NATIONAL CARDIAC REGISTRY

ANNUAL STATUS REPORT 2022

NATIONAL CARDIAC REGISTRY

A/Prof Jeffrey Lefkovits, Dr Rohan Poulter, Ms Rhiannon Jeffery, Ms Jasmine Pyyvaara, Ms Angela Brennan, Ms Harriet Carruthers, Mr Mark Lucas, Mr Milinda Abayawardana and Dr Diem Dinh on behalf of the Registry Steering Committee.

National Cardiac Registry Annual Report 2022. February 2023.

Report No 2, pages 80.

Any enquiries about, or comments regarding this publication should be directed to:

The Registry Project team
C/- School of Public Health and Preventive Medicine
Monash University
553 St Kilda Road
Melbourne VIC 3004
Phone: +61 3 9903 0984
Email: info@nationalcardiacregistry.org.au
Website: https://nationalcardiacregistry.org.au/

The National Cardiac Registry is supported by funding from the Australian Government Department of Health.

Data period: 1 January 2021 – 31 December 2021

Contents

Message from the Representative of the Indigenous Committee 8
Message from the Steering Committee Consumer Representative 9
Message from the Heart Foundation 10
Message from Australian Commission on Safety and Quality in Health Care 11
Message from the Chair of the Board 12
Message from the Steering Committee 13
Executive Summary 14
1. Key Findings 15
2. Improving Cardiovascular Health and Outcomes 16
3. A National Approach 17
4. The Next Steps 17
5. Towards a National Target 20
6. Pathway to Dynamic Reporting 22
   6.1 Platform Design 22
   6.2 Data Management 23
   6.3 Security 23
   6.4 Ethics 23
7. Measuring Quality and Performance 26
8. Variation in Healthcare 27
9. Coverage 28
10. Clinical Findings 33
   10.1 Patient Characteristics 33
   10.2 Clinical Presentation 36
   10.3 Clinical Presentation with Cardiogenic Shock and/or OHCA 37
   10.4 Access Site 38
   10.5 Procedural Success 39
11. Percutaneous Coronary Intervention for Acute STEMI 42
   11.1 Prehospital Notification 47
   11.2 In-Hours Versus Out-Of-Hours Presentation 49
   11.3 Times from Symptom Onset to First Medical Contact, Diagnostic ECG and Reperfusion 49
   11.4 Radial Access In Primary PCI 53
12. In-Hospital Outcomes following PCI 55
   12.1 In-Hospital Mortality 55
   12.2 In-Hospital Major Bleeding 57
   12.3 Outcomes by Clinical Presentation and Hospital Characteristics 59
13. Discharge Medications and Secondary Prevention Programs 61
   13.1 Compliance With Discharge Medication Prescribing 61
   13.2 Referral to Cardiac Rehabilitation 61

14. 30-Day Outcomes 64
14.1 30-Day Mortality 64
14.2 30-Day Unplanned Revascularisation 66
15. Conclusions and Future Plans 69
16. Acknowledgements 70
17. The Registry Project Management Team 70
18. Acronyms 71
19. Glossary 72
20. Governance Structure 73
20.1 National Cardiac Registry Audit and Risk Committee 74
20.2 National Cardiac Registry Indigenous Committee 74
20.3 National Cardiac Registry Variation Oversight Committee 75
20.4 National Cardiac Registry Steering Committee 75
20.5 The NCR Board 78

List of Figures

Figure 1: 2021 Public Hospital Participation Rates 20
Figure 2: The Registry Digital Platform Key Features 22
Figure 3: The Registry Data Flow 24
Figure 4: The Registry Quality Indicators for PCI 26
Figure 5: The Registry PCI cases numbers January 2019 to December 2021 28
Figure 6: Eligible participants 29
Figure 7: Age and sex distribution (%) of patients undergoing PCI 31
Figure 8: Percentage of cases in-hours and out-of-hours by clinical presentation 34
Figure 9: PCI cases by clinical presentation 34
Figure 10: Shock and/or OHCA cases by hospital volume 35
Figure 11: Arterial access route by hospital 36
Figure 12: Primary PCI cases as a percentage of overall case numbers by hospital 41
Figure 13: Door-to-reperfusion time for primary PCI cases by hospital 43
Figure 14: Percentage of primary PCI cases with door-to-device time of ≤90 min by hospital 44
Figure 15: Percentage of primary PCI cases with door-to-device time of ≤60 min by hospital 45
Figure 16: Percentage of primary PCI cases with door-to-device time ≤90 min by hospital - prehospital notification vs no prehospital notification 46
Figure 17: Percentage of primary PCI cases with door-to-device time of ≤90 min by hospital - in-hours vs out-of-hours presentation 48
Figure 18: Median times from symptom onset to PCI mediated reperfusion 49
Figure 19: First medical contact to diagnostic ECG time for primary PCI cases by hospital 50
Figure 20: First medical contact to PCI-mediated reperfusion time for primary PCI cases by hospital 51
Figure 21: Diagnostic ECG to reperfusion by hospital 51
Figure 22: Radial access rate in primary PCIs by hospital 52
Figure 23: In-hospital mortality rate by hospital 54
Figure 24: In-hospital major bleeding rate by hospital 56
Figure 25: In-hospital unplanned revascularisation rate by hospital 57
Figure 26: In-hospital stroke rate by hospital 57
Figure 27: Referral to cardiac rehabilitation rate by hospital 62
Figure 28: 30-day mortality rate by hospital 64
Figure 29: 30-day mortality rate for cardiogenic shock and/or OHCA cases by hospital 65
Figure 30: 30-day mortality rate for STEMI cases by age groups 65
Figure 31: 30-day unplanned revascularisation rate by hospital 66
Figure 32: 30-day unplanned cardiac readmission rate by hospital 67
Figure 33. The Registry Governance Structure 73

List of Tables

Table 1: The registry quality indicators (QI's) and participation rates 28
Table 2A: Patient characteristics by clinical presentation 32
Table 2B: Patient characteristics by hospital volume 32
Table 2C: Patient characteristics by on-site CABG vs off-site CABG hospitals 33
Table 2D: Patient characteristics by metro vs non-metro hospitals 33
Table 3A: Procedural data by clinical presentation 37
Table 3B: Procedural data by hospital volume 37
Table 3C: Procedural data by on-site CABG vs off-site CABG hospitals 38
Table 3D: Procedural data by metro vs non-metro hospitals 38
Table 4: Primary PCI cases as a proportion of overall case numbers by hospital types 42
Table 5: Time from door to PCI mediated reperfusion for primary PCI cases 42
Table 6: Door-to-device times for primary PCI cases by prehospital notification status 46
Table 7: Median times from symptom onset to reperfusion by prehospital notification status 49
Table 8A: In-hospital mortality rates for selected patient group 55
Table 8B: In-hospital mortality rates by hospital volume 55
Table 8C: In-hospital mortality rates by on-site CABG vs off-site CABG centres 55
Table 8D: In-hospital mortality rates by metro vs non-metro hospitals 56
Table 9A: In-hospital outcomes by clinical presentation 58
Table 9B: In-hospital outcomes by hospital volume 58
Table 9C: In-hospital outcomes by on-site CABG vs off-site CABG centres 59
Table 9D: In-hospital outcomes by metro vs non-metro hospitals 59
Table 10: Rates of prescription of DAPT and lipid lowering therapy by clinical presentation and hospital type 60
Table 11: Rates of referral to cardiac rehabilitation by clinical presentation and hospital type 61
Table 12. National Cardiac Registry Audit and Risk Committee 74
Table 13. National Cardiac Registry Indigenous Committee 74
Table 14. National Cardiac Registry Variation Oversight Committee 75
Table 15. National Cardiac Registry Steering Committee 75
Table 16. National Cardiac Registry Limited Board 78

Message from the Representative of the Indigenous Committee

Mr David Follent – Chair of the Indigenous Committee

Firstly, I would like to acknowledge and thank the foundational work of Associate Professor Luke Burchill and Doctor Dorothy Morrison in establishing the Indigenous Committee for the National Cardiac Registry and leadership to date. We know the burden of cardiovascular disease and the disparity of health outcomes on the Aboriginal and Torres Strait Islander peoples across our nation. The National Cardiac Registry is early in its journey and has an opportunity to build a solid foundation with a considered approach that involves real engagement with Aboriginal and Torres Strait peoples across the healthcare system to support positive change and improved outcomes. To achieve this, there are four critical areas of focus:

1. Embedding the principles of cultural safety and responsiveness into all its business
2. Exploring and embedding Indigenous Data Sovereignty Principles into its organisational thinking
3. Ensuring that there is an opportunity to discuss and expand minimum datasets to include a collection of data necessary to Aboriginal People (for example, including Rheumatic Heart disease).
4. Building relationships and forming partnerships with key stakeholders, such as:
    a) The Lowitja Institute: Australia's national institute for Aboriginal and Torres Strait Islander health research
    b) NACCHO: National peak for Aboriginal and Torres Strait Islander community-controlled health organisations
    c) The National Health Leadership Forum: a collective partnership of national organisations that represent a united voice on Aboriginal and Torres Strait Islander health.

