



# Notes on data sources and methods

## Australian Heart Maps 2.0

October 2018

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# 1 Background

The Australian Heart Maps provides a platform for comparing heart disease indicators across Australia. These maps show the relationship between disadvantage and heart disease, and as such, will be integral in identifying inequities in heart disease. The maps show hospital admission rates for heart attack (STEMI + NSTEMI), STEMI, NSTEMI unstable angina (chest pain) and heart failure across Australia. The Australian Heart Maps present data by State/Territory, Regional and Local Government Area (LGA). Socio-demographic data and risk factor data are also shown for comparison.

The Australian Heart Maps are based on a similar concept and design to other projects developed by Heart Foundation Victoria and Heart Foundation South Australian. The main differences are that the Australian Heart Maps enable investigating patterns of heart disease across all states and territories and the national maps have been developed using the Tableau software to improve functionality and accessibility.

# 2 Methods

## 2.1 Geographical structures

The Australian Heart Maps present data by various geographical areas including at the state/territory level; Statistical Area Level 4 (SA4); and by Local Government Area. It is intended that data will be presented by additional geographical areas in future iterations of the Australian Heart Maps, e.g. by Public Health Networks (PHN); commonwealth and federal electoral division; and new LGA boundaries when available.

Rates of heart disease related admissions and mortality as well as risk factors are presented at the state and territory and regional levels whereas admissions data by Statistical Area Level 2 (SA2) have been used in order to estimate rates of heart related admissions across LGAs.

Local area units SA2 and SA4 have been designed and developed by the Australian Bureau of Statistics (ABS) [Australian Statistical Geographical Standard 2016 \(ASGS\)](#). SA2s are optimised for demographic data and are designed to represent functional areas outside major urban areas and in regional Australia. Where possible, SA2s are based on gazetted suburbs and localities. In urban areas SA2s largely conform to whole suburbs and combinations of whole suburbs, while in rural areas they define functional zones of social and economic links. Geography is also taken into account in SA2 design. An SA2 has an average population size of 10,000 persons (range: 3,000 – 25,000). SA2s are consistent in population range and are designed to be stable over several population censuses. They also coincide largely with the non-ABS structure of Local Government Area (LGA).

Based on the latest definition from ABS, there are 107 SA4s and in aggregate, they cover the whole of Australia without gaps or overlaps. SA4s represent a mid-level geography reflecting “local regionality”. Mapping heart related admission rates at local levels of geography within a state/territory allows further insight into patterns of heart disease across Australia. Variation at a broad national level is shown for this project using SA4. The SA4 regions are the largest sub-State regions in the main ABS data structures with populations in the range of 100,000 to 500,000 and provide the best sub-state socio-economic breakdown. Under the ASGS, the SA4 classification is used to produce labour force estimates for 88 spatial areas across Australia. Note that the remaining 19 SA4s represent special purpose or migratory offshore areas (n=18) or areas classified as other territories (n=1) and which have zero/small population.

In order to better examine rates within the Australian Capital Territory (ACT), data were further disaggregated at the level of SA3 for this region as it is otherwise only considered as one area. The SA3 unit represents a middle level geography between

SA4 and SA2 and there are 10 SA3s for the ACT. Two SA3s in the ACT (Molonglo and Urriarra - Namadgi) have much smaller populations but are forecast to grow significantly in the coming years and were included when data were available.

Estimates for these regions within the ACT were obtained by aggregating SA2 level data for this particular region. Note that admission sub-type was not available for SA2 data and therefore only all heart-related admissions as a composite indicator could be derived for regions within the ACT.

In total, there were a total of 96 (SA3/4) regions for the admissions indicators; 92 (SA3/4) regions for risk factors (n=90 for High cholesterol); and 94 regions for CHD mortality for which estimates were available and no data suppression criteria applied. For the LGA level estimates, there were a total of 520 areas for the admissions indicators, 423 areas for risk factors, and 380 areas for CHD mortality for which estimates were available and no data suppression criteria applied.

