Technical supplement

Introduction

This is the *Third 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 the Australian Bureau of Statistics (ABS) Statistical Area Level 3 (SA3) geography, as well as 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 www.meteor.aihw.gov.au/content/index.phtml/itemId/708955.

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 or ways in which the data are analysed and presented)
- Data suppression rules (rules that set out what cannot be presented because of confidentiality and/or volatility reasons).

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Unless otherwise stated, indicators relate to all ages.

Analyses are based on the place of usual residence of the patient and not the location of the health service. If the place of usual residence of the patient was unknown or invalid, or could not be allocated to an SA3, or state or territory, the record was included for the total for Australia only. Records with unknown or invalid age or sex were also excluded from the analyses as they could not be age and sex standardised.

Four data sources were used in the Atlas:

1. Medicare Benefits Schedule (MBS) data
2. National Hospital Morbidity Database (NHMD)
3. National Perinatal Data Collection (NPDC)
4. Pharmaceutical Benefits Scheme (PBS) data.

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 Australians in the data sources used. Data by Aboriginal and Torres Strait Islander status should be interpreted with caution because Aboriginal and Torres Strait Islander patients are under-enumerated in health data, and there is variation in the under-enumeration among states and territories.

Medicare Benefits Schedule data

MBS data are a by-product of the assessment of claims for Medicare benefits by the Australian Government Department of Human Services, and are provided to the Australian Government Department of Health. The MBS data in this report comprise services provided in financial year 2016–17 for claims processed up to and including 28 February 2018. 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.

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 Health Care Agreement might also be entitled to benefits under MBS arrangements.

For some patients, the total service count for the services in question may be zero or negative (for example, due to cheque cancellations; see http://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 in MBS data is their age in years on the date the service was provided to them.

Components of MBS analysis

Referral provider specialty

Referral provider specialty is the field of specialty of the authorised health practitioner who requested the service. A provider's specialty is determined by taking into account both the health practitioner's registered medical specialties and their service pattern.

For the thyroid function test indicator, some records did not have a referral provider specialty. In these cases, the missing specialty was replaced with the service provider specialty. This was possible because a high percentage of the services were self-determined by the service provider (data provided by the Australian Government Department of Health). Services are classified as self-determined when they are in addition to those specified in the original request from the referral provider and are of the type that would have otherwise required a referral.

For the cardiac stress tests and imaging indicator, some records of stress echocardiography, myocardial perfusion scans and computed tomography of the coronary arteries did not have a referral provider specialty. This missing specialty was replaced with the service provider specialty because a high percentage of the services from each test type were self-determined by the service provider (data provided by the Department of Health).

For exercise stress tests (also known as stress or exercise electrocardiography [ECG]), no records had a referral provider specialty. Clinical advice indicated that stress echocardiography is usually performed in conjunction with an ECG. Therefore, the referral provider specialty of stress echocardiography records was used as a proxy for ECG records for patients who received stress echocardiography and ECG by the same provider on the same date. For these records, the referral provider specialty was replaced with the referral provider specialty of the stress echocardiography record or with the service provider specialty if the referral provider specialty was missing.

The remaining ECG records were apportioned according to the proportions of general practitioners, cardiologists and other health professionals who requested stress echocardiography in the above scenario (stress echocardiography and ECG performed by the same provider to the same patient on the same date).

National Hospital Morbidity Database

NHMD data used in this report are for 2016–17, except for the thyroidectomy indicator. For each reference year, the NHMD includes episodes for admitted patients discharged (separated) between 1 July and 30 June.

For the thyroidectomy indicator, the annual number of hospitalisations is too low or unreliable to report at a local level, so three financial years of data (2014–15, 2015–16 and 2016–17) 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 results from both methods will generally be the same, or very similar, especially for areas with low proportional population change between years.

