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Spatial variation in Aboriginal and Torres Strait Islander people's access to primary health care

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Authoritative information and statistics to promote better health and wellbeing

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Australian Institute of Health and Welfare
Canberra
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Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
AMPCo	Australasian Medical Publishing Company
ARN	Access Relative to Need
ASGS	Australian Statistical Geography Standard
COAG	Council of Australian Governments
EOC	episodes of care
FTE	full-time equivalent
ISPHCS	Indigenous-specific primary health-care service
nKPI	national Key Performance Indicator
OSR	Online Service Reporting
PHCS	primary health-care service
PPH	potentially preventable hospitalisation
RFDS	Royal Flying Doctor Service
SA1	Statistical Area level 1
SA2	Statistical Area level 2
SA3	Statistical Area level 3
SA4	Statistical Area level 4

Preface

This report presents the findings of work undertaken by the AIHW to map access to primary health-care services relative to the distribution of Aboriginal and Torres Strait Islander people. Identifying areas where access to primary health care is poor is important to inform policy decisions and planning of health services.

Access is measured in terms of physical access only, based on drive time to services. This report focuses primarily on access to Indigenous-specific primary health-care services funded by the Australian Government (referred to hereafter as ISPHCS). Access to GPs in general and hospitals are also taken into account in some of the analyses presented.

Outreach services are not included in this report as data on these services were not available to the AIHW at the time of writing this report. However, it is recognised that outreach plays an important role in health service delivery in regional, rural and remote communities, and aims to improve access to medical and specialist health services in certain parts of Australia.

This report includes maps and analyses that identify areas where critical service gaps exist for Aboriginal and Torres Strait Islander people with respect to their access to primary health care (ISPHCS and GPs at other services). The service gap areas were defined based on the locations of ISPHCSs and of all GPs (including mainstream GPs) in 2013. This is not a complete collection of the primary care service locations that are accessible to Aboriginal and Torres Strait Islander people. For example, some state/territory-funded Indigenous-specific services and new GP services (post 2013) will not be captured in the analyses. A search was undertaken of the National Health Service Directory and of state/territory websites in order to identify whether there were any services with GPs located within, or close to, service gap areas that may impact on Aboriginal and Torres Strait Islander people's access to primary health care. However, it is recognised that as a complete list of primary health-care services is not available from any 1 collection, there may still be some primary health-care services that were not able to be identified by the AIHW for inclusion in this report.

This report also examines the types of services provided by ISPHCS, with a specific focus on maternal health services and diabetes management. It should be noted that this analyses only focused on the availability of these services at ISPHCS locations. Aboriginal and Torres Strait Islander people may also access maternal health services and diabetes care at other service locations.

Summary

This report presents the findings of work undertaken to map access to primary health-care services across Australia relative to the distribution of Aboriginal and Torres Strait Islander people. It focuses primarily on physical access to Indigenous-specific primary health-care services funded by the Australian Government (referred to hereafter as ISPHCS) and also takes into account Indigenous people's access to GPs in general and to hospitals.

The report includes maps and analyses that identify areas where critical service gaps exist for Aboriginal and Torres Strait Islander people with respect to their access to primary health care. It also examines the types of services provided by ISPHCS, with a specific focus on maternal health services and diabetes management.

Key findings

- In 2012–13, 219 organisations that reported to the Online Services Reporting (OSR) and/or to the national Key Performance Indicator (nKPI) data collections were funded by the Australian Government to provide primary health-care services at 323 locations.
- Areas classified as *Remote* and *Very remote* in the Australian Bureau of Statistics' Australian Statistical Geography Standard have the most ISPHCS locations per 1,000 Aboriginal and Torres Strait Islander people. However, these areas also have the highest proportion of Aboriginal and Torres Strait Islander people needing to travel more than 1 hour to access the nearest ISPHCS.
- There are a number of areas with very limited access to both ISPHCS and to all GPs (referred to as 'service gap areas'). Forty SA2s (Statistical Areas Level 2) were identified as service gap areas with no ISPHCS locations within 1 hour's drive and with poor access to GP services in general (including services provided by the Royal Flying Doctor Service).
  - 10 service gap areas have Aboriginal and Torres Strait Islander populations of at least 600; 4 of these areas (the Torres Strait Islands, Torres and Central Highlands East in Queensland, and Ashburton in Western Australia), have Aboriginal and Torres Strait Islander populations of more than 1,200 (excludes Palm Island in Queensland which has recently had a new GP clinic opened).
  - The remaining service gap areas have Aboriginal and Torres Strait Islander populations ranging from fewer than 50 to close to 600.
  - 61% of the service gap SA2s have high rates of potentially preventable hospitalisations.
- Examination of GP services that were not part of the OSR or nKPI data collections—for example, state-funded services and very new services with GPs not included in the Access Relative to Need (ARN) index—revealed an additional 17 primary health-care services inside service gap SA2s or in adjacent SA2s. These additional services improved access significantly in 3 of the 40 identified service gap areas (Palm Island in Queensland; Tasmania's West Coast; and Exmouth in Western Australia).
- Access to primary health care in service gap areas may also be influenced by state-funded primary health-care services without permanent GPs. For example, the Torres Strait Islands SA2 has a number of such services funded by Queensland Health.

1 Introduction

The aim of this project is to map primary health-care services relative to the distribution of the Aboriginal and Torres Strait Islander population in order to identify geographic gaps in access to health services and health service delivery. It is clear that access to adequate primary health care varies across Australia, particularly for Aboriginal and Torres Strait Islander people (for example, AIHW 2014a). Access to adequate primary health care is likely to be an important factor in improving the health outcomes of Indigenous Australians. Identifying areas where access to primary health care is poor is important to inform policy decisions and planning of health services for Indigenous Australians.

This project focuses on the 219 organisations that are funded by the Australian Government to provide Indigenous-specific primary health-care services (ISPHCS) at 323 locations and required to provide data to the AIHW's Online Service Report (OSR) and/or to the AIHW's National Key Performance Indicators (nKPI) data collection. The project builds on previous mapping work undertaken by the AIHW, which focussed on mapping access to primary health-care services relative to need for the Aboriginal and Torres Strait Islander population, using a geospatial index developed by the AIHW (the 'Access Relative to Need' or ARN index) (AIHW 2014a). The earlier work makes it possible to take Aboriginal and Torres Strait Islander people's access to all GP services (not just Indigenous-specific services) into account when identifying service gaps.

This report presents results on geographic variation in Aboriginal and Torres Strait Islander people's access to ISPHCS locations at the small area level. Drive time to services is used as a measure of access.

The report also examines the types of services offered at each service location, with a specific focus on maternal and child health services and diabetes services. Maternal and child health is a focus of funding from the Australian Government, with $94 million announced in the 2014–2015 Budget to implement the Better Start to Life approach to increase access to maternal and child health services. It is also of critical importance to the Council of Australian Governments (COAG) target of halving the Indigenous child mortality gap within a decade. The Indigenous Australians' Health Programme includes a strong focus on the prevention, detection and management of chronic disease as this is a key driver of the life expectancy gap. One of the chronic diseases contributing most to ill health is diabetes. Improving diabetes care among Aboriginal and Torres Strait Islander people is viewed as essential to achieving the COAG target of closing the life expectancy gap within a generation.

The relationship between the location of these services, the target population, and relevant process and outcome indicators, is also examined. Data on potentially preventable hospitalisations (PPH) also enable the identification of areas where health outcomes suggest that more effective primary health care is needed.

Outreach services were not included in the analyses undertaken, however it is recognised that these services supplement other primary and specialist health services operating in some parts of Australia and play an important role in health service delivery in regional, rural and remote communities. State-funded primary health-care services without permanent GPs can also play a leading role in some areas, including in the Torres Strait.

Structure of this report

This report is structured with the following chapters:

1. Introduction
2. Methods: a brief summary of data sources and steps involved in the analyses presented in this report
3. Findings: including results in the form of tables and maps from the 4 main stages of work (distribution of ISPHCS locations relative to the Aboriginal and Torres Strait Islander population; areas identified as having service gaps in relation to primary health care; maternal and child health; and diabetes management).
4. Conclusion
5. Appendices A, B and C: including additional findings, background information, data limitations and detailed notes on methodology.

2 Methods

The data sources used for analysis presented in this report include the OSR; Estimated Resident Population data from the 2011 Census; the AIHW's geospatial index of access to primary health care relative to need (the ARN index); the nKPI data collection; and data on PPHs from the AIHW's National Hospital Morbidity Database. Further information on data sources can be found in Appendix B.

Geography

A major challenge for any spatial analysis is the choice of geographic framework and the unit of analysis. Choices are constrained by pre-existing spatial boundaries, the lowest available level of geographic detail available in the data, and the availability of other required information at a similar level (such as population data).

Within Australia, spatial data can be presented at various levels reflecting political boundaries (such as local councils or local government areas), service or funding boundaries (such as health districts), or administrative boundaries drawn for the purpose of consistent reporting of statistics (such as various ABS boundaries).

The main structure of the Australian Statistical Geography Standard (ASGS), developed by the ABS for the collection and dissemination of geographic statistics, was selected as the most relevant framework for this work (Box 2.1), because all of the data used in this report are based on the ASGS. There is a hierarchy of 54,805 SA1s, 2,214 SA2s, 351 SA3s and 106 SA4s in the ASGS. Areas at lower levels are wholly contained within single areas at higher levels enabling data available at lower levels to be aggregated to higher levels.

Box 2.1 Hierarchical construction of SA levels from the ASGS

Mesh Block (MB)

347,627 areas

↓

Statistical Area Level 1 (SA1)

54,805 areas with populations generally between 200 and 800

↓

Statistical Area Level 2 (SA2)

2,214 areas with populations generally between 3,000 and 25,000

↓

Statistical Area Level 3 (SA3)

351 areas with populations generally between 30,000 and 130,000

↓

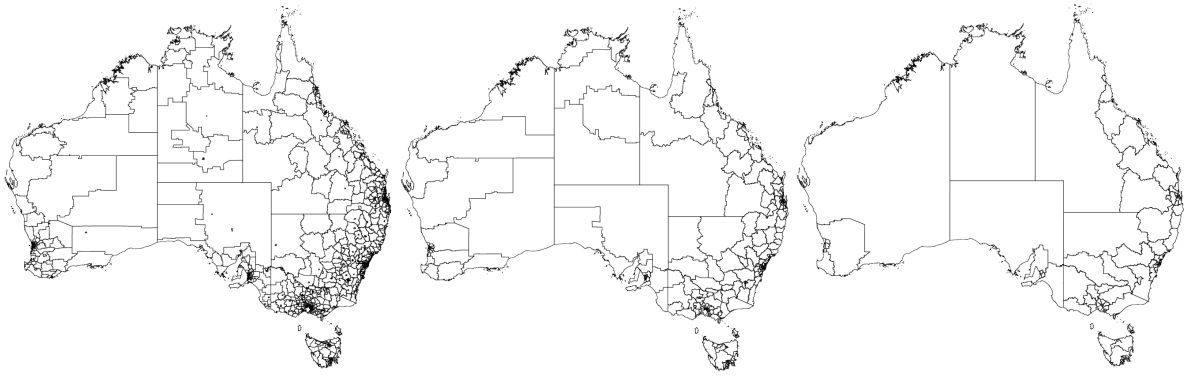
Statistical Area Level 4 (SA4)

106 areas with populations generally between 100,000 and 500,000

↓

State/Territory (STE)

Maps included in this report are presented at one of the Statistical Area Levels SA2, SA3 or SA4 of the ASGS (Figure 2.1), depending on the level of analysis the data were best able to support, and on consideration of how best to present the data being mapped (that is, large enough to provide reliable estimates, while small enough not to mask within-unit variations).



SA2 (2,214) SA3 (351) SA4 (106)

Figure 2.1: Boundaries of Statistical Area levels 2, 3 and 4 (SA2, SA3 and SA4)

Calculations underlying the presented information in this report have often been conducted at the SA1 level in order to make use of the most detailed information available about the location and characteristics of populations. However, presenting information about all individual SA1s results in maps that are too detailed to give a national overview of geographic variation in access to services. Conversely, presenting information on the location of services at the SA3 level would result in maps that fail to show much of the existing variation in access, particularly in regional and remote areas. Therefore, the SA2 level has been chosen to display information on the location of services and related health outcomes for most maps included in this report.

The exception to this are 2 maps (maps 3.1.1 and 3.1.3) that use the 351 SA3s to show the broad distribution of the Aboriginal and Torres Strait Islander population, and 2 maps (maps 3.1.4 and 3.1.5) that use the 106 SA4s to show service locations to population ratios. SA3s in urban and regional areas are large enough to show the broad population distribution and small enough in remote areas to show variation between neighbouring areas. However, urban and regional SA3s are too small for service locations to population ratios to be meaningful, as people are able to travel outside their area of residence to access services. To minimise this problem, service locations to population ratios were presented at the SA4 level in maps that show the large-scale variation in the supply of service locations across Australia.

Indigenous Areas are another level of geography that could have been used as an alternative to presenting information at SA levels in this report (there are 429 Indigenous Areas which are aggregates of SA1s). However, as some of the data used in this report (including hospitalisation data) are only available at the SA2 level, and some Indigenous Areas have boundaries that cross SA2 boundaries or are smaller than SA2s in some parts of Australia, the data could not be easily aggregated from the SA2 level to the Indigenous Area level. Furthermore, presenting geographic variation in access to services at the SA2 level is consistent with how access to GPs relative to need, in the form of the ARN index, has previously been presented (AIHW 2014a).

Access to services

The analysis presented in this report involved a number of steps including:

- sourcing of data on the physical addresses for each of the ISPHCS locations; other GP services; and public hospitals (including multi-purpose health services) in Australia. Where available, information was also sourced on the number of GPs working at each service and on a full-time equivalent (FTE) value for each GP
- derivation of latitude and longitude coordinates for each ISPHCS location
- validation of address information
- calculation of population centroids to represent the locations of populations, based on the geographic centre point of an ASGS-derived boundary (in this case the SA1)
- calculation of Indigenous-specific primary health-care service locations to Aboriginal and Torres Strait Islander population ratios
- calculation of the proportion of SA2 populations within 1 hour's drive time of the nearest ISPHCS location
- identification of service gap SA2s based on the locations of ISPHCSs and access to GPs in general, as measured by the ARN index (see next section)
- identification of additional services (for example, state/territory funded GPs, very new services with GPs) located inside or close to service gap SA2s
- calculation of PPH rates at the SA2 level and grouping of them into quartiles.

The Access Relative to Need (ARN) index

The ARN index describes geographic variation in physical access to primary health care relative to the per capita need for primary health care. It is a service provider (GPs in this case) to population ratio that takes into account that people travel between areas to access services and that different populations have different health-care needs. Access to service providers is assumed to decline with distance when the ARN index is calculated. Populations are assumed to be able to access services up to 1 hour's drive time away.

The per capita need for primary health care of a population depends on the distribution of age and socioeconomic status within the population. Age structure and socioeconomic factors were therefore taken into account when the ARN index was calculated (AIHW 2014a).

Composite measures

Composite measures were created to describe variation between ISPHCS in service outcomes related to maternal/antenatal care and diabetes care. The maternal/antenatal care measure was made up of data on birthweight and immunisation rates among young children. The diabetes care measure was calculated using data on the proportion of diabetic clients who had their HbA1c levels (long-term blood glucose) and blood pressure measured.

More detailed information on the methods used in this report can be found in Appendix A and Appendix C.

Limitations

There are data limitations that should be considered when interpreting the data and maps presented in this report.

First, only Indigenous-specific primary health-care services (ISPHCSs) that are required to take part in the OSR and/or nKPI reporting data collections and GP services as at 2013 were included in the primary analyses for this report. This is not a complete collection of the primary care service locations that are accessible to Aboriginal and Torres Strait Islander people. For example, new GP services (post 2013) and some state/territory-funded Indigenous-specific services with GPs that are not part of the OSR or nKPI data collections would not have been included in the analyses even if they do provide some primary care. Access to primary health care in some areas may be influenced by state-funded primary health-care services without permanent GPs. For example, the Torres Strait Islands SA2 has a number of such services funded by Queensland Health.

Furthermore, outreach services improve the range of health-care services that are available in many regional, rural and remote communities. Data on these services were not available to the AIHW at the time of writing this report.

A search was undertaken of the National Health Service Directory and of state/territory websites in order to identify whether there were any services with GPs located inside, or close to, the service gap areas that may impact on Aboriginal and Torres Strait Islander people's access to primary health care. However, it is recognised that as a complete list of primary health-care services is not available from any collection, there may still be some primary health-care services that were not able to be identified by the AIHW for inclusion in this report.

A second key limitation is that data on the availability of staff and episodes of care are currently only collected and reported at the service level (or, for up to about a quarter of all services, not reported at all or of sufficient quality). Because some Indigenous-specific primary health-care services operate at multiple service locations, these data are not available for all service locations. Service locations are often far apart, and the capacity of each location will be critical to the care the local population is able to access. The collection of these data at the level of service location would enable the construction of more precise measures of access to Indigenous-specific health-care services taking the capacity of individual service locations into account.

