

## Original articles

**AUSTRALIA'S POLIO RISK**

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**Abstract**

Australia, like all polio-free countries and regions, remains at risk of a wild poliovirus importation until polio is eradicated globally. The most probable route of importation will be through a traveller arriving in Australia either by air or sea from a polio-endemic or re-infected country. While the overall risk of an imported wild poliovirus infection leading to transmission within Australia is assessed as being low, some areas of the country have been identified as at increased risk. Local areas with relatively high arrivals from polio endemic countries, areas of low vaccination coverage and the potential for transmission to occur when these 2 factors are combined, were identified by this review as Australia's main polio risk. The risk of an importation event leading to locally acquired cases is mitigated by generally high polio vaccination coverage in Australia. This high coverage extends to residents of the Torres Strait Islands who are in close proximity to Papua New Guinea, a country identified as at high risk of poliovirus transmission should an importation occur. In 2012, all states and territories had vaccination coverage of greater than 90% at 1 year of age and all exceeded 93% at 2 years of age. Population immunity to wild poliovirus type 1, which remains the major cause of paralysis globally, has been estimated at 82%. This is sufficient to prevent outbreaks of this type in Australia. Of the 211 eligible non-polio acute flaccid paralysis (AFP) cases classified between 2008 and 2011, 91% (193) were vaccinated against polio at least once. High quality surveillance for AFP, which is supplemented by sentinel enterovirus and environmental surveillance activities, gives confidence that an imported case would be detected and appropriate public health action would ensue. *Commun Dis Intell* 2014;38(2):E107–E113.

Keywords: polio, risk assessment, epidemiology, acute flaccid paralysis

**Introduction**

Australia, as part of the World Health Organization's (WHO) Western Pacific Region, was certified polio-free during the Kyoto meeting in Japan on 29 October 2000. Poliomyelitis is a notifiable condition throughout Australia and laboratory investigation is recommended for cases of any age with a clinical suspicion of poliomyelitis. In 2007, a single imported poliomyelitis case

was detected in a university student from Pakistan residing in Melbourne, Australia. While there were no secondary cases, the public health outbreak response was extensive and included the tracing of airline passengers; household; medical clinic and hospital contacts; isolation of the case; home quarantine of close contacts; and vaccination of at risk contacts. This imported case of poliomyelitis in an adult who had reportedly been fully vaccinated as a child, served to highlight the potential for importation in individuals of any age, even with a prior history of vaccination.<sup>1</sup>

Globally, polio is still endemic in 3 countries, Afghanistan, Pakistan and Nigeria, down from 125 countries in 1988, yet the threat of resurgence remains. In addition to cases in all endemic countries, WHO had reported confirmed wild poliovirus infections in Kenya and Somalia at the time of this analysis in 2013.<sup>2</sup> In 2005, an outbreak in this region led to over 700 cases.<sup>2</sup> Polio-free countries and WHO regions remain at risk while poliovirus continues to circulate. Recent examples include the outbreak in the WHO European Region (polio-free since 2002), associated with an importation from India to Tajikistan in 2010, which ultimately resulted in 457 cases, including 29 deaths across 4 countries.<sup>3</sup> Closer to home, the Western Pacific Region experienced an outbreak in China in 2011 caused by an imported wild poliovirus type 1 from Pakistan, which resulted in 21 cases including 2 deaths.<sup>4</sup>

Australia, like all polio-free countries and regions, will remain at risk of a wild poliovirus importation until polio is eradicated globally. As Australia does not share borders with polio affected countries, the main risk will occur through importation from an endemic or re-infected country by a traveller arriving either by air or sea. Papua New Guinea (PNG), one of Australia's closest neighbours, is classified by the WHO as a country at high risk of transmission following an importation of wild poliovirus.<sup>5</sup>

A comprehensive national risk assessment has been undertaken to identify areas at highest risk of transmission should an importation of wild poliovirus occur in Australia. This assessment focuses on 4 main areas: population immunity; program delivery; importation threats; and surveillance.

## Data sources and methods

The Australian polio risk assessment was originally conducted by the Office of Health Protection in the Australian Government Department of Health, and reported at the 18th Meeting of the Regional Certification Commission for the Certification of the Eradication of Poliomyelitis in the Western Pacific Region in November 2012. This assessment applies to the risk of polio transmission based on the data available at the time of analysis in early 2013.

