Potentially preventable hospitalisations

in the Northern Territory

2005-06 to 2017-18

NORTHERN TERRITORY GOVERNMENT

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Acronyms	Full form
ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
AR-DRG	Australian Refined Diagnosis Related Groups
ASH	Alice Springs Hospital
CI	Confidence interval
COPD	Chronic obstructive pulmonary disease
ENTI	Ear, nose and throat infection
GDH	Gove District Hospital
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, 10th revision Australian modification
KH	Katherine Hospital
NHA	National Healthcare Agreement
NT	Northern Territory
PID	Pelvic inflammatory disease
PPH	Potentially preventable hospitalisation
RDH	Royal Darwin Hospital
RHD	Rheumatic heart disease
TCH	Tennant Creek Hospital
UTI	Urinary tract infection

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Summary

Potentially preventable hospitalisations (PPHs) are selected hospital admissions that are preventable through appropriate preventative health interventions and early disease management in primary care and community-based care settings. The Australian National Healthcare Agreement endorses a PPH indicator, which includes a selection of 22 conditions in three broad categories of the vaccine-preventable, chronic and acute PPH. National publications provide information and comparison on the PPH indicator by geographic area, population group and health service network. The Northern Territory (NT) has the highest rate of PPHs in Australia.

This report presents the results of a departmental project which analysed the PPHs in the NT during the 2017-18 financial year and of a time trend since 2005-06. The key findings include:

In the 2017-18 financial year:

- PPHs accounted for 18% of hospital costs and hospital bed days in the NT public hospitals.
- The PPH rate in the NT was two times the national average.
- In the NT, the PPH rate in Aboriginal peoples was 4 times higher than the non-Aboriginal population.
- PPHs were more prevalent in the Central Australia region than in the Top End region.
- The most common PPH condition in the NT was non-flu related other vaccine-preventable conditions, more specifically, hepatitis B. Hospitalisations for hepatitis B had a substantial impact on total PPH rate in the NT, especially among the Aboriginal population. These hospitalisations were mostly for patients with chronic hepatitis B infection being hospitalised for other health issues. This PPH is generally unavoidable because the infection was either acquired at birth or prior to the hepatitis B vaccination program.
- Other common PPH conditions in the NT included cellulitis, chronic obstructive pulmonary disease, ear nose throat infection and urinary tract infection.
- PPH for convulsions and epilepsy was also more common among the Aboriginal population.

Between 2005-06 and 2017-18 financial years:

- PPH rate increased in the NT, especially among the Aboriginal population. The increase occurred in vaccine-preventable and acute PPH categories.
- The increase in PPH rate in the NT was mainly driven by raised total hospitalisation and population ageing.
- The surge in vaccine-preventable PPHs in the NT Aboriginal population was due to an increased in hospitalisation of patients with chronic hepatitis B being admitted for other health issues.
- The rise in PPH rate was more pronounced in the Central Australia region than the Top End region.
- Ear, nose and throat infection PPH and cellulitis PPH were extreme among the Central Australia Aboriginal people and the rates surged from 2005-06 to 2017-18.
- Chronic obstructive pulmonary disease PPH was excessive among the Top End Aboriginal people and the rate rose significantly from 2005-06 to 2017-18.
- The rate for chronic PPH category was stable despite increasing population prevalence of chronic diseases such as type 2 diabetes.

Introduction

Background

Potentially preventable hospitalisations (PPHs) include hospital admissions that are preventable by timely provision of appropriate individualised preventive health interventions and early disease management, usually delivered in primary care and community-based care settings. The PPHs are used internationally as performance indicators for healthcare systems. In Australia, the National Healthcare Agreement (NHA) has endorsed a PPH performance indicator since 2010 as a progress measure for primary and community health[1]. The indicator includes a list of conditions, for which hospitalisation could have been prevented through the provision of appropriated individualised preventive health interventions and early disease management in primary care and community-based care settings. The PPH rate is often used as an indicator of unmet community health needs.

The PPH indicator is usually categorised into three components: chronic, acute and vaccine-preventable[2]. The chronic category includes conditions that may be preventable through lifestyle change or that may also be managed effectively through timely care (usually non-hospital) to prevent deterioration and hospitalisation, such as diabetes complications and chronic obstructive pulmonary disease (COPD). The acute category includes conditions such as urinary tract infections (UTI), cellulitis, dental conditions, ear, nose and throat infections (ENTI), that may not be preventable but would not result in hospitalisation if timely and adequate care (usually non-hospital) was received. The vaccine-preventable category includes conditions such as influenza, measles, diphtheria and hepatitis, which may be preventable through vaccination. The indicator is expressed as an age-standardised rate of PPHs in a population.

Northern Territory (NT) residents have a higher prevalence of many diseases and risk factors relative to populations of the similar age structure in other jurisdictions. This is underpinned by profound health challenges facing the NT Aboriginal population, who have a burden of disease 3.4 times that of the non-Aboriginal population[3]. The provision and access to primary and preventive care is low in the NT[4], resulting a higher hospitalisation rate, especially for the Aboriginal population. Among all the jurisdictions, the NT has the highest rate of PPHs in the country[5]. Previously, a NT study provided valuable information on the avoidable hospitalisations for the period of 1998-09 to 2005-06[6], indicating there was a rapid increase in chronic PPH in the NT.

This study is based on a long-term hospital inpatient dataset of the five NT public hospitals including Royal Darwin Hospital (RDH), Alice Springs Hospital (ASH), Katherine Hospital (KH), Gove District Hospital (GDH) and Tennant Creek Hospital (TCH). Diagnosis using International Statistical Classification of Diseases and Related Health Problems, 10th revision Australian modification (ICD-10-AM) was used to define selected conditions in NHA PPH. Other information such as procedure, block code or patient age was used as inclusion/exclusion criteria required for individual condition.

The objectives of this project are to:

- Compare the PPH rates with the national averages;
- Document the trend over time for total PPHs, PPH categories and for selected PPH conditions that are amenable to better community-based care;
- Compare PPHs by health service region and Indigenous status;
- Investigate other factors that may contribute to PPHs;
- Estimate hospital costs associated with PPHs.

Methods

Datasets

Episode level hospitalisation data were extracted from the NT Inpatient Activity Database. Information includes demographic, geographic and clinical characteristics, diagnoses and estimated costs of admitted patients in NT public hospitals.

Hospital records are separations and not individuals, as there can be multiple separations for the same individual. Hospital separation rates are not necessarily a direct reflection of the number of people who were hospitalised. Diagnoses were recorded using ICD-10-AM.

PPH classification

The PPH indicator in the NHA include 22 conditions, which are grouped into 3 categories (Table 1).

Table 1. Potentially preventable hospitalisation (PPH) classification

PPH conditions	Simplified names
Vaccine-preventable conditions:	
Pneumonia and influenza	Flu vaccine
Other vaccine-preventable conditions	Other vaccines
Chronic conditions:	
Asthma	Asthma
Congestive cardiac failure	Cardiac failure
Diabetes complications	Diabetes
Chronic obstructive pulmonary disease	COPD
Bronchiectasis	Bronchiectasis
Angina	Angina
Iron deficiency anaemia	Anaemia-iron
Hypertension	Hypertension
Nutritional deficiencies	Malnutrition
Rheumatic heart diseases	RHD
Acute conditions:	
Pneumonia (not vaccine-preventable)	Pneumonia
Urinary tract infections, including pyelonephritis	UTIs
Perforated/bleeding ulcer	Ulcer
Cellulitis	Cellulitis
Pelvic inflammatory disease	PID
Ear, nose and throat infections	ENTIs
Dental conditions	Dental
Convulsions and epilepsy	Seizures
Eclampsia	Eclampsia
Gangrene	Gangrene

The classifications of acute and chronic PPHs are based on principal diagnoses (except for the non-vaccine-preventable pneumonia and gangrene). The vaccine-preventable PPHs are constructed on all diagnoses and not mutually exclusive. For certain conditions, extra inclusion or exclusion criteria based on patient's age or additional diagnosis or procedure performed also determine whether a hospitalisation with the required diagnosis is classified as a PPH episode. The detailed classifications for PPH conditions are provided in the Appendix (Table A1).

The counting of PPH excludes the hospitalisations for care types of unqualified neonatal, hospital boarders and posthumous organ procurement as confidential in the national PPH indicator. Also

excluded are the episode for which patients are admitted for dialysis only as specified for the NT hospital statistics.

Cost estimation

The 2017-18 cost of PPHs and all hospitalisations in NT public hospitals was measured as cost weight-based estimates. The estimation was made using the Australian Refined Diagnosis Related Groups (AR-DRG) reported for each acute separation and the related estimated cost for each AR-DRG from the National Hospital Cost Data Collection. The most recent public hospital cost weights prepared by the Independent Hospital Pricing Authority of Australia is based on AR-DRG version 8.0 and relate to the 2016–17 reporting period. Caution should be used in interpreting the costing information presented in this report as the estimated costs presented in this report are not necessarily precise measures of the actual costs.

Statistics

Statistics are for hospitalisations of NT residents who were admitted to NT public hospitals. The statistic for the comparison between population groups by geographic region or over time is the age-standardised rate of PPHs. The rate is calculated as the number of PPHs per 1,000 population. The population data used is the NT resident population estimates by age, sex, Indigenous status and health districts (1971-2018)[7], which is a trend dataset based on various publications by the Australian Bureau of Statistics. The rate is age-standardised to the 2001 Australian population. Decomposition method was applied to assess the contributions to the trend of PPHs by other time-variant components[8].

Results

PPHs in the NT compared with the national average

Between 1 July 2017 and 30 June 2018, there were 11,802 hospital separations classified as PPHs, accounting for 15% of all 80,542 separations (excluding those for dialysis only and unqualified neonates, see Table 2). The proportion of PPHs in all hospitalisations among the Aboriginal patients (20%) was more than two times that among non-Aboriginal patients (10%).

Compared with the national averages, NT had higher rates of PPHs for each of the three categories of PPHs (Table 3). The PPH rate in the NT was two times the national average. Vaccine-preventable PPHs were 10.3 per 1,000 population in the NT, 3.3 times the national average.

Table 2. Hospitalisations for PPHs and non-PPHs, NT, 2017-18

	Aboriginal (%)	Non-Aboriginal (%)	All* (%)
PPHs	7,751 (20)	4,048 (10)	11,802 (15)
Non-PPHs	30,818 (80)	37,879 (90)	68,740 (85)
All hospitalisations	38,569 (100)	41,927 (100)	80,542 (100)

* included hospitalisations of patients with unknown Indigenous status.

Table 3. Number and age-standardised rates of PPH by category, NT and Australia, 2017-18

	NT			Australia*	Rate
	Number	Rate	(95%CI)	Rate	Ratio#
Vaccine-preventable	2,200	10.3	(9.8-10.8)	3.1	3.3
Chronic	4,149	22.0	(21.2-22.7)	12.9	1.7
Acute	5,887	25.5	(24.8-26.2)	12.3	2.1
Total PPHs†	11,802	55.7	(54.6-56.8)	27.9	2.0

CI = Confidence interval. Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population. * Data source: Disparities in potentially preventable hospitalisations across Australia, 2012–13 to 2017–18. Canberra: AIHW, 2020. # Rate ratio is for NT/Australia. † The sum of the numbers by PPH category may exceed the number of total PPHs because one separation can be classified into multiple categories. This is caused by the classification method for vaccine-preventable PPHs, which uses any diagnosis rather than principal diagnosis.

PPHs by Indigenous status

The PPH rates of the NT non-Aboriginal population (Table 4) were similar to the national averages (see Table 2) for total as well as the three categories of PPHs. Comparing to the non-Aboriginal Territorians, NT Aboriginal population had much higher rates of total PPHs (4.4 times) and every PPH category. Vaccine-preventable PPHs were particularly higher in the NT Aboriginal population, 9.9 times the rate of the non-Aboriginal population. The excess of total PPHs in Aboriginal population compared with the non-Aboriginal population exceeded the difference in all hospitalisations (rate ratio 2.3).

Nationwide, Indigenous Australians also have a higher PPH rate than their non-Indigenous fellow residents. However, compared with Indigenous populations elsewhere in Australia, NT Aboriginal peoples had the highest rate of PPHs of all jurisdictions[9].

Table 4. Number and age-standardised rates of PPH by category and Indigenous status, NT, 2017-18

	Aboriginal			Non-Aboriginal			Rate
	Number	Rate	(95%CI)	Number	Rate	(95%CI)	ratio*
Vaccine-preventable	1,740	33.7	(31.9-35.6)	460	3.4	(3.1-3.8)	9.9
Chronic	2,705	53.4	(51.1-55.7)	1,442	12.3	(11.6-13.1)	4.3
Acute	3,674	53.3	(51.3-55.4)	2,212	14.9	(14.2-15.6)	3.6
Total PPHs[#]	7,751	133.1	(129.9-136.3)	4,048	30.1	(29.1-31.1)	4.4
All hospitalisations		624.8			272.2		2.3

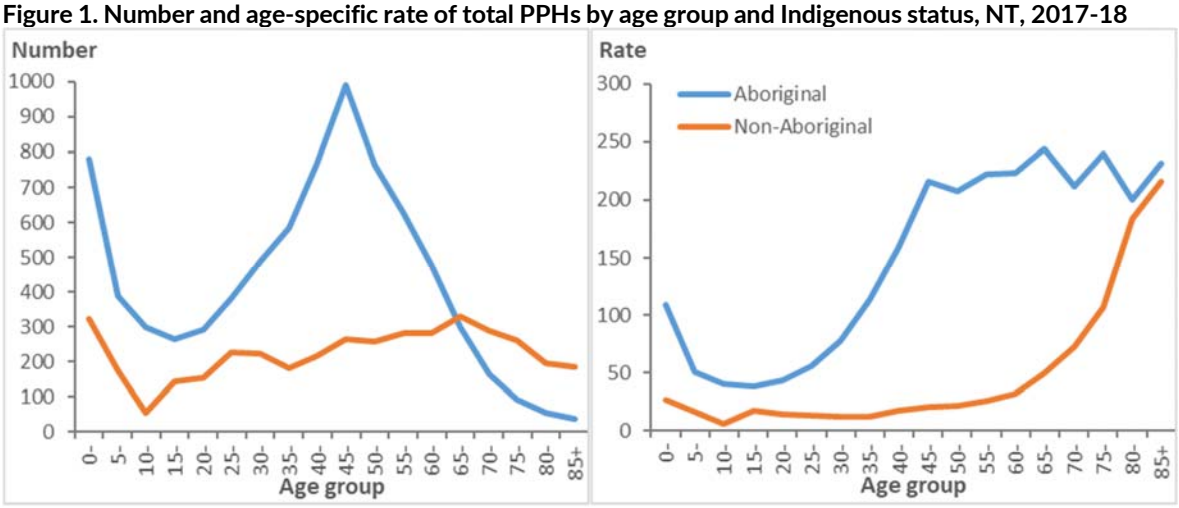
CI = Confidence interval. Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population. * Rate ratio is for Aboriginal /non-Aboriginal. [#] The sum of the numbers by PPH category may exceed the number of total PPHs because one separation can be classified into more than one category. This is mainly caused by the classification method for vaccine-preventable PPHs, which uses any diagnosis rather than principal diagnosis.

PPHs by age group

The age distribution of PPHs by Indigenous status contrasted greatly. When measured in age-specific rates, PPHs were initially high at 0-4 age group, became low and static after childhood, and then increased with age between 25-49 years for Aboriginal peoples and after 60 years for the non-Aboriginal population (Figure 1). The PPH rates were higher in the Aboriginal than non-Aboriginal population for every age group.