Third, it is important to note that the analyses of access to maternal and antenatal services and diabetes management only focused on the availability of these services at ISPHCS locations. Aboriginal and Torres Strait Islander people may also access these types of services at other service locations.

3 Findings

Findings from this project are structured around the following 4 stages of work:

1. Distribution of Indigenous-specific primary health-care services (ISPHCS) relative to the Aboriginal and Torres Strait Islander population
2. Areas identified as having poor access to primary health-care services with respect to ISPHCS and GP services in general ('service gap areas')
3. Maternal and child health
4. Diabetes management.

Maps and tables related to these 4 stages are presented in Sections 3.1–3.4 below. In the map legends, numbers within brackets refer to the number of areas in each category.

More detailed maps of the smaller service gap areas are included in Appendix A along with other additional findings and background information.

Appendix B and Appendix C contain detailed notes on data sources and methodology respectively.

3.1 Geography of primary health-care services

The maps and tables in this section show the geographic distribution of ISPHCSs funded by the Australian Government compared with the distribution of the Aboriginal and Torres Strait Islander population.

Overview of findings:

- *Very remote* areas have the most ISPHCS locations per person, but many Aboriginal and Torres Strait Islander people live far from their nearest service location in these areas.

Table 3.1.1 shows the distribution of ISPHCS locations and the Aboriginal and Torres Strait Islander population across the remoteness areas of the ASGS. It also presents the service location to population ratio for each remoteness area.

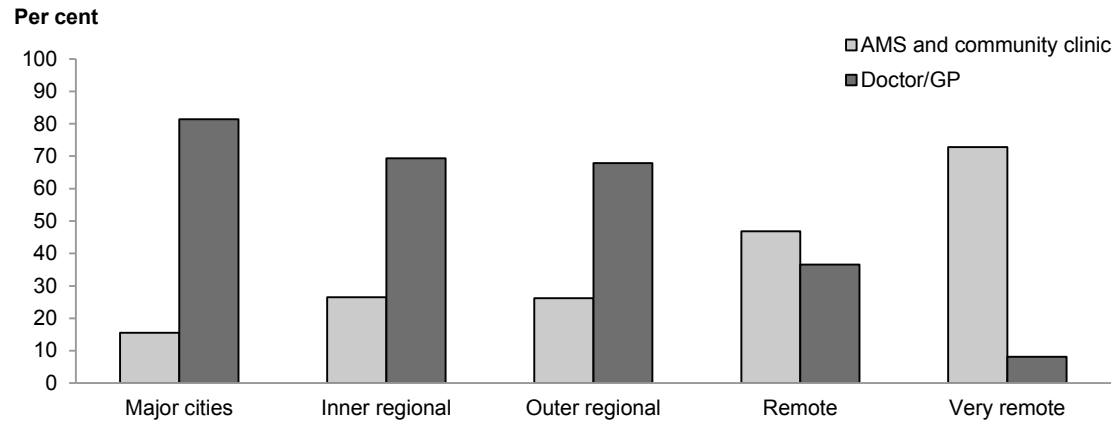
Table 3.1.1: ISPHCS locations and Aboriginal and Torres Strait Islander population across remoteness areas

Remoteness area	Number of ISPHCS locations	Percentage of all ISPHCS locations	Indigenous population	Percentage of Indigenous population	ISPHCS locations per 1,000 Indigenous people
Major cities	38	11.8	233,100	34.8	0.2
Inner regional	58	18.0	147,700	22.0	0.4
Outer regional	64	19.8	146,100	21.8	0.4
Remote	51	15.8	51,300	7.7	1.0
Very remote	112	34.7	91,600	13.7	1.2
Australia	**323**	**100**	**669,881**	**100**	**0.5**

Source: AIHW analysis of 2012–13 OSR and nKPI data collections; ABS 2013.

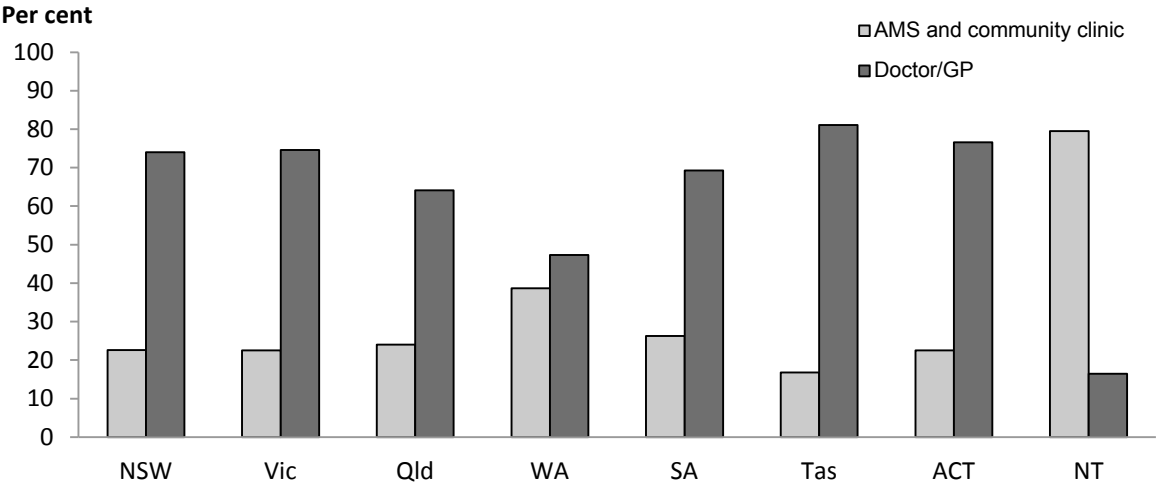
Data from the ABS 2012–13 Australian Aboriginal and Torres Strait Islander Health Survey suggests that the proportion of Aboriginal and Torres Strait Islander people who report using Aboriginal Medical Services (AMS) or community controlled health services for their regular source of health care is highest in *Very remote* areas and lowest in *Major cities* (Figure 3.1.1); and highest in the Northern Territory (Figure 3.1.2).

Some caution is needed when interpreting these data as respondents may not clearly differentiate between an AMS and a community clinic or between a doctor at an AMS or another practice (it is estimated that 3% of those who usually went to a 'doctor' went to an AMS doctor) (AHMAC 2015).



Source: AIHW analysis of ABS Australian Aboriginal and Torres Strait Islander Health Survey 2012–13 (2012–13 NATSIHS component).

Figure 3.1.1: Types of regular health care used by Indigenous Australians, by remoteness, 2012–13



Source: AIHW analysis of ABS Australian Aboriginal and Torres Strait Islander Health Survey 2012–13 (2012–13 NATSIHS component).

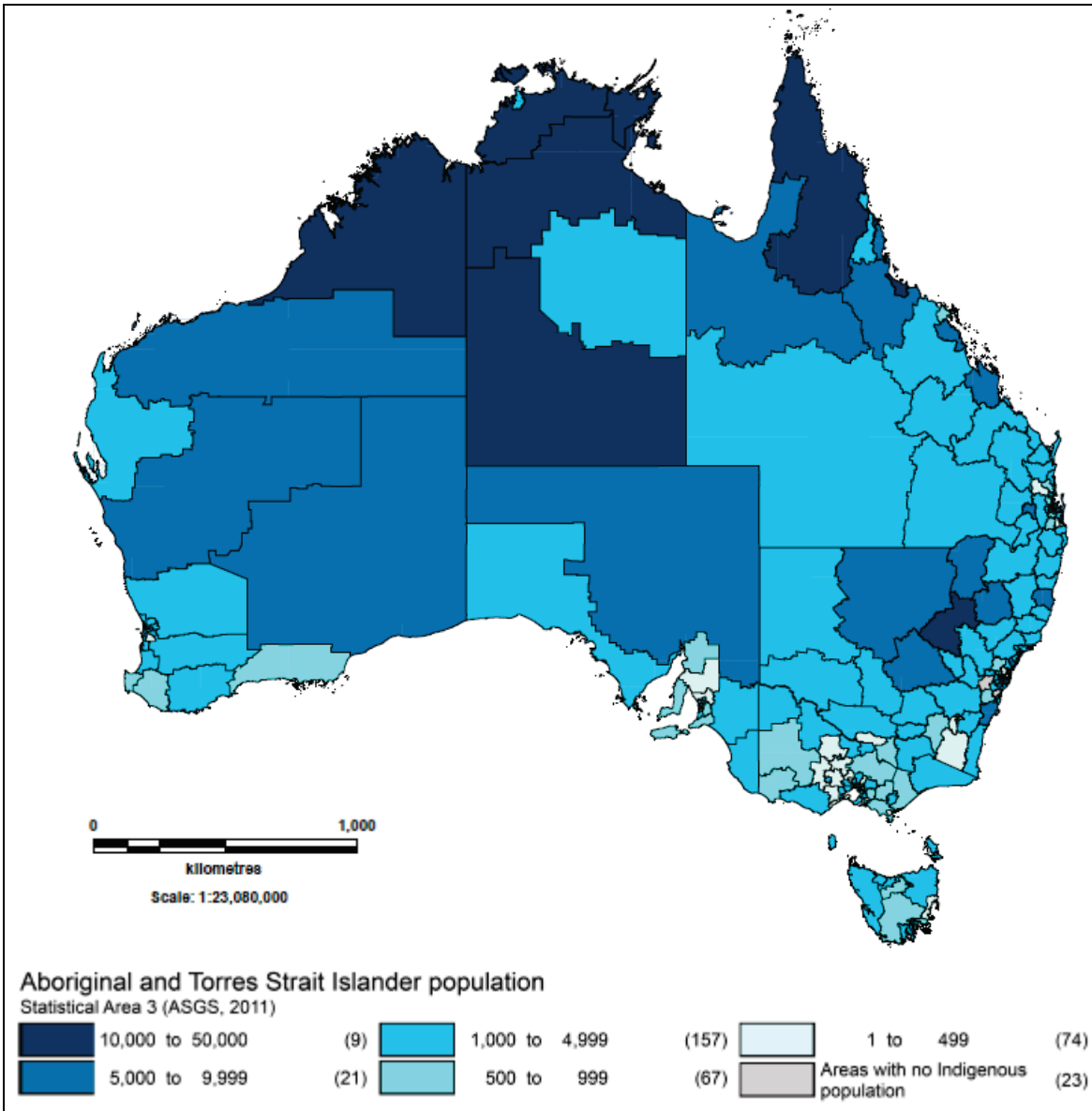
Figure 3.1.2: Types of regular health care used by Indigenous Australians, by state/territory, 2012–13

Distribution of the Aboriginal and Torres Strait Islander population

Local need for Indigenous-specific health-care services depends on the distribution of Aboriginal and Torres Strait Islander people across Australia.

Map 3.1.1 shows the Aboriginal and Torres Strait Islander population presented as the number of people living in each SA3 (colour coded). Note that this is not a map of population density and that SA3s are much smaller in densely populated areas around cities and towns than in the less densely populated *Remote* and *Very remote* areas.

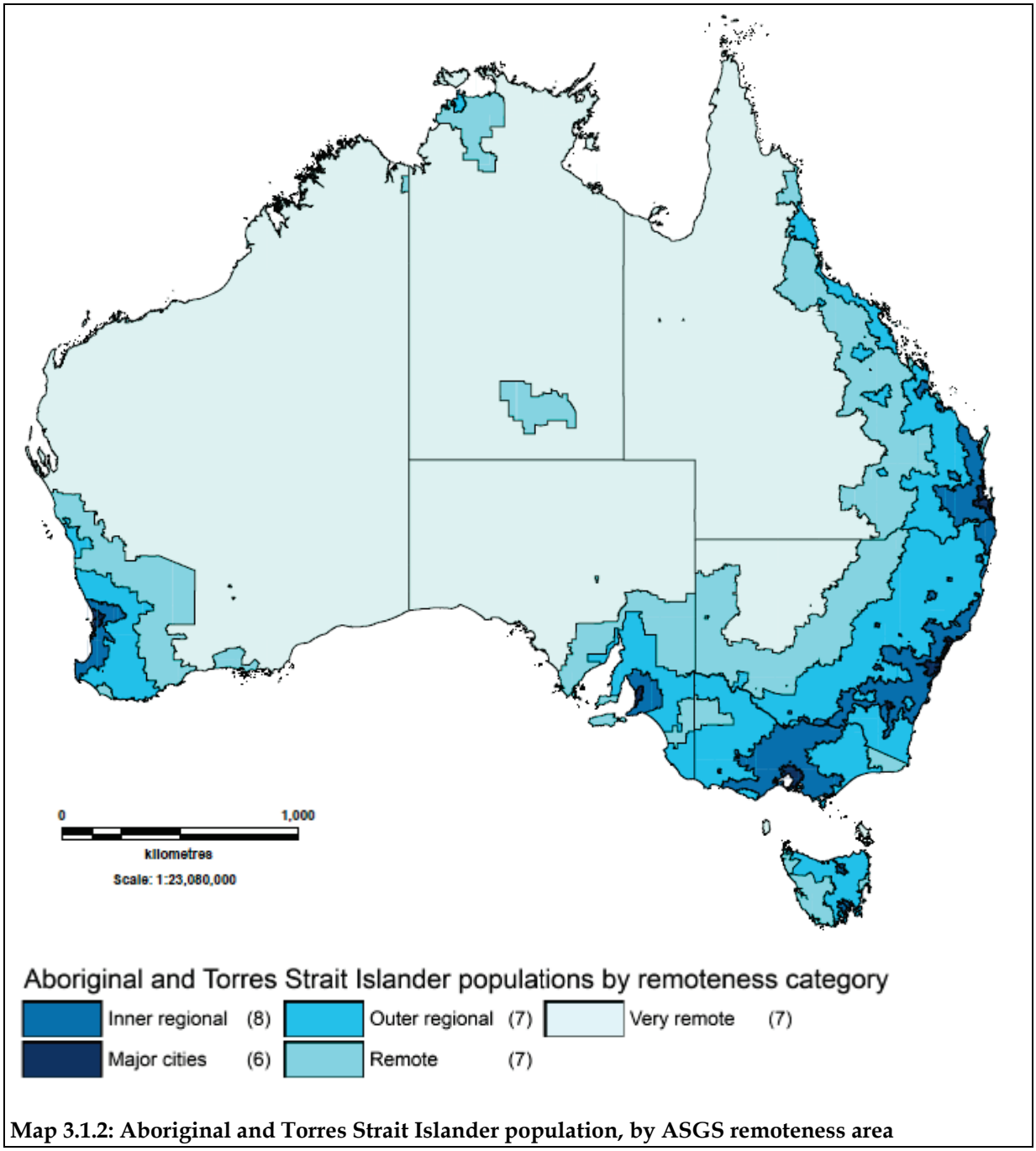
- The largest Aboriginal and Torres Strait Islander populations in eastern Australia are located in far north Queensland and in central New South Wales.
- A similar distribution of the Aboriginal and Torres Strait Islander population by remoteness is observed for the central and western states of Australia with large populations in *Very remote* parts of the Northern Territory and Western Australia.
- Areas with the densest Aboriginal and Torres Strait Islander populations are located within the much smaller SA3s of *Major cities*, *Inner regional* and *Outer regional* areas, rather than in *Remote* and *Very remote* Australia.



Map 3.1.1: Aboriginal and Torres Strait Islander population, by SA3

The ABS's remoteness classification is often used to describe large-scale variation in access to service centres. Map 3.1.2 displays the distribution of Aboriginal and Torres Strait Islander people by ASGS remoteness category (2011).

- Many more Aboriginal and Torres Strait Islander people live in *Major cities*, *Inner regional* and *Outer regional* areas than in *Remote* and *Very remote* areas. Urban areas are much more densely populated by Aboriginal and Torres Strait Islander people than remote areas.
- More than 140,000 Aboriginal and Torres Strait Islander people live in *Remote* and *Very remote* areas.



