# Appendix

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## Appendix: Supplementary information

### Data extraction

Data regarding heath service utilisation drew upon hospital separation data held within the National Hospital Morbidity Database (NHMD) under custodianship of the Australian Institute of Health and Welfare (AIHW). This database collects all episodes of care from public and private hospitals across all states and territories, and includes basic demographic information such as location of residence, as well as procedural components of care. All admissions and cardiac-specific admissions were used, excluding separations for same-day dialysis. Since 3 state jurisdictions did not report data for private hospital admissions, private hospital and total admissions were not available for 3 Medicare Locals (Tasmania, Northern Territory and the Australian Capital Territory).

Acute coronary syndrome separations were identified using the ICD-10AM primary diagnosis code of I20 and I21. In addition to procedural data from the NHMD, procedures undertaken in the context of ambulatory care (e.g. outpatient angiography and day-case percutaneous coronary interventions [PCI]) used data from the Medicare Benefits Schedule held by Medicare Australia. In both datasets, angiography procedures were identified with the procedural codes of 38215 and 38218, while PCI were identified using codes 38300–38318, and coronary artery bypass grafting (CABG) relied on codes 38497–38504. Some overlap between angiography and PCI rates exists, and angiography rates reported are confined to those episodes without a concurrent PCI code reported, while those with concurrent codes contributing the PCI rate. Furthermore, to mitigate against 'double-counting' of angiography procedures conducted among private patients that may have been recorded in both the NHMD and MBS, the MBS angiogram rates were reduced by the relative proportion of PCI procedures estimated to be reported to both MBS and NHMD, since PCI is rarely performed

as an outpatient procedure. This adjusted MBS rate for angiography was then combined with the NHMD rates to derive the total angiography rate for each Medicare Local. The quality of administrative coding from MI, coronary angiography and coronary revascularisation is high and regularly audited. Mortality was determined using the National Mortality Database (NMD), which records the deaths of all Australians in all jurisdictions and for this analysis coronary artery disease mortality was used.

For analysis of NHMD and NMD data, with geographical information on Statistical Local Area (SLA), the concordance file provided details of the corresponding Medicare Local for each SLA, and the SLA's surface area (in square kilometres) contained in that Medicare Local. In the majority of cases, the SLA mapped directly to a Medicare Local, however there were twelve SLAs that crossed over more than one Medicare Local. The AIHW allocated records with these SLAs to a Medical Local based on the proportion of the surface area of the SLA that was contained in each Medicare Local, not the proportion of the SLA population in the Medicare Local.

For the purposes of this analysis, individual episodes of care were aggregated according to their designated Medicare Local based on their stated place of residence, using postcode data or SLAs. Furthermore, Australian Bureau of Statistics (ABS) Estimated Resident Population (ERP) data were used as the denominator for the majority of rates provided. The ERP is an official estimate of the Australian population by 5-year age and sex, based on census counts by place of usual residence, and updated to take into account births, deaths and overseas migration.

**Angiography likelihood during suspected ACS presentations**

As an indicator of local clinical practice within each region, the "likelihood that a suspected ACS patient receives an coronary angiography compared with the national average", was

estimated from the SNAPSHOT ACS clinical audit published elsewhere.[1,2] In brief, 481

hospitals across Australia and New Zealand (91% of eligible hospitals) participated and 286

of these reported treating at least one patient, with a total of 4387 patients enrolled in the 2

week period from 14 May 2012. Data from the Australian SNAPSHOT cohort ($n = 3381$)

was used in this analysis to estimate the risk profile for each Medicare Local with respect to

the Global Registry of Acute Coronary Events (GRACE) score, in hospital treatments and

outcomes. To estimate the likelihood of angiography within the hospitals serving each

Medicare Local, SNAPSHOT patients were attributed to the hospital of initial presentation,

and data for hospitals from the same Medical Local area was aggregated. We calculated the

proportion of patients undergoing angiography and the average GRACE risk score for each

Medicare Local. This proportion of angiography and ACS patients was adjusted for the

difference in GRACE score between each Medicare Local and the national average using the

odds ratio for increased likelihood of angiography per point of GRACE score derived for the

whole study. i.e. local likelihood of angiography in ACS patients = local angiography

proportion/$1.005^{(\text{local GRACE score} - \text{national GRACE score})}$.

