Technical supplement

Introduction

This is the *Fourth Australian Atlas of Healthcare Variation* in a series providing statistics at a local level identifying variation across Australia for a number of health indicators. Statistics in the Atlas are presented in the form of maps, graphs and tables. This technical supplement provides information on the methods used for data extraction and analysis, for presentation in the maps and graphs. Activity rates are presented by local areas using Statistical Area Level 3 (SA3) geography defined by the Australian Bureau of Statistics (ABS), as well as Primary Health Network (PHN) areas defined by the Australian Government Department of Health, at state and territory, and national levels.

The Australian Commission on Safety and Quality in Health Care and the Australian Institute of Health and Welfare (AIHW) developed the specifications for each indicator. These can be found on the AIHW Metadata Online Registry (METeOR) at meteor.aihw.gov.au/content/index.phtml/itemId/723541

The specifications include details such as:

- The data source
- The relevant population
- Inclusions and exclusions (description of items included and excluded, and relevant data source codes)
- The numerator (what is being measured) and denominator (in what population)
- Computation (the calculation that shows how the numerator and denominator relate)
- Disaggregation (the way the data are analysed and presented)
- Data suppression rules (rules that set out what cannot be presented for reasons of confidentiality and/or reliability).

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Four data sources were used in the Atlas:

- Medicare Benefits Schedule (MBS)
- National Hospital Morbidity Database (NHMD)
- National Perinatal Data Collection (NPDC)
- Pharmaceutical Benefits Scheme (PBS).

Analyses are based on the place of usual residence of the patient (patient residence) and not the location of the hospital, clinic or pharmacy where the service was provided. If the patient residence was unknown or invalid, or could not be allocated to an SA3, PHN, or state or territory, the record was included in the total for Australia only.

For MBS and PBS data, the Medicare enrolment postcode is used as a proxy for the patient residence because it corresponds to most people's usual residence. The postcode of the dispensing pharmacy was substituted if the enrolment postcode was unknown or invalid.

Records with unknown or invalid age or sex were excluded from NHMD, MBS and PBS data because they could not be age and sex standardised (see 'Analysis methods'). NPDC data are not standardised, as a result of small numbers.

The AIHW conducted the data extraction and analysis, and presentation of the data in maps and graphs. Analyses in this report have not been adjusted to account for the under-identification of Aboriginal and Torres Strait Islander people in the data sources used. Data by Aboriginal and Torres Strait Islander status should be interpreted with caution because Aboriginal and Torres Strait Islander people are under-enumerated in health data, and there is variation in the under-enumeration among states and territories, and among datasets.

1. Medicare Benefits Schedule data

MBS data are a by-product of the assessment of claims for Medicare benefits by Services Australia, and are provided to the Australian Government Department of Health. The MBS data in this report comprise hospital and non-hospital services provided in financial year 2018–19 for claims processed up to and including 29 February 2020. A service includes any claims resulting in the payment of a Medicare benefit. Bulk-billing incentives and 'top-up' services are excluded from service counts as they are not attendances or procedures in their own right.

MBS data do not include:

- Services provided free of charge to public patients in hospitals
- Services that qualify for a benefit under the Department of Veterans' Affairs National Treatment Account
- Services provided under an entitlement, such as services covered by third-party or workers compensation, where an interim benefit has not been paid, or services provided to repatriation beneficiaries or defence personnel
- Services provided for insurance or employment purposes
- Health screening services, except for services as directed by the minister.

Some Australian residents may access medical services through other arrangements, such as salaried doctor arrangements. As a result, MBS data may underestimate the use of services by some members of the community.

Under Medicare, 'eligible persons' are persons who reside permanently in Australia. This includes New Zealand citizens and holders of permanent residence visas. Applicants for permanent residency may also be eligible, depending on their circumstances. In addition, overseas visitors from countries with which Australia has a reciprocal healthcare agreement might also be entitled to benefits under MBS arrangements.

For some patients, the total count for the services in question may be zero or negative (for example, due to cheque cancellations; see meteor.aihw.gov.au/content/index.phtml/itemId/601800). In these cases, all records of the patient are excluded from the analyses.

A patient's age calculated in MBS data is their age in years on the date the service was provided to them.

2. National Hospital Morbidity Database

The NHMD is a comprehensive dataset containing records for all episodes of admitted patient care from almost all hospitals in Australia. This includes all public and private acute and psychiatric hospitals, freestanding day hospital facilities, and alcohol and drug treatment centres. Hospitals operated by the Australian Defence Force and corrections authorities, and hospitals in Australia's offshore territories are not in scope, but some are included. The data elements included in the NHMD are based on the Admitted Patient Care National Minimum Data Set (APC NMDS). The NHMD includes episodes for admitted patients discharged (separated) between 1 July and 30 June for each financial year.

Data are collected at each hospital from patient administrative and clinical record systems, and forwarded to the relevant state or territory health authorities. The data are provided to the AIHW for national collation annually.

The counting unit for the NHMD is a 'separation'. Separation refers to an episode of admitted patient care, which can be a total hospital stay (from admission to discharge, transfer or death) or a portion of a hospital stay, beginning or ending in a change in the type of care (for example, from acute care to rehabilitation). In this report, separations are referred to as 'hospitalisations'.