## **2.2 Crude (unadjusted) rates**

Crude (or unadjusted) rates provide an estimate of the rate of specific events that a population experiences during a specified period. It is calculated by dividing the number of events recorded for a given period by the total size of the population at risk of the event in the population. Crude rates are presented for this project as the number of hospital admissions per ten thousand persons (for mortality: per 100,000; for risk factors: per 100) and can be presented at any sub-population of interest, e.g. males in metropolitan Melbourne, etc. Note that the crude rates are useful for understanding service delivery needs in individual areas but no adjustment is made here for confounders and/or strata within a given population, e.g. it does not take into account differences in age distribution between areas.

### 2.3 Age-standardisation of rates

Rates have been *adjusted* (or *standardised*) to remove the effect of factors such as age and enable a fair comparison after removing the effects of those factors. To use an example from the Victorian heart map project: two populations such as North and West metro and the Grampians might be compared in terms of the rate of STEMI separations. However, at least part of the difference in rates between these two populations can be attributed to differences in their age distributions. The comparison is said to be confounded by age. Standardisation (and other adjustment procedures) seeks to provide numbers and comparisons that minimize the influence of age and/or other extraneous factors.

Age-standardisation is a method of adjusting a crude rate to eliminate the effect of differences in population age structures when comparing crude rates for different periods of time, different geographic areas and/or different population sub-groups (e.g., between one year and the next, States and Territories, and/or Indigenous and non-Indigenous populations).

Adjustments are undertaken for each of the populations being examined (or the study population) against a standard reference population.

There are two methods (namely direct and indirect) of calculating age-standardised rates:

- The **direct method** is generally used for comparisons between study groups.
- The **indirect method** is used when calculating rates for small populations where fluctuations in age-specific rates can affect the reliability of rates calculated using the direct method. The indirect method is also useful for situations where age specific data are either limited or unavailable and is a technique commonly used to analyse many health indicators such as mortality data (referred to as the **Standardised Mortality Ratio**).

## 2.4 Age standardisation in the Australian Heart Maps/Data

### *National, state/territory, and regional level data*

The direct method has been used to calculate age-standardised rates (ASR) at the level of state/territory, region, as well as a way to assess health inequalities across different sub-populations of interest including SES quintile, region of birth, indigenous status, and remoteness area.

This provides the means to allow for differences in the age structure of populations and allow valid comparisons between states and territories. Estimates are also produced to measure the gap in rates between Indigenous and non-Indigenous Australians geographical areas as well and assess inequalities in area at the national level.

Using the direct method, which is the method recommended by the AIHW for assessing health inequalities, the ASR for heart disease admission rates is that which would have occurred if the observed age-specific rates for the condition had applied in a given standard population. The Australian resident population at 30 June 2012 (ERP2012) has been used as the standard population in order to directly age standardise rates for this project. Separate ASRs were also produced for males, females, and all persons by applying the relevant age-specific rate to the ERP2012 age-distribution.

Note that in sensitivity analyses (not presented in the Australian Heart Maps) the ASR was also estimated by adjusting for age and sex simultaneously giving age-and-sex-standardised death rates. In line with the AIHW and also as recommended by the World Health Organisation, we focus on age-standardised rates rather than age-sex standardised rates for the headline measures.

### *local level data*

Age-specific data for local government areas within states and territories could not be obtained for this project. That is, total numbers of hospital admissions were not further stratified by age. Furthermore, many LGAs for which estimates are sought, such data are relatively sparse resulting in too few admissions for many age groups at the local area level. As the data needed to facilitate estimating the ASR with the direct method were not available (and in any case would be sparse when stratified by age), the indirect method has been used to calculate Separation Ratios (SRs) for all geographical areas within a state/territory. The SR express the overall experience of a comparison population in terms of the standard population by calculating the ratio of observed to expected numbers in the comparison population.

The SR accounts for differences in population size and age in each sub-population. If the risk of heart attack across all areas was the same, they would all have an SR of one. An SR greater than one indicates the risk of heart attack for a given population is higher than would be expected if it had the same risk profile as the standard reference population. An SR of less than one indicates that the risk of heart attack is lower than what would be expected compared to the standard population.

