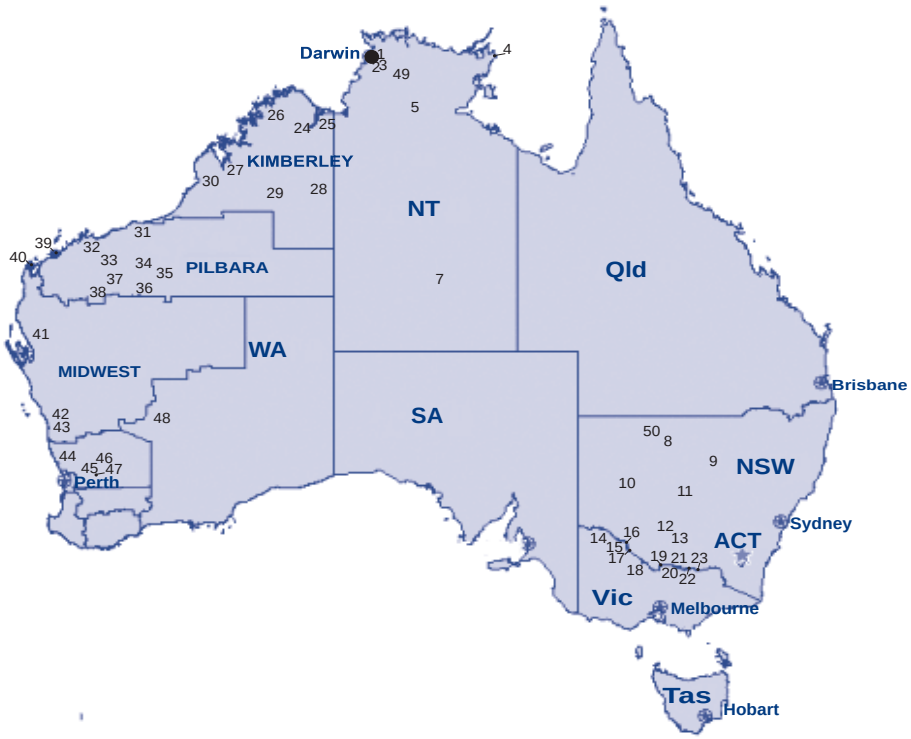
Chickens are replaced at least annually and more frequently if birds die or if a large proportion seroconvert. They are well positioned to detect flavivirus activity near the principal towns of the Northern Territory and hence provide timely and accurate indication of risk to people in those towns.

In the 2004–05 season, MVEV activity was detected in Katherine in January, February and June (probably May seroconversion), Tennant Creek in March (probably January or February seroconversion, Jabiru in April and June (probably May seroconversion), Nhulunbuy in April and May, and Darwin (Howard Springs) and Adelaide River in June. This reflects historical patterns of MVEV seroconversions usually starting in the more inland regions early in the wet season and soon after in the coastal/sub-coastal regions further north.

The MVEV total seroconversions this year (n=13) was considerably more than the last two years (n=2 and n=1), with most seroconversion this year (n=4) occurring in the Katherine flock, followed by the Jabiru flock (n=3). Most seroconversion this year occurred in June (n=6) while the long-term seroconversion peak occurred in May closely followed by March and then February.

There were no seroconversions in the two Alice Springs flocks, most probably due to the below average summer rainfall and low vector numbers. In addition, the successful effluent swamp drainage and better effluent management from nearby sew-

Map. Sentinel chicken testing sites, Australia, 2004–05



Northern Territory

1. Howard Springs
2. Beatrice Hill Farm
3. Leanyer
4. Gove
5. Katherine
6. Tennant Creek
7. Alice Springs (2)
49. Jabiru

New South Wales

8. Bourke
9. Macquarie Marshes
10. Menindee
11. Lake Cargellico
12. Griffith
13. Leeton
50. Wanaaring

Victoria

14. Mildura
15. Robinvale
16. Tooleybuc
17. Swan Hill
18. Kerang
19. Barmah
20. Toolamba
21. Barooga
22. Retherglen
23. Wodonga

Western Australia

24. Wyndham
25. Kununurra
26. Kalumburu
27. Derby (2)
28. Halls Creek
29. Fitzroy Crossing
30. Broome (2)
31. Port Hedland
32. Karratha
33. Harding Dam (2)
34. Marble Bar
35. Nullagine
36. Newman (2)
37. Tom Price
38. Paraburdoo
39. Onslow
40. Exmouth
41. Carnarvon
42. Geraldton
43. Dongara
44. Three Springs
45. Gingin
46. York
47. Bindoon
48. Leonora

age facilities in the Ilparpa area led to an overall reduction in vector numbers near the Alice Springs outskirts during summer.

The seroconversion in Tennant Creek was in a year of low rainfall and reinforces previous findings that MVEV is endemic in the Northern Territory as far south as Tennant Creek.