A record is included for each hospitalisation, not for each patient. Patients hospitalised more than once in the financial year have more than one record in the NHMD.

The NHMD does not include non-admitted patient care provided in outpatient clinics or emergency departments. If patients in these settings are admitted to hospital subsequently, the care provided to them as admitted patients is included in the NHMD.

Records for which the overall nature of care was 'newborn care with unqualified days only', 'posthumous organ procurement' or 'hospital boarder' were excluded from the analysis.

A patient's age calculated in NHMD data is their age in years on the date they were admitted to hospital.

NHMD data in this report comprise hospitalisations in:

- 2014–15 to 2017–18 for potentially preventable hospitalisations
- 2012–13 to 2017–18 for lumbar spinal surgery
- 2012–13, 2015–16 and 2017–18 for tonsillectomy and myringotomy.

The specifications developed for the potentially preventable hospitalisations are based on the nationally agreed specification, National Healthcare Agreement: PI 18 – Selected potentially preventable hospitalisations, 2021 (meteor.aihw.gov.au/content/index.phtml/itemId/725793).

For potentially preventable hospitalisations, data for New South Wales for 2017–18 in this report may not align with the data published by New South Wales because of changes in admission practices in New South Wales public hospitals in 2017.

For lumbar spinal surgery, the annual number of hospitalisations is not sufficient for reliable reporting at a local level. Three years of data (2012–13 to 2014–15 and 2015–16 to 2017–18) are combined. In this case, rates are based on the number of hospitalisations over three years and the summed population over three years. This method differs from the calculation of an average annual rate. However, the rates from both methods will generally be the same, or very similar, particularly for areas with low proportional population change between years.

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For lumbar spinal surgery, tonsillectomy and myringotomy, some private hospitals in Tasmania admit public patients under a contractual arrangement. There is a small over-count of hospitalisations for these procedures in Tasmania because hospitalisations were recorded by both contracting hospital and contracted hospital.

More information on the APC NMDS for 2012–13 to 2017–18 is available at:

- meteor.aihw.gov.au/content/index.phtml/itemId/466132 (2012–13)
- meteor.aihw.gov.au/content/index.phtml/itemId/491555 (2013–14)
- meteor.aihw.gov.au/content/index.phtml/itemId/535047 (2014–15)
- meteor.aihw.gov.au/content/index.phtml/itemId/588909 (2015–16)
- meteor.aihw.gov.au/content/index.phtml/itemId/612171 (2016–17)
- meteor.aihw.gov.au/content/index.phtml/itemId/641349 (2017–18).

The data quality statements for the NHMD for 2012–13 to 2017–18 are available at:

- meteor.aihw.gov.au/content/index.phtml/itemId/568730 (2012–13)
- meteor.aihw.gov.au/content/index.phtml/itemId/611030 (2013-14)
- meteor.aihw.gov.au/content/index.phtml/itemId/638202 (2014-15)
- meteor.aihw.gov.au/content/index.phtml/itemId/723825 (2015–16)
- meteor.aihw.gov.au/content/index.phtml/itemId/724186 (2016–17)
- meteor.aihw.gov.au/content/index.phtml/itemId/724188 (2017–18).

Components of NHMD analysis

Diagnoses and procedures

Hospital diagnosis and procedure data in this report were reported to the NHMD by states and territories using several editions of the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification* (ICD-10-AM), incorporating the *Australian Classification of Health Interventions* (seventh edition for 2012–13, eighth edition for 2013–14 and 2014–15, ninth edition for 2015–16 and 2016–17, and 10th edition for 2017–18).

The comparability of the coded diagnosis and procedure data can be affected by variations in the quality of the coding, and by state-specific coding standards. This should be taken into account when comparing across states and territories.

Aboriginal and Torres Strait Islander status

For NHMD data, hospitalisations for Aboriginal and Torres Strait Islander people are compared with hospitalisations for other Australians. Other Australians comprise people who were reported as not of Aboriginal and/or Torres Strait Islander origin, and people for whom information on Aboriginal and Torres Strait Islander status was not reported.

In 2011–12, an estimated 88% of Aboriginal and Torres Strait Islander patients were correctly identified in public hospital admission records. The estimated completeness of Aboriginal and Torres Strait Islander identification (with 95% confidence intervals) for public hospitals was 80% (76–83%) in New South Wales, 78% (71–84%) in Victoria, 87% (84–91%) in Queensland, 91% (85–95%) in South Australia, 96% (92–98%) in Western Australia, 64% (53–74%) in Tasmania, 98% (96–99%) in the Northern Territory and 58% (46–69%) in the Australian Capital Territory. It is not known to what extent Aboriginal and Torres Strait Islander patients might be under-identified in private hospital admission records.

There were wide variations in correct identification of Aboriginal and Torres Strait Islander patients by remoteness: estimates ranged from 77% (72–81%) in major cities to 99% (96–100%) in very remote areas. For more information, see *Indigenous Identification in Hospital Separations Data: Quality report* at aihw.gov.au/publication-detail/?id=60129543215

Patient funding status

Apart from potentially preventable hospitalisations, NHMD data are presented separately for hospitalisations according to the funding status of the patient. This reflects the funding arrangements for the patient's hospitalisation, not the sector of the hospital to which they were admitted. Hospitalisations were categorised by funding status of patients – public or private – based on three data elements:

- 'Source of funding' (meteor.aihw.gov.au/content/index.phtml/itemId/649391)
- 'Patient election status' (meteor.aihw.gov.au/content/index.phtml/itemId/326619)
- 'Hospital sector' (meteor.aihw.gov.au/content/index.phtml/itemId/269977).