The ASR for an area is calculated by applying the area level SR to the rate observed crude for the standard population. It is acknowledged here that indirectly standardised rates will not be strictly comparable, e.g. when the age structures of populations are very different. That is, adjusted rates based on this method can only be legitimately compared with the standard and not with each other. Nevertheless, in the absence of age-specific data at the local area level, it still provides a useful statistic to informally make comparisons and a means to better understand regional/local variation in rates of heart disease.

## **2.5 Confidence intervals**

A confidence interval is a range within which it is estimated the true population value lies. Confidence intervals of different sizes can be created to represent different



levels of confidence that the true population value will lie within a particular range. A common confidence interval used in statistics is the 95% confidence interval. In a 'normal distribution', the 95% confidence interval is measured by approximately two standard errors either side of the estimate.

A confidence interval can be used to describe how reliable the data are. The greater the level of confidence required, the wider the range between the lower and upper confidence intervals. A major factor determining the range of a confidence interval is the size of the population.

## **2.6 Confidence intervals used in the Australian Heart Maps Data**

Upper and lower confidence intervals at the 95% level are shown for the standardised rates at the aggregated level of state/territory as well as by SEIFA quintile, region of birth, indigenous status, and remoteness area. The 99% level of confidence has been used for standardised rates and associated ratios for local area estimates (SA4 and LGA). The confidence interval was calculated based on the exact Poisson method for all estimates at the local area level and via a normal approximation for the aggregated national level (state/territory; SEIFA quintile; region of birth; indigenous status; and remoteness area).

## **2.7 Statistical significance**

Statistical significance for estimates derived at the LGA level was based on whether confidence interval for the SR includes 1. This enables a user to assess the statistical significance of the difference between the observed and expected numbers. An instance where the lower confidence interval limit is above 1 indicates that the observed number of admissions for a sub-population is significantly higher than what would be expected when compared to the standard population. Conversely, an instance where the upper confidence interval limit is below 1 indicates that the observed number of admissions for a sub-population is significantly lower than what would be expected when compared to the standard population.

Statistical significance is indicated for the standardised rates presented in the Australian Heart Maps. Admission rates were statistically significant at the 99% confidence level are colour coded as shown in the data viz with red/green for significantly above/below the national average.

## **2.8 Rankings**

For regional data summaries, admission rates have been ranked in order from 1 (highest rate) to the *maximum* number of areas for SA4 (SA3 for the ACT: see comment in section 2.1 above) for both the crude and adjusted estimates. For LGA, the total number of areas for which the rate was estimable and which did not have data suppression applied depends on the indicator. For example, there were 520 LGAs where rates are presented.

## **2.9 Metrics used in the Australian Heart Maps**

Data analysis and presentation of the Hospital admissions indicators (listed below in the next section) were produced for average annual crude (unadjusted) rates per 10,000 population (all ages); average annual indirectly age-standardised rates (ASRs) per 10,000 population (all ages); and associated standardised ratios (SRs). Age adjustment for the SA4 level estimates is based on comparing to the national Australian standard population and, for LGA estimates, both versions of estimates with comparison against the state/territory specific standard population as well as national standard population. Note that age-standardised data enable comparisons between areas as they eliminate the effect of differences in population age structure. For further information, refer to the 'Age-standardisation of rates' information above.

The data for all indicators were presented based on the combined data from four financial years (2012/12 to 2015/16). The denominators used to calculate the indirectly age-standardised and crude rates are the ABS Estimated Resident Populations (ERPs) for the relevant periods.

## **3 Data sources and indicators**

### **3.1 Hospital admissions counts at the local area level**

Data were available from the AIHW based on the ASGS (2011) by SA2 for males and females combined which were aggregated by LGA for subsequent analysis.

Population weighted correspondence data available from the ABS were used to derive numbers of admissions by LGA based on ASGS (2016). Note that whilst SA2 does not map perfectly to LGA, over 80% of SA2s do fit entirely within an LGA. Data on the remaining (<20%) of SA2s were split according to the SA2:LGA correspondence data.

### **3.2 Hospital admissions counts at the regional area level**

Data were available from the AIHW based on the ASGS (2011) by SA4 for males and females separately and by age category. These data could also be obtained from the AIHW broken down by Indigenous status which enable separate estimates for regions where sufficient data were available. Population weighted correspondence data available from the ABS and admissions data at the SA2 level were used to derive numbers of admissions by SA4 based on ASGS (2016). That is, to provide separate estimates for the north and south areas within the Western Australian Outback.

