

INCREASING NOTIFICATIONS OF DENGUE IN AUSTRALIA RELATED TO OVERSEAS TRAVEL, 1991 TO 2012

Katrina Knope, the National Arbovirus and Malaria Advisory Committee, Carolein Giele

Abstract

Dengue is an important cause of illness in travellers returning to Australia. The risk of local transmission from imported cases is of particular concern, with several large and explosive outbreaks recorded in recent years in north Queensland in areas where the mosquito vector of dengue is present. The number and proportion of dengue cases that are overseas-acquired is increasing. The number of overseas cases in 2010 and 2011 had increased by 298% and 155% respectively compared with the 5 year mean. The number of overseas acquired cases in 2012 is likely to be the largest on record, with an average of 144 cases per month during the first 7 months of the year. More than half of all dengue cases with a known country of acquisition between 1999 and July 2012 were acquired in Indonesia. In Western Australia in 2010 and 2011, more than 80% of cases acquired in Indonesia were acquired in Bali and the trend has continued into 2012.¹ While the frequency of travel by Australians to Indonesia has steadily increased since 2000, this does not completely explain the increased number of dengue cases in returning travellers. The relative risk of dengue in travellers returning from Indonesia between 2000 and 2011 compared with all other destinations was 8.3 (95% confidence interval 7.9–8.9). *Commun Dis Intell* 2013;37(1):55-59.

Introduction

Dengue is an important cause of illness in travellers returning to Australia. The number and proportion of cases that are known to have been acquired overseas has been increasing in recent years from 156 cases in the 2005–06 season, to 581 cases in the 2009–10 season.²

The risk of local transmission from imported cases is of particular concern, with several large and explosive outbreaks recorded in recent years (Figure 1). At present, the risk of local transmission is restricted to urban areas of Queensland where *Aedes aegypti*, a mosquito vector for dengue virus, is well established. There is a risk that dengue could become endemic there. Infected travellers returning to north Queensland and those transiting through the region to other states and territories can present the risk of starting local outbreaks.

Dengue was considered endemic in north Queensland up to the end of World War II, and the last outbreaks outside north Queensland (Brisbane and northern New South Wales) also occurred during that period.³ There is the potential for *Ae. aegypti* incursions into the northern areas of Western Australia and the Northern Territory. The historical range of this mosquito species and of dengue transmission suggests a larger area of potential transmission risk on both the east and west coasts.⁴ Recently, *Aedes albopictus* has become established in the Torres Strait and is a known vector of dengue virus.⁵ An incursion to the mainland would have the potential to greatly extend the range of dengue in Australia.

Imported cases of dengue (and therefore local outbreaks) comprises all four serotypes. Infection with one serotype probably confers lifelong immunity. Antibodies cause an enhanced immune response to infection with a second serotype, increasing the risk of dengue haemorrhagic fever and dengue shock syndrome.⁶

Data sources and methods

In Australia, dengue is diagnosed and notified according to nationally agreed surveillance and laboratory case definitions.^{7,8} Case definitions can change over time, and this should be considered in the interpretation of dengue data. Notifications are compiled nationally in the National Notifiable Diseases Surveillance System (NNDSS). The National Arbovirus and Malaria Advisory Committee (NAMAC) publishes annual reports on arboviral diseases.⁹

Information on short term resident departures collected by Australian Customs and Border Protection, and published by the Australia Bureau of Statistics was used to estimate the number of Australians travelling to destinations that are frequently reported as the place of acquisition for dengue cases.¹⁰ Departure statistics relate to the number of movements of travellers rather than the number of travellers (i.e. multiple movements of individual persons during a given reference period are each counted separately) and are based on a combination of enumeration and estimation from samples. This dataset may underestimate the

denominator for overseas acquired dengue cases because it does not include visitors or migrants coming to Australia.

Numbers and rates of infection were calculated using Microsoft Excel, and incidence rate ratio analyses using the country of acquisition as a risk factor were conducted using Stata SE version 10.0.