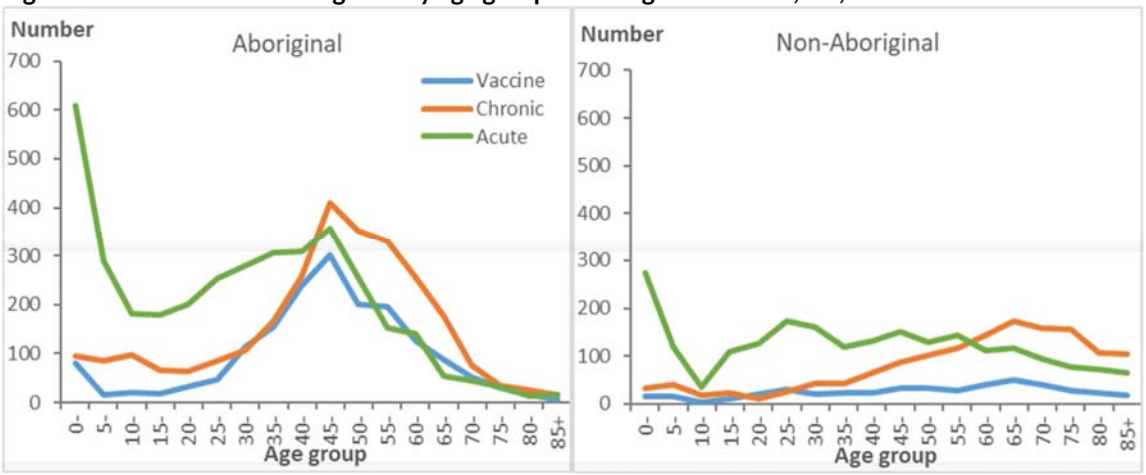
The age patterns also differed for three PPH categories, with more acute PPHs in the very young ages and more chronic PPHs in the older age groups (Figure 2).

Figure 1. Number and age-specific rate of total PPHs by age group and Indigenous status, NT, 2017-18



Rates are expressed as number of separations per 1,000 population.

Figure 2. Number of PPH categories by age group and Indigenous status, NT, 2017-18

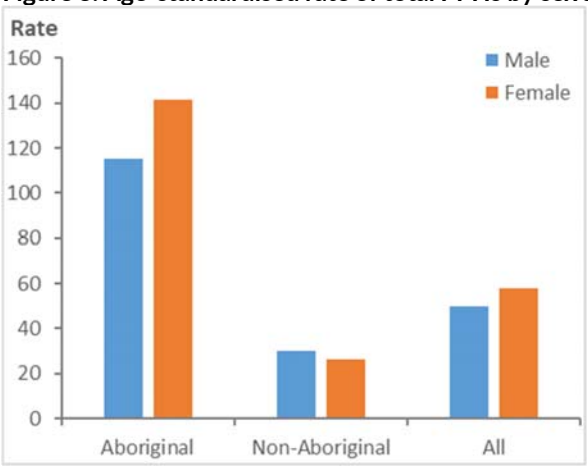


PPHs by sex

In the NT, the total age-standardised rate of PPHs was 15% higher in females than males (Figure 3). However, when stratified by Indigenous status, only the Aboriginal population showed a greater PPH rate for females (by 23%) compared to males, whiles the female rate was 12% lower than that of male in the non-Aboriginal population.

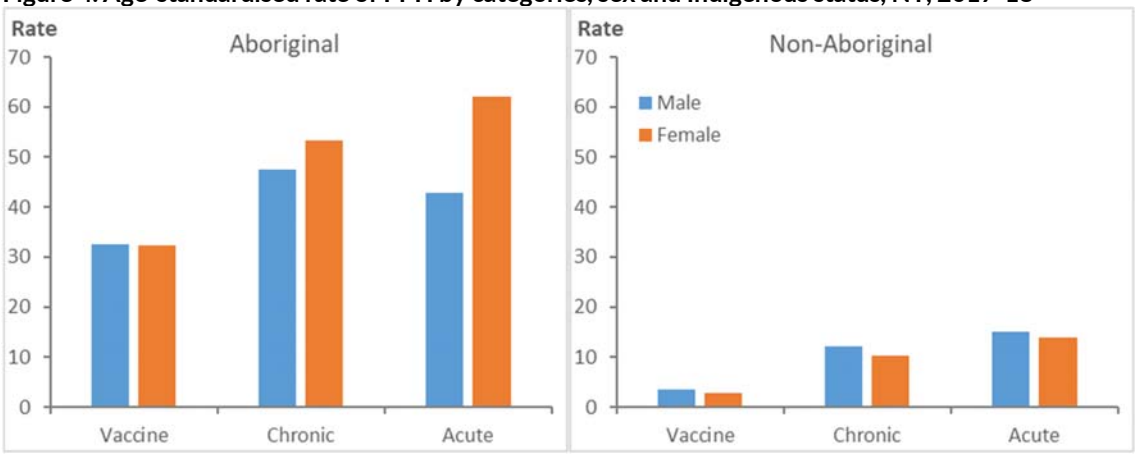
For the NT Aboriginal population, the greater level of total PPHs for females compared to males was mainly attributed to the acute PPH category (Figure 4). In the non-Aboriginal population, the higher rate of male PPHs was mostly seen in chronic PPHs.

Figure 3. Age-standardised rate of total PPHs by sex and Indigenous status, NT, 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Figure 4. Age-standardised rate of PPH by categories, sex and Indigenous status, NT, 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

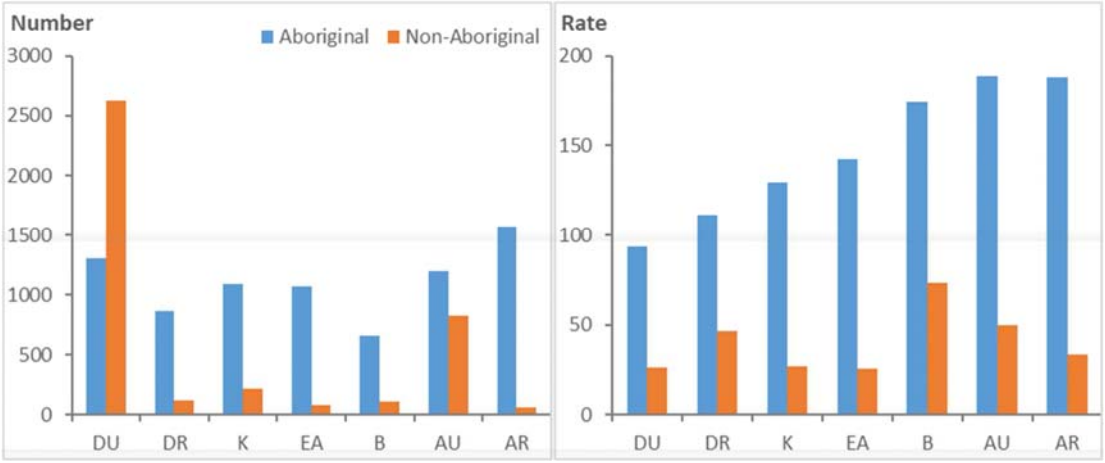
PPHs by health district

Health services in the NT are managed by two health service regions (Top End and Central Australia). Primary health care is further organised into seven health districts (see Appendix Figure A1). The Top End region is made of four districts, including Darwin Urban, Darwin Rural, Katherine and East Arnhem. The Central Australia region is consisted of three districts, comprising Barkly, Alice Springs Urban and Alice Springs Rural.

The distribution of PPHs varied between health districts and regions. This reflects the differences in geography, population characteristics including burden of disease and service provision. For the Aboriginal population, the health districts of the Central Australia region had higher rates of total PPHs than the Top End (Figure 5), mostly due to excessive acute PPHs (Figures 6 and 7).

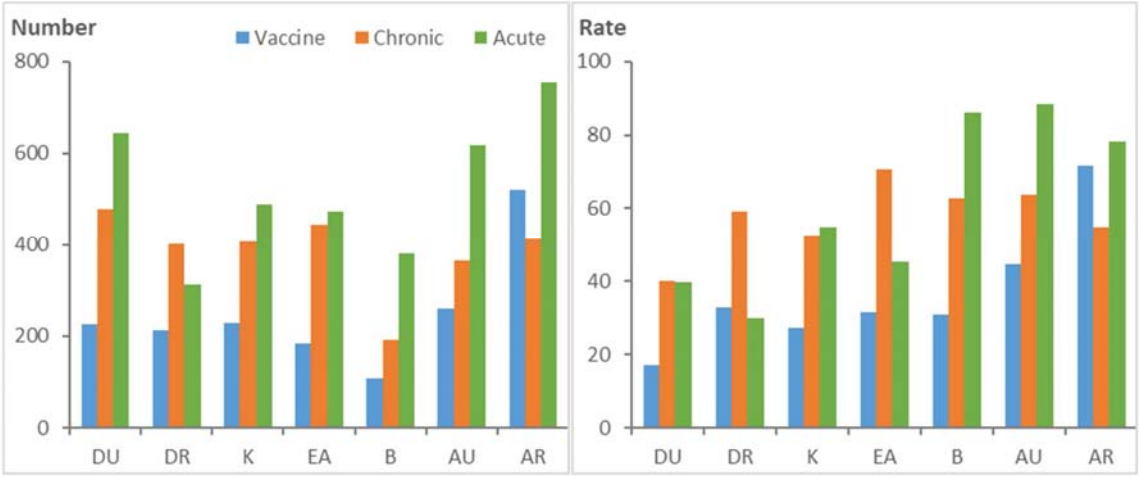
Although with the lowest PPH rate, non-Aboriginals in the Darwin Urban district contributed most (22%) to the actual number of PPHs because of its high proportion (54%) of the NT population (see Appendix Table A2).

Figure 5. Number and age-standardised rate of PPH by health district and Indigenous status, NT, 2017-18



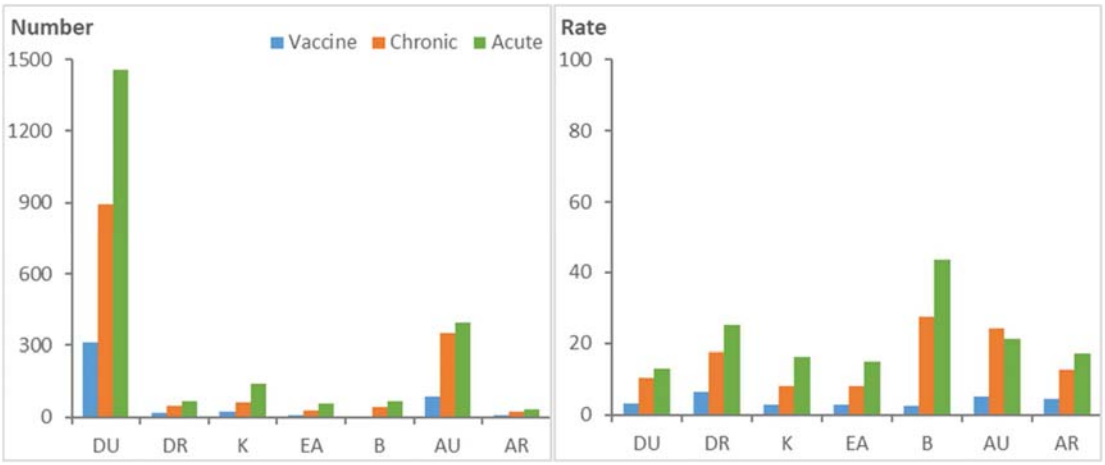
Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population. Health districts include Darwin Urban (DU), Darwin Rural (DR), Katherine (K), East Arnhem (EA), Barkly (B), Alice Springs Urban (AU) and Alice Springs Rural (AR).

Figure 6. Number and age-standardised rate of PPH by health district and PPH category, NT Aboriginal, 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population. Health districts include Darwin Urban (DU), Darwin Rural (DR), Katherine (K), East Arnhem (EA), Barkly (B), Alice Springs Urban (AU) and Alice Springs Rural (AR).

Figure 7. Number and age-standardised rate of PPH by health district and PPH category, NT non-Aboriginal, 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population. Health districts include Darwin Urban (DU), Darwin Rural (DR), Katherine (K), East Arnhem (EA), Barkly (B), Alice Springs Urban (AU) and Alice Springs Rural (AR).

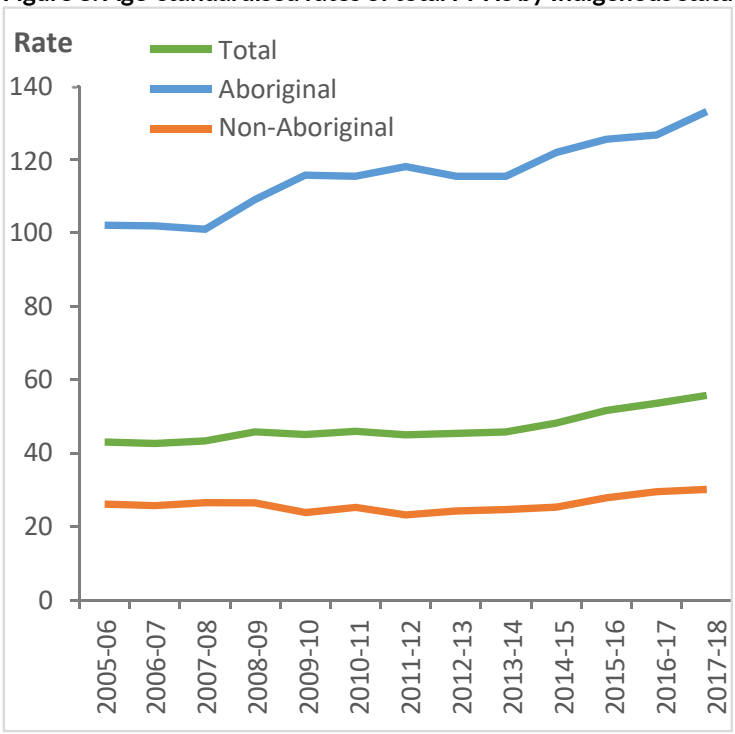
Time trend of PPHs

The age-standardised rates of total PPHs rose by 30% in the NT through the thirteen-year period of 2005-06 to 2017-18 financial years (Figure 8). At the starting point of 2005-06 the Aboriginal population started with a PPH rate of 3.9 times higher than that of the non-Aboriginal population. At the finishing point of 2017-18, the Aboriginal PPH rate was 4.4 times the non-Aboriginal rate.

The decomposition analysis demonstrated that the increase in the crude rate of total PPHs between 2005-11 period and 2012-18 period was due to (i) the increase in total hospitalisations, (ii) population ageing and (iii) change in PPH proportions in total hospitalisations. The increase in total hospitalisations contributed to the majority (87%) of the PPH increase in the Aboriginal population and exceeded the PPH increase by 134% in non-Aboriginal population (Table 5). When adjusting for the increase in total hospitalisations and population ageing over the study period, PPH as a proportion of total hospitalisations actually declined for both the Aboriginal (-19%) and non-Aboriginal populations (-98%).

The increase in age-standardised rate of total PPHs was due to the rises in the vaccine-preventable category and acute PPH category (as demonstrated in Figure 9). The chronic PPH category remained stable despite increasing population prevalence of conditions such as type 2 diabetes. When stratified by region, Top End and Central Australia regions showed very different pictures in PPHs, especially for the Aboriginal population (as demonstrated in Figure 10). The PPH rates were much higher in the Central Australia region and increased during the reporting period. For the Aboriginal population, the Central Australia region had much higher rates of acute PPHs and vaccine-preventable PPHs, which increased more than the Top End region.