Hospitalisations for publicly funded patients comprise those for whom the patient funding source was:

- Health service budget (not covered elsewhere)
- Health service budget (due to eligibility under a reciprocal healthcare agreement)
- Health service budget (no charge raised as a result of a hospital decision) AND in a public hospital
- Other hospital or public authority (contracted care) AND a patient election status of 'public' (regardless of hospital sector).

Hospitalisations for privately funded patients comprise those for whom the patient funding source was:

- Health service budget (no charge raised as a result of a hospital decision) AND in a private hospital
- Other hospital or public authority (contracted care) AND a patient election status of 'private' (or not reported)
- Department of Veterans' Affairs
- Department of Defence
- Correctional facility
- Private health insurance
- Workers compensation
- Motor vehicle third-party personal claim
- Other compensation (for example, public liability, common law, medical negligence)
- Self-funded
- Other funding source
- Not known.

For 2016–17, there were data quality issues relating to the recording of patient funding source for patients admitted to private hospitals in the Australian Capital Territory. Data for these private hospitals for 2016–17 were excluded from analysis by patient funding status for the lumbar spinal surgery indicators.

Condition onset flag

For the lumbar spinal surgery indicators, records with infections not noted as arising during the episode of admitted patient care are excluded. There is some variation between states and territories in the overall proportion of records for which a condition was reported as arising during the episode of care. Differences in the types of patients treated by states and territories may account for some of this variation. However, the variation may indicate that there are differences in the allocation of condition onset flag values (meteor.aihw.gov.au/content/index.phtml/itemId/651997). There are also differences in the quality of the provided condition onset flag data has improved since 2013–14, particularly for private hospitals.

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Further information on the quality of the coded diagnosis and procedure data, Aboriginal and Torres Strait Islander status data, and condition onset flag data at the state and territory level is available in *Australian Hospital Statistics 2012–13* at aihw.gov.au/reports/hospitals/australian-hospital-statistics-2012-13 and *Admitted Patient Care: Australian hospital statistics* reports at aihw.gov.au/reports/hospitals/admitted-patient-care-2017-18/report-editions (2013–14 to 2017–18).

3. National Perinatal Data Collection

The NPDC collects data about births in Australia, including births in hospitals, birth centres and the community (such as home births). All live births and stillbirths of at least 20 weeks gestation or at least 400 grams birth weight are included, except in Victoria and Western Australia, where births are included if gestational age is at least 20 weeks or, if gestation is unknown, birth weight is at least 400 grams. NPDC data in this report relate to births that occurred in the calendar year 2017.

NPDC data are based on births reported to the perinatal data collection in each state and territory. Midwives and other birth attendants, using information obtained from mothers and from hospital or other records, complete notification forms for each birth. Each state or territory provides a standard de-identified extract to the AIHW annually to form the NPDC. The data elements in the NPDC include the Perinatal National Minimum Data Set (Perinatal NMDS), the Perinatal National Best Endeavours Data Set (Perinatal NBEDS) and additional data elements. More information on the Perinatal NMDS and NBEDS for 2017 is available at meteor.aihw.gov.au/content/index.phtml/itemId/517456 and meteor.aihw.gov.au/content/index.phtml/itemId/654975, respectively.

Additional data elements are at different stages of standardisation. Some have national data standards but have not been implemented in the Perinatal NMDS or NBEDS, while others do not have common definitions for collecting the data.

The data quality statement for the NPDC for 2017 is available at meteor.aihw.gov.au/content/index.phtml/itemId/716326

Both 'main indication for caesarean section' (meteor.aihw.gov.au/content/index.phtml/itemId/695698) and 'main indication for induction of labour' (meteor.aihw.gov.au/content/index.phtml/itemId/655515) have been collected as voluntary non-standard data elements in the NPDC. Indication for caesarean section was revised and added to the Perinatal NBEDS from 2014 onwards, and indication for induction from 2015 onwards. There are differences in definitions and methods used for data collection of these data elements across states and territories; for this reason, data are not comparable across states and territories.

The reason for a method of birth (caesarean section or induction of labour) is not necessarily related to the reason for early birth. Data on the latter are not available.

In Australia:

- Clinical indications for early birth, such as fetal compromise, were not always recorded as the main indication for caesarean section when the decision to perform a caesarean section was pre-planned in the antenatal period
- Clinical events such as pre-labour rupture of membranes, which may lead to an unplanned early caesarean section, were not always recorded when the decision to perform a caesarean section was pre-planned in the antenatal period.

'Without medical or obstetric indication' includes the following reasons for caesarean section:

- Previous caesarean section
- Previous severe perineal trauma
- Previous shoulder dystocia
- Maternal choice in the absence of any obstetric, medical, surgical or psychological indication.

'Without medical or obstetric indication' includes the following reasons for induction of labour:

- Administrative or geographical indication
- Maternal choice in the absence of any obstetric, medical, fetal, administrative or geographical indication.

