Australian Government
Australian Institute of Health and Welfare

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The burden of vaccine preventable diseases in Australia—summary

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Vaccine preventable diseases (VPD) such as influenza and whooping cough can have a severe impact on individuals and the community.

In 2015, nearly 16,000 years of healthy life were lost in Australia due to the effects of 17 VPD. The majority of this burden of disease was due to premature death. The greatest burden was found among young adults aged 25–29 and people aged 85 and over.

This report presents results from the Burden of Vaccine Preventable Diseases in Australia study (BVPD study) to estimate the burden of VPD in 2005 and 2015. It focuses on the 17 diseases with vaccines in the National Immunisation Program (NIP) schedule in 2018, and on how the burden changed between 2005 and 2015. It also explores the burden of VPD among the Aboriginal and Torres Strait Islander population.

What is a vaccine preventable disease?

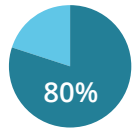
A VPD is a disease that can be prevented, or its impact reduced, through immunisation (generally with a vaccine).

Vaccines stimulate the body's immune system to protect against subsequent infection by the pathogen that caused the disease. The World Health Organization (WHO) estimates that immunisation prevents 2–3 million deaths worldwide each year, and recognises immunisation as being 'one of the most successful and cost-effective health interventions known' (WHO 2013).

The Australian Government provides free vaccines to eligible people, including young children, older Australians, Aboriginal and Torres Strait Islander Australians, and others at greater risk of serious harm from VPD (such as pregnant women).

In 2015:

15,781 years
of healthy life were lost due to VPD (62 DALY* per 100,000 population)



More than three-quarters of the VPD burden was due to
premature death

83%

The majority of VPD burden was due to:
- Influenza
- Pneumoccocal disease
- HPV*

4x

The rate of VPD burden was 4 times as high among
Indigenous Australians
as non-Indigenous Australians

Between 2005 and 2015:

31%

The rate of VPD burden fell by
nearly one-third

*DALY = disability-adjusted life years
HPV = human papillomavirus

The NIP schedule sets out which vaccines are provided at which ages (Table 1).

Table 1: Diseases for which vaccines are available under the NIP, 2018

Chickenpox (varicella)	Diphtheria	*Haemophilus influenzae* type b (Hib)
Hepatitis A[(a)]	Hepatitis B	Human papillomavirus (HPV)
Influenza	Measles	Meningococcal disease (invasive)
Mumps	Pneumococcal disease (invasive)	Poliomyelitis
Rotavirus	Rubella	Shingles (herpes zoster)
Tetanus	Whooping cough (pertussis)	

(a) Vaccine is available under the NIP for Aboriginal and Torres Strait Islander children living in Queensland, Western Australia, South Australia and the Northern Territory.

Note: The NIP schedule specifies the ages and at-risk groups for which individuals are eligible for free vaccination under the NIP. The latest version of the schedule is available at https://www.health.gov.au/health-topics/immunisation.

What is burden of disease?

Burden of disease analysis measures the combined impact of living with illness and injury (non-fatal burden) and dying prematurely (fatal burden). It takes into account age at death and severity of disease. The summary measure 'disability-adjusted life years' (or DALY) is used to count the years of healthy life lost from death (years of life lost, or YLL) and from illness (years lived with disability, or YLD).

The health loss that the DALY measures represents the difference between the current health status of the population and the ideal situation where everyone lives a long life, free of disease. Burden of disease estimates capture both the quantity and quality of life, and reflect the magnitude, severity and impact of disease and injury on the population. Because the same methods are used for all diseases, the health impacts of different diseases and injuries can be compared, making burden of disease analysis valuable for informing health policy and service planning.

The BVPD study used an incidence-based modelling approach to estimate the burden of disease. For each reference year, the analysis was based on all new cases of disease that occurred in that year, and the immediate and future consequences of those cases. This means that the future disability arising from VPD can be incorporated into the burden estimates.

This approach differs from that used in the Australian Burden of Disease Study (ABDS) (see Discussion; AIHW 2016, 2019a), so results from the 2 studies should not be directly compared.

What is the burden of vaccine preventable diseases?

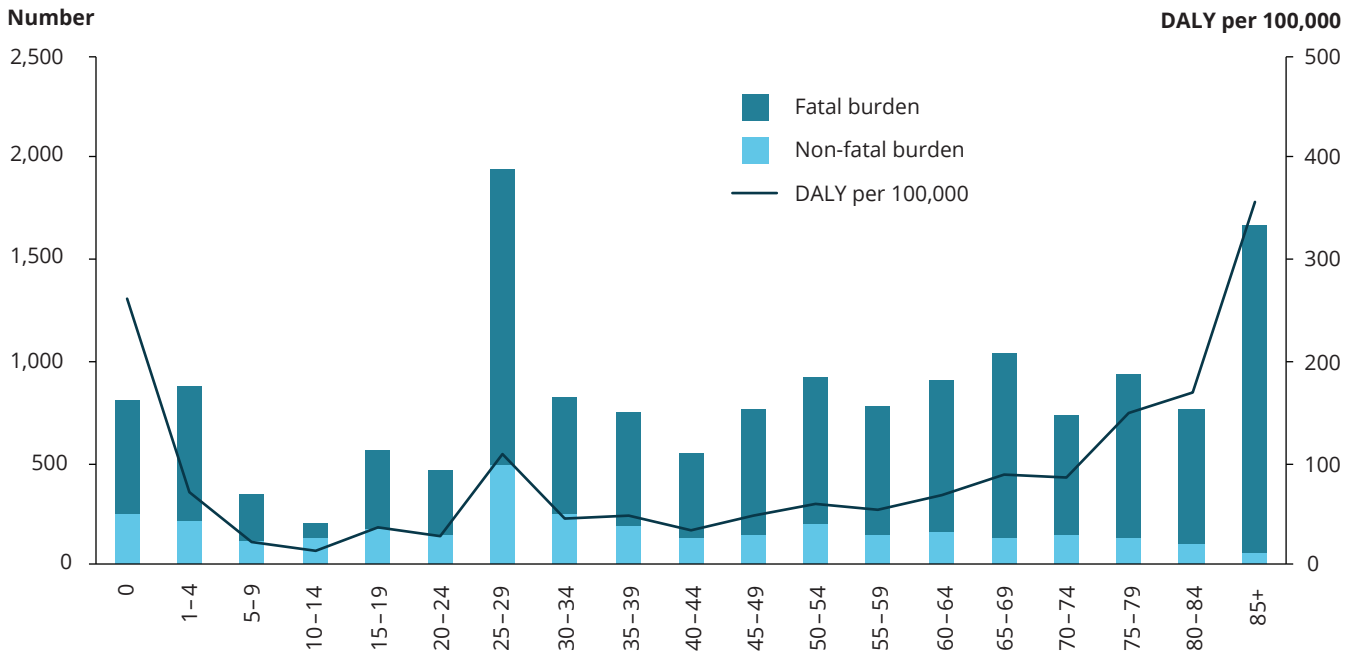
As a group, the 17 VPD were responsible for almost 16,000 DALY in 2015, at a rate of 62 DALY per 100,000 population. Most of the burden (80%) was due to premature death (fatal burden).

Burden is highest among young adults and the very old

In 2015, the number of DALY due to VPD was highest among people aged 25–29 (12% of DALY), followed by people aged 85 and over (11%). The high burden among people aged 25–29 is because of the potential long-term outcome of developing cervical cancer after infection with the human papillomavirus (HPV).