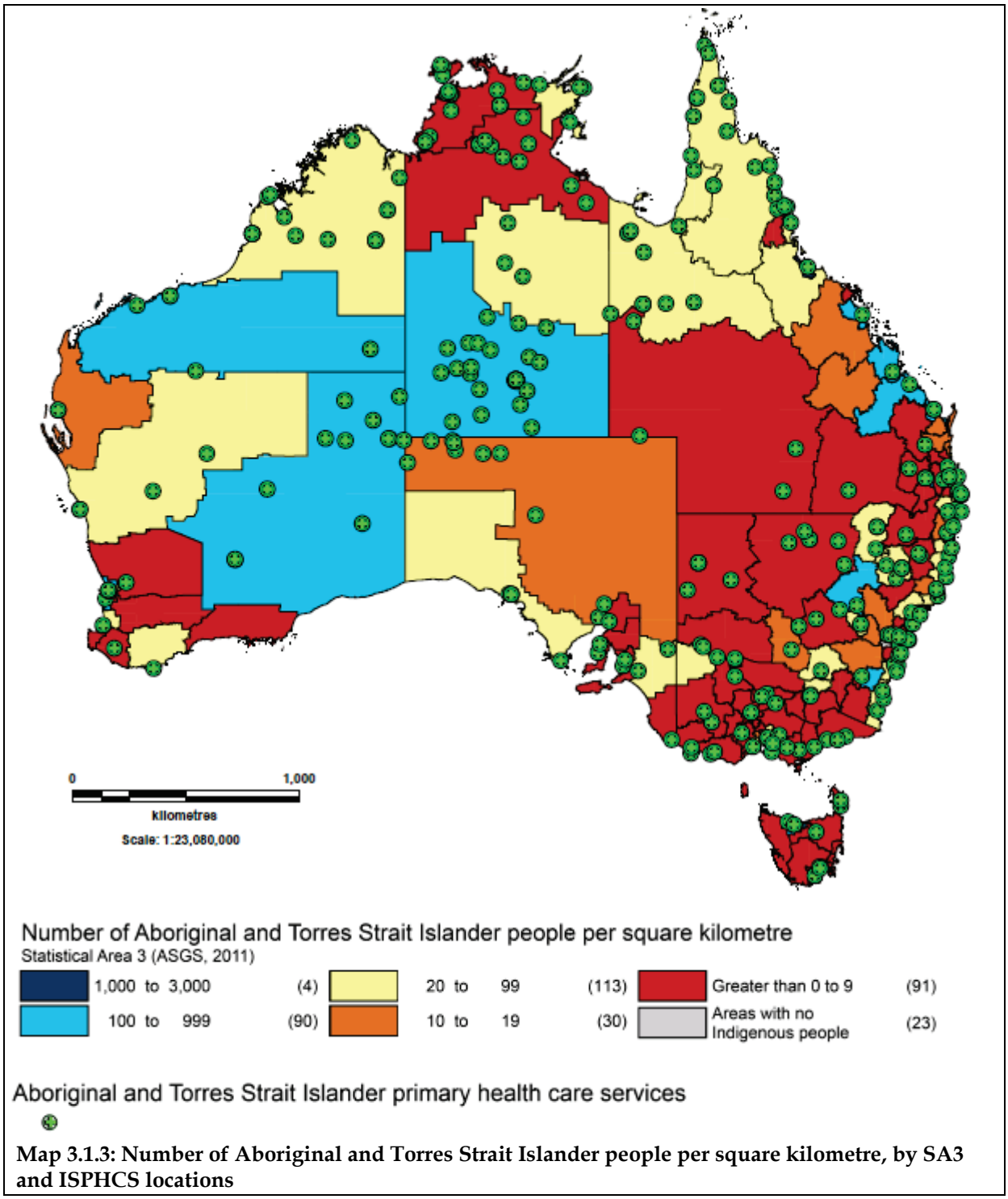
Map 3.1.2: Aboriginal and Torres Strait Islander population, by ASGS remoteness area

Aboriginal and Torres Strait Islander population density and the locations of ISPHCSs

Demand on local services depends on population density.

Map 3.1.3 shows the number of Aboriginal and Torres Strait Islander people per square kilometre by SA3 and the locations of ISPHCSs for 2012–13.

- The most densely populated areas (population density above 1 per square kilometre) are all small SA3s in and around cities and big towns.
- SA3s in regional and remote areas fall into 2 categories with respect to the density of the Aboriginal and Torres Strait Islander population—areas with more than 10 Aboriginal and Torres Strait Islander people per square kilometre and areas with fewer than 10 Aboriginal and Torres Strait Islander people per square kilometre.
- The distribution of ISPHCS locations tends to follow that of the Aboriginal and Torres Strait Islander population—more densely populated areas generally have more service locations than less densely populated areas.
- Most of the comparatively densely populated parts of regional and remote areas in Queensland, New South Wales, the Northern Territory and Western Australia appear to be relatively well-covered by ISPHCS locations.
- Service locations appear to cluster around areas with the greatest number of Aboriginal and Torres Strait Islander people, most notably in *Remote* and *Very remote* areas such as central Northern Territory, northern Western Australia and north-western South Australia (note that the APY Lands in the north-western corner of South Australia are more densely populated than the rest of the SA3).
- Some regions, including eastern Queensland and south-western Western Australia, have some relatively densely-populated areas with few nearby service locations.

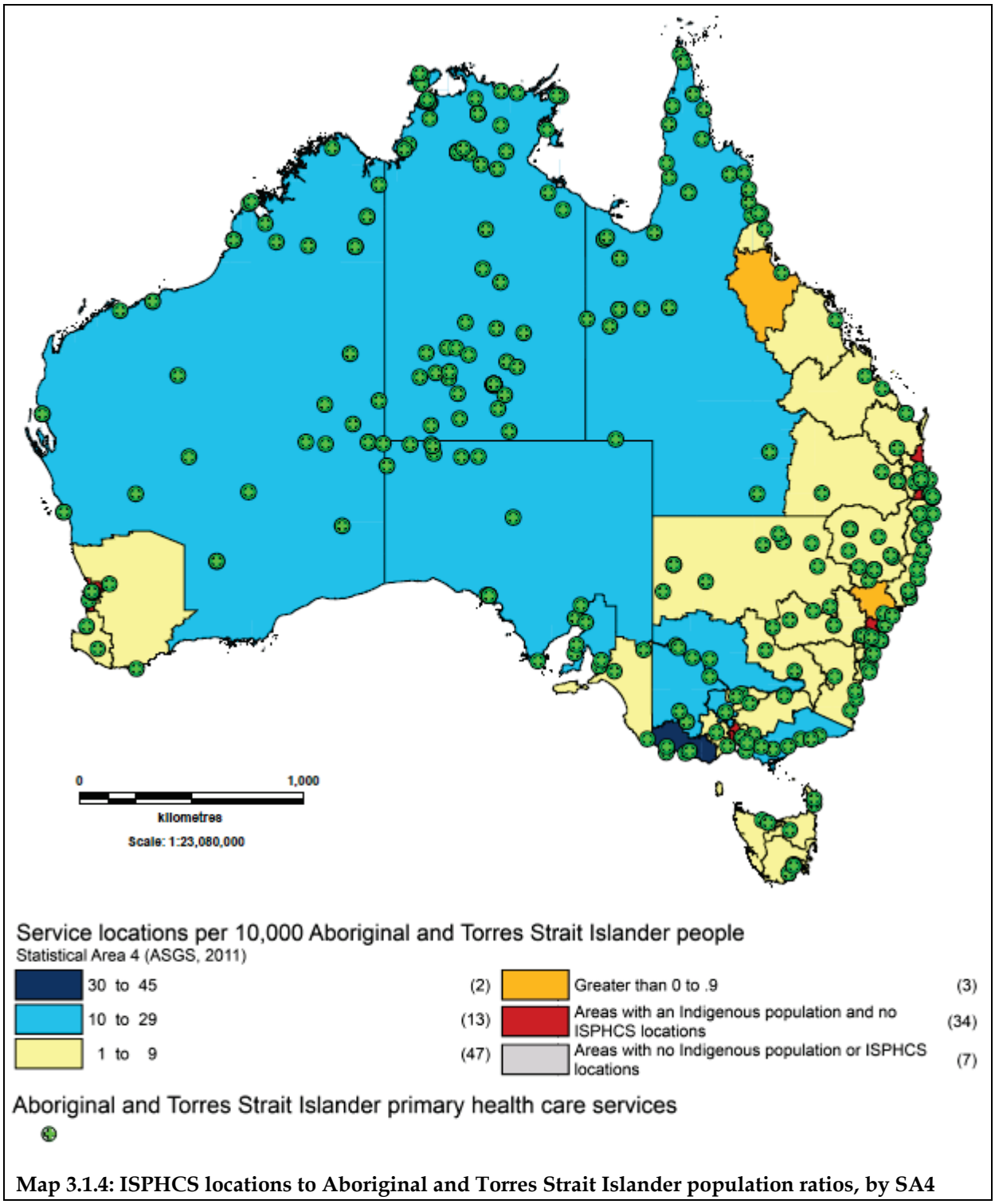


Map 3.1.3: Number of Aboriginal and Torres Strait Islander people per square kilometre, by SA3 and ISPHCS locations

Services to population ratios

ISPHCS locations to population ratios indicate the general availability of these services. Map 3.1.4 shows the ISPHCS locations to Aboriginal and Torres Strait Islander population ratios by SA4 as well as the locations of ISPHCS.

- ISPHCS locations to population ratios tend to be low in the small SA4s around big cities, but these areas generally have good access to other GP services and people have the option of travelling to services in nearby areas.
- The large SA4s in remote areas generally have relatively high ISPHCS locations to population ratios, but many people in these areas still live a long way from their nearest service location (see also Map 3.1.6).



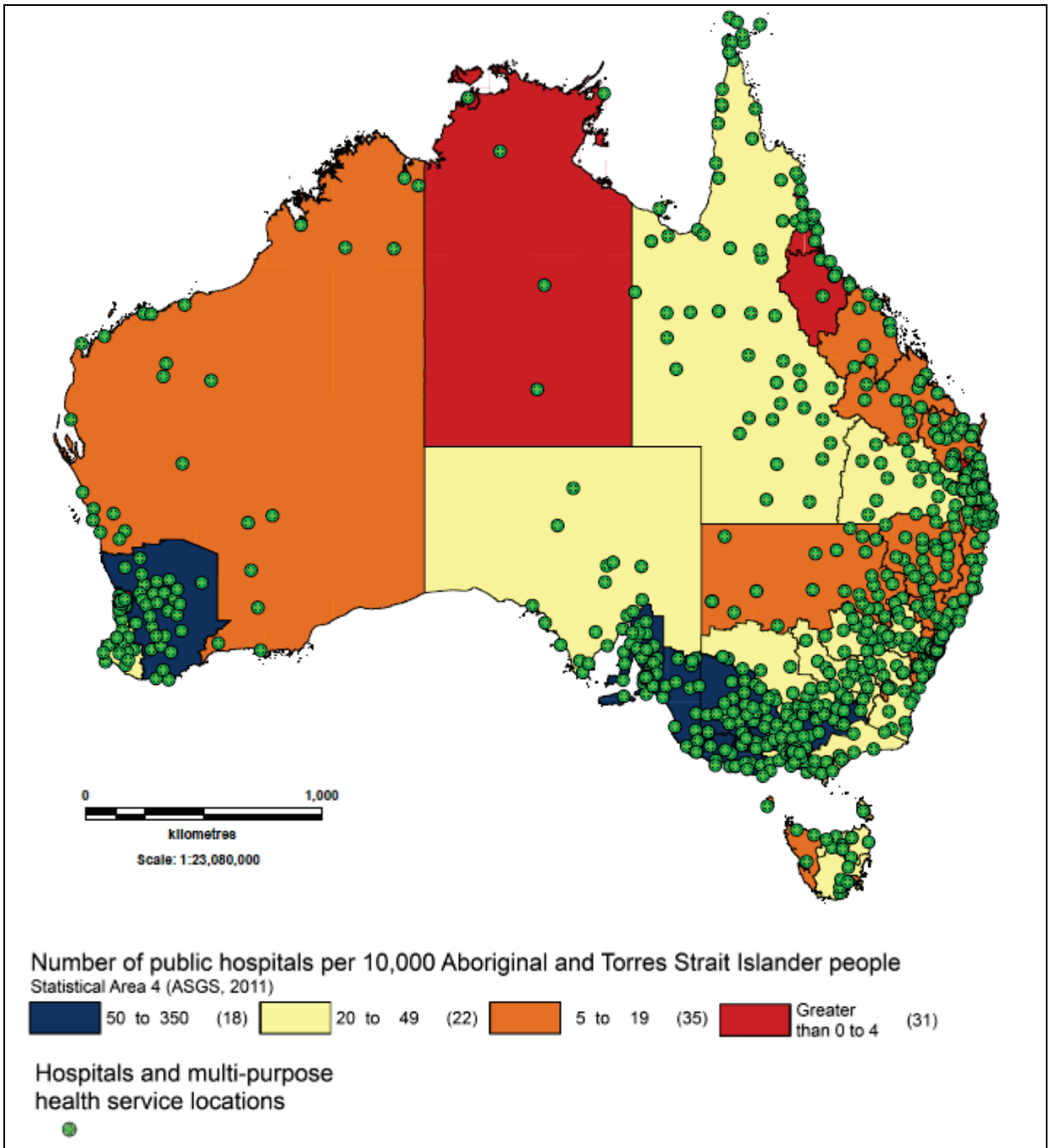
Map 3.1.4: ISPHCS locations to Aboriginal and Torres Strait Islander population ratios, by SA4

Number of public hospital locations to Aboriginal and Torres Strait Islander population ratios

Hospitals to population ratios (expressed as number of public hospitals per 10,000 Aboriginal and Torres Strait Islander population) indicate the general availability of these services.

Map 3.1.5 shows the locations of all public hospitals, including multi-purpose health services. It also shows the number of hospital locations to Aboriginal and Torres Strait Islander population ratios by SA4. Note that there is a very large variation in the capacity of each service. For example, a big city hospital is a very different service provider to a small multi-purpose health service in a small regional or remote town.

- The number of public hospitals per Aboriginal and Torres Strait Islander person is much higher in major cities than in remote and very remote areas.
- The distribution of the Aboriginal and Torres Strait Islander population in the Northern Territory means that relatively few seek services at the public hospitals located in the Northern Territory.



Source: MyHospitals website (data provided by AIHW on public hospitals).

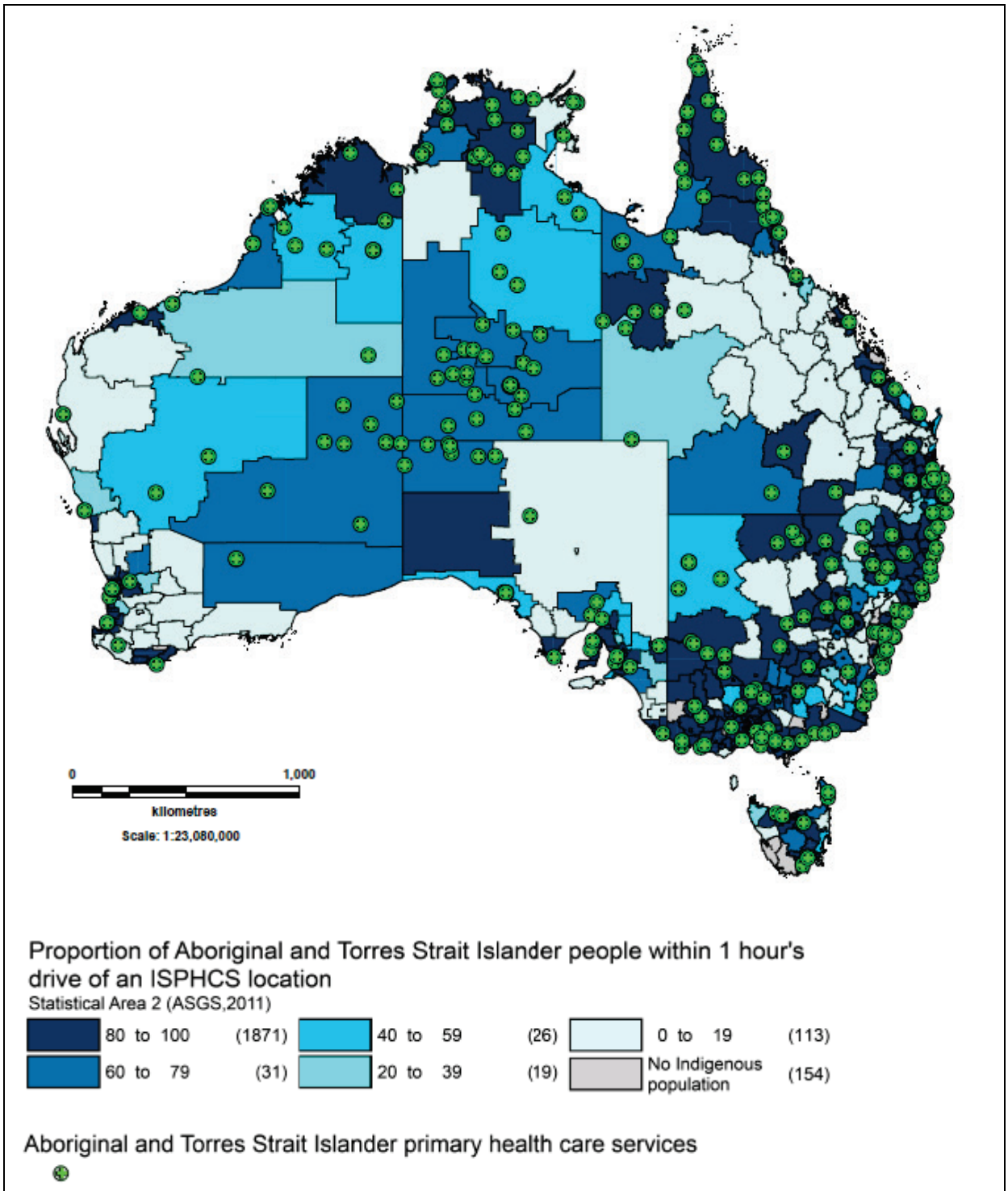
Map 3.1.5: Public hospital and multi-purpose health service locations to Aboriginal and Torres Strait Islander population ratios (number of public hospitals per 10,000 Aboriginal and Torres Strait Islander people), by SA4

Drive time to Indigenous-specific primary health-care services

The traditional way of illustrating variation in access with services to population ratios (as in maps 3.1.4 and 3.1.5) is of limited value as people in areas with high ratios can still have poor access because they live far from their nearest service location. Local measures that take into account how far people have to travel to access services can be more informative.