For the gastroscopy and colonoscopy indicators, admission practices across states and territories vary. Gastroscopies and colonoscopies can be performed in non-admitted care settings. This should be taken into account when comparing rates across states and territories, and local areas. For 2016–17, the NHMD received no data from the private freestanding day hospital facilities and one overnight private hospital in the Australian Capital Territory. For this reason, data for the Australian Capital Territory should be interpreted with caution for these two indicators.

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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 may be included. The data elements (variables) included in the NHMD are based on the Admitted Patient Care National Minimum Data Set (APC NMDS). More information on the APC NMDS for 2014–15, 2015–16 and 2016–17 can be found at http://meteor.aihw.gov.au/content/index.phtml/itemId/535047, http://meteor.aihw.gov.au/content/index.phtml/itemId/588909 and http://meteor.aihw.gov.au/content/index.phtml/itemId/612171.

For a summary of key data quality issues related to the NHMD for 2014–15, 2015–16 and 2016–17, see *Admitted Patient Care* reports of Australian hospital statistics for the specified years, available at www.aihw.gov.au/reports/hospitals/ahs-2014-15-admitted-patient-care, www.aihw.gov.au/reports/hospitals/ahs-2015-16-admitted-patient-care and www.aihw.gov.au/reports/hospitals/ahs-2016-17-admitted-patient-care.

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 of type of care (for example, from acute care to rehabilitation). In this report, separations are referred to as 'hospitalisations'.

Because a record is included for each hospitalisation, rather than 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.

Hospitalisation 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 in NHMD data is their age in years on the date they were admitted to hospital.

In 2011–12, it was estimated that 88% of Aboriginal and Torres Strait Islander patients were correctly identified as such in public hospital admission records. The estimated (weighted) levels of Aboriginal and Torres Strait Islander identification (and 95% confidence intervals) for public hospitals in 2011–12 were 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 Aboriginal and Torres Strait Islander identification by remoteness, ranging 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 www.aihw.gov.au/publication-detail/?id=60129543215.

Components of NHMD analysis

Diagnoses and procedures

Hospital diagnosis and procedure data used in this report were reported to the NHMD by states and territories using the ninth edition 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, for 2015–16 and 2016–17. For 2014–15, the eighth edition was used.

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. Further information on the quality and comparability of the coded data at a state and territory level can be found in *Admitted Patient Care* reports of Australian hospital statistics for the specified years, available at www.aihw.gov.au/reports/hospitals/ahs-2014-15-admitted-patient-care, www.aihw.gov.au/reports/hospitals/ahs-2015-16-admitted-patient-care and www.aihw.gov.au/reports/hospitals/ahs-2016-17-admitted-patient-care.

Aboriginal and Torres Strait Islander status

For NHMD data, hospitalisations for Aboriginal and Torres Strait Islander Australians 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.

Patient funding status

NHMD data in this report are presented separately for hospitalisations according to the funding status of the patient. This reflects the funding arrangements for the patient's hospitalisation, rather than the sector of the hospital to which they were admitted. Hospitalisations were categorised by funding status of patients – public or private – using the APC NMDS variable 'source of funding'. For further details, see http://meteor.aihw.gov.au/content/index.phtml/itemId/553314.

In some cases, the 'patient election status' (http://meteor.aihw.gov.au/content/index.phtml/itemId/326619) or 'hospital sector' (http://meteor.aihw.gov.au/content/index.phtml/itemId/269977) variables were also used. This is the approach used for reporting national hospital data by patient funding status.

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 Health Care Agreement)
- Health service budget (no charge raised as a result of 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 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-funding
- Other funding source
- Not known.

For 2016–17, there were data quality issues related to the recording of patient funding source for patients admitted to private hospitals in the Australian Capital Territory. For this reason, 2016–17 data for these private hospitals were excluded from analysis by patient funding status.

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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 2015.

NPDC data are based on births reported to the perinatal data collection in each state and territory in Australia. 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 perinatal data collection 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) and additional data elements. More information on the Perinatal NMDS for 2015 can be found at http://meteor.aihw.gov.au/content/index.phtml/itemId/517456.