The rate of burden was highest among infants and those aged 85 and over, at 262 and 357 DALY per 100,000 population, respectively (Figure 1). Among those aged 1–74, people aged 25–29 had the highest rate of burden (108 DALY per 100,000 population).

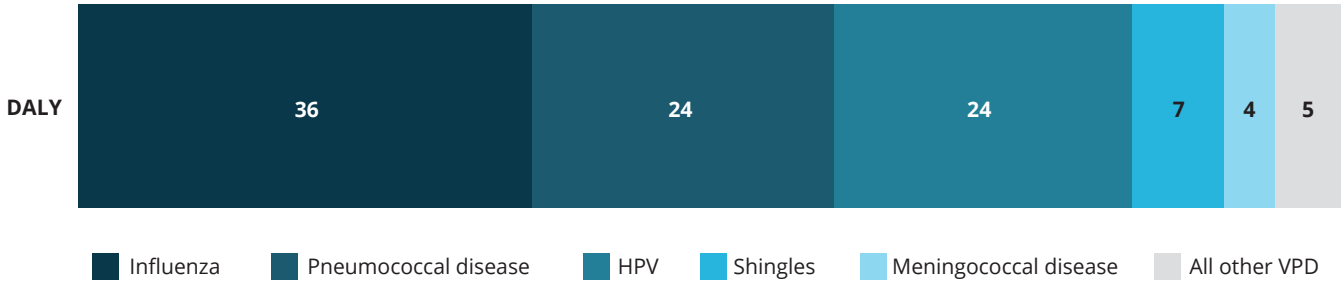
Figure 1: Non-fatal, fatal and total burden (DALY per 100,000 population) due to VPD, by age, 2015



Which diseases cause the most burden?

Influenza contributed more than one-third of the total burden (5,674 DALY, 36%), followed by pneumococcal disease (3,793 DALY, 24%) and HPV (3,710 DALY, 24%) (Figure 2). Shingles contributed a further 7% to the total and meningococcal disease just over 4%. Together, these 5 diseases accounted for just under 95% of the total burden associated with diseases covered by vaccines under the NIP.

Figure 2: Contribution of individual diseases to overall burden (DALY) due to VPD, 2015 (%)

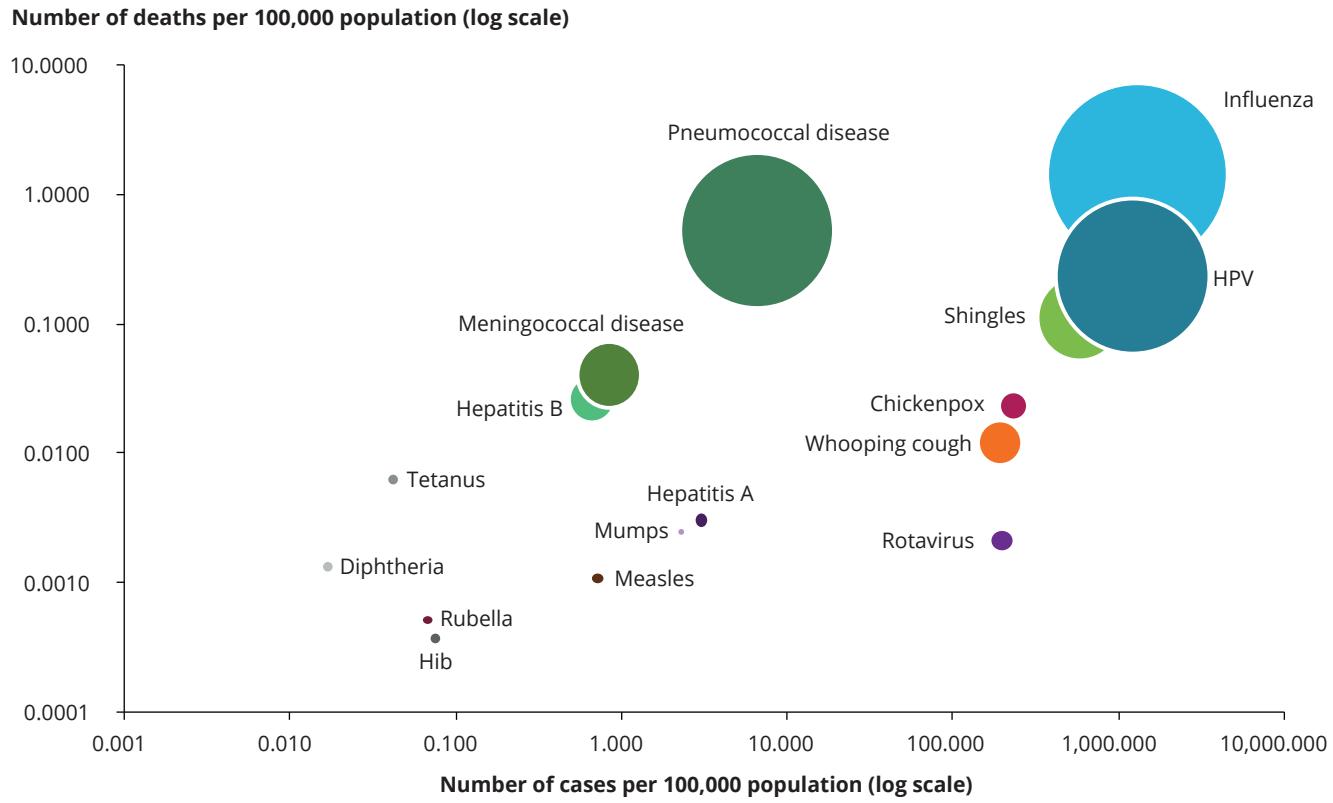


Note: 'All other VPD' comprises hepatitis B, whooping cough, chickenpox, rotavirus, hepatitis A, measles, diphtheria, tetanus, rubella, Hib, mumps and polio.

Some VPD cause severe illness and have a high burden of disease for each person with the disease (relatively high DALY per case). Other diseases may not be as severe at the individual level but, due to the large number of cases, have a greater total burden (relatively high DALY per 100,000 population, see Figure 3).

Influenza has a very low disease burden at the individual level, at 0.02 DALY per case, yet it affects a large number of people, resulting in a high population burden (36% of total DALY). Meningococcal disease has a relatively high level of individual burden (3.2 DALY per case) but, due to the much lower number of cases, it contributes substantially less to the overall population burden (4% of total DALY). HPV, although potentially having serious long-term consequences and a high population burden, has a relatively low individual burden (0.01 DALY per case); although the number of HPV infections is very large, only a fraction of these (about 1 in 700) progress to cervical cancer.

Figure 3: Number of cases, deaths and population-level burden of VPD, 2015



Notes

1. Size of bubbles indicates population-level burden (DALY per 100,000 population).
2. Polio is not included in the figure as there were no new cases of polio in Australia in 2015; therefore, the burden due to polio was zero.

How does burden differ by disease and sex?