Figure 8. Age-standardised rates of total PPHs by Indigenous status, NT, 2005-06 to 2017-18



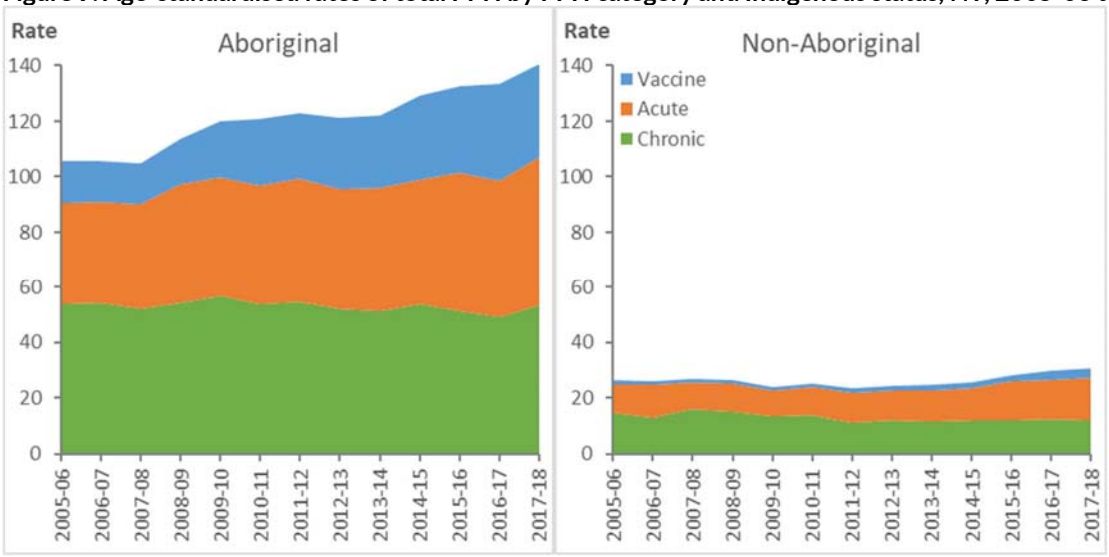
Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Table 5. Decomposition of the change in crude rates of total PPHs by Indigenous status, NT

	Aboriginal	Non-Aboriginal	Total
Crude rate*:			
2005-06 to 2010-11 period	76.2	17.6	35.5
2012-13 to 2017-18 period	93.3	20.0	41.9
Rate ratio:	1.22	1.14	1.18
Component of change:			
Total hospitalisation rate	87%	134%	117%
Population age profile	33%	64%	21%
PPH proportion in total hospitalisations	-19%	-98%	-38%
Total	100%	100%	100%

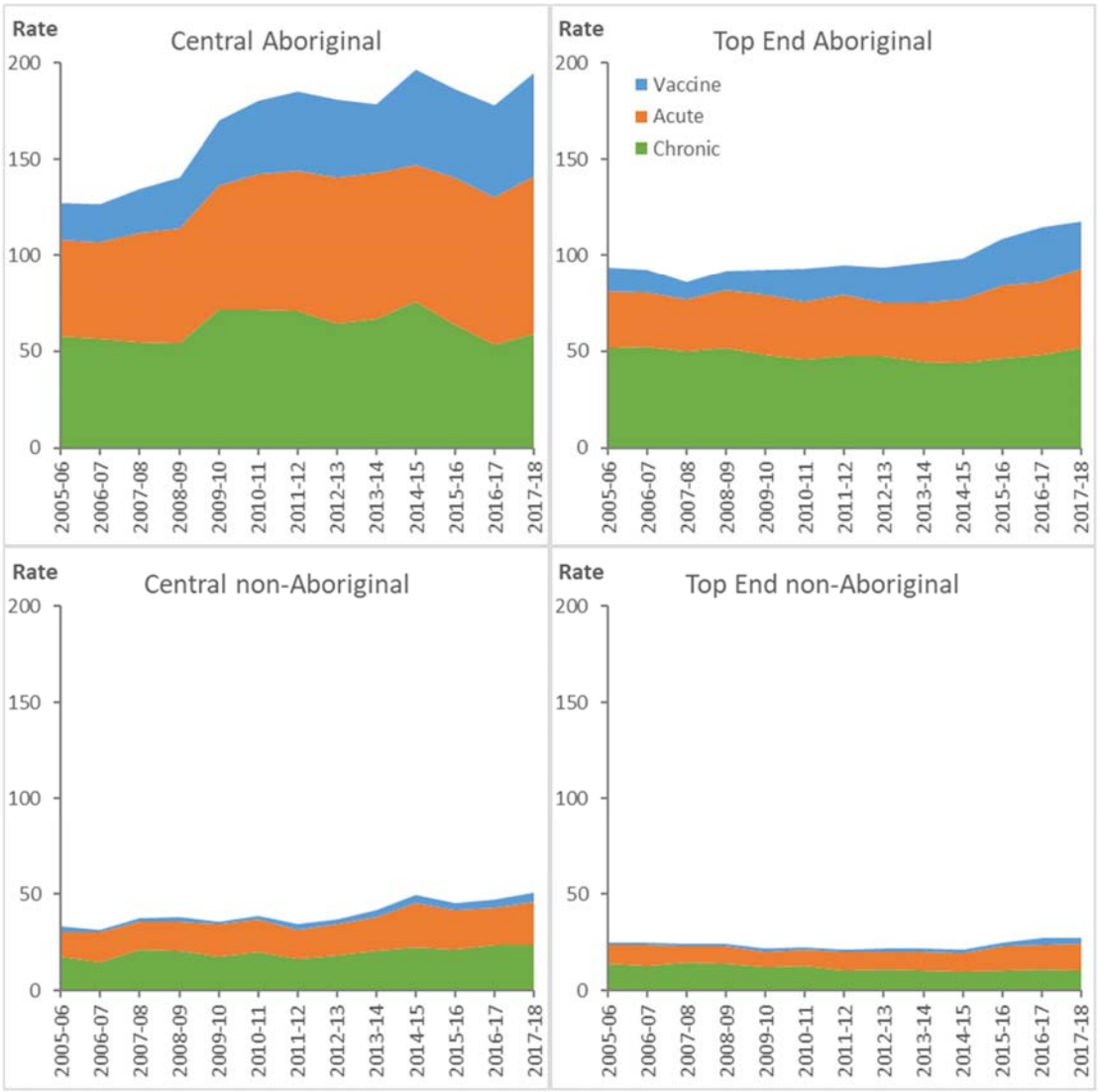
* Rates are expressed as number of separations per 1,000 population.

Figure 9. Age-standardised rates of total PPH by PPH category and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Figure 10. Age-standardised rates of total PPH by PPH category and Indigenous status, NT regions, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

PPHs by condition

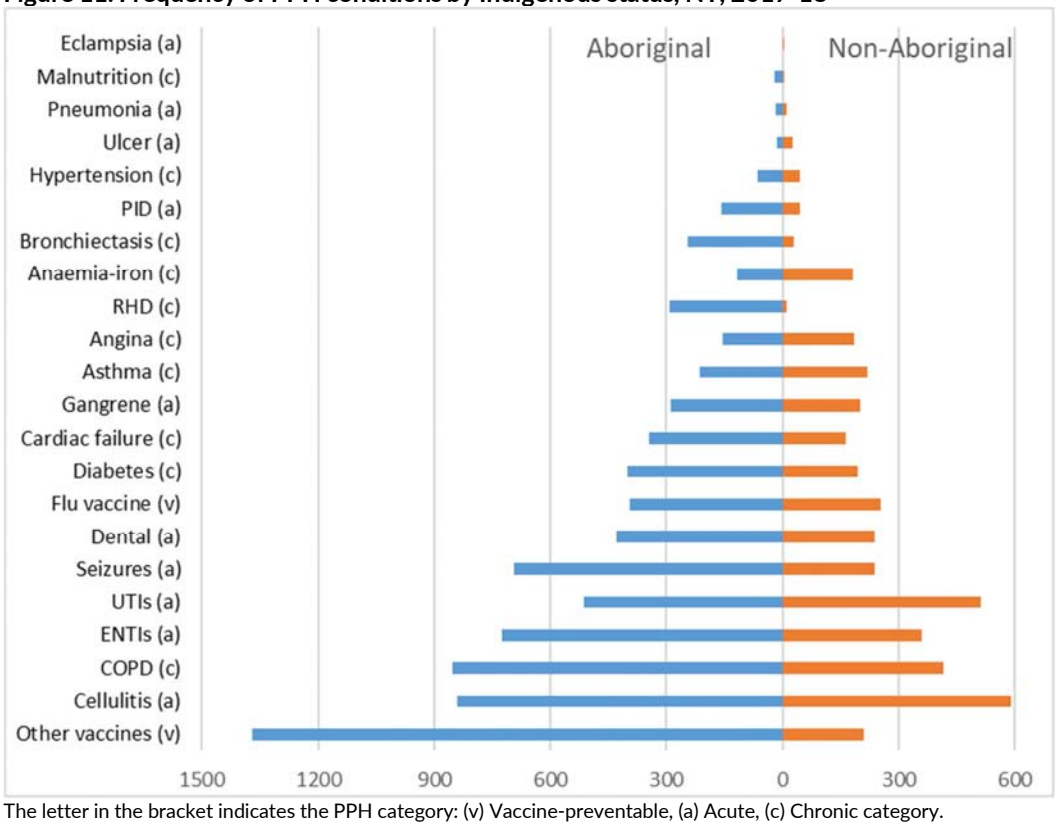
Ranked by number of PPH separations, the most common PPH conditions in the NT for 2017-18 included other vaccine-preventable conditions (other than vaccine-preventable pneumonia and flu), cellulitis, COPD, ENTI and UTI. There was a considerable difference in numbers of PPH for each condition by Indigenous status (Figure 11).

Other vaccine-preventable PPH was the most common PPH by far in the Aboriginal population, followed by COPD, cellulitis, ENTI and seizure (Figure 11). Among the non-Aboriginal population, the most common PPH condition was cellulitis, followed by UTI, COPD, ENTI and then, vaccine-preventable pneumonia and influenza.

For some PPH conditions, there was a difference by sex. Female patients represented the majority of UTI PPHs (23% as male), whilst males accounted for most of seizure PPH (62%) (Table 6). For non-Aboriginals, males were also over-represented in diabetes PPH (70%), cardiac failure (65%) and cellulitis (68%), COPD (61%) PPH. The sex patterns of these PPHs are likely consistent with the distribution of risk factors (e.g. smoking) for these conditions in the general population.

Comparing to the national averages, the NT Aboriginal population had much higher rates of the ten most common PPHs, especially for other vaccine-preventable conditions, cellulitis, COPD and seizures (Table 7). This was in contrast to the rates for non-Aboriginal Territorians, which were similar to the Australian average.

Figure 11. Frequency of PPH conditions by Indigenous status, NT, 2017-18



The letter in the bracket indicates the PPH category: (v) Vaccine-preventable, (a) Acute, (c) Chronic category.

Table 6. Male proportion in frequency of common PPH conditions by Indigenous status, NT, 2017-18

Common PPH conditions	Aboriginal	Non-Aboriginal	Northern Territory
Other vaccines (v)	49%	56%	50%
Cellulitis (a)	45%	68%	54%
COPD (c)	44%	61%	50%
ENTIs (a)	44%	49%	45%
UTIs (a)	14%	33%	23%
Seizures (a)	61%	64%	62%
Dental (a)	43%	59%	49%
Flu vaccine (v)	40%	55%	46%
Diabetes (c)	46%	70%	54%
Cardiac failure (c)	48%	65%	54%
All PPHs	43%	55%	47%
All hospitalisations	41%	48%	45%

The letter in the bracket indicates the PPH category: (v) Vaccine-preventable, (a) Acute, (c) Chronic category.

Table 7. Age-standardised rates of common PPH conditions by Indigenous status, NT and Australia, 2017-18

	NT Aboriginal			NT non-Aboriginal			Australia*
	Rate	(95%CI)	Rate ratio#	Rate	(95%CI)	Rate ratio#	Rate
Other vaccines (v)	25.7	(24.2-27.3)	23.8	1.3	(1.1-1.5)	1.2	1.1
COPD (c)	20.3	(18.7-21.8)	7.6	4.1	(3.7-4.5)	1.5	2.7
Cellulitis (a)	13.0	(11.9-14.1)	5.0	3.9	(3.5-4.2)	1.5	2.6
Seizures (a)	10.4	(9.5-11.3)	6.6	1.4	(1.3-1.6)	0.9	1.6
UTIs (a)	9.4	(8.3-10.4)	3.3	4.2	(3.8-4.7)	1.5	2.8
Flu vaccine (v)	8.5	(7.5-9.6)	4.1	2.1	(1.8-2.4)	1.0	2.1
ENTIs (a)	8.1	(7.5-8.8)	4.2	2.1	(1.9-2.3)	1.1	1.9
Cardiac failure (c)	8.0	(7.0-9.1)	3.9	1.9	(1.5-2.2)	0.9	2.1
Diabetes (c)	7.5	(6.6-8.3)	4.0	1.4	(1.2-1.6)	0.7	1.9
Dental (a)	4.8	(4.3-5.3)	1.6	1.4	(1.2-1.5)	0.5	2.9

CI = Confidence interval. Rates expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population. The letter in the bracket indicates the PPH category: (v) Vaccine-preventable, (a) Acute, (c) Chronic category.
* Data source: Australian Institute of Health and Welfare. Disparities in potentially preventable hospitalisations across Australia, 2012–13 to 2017–18. 2020. # Rate ratio is for NT/ Australia.

Other vaccine-preventable conditions

PPH for vaccine-preventable conditions is captured from 'any diagnosis', not just the 'principal diagnosis'. The vaccine-preventable category includes two conditions: (i) vaccine-preventable pneumonia and influenza, and (ii) other vaccine-preventable conditions, which refers to a large group of conditions covered by childhood immunisations. Australia-wide, most (67%) of vaccine-preventable PPHs were due to influenza, whiles other vaccine-preventable conditions were relatively uncommon[9].

In the NT, the other vaccine-preventable PPH was the most common PPH, with the majority of patients as Aboriginal (see Figure 11). Most hospitalisations for such a condition were by patients aged 35-64 (Figure 12). During the period of 2005-06 to 2017-18, the rates of other vaccine-preventable PPH surged in the Aboriginal population, especially in the Central Australia region. This increase might be the result of improved hepatitis B (HepB) sero-coding and increased hospitalisations by middle-aged Aboriginal patients due to chronic conditions with an existing HepB comorbidity. The rate was stable and remained low for non-Aboriginals (Figure 13).

Although covering many conditions, the other vaccine-preventable PPH in the NT was mostly (87%) attributed by HepB, which is preventable by HepB vaccine (Table 8 8). Compared to the national averages, the higher rate of other vaccine-preventable PPH in the NT, especially among the Aboriginal Territorians, was mainly attributed by HepB PPH. Almost of all HepB PPH were for chronic HepB codes were listed in additional diagnosis but none in the primary diagnosis for a hospitalisation. The vast majority of the Aboriginal patients with HepB were born before the year of 1990 when the HepB vaccine became available to the NT, ahead of the national vaccine program in 2000 (Table 9). The majority of the non-Aboriginal patients were born overseas, mostly the African or South-East Asian countries. Chronic HepB alone accounted for 12.5% of separations and 16% of the cost of total PPHs. Once separated, HepB alone was clearly the driver of the up-trend of other vaccine-preventable PPH in the Aboriginal population (Figure 14).