In his statement last year, Associate Professor Luke Burchill noted in his message that "quality data is the foundation for robust decision making, the Registry has a pivotal role to play in understanding where health system improvements can be made to advance Indigenous cardiovascular risk assessment, treatment and health outcomes". It is my view, the National Cardiac Registry has an opportunity to make some real impact to address some of the health inequities experienced by Aboriginal and Torres Strait Islander peoples.

Message from the Steering Committee Consumer Representative

Mr David Gist – Steering Committee Consumer Representative

502AG25. That's the model number of the tiny piece of hardware that's keeping me alive. I'm reminded it's there whenever a room gets very quiet; it sounds like a ticking watch. It's also a reminder of why the National Cardiac Registry is so important.

Registries like the National Cardiac Registry are critical to government efforts to improve Australia's healthcare system. To state the obvious, you can't solve a problem until you know what you're trying to solve.

The Registry is now live and already its potential for improving healthcare outcomes for cardiac patients is becoming apparent. As more and more eligible hospitals provide their minimum dataset, key target areas can be identified, and resources can be directed back into areas where it is needed most.

Clinicians, stakeholders, and specialists in digital storage and security all continue to offer their contributions to this undertaking, which will steadily expand to include data relating to a broader range of cardiac conditions.

I have one principal qualification for my role as Consumer Advocate on the NCR Steering Committee; some highly skilled medical professionals made sure I wasn't among the Australians whose lives are claimed by heart disease. The growth of the National Cardiac Registry will ensure there are more people like me.

Message from the Heart Foundation

Mr David Lloyd – CEO, Heart Foundation

For over 60 years, the Heart Foundation has been working towards a future free of heart disease. We remain dedicated to saving and improving lives through our work across research, support and care, and risk reduction. Since 1959, we have invested more than $710 million (in today's dollars) in life-saving research.

We continue to use National Cardiac Registry data at the Heart Foundation to inform our research priorities, health programs and advocacy initiatives. To ensure data available through the Registry is as meaningful as possible, the Heart Foundation encourages the involvement of hospitals across Australia. We were delighted to see all states and territories were represented this year. Only through collaboration and national engagement can we improve the care of those Australians who need it most.

In 2022 and beyond, the Heart Foundation has a renewed focus on those groups that disproportionately bear the burden of heart disease in this country. Working collaboratively, we must ensure we are reaching those most at risk of poor heart health. The Registry plays a transformative role in illuminating where and how we need to intensify our efforts.

We recognise there is work to be done to ensure all Australians have access to timely cardiac care to enable the best possible chance of survival. The procedural data captured through the Registry is crucial for informing Australia's next steps in delivering best practice, appropriate and effective care.

Aligning with the *Framework for Australian clinical quality registries* and the *National Clinical Quality Registry and Virtual Registry Strategy 2020-2030*, the Registry has a vision of better outcomes for all Australians. The Heart Foundation wholeheartedly shares this vision, which drives all aspects of our own work.

We congratulate the National Cardiac Registry on this report and strongly support this important national resource, recognising its crucial role in ensuring every Australian can access consistent, high quality cardiac care.

Message from Australian Commission on Safety and Quality in Health Care

Professor Anne Duggan – CEO
Australian Commission on Safety and Quality in Health Care (The Commission)

It is my pleasure to introduce the National Cardiac Registry (NCR) Annual Report for 2022.

Cardiovascular disease accounts for almost 13% of the total burden of disease in Australia, and 8.7% of health care expenditure ($11.8 billion) in the Australian health system, making it the second most expensive disease group in terms of health care costs[1]. A national Clinical Quality Registry (CQR) in cardiovascular disease is a priority for Australia, as there are well-defined clinical indicators to measure the management of cardiovascular disease and reduce unwarranted variation in health outcomes for this highly prevalent disease.

I am very pleased that the NCR has all states and territories across Australia contributing data to the 2022 Annual Report. CQRs are an effective mechanism to improve conditions such as cardiovascular disease where there is an evidence-based sequence of care which improves patient outcomes and serious consequences to the patient associated with poor quality of care. Together with key stakeholders and to assist groups such as the NCR, the Australian Commission on Safety and Quality in Health Care (the Commission) is updating the Framework for Australian CQRs (Second Edition).

We look forward to working with Dr Leo Mahar, Associate Professor Lefkovits and others in progressing national CQRs. These CQRs will enable jurisdictions to authorise and secure health service organisation clinical record-level data, within high-priority clinical domains, so that clinicians can build on the excellent work of registries such as the NCR to efficiently and effectively measure, monitor, report on and ensure the appropriateness and effectiveness of the health care they provide.

1 Heart, stroke and vascular disease—Australian facts, Expenditure on cardiovascular disease – Australian Institute of Health and Welfare (aihw.gov.au) 2018-2019

Message from the Chair of the Board

Dr Leo Mahar – Chair of the National Cardiac Registry Limited Board

After a promising year, we are happy to present our second annual status report on 2022 PCI data as we further develop the National Cardiac Registry (the Registry). We have strengthened the foundations of the company by continuing close engagement with the NCR Steering Committee in addition working with the NCR Audit and Risk Management Committee, NCR Indigenous Committee, and the NCR Variation Oversight Committee.

Accomplishments this past year include the securing of another contract with the Department of Health and Aged Care and successfully executing data sharing agreements with each Australian state and territory to enable us to receive de-identified patient data for analysis and reporting. We worked closely with our subcontractor Monash University and appreciate their services for the provision of a National Cardiac Registry.

Our gratitude extends particularly to each Participating Registry for their ongoing support and involvement in the NCR. With all Australian states and territories now active, each Participating Registry has worked diligently to achieve the maximum participation within their capacity. We look forward to increasing the eligible hospital NCR participation rate to 60% in the coming years, including a focus on participation of the private hospital sector with the goal of achieving 100% participation by 2027.

The greater the participation, the more meaningful this dataset becomes, allowing us to analyse the clinical findings to obtain a 'National Perspective' of the Clinical Quality National Cardiac Registry. Consequently, of the 127 eligible hospitals performing PCI operations within Australia, this report reveals 2021 data from 29% of hospitals contributing to the NCR by which 18,468 PCI cases were performed on 16,812 patients. This is an increase of 2,909 cases and 2,700 patients, as the Registry continues to mature, it will reach high or full coverage of the clinical population to allow for comprehensive risk adjusted outcomes benchmarked against the national pool.

We look forward to a promising future and the engagement of networking with industry in the cardiac health sector to support us achieve our vision. Attending the CSANZ 2022 Conference staffing a booth was our first-time promoting the Registry and we look forward to exploring other cardiac areas over time, ultimately, to improve patient outcomes and clinical excellence.

Message from the Steering Committee

A/Prof Jeff Lefkovits & Dr Rohan Poulter – Chair and Deputy Chair

On behalf of the Steering Committee we are pleased to present the second annual status report of the National Cardiac Registry. The report is a collaborative effort on a national scale for all participating states and territories to report on the quality, performance, and outcomes of percutaneous coronary interventions delivered nationally. Our vision is to ensure the delivery of high quality and safe care equitably to all Australians and encompasses a wide range of stakeholders, including patients needing care, clinicians involved in providing that care, hospitals, health funders, health bureaucracies and the general public. This report is the first component of the Registry's commitment to provide a comprehensive platform to support participating institutions in providing the highest quality care without unwanted variation and be a driving force for continuous improvement.

The NCR program is supported by the continued engagement of the members of the steering committee. We thank all members who have worked incredibly hard to support the Registry, and welcome new members who have recently joined for contributing their enthusiasm and expertise. The committee looks forward to working with the NCR board, the Department of Health and Aged Care, and other partners as we progress the vision of the Registry.

The tireless work of the NCR management team must be recognised for their engagement, understanding and enthusiasm for quality clinical processes that are supported by quality data, and we look forward to working together as the Registry expands.

Executive Summary

The National Cardiac Registry (The Registry) was originally conceived out of the Australian Government's vision for the integration of national clinical quality outcome data into Australia's health care information systems to drive patient-centred improvements in the quality and value of health care. The Registry team is proud to present the second public-facing report and the first in which all eight States and Territories are actively contributing data to provide the beginnings of a national perspective on the performance and outcomes of PCI in Australia.