Poliomyelitis was notifiable in all Australian states and territories by 1922 and these notification data have been captured by the National Notifiable Diseases Surveillance System since its inception in 1991. There is a national case definition for polio, which was revised in 2010–2011 and implemented in July 2011.

Information on vaccination coverage was extracted from publicly accessible reports published by the National Health Performance Authority,<sup>6</sup> the Australian Childhood Immunisation Register (ACIR) and unpublished ACIR data sourced through the Australian Government Department of Health. Immunisation coverage for residents of the Torres Strait Islands was estimated through coverage data available for postcode 4875, which covers the following islands in the Torres Strait: Badu, Boigu, Coconut, Dauan, Erub, Horn, Kubin Village, Mabuiag, Moa, Murray, Saibai, Stephens, Thursday, Warraber, Yam and Yorke. Population immunity was identified from a national serosurvey of poliovirus immunity in Australia conducted between 1996 and 1999, prior to the cessation of oral polio vaccine use in 2005.<sup>7</sup>

Overseas Arrivals and Departures (OAD) data refers to the arrival and departure of Australian residents or overseas visitors, through Australian air and sea ports, as recorded on incoming or outgoing passenger cards. OAD data describe the number of movements of travellers rather than the number of travellers. Unpublished data on arrivals in Australia from selected countries of residence was sourced from the Department of Immigration and Border Protection (DIBP) for Table 1. These data are obtained from visa information for settler arrivals, and from incoming passenger cards (IPCs) for visitors or temporary entrants and returning residents. Country of residence is self-reported in response to the IPC question ‘Your country of residence =’ for visitors or temporary entrants and from ‘The country where you spent most time abroad =’ for returning residents. These statistics exclude the movements of operational air and ships’ crew, transit passengers who pass through Australia but are not cleared for entry, passengers on pleasure cruises commencing and finishing in Australia, and unauthorised arrivals such as irregular maritime arrivals (IMAs). For purposes of confidentiality, DIBP did not provide small numbers (less than 5).

Settlement by the Australian Bureau of Statistics Statistical Division information in Table 2 were sourced from DIBP’s online Settlement Reporting Facility,<sup>8</sup> which allows customised reports to be generated on statistical data related to permanent arrivals in Australia. These data represent the last address known to DIBP of permanent arrivals of all migration streams from the following selected countries of birth (Afghanistan, Angola, Chad, the Democratic Republic of Congo, Nigeria, Pakistan, Kenya and Somalia) and may not accurately reflect the actual current address of the settler.

**Table 1: Arrivals in Australia, 2011–12, by selected country of residence and category of traveller**

Country of residence	Settler arrival	Long term resident return	Long term visitor arrival	Short term resident return	Short term visitor arrival	Grand total*
Pakistan	1,684	417	4,540	14,734	9,545	30,919
Afghanistan	293	66	152	3,740	331	4,581
Chad	–	–	–	20	199	226
Congo, Democratic Republic of	19	–	–	107	18	148
Nigeria	70	29	266	1,308	1,601	3,274
Angola	–	5	12	475	149	641
Kenya	643	235	775	9,356	2,967	13,976
Somalia	16	25	7	384	120	552
Grand total*	2,730	779	5,756	30,124	14,929	54,318

\* Row and column totals may not equal grand totals due to removal of small numbers.

Source: DIBP unpublished overseas arrivals and departures data

**Table 2. Settlers in Australia where country of birth was reported as Afghanistan, Pakistan, Nigeria, Kenya, Somalia, Chad, Angola, or the Democratic Republic of Congo, 2011–12,<sup>8</sup> by Statistical Division and financial year of arrival**

Adelaide	966	10
Canberra	148	2
Darwin	74	1
Greater Hobart	45	0
Melbourne	2,561	28
Perth	1,049	11
Sydney	1,720	19
Brisbane	834	9
All others	1,863	20
Total	9,260	100

Settlement statistics were cross referenced against Local Government Areas (LGA) with low vaccination coverage. Data on LGAs with low coverage were provided by the Australian Government Department of Health and sourced from unpublished ACIR data. An LGA with low coverage is defined as one in which the proportion of children assessed between April 2011 and March 2012 as being fully vaccinated according to ACIR guidelines was less than 85%. LGAs are only included in this assessment where there are 25 or more children. LGAs are included if coverage was assessed as less than 85% at any of the 3 age points (1, 2 or 5 years).