In the case of multiple births, gestational age and method of birth are based on the first-born baby.

Analysis was by place of usual residence of the mother and excluded Australian non-residents, residents of external territories, and records in which place of usual residence was not stated.

Components of NPDC analysis

Aboriginal and Torres Strait Islander status

For NPDC data, data for Aboriginal and Torres Strait Islander women are compared with data for non-Indigenous Australian women. Non-Indigenous Australian women comprise women who were reported as not of Aboriginal and/or Torres Strait Islander origin. Women for whom information on Aboriginal and Torres Strait Islander status was not reported were excluded from the analysis.

Data collection methods for Aboriginal and Torres Strait Islander status of the mother may vary between states and territories. In 2017, information on Aboriginal and Torres Strait Islander status was provided for nearly all mothers (99.7%) who gave birth. However, no formal assessment of the quality of Aboriginal and Torres Strait Islander identification in NPDC data has been undertaken. For more information, see *Australia's Mothers and Babies 2017: In brief*, available at aihw.gov.au/reports/mothers-babies/australias-mothers-and-babies-2017-in-brief

Patient funding status

For NPDC data, patient funding status was determined using the additional data element 'admitted patient elected accommodation status'. Public patients are those for whom the admitted patient's (mother's) elected accommodation status was 'public'. Private patients are those for whom the admitted patient's elected accommodation status was 'private'.

Women who gave birth at home or in birth centres attached to hospitals were excluded from the analysis. The specification for this data element is only for births in hospitals.

Some private hospitals in Western Australia admit public patients. The number of women who elected private status might be lower than the number of women admitted to private hospitals. For some records, mainly those related to giving birth before admission, admitted patient elected accommodation status was missing.

For Tasmania, the majority of private hospitals were unable to collect data for indication for caesarean section and indication for induction according to revised specifications introduced from 1 July 2015; this may affect women with an admitted patient elected accommodation status of both public and private. Data have been mapped to the new specifications where possible. Data for public hospitals were collected according to the new specifications.

Caution must be exercised when interpreting these data for Western Australia and Tasmania.

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4. Pharmaceutical Benefits Scheme data

The Australian Government subsidises the cost of a wide range of prescription medicines through two separate schemes: the PBS and the Repatriation Pharmaceutical Benefits Scheme (RPBS). Claims for reimbursement for the supply of PBS- or RPBS-subsidised medicines are submitted by pharmacies through Services Australia for processing, and are provided to the Australian Government Department of Health. Subsidies for prescription medicines are available to all Australian residents who hold a current Medicare card, and overseas visitors from countries with which Australia has a reciprocal healthcare agreement. Patients pay a contribution to the cost of the medicine (co-payment), and the Australian Government covers the remaining cost.

The PBS data in this report are from records of prescriptions dispensed in 2018–19 under the two schemes, where either:

- The Australian Government paid a subsidy
- The prescription was dispensed at a price less than the relevant patient co-payment (under co-payment prescriptions) and did not attract a subsidy.

The PBS data cover all prescriptions dispensed by approved suppliers, including community pharmacies, public and private hospital pharmacies, and dispensing doctors.

The PBS does not cover:

- Over-the-counter purchases (non-prescription)
- Private prescriptions (prescriptions that are not eligible for subsidy under the PBS – for example, prescriptions for medicines that are not listed on the PBS)
- Medicines supplied to admitted patients in public hospitals; however, prescriptions to patients on discharge and non-admitted patients in most states and territories are in scope, except in New South Wales and the Australian Capital Territory.

Patient categories of 'general', 'concessional', 'repatriation' and 'unknown' are included (meteor.aihw.gov.au/content/index.phtml/itemId/604103). Doctor's bag medicines (supply of medicines free to patients for emergency use) and medicines dispensed through alternative arrangements where the patient cannot be identified, such as direct supply to Aboriginal health services, are excluded.

Provision of some medicines may be under-represented in remote areas, particularly in the Northern Territory, that have a high proportion of Aboriginal and Torres Strait Islander people who access medicines through Aboriginal health services.

The number of prescriptions represents the total number of times that a prescribed medicine is supplied to a patient. Prescriptions can be written either as one-off (original with no repeats) or original with repeats. When an original prescription and all the repeats were supplied at the one time, the total number of prescriptions (original and repeats) was counted.

For individual prescriptions where the quantity dispensed varied from the listed maximum quantity, no adjustment was made for increased or reduced quantity supplied. The supply was counted as one prescription.

A patient's age calculated in PBS data is their age in years on the date the medicine was supplied to them.

Polypharmacy is based on PBS prescriptions. It is defined as five or more prescriptions for medicines with different Anatomical Therapeutic Chemical (ATC) codes at the fourth level (for example, A10BA), with each medicine dispensed at least four times in the year. Combination medicines (for example, amiloride/hydrochlorothiazide) are counted as one medicine.