The Australian Government, in its National Clinical Quality Registry and Virtual Registry Strategy 2020-2030, outlines the rationale for nationally coordinated clinical quality registries in that they are very well suited to facilitate patient-centred care through the monitoring of safety and performance of healthcare delivery. They help identify unwanted variation in patient care and through their design of performance benchmarking and risk adjustment, support clinical practice change and improvement in patients' outcomes and experiences. Their benefits extend to other stakeholders including clinicians and health care providers, governments and health insurers through reductions in unwarranted variation and low value care, improved health service design and delivery, and regulators and industry with enhanced capacity to monitor and make regulatory decisions. The Australian Government's vision has been supported by several important national initiatives including the National Digital Health Strategy[2] and the Australian Institute of Health and Welfare's Australian Health Performance Framework[3]. It has based its strategy on the best practice principles outlined in the Australian Commission on Safety and Quality in Health Care's Framework for Australian Clinical Quality Registries[4].

The Registry's model of collaboration by independent jurisdiction-based participating CQRs provides unique benefits to a national approach to quality assessment. Participating States and Territories have been at different stages of development with respect to their own clinical quality programs and the Registry has enabled maturing jurisdictions to learn from, and be guided by, jurisdictions with mature registries. Advantages of a national perspective that may not be reflected in individual State and Territory based datasets include the provision of information regarding the influence of hospital type, hospital location, socioeconomic status, and informed perspectives on the clinical needs and outcomes of Aboriginal and Torres Strait Islander people. On a practical level, a national registry enhances standardisation on ethics issues, database design and choice of data elements, and the development of broadly applicable operating principles and governance models.

In this report, data are presented with the primary focus on reporting on the performance and outcomes of PCI across the country. Hospitals' performances are benchmarked at a national level, unwanted variation in care identified, and feedback provided supports their quality assurance activities. In this report, patient level clinical data from public-sector hospitals only have been included. It is expected that both public and private sector participation will be included in the next reporting period.

A summary of the key findings in this year's report follows. We hope you find the report informative and interesting.

2 https://www.digitalhealth.gov.au/about-us/strategies-and-plans/national-digital-health-strategy-and-framework-for-action
3 https://www.aihw.gov.au/reports-data/indicators/australias-health-performance-framework
4 Australian Commission on Safety and Quality in Health Care, Framework for Australian clinical quality registries. Sydney. ACSQHC, March 2014.

1. Key Findings

75% of cases were performed on males, whose **average age was 64.**

19% of PCI cases were performed **out-of-hours**

PCI for **acute coronary syndromes** (ACS) accounted for **64% of the caseload**.

Radial access is now the **predominant arterial approach for PCI**, although there is considerable variation among hospitals in their utilisation of the radial technique.

With **PCI for STEMI**, the median diagnostic electrocardiogram to PCI mediated reperfusion time was **91 minutes**.

Moreover, the median door to PCI mediated reperfusion time was **56 minutes**, with all hospitals except one achieving a median time **≤90 minutes**.

The overall rate of **referral to cardiac rehabilitation was 77%**, but was found to be lower than average among low volume centres and those without onsite coronary artery bypass grafting (CABG).

The **in-hospital mortality rate** was 2%

30-day unplanned cardiac readmission rate was 5.3%

A door to **PCI mediated reperfusion time** ≤90 minute was achieved in **76% of cases**.

Major adverse events rate including; death, new myocardial infarction, stent thrombosis, unplanned revascularisation or stroke was highest among STEMI patients at 7.5% compared to the overall cohort at 3.3%.

The **in-hospital major bleeding rate** was 0.7% and was lower among radial access cases.

2. Improving Cardiovascular Health and Outcomes

Cardiovascular disease (CVD) is a collective term describing a variety of health conditions including heart disease and stroke. The most recent statistics from the Australian Institute for Health and Welfare (AIHW) reported that the underlying cause of death for one quarter of deaths in 2019 was CVD[5] and over 80% of CVD related hospitalisations are in those aged 55 and over[6]. The overall burden for cardiovascular disease in Australia is 13%. When adding social disadvantage to cardiovascular disease, the burden of disease is 1.6 times higher in the lowest compared to the highest socioeconomic group within Australia[7].

There are significant disparities in rates of hospitalisation between population groups for cardiovascular disease within Australia including between men and women. When compared to the general population, men are disproportionately impacted and Aboriginal and Torres Strait Islander people, lower socioeconomic groups and those living in rural and remote areas also experience higher rates of hospitalisation[8]. Interestingly, there is also a growing amount of evidence that women are less likely to receive guideline-directed care for PCI when compared with men. One example of this is the use of the radial access technique where multiple series have demonstrated usage rates are commonly lower in women, resulting in more frequent bleeding complications[9]. In this report, men accounted for 74.5% of the total cohort and women had lower rates of radial access and higher rates of overall major bleeding.

Five of the leading risk factors for cardiovascular disease include tobacco use, overweight (including obesity), dietary risks, high blood pressure, and alcohol use. The National Health Survey data from 2017-2018 revealed that adults living in the lowest socioeconomic locations were 1.6 times more likely to be obese, and 1.2 times more likely to have uncontrolled high blood pressure when comparted to the highest socioeconomic areas[10].

The Department of Health and Aged Care has committed to a Cardiovascular Health Mission with a core aim to eliminate disparities in cardiovascular health and outcomes by mobilising research efforts and developing collaborative and translational platforms like the National Cardiac Registry[11].

5,6,7,8. Australian Institute of Health and Welfare (2021) Heart, stroke and vascular disease—Australian facts, AIHW, Australian Government, accessed 29 September 2022.

9 Murphy AC, Dinh D, Koshy AN, et al. Comparison of Long-Term Outcomes in Men versus Women Undergoing Percutaneous Coronary Intervention. Am J Cardiol. 2021;153:1-8. doi:10.1016/j.amjcard.2021.05.013

10 Australian Bureau of Statistics. (2017-18). National Health Survey: First results. ABS. https://www.abs.gov.au/statistics/health/health-conditions-and-risks/national-health-survey-first-results/latest-release.

11 MRFF Cardiovascular Health Mission Roadmap - Australian Government Department of Health September 2021. https://www.health.gov.au/resources/publications/mrff-cardiovascular-health-mission-roadmap

3. A National Approach

The Registry is committed to embedding a national approach to the prevention, management and treatment of cardiovascular disease within Australia and has been established in line with *The National Strategy for Clinical Quality Registries 2020 to 2030* 10-year vision. It enables systematic data collection and reporting, examination and action on unwanted variation and ultimately ensures all Australians are receiving patient centred, high quality and cost-effective care. As the Registry data set grows it will inform health policy, support consumers and clinicians in decision making and support the sustainability of the healthcare system.

Additionally, The Registry is leading the way on core activities outlined within *The National Strategic Action Plan for heart disease and stroke 2020*[12] by bringing together each State and Territory to collect nationally consistent outcome measures for PCI and collaboratively track progress, share information for evidence-based decision making and address variation. The NCR provides Participating Registries the capacity to compare their health services to the national average and feedback this information to hospitals and their clinical teams.

4. The Next Steps

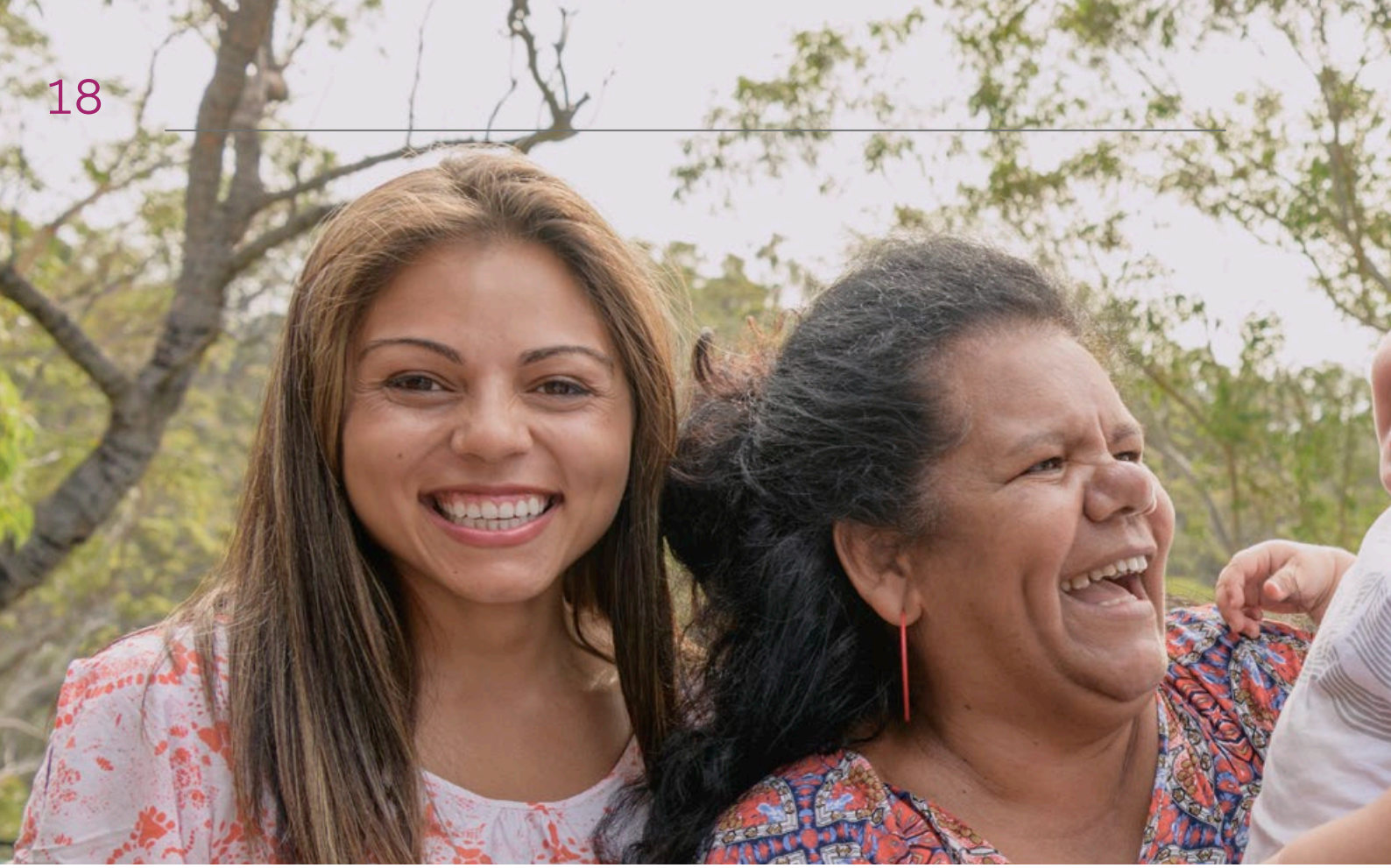
The Registry is working towards nationally consistent data collection. Currently there are still a number of data elements that are important to key performance and quality measures, that are not being uniformly collected by all jurisdictions. A national minimum dataset has been formally agreed to by all jurisdictions with a commitment to collect and report to The Registry. Feedback loops between Participating Registries, NCR committees, the Board and the Australian Government in relation to performance variation have been developed and will continue to be enhanced as data collection practices improve.