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

The data quality statement for the 2015 NPDC is available at http://meteor.aihw.gov.au/content/index.phtml/itemId/681798.

The key data element for the early planned caesarean section indicator is 'main indication for caesarean section'. This data element was added to the Perinatal Data Set Specification (http://meteor.aihw.gov.au/content/index.phtml/itemId/510127) from 1 July 2014 and was revised from 1 July 2015. Before July 2014, the data element was provided to the NPDC without a national data standard on a voluntary basis.

Across Australia:

- Data of sufficient quality for publication were available from four states/territories. Data on 'main reason for caesarean section' did not meet the specification for the remaining four states and territories
- Clinical indications for early planned birth, such as foetal 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.

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.

All states and territories have a data item on their perinatal notification form to record Aboriginal and Torres Strait Islander status of the mother, although there are some differences among the states and territories. In 2015, information on Aboriginal and Torres Strait Islander status was provided for nearly all mothers (99.9%) 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 2015: in brief*, available at www.aihw.gov.au/reports/mothers-babies/australias-mothers-babies-2015-in-brief.

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 other Australian women. Other 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.

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 not included in the analysis of patient funding status. The specification for this data element is only for births in hospitals. The exception to this was Northern Territory home birth services that were provided by the hospital with the mother as an admitted patient. The number of these records was small, and they were included in the analysis by the admitted patient elected accommodation status.

Pharmaceutical Benefits Scheme data

The PBS and Repatriation Pharmaceutical Benefits Scheme (RPBS) are the two main Australian Government subsidy schemes for medicines managed by the Department of Health and the Department of Veterans' Affairs, respectively. Claims for reimbursement for the supply of PBS- or RPBS-subsidised medicines are submitted by pharmacies through the Department of Human Services for processing. Subsidies for listed 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 Health Care 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 sourced from claim records of prescriptions dispensed under the PBS or RPBS, where either:

- The Australian Government paid the 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 data do not cover:

- Over-the-counter purchases (non-prescription)
- Private prescriptions (non-listed or prescriptions off-indication prescription medicines, or for overseas visitors who were not eligible for the PBS or RPBS)
- Medicines supplied to admitted patients in public hospitals (although discharge prescriptions dispensed in all states and territories except New South Wales and the Australian Capital Territory are included).

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Patient categories of 'general', 'concessional', 'repatriation' and 'unknown' are included (http://meteor.aihw.gov.au/content/index.phtml/itemId/604103). Closing the Gap prescriptions are also included (www.humanservices.gov.au/organisations/health-professionals/services/medicare/closing-gap-pbs-co-payment-measure). 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.

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 of 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 in PBS data is their age in years on the date the medicine was supplied to them.

The PBS data in this report were extracted in April 2018 and comprise prescriptions dispensed in:

- 2016–17 for three PBS indicators
- 2013–14 to 2016–17 for seven PBS indicators for time series analysis.

PBS and RPBS data maintained by the Department of Health are sourced from prescription information collected by the Department of Human Services as a by-product of the payment system. In 2015, the Department of Human Services implemented changes to the PBS and RPBS claiming arrangements with pharmacies. As a result, from 1 July 2016, new arrangements were put in place to transfer the daily data feed of prescription records from the Department of Human Services to the Department of Health. The Department of Health has advised that these new arrangements may have had a slight impact on 2016–17 prescription volumes that are presented in this report, and this should be taken into account when viewing time series.

For the antipsychotic medicines indicators, the PBS data do not include public hospital prescriptions dispensed through alternative arrangements that were claimed by public hospitals 'offline' for the data up to 2014–15. Clozapine was the only mental health–related medicine in this category. From 2010–11, clozapine claims transitioned to the 'standard' PBS or RPBS payment system. Clozapine offline claiming arrangements ceased completely as of 1 January 2015; all data are included in the standard payment system from 2015–16 onwards.