The ATC classification is a classification system for medicines maintained by the World Health Organization (WHO). The ATC classification groups medicines according to the body organ or system on which they act, and their therapeutic and chemical characteristics. More information on the ATC classification system can be found at whocc.no/atc/structure_and_principles

For proton pump inhibitor medicines, medicines that are purchased over the counter without a prescription are out of scope. On 1 May 2019, changes were made to improve the appropriate prescribing of prescription medicines. Medicines were changed from dose category of highest, high and low, to high, standard and low. Esomeprazole 40 mg is in the high dose category; esomeprazole 20 mg, lansoprazole 30 mg, omeprazole 20 mg, pantoprazole 40 mg and rabeprazole 20 mg are in the standard dose category; and lansoprazole 15 mg, omeprazole 10 mg, pantoprazole 20 mg and rabeprazole 10 mg are in the low dose category. More information on the changes is available at nps.org.au/radar/articles/proton-pump-inhibitors-pbs-changes-may-2019

Defined daily dose

Defined daily dose (DDD) is the average maintenance dose per day for a medicine used for its main indication in adults, defined by the WHO. DDDs are assigned to medicines by the WHO Collaborating Centre for Drug Statistics Methodology. Using DDDs allows comparisons of medicine dispensing independent of price, preparation and quantity per prescription. Medicine dispensing expressed in DDDs per thousand people per day (DDDs/1,000/day) allows data for medicines with differing daily doses to be aggregated. However, the DDD is only a unit of measurement and does not necessarily reflect the recommended or average prescribed dose. DDDs are not established for all medicines. More information on DDD is available at who.int/medicines/regulation/medicines-safety/toolkit_ddd/en

Combination medicines

Combination medicines are medicines with multiple active ingredients. The Australian Government Department of Health and WHO differ in their methods for assigning DDDs. The WHO method takes account of the main ingredient only (whocc.no/ddd/definition_and_general_considera/#DDDs), whereas the Department of Health method takes account of each ingredient. The WHO method is used for this report to allow international comparisons, and DDDs/1,000/day in this report may not align with those in the *Australian Statistics on Medicines* report, available at pbs.gov.au/info/statistics/asm/australian-statistics-on-medicines

DDDs are the WHO-assigned DDDs as at January 2019. Information on DDD assignment to medicines is available at whocc.no/atc_ddd_index

5. Analysis methods

Australian population

Most indicators use an estimated resident population from the ABS in the denominator. The exception is early planned births, for which the denominator is number of women who gave birth, from the NPDC.

The ABS produces estimates for the overall Australian population for two time points each year – 30 June and 31 December – at state and territory level. Estimates at 31 December are not available for lower geography levels (such as SA3), and Aboriginal and Torres Strait Islander people. Estimates as at 30 June are appropriate for use when calculating rates based on calendar year data, but they are not appropriate for use when calculating rates based on financial year data. In such instances, estimates for 31 December (the midpoint of the financial year) are needed.

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Population estimates as at 31 December in the relevant year were used as the denominator for indicators based on NHMD data for 2012–13 to 2017–18. For example, population estimates as at 31 December 2017 were used for 2017–18. Where three years of data were combined (for example, 2015–16, 2016–17 and 2017–18), the denominator was the sum of the population estimates as at 31 December 2015, 31 December 2016 and 31 December 2017. Population estimates as at 31 December were calculated as the average of the 30 June population estimates before and after the relevant December.

Population estimates as at 30 June 2018 were used as the denominator for indicators based on MBS and PBS data for 2018–19. ABS population estimates as at 30 June 2019 were not available for calculation of the 31 December population estimates in 2018 at the time the analysis was done.

Aboriginal and Torres Strait Islander status

The population estimates for Aboriginal and Torres Strait Islander people were based on the population estimates from the 2016 Census. For 2016 and earlier, population estimates (2016) and backcast estimates were used. For 2017 onwards, series B population projections were used. More information on series B is available at abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-and-projections-aboriginal-and-torres-strait-islander-australians/latest-release#frequently-asked-questions

The population estimates for non-Indigenous people (other Australians) were derived by subtracting the population estimates for Aboriginal and Torres Strait Islander people from the Australian population estimates.

Derived populations

The population estimates for the tonsillectomy and myringotomy (17 years and under) and lumbar spinal surgery (18 years and over) indicators require separate male and female estimates for Aboriginal and Torres Strait Islander people in the two age groups 15–17 years and 18–19 years. These have not been published by the ABS and were derived based on the combined-sex population estimates for Aboriginal and Torres Strait Islander people, and the 2016 Census counts of Aboriginal and Torres Strait Islander males and females:

- The sex ratios for Aboriginal and Torres Strait Islander people were calculated using the 2016 Census counts of Aboriginal and Torres Strait Islander males and females for each age between 15 and 19, in each state and territory
- The sex ratios were applied to the population estimates for Aboriginal and Torres Strait Islander people to calculate Aboriginal and Torres Strait Islander males and females for each age between 15 and 19, in each state and territory
- The corresponding population estimates for non-Indigenous people were calculated by subtracting the population estimates for Aboriginal and Torres Strait Islander people from the Australian population estimates.

People aged 15–17 years were placed in their own age group, and people aged 18–19 years were placed in the 18–24-year age group.

Age and sex standardisation

This report presents age- and sex-standardised rates, except for the early planned birth indicator, which is presented with percentages. Age and sex standardisation is a method to remove the influence of age and sex when comparing populations with different age and sex structures. For this report, the Australian estimated resident population as at 30 June 2001 was used as the standard population. Some indicators used specific age ranges. In these cases, only the relevant age groups were included in age- and sex-standardisation calculations. Standardised rates based on different age groups and/or standard populations are not directly comparable.