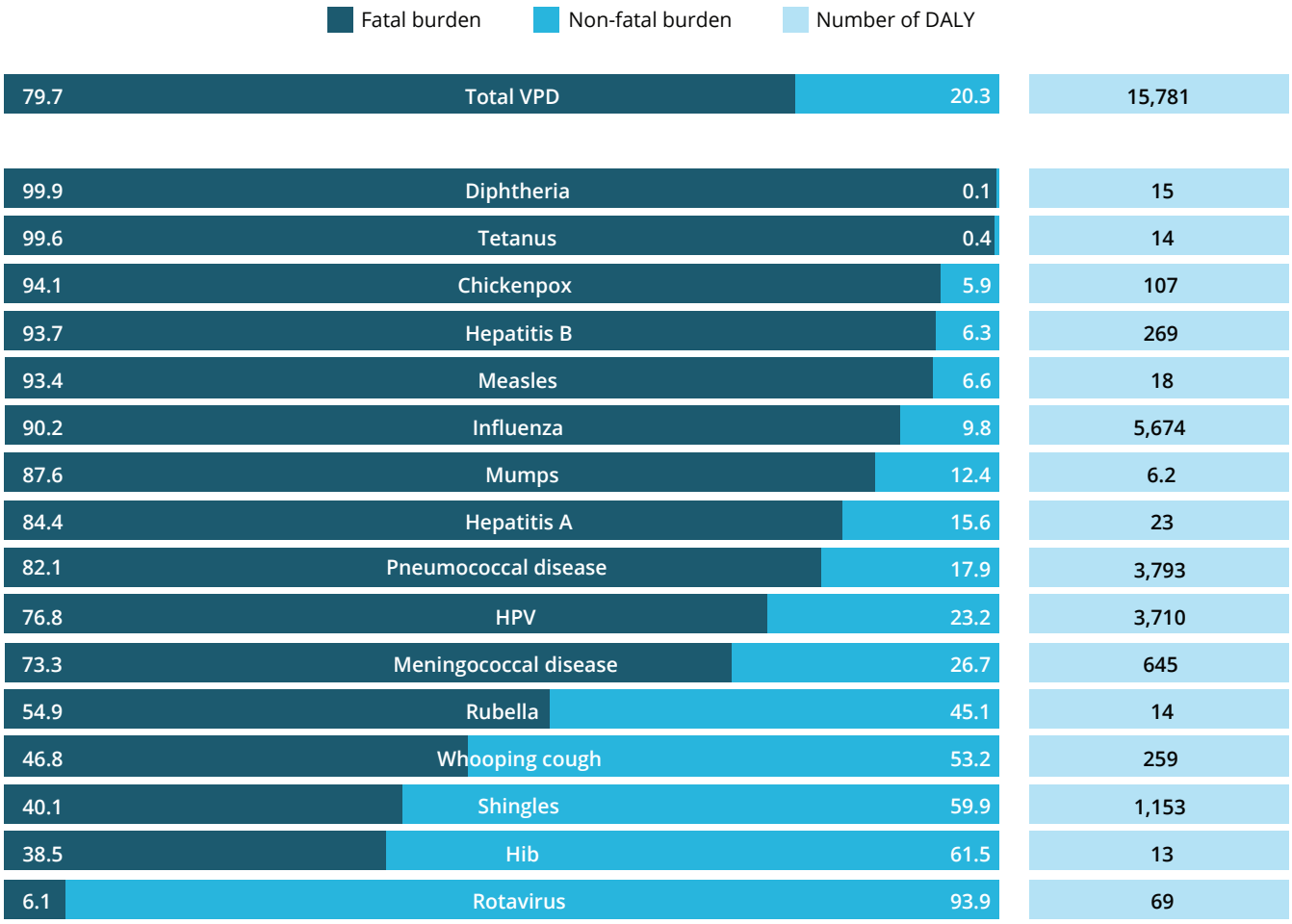
The distribution of burden between the sexes varied by disease. Males experienced a greater burden due to rubella (71%), hepatitis B (69%) and hepatitis A (57%); females experienced a greater burden due to influenza (58%) and more than 99% of the burden due to HPV. The higher rubella burden attributed to males was due to the higher number of congenital rubella syndrome cases among males.

For the other VPD, the burden was similar between the sexes.

Type of burden varies by disease

The contribution of fatal and non-fatal outcomes to the total burden by disease varied considerably (Figure 4). Fatal burden contributed at least three-quarters of the total burden for most diseases; however, less than half of the total burden was fatal for whooping cough (47%), shingles (40%) and *Haemophilus influenzae* type b (Hib) (39%). Only 6% of the burden due to rotavirus was fatal.

Figure 4: Proportion of fatal and non-fatal burden, by disease, 2015



Note: Polio is not included in the figure as there were no new cases of polio in Australia in 2015; therefore, the burden due to polio was zero.

What has changed over time?

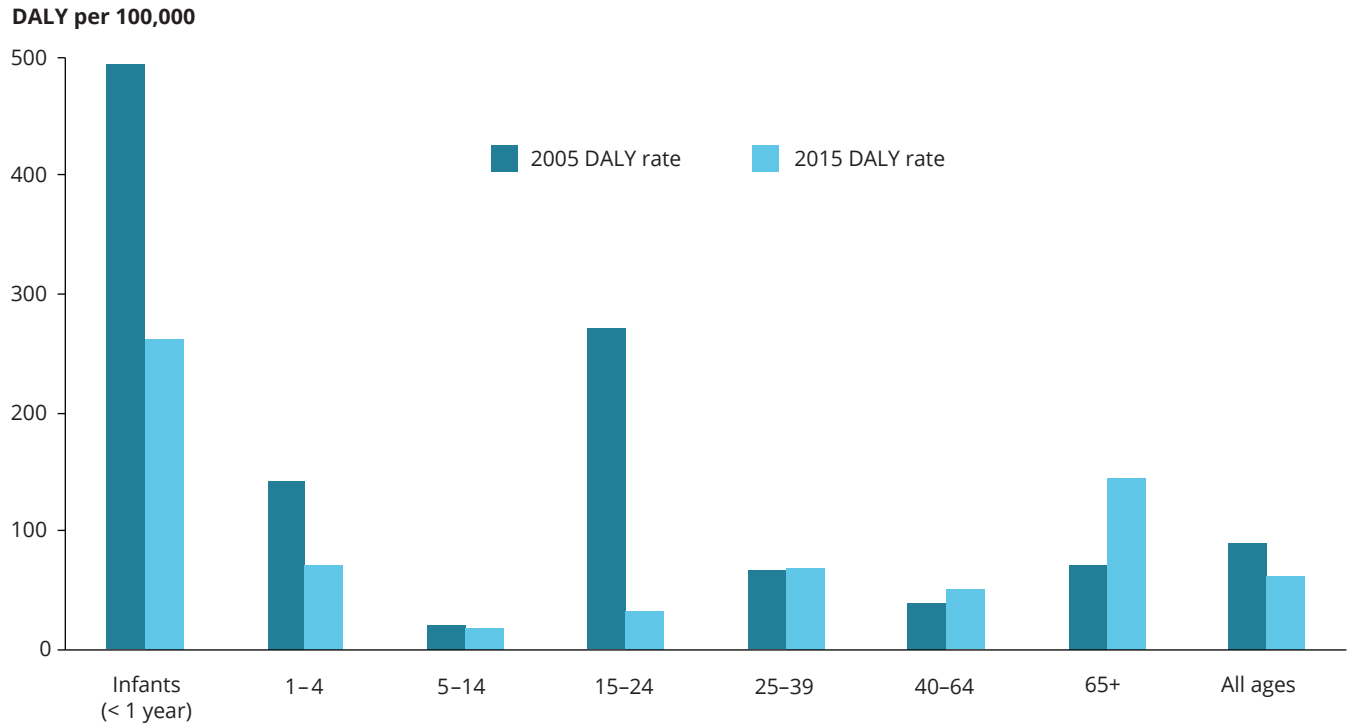
The overall burden of VPD decreased by 13% between 2005 and 2015, from 18,060 to 15,781 DALY. After adjusting for differences in the population age structures, the rate of burden decreased by 31% over the same period, from 89.9 to 62.5 DALY per 100,000 population.