One human case of MVEV disease was reported (Table 2) in a 3-year-old boy from a community in Arnhem Land who was transferred to Royal Darwin Hospital for treatment. The boy had a relatively mild illness and made a complete recovery. The boy's community was located near an extensive freshwater wetland with numerous water birds and frequently high numbers of common banded mosquitoes *Culex annulirostris* and *Culex palpalis*, two vectors of MVEV.

KUNV activity appeared to be restricted to coastal sites around the Top End of the Northern Territory, with seroconversion to KUNV in Darwin (Howard Springs) in January, May (possible April seroconversion), in Darwin (Leanyer) in March and May (possible April seroconversion) and Nhulunbuy in May. The seroconversions in Darwin (Leanyer) in August and September were probably a continuation of activity from the previous year, but could also reflect a perennial focus of activity in the nearby permanent wetland. The lack of activity in the Top End from the Adelaide River flock was surprising, as the sentinel flock is within five kilometres of a large wetland with water birds. However the flock is also near cattle that could be acting as vector diversions.

There has been a trend over the last 10 years to increasing numbers of seroconversions to KUNV, with this year's total (n=12) higher than last year (n=9) and the highest since the program started in 1992. Most seroconversions occurred in the Leanyer (n=5) and Nhulunbuy (n=5) flocks, which were the highest number for these flocks since surveillance commenced. Most seroconversions occurred this year in May (n=7), while the long term peak was also observed in May, followed by a substantially reduced level in April.

The KUNV activity this year was considerably less than the activity of MVEV, and probably reflects the different vector and virus ecologies of the two arboviruses. The Northern Territory did not report any human cases of KUNV infection this year. The last reported KUNV case from the Northern Territory was in a 23-year-old female from Alice Springs in May 2001.

Western Australia

The Map shows the location of the 31 Western Australian sentinel chicken flocks. Flocks are located in the Kimberley, Pilbara, Gascoyne, Goldfields and Midwest regions in the north and central areas of the state. Environmental Health Officers or trained volunteers usually bleed flocks once a fortnight from December to May (the major MVEV 'risk' season) and monthly at other times. Samples are tested for specific antibodies to MVEV and KUNV by the Arbovirus Surveillance Laboratory at the University of Western Australia. Sometimes for operational reasons, chickens are not bled fortnightly and hence a seroconversion shown in the next bleed could have occurred earlier. Media warnings are issued by

Table 2. Number and rate of flavivirus notifications, 1 July 2004 to 30 June 2005, Australia, by jurisdiction

Jurisdiction	DENV		Flavi NEC		KUNV		MVEV	
	Notifications	Rate*	Notifications	Rate*	Notifications	Rate*	Notifications	Rate*
ACT	2	NA	0	NA	0	0	0	0
NSW	33	NA	1	NA	0	0	0	0
NT	16	NA	0	NA	0	0	1	0.5
Qld	113	NA	19	NA	3	0.08	1	0.03
SA	4	NA	0	NA	0	0	0	0
Tas	0	NA	0	NA	0	0	0	0
Vic	8	NA	0	NA	1	0.02	0	0
WA	12	NA	0	NA	0	0	0	0
Australia	188	NA	20	NA	4	0.02	2	0.01

* Rate per 100,000 population.

NA Not applicable, rates not calculated since most cases of dengue (outside Queensland) and flavivirus infections not elsewhere classified were acquired overseas or unknown country of acquisition.

the Western Australian Department of Health when chickens from a flock in a particular region first sero-convert to MVEV. Additional warnings are issued if high levels of MVEV activity are detected in other flocks in the same region or if activity is detected in a second region in the north of the state. These warnings advise residents of the need to take added precautions to avoid mosquito bites.

Average summer rainfall (December 2004 to March 2005) was recorded in most areas of the Kimberley region but Pilbara rainfall was generally below average for the season. MVEV activity in sentinel chickens was only detected at Kununurra (Map, north-east Kimberley) during the 2004–05 wet season. Heavy rain and flooding was recorded at Kununurra in March 2005 and there were a total of six MVEV seroconversions occurring from March to June 2005. No KUNV activity was detected in sentinel chickens. In contrast to previous years, flavivirus activity was not detected in the Pilbara region.

The Western Australian Department of Health issued health warnings to residents and visitors to the Kimberley region in March and May 2005 warning of the increased risk of MVEV infection. No human cases were reported from Western Australia (Table 2). The last reported KUNV case from Western Australia was in a 27-year-old female from Kununurra in May 2001. The last reported MVEV case from Western Australia was in March 2002, when infection in a 32-year-old male from Bunyip was notified.