A review of the minimum data set will be undertaken in 2023. This will involve engagement with a broad range of stakeholders including clinicians, government representatives and consumer representation to ensure that the data elements collected for the Registry are valid and relevant. There are differing barriers to data collection across the eight jurisdictions and strategies will be explored to align jurisdictional activities.

The Registry is actively preparing to expand its scope to incorporate other therapeutic areas beyond PCI, other methods of data collection including electronic record-based information, and other measures of outcomes that are more patient-centred. The Registry has a long term vision to support international benchmarking and reporting of performance and to eventually contribute to international datasets.

As the dataset grows, there is opportunity to form linkages with other key datasets and registries and embed quality data into daily clinical practice through their incorporation into electronic medical records. Additionally, there is the opportunity to extend the scope of research activities including the automation of data extraction and analysis, use of artificial intelligence to develop predictive models to support clinical decision making and inform public health policy.

12 National Strategic Action Plan for Heart Disease and Stroke September 2020 – Australian Government Department of Health - https://www.health.gov.au/resources/publications/national-strategic-action-plan-for-heart-disease-and-stroke



November
2016

Ischaemic Heart Disease named as the #1 priority area in The Australian Commission on Safety and Quality in Health Care's Prioritised list of clinical domains for clinical quality registry development final report.

March
2018

The Department and existing State registries agree to form a National Cardiac Registry

October
2018

Engagement of clinicians from States & Territories and development of strategy

Jan-Mar
2019

Development of an initiation and establishment plan

April
2019

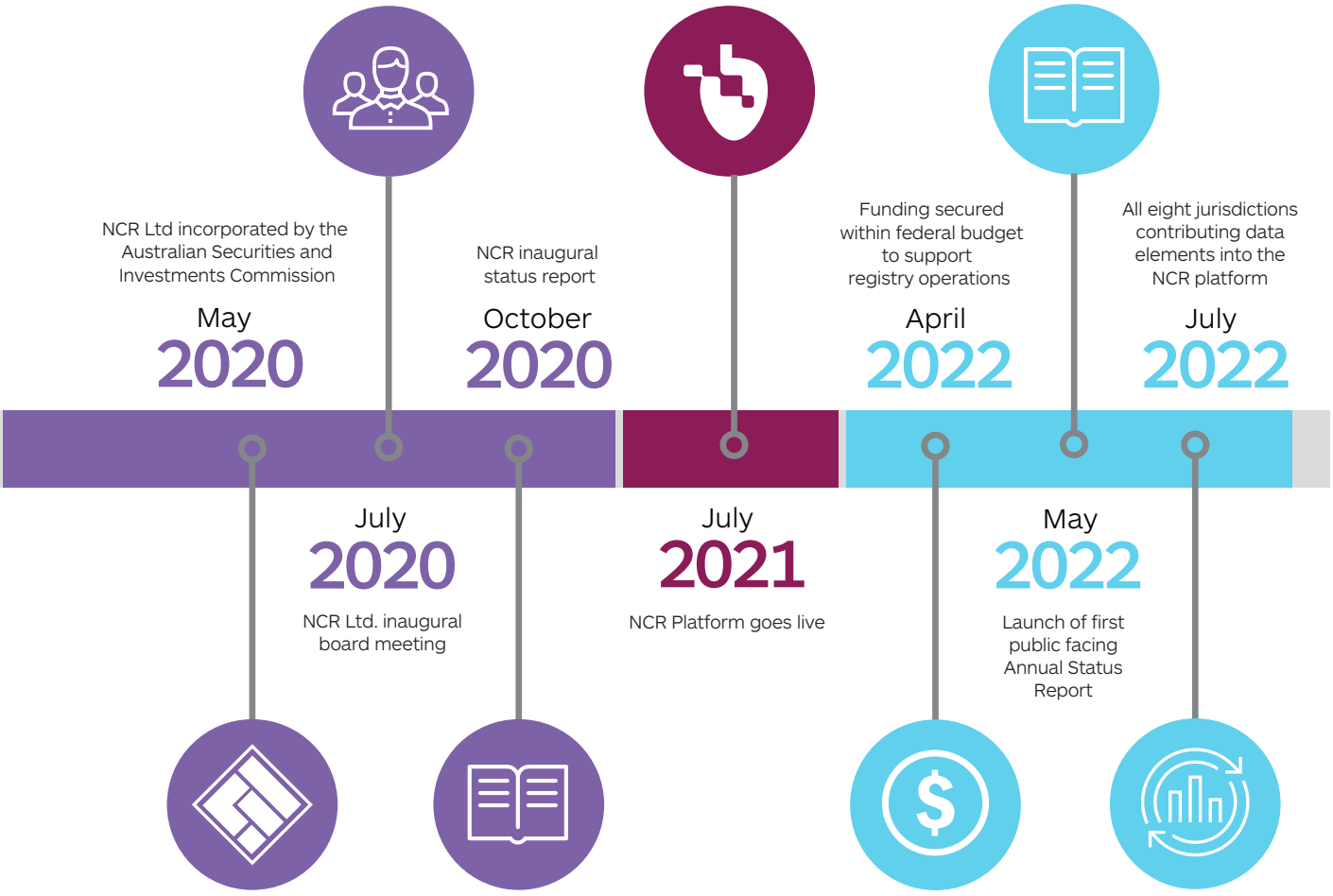
NCR project team employed through Monash University

August
2019

Funding approved for States and Territories to help facilitate in participation in NCR

November
2019

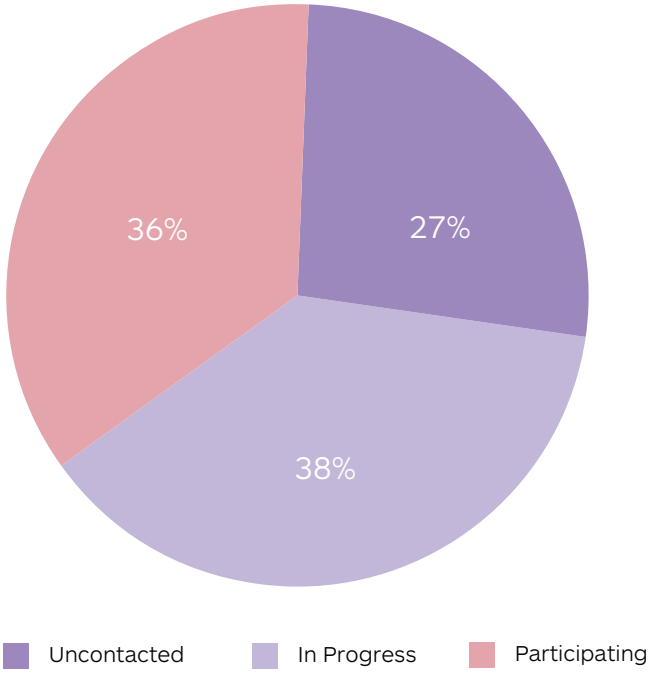
Inaugural Steering Committee meeting held with clinical and jurisdictional representatives from all eight States & Territories


NCR Ltd incorporated by the Australian Securities and Investments Commission
May 2020
July 2020
NCR Ltd. inaugural board meeting
NCR inaugural status report
October 2020
July 2021
NCR Platform goes live
Funding secured within federal budget to support registry operations
April 2022
May 2022
Launch of first public facing Annual Status Report
All eight jurisdictions contributing data elements into the NCR platform
July 2022

5. Towards a National Target

The Registry has set a target goal for a national participation rate of eligible hospitals to reach 40% over the next 12 months. Of that 40% it is expected to reach 54% of eligible public hospitals and 30% of eligible private hospitals. The establishment focus of the Registry was on public hospital participation as not all State and Territory registries have been able to extend their data collection activities to the private sector.