When comparing results from 2005 and 2015, it is important to note that differences in the burden may have been affected by both the cyclic epidemics of many diseases (for example, influenza and whooping cough) and changes in disease surveillance and reporting practices.

Burden decreases for children aged under 5 and young adults, and rises for people aged 40 and over

Age-specific burden rates were similar in 2005 and 2015 for those aged 5–14 and 25–39 and increased slightly for those aged 40–64. However, compared with the 2005 rates, 2015 rates were considerably lower for infants, young children and young adults aged 15–24, and considerably higher for those aged 65 and over (Figure 5). Decreased burden among young children was mostly driven by declines in the incidence of rotavirus and pneumococcal and meningococcal diseases, while the sharp decrease among young adults was driven by declines in HPV infection. The increased burden among older adults was mainly due to the increased incidence of influenza and shingles, along with greater numbers of deaths from these 2 diseases.

Figure 5: Burden (DALY per 100,000 population) due to VPD, by age, 2005 and 2015



Note: 'All ages' rates age-standardised to the 2001 Australian population.

Change in burden of individual diseases

Between 2005 and 2015, the rate of burden for several VPD rose, including for:

- influenza (the rate more than quadrupled, from 4.6 to 21.1 DALY per 100,000 population)
- whooping cough (73% increase, from 0.6 to 1.1)
- shingles (44% increase, from 3.0 to 4.3) (Figure 6).

Large decreases occurred for:

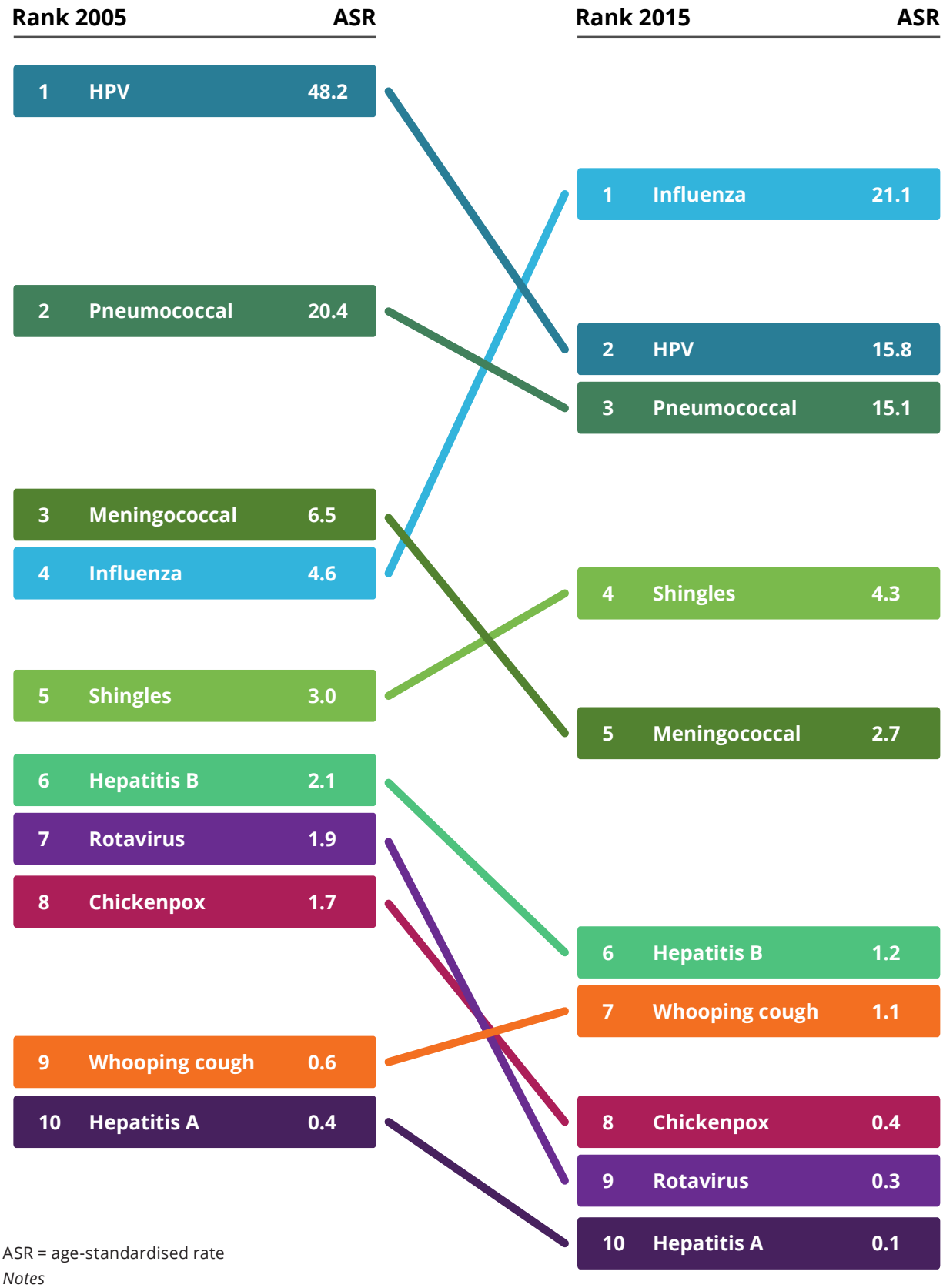
- rotavirus (85% decrease, from 1.9 to 0.3 DALY per 100,000 population)
- hepatitis A (75% decrease, from 0.4 to 0.1)
- chickenpox (75% decrease, from 1.7 to 0.4)
- HPV (67% decrease, from 48.2 to 15.8)
- meningococcal disease (58% decrease, from 6.5 to 2.7)
- hepatitis B (44% decrease, from 2.1 to 1.2)
- pneumococcal disease (26% decrease, from 20.4 to 15.1).

Vaccines for the following diseases were added to, or vaccine eligibility extended on, the NIP schedule during the past 20 years:

- hepatitis B, in 2000
- meningococcal disease, in 2003
- chickenpox, hepatitis A and pneumococcal disease, in 2005
- HPV and rotavirus, in 2007.

The rankings for most of the top 10 individual diseases changed between 2005 and 2015; for example, influenza went from fourth to first and meningococcal disease went from third to fifth (Figure 6).

Figure 6: Individual burden (DALY per 100,000 population) and rankings of top 10 VPD, 2005 and 2015



ASR = age-standardised rate

Notes

1. Rates age-standardised to the 2001 Australian population.
2. Hib, rubella, diphtheria, measles, mumps and tetanus are not included in the figure as each disease had an ASR of less than 0.2 DALY per 100,000 population for both 2005 and 2015.
3. Polio is not included in the figure as there were no new cases of polio in Australia in 2005 or 2015; therefore, the burden due to polio was zero.

What is the burden among Indigenous Australians?

Due to the very small number of cases of some VPD, it was not possible to estimate the burden for all 17 of the diseases mentioned in previous sections for Aboriginal and Torres Strait Islanders. Instead, estimates were calculated for 13 diseases: chickenpox, hepatitis A, hepatitis B, Hib, HPV, influenza, measles, meningococcal disease, mumps, pneumococcal disease, rotavirus, shingles and whooping cough.