New South Wales

Samples from sentinel chicken flocks were tested weekly for flavivirus antibodies in New South Wales from mid-November 2004 to April 2005. There were no seroconversions to MVEV or KUNV during this period. There were no human cases reported from New South Wales for either MVEV or KUNV. The last reported case of KUNV from New South Wales was notified in May 2001 from a 58-year-old female from Griffith. There have been no recorded cases of MVEV to date in NNDSS from New South Wales.

Victoria

Samples from sentinel chicken flocks were tested weekly for flavivirus antibodies from October 2004 to March 2005. No MVEV or KUNV activity was detected in this region. There were no human cases reported from Victoria for MVEV. In October 2004, a 35-year-old female was notified as having acquired KUNV infection. The person lived in metropolitan Melbourne, but a detailed investigation did not reveal any likely exposure within Victoria, nor was there any other evidence of KUNV activity. She had travelled extensively overseas and it is assumed that she acquired KUNV or a closely-related virus while overseas. The only other Victorian case of KUNV was notified in May 2001, from a 67-year-old male from the northern suburbs of Melbourne. There have been no recorded cases of MVEV from Victoria in NNDSS.

Queensland

There were no sentinel chicken flocks in Queensland during 2004–05 although flocks have been maintained in previous years. One case of MVEV was reported in a 30-year-old male from Normanton in March 2005 (Table 2). The previously last reported MVEV case from Queensland was in a 3-year-old boy from Mount Isa in 2001. Queensland reported three sporadic cases of KUNV infection in July 2004, December 2004, and February 2005.

Japanese encephalitis virus infections

There were no cases of Japanese encephalitis virus infections (JEV) during this reporting period. The last reported case was in February 2004, when Queensland notified that a 66-year-old male acquired JEV from Papua New Guinea. There have been nine other cases of JEV reported to NNDSS since 1995, although JEV was not nationally notifiable until 2001. Four of these notifications were reported in Torres Strait islanders from the Badu Island community. The other locally acquired JEV case was reported in a resident from the Cape York Peninsula, Queensland. The remaining four cases were reported as acquired from overseas countries.

AQIS, through the Northern Australia Quarantine Strategy (NAQS) program, conducted monitoring for JEV for the 2005 wet season using sentinel pigs at sites on Badu Island in Torres Strait and its northern peninsula area (NPA) site at Injinoo airport. The four sentinel pigs on Badu Island all sero-converted (based on results of testing at Queensland Health Scientific Services and the CSIRO Australian Animal Health Laboratory). JEV was also identified through the detection of viral RNA in a pool of culicine mosquitoes collected on Badu Island. This was collaborative mosquito trapping performed by NAQS for Queensland Health.

The five NPA sentinel pigs did not seroconvert and there was no evidence of transmission of JEV to the mainland in 2005.

Flavivirus infections not elsewhere classified

There were 20 flavivirus infections not elsewhere classified (NEC) notifications during the 2004–05 season, of which four were acquired overseas and two were locally acquired. The country of acquisition was unknown for the remaining 14 notifications.

Queensland reported 19 of the 20 flavivirus (NEC) notifications. Of these, there were four Kokobera and one Stratford virus. The 14 other flavivirus infections (NEC) were of unknown type. New South Wales reported the remaining one notification of flavivirus infection (NEC) which was of an unknown type.

Dengue virus infections

There were 188 notifications of DENV during the 2004–05 season. Table 2 shows that the cases were mainly from Queensland (n=113, 60%), New South Wales (n=33, 18%), the Northern Territory (n=16, 9%) and Western Australia (n=12, 6%). Figure 16 shows that the number of DENV notifications received during the 2004–05 season was much lower than the two previous seasons. There were two outbreaks caused by different genotypes of dengue type 4 during this season (Jeffery Hanna, Tropical Public Health Unit, personal communication). There was a peak in DENV notifications in March 2005 (n=50) which reflected an outbreak in the Torres Strait Islands. A separate smaller outbreak in Townsville involving 18 cases with an onset date in April 2005, is still ongoing as of November 2005.

Dengue notifications were reported as acquired from overseas in 86 of the 188 notifications. Locally acquired cases were reported by Queensland (n=21) and Western Australia (n=2), although the Western Australian cases were Western Australian residents who acquired DENV in Queensland (Gary Dowse, personal communication). The country of acquisition for the remaining notifications was either unknown or not stated (n=78).

Of the 188 notifications, dengue serotype 4 was reported in 32 per cent (n=60) of cases (Table 3). Serotype information was either not stated or unavailable for 54 per cent of the notifications (n=102).

Figure 17 shows that the largest number of notifications was reported in the 45–49 year male age group (n=17) and the 30–34 year female age group (n=13). Dengue virus infections notifications were higher for males than for females (102 cases: 86 cases).