Figure 12. Number of other vaccine-preventable PPHs by age group and Indigenous status, NT, 2017-18

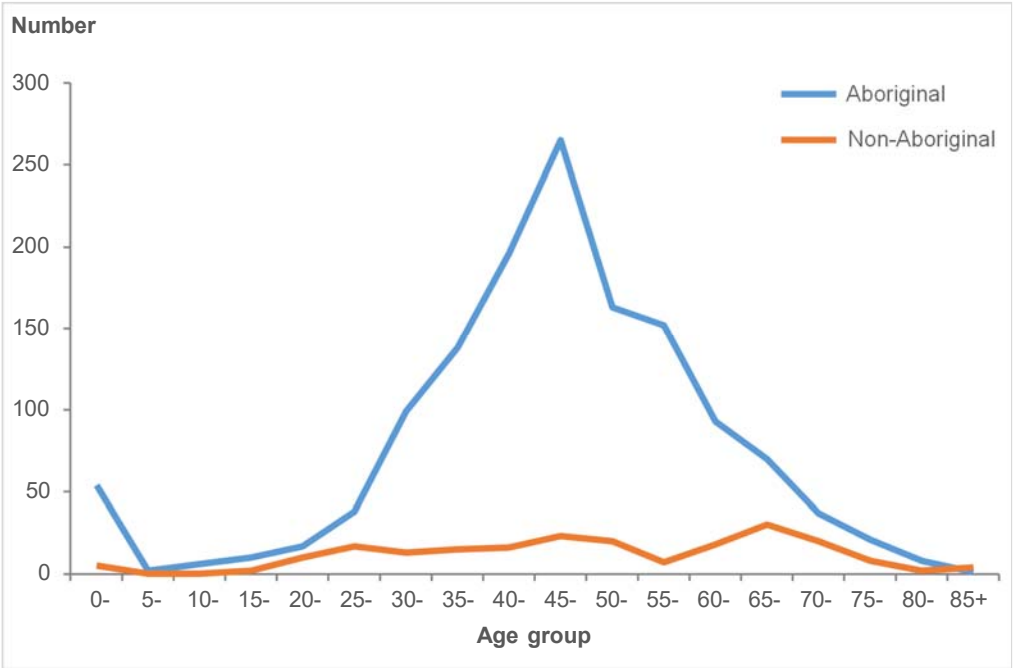
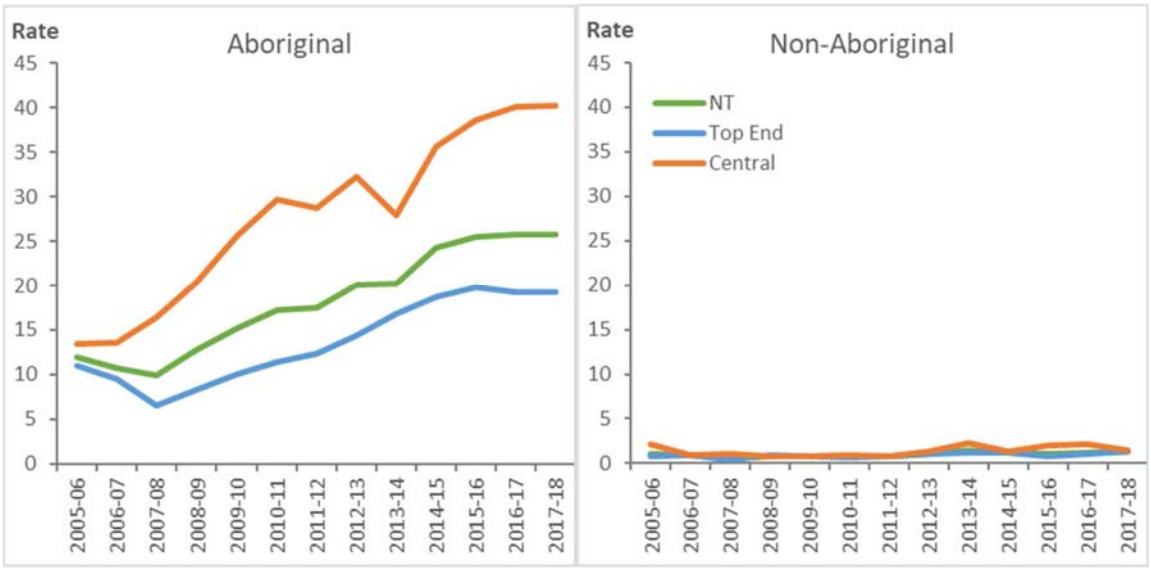


Figure 13. Age-standardised rates of other vaccine-preventable PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Table 8. Number and age-standardised rate of other vaccine-preventable PPHs by subtype and Indigenous status, NT and Australia, 2017-18

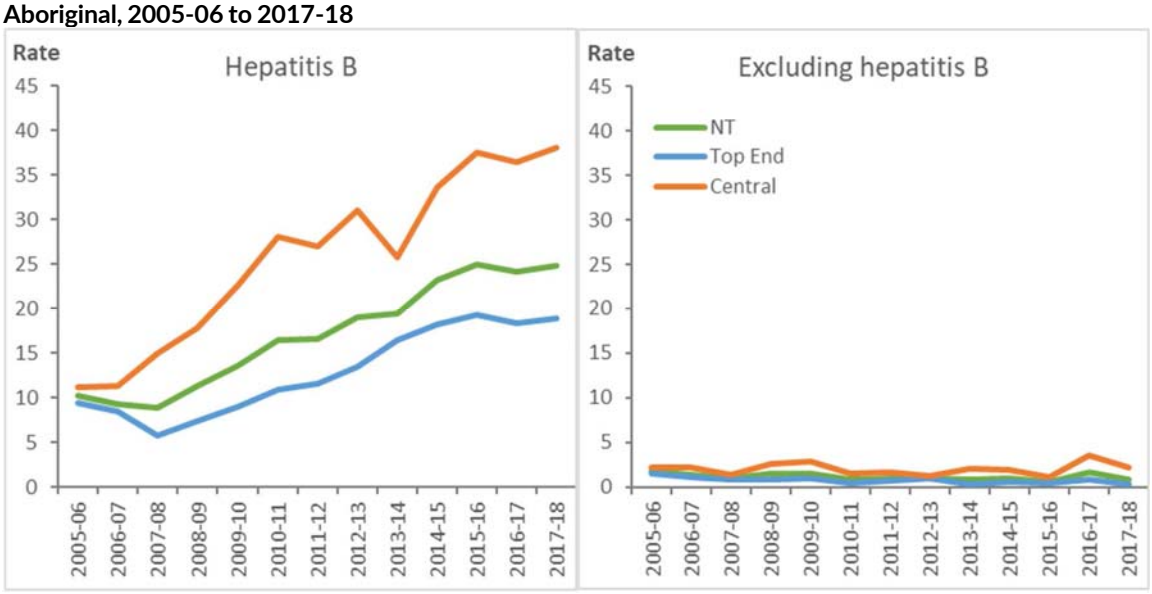
	Hepatitis B			Excluding hepatitis B			All other vaccines*		
	Number	Rate	(95%CI)	Number	Rate	(95%CI)	Number	Rate	(95%CI)
NT Aboriginal	1,290	24.9	(23.4-26.4)	80	0.9	(0.6-1.1)	1,370	25.7	(24.2-27.3)
NT non-Aboriginal	197	1.3	(1.1-1.5)	14	0.1	(0.0-0.1)	210	1.3	(1.1-1.5)
NT total	1,487	6.6	(6.2-6.9)	94	0.4	(0.3-0.4)	1,580	6.9	(6.6-7.3)
Australia[#]		0.9			0.1			1.1	

CI = Confidence interval. Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population. * The sum of the numbers by subtype may exceed the total number of other vaccine-preventable PPH because one separation can be classified into both subtypes. This is caused by the classification method for vaccine-preventable PPHs, which uses any diagnosis rather than principal diagnosis. [#] Data source: Australian Institute of Health and Welfare. Disparities in potentially preventable hospitalisations across Australia, 2012–13 to 2017–18. 2020.

Table 9. Number of hepatitis B PPHs by birth cohort and Indigenous status, NT, 2017-18

	Aboriginal	Non-Aboriginal
Chronic hepatitis B	1,283	197
Born before 1990	1,239	175
Mean age (years)	49.4	55.6
Born overseas	0	138
All hepatitis B PPHs	1,290	197

Figure 14. Age-standardised rates of other vaccine-preventable PPH by condition subtype and region, NT Aboriginal, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Cellulitis

For a separation with cellulitis as the primary diagnosis to be qualified as a PPH, either no procedure or only simple non-specific procedures had been performed in that episode of hospital care (see Appendix Table A1). In 2017-18, almost half (49%) of all hospitalisations for cellulitis are classified as PPH (Table 10). The proportion was higher for non-Aboriginal than Aboriginal patients and lower for patients in the Alice Springs districts. The proportion of cellulitis hospitalisations as PPH was also higher in the smaller regional hospitals (TCH, GDH and KH) than the two bigger main hospitals (RDH and ASH) (Table 11).

PPHs for cellulitis widely spread through all age groups and were the highest in Aboriginal patients aged less than 5 years-old (Figure 15). The age-standardised rate was the highest among Aboriginal in the Central Australia region (Figure 16). However, a large proportion (35%) of total cellulitis PPH were for non-Aboriginal patients in Darwin Urban district. When stratified by region, the Aboriginal population in the Central Australia region had an increasing and disproportionate burden of cellulitis PPH compared to the Aboriginal population in the Top End. The increase in cellulitis PPH in the Central Australia region correlated with the rise of all hospitalisations for cellulitis (Figure 17).

Table 10. Number of cellulitis hospitalisations and proportion as PPH by health district and Indigenous status, NT, 2017-18

	Aboriginal		Non-Aboriginal		Total*	
	All hospitalisations	As PPH	All hospitalisations	As PPH	All hospitalisations	As PPH
Darwin Urban	307	46%	575	62%	883	56%
Darwin Rural	172	40%	26	69%	198	43%
Katherine	230	53%	71	66%	301	56%
East Arnhem	174	62%	24	79%	198	64%
Barkly	171	57%	30	80%	201	61%
Alice Springs Urban	368	38%	215	53%	583	43%
Alice Springs Rural	535	31%	28	43%	563	32%
NT	1957	43%	969	61%	2927	49%

* included hospitalisations of patients with unknown Indigenous status.

Table 11. Number of cellulitis hospitalisations and proportion as PPH by hospital and Indigenous status, NT, 2017-18

	Aboriginal		Non-Aboriginal		Total*	
	All hospitalisations	As PPH	All hospitalisations	As PPH	All hospitalisations	As PPH
Royal Darwin Hospital	670	44%	619	62%	1290	52%
Katherine Hospital	149	66%	61	72%	210	68%
Gove District Hospital	88	70%	25	84%	113	73%
Tennant Creek Hospital	86	85%	21	95%	107	87%
Alice Springs Hospital	964	32%	243	51%	1207	36%
Total	1957	43%	969	61%	2927	49%

* included hospitalisations of patients with unknown Indigenous status.

Figure 15. Number of cellulitis PPHs by age group and Indigenous status, NT, 2017-18

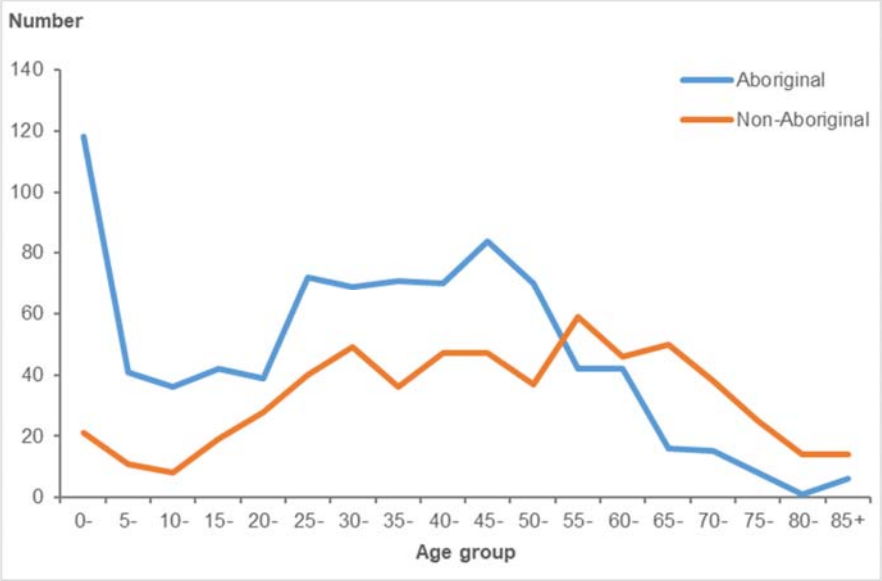
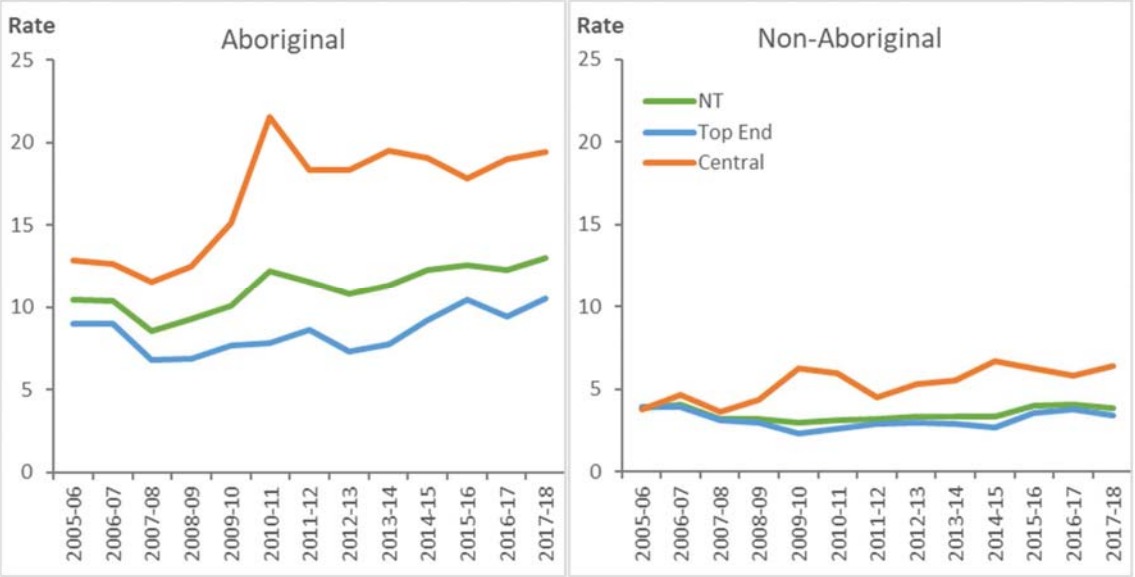
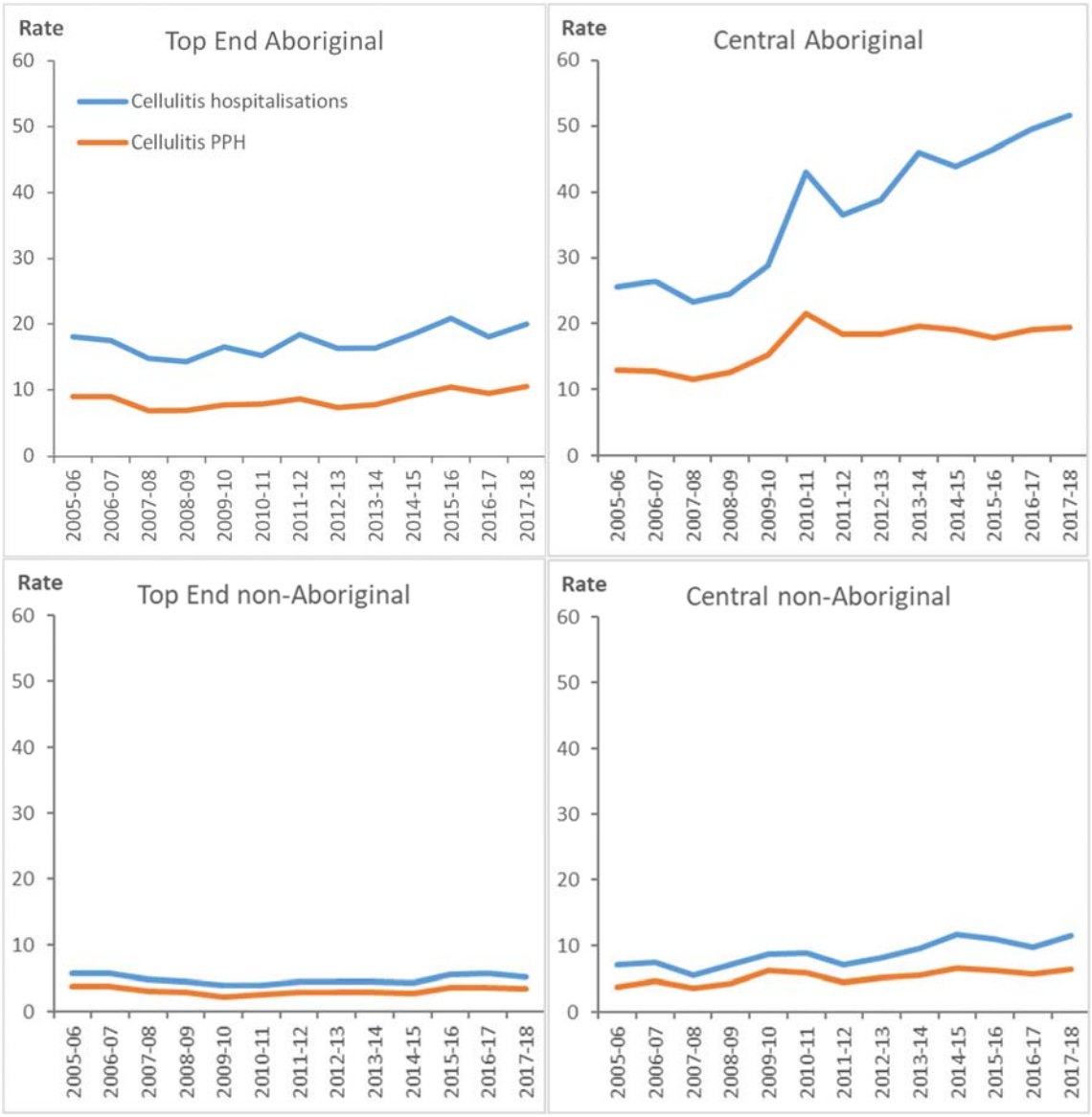