### **3.3 Census data**

Estimates made available by the ABS for the Estimated Resident Population (ERP) have been used in order to define the denominator and standard populations for all analyses in this project. Specifically:

- ERP estimates by SA2 (ASGS 2016) were used for to define the populations by SA4 and LGA during the relevant time periods (2012-13 to 2015/16).
- Population weighted SA2 to LGA correspondence data were applied to the SA2 ERP to estimate rates by LGA from SA2 level data<sup>1</sup>
- Population weighted SA2 to Remoteness area correspondence data were applied to the SA2 ERP to derive the denominator for analyses involving remoteness area.
- ABS estimates of ERP by Country of birth Estimated Resident Population (Recast) at 30 June 2012 were used as the denominator for analyses involving remoteness area.
- ABS estimates of ERP for the Aboriginal and Torres Strait Islander Population were obtained from the ABS “Projections: Persons by Age by Sex by State/Territory (2011-26); 2011 Census based (Confidentialised)”.

### **3.4 Hospital admissions data**

The data presented are the number of separations, or completions of the episode of care of a patient in hospital, where the completion can be the discharge, death or transfer of the patient, or a change in the type of care (e.g., from acute to rehabilitation). In the Australian Heart Maps the term ‘admission’ is used in place of the more technical ‘separation’.

The following admissions were excluded from the dataset provided by the AIHW:

- Separations for which the care type was reported as Newborn with no qualified days, and records for Hospital boarders and Posthumous procurement have been excluded.
- Admissions where the mode of admission is Admitted patient transferred from another hospital are excluded.

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<sup>1</sup> Information Paper: Converting Data to the Australian Statistical Geography Standard, 2012 (cat. no. 1216.0.55.004).

The hospital admission data comprise separations by principal diagnosis only. The ICD codes are documented separately under the relevant Indicator information in section 3.5 below.

Note that, as detailed in many reports produced by the AIHW, single events involving heart disease can result in more than one episode in hospital due to transfers and readmissions. For this reason, hospital records are likely to overestimate the number of new cases of heart disease and it is not possible, at the national level, to avoid such over-counting. In order to reduce over-counting of cases for the Australian Heart Map project, records have been omitted in which the mode of admission is the result of a transfer between hospitals. Whilst such records would be useful in determining hospital burden, e.g. length of stay etc, excluding those records should provide a more reliable assessment of variation in rates across different areas and sub-populations. In particular, transfers will account for a high proportion of admissions for heart disease where procedures such as angiograms tend to be conducted in hospitals within major cities and inner regional areas. Therefore, exclusions of transfers from calculation of rates here should provide a less biased comparison of rates across areas with disparate geographies and/or remoteness. The subject of hospital transfers is an area that will receive greater interest for this project and the intention is to obtain more data and carry out further analyses to better understand the level and regional patterns of hospital transfers.

### **3.5 Confidentialisation**

To protect individuals' privacy, numbers and rates are not presented for (LGA) areas where the number of admissions was less than 10; or where the population was less than 1000. For analyses involving hospitalisation rates for Aboriginal and Torres Strait Islander Peoples, data have been suppressed where the population in any age group is less than 100 and/or the total population is less than 30 or there are fewer than 80 admissions during the 2012-2016 period.

Due to issues in relation to the potential deduction of confidentialised nos. several additional steps were carried during the analysis of data presented in the Australian Heart Maps version 2.0. For estimates of rates at the level of LGA, a small number of SA2s (n=8 of the 2,310 SA2s) were removed prior to calculations of admission rates. These SA2s had a data suppression applied prior to the data extract and corresponding data on the numerator (number of admissions) and denominator (ERP) were excluded. This step in the analysis was applied to conservatively maintain confidentiality for several of the smaller populations where sex specific data are not available.

Finally, only the composite outcome of all heart-related admissions is presented at LGA level overall, i.e. not broken down by heart disease sub-type and/or males and females separately. It is planned that a more granular level of estimation will be possible for future iterations of the Australian Heart Maps analyses once more data is available.