Figure 16. Dengue notifications (locally acquired and imported cases), select jurisdictions, January 1998 to June 2005, by month and season of onset

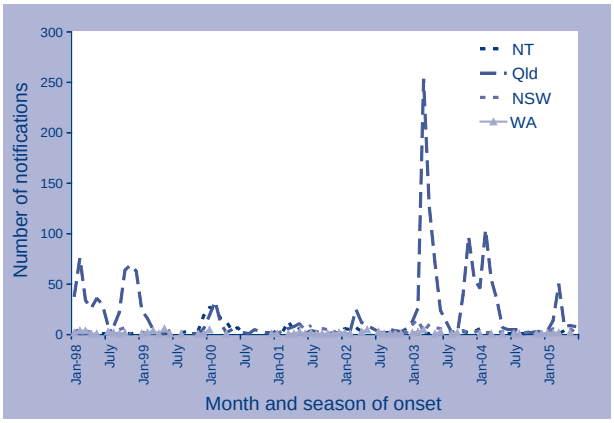


Figure 17. Dengue notifications (locally acquired and imported cases), Australia, 1 July 2004 to 30 June 2005, by age group and sex

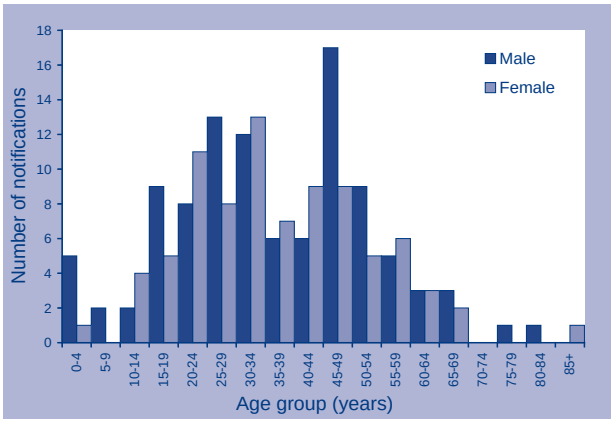


Table 3. Dengue notifications (locally acquired and imported cases), Australia, 1 July 2004 to 30 June 2005, by serotype

	Serotype					Total
	Not typed	Serotype 1	Serotype 2	Serotype 3	Serotype 4	
Notifications	102	8	10	8	60	188
Serotype (%)	54	4	5	4	32	100

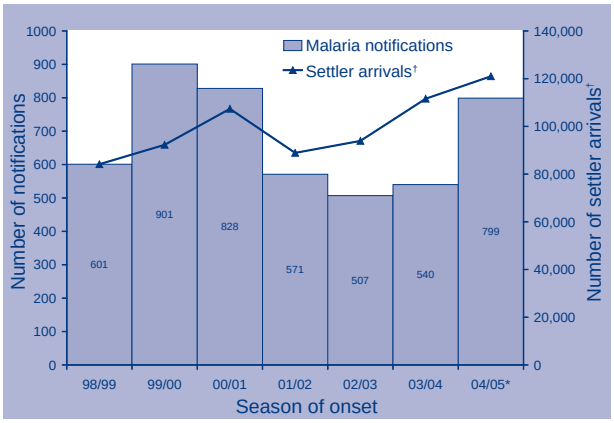
Malaria

There were 799 notifications of malaria in Australia in the period 1 July 2004 to 30 June 2005. Queensland reported the majority of cases (n=309, Table 4). There were no reports of locally acquired malaria during the reporting period.

Figure 18 shows that the 2004–05 season was the third highest reporting period for malaria notifications since 1998, and that malaria notifications may be associated with increases in settler arrivals from overseas countries. Previously published work has shown that of Victorian malaria notifications reported in 1999–2000, malaria was most often acquired in Papua New Guinea (36%) and East Timor (13%).[4] Data published on Western Australian notifications[5] from 1990–2001 has shown that a rise in falciparum malaria was reflected by an influx of Indonesian immigrants in detention and the deployment of Australian Defence personnel to East Timor. More recent surveillance status reports from New South Wales,[6] the Northern Territory,[7] Victoria[8] and Queensland have associated malaria notifications with immigrant arrivals from African countries. This has lead to the development of protocols in some jurisdictions for the screening of malaria parasites upon arrival for persons from high risk areas.[9]

Malaria notifications were reported to be highest in children in the 5–9 year age group (Figure 19), which is the first time that notifications in children have predominated. Overall, male notifications (n=473) were more common than female notifications (n=296). Males in the 20–24 year age group were the largest reported sex-specific cohort whereas the largest reported numbers of female cases were observed in the 5–9 year age group. Appendix 5 shows that since 1998, the highest number of cases has been in the young adult age groups of 20–24 and 25–29 years. These young adult age groups were also the most affected in Australia from 1991–1997.[10]

Figure 18. Number of notifications of malaria and DIMIA settler arrivals[2,3] from all overseas countries, Australia, 1998–2005, by season of onset



* Annualised settler arrivals based on July to December 2004 data.