Map 3.1.6 shows the proportion of Aboriginal and Torres Strait Islander people in each SA2 who live within 1 hour's drive of their nearest ISPHCS location. It also shows the locations of ISPHCSs.

- Many of the SA2s where a majority of Aboriginal and Torres Strait Islander people do not live within 1 hour's drive of their nearest ISPHCS location are located in eastern and central Queensland; in central New South Wales; northern, central and south-eastern South Australia; and in western and south-western Western Australia.
- While close to 100% of Aboriginal and Torres Strait Islander people in *Major cities* live close to their nearest ISPHCS location, only 47% of Aboriginal and Torres Strait Islander people in *Very remote* areas live within 1 hour's drive of their nearest ISPHCS location.



Map 3.1.6: Proportion of the Aboriginal and Torres Strait Islander population within 1 hour's drive of an ISPHCS location, by SA2

3.2 Service gap areas

Aboriginal and Torres Strait Islander people can use Indigenous-specific health-care services as well as other primary health-care services. The most serious lack of access to primary health care is likely to occur in areas where access to both Indigenous-specific and other GP services is limited.

This section identifies areas where Aboriginal and Torres Strait Islander people live far from the nearest ISPHCS location and where access to GPs in general is also very poor. Areas with poor access to services and large Aboriginal and Torres Strait Islander populations should be strong candidates for increased investment in primary health-care services.

This section also includes results of analyses of rates of potentially preventable hospitalisations (PPH) for Aboriginal and Torres Strait Islander people living in the areas identified as having poor access to primary health-care services—health outcomes that signal unmet need for primary health care.

Overview of findings:

- There are 40 SA2s where 0% of Aboriginal and Torres Strait Islander people live within 1 hour's drive of their nearest ISPHCS location and where access to GPs in general is very poor (bottom 2 deciles of the AIHW's ARN index).
- 11 of the 40 service gap SA2s have Aboriginal and Torres Strait Islander populations of more than 600: 8 SA2s in Queensland, 2 in New South Wales and 1 in Western Australia.
  - Most service gap SA2s with a sizeable Aboriginal and Torres Strait Islander population are in Queensland.
  - The Torres Strait Islands, Torres, and Central Highlands East in Queensland, and Ashburton in Western Australia, are service gap SA2s with large Aboriginal and Torres Strait Islander populations (more than 1,200 Aboriginal and Torres Strait Islander people).
- Examination of GP services that were not part of the OSR or nKPI data collections (for example, state-funded services and very new services with GPs) revealed an additional 17 primary health-care services inside service gap SA2s or in adjacent SA2s.
- These additional services are likely to improve access significantly in 3 of the 40 identified service gap areas (Palm Island in Queensland, Tasmania's West Coast and the Exmouth area of Western Australia).
- 61% of the service gap SA2s have high rates of PPH (rates above the median for all SA2s).

Indigenous-specific and other primary health-care services

The proportion of the available primary health-care services (PHCS) that are ISPHCSs varies greatly between ASGS remoteness areas and between states and territories. Tables 3.2.1a and 3.2.1b show the distribution of ISPHCS locations across remoteness areas and states and territories compared with that of all GP and ISPHCS locations combined. ISPHCS locations make up a much higher proportion in *Very remote* and *Remote* areas than in other remoteness areas. This is also reflected by the very high proportion of PHCS locations that are ISPHCS locations in the Northern Territory.

Table 3.2.1a: Primary health-care service locations and Indigenous-specific primary health-care service locations, by remoteness area

	Total number of GP and ISPHCS locations	Number of ISPHCS locations	Percentage of locations that are ISPHCSs
Major cities	5,383	38	0.7
Inner regional	1,369	58	4.2
Outer regional	742	64	8.6
Remote	160	51	31.9
Very remote	157	112	71.3
Australia	**7,811**	**323**	**4.1**

Source: AIHW analysis of 2012–13 OSR.

Table 3.2.1b: Primary health-care service locations and Indigenous-specific primary health-care service locations, by state or territory

	Total number of GP and ISPHCS locations	Number of ISPHCS locations	Percentage of locations that are ISPHCSs
NSW	2,996[(a)]	78[(a)]	2.6
Vic	1,774	28	1.6
Qld	1,469	58	3.9
WA	636	48	7.5
SA	545	23	4.2
Tas	169	9	5.3
ACT	83	1	1.2
NT	139	78	56.1
Australia	**7,811**	**323**	**4.1**

(a) Includes 1 service in Jervis Bay

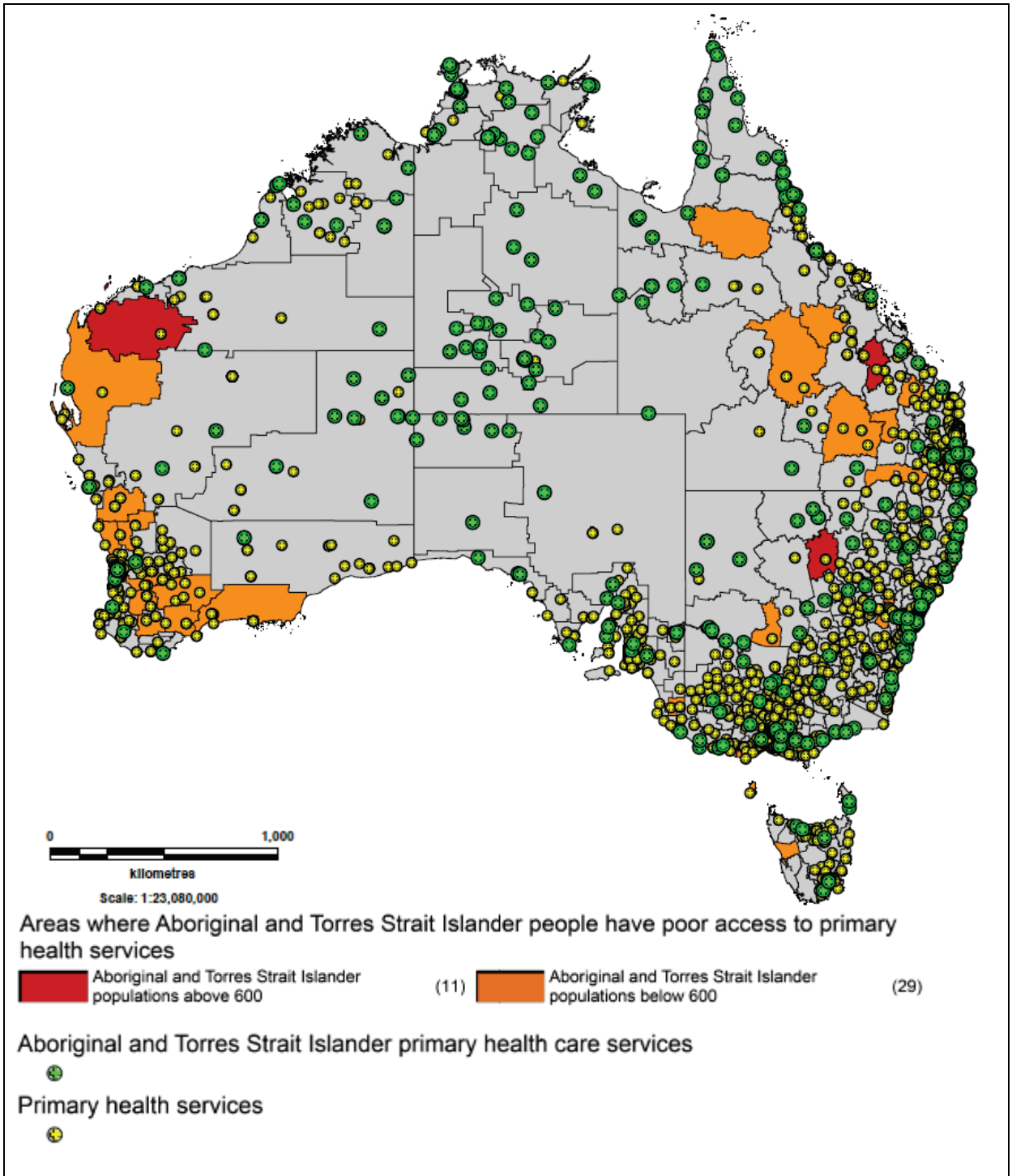
Source: AIHW analysis of 2012–13 OSR.

Indigenous primary health-care service gap areas

Map 3.2.1 shows the SA2s that have been identified as primary health-care service gap areas for Aboriginal and Torres Strait Islander people. Whether the Aboriginal and Torres Strait Islander population of a service gap SA2 is larger or smaller than 600 is indicated by colour.

- There are 40 SA2s where 0% of Aboriginal and Torres Strait Islander people live within 1 hour's drive of their nearest ISPHCS location and where access to GPs in general is very poor (in the bottom 2 deciles of the AIHW's ARN index).
- Central and south-eastern Queensland and western and south-western Western Australia are standout regions with high concentrations of service gap SA2s (16 and 12 service gap SA2s respectively).
- 11 of the 40 service gap SA2s have Aboriginal and Torres Strait Islander populations of more than 600: 8 SA2s in Queensland, 2 in New South Wales and 1 in Western Australia.
  - Most service gap SA2s with a sizeable Aboriginal and Torres Strait Islander population (more than 600) are in Queensland. In particular, the Torres Strait Islands, Torres and Central Highlands East in Queensland, and Ashburton in Western Australia, are service gap SA2s with large Aboriginal and Torres Strait Islander populations (more than 1,200).
  - While Palm Island in Queensland was also an area identified as a service gap SA2, with a large Aboriginal and Torres Strait Islander population, the opening of a new GP clinic in November 2013 has recently improved access to GPs on the island (see 'Service gap areas and additional services' on p. 23). This means that Palm Island would be unlikely to be considered a service gap area if an updated version of the ARN index were used as a measure of access to GPs.
- GP services, including GP locations operated by the Royal Flying Doctor Service (RFDS), in the Torres Strait (Torres Strait Islands and Torres SA2s) were accounted for in the ARN index. However, some islands in the Torres Strait have services without permanent GPs, run by Queensland Health. The impact of these services on access to primary health care was not assessed in this study.
- For a more detailed description of the service gap SA2s and how they were identified, see Map A.1 in Appendix A. More detailed maps of the smaller service gap SA2s can also be found in the same appendix.

Table 3.2.2 lists all 40 service gap SA2s and their Aboriginal and Torres Strait Islander population size.



Map 3.2.1: Service gap areas (areas where Aboriginal and Torres Strait Islander people have poor access to primary health-care services), by SA2

Table 3.2.2: Service gap SA2s (ERP) with low access to both Indigenous-specific health-care services and GPs, by size of the Aboriginal and Torres Strait Islander population

SA2 Name	SA2 Code	State	Indigenous population
Torres Strait Islands	315011402	Qld	4304
Torres	315011401	Qld	2587
Palm Island[(a)]	318011466	Qld	2447
Central Highlands - East	308011190	Qld	1476
Ashburton (WA)	508061218	WA	1214
Maryborough (Qld)	319051524	Qld	1049
Charters Towers	318011462	Qld	1018
Nyngan - Warren	105011095	NSW	938
Bowen	312011337	Qld	845
Roma	307011176	Qld	787
Lithgow	103031070	NSW	699
Pialba - Eli Waters	319041518	Qld	581
Narrogin	509031249	WA	493
Moora	509021241	WA	458
Roma Region	307011177	Qld	431
Lithgow Region	103031071	NSW	391
West Coast (Tas.)[(a)]	604031097	Tas	391
Barcaldine - Blackall	315031408	Qld	352
Kojonup	509011231	WA	340
Exmouth[(a)]	508021197	WA	332
Monto - Eidsvold	319021508	Qld	328
Brookton	509031246	WA	318
Morawa	508051216	WA	317
Gympie - South	319031513	Qld	211
Inglewood - Waggamba	307011174	Qld	206
Kulin	509031247	WA	206
Gingin - Dandaragan	509021239	WA	206
Hay	109021177	NSW	203
Gnowangerup	509011229	WA	178
Cooloola	319031511	Qld	174
Oberon	103011061	NSW	169
Esperance Region	508011195	WA	165
Granville	319051523	Qld	149
Miles - Wandoan	307011175	Qld	147
Croydon - Etheridge	315011397	Qld	128
Wagin	509031250	WA	119
Clermont	312011339	Qld	111
Otway	217021431	Vic	59
King Island	604031093	Tas	39
Naracoorte Region	407021155	SA	29

(a) Palm Island, West Coast Tasmania and Exmouth are SA2s in which examination of additional GP services (State-funded and very new services with GPs) indicated that access is better than originally estimated (for example, Palm Island has recently had a new GP clinic opened).

Service gap area and potentially preventable hospitalisations (PPHs)

Analysis undertaken by the AIHW showed that 61% of the service gap SA2s have high rates of PPH (PPH rates above the median for all SA2s). PPHs are hospitalisations that signal unmet need for primary health care. They depend not only on access to primary health-care services but also on many other factors, including characteristics of the population in question. Populations in service gap areas with high PPH rates are likely to both experience poor access to primary health-care services and to have a high need for more effective primary health care. However, it is important to note that PPH rates in areas with very small populations will be very sensitive to random fluctuations in PPH rates.

Service gap areas and additional services

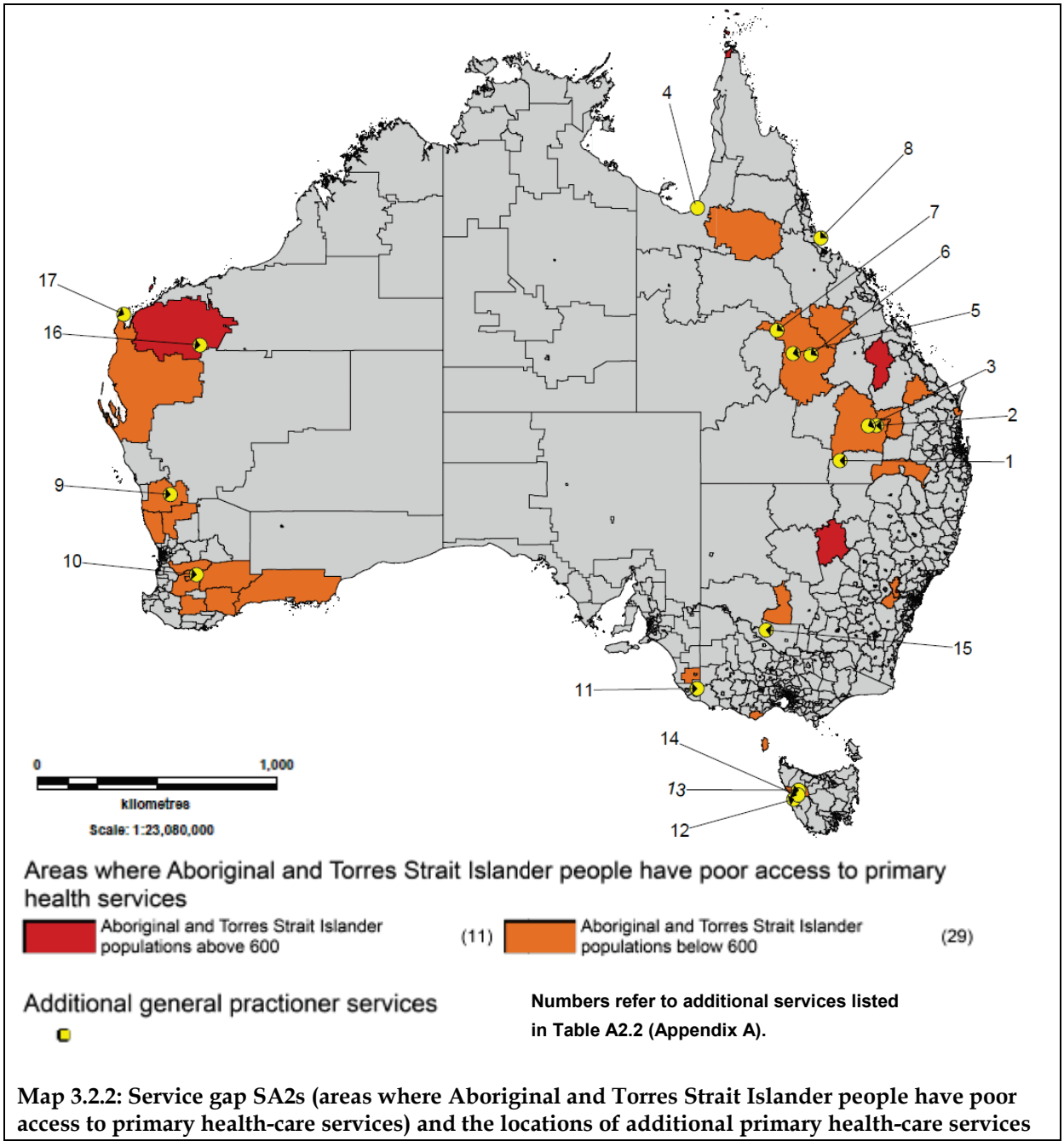
The service gap SA2s identified in Map 3.2.1 were defined based on the locations of ISPHCSs taking part in the OSR and/or nKPI reporting data collections and the locations of all GPs as listed by the Australasian Medical Publishing Company (AMPCo) or reported by the RFDS in 2013 (when the AIHW's ARN index was constructed). This is not a complete collection of the primary health-care service locations that are accessible to Aboriginal and Torres Strait Islander people. For example, any state-funded Indigenous-specific service that is not partaking in the OSR or nKPI data collections, or any very new GP services, would not have been included in the analysis.