As a group, these 13 VPD were responsible for 1,552 DALY among Indigenous Australians in 2015. Most (85%) of this burden was due to premature death (fatal burden).

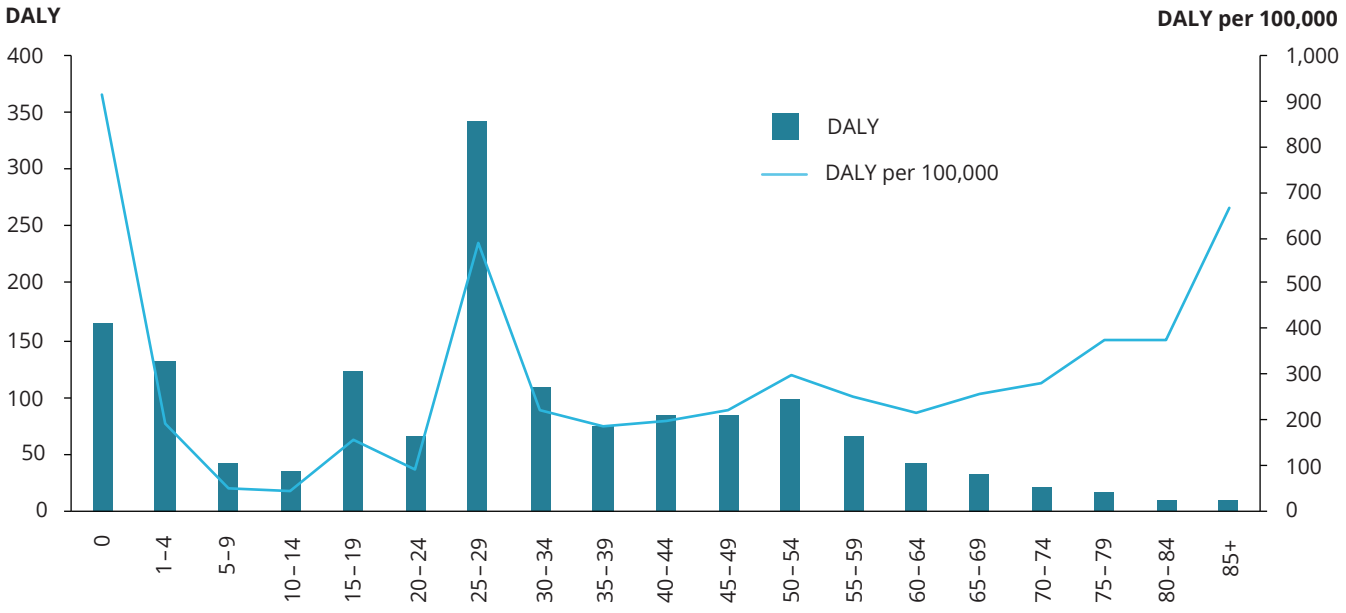
For these 13 VPD, the burden among Indigenous Australians was 10% of the total burden. After adjusting for differences in population age structure, the Indigenous burden rate was 4.1 times that for non-Indigenous Australians.

Burden is highest in young adults and infants

Among Indigenous Australians, the number of DALY due to VPD was highest in young adults aged 25–29 and in infants, accounting for 22% and 11% of the total DALY, respectively (Figure 7). The high burden among young adults is as a result of the potential long-term outcome of developing cervical cancer following HPV infection.

The rate of burden was highest among Indigenous infants and those aged 85 and over, at 911 and 663 DALY per 100,000 population, respectively. Among Indigenous Australians aged 1–74, young adults aged 25–29 had the highest rate of burden (587 DALY per 100,000).

Figure 7: Burden (DALY and DALY per 100,000 population) due to VPD, by age, Indigenous Australians, 2015

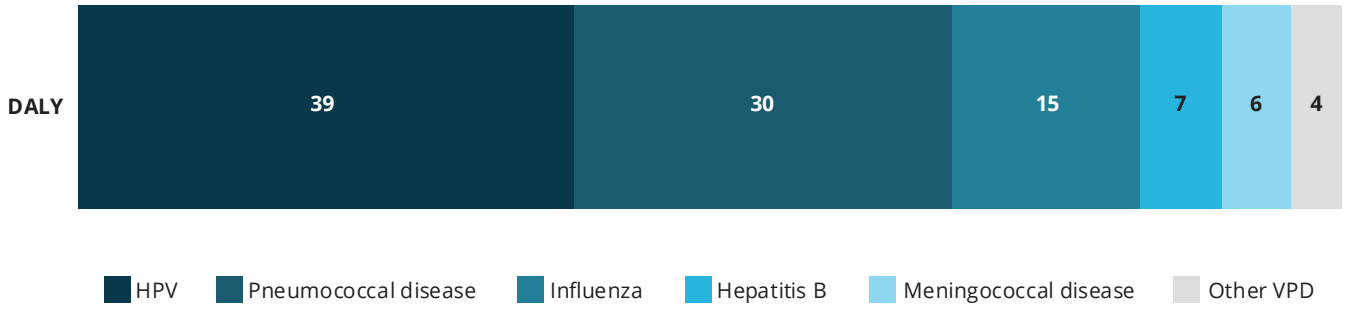


Note: Includes chickenpox, Hib, hepatitis A, hepatitis B, HPV, influenza, measles, meningococcal disease, mumps, pneumococcal disease, rotavirus, shingles and whooping cough. Estimates of burden for diphtheria, rubella and tetanus could not be calculated by Indigenous status.

Which diseases cause the most burden?

HPV contributed the greatest proportion of the burden among Indigenous Australians in 2015 (39% of total DALY), followed by pneumococcal disease (30%) and influenza (15%) (Figure 8).

Figure 8: Contribution of individual diseases to overall burden (DALY) due to VPD, Indigenous Australians, 2015 (%)



Notes

1. Includes chickenpox, Hib, hepatitis A, hepatitis B, HPV, influenza, measles, meningococcal disease, mumps, pneumococcal disease, rotavirus, shingles and whooping cough. Estimates of burden for diphtheria, rubella and tetanus could not be calculated by Indigenous status.
2. 'Other VPD' comprises shingles, whooping cough, rotavirus, mumps, Hib, measles, chickenpox and hepatitis A.

How does burden differ by disease and sex?

The distribution of burden between the sexes among Indigenous Australians varied by disease. Indigenous males experienced a greater burden due to hepatitis A (88%), Hib (67%) and meningococcal disease (61%). Indigenous females experienced greater burden due to HPV (more than 99%), hepatitis B (83%), influenza (64%), chickenpox (63%) and shingles (61%).

For the other 5 VPD, the burden was similar between the sexes.

Premature death causes most burden for 9 diseases

For 9 of the 13 diseases, fatal burden (premature death) contributed at least three-quarters of the total burden. However, more than two-thirds—or, in one case, all—of the burden for Hib (68%), shingles (72%), rotavirus (more than 99%) and chickenpox (100%) was non-fatal.

What has changed over time?

Among Indigenous Australians, the overall burden due to the 13 specified VPD decreased between 2005 and 2015. The number of DALY decreased by 45%, while the age-standardised rate decreased by 41%.