† Settler arrivals from all overseas countries.

Table 4. Malaria notifications in Australia, 1 July 2004 to 30 June 2005, by parasite type and jurisdiction

Parasite type	Type (%)	Jurisdiction								
		ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Australia
Plasmodium species	1	0	1	0	2	0	1	0	7	11
Plasmodium falciparum	57	3	131	37	159	31	16	34	46	457
Plasmodium malariae	1	1	1	0	5	0	0	1	1	9
Plasmodium ovale	3	1	6	1	9	1	0	4	5	27
Plasmodium vivax	34	8	53	14	134	2	7	51	2	271
Mixed infection (unspecified)*	0.4	0	0	0	-	0	0	0	3	3
Mixed *P. falciparum* and *P. vivax**	0.5	0	1	2	-	1	0	0	0	4
Mixed *P. falciparum* and *P. ovale**	1.0	0	6	0	-	0	0	5	0	11
Mixed *P. falciparum* and *P. malariae**	0.8	0	3	2	-	1	0	0	0	6
Total	100	13	202	56	309	36	24	95	64	799

* New South Wales, South Australia, Tasmania, Victoria and Western Australia report mixed species infections as one notification. Queensland, the Northern Territory and the Australian Capital Territory report one notification for each species in a mixed infection.

– Unknown

Figure 19. Number of notifications of malaria, Australia, 1 July 2004 to 30 June 2005, by age group and sex

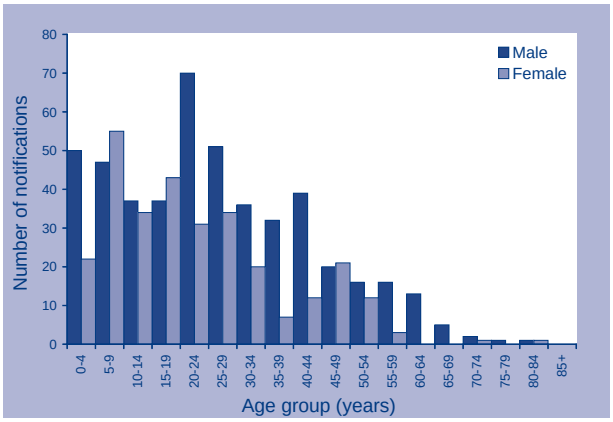
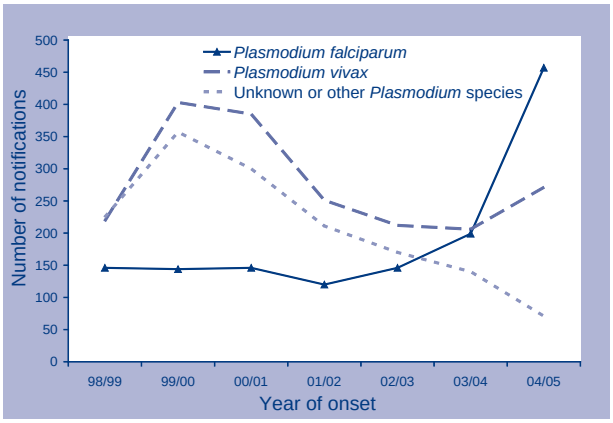


Table 4 shows that the infecting *Plasmodium* species were reported for more than 98 per cent of malaria notifications in 2004–05. Of these 799 notifications, more than half were *P. falciparum* (57%, n=457). *P. vivax* accounted for 34 per cent of cases (n=271) while untyped *Plasmodium* species accounted for one per cent (n=11). The remaining cases were *P. ovale* (3%, n=27) and *P. malariae* (1%, n=9). It should be noted that mixed infections (3%, n=24) are underestimated due to the variation in reporting practice in different states and territories.

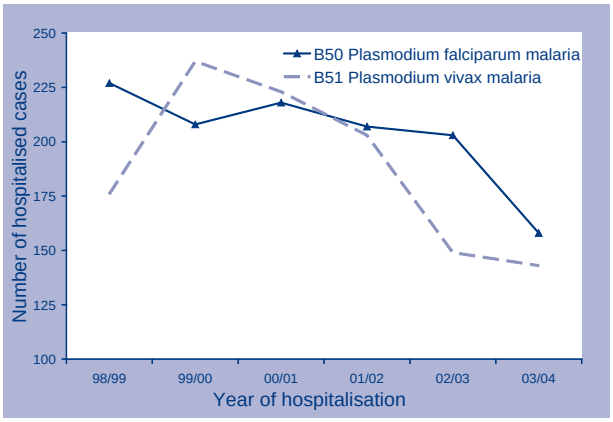
Figure 20 and Table 5 show that in 2004–05 the number of falciparum malaria notifications (n=457) in Australia increased significantly from previous years and was three times the five-year mean for the same species. This appears to be the first time[11] in which *P. falciparum* has become the predominant infecting species for malaria notifications in Australia, as previously published data in earlier years showed *P. vivax* accounting for 64–70 per cent of cases and *P. falciparum* 20–32 per cent of cases both nationally[10,12] and in individual states.[4,5]

Figure 20. Malaria notifications in Australia, by select species and year of onset



Australian malaria hospitalisation data[13] shows that falciparum malaria was the predominant species for malaria hospitalisations in 2002–03 and 2003–2004 (Figure 21).