Unpublished acute flaccid paralysis (AFP) surveillance data were provided by the National Enterovirus Reference Laboratory, which coordinates Australia's polio surveillance program. Information on risk groups and threat assessments were identified through document review and personal communication with key informants from DIBP, the Department of Foreign Affairs and Trade (DFAT) including the former AusAID, and the Department of Defence.

## Results

### Population immunity (susceptibility assessment)

Vaccination coverage for polio in Australia is generally high. This includes residents of the Torres Strait Islands (TSIs) that are geographically in close proximity to PNG and who have contact with residents of PNG through the movement of peoples

for traditional purposes under the Torres Strait Islander Treaty.<sup>9</sup> In 2012, all states and territories including the TSIs had vaccination coverage for all children of greater than 90% (range 91%–94%) at 12 months of age resulting in a national coverage of 92% and coverage of 93% in the TSIs. This coverage had improved by 2 years of age with all states and territories having coverage of 93% or more (range 93%–96%), resulting in a national coverage of 95%, and 97% in the TSIs. Coverage at 2 years of age is particularly important as it reflects the children at this age having received all 3 recommended doses of the primary course of inactivated polio vaccine (IPV). By 5 years of age coverage had declined from the peak at 2 years to a national coverage of 91% with all states and territories and the TSIs being at least 89%. Trends over the last 6 years show no real change in coverage between 2007 and 2012 at 1 year of age but an improved coverage at 5 years of age from 84% in 2007 to 91% in 2012 (unpublished data).

Vaccination coverage varies widely across Australia by geographical area, age group and Indigenous status. In 2011–12, areas of low vaccination coverage ( $\leq 85\%$ ) were identified across the 61 newly established Medicare Locals where the proportion of children aged 1 year who were fully immunised against all assessable vaccines, including IPV, ranged from 85% to 94%. Those fully immunised at 2 years ranged from 89% to 96% and those fully immunised at 5 years ranged from 84% to 95%. This pattern of wide ranging coverage is reflected amongst Aboriginal and Torres Strait Islander children who, while exceeding or equalling the highest range of coverage for all children, had a substantially lower bottom range at all 3 age points. Coverage amongst this group is highest and closest to that for all children at the 2 year age point.<sup>6</sup>

Coverage can be further broken down for all children by the smaller local Statistical Area Level 3, of which there are 333 in Australia. In 2011–12 there were 32 statistical areas where the percentage of children fully immunised was 85% or lower for at least 1 age group representing a total of 76,769 children who were not fully immunised.<sup>6</sup>

A national serosurvey of poliovirus immunity in Australia, conducted between 1996 and 1999, indicated that herd immunity was likely to be sufficient to prevent generalised outbreaks due to type 1 and type 2 poliovirus at 82% and 88% respectively. However, this may not be the case for type 3 for which immunity was measured at 74%.<sup>7</sup> There was considerable variation by age, with peak immunity amongst children aged 2–4 years.<sup>7</sup> Results of a second serosurvey of polio immunity in Australia, conducted in 2012–13, are expected in 2014.

Of the 211 eligible non-polio AFP classified between 2008 and 2011, 91% (193) were vaccinated against polio at least once (noting that the AFP questionnaires provide the last date of vaccination and not the complete vaccination history) (unpublished data).

### Program delivery assessment

Australia has a modern, sophisticated health care system with access to quality laboratory diagnosis. The Australian Government funds a National Immunisation Program, which includes 3 primary doses and 1 booster dose of inactivated polio vaccine, which is free to all Australian children. Australia has a polio importation plan that was endorsed by the Australian Health Protection Principal Committee in December 2008. The plan is currently under review.

The vast majority of Australians have access to safe water and adequate sewerage. To prevent disease, a community requires a clean, adequate and reliable supply of water, a functional sewerage system and reliable electricity supply. The majority of Australians live in urban or regional areas with access to these essential services.<sup>10,11</sup> While the performance of essential service providers varies across Australia, cities and large towns generally monitor the quality of drinking water and have reticulated sewerage systems where waste is collected and treated at central treatment plants. In rural and remote areas there is increased reliance on local or individual household systems such as generators, septic tanks and drinking water sourced from bores and rainwater tanks.<sup>10</sup>