The overall rate of burden decreased from 400 to 237 DALY per 100,000 population, largely due to a decrease in the burden of HPV (from 263 to 81 DALY per 100,000 population). There were also decreases in burden for hepatitis A (98%), rotavirus (95%), Hib (81%), meningococcal disease (53%) and hepatitis B (52%). Vaccines for some of these diseases—hepatitis A, hepatitis B, HPV, meningococcal disease and rotavirus—were added to, or vaccine eligibility extended on, the NIP schedule during the past 20 years.

Between 2005 and 2015, the rate of burden among Indigenous Australians for several VPD rose, including for:

- influenza (the rate more than quadrupled, from 11.4 to 49.4 DALY per 100,000 population)
- shingles (91% increase, from 3.6 to 6.9 DALY per 100,000)
- whooping cough (56% increase, from 1.0 to 1.5 DALY per 100,000)
- pneumococcal disease (16% increase, from 67.5 to 78.3 DALY per 100,000) (Table 2).

Table 2: Burden (DALY per 100,000 population) of top 10 VPD, Indigenous Australians, 2005 and 2015

	DALY		DALY per 100,000 population		
Disease	**2005**	**2015**	**2005**	**2015**	**% change**
HPV	1,925	610	263.4	81.0	–69 ↓
Pneumococcal disease	333	465	67.5	78.3	16 ↑
Influenza	59	229	11.4	49.4	334 ↑
Hepatitis B	179	102	19.5	9.3	–52 ↓
Meningococcal disease	161	85	15.4	7.2	–53 ↓
Shingles	12	25	3.6	6.9	91 ↑
Mumps	<0.1	3.5	<0.1	2.6	—[(a)]
Whooping cough	10	20	1.0	1.5	56 ↑
Rotavirus	110	7.4	12.9	0.7	–95 ↓
Hib	8.3	3.0	1.3	0.2	–81 ↓
Total burden due to 13 VPD	**2,807**	**1,552**	**400.0**	**237.3**	**–41 ↓**

(a) Due to the extremely low rate for mumps in 2005 compared with the outbreak in 2015, a reliable value for change over time could not be calculated.

Notes

1. Data for hepatitis A, measles and chickenpox have not been included in the table as each disease had an age-standardised rate of less than 0.1 DALY per 100,000 population for both 2005 and 2015.
2. Estimates of burden for diphtheria, rubella and tetanus could not be calculated by Indigenous status.
3. Rates age-standardised to the 2001 Australian population.

Burden is higher among Indigenous Australians in all age groups

Across all age groups, Indigenous Australians had higher rates of burden than non-Indigenous Australians (Figure 9).

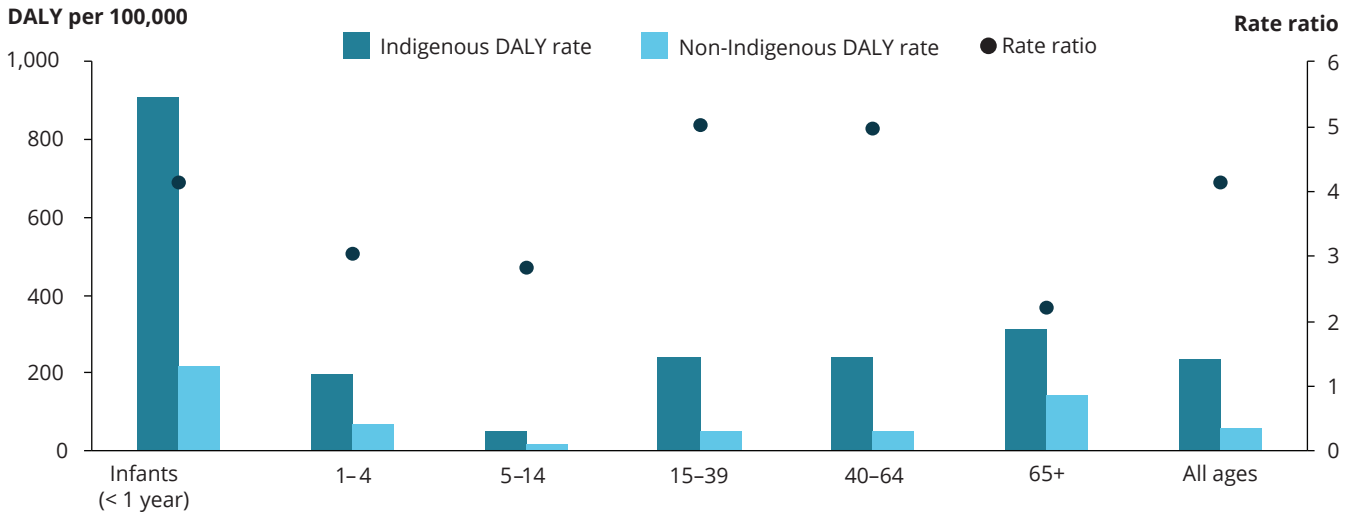
Rate differences and rate ratios are presented as measures of the gap in burden between Indigenous and non-Indigenous Australians. Rate differences provide a measure of the absolute gap (or difference), while rate ratios are a measure of the relative gap (or difference) between the 2 populations.

The largest absolute difference in VPD burden rates was between Indigenous and non-Indigenous infants. The largest relative differences were for people aged 15–39 and 40–64, where the rates among Indigenous Australians were 5 times those for non-Indigenous Australians.

How does the gap vary by disease?

HPV and pneumococcal disease had the largest absolute differences between Indigenous and non-Indigenous rates, as well as large relative differences, with rate ratios of 5.9 and 5.8, respectively. Hepatitis B had the second-largest relative difference between Indigenous and non-Indigenous Australians (rate ratio of 12) (Table 3).

Figure 9: Burden rates (DALY per 100,000 population) and rate ratios, by age, Indigenous and non-Indigenous Australians, 2015



Notes

1. Includes chickenpox, Hib, hepatitis A, hepatitis B, HPV, influenza, measles, meningococcal disease, mumps, pneumococcal disease, rotavirus, shingles and whooping cough. Estimates of burden for diphtheria, rubella and tetanus could not be calculated by Indigenous status.
2. 'All ages' rates age-standardised to the 2001 Australian population.

Table 3: Burden, rate ratios and rate differences of top 10 VPD, Indigenous and non-Indigenous Australians, 2015

	DALY per 100,000 population			
Disease	**Indigenous**	**Non-Indigenous**	**Rate ratio**	**Rate difference**
HPV	81.0	13.7	5.9	67.3
Pneumococcal disease	78.3	13.5	5.8	64.7
Influenza	49.4	20.6	2.4	28.9
Hepatitis B	9.3	0.8	12.4	8.5
Meningococcal disease	7.2	2.5	2.9	4.7
Shingles	6.9	4.2	1.6	2.7
Mumps	2.6	<0.1	n.p.[(a)]	2.6
Whooping cough	1.5	1.1	1.4	0.4
Rotavirus	0.7	0.3	2.5	0.4
Hib	0.2	<0.1	5.3	0.2
Total for 13 VPD	**237.3**	**57.3**	**4.1**	**180.0**

(a) A reliable rate ratio for mumps could not be calculated due to the very low rate of burden in the non-Indigenous population.

Notes

1. The burden for hepatitis A, measles and chickenpox among Indigenous Australians in 2015 was less than 0.1 DALY per 100,000 population.
2. Rates age-standardised to the 2001 Australian population.