Figure 21. Malaria hospitalisations in Australia, 1998 to 2004, by species and principal diagnosis (ICD10-AM)



Source: Australian Institute of Health and Welfare.

Table 5. Malaria notifications in Australia, by select species and year of onset

Infecting species	Year of onset							Last 5 year mean	Ratio 04/05 5 year mean
	98/99	99/00	00/01	01/02	02/03	03/04	04/05		
Plasmodium falciparum	146	144	146	120	146	199	457	151	3.0
Plasmodium vivax	219	403	385	251	212	206	271	291	0.9
Unknown or other *Plasmodium* species	225	357	300	211	170	140	71	236	0.3
Total	590	904	831	582	528	545	799		

Malaria mortality

There have been 12 deaths due to malaria reported in Australia, of which seven have been published.[12,14] Of these seven deaths, six were notified to the Australian Malaria Register, and one to NNDSS. The most recent deaths occurred in 2002 (a 26-year-old, New South Wales) and 2003 (a 1-year-old, Queensland). Table 6 shows the 12 deaths due to malaria, the infecting malaria species and the country of acquisition.

The Australian Institute of Health and Welfare (AIHW) National Mortality Database contains eight deaths for the years of registration 1998–2003 where falciparum malaria was listed as the underlying cause of death (AIHW, personal communication). *Plasmodium vivax* was listed as an associated cause of death for one of the falciparum malaria deaths most probably representing death resulting from a mixed infection of *P. falciparum* and *P. vivax* (for which there is no ICD10-AM code).

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Simon Forsyth, Australian Malaria Register

Table 6. Malaria deaths in Australia, 1992 to 2005, by year, species and country of acquisition

Year of death	Age at death (years)	Infecting species	Country of acquisition
1992	43	*Plasmodium falciparum*	Solomon Islands
1992	71	Plasmodium falciparum	Papua New Guinea
1992	21	*Plasmodium falciparum*	Papua New Guinea
1992	17	*Plasmodium falciparum*	Nigeria
1992	86	*Plasmodium falciparum*	Australia (blood transfusion)
1993	46	*Plasmodium vivax*	Indonesia
1995	58	Plasmodium falciparum	Indonesia
1995	58	*Plasmodium falciparum*	Kenya
1996	33	*Plasmodium falciparum*	Indonesia
2000	32	*P. falciparum* and *P. vivax*	East Timor
2002	26	*Plasmodium falciparum*	Indonesia
2003	1	Plasmodium vivax	Papua New Guinea

Source: National Notifiable Diseases Surveillance System, ICPMR, Australian Malaria Register, and States and Territories.

Appendix 1. Notifications and notification rates of mosquito-borne diseases, Australia, 1 July 1998 to 30 June 2005, by season of onset*

Mosquito-borne disease	Notifications							Rate per 100,000 population						
	98/99	99/00	00/01	01/02	02/03	03/04	04/05	98/99	99/00	00/01	01/02	02/03	03/04	04/05
Barmah Forest virus infection	618	556	1,134	943	1,299	967	1,256	3.3	2.9	5.9	4.8	6.6	4.8	6.2
Dengue virus infection	352	221	122	185	664	551	188	NA	NA	NA	NA	NA	NA	NA
Flavivirus infection NEC	104	66	32	68	40	89	20	NA	NA	NA	NA	NA	NA	NA
Japanese encephalitis virus infection	– 1	–			1	1	0	–	–	0	0	<0.1	<0.1	0
Kunjin virus infection	†2	†4	5		17	11	4	†	†	<0.1	0	<0.1	<0.1	<0.1
Malaria	590	904	831	582	528	545	799	NA	NA	NA	NA	NA	NA	NA
Murray Valley encephalitis virus infection	†	†16	5	3		1	2	†	†	<0.1	<0.1	0	<0.1	<0.1
Ross River virus infection	4,592	4,265	3,629	1,580	3,162	4,735	1,858	24.4	22.4	18.8	8.1	16.0	23.7	9.2
Total	6,259	6,032	5,758	3,361	5,711	6,900	4,127							

* 1 July to 30 June.

† Included in 'Arbovirus NEC' 1999–2000 except for the Northern Territory and Western Australia.

– Not notifiable in these years except in Western Australia.