Figure 16. Age-standardised rates of cellulitis PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Figure 17. Age-standardised rates of cellulitis total hospitalisations and PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

COPD

PPHs for COPD were the greatest for Aboriginal patients aged 40-69 and relatively higher in the older ages among non-Aboriginal patients (Figure 18). After age-standardisation, the Top End region had much higher rates of COPD PPH than those in the Central Australia region in Aboriginal population (Figure 18).

From 2005-06 to 2017-18, the rate of COPD PPH in Aboriginal population increased by more than 40% (Figure 19). The rate of COPD PPH in non-Aboriginal population of the Central Australia region also rose.

Figure 18. Number of COPD PPHs by age group and Indigenous status, NT, 2017-18

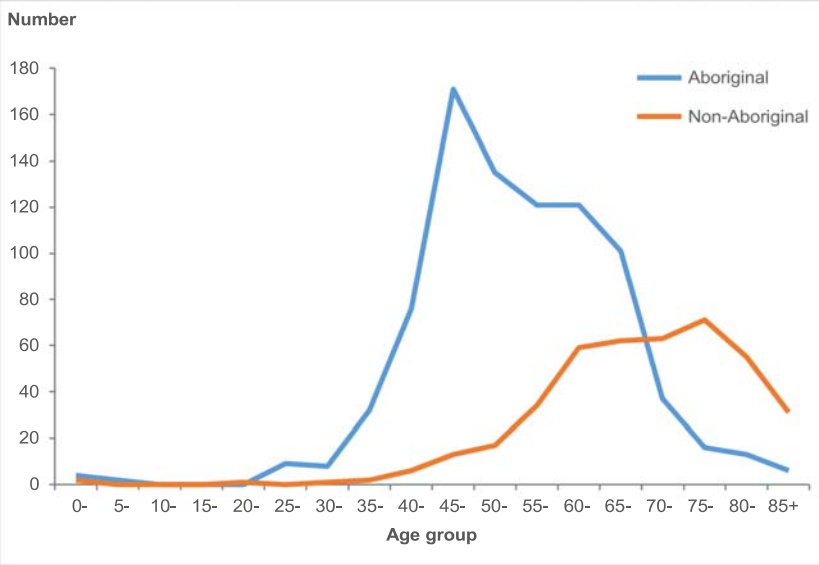
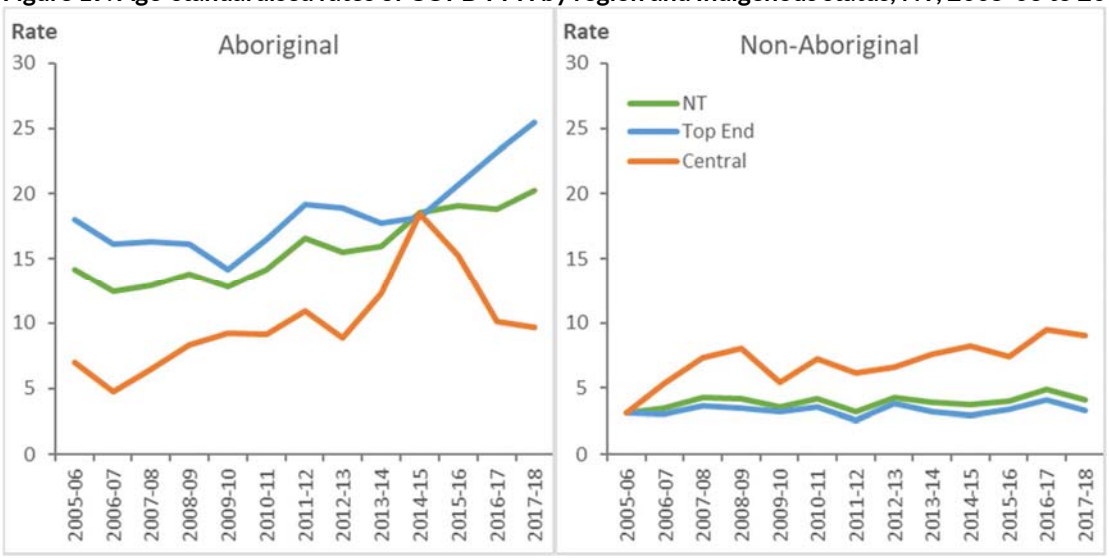


Figure 19. Age-standardised rates of COPD PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

ENTI

Most PPHs for ENTI were for patients of very young ages (Figure 20). After age-standardisation, ENTI PPHs were at much higher rate among Aboriginal peoples in the Central Australia region (Figure 21).

ENTI PPHs have increased among the Aboriginal population. When further stratified by region, the Aboriginal population in the Top End showed much less intensity in the uptrend of the PPH than those in the Central Australia region (Figure 21). The PPH rate in the Aboriginal population of the Central Australia region rose more than 4 times between 2005-06 and 2017-18 financial years.

Figure 20. Number of ENTI PPHs by age group and Indigenous status, NT, 2017-18

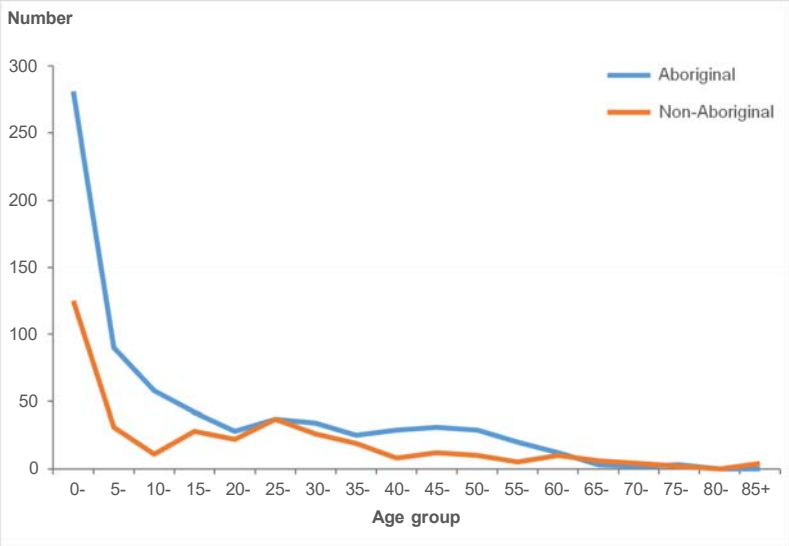
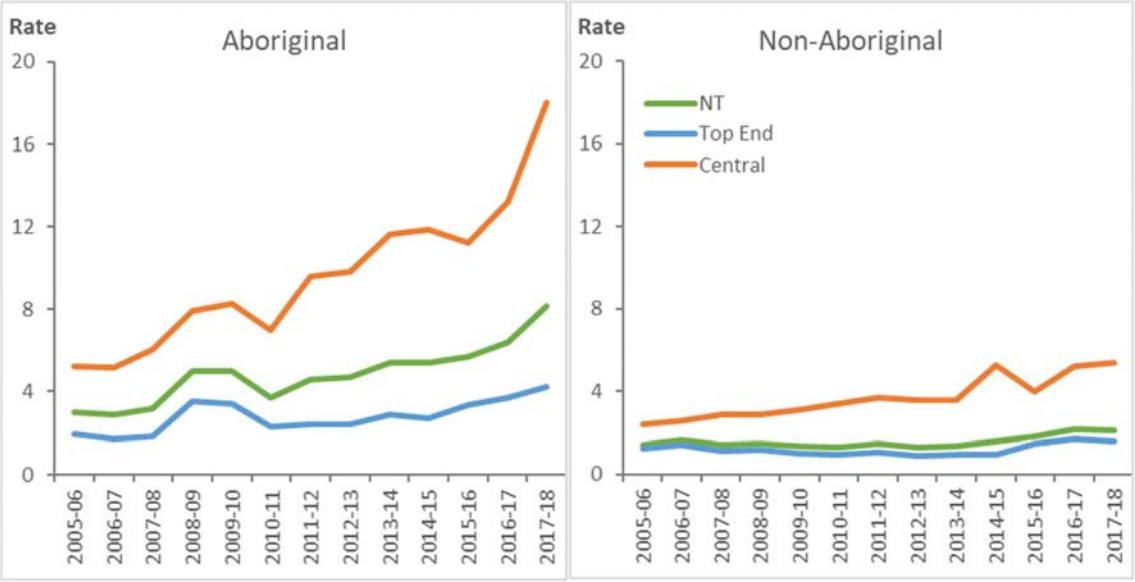


Figure 21. Age-standardised rates of ENTI PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

UTI

PPHs for UTI slightly peaked at aged less than 5 and widely spread through adult age range (Figure 22). The age-standardised rate of UTI PPH was much higher in the Aboriginal populations of the Central Australia region (Figure 23).

Figure 22. Number of UTI PPHs by age group and Indigenous status, NT, 2017-18

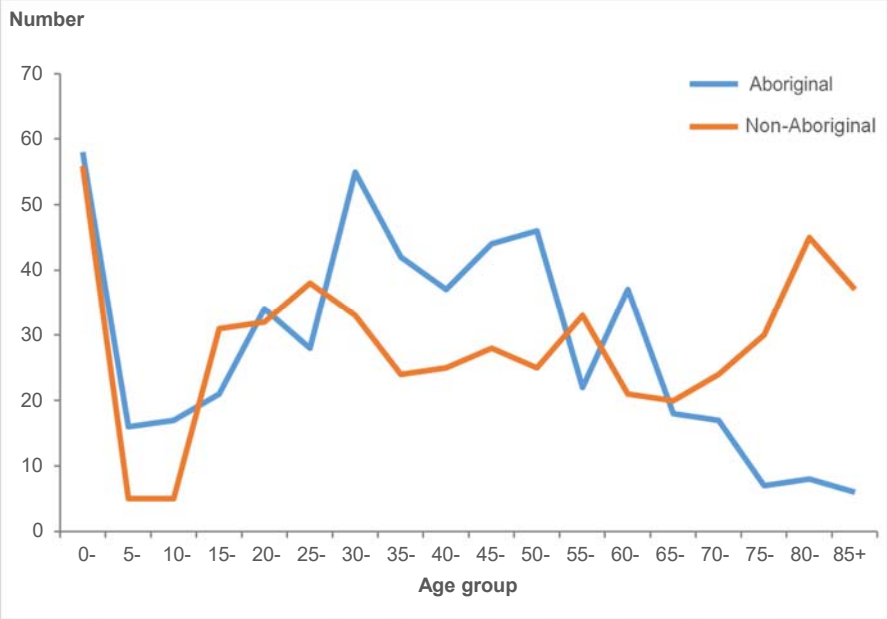
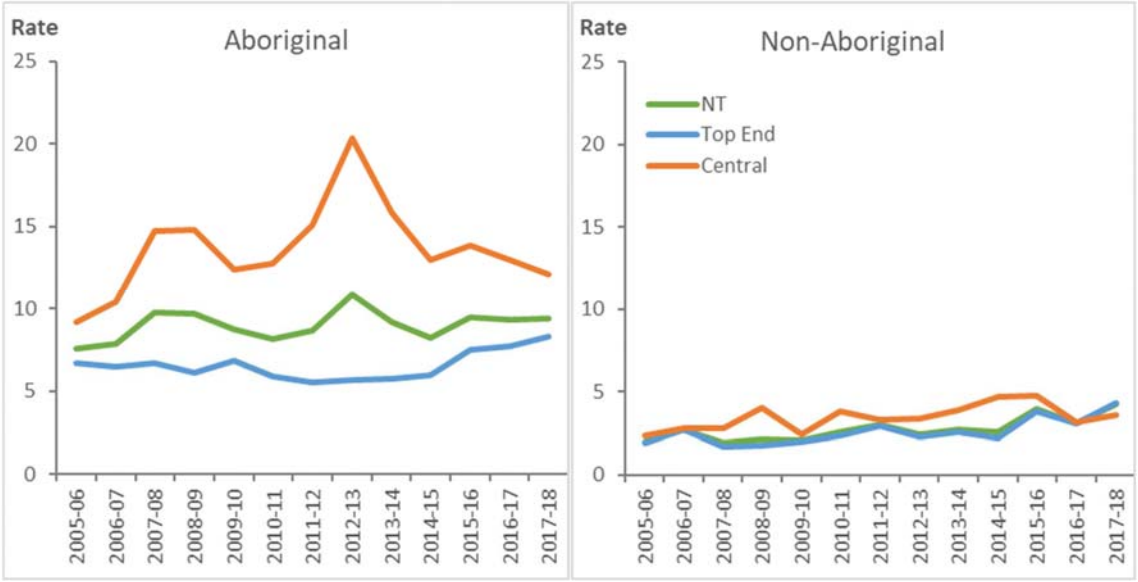


Figure 23. Age-standardised rates of UTI PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Seizure

PPHs for seizure (convulsions and epilepsy) were mostly for Aboriginal patients aged 30-54 (Figure 24). The age-standardised rate of seizure PPH was much greater among Aboriginal populations of Central Australia region (Figure 25).