Crowded living conditions and lack of maintenance can impact on the quality of water and system effectiveness.<sup>10,11</sup> These conditions are known to facilitate the spread of many infectious diseases, including faecal-oral infections.<sup>12</sup> Exposure to crowded living conditions, which places pressure on household infrastructure such as septic tanks, sewerage pipes and washing facilities, disproportionately affects Aboriginal and Torres Strait Islander people, with rates of 'overcrowding', as defined by the Productivity Commission, amongst this population almost 5 times more common than for non-Indigenous people.<sup>10,11</sup>

### Importation threats

In 2012, there were 3 remaining polio endemic countries in which polio transmission has never been interrupted: Afghanistan, Pakistan and Nigeria. There were 3 countries in which transmission was considered to have been re-established: Angola, Chad and the Democratic Republic of the Congo (DRC). In 2013, cases were reported in the

3 endemic countries and in Somalia and Kenya.<sup>13</sup> Angola, Chad and the DRC have now been polio-virus free for 12 months.

The likelihood of Australian residents travelling to the current polio endemic or re-infected countries for tourism is low given that most of these last reserves of polio are in areas of conflict and political unrest, or are uncommon destinations for Australian travellers. Advice is available on the Department of Foreign Affairs and Trade Smartraveller web site encouraging all travellers to these countries to be up to date with polio immunisation.<sup>14</sup>

Australian Government Agencies such as DFAT have internal health policies as part of their overseas conditions of service that recommend all employees and their dependents have country specific vaccinations, including polio vaccination, prior to travel on posting (personal communication Dr Kerry McMekin, DFAT). Australian Defence Force personnel are provided with all routine immunisations and undergo a targeted review of country specific immunisation requirements prior to deployment overseas. Personnel deploying to a polio endemic area are given a booster dose of polio vaccine if the last dose was more than 10 years prior, in accordance with the *Australian Immunisation Handbook*<sup>15</sup> and the Australian Defence Force Publication 1.2.2.1 Immunisation Procedures (email correspondence, Director Military Medicine, Department of Defence).

The following groups of people arriving in Australia from endemic or re-infected countries could potentially be a source of importation:

- Australian residents returning from visiting a polio infected country;
- Australian defence force personnel returning to Australia after active service;
- government and non-government employees returning to Australia;
- migrants;
- asylum seekers including irregular maritime arrivals;
- international students; and
- short term visitors.

In the 2011–12 financial year there were approximately 54,000 arrivals from countries with endemic or re-established polio transmission or recent outbreaks, including from Pakistan (30,919), Afghanistan (4,581), Nigeria (3,274), Angola (642), Chad (226), the DRC (149), Kenya (13,976) and Somalia (552). These numbers include international students, migrants and offshore humanitar-

ian entrants from these countries in the settler, long and short term visitor arrival statistics and returning Australian residents who nominated these countries as the place where they spent the majority of their time while overseas (Table 1). There are also a number of people who enter the country as IMAs. Of the above countries information on arrivals is publicly available only for Afghanistan and Pakistan. IMAs from Afghanistan represented 42% (7,672) of all IMAs from 2009 to 2012 and less than 5% (818) of IMAs were from Pakistan.<sup>16</sup>

Definitive information on where migrants settle once arriving in Australia is difficult to obtain. Available data indicate that the majority settle in the most populous states, with Perth, Sydney and Melbourne having the highest proportion of overseas-born residents.<sup>17</sup> This also appears to be true for settlers who nominated one of the 8 endemic or polio infected countries listed above as their country of birth. Data from the DIBP indicate that of those settlers arriving in the 2011–12 financial year, 80% (7,397 people) had a last known address in one of the capital cities, with Melbourne and Sydney having the highest proportion at 28% and 19% respectively (Table 2).<sup>8</sup> Of these arrivals, 13% (n=1,216) provided their last address in a LGA of low vaccination coverage, represented by 31 LGAs with approximately 3,400 un- or under-immunised children (unpublished data).<sup>8</sup>

There is also the potential for escape of a wild poliovirus from the laboratory to the community. While the probability of this occurring is low, the potential consequences of such transmission will become increasingly serious as polio-free countries increase and immunisation decreases or stops. Australia has complied with the requirements of phase one of the *Global action plan for laboratory containment of wild polioviruses*<sup>18</sup> by completing the laboratory survey and inventory phase, and maintaining a national inventory of laboratories holding wild-type poliovirus and potentially polio infectious materials since 2002. The inventory, which initially consisted of 16 laboratories across Australia, in 2012 had decreased to two: the Victorian Infectious Diseases Reference Laboratory and the Therapeutic Goods Administration. It is reviewed annually to ensure that samples have either been destroyed or are appropriately contained at biosafety level two (physical containment level 2). The Australian/New Zealand Standard for Safety in Laboratories, Part 3: Microbiological Safety and Containment (AS/NZS 2243.3:2010)<sup>20</sup> currently requires that 'All laboratories retaining wild poliovirus infectious materials or potential wild poliovirus infectious materials should be listed on the inventory held by the national government', however, there is no mechanism in place to enforce

this. A permit from the Australian Quarantine and Inspection Service is required to import human viruses such as poliovirus.