### **3.6 Health Indicators**

All indicators involving hospital admissions are based on 4 years of data (2012/13 to 2015/16).

Heart Attack = STEMI AND NSTEMI (added together)

#### **Heart attack - STEMI (ST segment elevation myocardial infarction)**

##### **Indicators:**

- Hospital admissions for STEMI, males (all ages)
- Hospital admissions for STEMI, females (all ages)
- Hospital admissions for STEMI, persons (all ages)

**Indicator detail:** Also known as a myocardial infarction, a heart attack is caused by a sudden blockage of a coronary artery supplying blood to the heart, and results in

damage to the heart muscle. Risk factors for heart attack include smoking, being overweight, insufficient physical activity, high blood pressure, high blood cholesterol, diabetes and depression.

ICD codes: I21.0, I21.1, I21.2, I21.3, I22.0, I22.1, I22.8, I22.9

### **Heart attack - NSTEMI (Non-ST segment elevation myocardial infarction)**

#### **Indicators:**

- Hospital admissions for heart attack: NSTEMI, males (all ages)
- Hospital admissions for heart attack: NSTEMI, females (all ages)
- Hospital admissions for heart attack: STEMI, persons (all ages)

**Indicator detail:** Non-ST segment elevation myocardial infarction (NSTEMI) is a less severe form of heart attack caused by a partial blockage of a coronary artery supplying the heart and results in less damage to the heart muscle.

ICD codes: I21.4, I21.9

### **Unstable angina**

#### **Indicators:**

- Hospital admissions for unstable angina, males (all ages)
- Hospital admissions for unstable angina, females (all ages)
- Hospital admissions for unstable angina, persons (all ages)

**Indicator detail:** Angina is chest pain or discomfort caused by poor blood flow to the heart muscle, usually due to narrowing of coronary arteries. Unstable angina occurs at rest or worsens over time and may lead to a heart attack.

ICD codes: I20.0

### **Heart Failure**

#### **Indicators:**

- Hospital admissions for heart failure, males (all ages)
- Hospital admissions for heart failure, females (all ages)
- Hospital admissions for heart failure, persons (all ages)

**Indicator detail:** Heart failure is an ongoing condition in which the heart cannot pump blood around the body as well as normal. Heart failure may cause tiredness, difficulty breathing and/or swelling of the ankles and belly. Common causes of heart failure are coronary heart disease (narrowing of coronary arteries), previous heart attack, high blood pressure and diseases which damage the heart muscle.

ICD codes: I11.0, I13.0, I13.2, I42.0, I42.1, I42.2, I42.3, I42.4, I42.5, I42.6, I42.7, I42.8, I42.9, I43.0, I43.1, I43.2, I43.8, I50.0, I50.1, I50.9

### **All heart related admissions**

#### **Indicators:**

- Hospital admissions for all heart related admissions, males (all ages)
- Hospital admissions for heart related admissions, females (all ages)
- Hospital admissions for heart related admissions, persons (all ages)

**Indicator detail:** A composite outcome where STEMI, NSTEMI, Unstable Angina, and Heart failure are all combined.

### **3.7 Heart disease risk factor data**

Estimates for risk factor prevalence (%) are presented at the SA4 level for all states and territories except ACT where rates are presented by SA3. Estimates are also



presented by LGA. The risk factor data has been sourced from the Public Health Information Development Unit (PHIDU) at Torrens university. These data are part of the PHIDU Social Health Atlas series. Refer to the PHIDU data and methods for further details. <sup>2</sup>

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<sup>2</sup> Public Health Information Development Unit (PHIDU). Social Health Atlas Australian atlas: Local Government Areas. Health risk factors - adults (modelled estimates). Adelaide: PHIDU, Torrens University; 2014-15. At: <http://phidu.torrens.edu.au/social-health-atlases/data#social-health-atlases-of-australia-local-government-areas> (accessed July 2018).