Figure 24. Number of seizure PPHs by age group and Indigenous status, NT, 2017-18

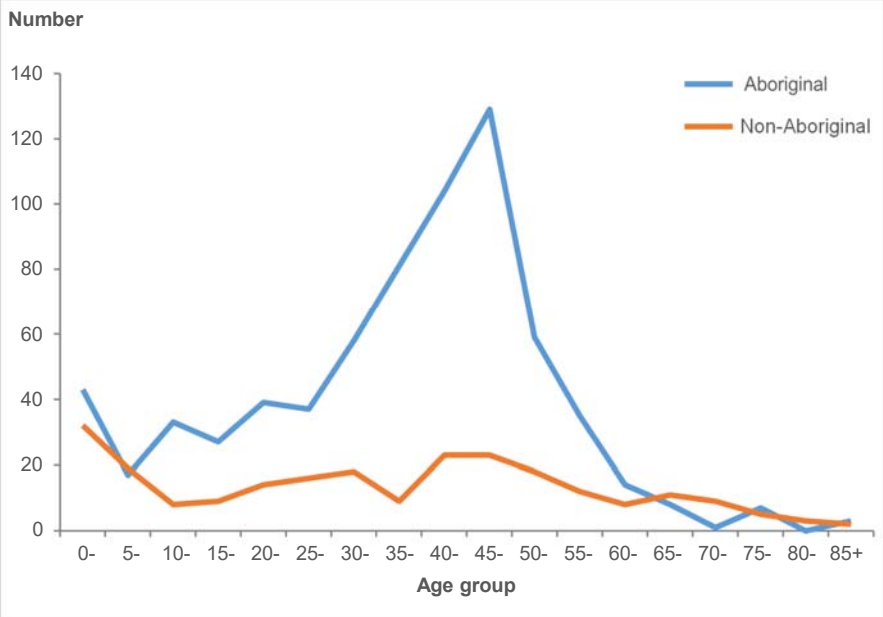
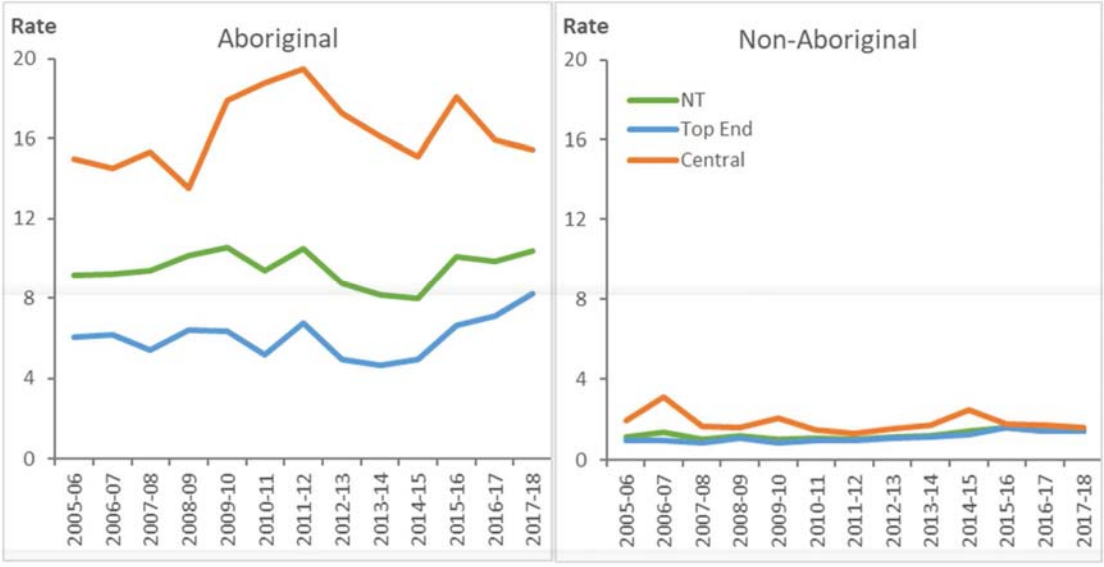


Figure 25. Age-standardised rates of seizure PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian Estimated resident population.

Dental

PPHs for dental conditions were mostly for patients aged less than 10 years (Figure 26). The age-standardised rate of dental PPH was higher among Aboriginal people, especially those of Central Australia region (Figure 27).

Figure 26. Number of dental PPHs by age group and Indigenous status, NT, 2017-18

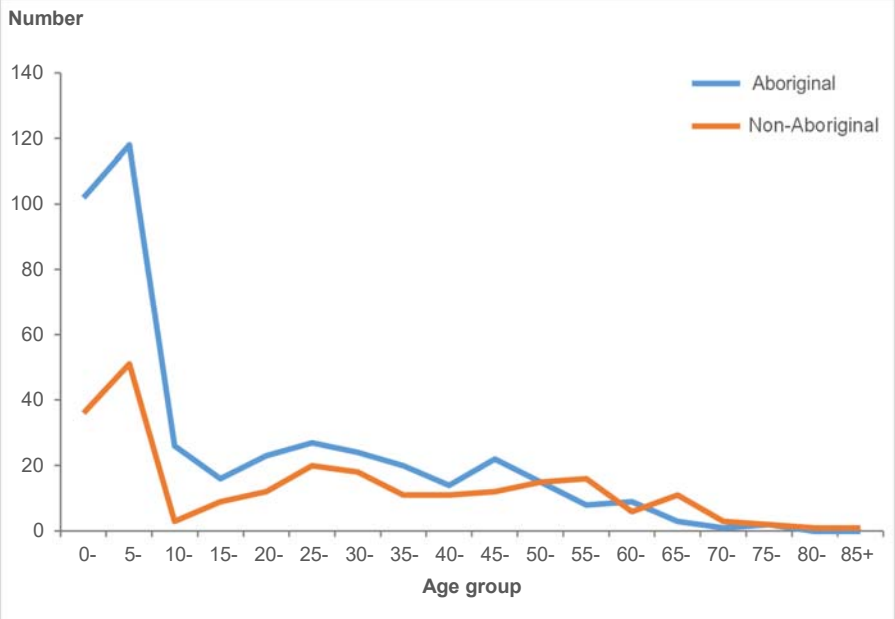
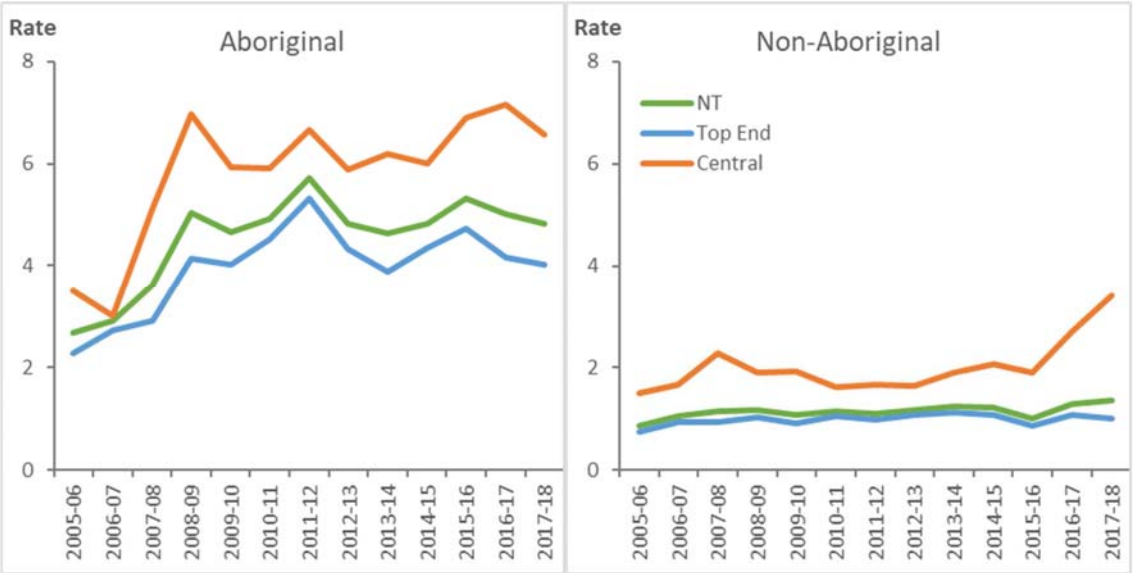


Figure 27. Age-standardised rates of dental PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Flu vaccine-preventable

PPHs for vaccine-preventable pneumonia and influenza were higher for Aboriginal patients aged 40-64 and the very young age (Figure 28). The age-standardised rate of this PPH was higher among Aboriginal peoples (Figure 29 29), particularly in Central Australia.

Figure 28. Number of flu vaccine-preventable PPHs by age group and Indigenous status, NT, 2017-18

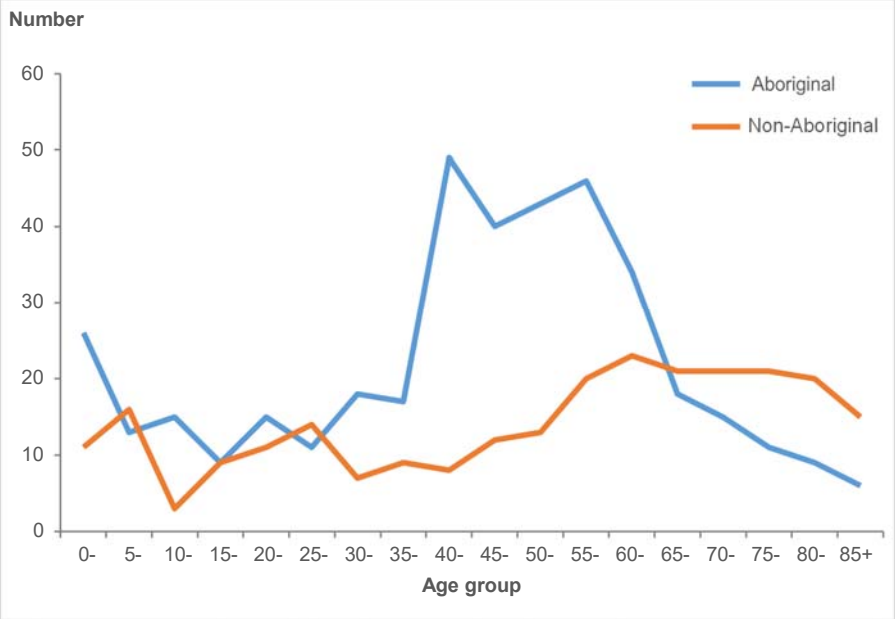
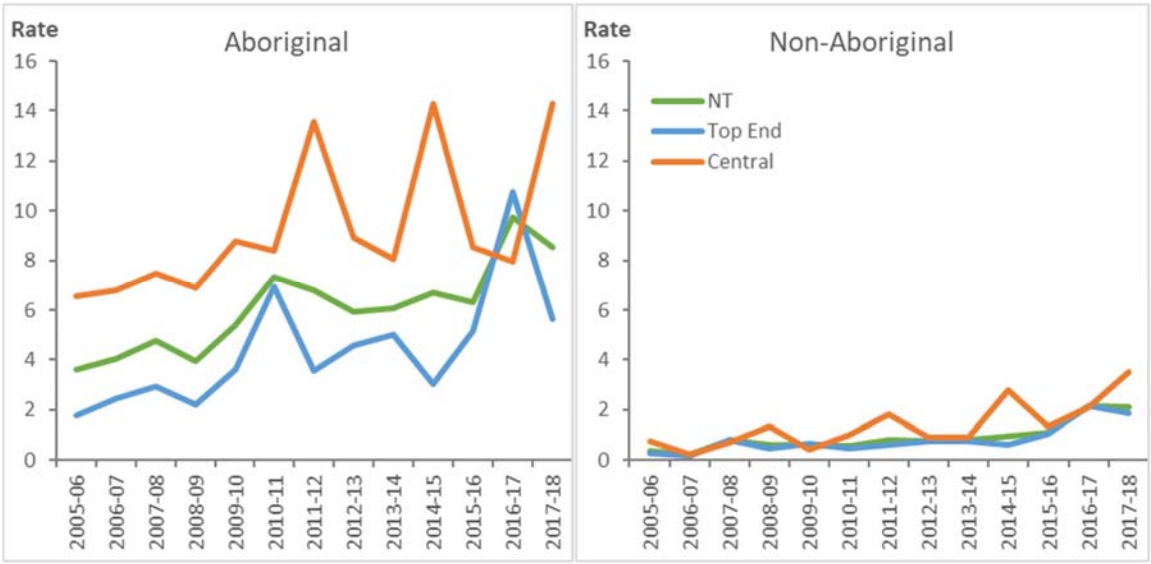


Figure 29. Age-standardised rates of flu vaccine-preventable PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Diabetes

PPHs for diabetes complications were much greater for Aboriginal patients aged 40-59 (Figure 30). The age-standardised rate of diabetes PPH was higher among Aboriginal peoples, especially those of Central Australia (Figure 31). However, since 2010 the Aboriginal diabetes PPH rate had a rapid decline from a high level of about 20 times of the national rates[9].

Figure 30. Number of diabetes PPHs by age group and Indigenous status, NT, 2017-18

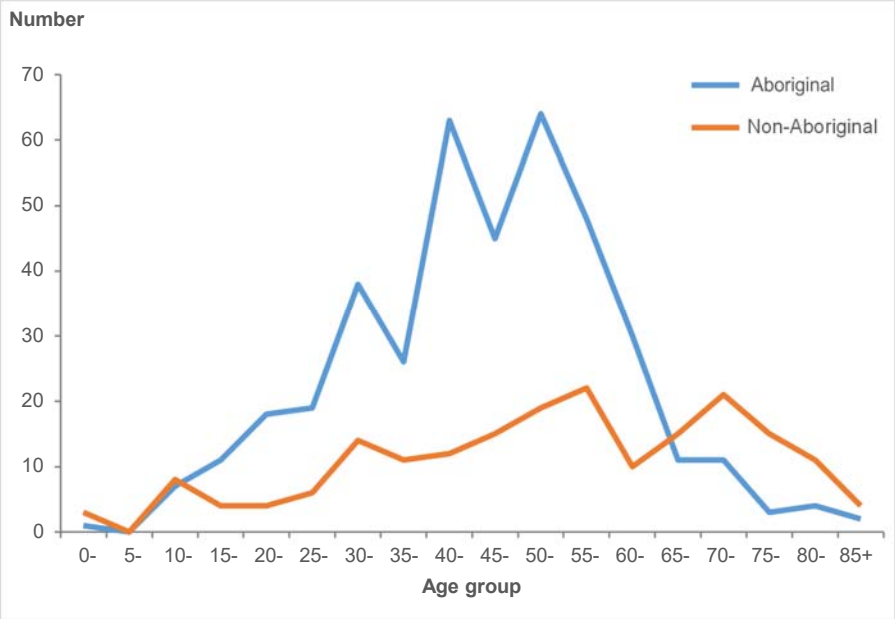
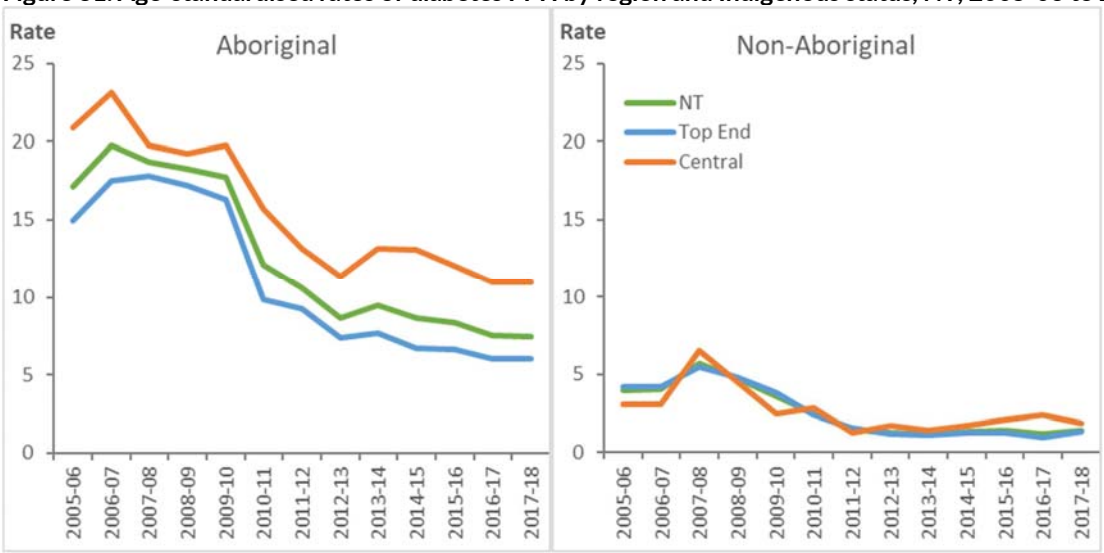


Figure 31. Age-standardised rates of diabetes PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Cardiac failure

PPHs for congestive cardiac failure were most common in Aboriginal patients aged 50-54 (Figure 32). The age-standardised rate of cardiac failure PPH was higher among Aboriginal peoples, especially those of the Central Australia region (Figure 33).