### Surveillance assessment

Australia has a well-established surveillance system for poliomyelitis based on the WHO recommended AFP surveillance and supplemented in recent years by sentinel environmental and enterovirus surveillance. A 2012 review of polio surveillance in Australia found that high immunisation coverage, sensitive polio surveillance and an effective polio response plan would ensure that any imported poliomyelitis would rapidly be contained in Australia.<sup>20</sup>

Australia has met the non-polio AFP rate clinical indicator for the last 5 years consecutively (2008–2012) and 9 times since surveillance began in 1995. Australia has never met the virological surveillance indicator for adequate stool specimen collection (5-year mean of 34%).<sup>21</sup>

The Enterovirus Reference Laboratory Network of Australia was established in 2008 primarily as a means of detecting poliovirus amongst untyped enteroviruses from clinical specimens. Further typing targets those from cases with a history of neurological symptoms potentially related to a poliovirus infection such as meningitis. Sentinel environmental surveillance was established in 2010 at 3 sites in New South Wales targeted as areas with low vaccination coverage, high volumes of tourism and a large proportion of international students. These additional virological surveillance systems have not detected any wild polioviruses, providing additional evidence that there is no wild poliovirus circulating undetected in Australia.<sup>21</sup>

### Discussion

Vaccination coverage for polio is high in Australian children. Discrepancies between coverage for Aboriginal and Torres Strait Islander children and coverage for all children are minimised by 2 years of age. There are no major differences in polio vaccine coverage or immunity by state or territory and vaccination coverage in the TSIs is higher than the national overall coverage at all age points. The first national serosurvey for polio indicated herd immunity sufficient to prevent outbreaks of type 1 and type 2 poliovirus.

There are areas of low coverage identified amongst the general population. Improving vaccination coverage in areas of low coverage is the subject of an agreement between states and territories and the Australian Government. Most of these low coverage communities are in areas with high

quality water and sanitation services. The risk to remote Aboriginal and Torres Strait Islander communities is mitigated by their remoteness and consequent lower likelihood of poliovirus introduction through international travel or visitors from endemic regions, and generally high vaccination coverage.

Despite inadequate stool specimen collection rates, surveillance quality is high and there is reasonable confidence that polio surveillance in combination with the health care system would identify polio cases should they occur.<sup>20</sup> The importance of collecting stool specimens as part of the routine clinical work up in the differential diagnosis of acute neurological presentations in which AFP is evident cannot be underestimated.

The potential for importation of a wild poliovirus exists in Australia with a large number of arrivals from polio endemic or re-infected countries. The majority of new permanent arrivals from these countries settle in the major capital cities, especially Sydney and Melbourne.

In 2011–12, 13% of these settlers had a last known address in a LGA known to have low vaccination coverage.

## Conclusion

While the overall risk of an imported wild poliovirus leading to transmission within Australia is assessed as being low, the consequences of such an event are very serious. Every possible effort should be made to mitigate against the risk of polio transmission following possible importation of poliovirus into Australia. Geographical areas, which have a relatively higher risk through lower vaccination coverage and relatively high volume of arrivals from polio endemic countries, have been identified. Ensuring the AFP surveillance system is sensitive enough to detect an imported wild poliovirus to allow timely follow-up of all cases in which poliovirus infection is suspected, supplemented by environmental and enterovirus surveillance, is essential. High vaccination coverage, not just nationally, but at all sub-national levels, must be maintained and identification of immunity gaps reviewed using the latest population-wide serosurvey results. Consideration should also be given to ways in which new arrivals from high risk countries may be immunised to reduce the risk of introduction and spread in these potentially susceptible communities. Travel advisories need to be continually reviewed and updated with information about countries with active transmission of polio and recommending that all visitors are up-to-date with polio vaccinations prior to travel. Finally, as

the global goal of eradication approaches, regular review of Australia's importation and subsequent transmission risk is increasingly important.

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