In addition to prescription counts, patient counts (patients dispensed at least one prescription) and defined daily doses per thousand people per day (DDDs/1,000/day) are also presented in this report.

Defined daily dose

DDD is defined by the World Health Organization (WHO) as the assumed average maintenance dose per day for a medicine used for its main indication in adults. DDDs are assigned to medicines by the WHO Collaborating Centre for Drug Statistics Methodology. Using DDDs allows comparisons of medicine dispensing independent of differences in the price, preparation and quantity per prescription. Expressing medicine dispensing in 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. For the antimicrobial medicines indicator, some antimicrobials do not have a DDD. Further information on DDD is available at www.who.int/medicines/regulation/medicines-safety/toolkit_ddd/en.

As DDD is an adult dose, caution should be exercised when interpreting DDDs/1,000/day for indicators in this report that relate to all ages, or age 17 years

and under. For this reason, DDDs/1,000/day are not calculated for the antibiotics in children indicator.

Combination medicines

For combination medicines (with multiple active ingredients), there is a difference in DDD assignment by the WHO and by the Australian Government Department of Health. The WHO method takes account of the main ingredient of the combination medicine (www.whocc.no/ddd/definition_and_general_considera/#DDDs), whereas the Department of Health method takes account of each ingredient. The WHO method is used in this report to allow international comparisons. Because of this, DDDs/1,000/day in this report may not always align with those published in the *Australian Statistics on Medicines* annual report.

DDDs used in this report are the WHO-assigned DDDs at January 2018. Information on DDD assignment to medicines is available at www.whocc.no/atc_ddd_index.

Components of PBS analysis

Prescriber specialty

Prescriber specialty is the field of specialty of the authorised health practitioner responsible for writing a prescription. A prescriber's specialty is determined by taking into account both the health practitioner's registered medical specialties and their service pattern.

Analysis methods

Populations

All indicators use an estimated resident population in the denominator, except the early planned caesarean section indicator, for which the denominator is women who gave birth by caesarean section from the NPDC.

Where available, populations were based on the estimated resident population from the ABS at the start of the reporting period, based on data from the 2011 and 2016 Census of Population and Housing.

For example, for the reporting period 2016–17, the estimated resident population at 30 June 2016 was used. For the thyroidectomy indicator, where three financial years of data (2014–15, 2015–16 and 2016–17) were used, the population was the sum of the estimated resident population at 30 June 2014, 30 June 2015 and 30 June 2016.

The population of Aboriginal and Torres Strait Islander Australians was based on the projected Aboriginal and Torres Strait Islander population (Series B projection using the Aboriginal and Torres Strait Islander population from the 2011 Census: www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/AEE5C09DB715A1BBCA257CC900143F80/$File/aboriginal%20and%20torres%20strait%20islander%20population%20projections%20fact%20sheet.pdf). The population of other Australians was based on the estimated resident population.

Derived populations

For the thyroidectomy indicator with an age range of 18 years and over, separate male and female estimates for Aboriginal and Torres Strait Islander Australians aged 18 and 19 years were not published by the ABS. They were derived as follows:

- Sex ratios for Aboriginal and Torres Strait Islander Australians were calculated for people aged 18 and 19 years separately, and for each state and territory, based on the 2011 Census counts of Aboriginal and Torres Strait Islander males and females aged 18 and 19 years, in each state and territory
- The sex ratios were applied to the total of Aboriginal and Torres Strait Islander Australians aged 18 and 19 years in each state and territory, to calculate Aboriginal and Torres Strait Islander males and females by single year of age in each state and territory
- The corresponding population of other Australians was calculated by deducting the estimate of Aboriginal and Torres Strait Islander Australians from the estimated resident population.

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Age and sex standardisation

This report presents age- and sex-standardised rates, except for the early planned caesarean section and proton pump inhibitor medicines dispensing for 1 year and under indicators. Age and sex standardisation is a method used 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 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.