Figure 32. Number of cardiac failure PPHs by age group and Indigenous status, NT, 2017-18

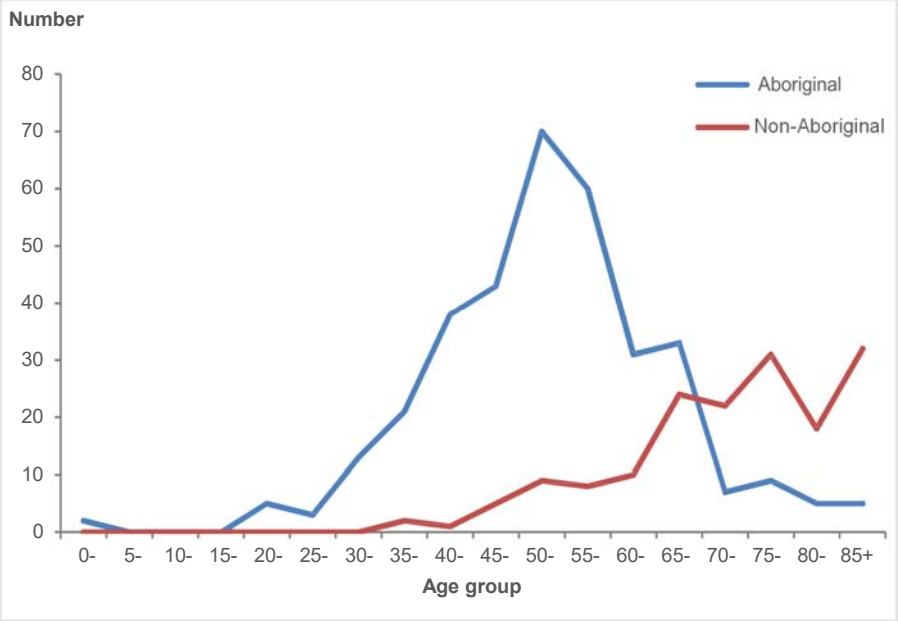
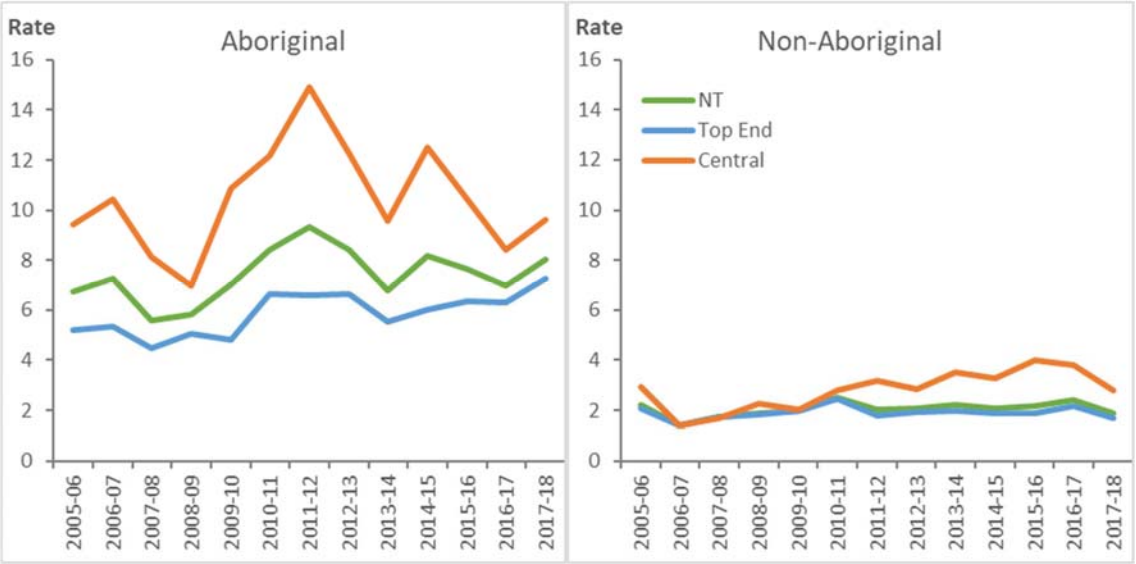


Figure 33. Age-standardised rates of cardiac failure PPH by region and Indigenous status, NT, 2005-06 to 2017-18



Rates are expressed as number of separations per 1,000 population and age-standardised using the 2001 Australian estimated resident population.

Hospital care for PPHs

PPHs contributed to 18% of total hospital bed days for all hospitalisations (excluding separations for hospital boarders, unqualified neonates, posthumous care and dialysis only) (Table 12). The average length of stay for a PPH separation (4.03 days) was longer than that for non-PPH hospitalisations (3.08). That was due to both a smaller proportion of same-day separations for PPH (27%) compared with non-PPHs (45%) and a longer stay of overnight separations for PPHs (5.15) than non-PPHs (4.80 days). The cost estimates based on cost weights of AR-DRG for PPHs accounted for 18% of the total costs for all hospitalisations (Table 13). The proportions of PPHs in all hospitalisations were higher in Aboriginal patients (20%) than in non-Aboriginal patients (12%). Acute conditions accounted for the largest share of all PPH separations (50%), costs (44%) and bed days (42%) (Table 14).

Top PPH conditions are ranked by number of hospitalisations, total bed days and total costs differently (Table 15). The other vaccine-preventable condition ranked as the number one by all three criteria. Despite having relatively fewer separations, gangrene was the number two PPH for bed days and total costs because of the extreme average cost associated with the condition's management. Diabetes complications and vaccine-preventable pneumonia and influenza were also among the top PPHs associated with long bed days and high costs. Hospital care cost and length of stay are proxy indicators of severity and complexity of the diseases coded by AR-DRG. It is reasonable to assume that many of these low cost and short stay conditions should be treated in primary care settings rather than in acute care settings.

In term of total costs for each PPH condition, just under half (45%) of the PPH conditions in 2017-18 financial year on average costed less than and or involving shorter hospital stay than non-PPHs (also with dialysis only patients excluded) (Table 16). Other vaccine-preventable conditions were the highest, which was attributed by the highest prevalence and relatively high average cost; that was seconded by gangrene because of being the highest in average cost. Despite being relatively less costly on average, cellulitis PPH ranked the 3rd in total costs for the high prevalence.

Table 12. Hospital bed days and costs for PPHs and non-PPHs, NT, 2017-18

	PPHs	(%)	Non-PPHs	(%)	All hospitalisations	(%)
Same-day separations	3,200	(27)	31,165	(45)	34,365	(43)
Overnight separations	8,602	(73)	37,575	(55)	46,177	(57)
Overnight: average length of stay (days)	*5.15*		*4.80*		*4.87*	
Total separations	11,802	(100)	68,740	(100)	80,542	(100)
Total bed days	47,500	(18)	211,568	(82)	259,068	(100)
Average length of stay (days)	*4.03*		*3.08*		*3.22*	
Total costs ($million)	82.2	(18)	377.3	(82)	459.5	(100)
Average costs ($) per hospitalisation	*6,964*		*5,489*		*5,705*	

Table 13. Hospitalisations, costs and bed days for PPHs and non-PPHs by Indigenous status, NT, 2017-18

	Hospitalisations	Costs ($'000)	Bed days
Aboriginal			
PPHs (%)	7,751 (20)	55,520 (23)	32,338 (23)
Non-PPHs (%)	30,818 (80)	183,400 (77)	106,050 (77)
Non-Aboriginal			
PPHs (%)	4,048 (10)	26,660 (12)	15,163 (13)
Non-PPHs (%)	37,879 (90)	193,823 (88)	105,473 (87)
Total*			
PPHs (%)	11,802 (15)	82,193 (18)	47,504 (18)
Non-PPHs (%)	68,740 (85)	377,330 (82)	211,568 (82)

* included hospitalisations of patients with unknown Indigenous status.

Table 14. Health care cost and length of hospital stay of PPHs by PPH category, NT, 2017-18

	Separations	Cost ($'000)	Bed days
Vaccine-preventable (%)	2,200 (19)	21,274 (26)	13,441 (28)
Chronic (%)	4,149 (35)	29,932 (36)	17,410 (37)
Acute (%)	5,887 (50)	36,031 (44)	19,942 (42)
Total PPHs (%)*	11,802 (100)	82,193 (100)	47,504 (100)

* PPH categories are not mutually exclusive and the sum of all categories may exceed 100%.

Table 15. Top PPH conditions by different criteria, NT, 2017-18

Rank	Hospitalisations	Bed days	Costs
1	Other vaccines (v)	Other vaccines (v)	Other vaccines (v)
2	Cellulitis (a)	Gangrene (a)	Gangrene (a)
3	COPD (c)	Diabetes (c)	COPD (c)
4	ENTIs (a)	Flu vaccine (v)	Cellulitis (a)
5	UTIs (a)	COPD (c)	Flu vaccine (v)
6	Seizures (a)	UTIs (a)	Diabetes (c)
7	Dental (a)	Cellulitis (a)	UTIs (a)
8	Flu vaccine (v)	Seizures (a)	Cardiac failure (c)
9	Diabetes (c)	Cardiac failure (c)	Seizures (a)
10	Cardiac failure (c)	ENTIs (a)	ENTIs (a)

The letter in the bracket indicates the PPH category: (v) Vaccine-preventable, (a) Acute, (c) Chronic category.

Table 16. Average health care cost and length of hospital stay of PPHs by PPH condition, NT, 2017-18

	Hospitalisations	Costs ($'000)	Average costs ($)	Average stay (days)
High cost PPHs:				
Gangrene (a)	491	9,028	18,387	13.08
Malnutrition (c)	23	400	17,381	18.57
Pneumonia (a)	26	446	17,164	8.54
Flu vaccine (v)	649	7,594	11,701	6.93
Diabetes (c)	596	6,937	11,639	8.51
Ulcer (a)	41	4717	11,496	5.56
Cardiac failure (c)	507	4,925	9,713	5.03
Other vaccines (v)	1,580	14,045	8,889	5.83
RHD (c)	301	2,483	8,250	4.53
Bronchiectasis (c)	276	2,253	8,164	5.08
COPD (c)	1,270	8,965	7,059	3.44
UTIs (a)	1,026	6,395	6,233	3.49
Low cost PPHs:				
Cellulitis (a)	1,431	8,046	5,622	2.49
Seizures (a)	934	4,650	4,978	2.93
PID (a)	202	863	4,273	2.51
Hypertension (c)	108	417	3,865	2.19
Angina (c)	338	1,294	3,827	1.95
Dental (a)	668	2,501	3,744	1.55
Asthma (c)	431	1,516	3,518	1.85
ENTIs (a)	1,084	3,746	3,456	1.55
Anaemia-iron (c)	299	742	2,482	1.79
Eclampsia (a)	1	1	1,129	1.00
Non-PPHs	68,740	377,330	5,489	3.08

The letter in the bracket indicates the PPH category: (v) Vaccine-preventable, (a) Acute, (c) Chronic category.

Discussion

As a performance indicator, PPH was intended to highlight access and equity to primary care but is increasingly recognised as highlighting poor social determinants leading to inequitable health outcomes. A recent AIHW report[9] flagged PPH as an indicator of the performance of primary and community care. That report recognized that the reasons for an area or group of people having higher rates of PPH also include higher rates of disease, lifestyle factors and other risks, as well as a genuine need for hospital services. Therefore, some PPHs may not be avoidable by improving primary care, such as those for patients with complex illness, or patients missed immunisations long time ago. Nevertheless, PPH is a useful tool for identifying health inequality and unmet demand. There are three ways that health systems may address PPH. Firstly, through preventing the onset of a disease (primary prevention). Secondly, through managing risk factors to prevent progression to disease (secondary prevention). Thirdly, preventing an existing condition deteriorating to the point where hospitalisation is required (tertiary prevention). The first relies on public health programs, such as vaccination programs for vaccine-preventable conditions and health promotion programs to reduce the prevalence of risk factors of many diseases; the second and third areas rely on good quality primary care for early detection and management of preventable chronic diseases and early community based treatment of acute illness.

Primary care in the NT remote areas may not be as effective and efficient as expected in urban settings. The growth in health needs is much greater than any growth in resources, leading to disproportionate pressure on the very expensive and readily available parts of the health system, e.g. hospital services. The cheaper and more satisfactory option of primary care close to home is by far more attractive and sustainable.

Analysing PPHs in the NT provides an opportunity for policy makers and service providers to develop a shared understanding of gaps in care and populations at risk through a measure for poor access to primary and community-based care. The findings from this study help them to identify areas for improvement. Time trend and geographic distribution of PPHs can be used to estimate the contribution of healthcare systems to reductions in preventable hospitalisations, and compare the effectiveness of health care system across different regions in the NT. Further information by common condition or disease category will provide feedback on the effective programs and suggest the areas for preventative actions in the future.

The NT has the highest rate of total PPHs in the country. This reflects that NT has less adequate primary and preventive health care to meet the population health needs than the rest of the county and, therefore, requires long-tern continuous investments in primary care to address surging PPHs. The higher rate of total PPHs in the NT Aboriginal population is not surprising given the profound social disadvantages, early onset of chronic conditions and poor access to comprehensive primary health care in the remote areas where the majority of the NT Aboriginal population reside.

Previously, a similar study provided valuable information on the avoidable hospitalisations in the NT for the period of 1998-09 to 2005-06[6]. This previous study demonstrated a rapid increase in hospitalisations for chronic conditions in Aboriginal peoples, primarily attributable to diabetes complications. However, this trend was mainly driven by the counting rules at that time of publication, which used all diagnosis fields for counting diabetes hospitalisations. This has been changed in NHA's PPH classification, which only uses principle diagnosis for counting diabetes hospitalisations. This change in counting rules partly explains the decline in diabetes PPH demonstrated in this current report.

This report analyses data from 2005-06 to 2017-18 financial years using the standard PPH definition and methodology set in the 2018 NHA. Our findings provide an accurate picture of PPHs by disease

categories, demographic variables, regions and trend over time in the NT and also a direct comparison with the current national figures. This project also measures the direct hospital costs incurred from PPHs.

There is a significant regional disparity in PPHs within the NT. The higher rate of total PPHs in the Central Australia region compared to the Top End possibly reflects inadequate access to comprehensive primary health care in the Central Australia region.