To determine whether there are any additional services that are likely to have a substantial impact on Aboriginal and Torres Strait Islander people's access to primary health care in the identified service gap SA2s, the National Health Service Directory <http://www.nhsd.com.au/> and state/territory websites were used to identify services located inside or close to service gap SA2s.

See Section A2 of Appendix A for more information about the additional services and their likely influence on service gap SA2s.

Map 3.2.2 shows the service gap SA2s and the locations of additional primary health-care services. This shows the following:

- Seventeen additional services, listed as 'General practice services' in the National Health Service Directory, were found inside service gap SA2s or in adjacent SA2s.
- The additional services are likely to have a substantial positive impact on access to primary health care in 3 of the 40 service gap areas: Palm Island in Queensland (for which access to GPs has recently improved with the opening of a new GP clinic in November 2013), West Coast in Tasmania and Exmouth in Western Australia.



Map 3.2.2: Service gap SA2s (areas where Aboriginal and Torres Strait Islander people have poor access to primary health-care services) and the locations of additional primary health-care services

3.3 Maternal and child health

This section shows the distribution of all OSR services that provide maternal and/or antenatal services.

Overview of findings:

- 226 of 323 ISPHCS locations are operated by OSR services offering both maternal and antenatal services.
- 245 of 323 service locations offer maternal services and 236 offer antenatal services.
- ISPHCS locations without maternal and antenatal services are not concentrated in any specific region.
- Tasmania, Cape York (Queensland), the APY Lands (South Australia) and the Leinster-Leonora SA2 (Western Australia) are areas where the existing Indigenous-specific health-care services have relatively good outcomes with respect to birthweight and immunisation rates.
- The Kimberley region (Western Australia) and north-western Queensland are areas where the existing services have relatively poor outcomes with respect to low birthweight (less than 2,500 g) and immunisation rates (no services in the 'high' category of the composite measure of birthweight and immunisation rates presented in Map 3.3.2).

Table 3.3.1 shows the distribution of OSR service locations with both antenatal and maternal care across states and territories. It also shows the number of OSR service locations with both antenatal and maternal care per 1,000 Aboriginal and Torres Strait Islander people for each jurisdiction. The Northern Territory has the highest number per 1,000 Aboriginal and Torres Strait Islander people (0.86) and Queensland and the Australian Capital Territory the lowest (0.17 and 0.16). It is important to remember that care at other services will also be important to maternal and child health, and that ISPHCSs make up a much larger proportion of the available services in the Northern Territory than in any other jurisdiction (see Table 3.2.1b).

Table 3.3.1: ISPHCS locations operated by OSR services with both maternal and antenatal care, by state or territory

	Number of ISPHCS locations	ISPHCS locations with maternal and antenatal care	Percentage of ISPHCS locations with maternal and antenatal care	Indigenous population (ERP)	ISPHCS locations with mat and ant per 1,000 Indigenous people
NSW	78[(a)]	45[(a)]	57.7	208,476	0.22
Vic	28	18	64.3	47,333	0.38
Qld	58	32	55.2	188,954	0.17
WA	48	44	91.7	88,270	0.50
SA	23	20	87.0	37,408	0.53
Tas	9	6	66.7	24,165	0.25
ACT	1	1	100.0	6,160	0.16
NT	78	59	75.6	68,850	0.86
Australia	**323**	**226**	**70.0**	**669,881**	**0.34**

(a) Includes 1 service in Jervis Bay.

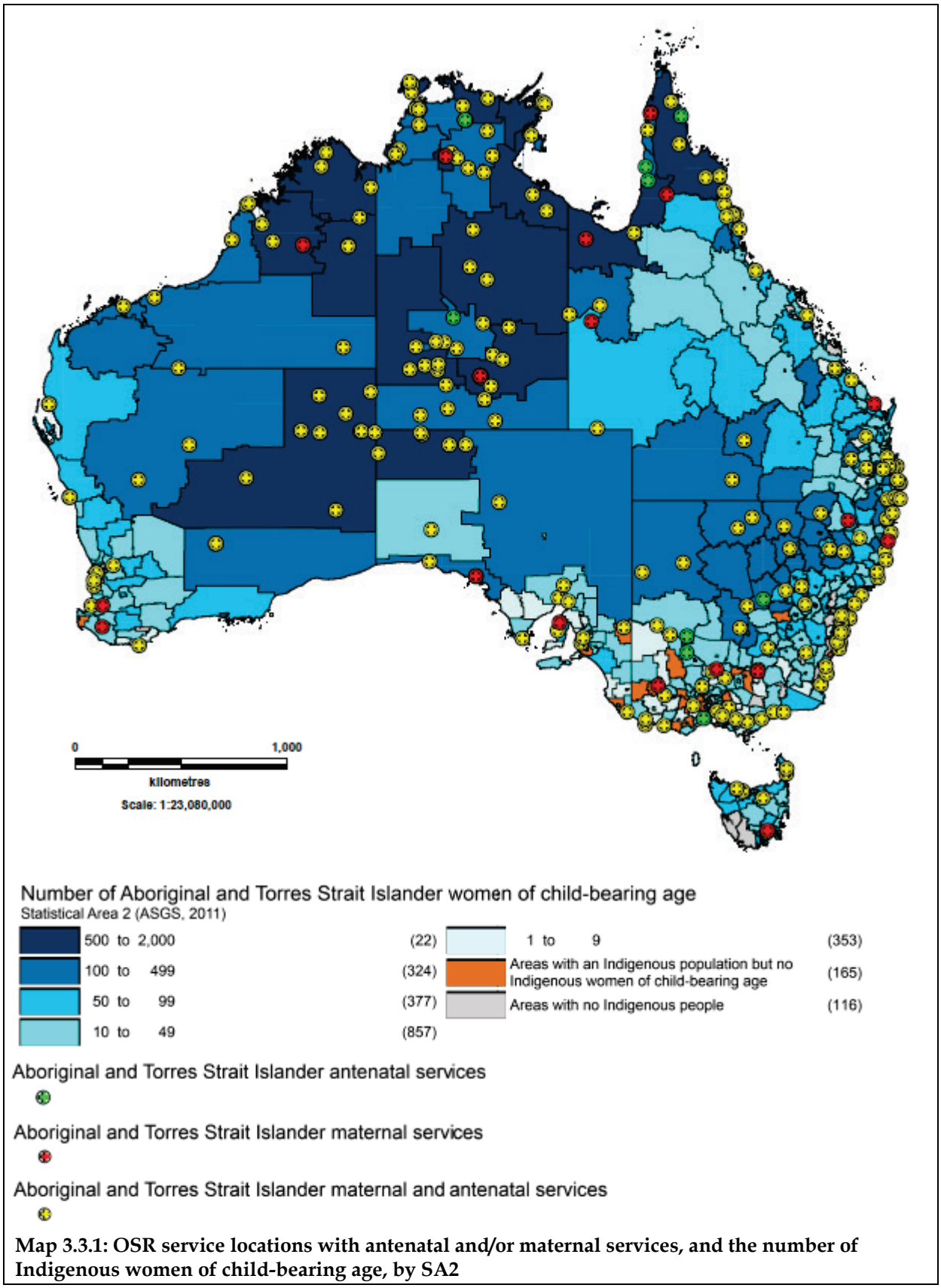
Source: AIHW analysis of OSR survey and ABS estimates of Aboriginal and Torres Strait Islander Australians, June 2011.

OSR service locations with antenatal and/or maternal services

Map 3.3.1 shows the locations of ISPHCSs that are OSR service locations with maternal and/or antenatal health services contrasted against the target population of Aboriginal and Torres Strait Islander women of child-bearing age (15–44). The Aboriginal and Torres Strait Islander population of young children is very small in many SA2s and, as a consequence, will show substantial year-to-year random variation. As the population of women of child-bearing age is normally larger, the size of this population is a more reliable predictor of the need for maternal and antenatal care over a few years.

It is clear from Map 3.3.1 that the areas with poor access to ISPHCSs with maternal and/or antenatal services are, to a great extent, the same areas that have been identified as service gap SA2s. Most areas with relatively large populations of Aboriginal and Torres Strait Islander women of childbearing age have at least some ISPHCSs with maternal and/or antenatal services.

- 226 of 323 ISPHCS locations are operated by OSR services offering both maternal and antenatal services.
- 245 of 323 offer maternal services and 236 antenatal services.
- The ISPHCS locations without maternal and antenatal services are not concentrated to any specific region.
- Central Queensland is a region where access is particularly poor. This is mainly because of the few ISPHCS locations in this region—not because of a large number of ISPHCS locations without maternal or antenatal services.

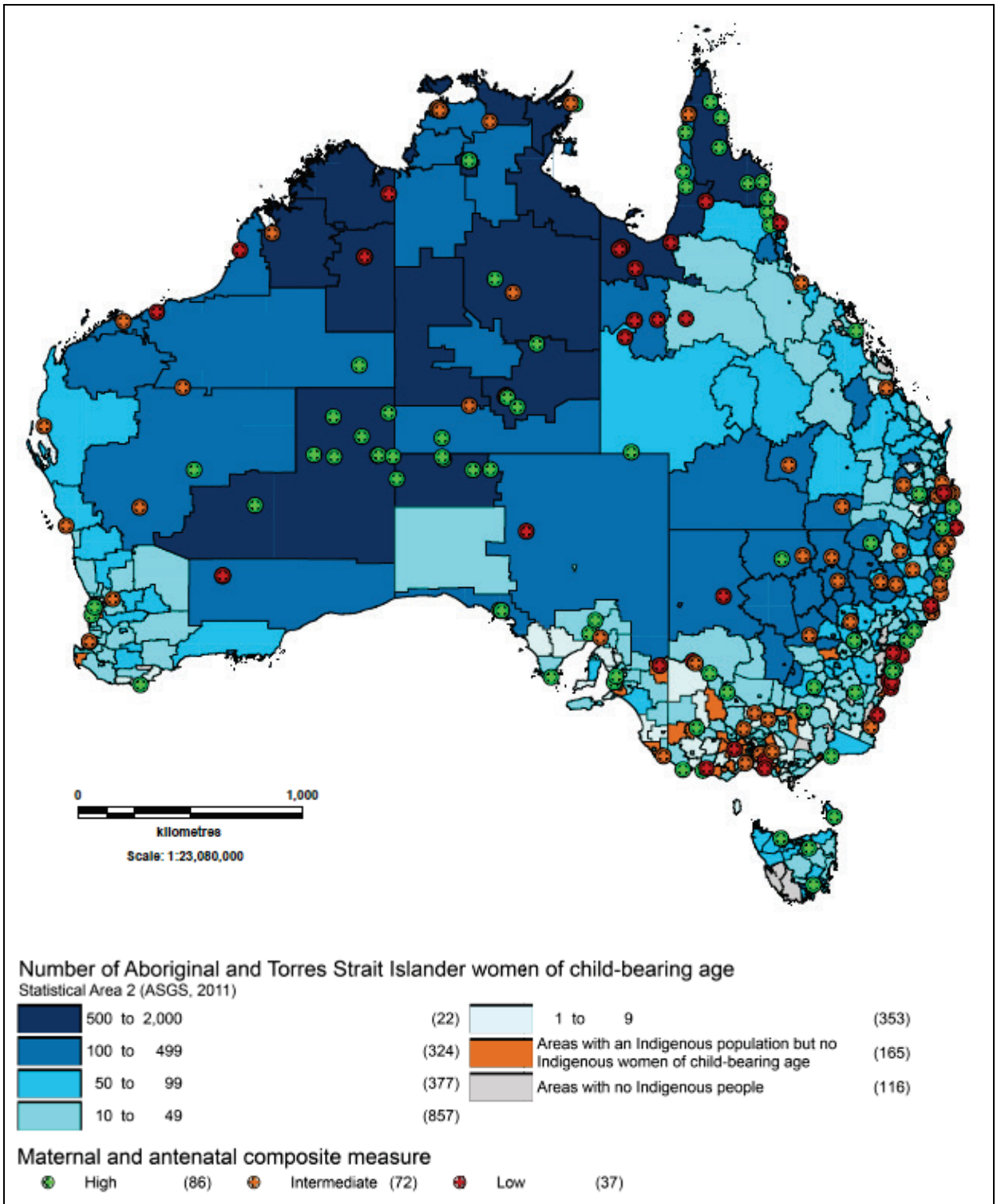


Map 3.3.1: OSR service locations with antenatal and/or maternal services, and the number of Indigenous women of child-bearing age, by SA2

Maternal and antenatal care service and health outcomes

Map 3.3.2 shows a composite measure of maternal and antenatal care service and health outcomes. The composite measure is based on proportions of babies with low birthweight and the proportion of fully immunised children aged 2 and 5 years. A high score indicates a desirable service outcome—that is, a low proportion of babies with low birthweight and a high proportion of immunised children. For more information of the composite measure, see Section A3 of Appendix A.

- Tasmania, Cape York (Queensland), the APY Lands (South Australia) and the Leinster-Leonora SA2 (Western Australia) are areas where the existing ISPHCSs have relatively good service and health outcomes with respect to immunisation and birthweight.
- The Kimberley region (Western Australia) and north-western Queensland are areas where the existing services have relatively poor service and health outcomes.
- The composite measure of maternal and antenatal care service and health outcomes shows no clear pattern by remoteness.



Map 3.3.2: Maternal and antenatal care composite measure (birthweight and child immunisation) by service location and number of Aboriginal and Torres Strait Islander women of childbearing age, by SA2

3.4 Diabetes management

This section focuses on the relationship between OSR services with diabetes specialists and/or educators, the Aboriginal and Torres Strait Islander target population for diabetes management, relevant nKPI process indicators (HbA1c levels and blood pressure checked), and PPH for diabetes complications. As for maternal and child care, it is important to note that there are a range of service providers, and a range of factors, that influence outcomes for Aboriginal and Torres Strait Islander people with diabetes.

ISPHCSs counted as having diabetes specialists and educators in this chapter are those that reported that they had diabetes specialists or diabetes educators in the 2012–13 OSR questionnaire. All services with diabetes specialists also had diabetes educators and vice versa.