**Bayesian linear regression**

Given the relatively small numbers of Medicare locals, and the availability of prior data to

evaluate these relationships, a Bayesian linear regression approach with a Metropolis–

Hastings algorithm was used to adjust for the location of the Medicare Local (defined by the

AIHW peer group classification: metropolitan, regional or rural modelled as indicator

variables) with 95% "credible limits" reported. Within these models, the prior distributions

for mortality and angiography rates were not assumed and were modelled using non-

informative Jeffreys priors. ACS rates and the likelihood of angiography for patients with

suspected ACS were informed by prior available data including from historical clinical

registries conducted in Australia and the concurrent cohort of New Zealand patients in the

SNAPSHOT ACS dataset. For SEIFA, geographic location, and admissions to public and private hospitals, "flat", non-informative and therefore conservative prior distributions were used in the analysis. Each model explored influence of the socioeconomic indicators, chronic health indicators, measures of health access and health service utilization measures as well as the location of the Medicare local (metropolitan, regional or rural as indicator variables). With the exception of rural location, all non-significant associations were removed before reporting. All analyses were undertaken using Stata 14.0 and a probability value of < 0.05 was considered statistically significant.

## References

1 Chew DP, French J, Briffa TG, et al. Acute coronary syndrome care across Australia and New Zealand: the SNAPSHOT ACS study. *Med J Aust* 2013; 199: 185–191. https://www.mja.com.au/journal/2013/199/3/acute-coronary-syndrome-care-across-australia-and-new-zealand-snapshot-acs-study
2 Ellis C, Gamble G, Devlin G, et al. The management of acute coronary syndrome patients across New Zealand in 2012: results of a third comprehensive nationwide audit and observations of current interventional care. N Z Med J 2013; 126: 36–68.

**Table of variables**

|  | Units | Model | Source |
|---|---|---|---|
| **Angiography** | Per 100,000, mean, SD | linear | NHMD and MBS |
| **PCI** | Per 100,000, mean, SD | linear | NHMD and MBS |
| **CABG** | Per 100,000, mean, SD | linear | NHMD |
| **MI incidence** | Per 100,000, mean, SD | linear | NHMD |
| **ACS incidence** | Per 100,000, mean, SD | linear | NHMD |
| **Total CAD deaths** | Per 100,000, mean, SD | linear | NMD |
| **Peer Group** | Metro, Regional, Remote | Indicator | AIHW |
| **SEIFA** | Score, mean, SD | linear | PHIDU |
| **Indigenous Status** | %, mean, SD | linear | PHIDU |
| **Long-term Unemployment** | %, mean, SD | linear | PHIDU |
| **Private Insurance** | %, mean, SD | linear | PHIDU |
| **Diabetes** | %, mean, SD | linear | PHIDU |
| **Hypertension** | %, mean, SD | linear | PHIDU |
| **Smokers** | %, mean, SD | linear | PHIDU |
| **Obesity** | %, mean, SD | linear | PHIDU |
| **Hypercholesterolaemia** | %, mean, SD | linear | PHIDU |
| **Chronic CV condition** | Per 100,000, mean, SD | linear | PHIDU |
| **Premature IHD deaths,** | Per 100,000, mean, SD | linear | PHIDU |
| **Delay in Medical Consultation due to cost** | %, mean, SD | linear | PHIDU |
| **Primary Care Physicians** | Per 100,000, mean, SD | linear | PHIDU |
| **Specialist Physician** | Per 100,000, mean, SD | linear | PHIDU |
| **Primary care health check** | Per 100,000, mean, SD | linear | PHIDU |
| **Public Cardiac admissions** | Per 100,000, mean, SD | linear | NHMD |
| **Private Cardiac admissions** | Per 100,000, mean, SD | linear | NHMD |
| **ED presentations** | Per 100,000, mean, SD | linear | NHMD |

CABG = coronary artery bypass grafting; CV = cardiovascular; ED = emergency department; IHD = ischaemic heart disease; MBS = Medical Benefits Schedule; NHMD = National Hospital Morbidity Database; NMD = National Mortality Database; PCI = percutaneous coronary intervention; PHIDU = Public Health Information Development Unit; SEIFA = Socio-Economic Indexes for Areas.