NA Not applicable. Rates for dengue virus infection, flavivirus infection NEC and malaria were not calculated since the majority of cases were acquired overseas.

Appendix 2. Notifications of mosquito-borne diseases, Australia, 1 July 2004 to 30 June 2005, by month of onset

Mosquito-borne disease	Total	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05
Barmah forest virus infection	1,256	47	66	79	80	109	85	93	131	135	166	168	97
Dengue virus infection	188	10	14	6	6	8	5	12	28	56	13	18	12
Flavivirus infection NEC	20	4	1	1	0	3	2	1	0	4	0	2	2
Japanese encephalitis virus infection	0	0	0	0	0	0	0	0	0	0	0	0	0
Kunjin virus infection	4	1	0	0	1	0	1	0	1	0	0	0	0
Malaria	799	50	46	40	53	49	47	66	110	171	57	63	47
Murray Valley encephalitis virus infection	2	0	0	0	0	0	0	0	0	2	0	0	0
Ross River virus infection	1,858	54	51	47	62	89	87	143	304	469	312	155	85

Appendix 3. Notification rates* for Ross River virus infections, select jurisdictions, 1 July 2004 to 30 June 2005, by age group and sex

Age group	State or territory														
	NSW			NT			Qld			WA			Australia		
	Male	Female	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female	Persons
0–4	1	0	0.2	0	11.7	5.7	0.8	2.5	1.6	0	0	0	0.3	0.6	0.5
5–9	0	0	0.2	0	0	0	3.6	2.3	3.0	0	0	0	1.0	0.6	0.8
10–14	0	0.9	0.4	11.8	50.9	30.7	4.2	3.7	3.9	0	4.4	2.1	1.0	2.2	1.6
15–19	2.2	4.5	3.3	13.0	114.6	61.4	13.6	16.5	15.0	5.4	2.8	4.1	4.1	6.4	5.2
20–24	3.4	5.8	4.6	23.2	96.5	56.7	19.0	23.6	21.3	2.8	4.4	3.5	5.7	8.6	7.1
25–29	5.2	4.8	5.0	92.5	111.1	101.5	35.3	24.7	30.0	3.0	7.6	5.3	10.1	8.7	9.4
30–34	3.1	8.9	6.0	150.5	165	157.7	29.7	26.6	28.1	12.1	10.9	11.5	10.2	12.3	11.3
35–39	11.2	9.1	10.1	114.5	138.7	126	44.4	58.0	51.3	6.8	10.9	8.9	14.6	17.7	16.2
40–44	5.8	9.0	7.4	161.8	119.2	142	49.2	42.7	45.9	15.5	23.2	19.3	15.4	15.2	15.3
45–49	14.8	11.7	13.5	112.1	299	202.6	41.2	47.8	44.5	12.4	10.9	11.6	16.4	18.3	17.4
50–54	14.7	6.4	10.6	162.9	155.5	159.5	44.0	28.2	36.1	11.9	10.5	11.2	17.6	10.4	14.0
55–59	10.9	11.6	11.5	19.1	167.5	84.9	39.1	49.9	44.4	6.6	7.0	6.8	13.7	16.8	15.3
60–64	13.0	8.6	10.8	0	75.3	32.2	36.6	35.9	36.3	9.1	4.7	7.0	13.7	12.8	13.2
65–69	8.8	7.7	8.6	97.6	0	55.8	21.4	20.4	20.9	8.6	8.6	8.6	9.3	7.9	8.7
70–74	12.5	7.0	9.6	82.8	99	90.2	23.6	12.2	17.8	3.7	0.0	1.8	9.6	5.2	7.3
75–79	5.8	3.8	4.7	123.0	139.5	130.7	11.4	11.6	11.5	14.1	3.9	8.6	6.7	4.0	5.2
80–84	7.3	3.7	5.1	0	0	0	10.9	5.1	7.5	0.0	5.2	3.1	5.5	3.2	4.1
85+	3	0	1.0	0	0	0	17.5	2.9	7.8	0	0	0	4.4	0.5	1.7

* Age and sex specific rates by cases per 100,000 population.

Appendix 4. Notification rates* for Barmah Forest virus infections, select jurisdictions, 1 July 2004 to 30 June 2005, by age group and sex