Overview of findings:

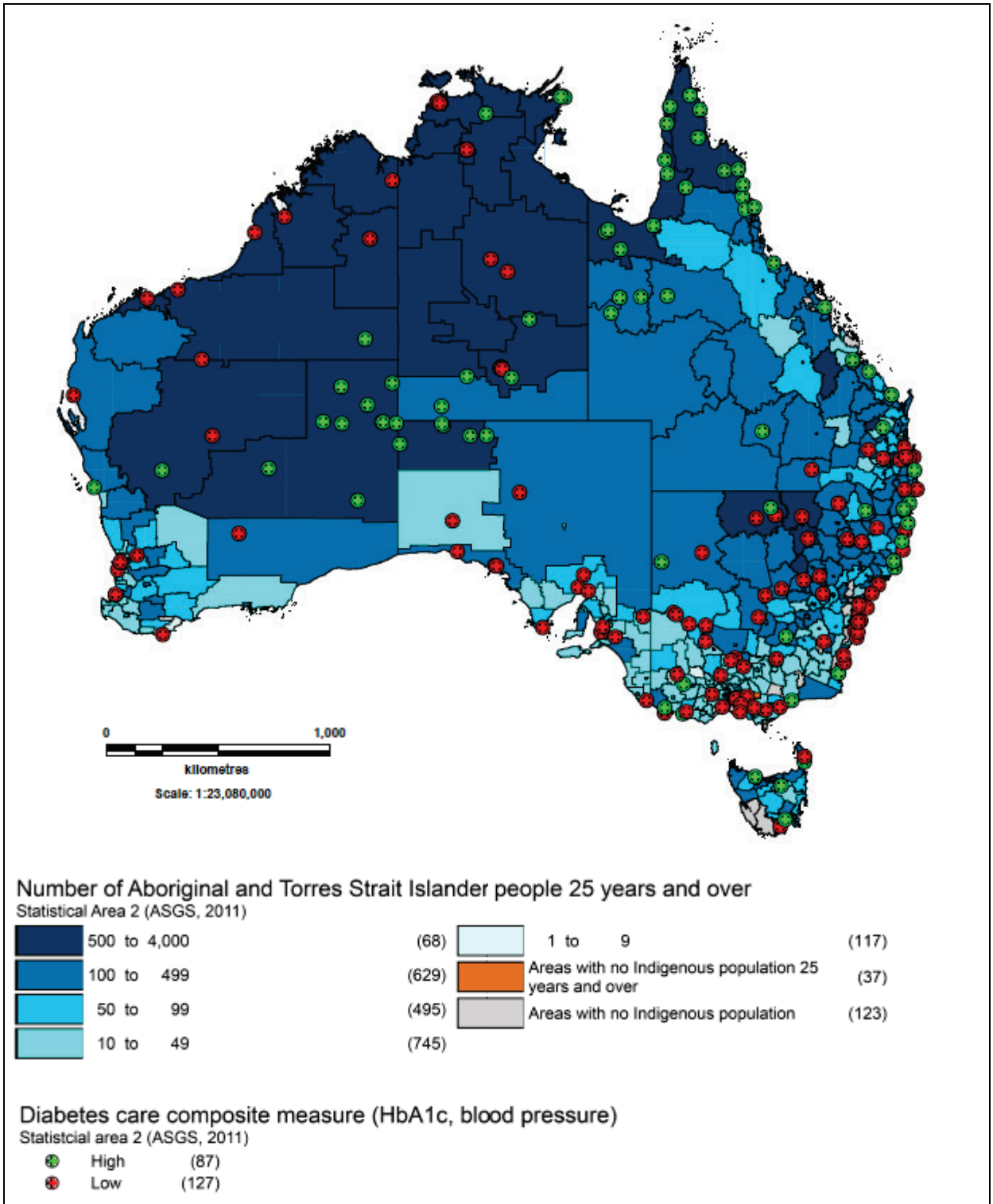
- Most Aboriginal and Torres Strait Islander people who live close to an ISPHCS have access to diabetes care and education. The quality of diabetes care offered by ISPHCSs is important to the health outcomes of diabetic clients.
  - 307 of 323 ISPHCS locations are OSR services with diabetes specialists and educators.
- Some areas, including the service gap SA2s of Ashburton and Moora in Western Australia, have no access to ISPHCSs with diabetes specialists and educators.
- Preliminary analyses suggest an association between diabetes management provided by ISPHCS and rates of PPH due to diabetes complications: areas with relatively low proportions of diabetic clients who have their blood pressure checked regularly also tend to have relatively high rates of PPH due to diabetes complications.
- A composite measure based on the proportion of clients with diabetes who had their HbA1c (long-term blood glucose) levels checked and the proportion of Aboriginal and Torres Strait Islander clients with diabetes who had their blood pressure checked, suggests that ISPHCSs around major cities tend to have relatively poor diabetes-care service outcomes. This may reflect availability of, and access to, diabetes care by Aboriginal and Torres Strait Islander people at other services or difficulties with monitoring and following up diabetic patients in urban areas.

Locations of OSR services with diabetes specialists and educators, and diabetes composite measure

Map 3.4.1 shows the distribution of ISPHCS locations with diabetes specialists and educators, contrasted against the population of Aboriginal and Torres Strait Islander people aged 25 and over. This target population was chosen because 25 is the age at which we start to see Aboriginal and Torres Strait Islander people develop and be hospitalised for Type II diabetes. The number of Aboriginal and Torres Strait Islander people with diabetes in each SA2 was not available.

The map also shows a composite measure of diabetes care outcomes based on the proportion of Aboriginal and Torres Strait Islander clients with diabetes who had their HbA1c levels (long-term blood glucose) checked; and the proportion of Aboriginal and Torres Strait Islander clients with diabetes who had their blood pressure checked for each service. A high score represents a desirable service outcome—that is, high proportions of diabetic clients who have had their HbA1c (long-term blood glucose) levels and blood pressure checked. For more information about the composite measure, see Section A4 of Appendix A.

- 307 of 323 ISPHCS locations are OSR service locations with diabetes specialists and educators.
- The composite measure suggests that ISPHCSs around major cities tend to have relatively poor service outcomes. However, this may reflect availability of, and access to, diabetes care at other services or difficulties associated with monitoring and following up diabetic patients in urban areas.
- High- and low-performing services tend to occur in clusters. For example, while almost all of the service locations around cities are low-performing, northern Queensland and eastern Western Australia have almost only high-performing services. This may reflect the availability of other services as well as the performance of the ISPHCSs.



Map 3.4.1: Locations of OSR services with diabetes specialists and educators, diabetes composite measure (HbA1c, blood pressure), and Aboriginal and Torres Strait Islander population aged 25 and over, by SA2

Potentially preventable hospitalisations and diabetes care

PPH due to diabetes complications are thought to signal unmet need for diabetes-related primary health care.

- Preliminary results of analyses undertaken by the AIHW suggest that areas with relatively low proportions of Aboriginal and Torres Strait Islander people with diabetes who have had their blood pressure checked also tend to have relatively high rates of PPH due to diabetes. Hospitalisations due to diabetes complications signal unmet need for diabetes-related primary health care.
- Among all the nKPI-reporting ISPHCSs in an SA2, the overall proportion of Aboriginal and Torres Strait Islander diabetic clients who had had their blood pressure checked showed a negative association with rates of PPH due to diabetes complications among Aboriginal and Torres Strait Islander people (Pearson correlation: $r = -0.25$, $p = 0.005$). Note that this association may be influenced by access to other services.

This analysis suggests that diabetic clients who have their blood pressure checked regularly are less likely to develop preventable diabetes complications requiring hospitalisations. There was a trend suggesting a similar association between HbA1c tests and PPH due to diabetes complications, but this association was not statistically significant.

It is important to note that these are preliminary results, as a number of factors have not been controlled for in the analysis—including care at non-OSR services; care at OSR services outside the SA2 of residence; and underlying rates of diabetes (as more diabetics will lead to higher rates of PPH due to diabetes complications).

4 Conclusion

Aboriginal and Torres Strait Islander people still experience primary health-care service gaps

Overall, Australian Government funded Indigenous-specific primary health-care services (ISPHCS) appear to be well positioned relative to the geographic distribution of Aboriginal and Torres Strait Islander people and to the distribution of other GP services. The services are mainly located in densely populated areas and regional areas with relatively large Aboriginal and Torres Strait Islander populations in northern Queensland, the Northern Territory, northern South Australia and Western Australia (Section 3.1).

However, there are clearly still areas where Aboriginal and Torres Strait Islander people experience very limited access to both Indigenous-specific services and to GP services in general (Section 3.2). The Aboriginal and Torres Strait Islander populations of 40 SA2s have more than 1 hour's drive to their nearest ISPHCS location and poor access to GP services in general. Ten of these SA2s have an Aboriginal and Torres Strait Islander population of 600 or more. Central and south-eastern Queensland and western and south-western Western Australia are standout regions with high concentrations of service gap SA2s.

Four areas—the Torres Strait Islands, Torres, and Central Highlands East in Queensland, and Ashburton in Western Australia—are service gap SA2s with large Aboriginal and Torres Strait Islander populations (more than 1,200 Aboriginal and Torres Strait Islander people). While Palm Island in Queensland was also an area identified as a service gap SA2 with a large Aboriginal and Torres Strait Islander population, the opening of a new GP clinic in November 2013 has recently improved access to GPs on the island.

Examination of GP services that were not part of the OSR or nKPI data collections (for example, state-funded services and very new services with GPs) revealed an additional 17 primary health-care services inside service gap SA2s or in adjacent SA2s. These additional services improved access significantly in 3 of the 40 identified service gap areas (Palm Island in Queensland as discussed above, Tasmania's West Coast and Exmouth in Western Australia).

Some areas with low access to primary health-care services and relatively large Aboriginal and Torres Strait Islander populations also have high numbers of PPH—hospitalisations that signal unmet need for primary health care. Analysis undertaken by the AIHW showed that 61% of the service gap SA2s have high rates of PPH (above the median for all SA2s).

Maternal, antenatal and diabetes care are widely, but not universally, available at ISPHCSs

Maternal care and antenatal care are available at most OSR services. Out of the 323 ISPHCS locations, 226 were OSR services offering both maternal and antenatal services (Section 3.3).

Most OSR service locations (307 out of 323) have diabetes specialists and educators. However, there are some areas with no access to Indigenous-specific health-care services with diabetes specialists and educators and high rates of PPH due to diabetes complications. Furthermore, areas with diabetes services that report that low proportions of their diabetic

clients have had their blood pressure checked also tend to have relatively high rates of such hospitalisations. This suggests both that the diabetes care provided by ISPHCSs is important, and also that service outcomes vary between service locations in ways that are associated with variation in the health outcomes of their diabetic Aboriginal and Torres Strait Islander clients.

Aboriginal and Torres Strait Islander people also receive maternal, antennal and diabetes care at other services. How this influences geographic variation in the health outcomes of ISPHCS clients or the service outcomes of ISPHCSs is not known at this time.

Better data would enable better measures of access

Because many services operate at multiple locations (sometimes in multiple SA2s), the construction of an index that captures geographic variation in access to Indigenous-specific health-care services relative to the need for health care of Aboriginal and Torres Strait Islander people—similar to the AIHW's ARN index—would require the collection of FTE data at the level at which services are delivered (service locations). Currently, these data are only collected at the organisational level (services). Similarly, the availability of data on episodes of care for all locations would also aid in the development of measures of access relative to need that take the capacity and performance of all service locations into account.

Appendix A: Additional findings and background

A1: Distribution of ISPHCS locations and Aboriginal and Torres Strait Islander people

Table A1.1 shows that the highest proportion of ISPHCS locations are in SA2s with a population density between 0.02 and 0.50 Aboriginal and Torres Strait Islander people per square km. This is the population density of most of the regional and remote SA2s with the densest Aboriginal and Torres Strait Islander populations (see Map 3.1.3 for a comparison of variation in population density at the SA3 level).

Table A1.1: Distribution of ISPHCS locations across SA2s, by population density

Indigenous people per km^2	Percentage of SA2s	Percentage of ISPHCS locations
< 0.002	5.3	0.9
0.002-0.020	3.6	12.1
0.021-0.50	15.1	31.1
0.51-1.0	4.4	2.1
1.1-10.0	25.9	14.9
10.0-25.0	21.4	13.7
25.1-50.0	15.4	11.8
50.1-100.0	6.0	9.9
100.1-150.0	1.2	1.6
150.1+	1.7	1.9

Source: AIHW analysis of 2012–13 OSR and nKPI, and ABS estimates of Aboriginal and Torres Strait Islander Australians, June 2011.

Indigenous-specific primary health-care services to Aboriginal and Torres Strait Islander population ratios

Map 3.1.4 shows the number of ISPHCS locations to Aboriginal and Torres Strait Islander population ratio for all SA4s. Calculating this ratio for smaller areas is of limited value as people cross borders to access services. For example, major cities typically have fewer Indigenous health services than SA2s or SA3s. *Major city* SA2s and SA3s are relatively small, and Aboriginal and Torres Strait Islander people living in areas without services can easily travel to services in nearby areas. This means that *Major city* areas with services will have services to population ratios that do not reflect the fact that these services are also used by people in other areas, and that areas without services will have ratios of 0 even though people in these areas have access to services elsewhere. Calculating the services to population ratios at the SA4 level means that, even in *Major cities,* areas are large enough to minimise this problem. However, it is important to note that people will also travel across SA4 boundaries to access services and that, even in areas with relatively high services to population ratios, people in large SA4s may live far from existing services.

It is also important to note that different services have different capacities. Without more complete data on episodes of care (EOC) and FTE at each service site (see 'Data quality and limitations' in Appendix B), it is impossible to take this into account when comparing the access to Indigenous health services of different areas.

Table 3.1.1 shows the distribution of ISPHCSs and the Aboriginal and Torres Strait Islander population across remoteness areas. It also presents the services to population ratio for each remoteness area. *Remote* and *Very remote* areas generally have much higher service locations to population ratios than *Inner regional* and *Outer regional* areas and *Major cities*. For comparison, Table A1.2 summarises the service locations to population ratios for each state or territory.

It is important to note that even though ISPHCS locations to population ratios tend to be low in areas around big cities, these areas generally have good access to other GP services (see Chapter 3). It is also important to note that people do have the option of travelling to services in nearby areas in cities where SA4s are very small compared with the very large SA4s in remote areas (see Map 3.1.4).

There are also areas outside of the major cities with services to population ratios that can be misleading. For example, the area with the highest ratio in Australia is the very small Jervis Bay territory. This area has 1 service located at the Aboriginal community of Wreck Bay. However, this service is also within easy reach of nearby towns in SA4s outside the Jervis Bay territory.

Table A1.2: ISPHCS locations and Aboriginal and Torres Strait Islander population across states and territories

Jurisdiction	Number of ISPHCS	Percentage of all ISPHCS	Indigenous population	Percentage of Indigenous population	ISPHCS per 1,000 Indigenous people
NSW	78[(a)]	24.1	208,476	31.1	0.4
Vic	28	8.7	47,333	7.1	0.6
Qld	58	18.0	188,954	28.2	0.3
WA	48	14.9	88,270	13.2	0.5
SA	23	7.1	37,408	5.6	0.6
TAS	9	2.8	24,165	3.6	0.4
ACT	1[(b)]	0.3	6,160	0.9	0.2
NT	78	24.1	68,850	10.3	1.1
Australia	**323**	**100**	**669,881**	**100**	**0.5**

(a) Includes the service in Jervis Bay.

(b) Does not include the service in Jervis Bay.

Source: AIHW analysis of 2012–13 OSR and ABS estimates of Aboriginal and Torres Strait Islander Australians, June 2011.

Drive time to Indigenous-specific primary health services

In a large SA4, substantial proportions of the Aboriginal and Torres Strait Islander population may live far from existing services even if the SA4 has a relatively high service locations to population ratio. Estimating the drive time to the nearest ISPHCS location at a lower geographic level gives a better idea of how access to ISPHCS locations varies geographically (see Appendix B for details on how drive times were estimated). Map 3.1.6

shows the proportion of the Aboriginal and Torres Strait Islander population who live within 1 hour's drive of the nearest ISPHCS location for all SA2s. One hour is often assumed to be the maximum time people can reasonably be expected to travel to access health care. Drive times were calculated for the population of each SA1 and the results were then aggregated to the SA2 level (population data from the 2011 Census—see Appendix B). Clearly, there is much more variation in access to ISPHCS locations within states and regions than would be suggested by the ISPHCS locations to population ratios at the SA4 level (Map 3.1.4). The map also shows all ISPHCS locations for reference.

Table A1.3 shows the number and proportion of Aboriginal and Torres Strait Islander people who live within 1 hour's drive of their nearest ISPHCS location, by state or territory.

Table A1.3: Aboriginal and Torres Strait Islander people who live within 1 hour's drive of their nearest ISPHCS location, by remoteness area and state/territory

Remoteness		NSW	Vic	Qld	WA	SA	Tas	ACT	NT
	Number	72,906	12,365	45,903	25,468	13,778		4,898	
Major cities	Proportion	99.8%	99.9%	99.7%	99.9%	100.0%	. .	100.0%	. .
	Number	55,141	11,337	27,825	4,782	2,108	10,980	5	
Inner regional	Proportion	90.8%	99.7%	85.8%	94.9%	93.9%	100.0%	100.0%	. .
	Number	26,347	5,351	41,283	7,852	6,940	8,108		11,875
Outer regional	Proportion	83.3%	97.2%	84.0%	74.0%	92.6%	90.0%	. .	99.8%
	Number	3,699	24	6,541	9,953	1,044	0[(a)]		11,675
Remote	Proportion	71.1%	68.6%	59.3%	85.5%	85.6%	0.0%	. .	97.7%
	Number	2,202		8,985	8,412	2,655	153		19,578
Very remote	Proportion	77.3%	. .	44.7%	48.0%	61.5%	81.8%	. .	56.0%

(a) 0 out of 474.