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 for all other analyses, except those that used specific age ranges under 85 years.

The general age standardisation formula for populations is available at http://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 between 30,000 and 130,000 people, and comprise clusters of whole SA2s (http://meteor.aihw.gov.au/content/index.phtml/itemId/659727). These areas were grouped by state or territory, remoteness and socioeconomic status to assist comparisons. For further information, see www.abs.gov.au/geography.

Allocation to an SA3 was based on the patient's place of usual residence, rather than 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).

For 2014–15 to 2016–17, SA2s collected in the NHMD were based on the ASGS 2011. 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.

Table 1: Geographical data used to allocate an SA3, 2016

Data source	Data on geographic location
MBS data	Postcode
NHMD	SA2 2011, except New South Wales For New South Wales, SA2 2011 was derived. For 2014–15, SA2 was mapped from Statistical Local Area* (SLA). For 2015–16 and 2016–17, SA2 was mapped from SLA; 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).

For the MBS and PBS data, an ABS correspondence file was used to correspond postcode to SA3 2011. In some cases, a postcode overlapped SA3 boundaries. Where this occurred, the number of events that overlapped boundaries was apportioned across the SA3s, according to the proportion of the postcode population in the SA3s. The number of events at SA3 2011 was then mapped to SA3 2016 using an ABS correspondence file. Consistent with the above, where an SA3 2011 overlapped SA3 2016 boundaries, the number of events that overlapped boundaries was apportioned across the SA3s 2016, according to the proportion of the population of SA3 2011 in the SA3s 2016. Because of this apportionment, events by SA3 2016 for individual records might not be precise; however, the overall distribution of records by SA3 2016 is considered to be statistically representative of the split population.

For the PBS data, the number of patients was determined at the Australian level. In some cases, patients can have multiple records, with different postcodes recorded in those records. Where this occurred, the patient count was apportioned across the postcodes, according to the proportion of the patient's prescriptions in that postcode. The number of patients at postcode level was mapped to SA3 2011 and then mapped to SA3 2016 using the same process as above.

For the NHMD, when Statistical Local Area (SLA) or postcode was used, appropriate ABS correspondence files were used to identify the corresponding SA2 2011. In some cases, a geographic unit overlapped SA2 boundaries. Where this occurred, records for that geographic unit 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 nature of the allocation, the SA2 data for individual records might not be accurate or reliable; however, the overall distribution of records by SA2 is considered useful. The SA2 2011 was then aggregated to SA3 2011. The number of hospitalisations at SA3 2011 was mapped to SA3 2016 using the same process as for MBS and PBS data.

As a result of boundary misalignment between postcode and SA3 2011, the proportions of the population in an SA3 2011 for a number of postcodes either did not equal or did not sum to one in the ABS correspondence file. The same applied to the SA3 2011 to SA3 2016 correspondence file. These proportions were rescaled to make the sum equal to one.

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 level, 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 ABS ASGS 2016 and the ABS Socio-Economic Indexes for Areas (SEIFA) 2016, respectively. For more information on SEIFA, see http://meteor.aihw.gov.au/content/index.phtml/itemId/695778. This method of grouping was applied to the data used in this report to assign the derived SA3s to remoteness and socioeconomic groups. Owing to the method used, national data by remoteness and socioeconomic status presented here 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.

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The ABS 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.

The ABS publishes a remoteness category for each SA1 (available at www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1270.0.55.005July%202016?OpenDocument). The proportion of the population in each remoteness category was calculated for each SA3 using the ABS correspondence file SA1 to remoteness area, and the hierarchical code structure of SA1 to SA3 (see http://meteor.aihw.gov.au/content/index.phtml/itemId/659750). The remoteness category with the highest proportion of population was allocated to the SA3.