Age group	State or territory														
	NSW			NT			Qld			WA			Australia		
	Male	Female	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female	Persons
0–4	0	0.5	0.2	0	0	0	0.8	0	0.4	0	0	0	0.2	0.2	0.2
5–9	0	0.5	0.2	0	0	0	0.7	0.8	0.7	0	0	0	0.1	0.3	0.2
10–14	0.8	0.4	0.7	0.1	0	0.1	4.2	6.6	5.4	0	2.9	1.4	1.3	1.8	1.5
15–19	5.2	6.3	5.7	0	0	0	8.6	12.7	10.6	1.3	1.4	1.4	3.7	4.9	4.3
20–24	3.8	2.2	3.0	0.1	0.4	0.3	12.0	17.0	14.4	6.9	2.9	5.0	4.6	5.0	4.8
25–29	2.6	4.4	3.5	0	0.3	0.1	21.5	18.6	20.0	4.4	3.0	3.8	5.4	5.6	5.5
30–34	6.7	7.0	6.8	0.1	0	0.1	28.3	18.4	23.3	2.7	0	1.4	8.5	6.1	7.3
35–39	8.3	10.3	9.7	0.3	0.1	0.2	34.9	17.7	26.2	8.2	6.8	7.5	10.6	8.2	9.5
40–44	8.1	8.6	8.3	0.5	0.3	0.4	32.8	32.0	32.4	2.6	6.4	4.5	10.0	10.1	10.1
45–49	14.8	12.6	13.7	0.4	0.6	0.5	29.4	25.4	27.4	2.8	5.4	4.1	12.1	10.8	11.4
50–54	16.5	10.5	13.5	0.3	0.9	0.6	27.5	23.5	25.5	5.9	4.5	5.2	12.1	9.6	10.8
55–59	9.4	6.1	7.8	0.9	0.2	0.5	25.0	30.1	27.5	1.7	5.3	3.4	9.9	9.5	9.7
60–64	9.1	11.9	10.5	0.2	0.5	0.3	25.5	13.9	19.8	2.3	9.5	5.8	9.1	9.3	9.2
65–69	10.3	6.9	8.6	0.3	0.0	0.1	22.8	14.5	18.7	0	5.7	2.9	8.5	6.0	7.2
70–74	12.5	8.8	10.6	0	0.3	0.2	18.2	14.0	16.0	11.1	3.4	7.1	9.6	6.1	7.8
75–79	3.5	2.8	3.1	0	0	0	4.6	7.7	6.3	0	0	0	2.5	2.3	2.4
80–84	11.0	1.2	5.1	0	0	0	7.2	10.2	9.0	0	0	0	6.1	2.3	3.8
85+	0	2.8	1.9	0	0	0	5.8	5.8	5.8	0	0	0	1.1	2.0	1.7

* Age and sex specific rates by cases per 100,000 population.

Appendix 5. Malaria notifications, Australia, 1 July 1998 to 30 June 2005, by age group and sex

Age group	Year of onset																				
	1998–1999			1999–2000			2000–2001			2001–2002			2002–2003			2003–2004			2004–2005		
	M	F	P	M	F	P	M	F	P	M	F	P	M	F	P	M	F	P	M	F	P
0–4	16	11	27	7	7	14	8	10	18	5	5	10	7	18	25	14	11	25	50	22	72
5–9	13	8	21	13	16	29	8	6	14	10	15	25	16	17	33	15	16	31	47	55	102
10–14	15	7	22	19	22	41	18	7	25	11	12	23	12	6	18	24	14	38	37	34	71
15–19	42	32	74	58	18	76	41	21	62	36	16	52	34	10	44	32	10	42	37	43	80
20–24	47	22	69	151	27	178	144	21	165	51	22	73	50	13	63	55	17	72	70	31	101
25–29	59	24	83	127	19	146	109	34	143	47	16	63	41	36	77	41	20	61	51	34	85
30–34	47	17	64	87	16	103	92	26	118	53	18	71	33	14	47	28	26	54	36	20	56
35–39	43	19	62	69	15	84	51	23	74	38	24	62	22	10	32	36	7	43	32	7	39
40–44	33	10	43	59	9	68	43	24	67	38	15	53	29	18	47	25	18	43	39	12	51
45–49	26	6	32	31	19	50	35	14	49	29	16	45	23	10	33	22	10	32	20	21	41
50–54	21	8	29	36	11	47	22	11	33	24	11	35	20	6	26	15	4	19	16	12	28
55–59	15	4	19	12	5	17	16	6	22	25	5	30	22		22	23	7	30	16	3	19
60–64	11	1	12	12	3	15	11	4	15	13	2	15	9	8	17	14	4	18	13	0	13
65–69	6	4	10	5	2	7	9	1	10	3	2	5	4	1	5	3	2	5	5	0	5
70–74	2	3	5	4	1	5	2	1	3	2	1	3	5	0	5	2	1	3	2	1	3
75–79	1	0	1	2	1	3	0	0	0	3	0	3	0	0	0	0	0	0	1	0	1
80-84	0	0	0	1	1	2	0	0	0	1	0	1	1	0	1	1	0	1	1	1	2
85+	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	398	176	574	694	192	886	609	209	818	389	180	569	328	167	495	350	167	517	473	296	769
Excluded*	16			18			13			13			33			28			30		

* Notifications for which date of birth, or sex, or date of birth and sex was not supplied.

M Male

F Female

P Persons

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