Five-year age groups were used (except for the special cases of the 15–17-year and 18–24-year age groups described above). The age group of 65 years and over was the highest used in standardisation for Aboriginal and Torres Strait Islander status analysis, and 85 years and over was the highest age group used in other analyses. These age groups were adjusted for specific age ranges.

The age and sex standardisation method was adapted from the general age standardisation formula for populations, available at meteor.aihw.gov.au/content/index.phtml/itemId/327276

Geography levels

This report presents data based on the ABS Australian Statistical Geography Standard (ASGS) 2016 SA3 geography, which incorporates the Territory of Norfolk Island for the first time. There are 340 spatial SA3s, covering Australia without gaps or overlaps. SA3s generally have a population of 30,000–130,000 people, and comprise clusters of whole SA2s (meteor.aihw.gov.au/content/index.phtml/itemId/659727). These areas were grouped by PHN area, state or territory, remoteness and socioeconomic status to assist comparisons. For more information on ASGS 2016, see meteor.aihw.gov.au/content/index.phtml/itemId/659352

Allocation to an SA3 was based on the patient's residence, not the place where they received the service. The geographical data that were used to allocate the number of events (hospitalisations, services, prescriptions, DDDs and patients) to an SA3 level varied depending on the data source (Table 1).

Table 1: Geographical data used to allocate an SA3

Data source	Data on geographic location
MBS data	Postcode
NHMD	SA2, when available; otherwise, SA2 was derived from Statistical Local Area* (SLA) or postcode. Between 2012–13 and 2016–17, New South Wales provided SLA instead of SA2, and all other states and territories provided SA2 for most records. In 2017–18, all states and territories provided SA2 for all records. SA2s were derived as follows. For 2012–13: • SA2 was mapped from SLA for all New South Wales records • SA2 was mapped from postcode for some South Australian and some Northern Territory records. For 2013–14: • SA2 was mapped from SLA for all New South Wales records • SA2 was mapped from postcode for some Victorian records. For 2014–15: • SA2 was mapped from SLA for all New South Wales records and some Victorian records. For 2015–16 and 2016–17: • SA2 was mapped from SLA for all New South Wales records and some Victorian records; where mapping could not be undertaken on SLA, postcode was used.
NPDC	Not applicable; data are presented by state or territory of mother's residence
PBS data	Postcode

* This is the geographic area defined in the ABS Australian Standard Geographical Classification (the classification used before the ASGS).

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For 2012–13 to 2016–17, SA2s in the NHMD were collected using the ASGS 2011. For 2017–18, the ASGS 2016 was used. The accuracy of the information on geography (SA2 or other) could vary across and within states and territories, depending on the methods of allocation used by the hospital and the level of detail on the patient's address captured at the service level.

When Statistical Local Area (SLA) or postcode was used, ABS correspondences were used to identify the corresponding SA2 2011 (2012–13 to 2016–17) or SA2 2016 (2017–18). Where a geographic unit overlapped SA2 boundaries, records were randomly allocated to the SA2s, according to the proportion of the unit (postcode or SLA) population in the SA2s. This is standard practice for the NHMD. Because of the random allocation, individual records in SA2s might not be accurate or reliable; however, the overall distribution of records by SA2 is considered useful.

For 2012–13 to 2016–17, the SA2 2011 was aggregated to SA3 2011. The number of hospitalisations at SA3 2011 was mapped to SA3 2016 using an ABS correspondence. Where an SA3 2011 overlapped SA3 2016 boundaries, the number of hospitalisations was apportioned across the SA3s 2016, according to the proportion of the population of SA3 2011 in the SA3s 2016.

Time series

Data were re-run for selected hospitalisation indicators presented in the first and second Atlases for the time-series analyses in this Atlas to allow robust comparison of rates over time. Since the first Atlas was published, in November 2015, there have been a number of minor changes to data specifications, updates to NHMD datasets and changes to improve data analysis, as listed in Table 2. This means that some fourth Atlas results for a given year may differ from those reported in previous Atlases. The results reported in this Atlas should be used for monitoring change over time.

MBS and PBS data

For the MBS and PBS data, an ABS correspondence was used to map postcode to SA3 2016. Where a postcode overlapped SA3 boundaries, the number of events was apportioned across the SA3s, according to the proportion of the postcode population in the SA3s. The overall distribution of events by SA3 is considered to be statistically representative of the split population.

The number of patients was determined at the Australian level. In some cases, patients can have multiple records, with different postcodes recorded. Where this occurred, the patient count was apportioned across the postcodes, according to the proportion of the patient's services or prescriptions in that postcode. The number of patients at postcode level was mapped to SA3 2016 using the same process as above.

Table 2: Changes in analysis methods for time series of hospitalisation indicators

Atlas	Age standardised	Age and sex standardised	Postcode to SA3	SA2 to SA3	ASGS 2011	ASGS 2016	Population estimate
1	✔		✔		✔		30 June
2		✔		✔	✔		30 June
3		✔		✔		✔	30 June
4		✔		✔		✔	31 December*

* Estimated from average of 30 June estimated residential populations from the relevant years.