The SEIFA Index of Relative Socio-Economic Disadvantage (IRSD) was used for socioeconomic analysis. The SEIFA IRSD is a product developed by the ABS (see *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2016*, www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/6CD4E5CE952FEDBFCA257B3B001AC3E5?opendocument) that 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 www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/2033.0.55.0012016?OpenDocument). The SA1s are then ranked according to their level of disadvantage (index value) and grouped into 10 equal categories (deciles), with the lowest category reflecting the lowest 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 that SA3.

Combining remoteness and SEIFA

When remoteness categories and socioeconomic quintiles are combined, there are 25 possible 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 2).

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+).

Table 2: Number* of SA3s by combined ASGS remoteness categories and SEIFA IRSD quintiles

ASGS remoteness	Quintiles of SEIFA IRSD				
	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 not in proper columns where socioeconomic quintiles were combined.

Suppression protocol

Rates based on low numbers of events and/or very small populations are more susceptible to random fluctuations and therefore may not provide a reliable representation of activity in that area. For this reason, results for some areas were suppressed (Table 3). Results that could lead to the identification of individual patients, providers or business entities were also suppressed. Suppression of areas to protect business entity confidentiality was advised by the Australian Government Department of Health. If applicable, consequential suppression was applied to manage confidentiality. Geographic areas with suppressed results were marked as not published and coloured grey in maps.

Table 3: Rules for suppression of rate for an area of patient residence

Data source	Numerator	Denominator	Denominator for age- and sex-specific 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 1,000	Fewer than 30
NHMD	• Fewer than 20 (single year of data) • Fewer than 10 (three 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 1,000	Fewer than 30

* Suppression rules relating to protecting confidentiality set by the Department of Health. Suppression rules not marked with an asterisk relate to volatility.

Data from suppressed SA3s were included in analyses for larger geographic areas – for example, analysis by state and territory, remoteness and socioeconomic status.

Technical supplement

As most of the 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 used for standardisation was fewer than 30. As a result, 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 of the affected SA3s. For consistency, this sensitivity analysis was conducted for all data at the SA3 level – that is, not just results from Northern Territory SA3s. A refined sensitivity analysis used in this report is summarised in Box 1.

Rates were suppressed because of volatility and/or confidentiality, and publishable rates (including those published with caution) are presented in the report as whole numbers. The exception was the DDDs/1,000/day, which are presented with two decimal places.

Box 1: Summary of sensitivity analysis

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

1. The numerator was increased by 1 in each of the groups with a low denominator to generate a simulated rate.
2. All rates, including the simulated rates, were rounded to whole numbers.
3. All publishable SA3 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 SA3 rates for non-affected SA3s and the actual rates for affected SA3s were ranked from lowest to highest and split into deciles.
5. The allocated decile of the simulated rate (step 3) was compared with the allocated 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 with the actual rates (the most extreme scenario). This was a conservative approach 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):

1. There was no difference in the decile allocated for the simulated and actual rate; for example, both simulated and actual rates were in the lowest decile.
2. There was a difference of one decile, and the simulated rate was not on the cusp of the next decile; 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 has been published with caution. This is because the rate is considered potentially more volatile than other published SA3 rates. The rates published with caution are not included in the calculation of the total magnitude of variation, and are represented in the report with an asterisk (tables), hollow circle or rectangle (graphs) and dotted area (maps).

Presentation of data in Australia maps, capital city areas maps and time series graphs

Rounded rates for SA3s were ranked from lowest to highest and then 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 there was more than one SA3 with the same rate at the boundary of a decile. Where this occurred, SA3s with the same rate were assigned to the same decile.

Identification of highest and lowest rate areas

SA3s with the highest and lowest rates have been identified for each indicator. 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. This is because inclusion of the next column of the histogram would have resulted in a list of SA3s too long for publication.

Identification of consistently high and low rate areas

SA3s with consistently high or consistently low rates have been identified for PBS indicators analysed for 2013–14 to 2016–17. Consistently high or consistently low is defined as those SA3s that fall in the top 10% or bottom 10% of all SA3s for all four years.