Figure 1: 2021 Public Hospital Participation Rates



As we progress towards the national goal, the Registry will be in a position to move to the next phase of CQR activity which involves the implementation of risk adjusted analysis for key outcome measures such as 30-day mortality. To achieve this the Registry needs to:

- Support jurisdictions in embedding robust data collection methods of the agreed dataset and high rates of hospital participation
- Ensure the use of well-organised and effective methods of data cleaning and analysis
- Establish a comprehensive data auditing process.

Participating jurisdictional registries will need to:

- Develop and implement protocols for receiving and dealing with NCR-derived outlier data
- NCR-based committees that will manage data and oversee variation management.

Local Reflection – New South Wales (NSW)

2021-22 has been a challenging year for the NSW Cardiac Outcome Registry (NSWCOR) with a pandemic context and staff changes. Regardless, five sites have continued to participate and achieved annual data submission in addition to two sites joining this year. The Community of Practice sessions have been held bimonthly to understand the site level challenges, which has facilitated in upgrading our REDCap database design.

Jean-Frederic Levesque, MD PhD FRCPC
Chief Executive, NSW Agency for Clinical Innovation

6. Pathway to Dynamic Reporting

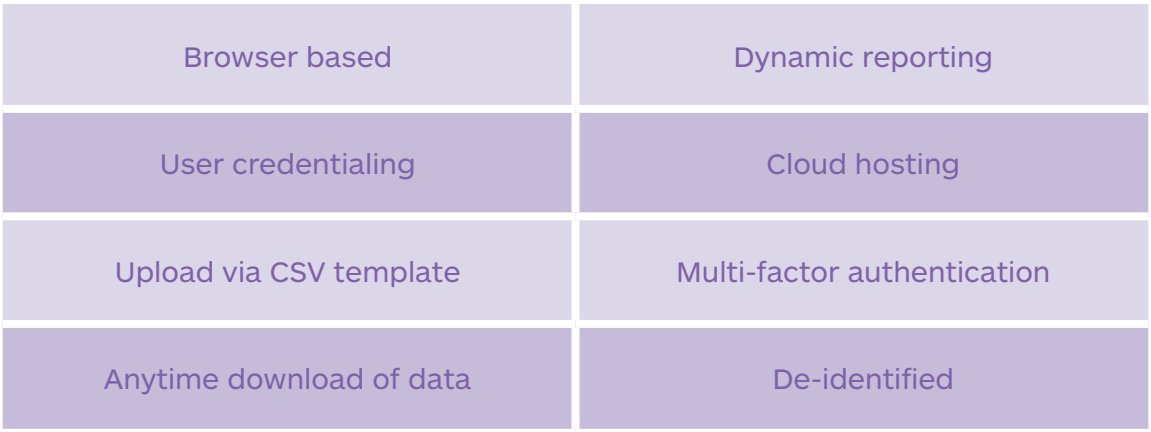
The Registry has purpose built a state-of-the-art digital platform which hosts national level data enabling State and Territory Registries to upload data on PCI's performed within eligible hospital sites.

Through this mechanism, dynamic and interactive reports are produced, aligning to key quality performance indicators which are used by participating registries to report back to sites, providing valuable insights and feedback directly to clinicians and hospitals. This model provides State and Territory governments, clinicians and hospitals the ability to compare performance amongst the national cohort, identify areas for clinical quality improvement and enhance care quality. Under this model, each participating registry is responsible for the coordination of site level activities including data management and collection, hospital and clinician engagement, data integrity, local ethics requirements, and audit activities within their region.

6.1 Platform Design

The Registry platform has been developed through extensive consultation with stakeholders to support the specific needs and requirements of the Registry, including supporting anytime Comma Separated value data uploads and in-built reporting. These reports are customisable by a series of filters, which allow jurisdictions to tailor the registry's quality indicator reports to their own needs. The platform is adaptable to allow for enhancements to be made as the registry matures. The platform includes a range of features to ensure security and data safety such as secure user credentialing, multi-factor authentication, and cloud hosting in a secure browser-based environment.

Figure 2: The Registry Digital Platform Key Features



6.2 Data Management

Once hospitals agree to participate in the Registry, participating registries complete training and engagement activities, including an introduction to the NCR data dictionary, assisting sites to implement appropriate monitoring, data collection and verification methods. In order to ensure data accuracy and completeness, participating registries and the NCR have implemented vigorous analysis and auditing processes.

The Registry management team work alongside the state and territory-based registry to ensure data is appropriately mapped in accordance to the Registry data dictionary, and relevant protocols, policies and procedures. Data elements are de-identified, encrypted and uploaded to the Registry Platform, which is securely hosted within Australia. (Figure 3)

Once the data are accepted into the live reporting system, the Registry management team conducts an initial analysis ensuring completeness, reliability and accuracy of the data. If there are any errors or inconsistencies found, this is reported back to participating registries for further investigation and management. Once data entry is finalised, an extensive statistical analysis is undertaken to identify trends, patterns and outcomes forming the content of this report.

State and Territory Registries are also able to view and download dynamic and interactive reports for all 11 PCI Quality Indicators (Figure 4) which are presented as Bar Graphs, Box and Whisker Plots and Funnel Plots.

6.3 Security

The Registry has multiple layers of security in place, and rigorous testing has been conducted to ensure appropriate levels of security have been applied to the NCR platform. This includes data import, storage and output of data and reports, along with interaction with contributing jurisdictional users. Platform penetration testing and ethical hacking is also conducted to ensure internal and external access to the platform is secure.

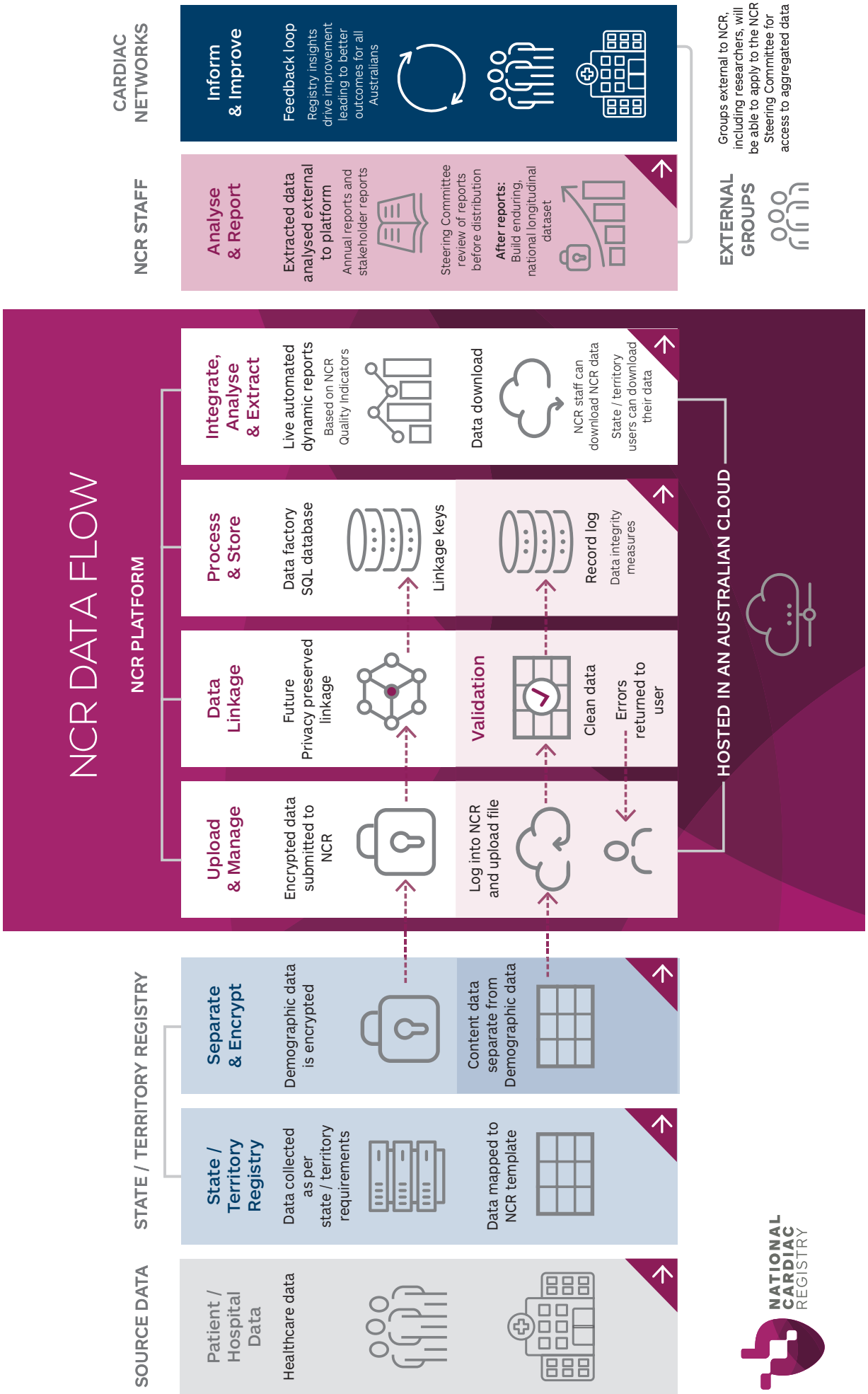
Before data is uploaded, it is de-identified and encrypted. Patient and clinician identifiers are not provided to the Registry, and as such, are not stored within its database. The de-identified data which is securely stored within the platform is managed in line with NCR privacy, data access and governance policies, and vigorous testing is carried out to ensure all layers of security are effective.