. . not applicable

Note: The 2011 Census population was used for calculations of proportions of Aboriginal and Torres Strait Islander people who live within 1 hour's drive of their nearest ISPHCS location because the ABS's Estimated Resident Population is not available at the necessary SA1 level.

Source: AIHW analysis of OSR survey and 2011 Census data.

A2: Service gaps

Service gap SA2s

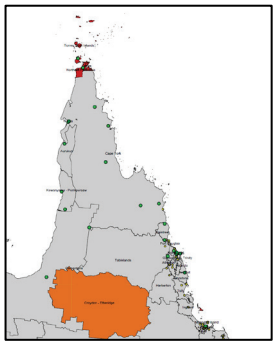
Map 3.2.1 highlights areas where there is poor access to both ISPHCS locations and GP services in general (service gap SA2s). The highlighted areas are all areas where 0% of the Aboriginal and Torres Strait Islander population live within 1 hour's drive of the nearest ISPHCS location. Aboriginal and Torres Strait Islander people in these areas also experience poor access to GPs (Indigenous-specific and GP services in general). Access to GPs relative to need is in the 2 worst deciles of the AIHW's Indigenous ARN index (see Map A.2 for a map of the Indigenous ARN index by SA2). In the maps, service gap SA2s with an Aboriginal and Torres Strait Islander population of more than 600 are separated from service gap SA2s with fewer than 600 people. The maps also show all ISPHCS locations and the locations of all GP services that are not also ISPHCS locations. Map A.1 presents 5 more detailed maps of small service gap SA2s in Queensland that are not visible on Map 3.2.1. Table 3.2.2 lists all service gap SA2s by Aboriginal and Torres Strait Islander population size.

ARN index

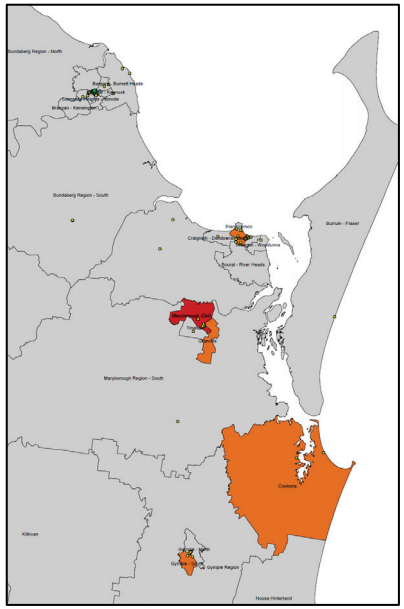
The Access Relative to Need (ARN) index describes geographic variation in physical access to primary health care relative to the per capita need for primary health care (AIHW 2014a). It is a ratio of service providers (full-time equivalent GPs in this case) to population that takes into account that people travel between areas to access services and that different populations have different health-care needs. Access to service providers is assumed to decline with distance when the ARN index is calculated. This means that the further a GP is from a population, the less that GP will contribute to the access of that population. It also means that when the populations of 2 areas compete over access to the same services, 1 population will influence the provider to population ratio of the other less the further away from the shared services it is located. Populations are assumed to be able to access services up to 1 hour's drive away.

The per capita need for primary health care of a population depends on the distribution of age and socioeconomic status within the population. Small children, women of child-bearing age and the elderly are more likely to need to access the health-care system than other age groups. The same applies to people from a disadvantaged socioeconomic background. Age structure and socioeconomic factors are therefore taken into account when the ARN index is calculated (AIHW 2014a).

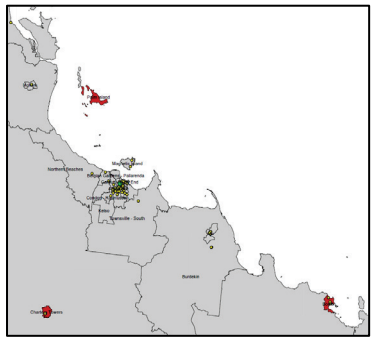
The ARN index can be calculated separately for Indigenous and non-Indigenous people (Map A.2).



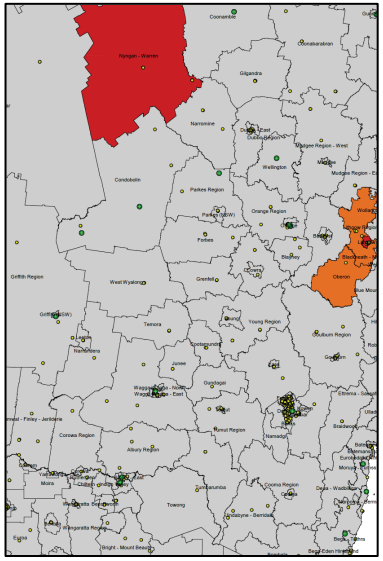
Northern Qld (Cape York)



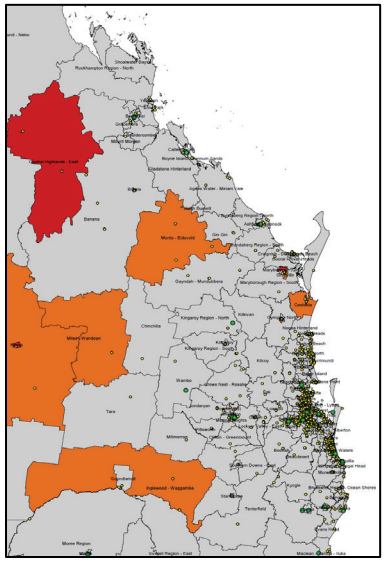
Northern Qld (Maryborough)



Northern Qld (Cairns)

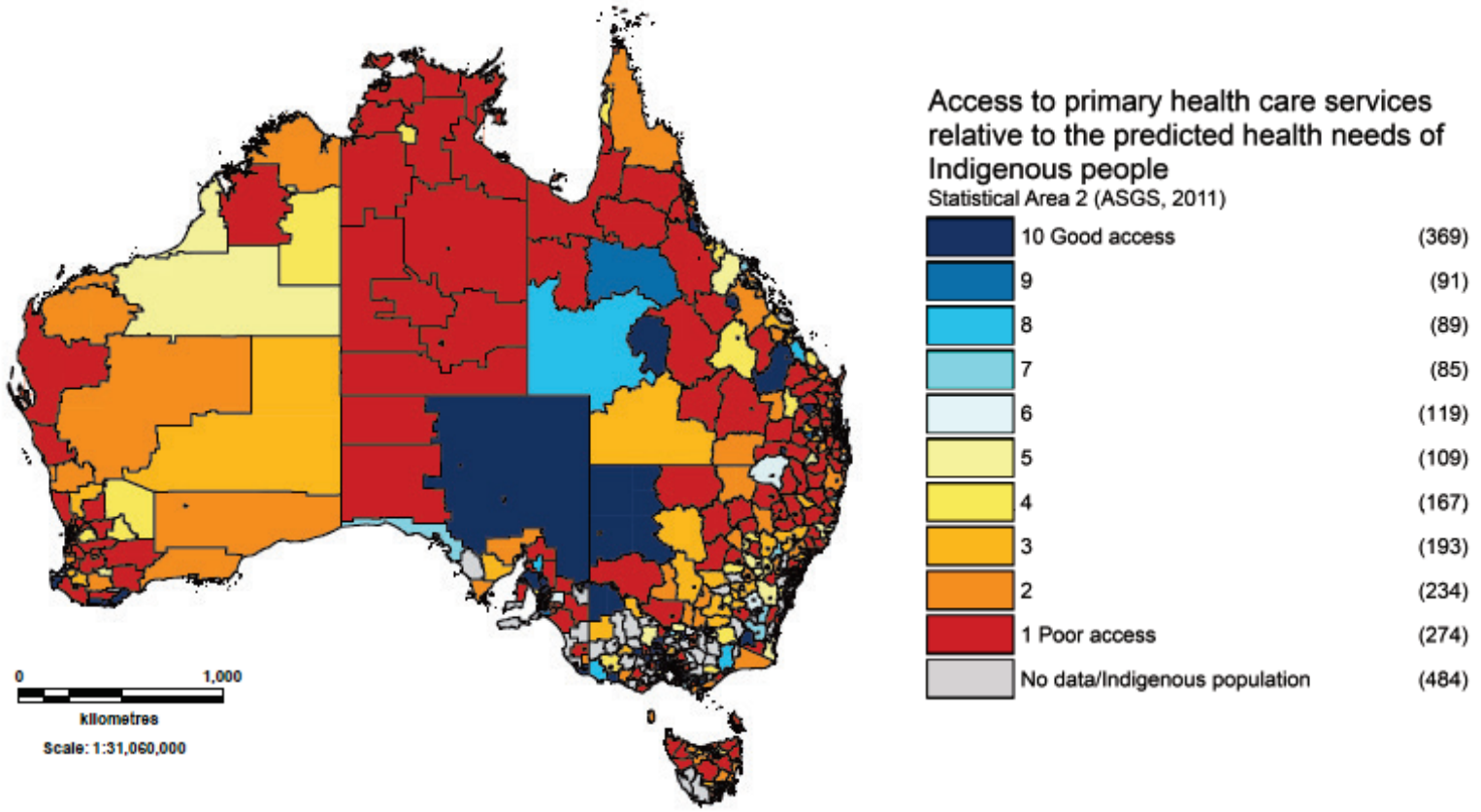


Central NSW



Eastern and central Qld

Map A.1: Small service gap SA2s in Queensland and central New South Wales that are difficult to see on a national map (areas with more than 600 Aboriginal and Torres Strait Islanders in red, and areas with fewer than 600 Aboriginal and Torres Strait Islanders in orange)



Map A.2: Access to primary health-care services relative to predicted health needs for Aboriginal and Torres Strait Islander people (Indigenous ARN index), by SA2

Distribution of service gap SA2s

A total of 40 SA2s have been identified where Aboriginal and Torres Strait Islander people have poor access to both Indigenous-specific primary health-care services (no services within 1 hour's drive) and to GPs in general (ARN index score in the lowest 2 deciles). These are listed in Table 3.2.2. The majority of these SA2s are in the *Remote* and *Very remote* areas of Queensland and Western Australia. In the 2011 Census, a total of 23,316 Aboriginal and Torres Strait Islander people were counted in the service gap SA2s (just over 4% of the total Indigenous population).

Map 3.2.1 shows that areas where the Aboriginal and Torres Strait Islander population has very poor access to ISPHCSs and GPs are scattered throughout all states and territories except the Northern Territory.

Queensland

Queensland has the greatest number of service gap SA2s, with 19 of the 40 areas. These areas can be divided into 3 groups. The first is made up of a broken string of SA2s through the regional and remote parts of central and eastern Queensland. Croydon–Etheridge, Clermont, Barcaldine–Blackall, Central Highlands–East, Monto–Eidsvold, Roma Region, Cooloola, Miles–Wandoan and Inglewood–Waggamba are part of this group. The second group is made up of small SA2s containing the towns or suburbs of Charters Towers, Maryborough, Bowen, Roma, Gympie–South, Pialba–Eli Waters (Hervey Bay) and Granville (Maryborough) in south-eastern Queensland. The third group includes the 3 island SA2s of Torres, Torres Strait Islands and Palm Island (note that Palm Island has a new GP clinic—see Map 3.2.2 and Table A2.2).

Western Australia

Western Australia has 12 service gap SA2s. These are all in the south-western and western parts of the state. Ashburton and Exmouth are in the *Very remote* part of the Western Australian west coast near the North West Cape (note that the ISPHCS location between North West Cape and Shark Bay is in the small SA2 surrounding the town of Carnarvon and not in the Exmouth SA2). Morawa, Gingin-Dandaragan and Moora are in the regional and remote region north of Perth. Brookton, Wagin, Narrogin, Kulin, Kojonup, Gnowangerup and Esperance Region are all in the regional and remote parts of south-western Western Australia.

New South Wales

New South Wales has 5 service gap SA2s. Hay is in the Riverina region of southern New South Wales. Nyngan-Warren is in central New South Wales. Lithgow, Lithgow Region and Oberon are smaller SA2s west of the Blue Mountains.

Tasmania

Tasmania has 2 service gap SA2s. The West Coast SA2 is in the *Remote* central part of Tasmania's west coast (note that this area has additional primary health-care services—see Map 3.2.2 and Table A2.2). The second service gap SA2 is King Island.

South Australia

South Australia has 1 service gap SA2. Naracoorte Region is an SA2 in the *Outer regional* part of south-eastern South Australia with the smallest Indigenous population of all the 40 service gaps SA2s identified (29 in 2011).

Victoria

Victoria has 1 service gap SA2. The Otway SA2 includes Cape Otway and is in the *Inner regional* and *Outer regional* part of southern Victoria.

Additional services

The service gap SA2s were defined based on the locations of ISPHCSs taking part in the OSR and/or nKPI reporting data collections and the locations of GPs as listed by AMPCo or reported by the RFDS. However, there may be a small number of additional primary health-care services with GPs that have not been captured in the above analysis, either because they are state or territory-funded services not taking part in the OSR and/or nKPI reporting, new services, or because their GPs were not listed by AMPCo or part of the RFDS.

To determine whether any additional services would influence Aboriginal and Torres Strait Islander people's access to primary health care in the identified service gap SA2s, the National Health Service Directory <http://www.nhsd.com.au/> and state/territory websites were used to identify services located inside or close to service gap SA2s. Sixteen additional services listed as 'General practice services' in the National Health Service Directory were found inside service gap SA2s or in adjacent SA2s (Table A2.2; Map 3.2.2). The GP FTEs of each service were obtained from the service website or by contacting the service.

Table A2.2: Additional services in or near service gap SA2s

Number on map	Service	GP FTEs
1	Bollon Bush Nursing Centre	0.2
2	Wallumbilla Hospital - General Practice Service	0.2
3	Charleville and Western Areas Aboriginal and Torres Strait Islanders Community Health - Roma	0.2
4	Karumba Primary Health Care	0.3
5	Barcaldine Medical Centre	1
6	Jericho Health Centre	0.2
7	Muttaburra PHC	0.2
8	Joyce Palmer Health Service	3
9	Perenjori Medical Centre	0[(a)]
10	Wickepin Health Centre	0.2
11	Nangwarry Medical Centre	0.5
12	Strahan General Practice	1
13	Rosebery General Practice	1
14	Zeehan General Practice	0.4
15	Moulamein Community Health Centre	0.2
16	Paraburdoo Medical Centre	1
17	Exmouth Hospital	3.5

(a) Needs-only basis at Perenjori

Access to primary health care is likely to be affected by the additional services in 11 out of the 40 service gap SA2s (Table A2.3). However, in most cases, overall access to primary health care will only improve slightly as a result of the additional services. The 2 main exceptions are Palm Island which, as mentioned earlier, has a new GP clinic and West Coast (Tasmania) which has 3 additional services with a total of 2.4 GP FTEs.

Table A2.3: Service gap SA2s influenced by the additional services

SA2 Name	State	Indigenous population	Additional services	Additional services in adjacent SA2s	Total additional GP FTEs
Palm Island[(a)]	Qld	2447	1	0	3
Ashburton (WA)	WA	1214	1	0	1
Roma	Qld	787	1	1	0.4
Roma Region	Qld	431	1	1	0.4
West Coast (Tas.)[(a)]	Tas	391	3	0	2.4
Barcaldine – Blackall	Qld	352	3	0	1.3
Exmouth[(a)]	WA	332	1	0	3.5
Morawa	WA	317	1	0	0
Gingin - Dandaragan	WA	206	1	0	0.2
Hay	NSW	203	0	1	0.2
Croydon - Etheridge	Qld	128	0	1	0.3
Naracoorte Region	SA	29	0	1	0.5

(a) SA2s where the additional services are likely to have a substantial impact on access to primary care.

A3: Maternal and child health

Maternal and antenatal care composite measure

The services that are required to take part in the nKPI reporting record data for several indicators that are relevant to maternal and antenatal care. Map 2.3.2 shows a composite measure of indicators that together reflect both the quality of the maternal and antenatal care provided to clients and the health outcomes of child clients.

The nKPI indicators on proportion of babies with low birthweight (less than 2,500 grams), proportion of children aged 2 years who have been fully immunised, and proportion of children aged 5 years who have been fully immunised were combined into 1 composite measure.

1. The overall proportion of 2 and 5 year-olds who had been fully immunised was calculated. The services were then divided into quartiles based on the overall proportion: the 25% of services with the highest proportion immunised were given a score of 4 and the 25% with the lowest proportion were given a score of 1.
2. All reporting services were divided into quartiles based on the proportion of baby clients who had a low birthweight. This time, the 25% of services with the lowest proportion of babies with low birthweight were given a score of 4.
3. The birthweight quartile was subtracted from the immunisation quartile to create a composite measure.

Note that the composite measure is a relative measure of performance and health outcomes, as it is based on quartile scores and not on absolute proportions.

Map 2.3.2 shows the services divided into 3 groups, based on the composite measure (Table A3.1). The high-performing group includes services with relatively high immunisation rates and relatively low proportions of low birthweight. The low-performing group includes services with relatively low immunisation rates and relatively high proportions of low birthweight.