Unlike anywhere else in the country, the most common PPH condition in the NT, especially for Aboriginal population, is the other vaccine-preventable conditions. This PPH was, in fact, typically for chronic HepB as secondary diagnoses not the primary reason for hospitalisation. The high number of hospitalisations for chronic HepB in the NT Aboriginal population reflects: (i) a cohort of adults born prior to the HepB immunisation program, (ii) a rigorous system for case finding in the NT, and (iii) the anticipated needs for hospital care of the older cohort of people with chronic HepB who develop comorbid conditions. The over-representation of chronic HepB in total PPHs in the NT illustrates a clear limitation of PPH as measure of current health needs because HepB acquisition was likely to have occurred decades previously.

The increase in total PPH rate in the NT correlates with the rise in total hospitalisations. The latter reflects the genuine demand for health care in a population. Chronic conditions PPH rate has been plateauing for Aboriginal population despite increasing prevalence of chronic diseases. This is most likely due to effective primary health care for chronic diseases over many years of concerted effort that includes: a jurisdictional preventable chronic disease strategy, chronic disease workforce reforms, standardised treatment pathways and continuous quality improvement programs[10].

Several acute PPH conditions, such as ENTI and cellulitis, are much higher in the NT. The PPHs for these conditions are generally avoidable by timely access to primary care. The acceleration of these acute PPHs among the Central Australia Aboriginal population requires further investigation. In the future, the use of linked data sets could allow investigation of the relationships between PPH and disease prevalence, use of primary health care, use of medicines and health outcomes.

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Appendix

Table A1. Classification of PPH conditions

Category	Condition	ICD-10-AM codes and description		Additional requirements	
Vaccine-preventable conditions	Pneumonia and influenza (vaccine-preventable)	J10	Influenza due to other identified influenza virus	In any diagnosis	Exclude people less than 2-month old
		J11	Influenza, virus not identified		
		J13	Pneumonia due to Streptococcus pneumonia		
		J14	Pneumonia due to Haemophilus influenza		
	Other vaccine-preventable conditions	A08.0	Rotaviral enteritis	In any diagnosis	See note (1)
		A35	Other tetanus		
		A36	Diphtheria		
		A37	Whooping cough		
		A80	Acute poliomyelitis		
		B01	Varicella [chicken pox]		
		B05	Measles		
		B06	Rubella [German measles]		
		B16.1	Acute hepatitis B with delta-agent (coinfection) without hepatic coma		
		B16.9	Acute hepatitis B Without delta-agent and without hepatic coma		
		B18.0	Chronic viral hepatitis B with delta-agent		
		B18.1	Chronic viral hepatitis B without delta-agent		
		B26	Mumps		
		G00.0	Haemophilus meningitis		
Chronic	Asthma	J45	Asthma	As principal diagnosis	
		J46	Status asthmaticus		
	Congestive cardiac failure	I50	Heart failure	As principal diagnosis	See note (2)
		I11.0	Hypertensive heart disease with (congestive) heart failure		
		J81	Pulmonary oedema		
	Diabetes complications	E10	Type 1 diabetes mellitus	As principal diagnosis	
		E11	Type 2 diabetes mellitus		
		E13	Other specified diabetes mellitus		
		E14	Unspecified diabetes mellitus		

Table A1. Classification of PPH conditions (continued)

Category	Condition	ICD-10-AM codes and description		Additional requirements	
Chronic (continued)	Chronic obstructive pulmonary disease (COPD)	J41 J42 J43 J44	Simple and mucopurulent chronic bronchitis Unspecified chronic bronchitis Emphysema Other chronic obstructive pulmonary disease	As principal diagnosis	
		J20	Acute bronchitis	As principal diagnosis	Only with additional diagnosis of J41-J44
	Bronchiectasis	J47	Bronchiectasis	As principal diagnosis	
		J20	Acute bronchitis	As principal diagnosis	Only with additional diagnosis of J47
	Angina	I20 I24.0 I24.8 I24.9	Angina pectoris Coronary thrombosis not resulting in myocardial infarction Other forms of acute ischaemic heart disease Acute ischaemic heart disease, unspecified	As principal diagnosis	See note (2)
	Iron deficiency anaemia	D50.1 D50.8 D50.9	Sideropenic dysphagia Iron deficiency anaemia, unspecified Other iron deficiency anaemia	As principal diagnosis	
	Hypertension	I10 I11.9	Essential (primary) hypertension Hypertensive heart disease without (congestive) heart failure	As principal diagnosis	See note (2)
	Nutritional deficiencies	E40 E41 E42 E43 E55.0	Kwashiorkor Nutritional marasmus Marasmic kwashiorkor Unspecified severe protein-energy malnutrition Rickets, active	As principal diagnosis	
	Rheumatic heart disease	I00 I01 I02 I05 I06 I07 I08 I09	Rheumatic fever without mention of heart involvement Rheumatic fever with mention of heart involvement Rheumatic chorea Rheumatic mitral valve diseases Rheumatic aortic valve diseases Rheumatic tricuspid valve diseases Multiple valve diseases Other rheumatic heart diseases	As principal diagnosis	

Table A1. Classification of PPH conditions (continued)

Category	Condition	ICD-10-AM codes and description		Additional requirements	
Acute	Pneumonia (not vaccine-preventable)	J15.3	Pneumonia due to streptococcus, group B	In any diagnosis	Exclude people under 2 months
		J15.4	Pneumonia due to other streptococci		
		J15.7	Pneumonia due to *Mycoplasma pneumoniae*		
		J16.0	Chlamydial pneumonia		
	Urinary tract infections, including pyelonephritis	N10	Acute tubulo-interstitial nephritis	As principal diagnosis	
		N11	Chronic tubulo-interstitial nephritis		
		N12	Tubulo-interstitial nephritis, not specified as acute or chronic		
		N13.6	Pyonephrosis		
		N15.1	Renal and perinephric abscess		
		N15.9	Renal tubulo-interstitial disease, unspecified		
		N28.9	Disorder of kidney and ureter, unspecified		
		N39.0	Urinary tract infection, site not specified		
		N39.9	Disorder of urinary system, unspecified		
	Cellulitis	L02	Cutaneous abscess, furuncle and carbuncle	As principal diagnosis	See note (3)
		L03	Cellulitis		
		L04	Acute lymphadenitis		
		L08	Other local infections of skin and subcutaneous tissue		
		L88	Pyoderma gangrenosum		
		L98.0	Pyogenic granuloma		
		L98.3	Eosinophilic cellulitis [Wells]		
	Pelvic inflammatory disease	N70	Salpingitis and oophoritis	As principal diagnosis	
		N73	Other female pelvic inflammatory diseases		
		N74	Female pelvic inflammatory disorders in diseases classed elsewhere		
	Ear, nose and throat infections	H66	Suppurative and unspecified otitis media	As principal diagnosis	
		J02	Acute pharyngitis		
		J03	Acute tonsillitis		
		J06	Acute upper respiratory infections of multiple and unspecified sites		
		J31.2	Chronic pharyngitis		

Table A1. Classification of PPH conditions (continued)

Category	Condition	ICD-10-AM codes and description		Additional requirements	
Acute (continued)	Perforated/bleeding ulcer	K25.0	Gastric ulcer, acute with haemorrhage	As principal diagnosis	
		K25.1	Gastric ulcer, acute with perforation		
		K25.2	Gastric ulcer, acute with both haemorrhage and perforation		
		K25.4	Gastric ulcer, chronic or unspecified with haemorrhage		
		K25.5	Gastric ulcer, chronic or unspecified with perforation		
		K25.6	Gastric ulcer, chronic or unspecified with both haemorrhage and perforation		
		K26.0	Duodenal ulcer, acute with haemorrhage		
		K26.1	Duodenal ulcer, acute with perforation		
		K26.2	Duodenal ulcer, acute with both haemorrhage and perforation		
		K26.4	Duodenal ulcer, chronic or unspecified with haemorrhage		
		K26.5	Duodenal ulcer, chronic or unspecified with perforation		
		K26.6	Duodenal ulcer, chronic or unspecified with both haemorrhage and perforation		
		K27.0	Peptic ulcer, acute with haemorrhage		
		K27.1	Peptic ulcer, acute with perforation		
		K27.2	Peptic ulcer, acute with both haemorrhage and perforation		
		K27.4	Peptic ulcer, chronic or unspecified with haemorrhage		
		K27.5	Peptic ulcer, chronic or unspecified with perforation		
		K27.6	Peptic ulcer, chronic or unspecified with both haemorrhage and perforation		
		K27.0	Peptic ulcer, acute with haemorrhage		
		K27.1	Peptic ulcer, acute with perforation		
		K27.2	Peptic ulcer, acute with both haemorrhage and perforation		
		K27.4	Peptic ulcer, chronic or unspecified with haemorrhage		
		K27.5	Peptic ulcer, chronic or unspecified with perforation		
		K27.6	Peptic ulcer, chronic or unspecified with both haemorrhage and perforation		
		K28.0	Gastrojejunal ulcer, acute with haemorrhage		
		K28.1	Gastrojejunal ulcer, acute with perforation		
		K28.2	Gastrojejunal ulcer, acute with both haemorrhage and perforation		
		K28.4	Gastrojejunal ulcer, chronic or unspecified with haemorrhage		
		K28.5	Gastrojejunal ulcer, chronic or unspecified with perforation		
		K28.6	Gastrojejunal ulcer, chronic or unspecified with both haemorrhage and perforation		

Table A1. Classification of PPH conditions (continued)

Category	Condition	ICD-10-AM codes and description		Additional requirements	
Acute (continued)	Dental conditions	K02	Dental caries	As principal diagnosis	
		K03	Other diseases of hard tissues of teeth		
		K04	Diseases of pulp and periapical tissues		
		K05	Gingivitis and periapical diseases		
		K06	Other disorders of gingiva and edentulous alveolar ridge		
		K08	Other disorders of teeth and supporting structures		
		K09.8	Other cysts of oral region, not elsewhere classified		
		K09.9	Cyst of oral region, unspecified		
		K12	Stomatitis and related lesions		
		K13	Other diseases if lip and oral mucosa		
		K14.0	Glossitis		
	Convulsions and epilepsy	G40	Epilepsy	As principal diagnosis	
		G41	Status epilepticus		
		R56	Convulsions, not elsewhere classified		
	Eclampsia	O15	Eclampsia	As principal diagnosis	
	Gangrene	R02	Gangrene, not elsewhere classified	In any diagnosis	
		I70.24	Atherosclerosis of arteries of extremities with gangrene	As principal diagnosis	
		E09.52	Intermediate hyperglycaemia with peripheral angiopathy, with gangrene		

Notes:

(1) Other vaccine-preventable conditions include ICD-10-AM code of Z22.51 (Carrier of viral hepatitis B). This code was used in hospital data prior to 2012-13 and reassigned as B18.0 (Chronic viral hepatitis B with delta agent on 1 July 2013.

(2) Exclude cases with the following cardiac procedure codes: blocks 600-606, 608-650, 653-657, 660-664, 666, 669-682, 684-691, 693, 705-707, 717 and codes 33172-00[715], 33827-01[733], 34800-00[726], 35412-00[11], 38721-01[733], 90217-02[734], 90215-02[732].

(3) Exclude cases with any procedure except those in blocks 1820 to 2016, or if procedure is 30216-00[1604], 30216-01[1604], 30216-02[1604], 30676-00[1659], 30223-01[1606], 30223-02[1606], 30064-00[1605], 90660-00[1602], 90661-00[1608], and this is the only listed procedure.

Figure A1. Map of Northern Territory health district

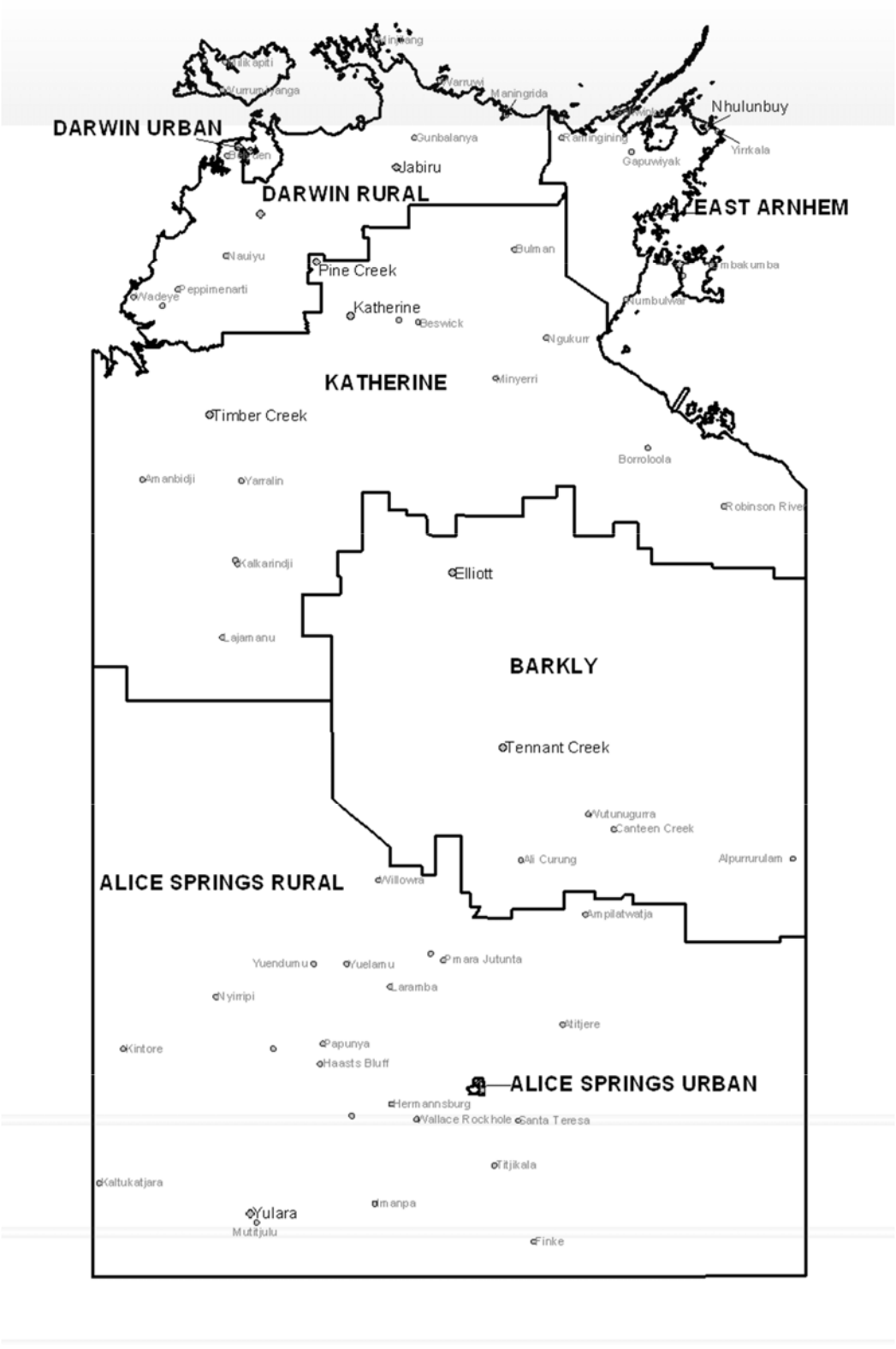

Table A2. Estimated resident population by health district and Indigenous status, NT, 2017

Health district	Aboriginal	Non-Aboriginal	Total
Darwin Urban	18,408	132,647	151,055
Darwin Rural	12,476	2,806	15,282
Katherine	11,121	8,859	19,980
East Arnhem	11,431	4,041	15,472
Barkly	4,396	1,796	6,192
Alice Springs Urban	6,849	20,170	27,019
Alice Springs Rural	10,241	2,276	12,517
Northern Territory	74,922	172,595	247,517

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