Access to the Registry platform is only available to authorised users through verification and multi factor authentication, and authorised users are only able to view data uploaded by their own participating registry, with all other data aggregated. The security of data and the platform extends through to formally executed data sharing deeds and agreements with each State and Territory to ensure appropriate levels of security are in place, and which cover relevant Australian legislation.

6.4 Ethics

Human Research Ethics Committee (HREC) approval has been granted for the Registry, operating with a waiver of consent model, and under the National Mutual Acceptance (NMA) scheme. State and Territory participating registries operate under different models of ethics and governance, and each jurisdiction has appropriate approvals in place in order to contribute to the Registry.

Figure 3: The Registry Data Flow



Local Reflection – Western Australia (WA)

WACOR has contributed limited data for the first time from 3 public hospitals. As a virtual registry, WACOR aims to repurpose existing data where possible, with the collaboration of participating hospitals and clinicians, minimising the burden of additional data collection on front-line staff. Building on this groundwork, WACOR will expand the data elements reported with an emphasis on transparency, trust and rigour of quality assurance processes. WACOR looks forward to furthering its participation and the insights and national benchmarking opportunities presented in the NCR's online portal and Annual Report.

Ben Weber
Healthcare Quality Intelligence Unit,
Patient Safety and Clinical Quality Directorate, Department of Health Western Australia,
WA Jurisdictional Representative

7. Measuring Quality and Performance

The Registry collects data on 11 indicators for PCI and includes five performance indicators and six quality indicators. These are recognised measures for national benchmarking and clinical outcomes to inform clinical practice and health service decision making.

Figure 4: The Registry Quality Indicators for PCI

Indicator Type: Performance, Outcome

1. Time from diagnostic electrocardiogram to PCI mediated reperfusion
2. Time from door to PCI mediated reperfusion
3. Peri-PCI Stroke
4. In-hospital major bleeding
5. In-hospital mortality
6. 30-day unplanned cardiac readmission rate after PCI
7. Unplanned revascularisation within 30 days
8. 30-day mortality after PCI
9. Patients without contraindication discharged on lipid-lowering therapy
10. Patients referred to cardiac rehabilitation or other secondary prevention program
11. Proportion of patients, without a clear and documented contraindication for Aspirin and/or P2Y12 inhibitor, discharged on DAPT

The eleven indicators were selected via a consultative process guided by the steering committee and reflect the care continuum for patients undergoing PCI, including the pre-procedure acute phase, continuing through to recovery and rehabilitation.

Indicators 1 and 2 are representative of the acute phase of the overall PCI procedures, specifically patients presenting within 12 hours of heart attack symptom onset and are widely accepted performance indicators within Australia and internationally. Indicators 3 through to 8 report on the PCI procedures as a whole and include both acute and planned PCI procedures. They measure best practice guidelines and quality indicators[13] including in-hospital and post discharge up to 30 days. Indicators 9 to 11 measure performance on best practice recommendations post PCI procedure, including medication and referral to rehabilitation and are representative of the cohort who have survived.

In this, the Registry's second public status report we are able to present information related to all 11 indicators. However, as some participating registries are still working towards the capture of the complete minimum dataset, there is a range of completeness of data for analyses pertaining to the quality indicators, thus some cases were excluded (see Table 3).

8. Variation in Healthcare

Variation in healthcare refers to an identifiable difference in healthcare processes and/or outcomes when compared to a standard of practice or peers and can occur across all levels of the healthcare continuum. Appropriate variation occurs when a health service responds to the specific needs and complexities of each patient. Unwanted variation occurs when the patient is not treated for their specific needs and leads to poor outcomes including morbidity and mortality.[14]

Identifying unwanted variation is essential to improving quality of care and outcomes. It requires the measurement, feedback and reporting of relevant data to meaningfully understand outcomes and performance with the aim to reduce variation. It is expected that reductions in variation will lead to improvements in the efficiency of the health system. Reporting on the process of care through registries such as the National Cardiac Registry is important for continuous quality improvement of the clinical care provided in Australia[15].

The Registry is committed to ensuring adequate reporting of identified variations and has developed a variation management policy to provide a standard for monitoring, investigating and reporting variation deemed outside of the expected range of performance. As part of the reporting process, participating registries will be supplied with a supplementary report in addition to the platform reporting. This will include their contributing sites performance compared to all sites using funnel plot methodology. These reports will be provided to each contributing registry who will then review, manage and report according to their own quality assurance policies.

Additionally, a Variation Oversight Committee is currently being established to ensure that unwanted variation is addressed in a timely manner and communicated appropriately to relevant stakeholders. As the registry continues to mature, further development and growth is required to support appropriate follow up of variation and outlier management across sites and amongst data collected. This will include:

- Effective and well-organised participating registries that have established and high-quality methods of data collection, cleaning and analysis and effective data auditing processes
- Establishment of robust data collection methods among participating hospitals, overseen and managed by each of the hospitals' registry
- High rates of hospital participation in each state/territory

13 National Cardiac Registry Annual Status Report 2021. A/Prof Jeffrey Lefkovits, Dr Rohan Poulter, Ms Michaela O'Regan, Ms Kelly Tapley, Ms Angela Brennan, Ms Harriet Carruthers, Dr Diem Dinh, Ms Rhiannon Jeffery, Ms Jasmine Pyyvaara and Mrs Claudia Lassetter on behalf of the Registry Steering Committee. Report No 1, pages 80.

14, 15 Australian Commission on Safety and Quality in Health Care. National arrangements for clinical quality registries- https://www.safetyandquality.gov.au/our-work/health-and-human-research/national-arrangements-clinical-quality-registries

- Established protocols and procedures among participating registries for receiving and dealing with NCR-derived variation data
- Well-established statistical methods developed within NCR for analysis of data from multiple different sources. This includes the development and validation of a statistically sound method for risk adjustment
- Establishment and appropriate composition of committee(s) within NCR to manage data and oversee variation management
- Established feedback loops between participating registries, NCR committees and the Board in relation to performance variation.

9. Coverage

Of the 127 hospitals that perform PCI nationally, 37 public hospitals provided data in the 2021 reporting period. This is an increase of four public hospitals since the 2020 reporting period.

Figure 5: The Registry PCI cases numbers, January 2019 to December 2021

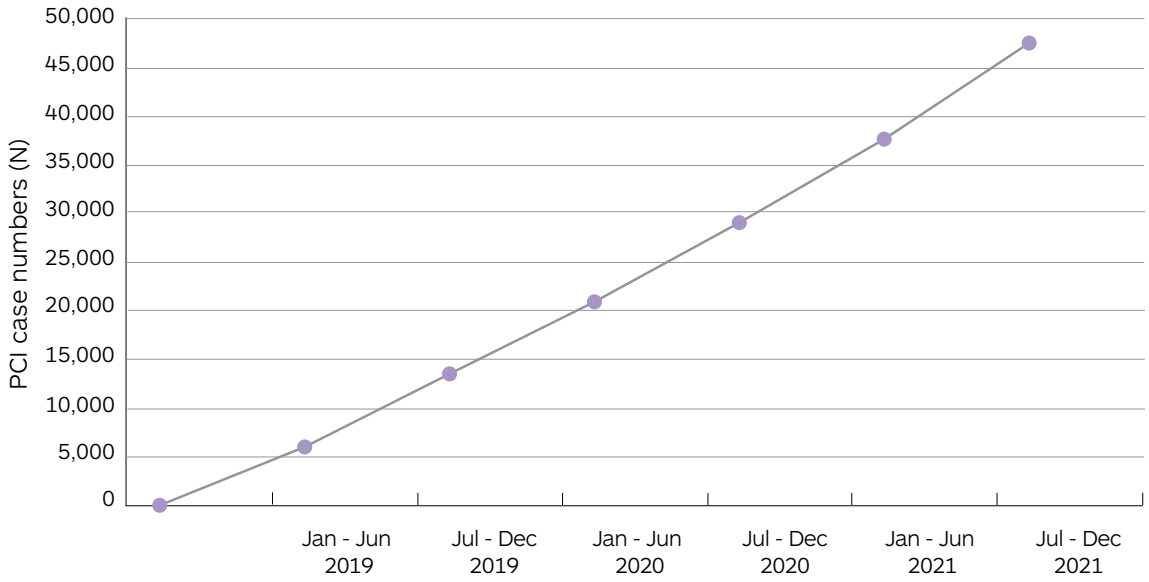


Table 1 represents the percentage of site participation of the 37 contributing hospitals for each of the eleven quality indicators for the Registry.