Overseas acquired cases 1991–1999

Imported cases of dengue are estimated to account for 23% of all notifications between 1991 and 1999. Place of acquisition was not routinely recorded in NNDSS data prior to 1999. However, observed peaks in notifications (Figure 1) can be explained by reported outbreaks of locally-acquired infection in north Queensland rather than increases in the number of imported cases. Significant local outbreaks that occurred during this period were an outbreak of dengue virus serotype 2 (DENV2) in 1992–93 in Townsville and Charters Towers, with 900 cases;^{11–13} outbreaks of DENV2 in 1996–97 in the Torres Strait and Cairns with 208 cases; and an outbreak of DENV3 in 1997–99 in Cairns,^{11,14} Mossman and Port Douglas with 498 cases.^{11,15} These large outbreaks and other smaller outbreaks during the period account for 77% (1,649/2,139) of reported cases.¹¹

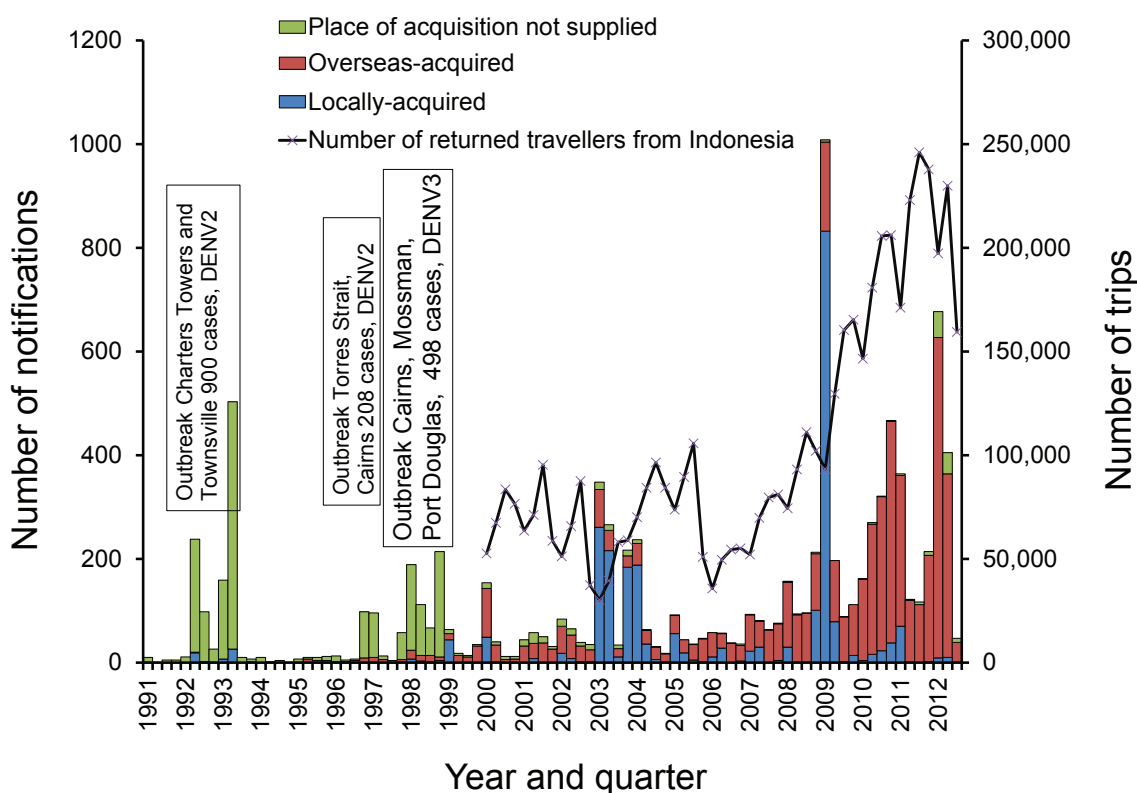
Overseas acquired cases 2000–2012

More than half of all dengue cases in Australia since 2000 (64%, 4,965/7,693) were related to overseas travel (Figure 1). The number and proportion of cases that are overseas-acquired is increasing. In 2010, there were 1,132 overseas-acquired cases (comprising 93% of all dengue notifications in 2010), and 727 cases in 2011 (comprising 89% of all dengue notifications in 2011) (Table 1). This compares with a mean of 284.6 cases per year between 2005 and 2009, when overseas-acquired cases comprised only 46% of all dengue notifications. The number of overseas acquired cases in 2012 is likely to be the largest on record, with an average of 144 cases per month during the first 7 months of the year.

The largest number of overseas-acquired dengue cases in 2010–2011 was reported by Western Australia (820 cases comprising 44% of overseas-acquired cases in 2010–11). The largest increases in the number of overseas-acquired cases were in Victoria and Western Australia, with ratios of 7.8 each for 2010 cases compared with the 5 year mean and 6.8 and 5.0 respectively for 2011 compared with the 5 year mean (Table).

Overseas-acquired dengue infections were of all four serotypes. Between 2005 and July 2012, serotypes 1 and 2 were the most commonly reported.