Primary Health Network areas

PHNs connect health services across a specific geographic area so that patients, particularly those needing coordinated care, have access to a range of services, including primary healthcare services, secondary healthcare services and hospital services. There are 31 PHN areas that cover the whole of Australia.

The number of events at SA3 2016 level was mapped to a PHN area (2017) using an ABS correspondence. The correspondence reflects the reconstructed PHN boundaries based on the ASGS 2016 and the 2011 Census population data (as the weighting unit). Where an SA3 overlapped PHN boundaries, the number of events was apportioned across the PHN areas, according to the proportion of the SA3 population in the PHN areas.

Tasmania, the Australian Capital Territory and the Northern Territory have only one PHN area each. PHN rates may differ from state or territory rates because:

- For the MBS and PBS data, populations are sourced from different data
- For the NHMD, populations and hospitalisations are sourced from different data – PHN hospitalisations are based on SA3 of patient residence, whereas state or territory hospitalisations are based on state or territory of patient residence, including records where the SA3 may not be known.

Post office boxes

For indicators based on MBS and PBS data, six post office box postcodes in major cities were excluded from analyses by SA3, PHN area, remoteness and socioeconomic status. This is because it is difficult to estimate the place of patient residence in these cases. However, these post office box postcodes were included in analyses by state and territory, and at national level.

The following post office box postcodes were excluded:

- 2001 Sydney
- 2124 Parramatta
- 3001 Melbourne
- 4001 Brisbane
- 5001 Adelaide
- 6843 Perth.

Remoteness and socioeconomic analysis

SA3s were grouped into remoteness categories and socioeconomic quintiles based on the ASGS 2016 and the ABS Socio-Economic Indexes for Areas (SEIFA) 2016, respectively. Data by SA3 were assigned to remoteness and socioeconomic groups using this method of grouping. As a result of the method used, national data by remoteness and socioeconomic status in this report may differ slightly from equivalent data calculated using the geographic unit (postcode, SLA or SA2) recorded on the individual records. However, it is expected that the overall patterns would be similar. For more information on SEIFA 2016, see meteor.aihw.gov.au/content/index.phtml/itemId/695778

Derived remoteness categories

The ASGS 2016 remoteness categories divide Australia into broad geographic regions that share common characteristics of remoteness for statistical purposes. These categories divide each state and territory into several regions based on their relative access to services.

The following remoteness categories are used:

- Major cities
- Inner regional
- Outer regional
- Remote
- Very remote.

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The ABS publishes a remoteness category for each SA1, available at abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1270.0.55.005July%202016?OpenDocument. SA1 population was allocated to a remoteness category using the correspondence SA1 to remoteness area, and remoteness category was allocated to an SA3 using the hierarchy of SA1 to SA3 (meteor.aihw.gov.au/content/index.phtml/itemId/659750). The total population in each remoteness category was calculated for each SA3. The remoteness category with the largest population was selected for the SA3.

Derived socioeconomic quintiles

There are four indexes in SEIFA 2016, and the Index of Relative Socio-Economic Disadvantage (IRSD) 2016 was used for socioeconomic analysis. IRSD 2016 ranks areas in Australia according to relative socioeconomic disadvantage. The index is based on information collected in the 2016 Census on different aspects of disadvantage, such as low income, low educational attainment and high unemployment.

A low score indicates a high proportion of relatively disadvantaged people in an area. For example, an area could have a high proportion of people without educational qualifications or working in low-skill occupations. In contrast, a high score indicates a low proportion of relatively disadvantaged people in an area. It is important to note that the index reflects the overall socioeconomic position of the population in an area, and that the socioeconomic position of individuals in that area may vary.

The ABS publishes an index value for each SA1, available at abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/2033.0.55.0012016?OpenDocument. SA1s are ranked according to their level of disadvantage (index value) and grouped into 10 equally populated categories (deciles), with the lowest category reflecting the 10% of areas with the greatest overall level of disadvantage. For each SA3, the deciles were combined to form quintiles, and the number of SA1s in each quintile was calculated. The quintile with the largest number of SA1s was selected as the quintile for the SA3.

Table 3: Number* of SA3s by combined remoteness categories and socioeconomic quintiles

Remoteness	Socioeconomic quintile				
	1 (Low)	2	3	4	5 (High)
Major cities	29	22	35	41	63
Inner regional	37	23	11	11†	
Outer regional	27	10	10†		
Remote and very remote	10	9†			

* Two SA3s (Blue Mountains – South, and Illawarra Catchment Reserve) were not included because the population in these areas was too small for them to be assigned a socioeconomic quintile.
† Numbers are between columns where adjacent socioeconomic quintiles were combined.

Combining remoteness and socioeconomic quintiles

When remoteness categories and socioeconomic quintiles are combined, there are 25 combinations to which SA3s can be assigned. Some categories and quintiles were combined to ensure that each of the final 14 combinations contained at least six SA3s for comparison purposes (Table 3).

In this report, the SA3s in the combined 'remote' and 'very remote' areas are labelled 'remote'. The SA3s with the most overall disadvantage are labelled 'low SES (1)', and the SA3s with the least overall disadvantage are labelled 'high SES (5)'. Where socioeconomic quintiles are combined (for example, quintiles 4 and 5), the SA3s with the least overall disadvantage are labelled 'higher SES' (for example, 4+).