Discussion

Of the diseases included in the BVPD study, influenza was the largest overall contributor to burden in 2015. A particularly high number of influenza cases were notified in the 3-year period 2014–2016, and more than twice the number of deaths than in the periods 2011–2013 and 2008–2010. Heightened awareness and an increased propensity for testing caused some of this increase, meaning that influenza cases and deaths are more likely to be identified. It is difficult to determine, though, how much of the increase in reported influenza cases is due to increased awareness and testing and how much is due to an increase in the number of cases occurring.

Invasive pneumococcal disease was the second largest contributor to the total burden, accounting for just under one-quarter (24%) of total DALY in 2015. It has a relatively high case-fatality rate, with more than 80% of the total pneumococcal disease burden attributed to fatal burden. Most of the remaining burden was the non-fatal burden associated with long-term effects of bacterial meningitis.

The next greatest contributor was HPV, which also accounted for just under one-quarter (24%) of the total DALY. HPV infection is generally asymptomatic, with only certain HPV types causing genital warts. The majority of the HPV burden results from the potential long-term outcome of developing cervical cancer; although only a small proportion of infections progress to cancer, the large number of cases (estimated at 291,000 in 2015), and the severity of the outcome, result in a relatively high number of DALY at a population level.

The burden of disease was noticeably small (fewer than 20 DALY) for a number of diseases for which vaccines have been widely available for many years, such as diphtheria, measles and rubella. The latter 2 diseases have been declared eliminated in Australia. The remaining burden of these diseases relates mostly to infections acquired overseas and carried back to Australia, showing the importance of maintaining high levels of vaccination coverage within the Australian population to avoid increases in burden in the future.

What is the impact of vaccination?

The BVPD study has shown a reduction in the burden for a number of diseases that have been added to Australia's NIP schedule during the past 20 years, such as chickenpox, hepatitis A, hepatitis B, HPV, meningococcal disease, pneumococcal disease and rotavirus. The introduction of vaccines appears to have reduced both the number of cases and the overall burden associated with these diseases (Table 4).

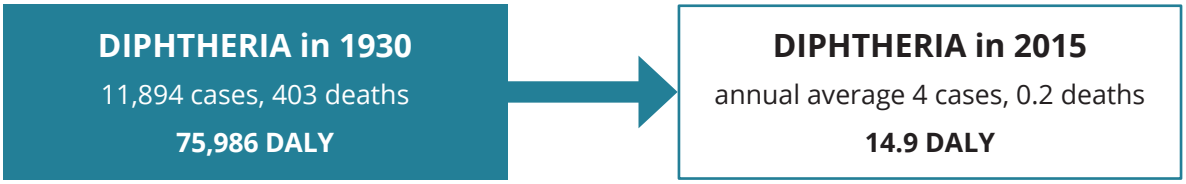
Table 4: Number of cases and burden (DALY per 100,000 population) due to selected VPD, Australia, 2005 and 2015

		Number of cases			DALY per 100,000 population		
Disease	Year widespread vaccination introduced	2005	2015	% change	2005	2015	% change
Rotavirus	2007	241,000	47,700	–80 ↓	1.9	0.3	–85 ↓
Chickenpox	2005	95,200	55,300	–42 ↓	1.7	0.4	–75 ↓
HPV	2007 for girls, 2013 for boys	545,600	291,000	–47 ↓	48.2	15.8	–67 ↓
Pneumococcal disease	2001 for at-risk infants, 2005 for all infants and those aged 65 and over	1,824	1,576	–14 ↓	20.4	15.1	–26 ↓
Hepatitis A	2005	1,200	720	–40 ↓	0.4	<0.1	–75 ↓
Hepatitis B	Early 1980s for at-risk groups, 2000 for all infants	580	340	–41 ↓	2.1	1.2	–44 ↓
Meningococcal disease	2003	369	201	–46 ↓	6.5	2.7	–58 ↓

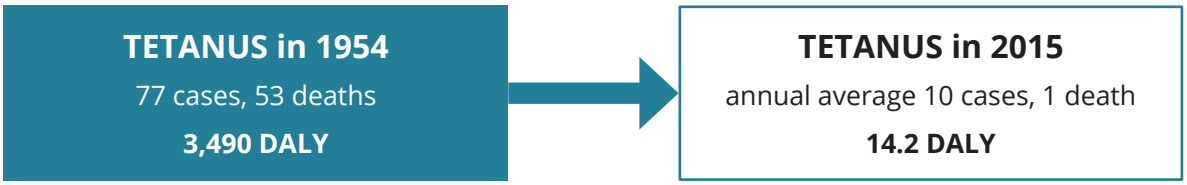
Note: Rates age-standardised to the 2001 Australian population.

Historical data show the impact of long-term widespread vaccination in Australia. Diseases such as diphtheria (widespread vaccination introduced in 1932), tetanus (1953) and Hib (1991) appear to be well controlled and have remained at low levels over recent decades.

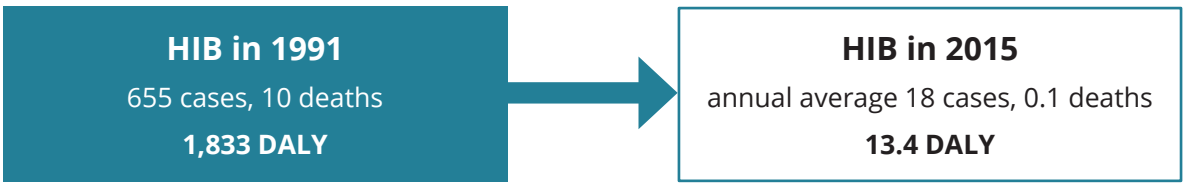
The burden of diphtheria in Australia in 1930 was estimated at almost 76,000 DALY. This burden resulted from almost 12,000 cases and around 400 deaths, mostly in children. By 2015, the burden of diphtheria was estimated to be fewer than 15 DALY, occurring in adults and mostly related to infections acquired overseas.



The burden of tetanus also decreased dramatically after widespread vaccination was introduced in the 1950s. In 1954, the estimated burden was 3,490 DALY (almost entirely attributed to fatal cases, and mostly in children) compared with 14 DALY in 2015. Although there are still a few cases each year, there are few deaths, and those that do occur are among older people who may have been vaccinated many years previously, if at all.



Similarly, the burden associated with Hib in 1991 was estimated at 1,833 DALY, mostly among infants and young children. By 2015, the burden had decreased to 13 DALY. In the late 1980s, Hib was the predominant cause of bacterial meningitis in Australia, accounting for up to 70% of cases. An estimated 40–50% of children with Hib developed meningitis, with the subsequent long-term complications affecting cognition, hearing, vision and other functions (Hanna & Wild 1991; McIntyre et al. 1991, 1993; Thomas 1992). The number of Hib cases in Australia declined substantially after vaccination of infants under the NIP began in 1993.



How does the BVPD study compare with others?