Table 1: The Registry quality indicators (QI's) and participation rates

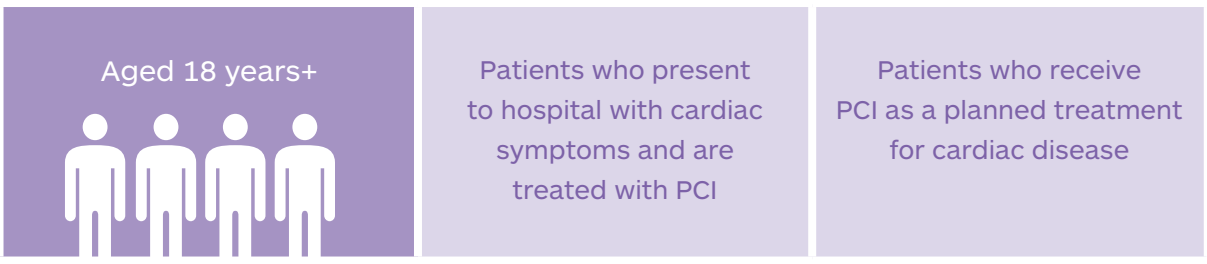
	Indicator Type	Quality Indicator	Data completeness (%)	Sites contributing to QI	State/ Territories included in 2022 QI reports
1	Performance	Time from diagnostic electrocardiogram to PCI mediated reperfusion	84	31	6†
2	Performance	Time from door to PCI mediated reperfusion	84	31	6†
3	Outcome	Peri-PCI stroke	89	33	7*
4	Outcome	In hospital major bleeding	89	33	7*
5	Outcome	In hospital mortality	89	33	7*
6	Outcome	30-day unplanned cardiac readmission rate after PCI	73	27	6*
7	Outcome	Unplanned revascularisation within 30 days	51	19	5*
8	Outcome	30-day mortality after PCI	73	27	6*
9	Performance	Patients without contraindication discharged on lipid-lowering therapy	68	25	6*
10	Performance	Patients referred to cardiac rehabilitation or other secondary prevention program	89	33	7*
11	Performance	Proportion of patients without a clear and documented contraindication for Aspirin and/or a P2Y12 inhibitor, discharged on DAPT	68	25	6*

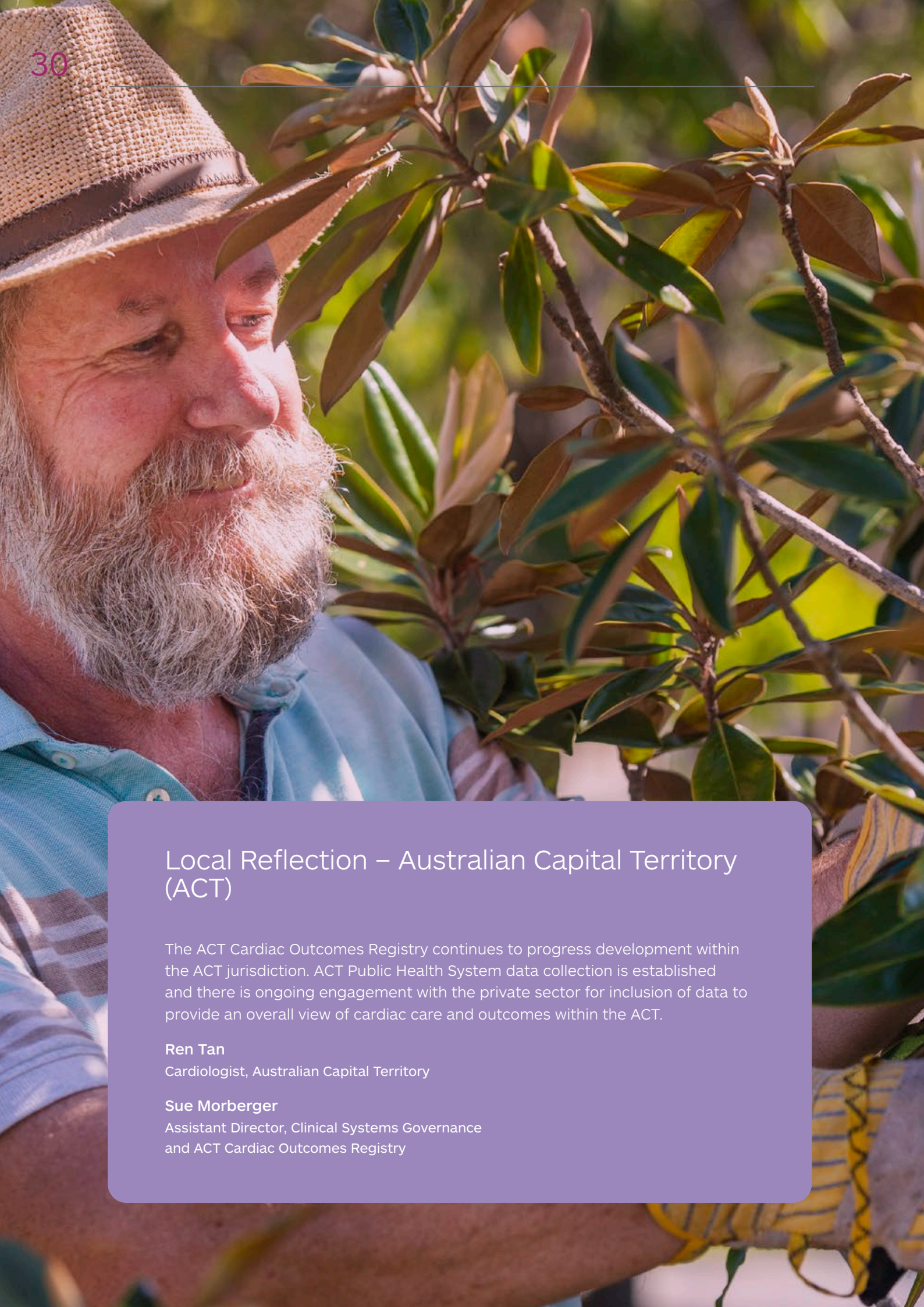
** NTTCD only provided data for four months and are excluded from QI comparative plots but included in cohort/subgroup tables.*

† *Primary PCI's are not undertaken in the Northern Territory.*

States and territories are responsible for the management of their own jurisdictional data. Some jurisdictions have newly established registries which influence the percentage of data completeness for each quality indicator and not all of the eleven quality indicators had complete data from all jurisdictions for this report. As the Registry (and the contributing participating registries) develop and mature, it is expected that all jurisdictions will provide the agreed minimum dataset. This will facilitate the provision of comprehensive insights in future Registry reporting.

Figure 6: Eligible participants





Local Reflection – Australian Capital Territory (ACT)

The ACT Cardiac Outcomes Registry continues to progress development within the ACT jurisdiction. ACT Public Health System data collection is established and there is ongoing engagement with the private sector for inclusion of data to provide an overall view of cardiac care and outcomes within the ACT.