Suppression protocol

Rates based on small numbers of events and/or very small populations are more susceptible to random fluctuations and may not provide a reliable representation of activity in that area. For reliability reasons, areas with volatile rates were suppressed (Table 4). Data that could lead to the identification of individual patients, providers or prescribers were also suppressed. If applicable, consequential suppression was applied to manage confidentiality.

Suppressed SA3s were marked as not published and coloured grey in maps. Data from these suppressions were included in analyses for larger geographic areas – for example, analysis by state and territory, remoteness and socioeconomic status.

Sensitivity analysis

Most data were age and sex standardised. Several SA3s in the Northern Territory were consistently suppressed because the population in one or more age and sex groups for standardisation was less than 30. The Northern Territory requested that consideration be given to relaxing this suppression rule. The AIHW developed a sensitivity analysis to investigate the volatility of the rates for the affected SA3s. For consistency, the sensitivity analysis was applied to all affected SA3s, not just those in the Northern Territory. The procedure to conduct the sensitivity analysis is summarised in Box 1.

Table 4: Rules for suppression of an area of patient residence

Data source	Numerator	Denominator	Denominator for age and sex groups
MBS data	• Fewer than 20 • Fewer than 6 services* • Fewer than 6 patients* • Fewer than 6 providers* • One provider provided more than 85% of services* • Two providers provided more than 90% of services*	• Fewer than 200 (medication management reviews) • Fewer than 1,000 (otherwise)	Fewer than 30
NHMD†	• Fewer than 20 (single year of data) • Fewer than 10 (3 years of data)	Fewer than 1,000	Fewer than 30
NPDC	Fewer than 5*	Fewer than 100	Not applicable; data are not standardised
PBS data	Fewer than 20	Fewer than 200	Fewer than 30

* Suppression rules relate to protecting confidentiality. Suppression rules not marked with an asterisk relate to volatility.
† Additional suppression rules may apply if required by state or territory data custodians.

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Box 1: Summary of sensitivity analysis

For each SA3 that was suppressed because of a small (below-threshold) denominator for one or more age and sex groups (affected SA3), the following analysis was undertaken:

1. The numerator was increased by 1 in each group with a small denominator, to generate a simulated rate
2. All rates, including the simulated rates, were rounded to whole numbers
3. All publishable rates for non-affected SA3s and the simulated rates for affected SA3s were ranked from lowest to highest and split into 10 categories (deciles)
4. All publishable rates for non-affected SA3s and the actual rates for affected SA3s were ranked from lowest to highest and split into deciles
5. The decile of the simulated rate (step 3) was compared with the decile of the actual rate (step 4)
6. Steps 1 to 5 were repeated with a decrease in the relevant numerators by 1. Negative numerators were reset to zero before generating a simulated rate.

All affected SA3s were included in the simulation simultaneously, to generate maximum differences between the deciles calculated using the simulated rates and the deciles calculated using the actual rates (the most extreme scenario). This was a conservative method compared with simulation conducted for one affected SA3 at a time.

The volatility of the actual rate for an affected SA3 was not considered to have a material impact on its decile if either of the following conditions was met in each simulation (increasing or decreasing the relevant numerators by 1):

- There was no difference in the decile for the simulated and actual rates; for example, both simulated and actual rates were in the lowest decile
- There was a difference of one decile, and the simulated rate was not on the cusp of the next decile (the decile that would make the difference become two deciles); for example, the actual rate was in the lowest decile and the simulated rate was in the second decile, and not on the cusp of the third decile.

Where the decile for an affected SA3 was considered to be robust against the volatility of the rate, the rate was published with caution, although it was considered potentially more volatile than other published rates. The rates with caution were not included in the calculation of the national magnitude of variation, and were presented with an asterisk (tables), or as squares or red rectangles (graphs) and dotted areas (maps).

Presentation of rates in Australia maps, capital city area maps and time-series graphs

Rates for SA3s were rounded to whole numbers. Rounded rates were ranked from lowest to highest and split into 10 categories (deciles). The deciles are displayed using various shades of colour, where darker colours represent higher rates and lighter colours represent lower rates. Each decile may not have the same number of SA3s if the number of publishable SA3s is not a multiple of 10. Furthermore, if there was more than one SA3 with the same rate at the boundary of a decile, SA3s with the same rate were assigned to the same decile.

Identification of areas with the highest and lowest rates

SA3s with the highest and lowest rates have been identified for all indicators with data presented by SA3. Having regard to the overall distribution of the rates, selection of SA3s was made from the histogram column by column, with the aim of identifying at least the 10 highest and lowest rate areas for SA3s. The selection of SA3s was also dependent on the width of the column in the histogram, and the choice of what width to use was somewhat arbitrary. For some indicators, fewer than 10 SA3s are listed because inclusion of the next column of the histogram would result in a list of SA3s too long for publication.

Identification of areas with consistently high and low rates

SA3s with consistently high or consistently low rates have been identified. Consistently high or consistently low is defined as those SA3s that fall in the top 10% or bottom 10% of all SA3s for all reporting years.