### **Risk Factor Definitions**

| <b>Risk factor</b>    | <b>Definition and data source</b>  |
|-----------------------|--|
| Obesity               | Based on adults with BMI equal to or greater than 30.00.   |
| Smoking               | Based on adults who smoke (includes daily smokers and those who smoke 'at least once a week, but not daily' and current smoker 'less than weekly').  |
| Insufficient Exercise | Based on self-reported responses, reported to interviewers in the 2014–15 AHS. Data from the AHS for exercise were collected for fitness, sport or recreation in the week prior to being interviewed. Exercise level was calculated 'Duration of exercise (minutes) x Intensity factor (walking for fitness = 3.5, moderate = 5, vigorous = 7.5): low exercise refers to scores of less than 800 |
| Hypertension          | Defined as measured systolic BP of 140 mmHg or more or diastolic BP of 90 mmHg or more, irrespective of the use of BP medication.  |
| High Cholesterol      | Defined as high total cholesterol indicated by levels $\geq$ 5.5 mmol/L.   |

### **3.8 Analysis by indigenous status**

Hospital admissions data were disaggregated by Indigenous status at the regional (SA4) level. Data were age standardised using the direct method. In order to derive rates and ASRs, a set of population estimates by Indigenous status was obtained from PHIDU. These population estimates were developed by Prometheus Information to enable better estimates of population by Indigenous status by year,

age category, and sex, at the Statistical Areas Level 2 (SA2) across Australia. The Indigenous population estimates were summed to ABS Estimated Resident Populations (ERPs) for the Indigenous population at the SA4 level for 2012 to 2016.

### **3.9 Mortality data**

Estimates for CHD mortality are presented at the SA4 level for all states and territories except ACT where rates are presented by SA3. Estimates are also presented by LGA. The risk factor data has been sourced from the AIHW. For further details regarding the definitions and methods used by AIHW, refer to the MORT books for further details regarding data and methods used to derive estimates for CHD mortality.<sup>3</sup>

A specific request was made to AIHW MORT to obtain CHD mortality data by Indigenous status at the state/territory level.

### **3.10 Demographic and social data**

All socio-demographic data used to derive hospital admission rates as well as social data were obtained from the ABS. Definition of each social indicator is defined as follows:

#### **Indigenous Status**

Whether a person identifies as being of Aboriginal or Torres Strait Islander origin.

#### **SES**

Socioeconomic status (SES) groups are based on the Australian Bureau of Statistics Index of Relative Socio-Economic Disadvantage (IRSD) for the area of usual residence (SA2) of the patient. These SES groups represent approximately 20% of the national population, but do not necessarily represent 20% of the population in each

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<sup>3</sup> AIHW (Australian Institute of Health and Welfare) 2018. MORT (Mortality Over Regions and Time) books: Local Government Area (LGA), 2012–2016. Canberra: AIHW

state or territory. Disaggregation by SES group is based on the patient's usual residence, not the location of the hospital.

### **Country of Birth**

The ABS use the Standard Australian Classification of Countries (SACC) (cat. no. 1269.0) when collecting, aggregating and disseminating Country of Birth data. The highest level of aggregation (major group) has been used here to report on admission rates by 9 groups with Australia and Oceania combined into one group 'Australia and Oceania'.

Classification for Country of Birth (COB) categories is based on the standard Australian Classification of Countries (SACC) (cat. no. 1269.0) developed by the ABS for use in the collection, storage, and dissemination of all Australian statistical data classified by country. It provides a single classificatory framework for both population and economic statistics. The highest level of aggregation (major group) has been used here to report on admission rates by 9 groups as listed below with Australia and Oceania combined into one group 'Australia and Oceania'.

1. Oceania
2. North-West Europe
3. Southern and Eastern Europe
4. North Africa and the Middle East
5. South-east Asia
6. North-east Asia
7. Southern and Central Asia
8. Americas
9. Sub-saharan Africa

For further details involving this classification, refer to the ABS Standard Australian Classification of Countries, 2011, Version 2.3, Cat. No. 1269.0 (SACC 2011).

### **Remoteness Area**

The Remoteness Structure is a geographic classification designed by the ABS. The purpose of the Remoteness Structure is to divide Australia into broad geographic regions that share common characteristics of remoteness for statistical purposes. For more information refer ABS Remoteness Structure (ASGS 2016). Remoteness Area (RA) categories are as follows:

1. Major cities
2. Inner Regional
3. Outer Regional
4. Remote
5. Very Remote