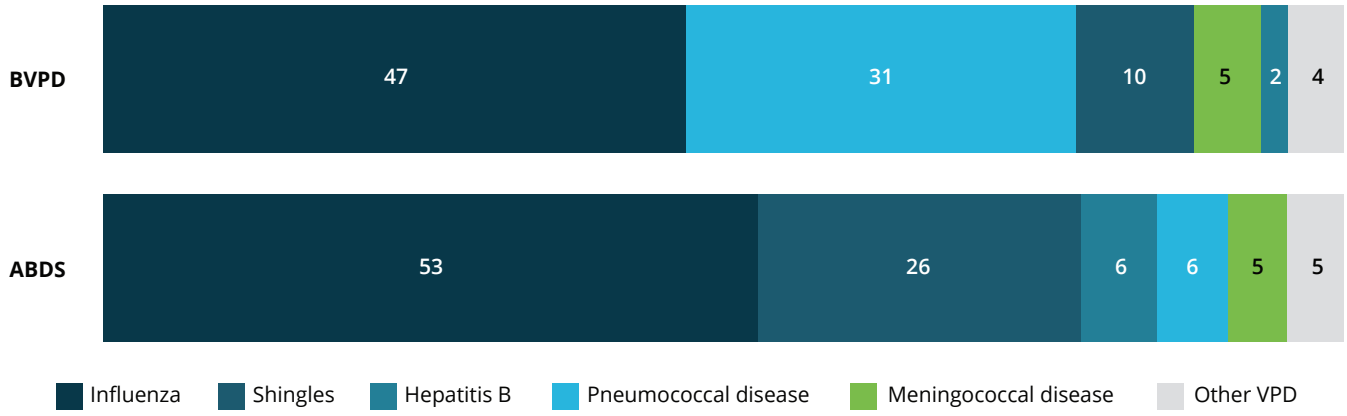
Two main methods are generally used in burden of disease studies: incidence-based or hybrid modelling (see Glossary). The BVPD study used an incidence-based methodology; the ABDS used hybrid modelling. Although the results of the 2 studies are not strictly comparable, it is useful to consider them and understand the reasons for any differences.

Australian Burden of Disease Study 2015

HPV was not a stand-alone disease in the ABDS; instead, the burden due to HPV was captured under 'other reproductive conditions' (for genital warts and cervical abnormalities) and 'cervical cancer'. The remaining VPD were included in both studies as stand-alone diseases.

Excluding HPV, the overall VPD burden was 15% higher in the BVPD study than in the ABDS 2015. The same 5 diseases accounted for 95% of the VPD burden in both studies, although the positions within the top 5 differed. Influenza was the top ranked VPD in both studies, accounting for just over half of the VPD burden (53%) in the ABDS and just under half (47%) in the BVPD study. Pneumococcal disease was the second highest ranked disease in the BVPD study, but fourth in the ABDS 2015 (Figure 10).

Figure 10: Contribution of total VPD burden excluding HPV, top 5 VPD, BVPD study and ABDS, 2015 (%)



Note: 'Other VPD' includes chickenpox, diphtheria, hepatitis A, Hib, measles, mumps, rotavirus, rubella, tetanus and whooping cough.

Sources: AIHW BVPD study; AIHW 2019a.

The burden estimates for influenza, whooping cough and mumps were similar across the 2 studies. These are all acute infections, with no or very rare long-term complications. However, the BVPD study estimated a smaller burden than the ABDS 2015 for hepatitis A, hepatitis B, rotavirus, rubella and shingles and a larger burden for chickenpox, diphtheria, Hib, measles, meningococcal disease, pneumococcal disease and tetanus.

Apart from the differences that result from including long-term complications in the BVPD study, many of the remaining differences between the studies are due to the methods and availability of data sources used to derive input data. For example, to estimate case numbers, the BVPD study used averages from a number of years of notifications, hospitalisation and deaths data, whereas the ABDS used data only for 2015 (see AIHW 2019b for more information).

International studies

The Burden of Communicable Diseases in Europe (BCoDE) and the Ontario Burden of Infectious Disease Study (ONBOIDS) also used incidence-based methods to derive estimates.

Influenza and pneumococcal disease both appear in the top 5 ranked diseases in all 3 incidence-based studies (Table 5). Hepatitis B and Hib appear among the top 5 ranked diseases in both the BCoDE and ONBOIDS, but not in the BVPD study.

Infant vaccination for hepatitis B was rolled out nationally in Australia in 2000. Since then, the number of new hepatitis B infections acquired in Australia has fallen dramatically, resulting in decreased burden. Most newly diagnosed chronic hepatitis B cases in Australia are now the result of infections acquired overseas, particularly in high-prevalence countries.

As noted earlier, Hib has been considerably less common in Australia since vaccination was introduced in 1993, with a substantial reduction in the number of cases and burden. In 2015, an estimated 72% of Canadian children aged 2 were fully vaccinated against Hib (Public Health Agency of Canada 2017) compared with around 90% of Australian 2-year-olds (Department of Health 2019).

Table 5: Comparison of the top 5 VPD in selected incidence-based burden of disease studies

Ranking	BVPD (Australia)	BCoDE (Europe)	ONBOIDS (Canada)
1	Influenza	Influenza	Pneumococcal disease
2	Pneumococcal disease	Pneumococcal disease	HPV[(a)]
3	HPV	Hepatitis B	Hepatitis B
4	Shingles	Hib	Influenza
5	Meningococcal disease	Whooping cough	Hib

(a) The ONBOIDS used prevalent cases of HPV-related cancers to measure the burden.

Note: HPV was not included in the list of diseases for the BCoDE study.

Sources: AIHW BVPD study (for BVPD); Cassini et al. 2018 (for BCoDE); Kwong et al. 2012 (for ONBOIDS).

More information

For more information, see *The burden of vaccine preventable diseases in Australia* (AIHW 2019b) as well as additional resources on the Australian Institute of Health and Welfare (AIHW) website at: https://www.aihw.gov.au/reports-data/health-welfare-services/immunisation/overview.

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Abbreviations

ABDS	Australian Burden of Disease Study
AIHW	Australian Institute of Health and Welfare
BCoDE	Burden of Communicable Diseases in Europe
BVPD	Burden of Vaccine Preventable Diseases in Australia
DALY	disability-adjusted life years
Hib	*Haemophilus influenzae* type b
HPV	Human papillomavirus
NIP	National Immunisation Program
ONBOIDS	Ontario Burden of Infectious Disease Study
VPD	vaccine preventable diseases
WHO	World Health Organization
YLD	years of life lost due to disability
YLL	years of life lost due to premature death

Glossary

age-standardised rate: A rate that takes into account the age structure of the population.

disability-adjusted life years (DALY): A measure of healthy life lost, either through premature death or living with disability due to illness or injury. Often used synonymously with health loss.

fatal burden: The burden from dying prematurely as measured by years of life lost. Often used synonymously with **years of life lost**, and also referred to as 'life lost'.

hybrid modelling: A methodology that takes into account the current burden of all cases existing in the reference year, regardless of when the case was first diagnosed. This methodology assigns the burden due to long-term disabilities to the body system affected (for example, hearing, vision or mental/behavioural disorders) rather than to the originating condition.

incidence: The number of new cases (of an illness or injury) that occur during a given period.

incidence-based modelling: A methodology that reflects the burden of all new cases of disease that occur in the reference year and the immediate and future consequences (including death) of those cases. The incidence-based model does not include the burden due to cases already diagnosed in previous years.

non-fatal burden: The burden from living with ill-health as measured by years lived with disability. Often used synonymously with **years lived with disability**.

rate difference: A measure of the absolute gap between 2 population groups. A rate difference shows the difference between one rate and another.

rate ratio: A measure of the relative gap between 2 population groups. A rate ratio shows how many times one rate of burden is relative to another.

years lived with disability (YLD): The number of years of what could have been a healthy life that were instead spent in states of less than full health. YLD represent non-fatal burden.

years of life lost (YLL): The number of years of life lost due to premature death, defined as dying before the ideal life span. YLL represent fatal burden.

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