It is important to note that the clients of ISPHCS reporting these indicators also receive care from other service providers. This means that the care provided by an ISPHCS is not the only health care influencing the nKPI performance of a service.

Table A3.1: Relative performance on maternal and antenatal care composite measure

Maternal and antenatal care performance	Number of services
High-performing	84
Intermediate	72
Low-performing	37

A4: Diabetes management

Diabetes care composite measure

Two nKPI process indicators are related to diabetes care: the proportion of Aboriginal and Torres Strait Islander clients with diabetes who had their HbA1c (long-term blood glucose) levels checked; and the proportion of Aboriginal and Torres Strait Islander clients with diabetes who had their blood pressure checked.

A composite measure was created based on these indicators. All ISPHCSs reporting these nKPIs were divided into quartiles (1–4, with 4 being the 25% of services with the highest proportion for the indicator in question) based on each indicator. The quartile scores of the HbA1c indicator were then added to the quartiles scores of the blood pressure indicator. Services with a combined score of 5 or higher were considered 'high performing' and services with combined score of 4 or lower were considered 'low performing' (Table A4.1). High- and low-performing services are indicated in maps 5.1a and 5.1b. Note that the composite measure is a relative measure as it is based on quartile scores and not on absolute proportions.

Table A4.1: Relative performance on composite diabetes care measure

Diabetes care performance	Number of ISPHCSs
High-performing	87
Low-performing	127

Source: AIHW analysis of 2012–13 nKPI.

Appendix B: Data sources, quality and limitations

Data sources

Data included in this report on the locations and service characteristics of Indigenous-specific primary health-care services (ISPHCS) funded by the Australian Government were sourced from the AIHW's Online Services Report (OSR) for 2012–13.

Data on the geographic distribution of the Aboriginal and Torres Strait Islander population were sourced from the Australian Bureau of Statistics' (ABS) 2011 Census of Population and Housing. This population, rather than a more recent estimated resident population, was used because it is available at the SA1 level. Having population data at this level is necessary for both the calculation of drive times to nearest ISPHCS location and the ARN index (see below).

The AIHW's geospatial Access Relative to Need (ARN) index has been used as a measure of how access to all GP services relative to need varies geographically in the Aboriginal and Torres Strait Islander population (AIHW 2014a). GP service addresses for the ARN index were sourced from the Australasian Medical Publishing Company (AMPCo), and are for 2013. It should be noted that any changes made to these service addresses after 2013, including the opening of new GP services, will not be captured in the analyses presented in this report. The AIHW is currently in the process of obtaining the most up-to-date list of GP service addresses for future analyses.

Locations of public hospitals (and multipurpose service locations) were sourced from data held by the AIHW. These data have been made available on the MyHospitals website <http://www.myhospitals.gov.au/>. It should be noted that the MyHospitals website also presents hospital information provided by data custodians other than the AIHW and may therefore show some hospital locations (in particular private hospitals) which are not included in this report.

Data from the AIHW's National Key Performance Indicators for Aboriginal and Torres Strait Islander primary health-care services data collection (nKPI data) for 2012–13 have been used to report on the performance of health services in terms of process indicators, as well as health outcomes of clients.

Data on potentially preventable hospitalisations (PPH) were sourced from the AIHW's National Hospital Morbidity Database for the 2011–12 financial year.

Maps included in this report are presented at either the statistical area level 2 (SA2), SA3 or SA4 levels of the ABS's Australian Statistical Geography Standard (ASGS), depending on what the data were able to support and what the AIHW considered the most useful and informative to represent the data being mapped. Australia is divided into 54,805 SA1s; 2,196 SA2s; 351 SA3s and 106 SA4s in the ASGS geography (ABS 2011).

Data quality and limitations

Locations of services relative to the distribution of the Aboriginal and Torres Strait Islander population

Longitude and latitude were assigned to all ISPHCS locations based on their addresses. For some service sites, the available address information was not detailed enough to determine an exact location. This may have led to some coordinates deviating slightly from the actual location of service sites. However, this deviation should be very small (< 50 m) for most service sites and never exceed 1 km even in extreme cases.

Data on the distribution of the Aboriginal and Torres Strait Islander population were from the ABS's 2011 Census of Population and Housing. This is the most recent available source of population data at the necessary SA1 level. These data have not been adjusted for under-enumeration or the estimated under-identification of Aboriginal and Torres Strait Islander people in the Census.

Capacity of each service site

Data on episodes of care (EOC) are reported by some, but not all, OSR services. Currently, EOC data are only available for 71% of the OSR service sites (65% when nKPI-only services are included). Services that do not report EOC data are spread all around Australia. However, some areas, for example north Queensland, have a particularly high proportion of service sites with no available EOC data. Knowing how the number of EOC delivered to Aboriginal and Torres Strait Islander people by Indigenous-specific health-care services—relative to the Aboriginal and Torres Strait Islander population and the rates of health outcomes like PPH—varies between areas would be useful when assessing the need for increased service capacity or improved service performance in an area. The current low service coverage means that any measure using EOC data by Statistical Area would be misleading and unreliable—even when data are aggregated to as high a level as SA4. Collecting EOC data from all services would give a more complete picture of the relative importance of the care delivered by Indigenous-specific health-care services in different parts of Australia.

Another important indicator of the capacity of a service is the number of full-time equivalent (FTE) positions of each category of staff involved in primary health care (for example, GPs, nurses, community health workers and Aboriginal health workers). Currently, FTE data are reported by service, not by service location. Many Indigenous-specific services operate at multiple sites, and having FTE data by site would enable the construction of a more accurate measure of access to these services relative to the size and needs of the local Aboriginal and Torres Strait Islander population.

Primary health-care services and other health services

The services considered as providing primary health care to Aboriginal and Torres Strait Islander people were the Indigenous-specific primary health-care services that are required to take part in the OSR and/or nKPI reporting and all services with GPs (GP services in general as included in the ARN index). Other services may provide some primary care in some areas. For example, any state-run health services, with or without doctors, that are not part of the OSR or nKPI reporting would not have been included even if they do provide

some primary care services. Also, hospitals (including multi-purpose health services) are included in the ARN index if they have GPs. Some hospitals and multi-purpose health services do not have GPs but may still provide some primary care in areas where there are no other available services. Some pharmacies may also provide some primary care.

The National Health Service Directory <http://www.nhsd.com.au/> and state/territory government websites were used to search for additional primary health-care services in and near SA2s that had been identified as service gap areas based on access to OSR/nKPI services and GPs (as included in the ARN index). The additional services that were found are likely to have a small impact on overall access to primary health care in most service gap SA2s.

Potentially preventable hospitalisations

Potentially preventable hospitalisations (PPH) are hospitalisations due to conditions that are deemed avoidable if timely and adequate non-hospital care had been provided. They are often used as an indicator of unmet need for primary health care. For a list of conditions used when identifying PPHs see:
<http://meteor.aihw.gov.au/content/index.phtml/itemId/443687>.

The data on PPH from the AIHW's National Hospital Morbidity Database are generally of very high quality (for data quality statement, including regarding Indigenous identification, see <http://meteor.aihw.gov.au/content/index.phtml/itemId/568730>). However, rates of PPH, and especially rates of PPH due to diabetes complications, for areas with small Aboriginal and Torres Strait Islander populations must be interpreted with care as the small number of cases results in much random variation in rates between areas. Furthermore, it is possible that there is some variation between areas in the likelihood that certain preventable conditions result in hospitalisation.

Analyses of PPH presented in this report are for the 2011–12 financial year and based on the ICD codes used for the indicator on 'Selected potentially preventable hospitalisations' (PI-22) in the National Healthcare Agreement, 2012. These data are not affected by changes in ICD-10 coding standards for diabetes complications which occurred between 2007–08 and 2008–09.

Box B1: Limitations of access measure

Case study: Palm Island SA2

Palm Island, located in the sea 57 km north of Townsville (Queensland), exemplifies 3 main limitations of the methods used when describing Aboriginal and Torres Strait Islander people's access to primary health-care services in this report.

Road access

The people who live on Palm Island have no road access to the mainland. This means that the Drive Time software of MapInfo professional regards any services that are not on the island as not being within reach from this SA2. There is a ferry service from Palm Island to Townsville, which people may use to access services on the mainland. However, the ferry takes more than 1 hour, and it is therefore reasonable to say that services on the mainland are outside the 1 hour driving limit in this case.

Other services

A multi-purpose health service has operated on the island since 2000. This service is neither an ISPHCS nor a service offering primary health care through GPs that would therefore be included in the ARN index. However, the people of Palm Island are likely to have received some primary care from this health service.

New services

A new GP clinic opened on Palm Island in November 2013. Before then, the island did not have any GP services. November 2013 is too recent for the GPs working at the clinic to have been included in the ARN index.

nKPI data

Limitations in the nKPI data are discussed in the nKPI first national results report (AIHW 2014b). Important to note is that clients of nKPI services may use multiple services, including other nKPI services and services that are not part of the nKPI reporting. This means that some clients will be included in the data of more than 1 nKPI organisation. It also means that the nKPI data may not reflect the extent to which the clients of 1 nKPI service receive appropriate care when this care may have been provided by a different service. For example, many children who are clients of nKPI services may receive their immunisations at other health-care services. The rates of immunisations are lower in the nKPI data than in the Australian Childhood Immunisation Register. It has been suggested that this is due to a systematic issue related to how the nKPI services obtain immunisation data about their clients (see page 52 of AIHW 2014b).

Appendix C: Detailed notes on methodology

Spatial distribution of general practitioners

The physical addresses for each of the OSR/nKPI ISPHCS locations included in the analysis were obtained from the AIHW's Indigenous Community and Health Service Reporting Unit and the Department of Health.

Health-care service addresses for the ARN index were sourced from the Australasian Medical Publishing Company (AMPCo), which provides year-to-date information on registered general practitioners (GPs) including GP service addresses, the number of GPs working at each service, and an FTE value for each GP. Additional GP service location and FTE data were sourced from the Australian Royal Flying Doctor Service. Services deemed not to provide 'traditional' GP medical care—such as homeopaths, naturopaths, cosmetic services, tanning clinics and plastic surgeons—were disregarded. All GP data were for 2013.

Latitude and longitude coordinates for each ISPHCS were derived from service address information using GPS Visualizer (Schneider 2013), an online geo-coder that converts physical address information into latitude and longitude coordinates. The resulting coordinates were loaded into MapInfo Professional (a GIS software application) and plotted onto Australian Statistical Geography Standard digital boundary maps of Australia obtained from the ABS website.

Address data were validated using Bing satellite maps (a web-based mapping service provided by Microsoft) to determine the service locations of GPs. A potential disadvantage of using satellite imagery to validate the locations of services is the age of the satellite maps available in the public domain. Often satellite imagery is composed of several years of data, meaning it is possible for a service to exist in a particular area even though it does not appear in the satellite map. When this issue arose, other satellite mapping applications such as Google Earth (maps and street view) were used to confirm the existence of a service. However, there were instances when these too failed and a call to the health service in question was necessary to validate its street address.

A second issue associated with the validation of GP locations using satellite maps was the loss of map resolution with increased remoteness, making it difficult to verify the location of GP services in remote and very remote locations. When this occurred, validation of GP service locations was undertaken in the same way as described above for dealing with older satellite maps.

Population centroids

MapInfo Professional's Drivetime application was used to calculate travel distances between population centroids and ISPHCS locations, GPs and public hospitals (including multi-purpose health services). A population centroid denotes the geographic centre point of an ASGS-derived boundary. As populations tend to be distributed throughout a geographic boundary, the boundary's centre point is used to represent the location of the boundary's population in much the same was as a mean represents the average point within a data set. SA1 centroids were selected to represent the locations of populations primarily because they

are the smallest geography level at which ABS population data is available and their relatively small size compared to the other geographic boundaries available. How well the geographic midpoint represents the location of the population of an SA1 depends on the size of the SA1 and the distribution of people within its borders. The ABS determined the size of SA1s with the aim of most areas having a population size ranging from 200–800 people (ABS 2011). In most instances, the dense populations in metropolitan areas ensure that SA1s are small enough to be adequately represented by a given area's geographic midpoint (centroid). However, the size of areas is population-dependant and therefore increases in size as populations become distributed over greater areas with remoteness. As a result, centroids—defined as the geographic midpoints of SA1s—are less precise approximations of the actual locations of people in remote areas than in more densely populated urban and regional areas. The size of some SA1s in *Very remote* areas of Australia exceeds 100,000 square kilometres (1 SA1 in Western Australia covers 329,000 square kilometres). However, there are many small SA1s around towns, villages and settlements in *Remote* and *Very remote* areas. In *Very remote* areas, 85% of Aboriginal and Torres Strait Islander people live in SA1s that are smaller than 100 square kilometres. In combination with the manual adjustment of centroids described in the next section, this ensures that the centroids provide an accurate representation of the location of SA1 populations.

A common method used to ensure that centroids are placed where they best represent the location of people within an area is the construction of population-weighted centroids. Population data, at a smaller geographic level than that used in the analysis, are used to create a centroid that represents the average location of people within the larger area. However, it was not possible to use population-weighted centroids in this study as population data from the 2011 Census have not been released at a level lower than SA1 for reasons related to confidentiality and privacy. Instead, the centroids of larger SA1s in *Remote* and *Very remote* areas were adjusted manually based on the actual locations of communities in these areas.

Manual adjustment of area centroids

The location of area centroids in larger SA1s in *Remote* and *Very remote* areas were derived manually using the Australian Government Indigenous Programs & Policy Locations data in conjunction with GIS 'Bing' web-based satellite maps. Once the locations of population centres were determined, area centroids were placed in such a way that the total distance to all known communities within each area was minimised. In total, 105 SA1 area centroids in *Remote* and *Very remote* areas were adjusted manually, representing less than 1% (0.19%) of all SA1s. All distances were measured using MapInfo Professional.

It should be noted that the use of a single population centroid to represent populations spread out over large areas is a limitation of any geospatial analysis. One possible solution to this problem, and one that future studies of access to primary health care in *Remote* and *Very remote* areas of Australia may be able to use, would be to develop multiple centroids for the largest areas.

Calculating drive times from population centroid to primary health services

Coordinates for geographic centroids and health service locations were entered into a rectangular matrix within Drivetime, and the travel times (by road in a motor vehicle), from each centroid to all primary health services located within 60 minutes were calculated. Drivetime determines travel times based on the quickest route between the origin (centroid) and destination (ISPHCS, GPs, public hospitals). Travel times are generated according to the ambient travel speed available on a given road network. The time represents the minimum off-peak travel time for the road type (highway, suburban street and so forth), assuming the highest driving speeds available to a driver of a car on a given road network between 8.30 am and 3.30 pm and after 7 pm on weekdays.

A potential limitation of using geographic-based centroids when calculating population travel times to health providers is that the location of the centroid representing the population may not be on a road. MapInfo Professional's Drivetime attempts to control for this by allowing for the adjustment of off-network travel speed at the point of origin and point of destination. Off-network travel speeds for the origin and destination were both set at 200 km/h. When an area centroid (origin point) is located some distance from a road network, Drivetime travels the distance between the origin/destination point and the nearest road at 200 km/h. This ambient travel speed of 200 km/h was selected arbitrarily and is based on the assumption that the majority of Australian cities, towns and communities, including Indigenous communities are accessible by road. Therefore, travel times between area centroids and the nearest road network should be set at a high speed in order to model travel times as realistically as possible. Off-network travel time is a concern only in very large SA1s where the area centroid is more likely to be located far from a road network. In this study, in addition to setting the off-network travel times to 200 km/h, the locations of area centroids were adjusted manually in these larger SA1s to make travel time estimates more realistic.

One hour is often considered the maximum time people should have to travel to access primary or emergency health care (for example, Bagheri et al. 2008). Of course, the time people are prepared to travel to access health care is likely to vary between different areas and populations. Improved knowledge of how distance affects the use of primary health care in Australia may lead to refinements of the maximum travel time and of how access decays with distance in the model used to calculate access to ISPHCS locations and the ARN index.

Proportion of SA2 population within 1 hour's drive of nearest ISPHCS

The whole Aboriginal and Torres Strait Islander population of each SA1 was assumed to have the same drive time to their nearest ISPHCS location (SA1 centroid-to-service as described above). The proportion of the Aboriginal and Torres Strait Islander population of an SA2 who live within 1 hour's drive of their nearest ISPHCS location was then taken to be the proportion who live in an SA1 with a centroid within 1 hour of the nearest service.

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The report shows that overall, Australian Government funded Indigenous-specific primary health-care services appear to be well positioned relative to the geographic distribution of Aboriginal and Torres Strait Islander people and to the distribution of other GP services. However, there are a number of areas where Aboriginal and Torres Strait Islander people have very limited access to both Indigenous-specific services and GP services in general.