Figure 1: Dengue in Australia,* January 1991 to July 2012, by place of acquisition and number of returned travellers from Indonesia



* Outbreaks of dengue in North Queensland with >100 cases prior to the recording of place of acquisition in NNDSS are shown

Rates and countries of acquisition between 1999 and July 2012

Indonesia was the most frequently reported country of acquisition among overseas acquired cases of dengue in Australia between 1999 and July 2012, with overseas travel there accounting for 52% (2,306/4,403) of cases with a known country of acquisition during those years. Most cases related to travel in Indonesia occurred between 2010 and July 2012 (1,834 cases). More than half of all cases related to travel to Indonesia were from Western Australia (56%, 1,295/2,306), and in 2010 and 2011, more than 80% of these were among travellers returning from Bali (Carolein Giele, personal communication, place of acquisition for overseas acquired cases of dengue in Western Australia, 2012). This trend has continued into 2012, with 83% of cases between January and September 2012 in Western Australia associated with Indonesia, and of these, 96% reported travel to Bali.¹

Nationally, other frequently reported places of acquisition were Thailand and East Timor, together accounting for 18% of overseas-acquired cases during the period. Complete information on country of acquisition was supplied for 87% (4,403/5,034) of overseas acquired cases.

The rates of Australians acquiring dengue overseas has varied from year to year, ranging from 2.5 per 100,000 trips in 2004 to a high of 15.9 per 100,000 in 2010 (Figure 2). Rates of infection among returned travellers from key destinations varied between 2000 and 2011, with a peak in rates among returned travellers from Papua New Guinea in 2002–2003, and a dramatic increase in rates among returned travellers from Indonesia peaking in 2010. Whilst rates of dengue among returned travellers from East Timor have exceeded that for every country in every year except Indonesia in 2010 (Figure 2, inset),

rates have decreased in recent years (between 6 and 36 cases per year between 2007 and 2011, compared with 100 cases in 2000).

Risk of acquiring dengue in Indonesia

The popularity of Indonesia as a destination for Australians continues to rise. In 2011, there were 9 times as many travellers to Indonesia as in 2000 (Figure 1), while overall overseas travel was not quite double that in 2000.¹⁰ Cases of dengue acquired in Indonesia are most frequently diagnosed between December and April, whilst the peak season of travel to Indonesia is between June and October 2012.

While the frequency of travel by Australians to Indonesia has steadily increased since 2000, this does not completely explain the increased number of dengue cases in returning travellers. The relative risk (RR) of dengue in travellers returning from Indonesia compared with all other destinations was 8.3 (95% confidence interval (CI) 7.9 to 8.9) while for travellers returning from Thailand, the RR was 1.8 (95% CI 1.76 to 2.0). The risk of a traveller acquiring dengue in Indonesia varies from year to year and appears to have increased overall between 2000 and 2011, peaking in 2010.

The incidence of dengue in Indonesia increased from 24.4 cases per 100,000 in 2003 to 66 cases per 100,000 in 2009.¹⁶ Between 2005 and 2009, Bali had the fourth highest incidence of the Indonesian provinces, and ranged between 109 and 193 cases per 100,000.¹⁷

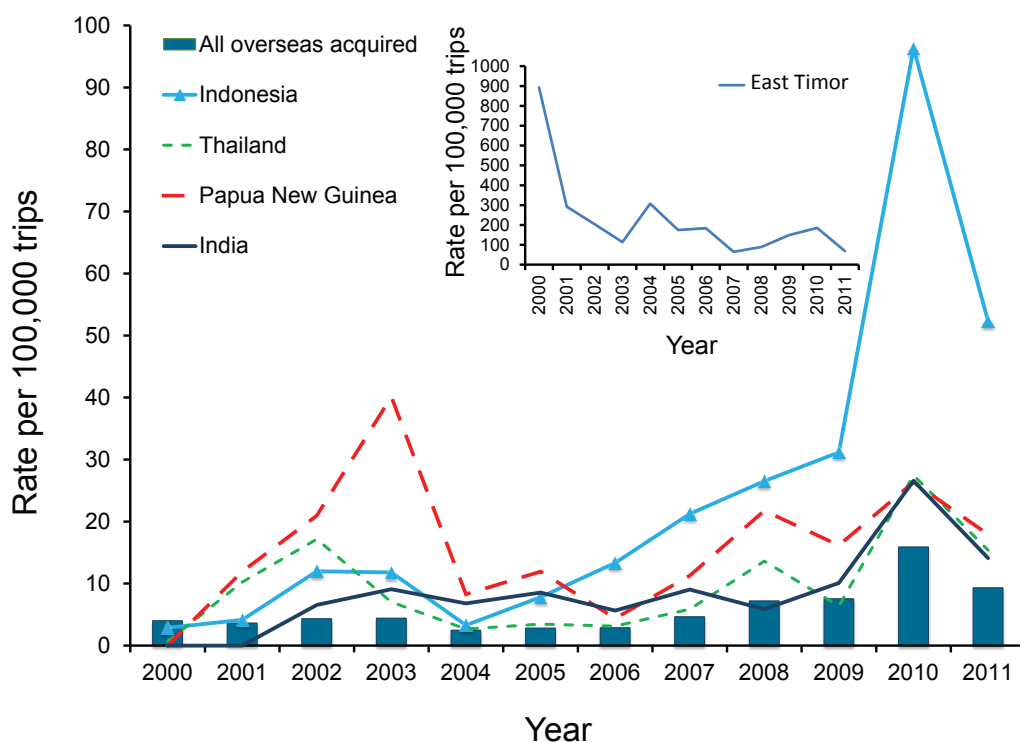
Age and sex of overseas acquired cases 2005 to July 2012

Overseas-acquired infections were most commonly reported among young and middle-aged adults

Table: Number of overseas-acquired cases of dengue, Australia, 2010 and 2011 compared with the five year average, by state or territory of residence

State or territory	Percentage of cases 2005–2011 with information on place of acquisition	Number of overseas-acquired cases				Ratio 2010/5 year average	Ratio 2011/5 year average
		2010	2011	Jan to Jul 2012	5 year average (2005 to 2009)		
ACT	100.0%	15	15	0	7	2.1	2.1
NSW	99.6%	224	135	156	89.2	2.5	1.5
NT	99.4%	40	25	63	20.8	1.9	1.2
Qld	99.1%	202	118	159	69.6	2.9	1.7
SA	89.2%	24	10	0	16.6	1.4	0.6
Tas	100.0%	7	3	5	2.2	3.2	1.4
Vic	96.6%	118	103	173	15.2	7.8	6.8
WA	99.9%	502	318	454	64	7.8	5.0
Total	99.0%	1,132	727	1,010	284.6	4.0	2.6

Figure 2: Rates of dengue virus infection in returning travellers by selected destinations of travel, and inset, rates of dengue virus infection in returning travellers from East Timor



reflecting the frequency of travel among these age groups. The median age of cases was 39, and 52% of cases were male.

Discussion

The increasing numbers of overseas-acquired cases of dengue in Australia are occurring in the context of endemic disease and periodic epidemics in many countries in South East Asia, including Indonesia, where incidence peaks in January and February and reported incidence doubled between 2003 and 2006.¹⁸

The source countries for overseas-acquired cases can be expected to change over time due to changing patterns of travel and local disease epidemiology in the source country. Papua New Guinea and East Timor have declined as important sources of dengue among travellers in recent years. In north Queensland in recent years, cases linked to Papua New Guinea predominated between 1999 and 2003 (51%) whilst between 2004 and 2008 Papua New Guinea was the source of only 12% of notifications.¹⁹

Improved diagnostic techniques, in particular the availability of the rapid NS1 antigen detection kit in recent years, have improved detection and would have contributed to the observed increase in reported numbers of overseas-acquired dengue in Australia.

The frequency of travel by Australians to Indonesia has increased sharply in recent years, particularly from Western Australia where the largest percentage

increase in overseas-acquired cases is being reported. However, the increase in travel does not completely explain the increased number of cases of dengue in returning travellers from Indonesia.

Differences in the risk of acquiring dengue in Indonesia from year to year may be due to changes in the epidemiology of dengue in the country, particularly in Bali, or changes in traveller behaviour. Further research to determine the ecology and epidemiology of dengue in Bali, together with behaviour of Australian travellers, are urgently needed to improve our understanding of the changing risk of acquiring dengue in Indonesia.

Travellers to South East Asia need to take appropriate precautions to avoid being bitten by mosquitoes.²⁰ These include ensuring sleeping accommodation is free of mosquitoes by closing window screens, using insecticide sprays indoors or using bed nets, wearing light-coloured, long-sleeved clothing in urban or residential areas to minimise skin exposure to day-biting mosquitoes and using an appropriate mosquito repellent on exposed skin.

Acknowledgements

We are indebted to the private and public health laboratories and health departments who produce and collect the data on which this report is based.

Members of the National Arbovirus and Malaria Advisory Committee are (in alphabetical order): Bart

Currie, Peter Dagg, Peter Daniels, Stephen Doggett, Jenny Firman, Katrina Knope, Ann Koehler, Rogan Lee, Mike Lindsay, John Mackenzie, Scott Ritchie, Richard Russell, Christine Selvey, David Smith, Peter Whelan, Craig Williams. Jennifer Wall and Phil Wright (Secretariat).

Author details

Katrina Knope¹
the National Arbovirus and Malaria Advisory Committee (see acknowledgement)
Carolein Giele²

1. Office of Health Protection, Department of Health and Ageing, Canberra, Australian Capital Territory
2. Department of Health, Western Australia, Subiaco, Western Australia

References

1. Department of Health Western Australia. Bali travel behind spike in dengue fever. *Disease Watch* 2012;16.
2. Wright P, Fitzsimmons GJ, Johansen CA, Whelan PI, National Arbovirus and Malaria Advisory Committee. Arboviral diseases and malaria in Australia, 2009–10: annual report of the National Arbovirus and Malaria Advisory Committee. *Commun Dis Intell* 2012;36(1):70–81.
3. McBride WJH. Dengue fever: is it endemic in Australia? *Intern Med J* 2010;40(4):247–249.
4. Russell RC, Currie BJ, Lindsay MD, Mackenzie JS, Ritchie SA, Whelan PI. Dengue and climate change in Australia: predictions for the future should incorporate knowledge from the past. *Med J Aust* 2009;190(5):265–268.
5. Moore PR, Johnson PH, Smith GA, Ritchie SA, Van Den Hurk AF. Infection and dissemination of dengue virus type 2 in *Aedes aegypti*, *Aedes albopictus*, and *Aedes scutellaris* from the Torres Strait, Australia. *J Am Mosquito Control Assoc* 2007;23(4):383–388.
6. Morens DM. Antibody-dependent enhancement of infection and the pathogenesis of viral disease. *Clin Infect Dis* 1994;19(3):500–512.
7. Australian National Notifiable Diseases Surveillance Case Definitions. Accessed on 15 May 2012. Available from: <http://www.health.gov.au/casedefinitions>
8. Laboratory case definitions for diagnosis of communicable diseases. Accessed on 14 August 2012. Available from: <http://www.health.gov.au/internet/main/publishing.nsf/content/Laboratory%20case%20definitions-1>
9. National Arbovirus and Malaria Advisory Committee annual reports. Available from: <http://www.health.gov.au/internet/main/publishing.nsf/content/cda-arboanrep.htm>
10. Australian Bureau of Statistics. Overseas Arrivals and Departures, Australia, Table 9: Short-term Movement, Resident Departures – Selected Destinations: Original. Australian Bureau of Statistics; Canberra: 2012. ABS catalogue no.3401.0
11. Hanna JN, Ritchie SA. Outbreaks of dengue in north Queensland, 1990–2008. *Commun Dis Intell* 2009;33(1):32–33.
12. Streatfield R SD, Bielby G, Sheridan J, Pearce M, Phillips D. Dengue serotype 2 epidemic, Townsville, 1992–93. *Commun Dis Intell* 1993;17:330–332.
13. McBride WJH MH, LaBrooy JT, Wronski I. The 1993 dengue 2 epidemic in Charters Towers, North Queensland: clinical features and public health impact. *Epidemiol Infect* 1998;121(1):151–156.
14. Hanna JN RS, Merritt AD, van den Hurk AF, Phillips DA, Serafin IL, et al. Two contiguous outbreaks of dengue type 2 in north Queensland. *Med J Aust* 1998;168(5):221–225.
15. Hanna JN RS, Phillips DA, Serafin IL, Hills SL, van den Hurk AF, et al. An epidemic of dengue 3 in Far North Queensland, 1997–1999. *Med J Aust* 2001;174(4):178–182.
16. World Health Organization. Dataset – Dengue in SEARO member countries 2010, 2011. Geneva; World Health Organization: 2012.
17. Demam berdarah dengue. *Bull Jendela Epidemiologi* 2010;3.
18. Situation update of dengue in the SEA Region, 2010. Available from: http://www.searo.who.int/LinkFiles/Dengue_Dengue_update_SEA_2010.pdf
19. Hanna JN RS. An apparent recent decline in importations of dengue from Papua New Guinea into north Queensland. *Commun Dis Intell* 2009;33(1):34–35.
20. Australian Government Department of Foreign Affairs and Trade. Smartraveller: The Australian Government's travel advisory and consular assistance service. Accessed on 24 December 2012. Available from: <http://www.smartraveller.gov.au/>