Ren Tan
Cardiologist, Australian Capital Territory

Sue Morberger
Assistant Director, Clinical Systems Governance and ACT Cardiac Outcomes Registry

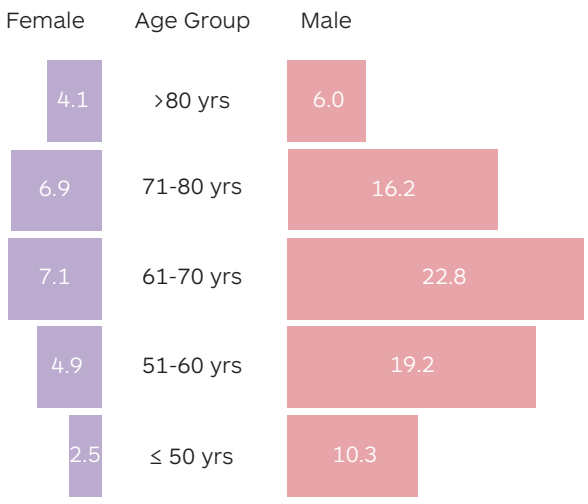
10. Clinical Findings

This report focuses on PCI activity in public hospitals for the calendar year of 1 January to 31 December 2021. The overall PCI cohort was 18,468 cases. All eight state and territory jurisdictions contributed data as outlined in Table 1. A number of state and territory registries did not yet have the minimum dataset or were unable to provide a full dataset for the 2021 calendar year. Therefore, for some reportable outcomes, the analysis was limited to 16,244 cases and interpretations on volume and variation in care need to be considered with these limitations in mind.

10.1 Patient characteristics

In contributing public hospitals, a total of 18,468 PCI cases were performed on 16,812 patients with 8.9% patients (n=1,656) undergoing more than one procedure. The median age for males was 64 years (interquartile range; IQR: 56, 72) and for females, 68 years (IQR: 59, 77). The distribution of cases by age and sex are shown in Figure 7. Age and sex characteristics were consistent compared to the previous year. Similarly, the difference in PCI rates between males and females persisted, including across all age groups. Almost three quarters of PCIs (74.5%) were performed on males. This could be attributable to cardiovascular disease developing at an older age in women when compared to men, however other factors may influence this large disparity including biological and differences in clinical presentation as well as under-recognition of cardiac disease[16]. The peak frequency of PCI procedures occurred in the seventh decade for both males and females. This difference is something the NCR will continue to monitor overtime.

Figure 7: Age and sex distribution (%) of patients undergoing PCI



Selected patient characteristics and demographic information are presented by clinical presentation, comprising ST-elevation myocardial infarction (STEMI), non-ST-elevation acute coronary syndromes (NSTEACS) and non-acute coronary syndromes (non-ACS) (Table 2A). STEMI patients were younger on average than other clinical presentations and had lower rates of the traditional cardiac risk factors of diabetes, peripheral vascular disease or severe obesity. Presentations with cardiogenic shock, out-of-hospital cardiac arrest and moderately or severely reduced left ventricular ejection fraction (LVEF) were observed primarily in STEMI patients. The overall prevalence of severe obesity (BMI ≥35kg/m2) of 14.6% was considerably greater than the national average of 11.5%[17]. Severe obesity was more prevalent in females (19.6% vs 12.9% in males).

16 Dagan, M., Dinh, D. T., Stehli, J., Zaman, S., Brennan, A., Tan, C., Liew, D., Reid, C. M., Stub, D., Kaye, D. M., Lefkovits, J., Duffy, S. J., & Victorian Cardiac Outcomes Registry (2021). Impact of Age and Sex on Treatment and Outcomes Following Myocardial Infarction. *Journal of the American College of Cardiology*, 78(19), 1934–1936. https://doi.org/10.1016/j.jacc.2021.08.057

17 Australian Institute of Health and Welfare (2020) *Overweight and obesity: an interactive insight*, AIHW, Australian Government, accessed 30 September 2022

Table 2A: Patient characteristics by clinical presentation

Patient characteristics	STEMI (N=4,981)	NSTEACS (N=5,444)	Non-ACS (N=5,877)	All (N=16,302)
Age - years (mean+/-SD)	62.7+/-12.6	64.6+/-12.3	66.4+/-11.3	64.7+/-12.1
Gender - female (%)	23.4	27.5	25.4	25.5
Diabetes (%)	21.2	28.8	31.3	27.4
Peripheral vascular disease (%)	2.0	4.0	4.5	3.6
Previous PCI (%)	11.8	21.5	40.6	25.4
Previous CABG (%)	2.7	7.5	8.3	6.3
Severe obesity (BMI≥35kg/m²) (%)	12.3	15.6	15.6	14.6
Moderate or severe LV dysfunction (LVEF<45%) (%)	33.3	15.5	18.3	22.5
Cardiogenic shock (%)	6.3	0.8	0.9	2.5
Out-of-hospital cardiac arrest (%)	7.4	0.6	1.3	2.9
Estimated glomerular filtration rate ≤30mls/min (%)	3.1	3.7	3.3	3.4

Tables 2B to 2D present demographic data by hospital characteristics. Grouping of hospitals in these ways aims to ensure appropriate comparison with respect to performance and outcomes. The proportions of patients with the selected characteristics including demographics and clinical presentation did not vary widely by hospital volume, the presence of on-site cardiac surgery facilities or whether the hospital was located in a metropolitan or non-metropolitan setting.

Table 2B: Patient characteristics by hospital volume

Patient characteristics	Low volume <250 (N=858)	Medium volume 250-500 (N=4,556)	High volume >500 (N=10,888)
Age - years (mean+/-SD)	64.3+/-12.0	65.0+/-12.1	64.6+/-12.1
Gender - female (%)	26.5	27.3	24.7
Diabetes (%)	28.6	25.6	28.1
Peripheral vascular disease (%)	4.5	3.2	3.6
Previous PCI (%)	24.0	24.8	25.8
Previous CABG (%)	5.2	6.2	6.4
Severe obesity (BMI≥35kg/m²) (%)	14.2	15.1	14.4
Moderate or severe LV dysfunction (LVEF<45%) (%)	20.7	22.3	22.7
Cardiogenic shock (%)	2.7	2.9	2.3
Out-of-hospital cardiac arrest (%)	2.9	2.8	3.0
Estimated glomerular filtration rate ≤30mls/min (%)	2.7	3.6	3.4

Table 2C: Patient characteristics by on-site CABG vs off-site CABG hospitals

Patient characteristics	On-site CABG (N=8,574)	Off-site CABG (N=7,728)
Age - years (mean+/-SD)	64.7+/-12.2	64.7+/-12.0
Gender - female (%)	25.4	25.6
Diabetes (%)	28.2	26.6
Peripheral vascular disease (%)	3.9	3.2
Previous PCI (%)	24.7	26.3
Previous CABG (%)	7.0	5.6
Severe obesity (BMI≥35kg/m²) (%)	14.3	15.0
Moderate or severe LV dysfunction (LVEF<45%) (%)	23.5	21.3
Cardiogenic shock (%)	2.5	2.5
Out-of-hospital cardiac arrest (%)	3.0	2.8
Estimated glomerular filtration rate ≤30mls/min (%)	3.7	3.1

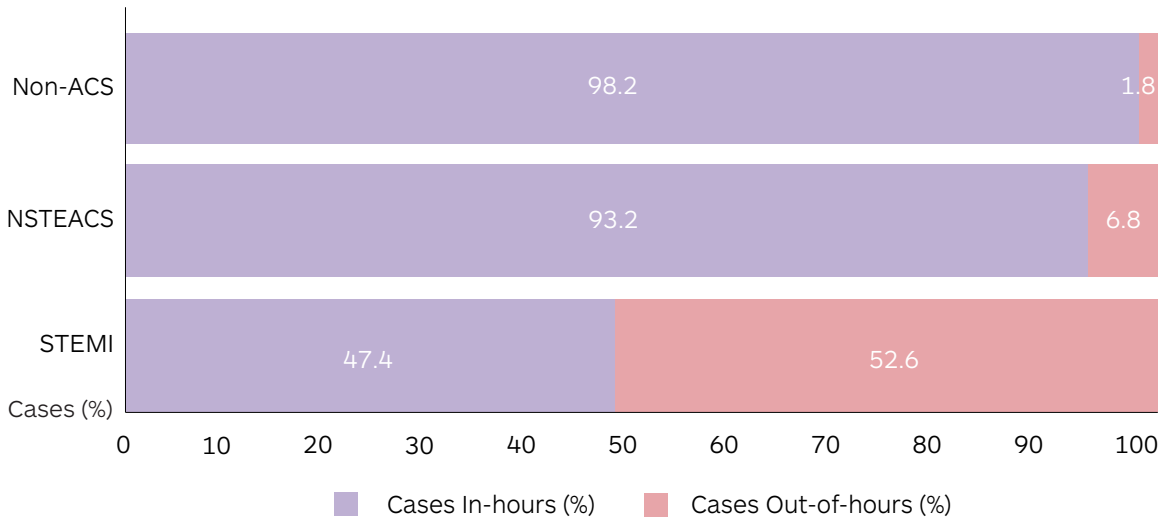
Table 2D: Patient characteristics by metro vs non-metro hospitals

Patient characteristics	Metro (N=12,713)	Non-metro (N=3,589)
Age - years (mean+/-SD)	64.6+/-12.2	65.0+/-11.8
Gender - female (%)	25.4	25.9
Diabetes (%)	28.0	25.1
Peripheral vascular disease (%)	3.8	2.6
Previous PCI (%)	25.6	24.9
Previous CABG (%)	6.1	6.9
Severe obesity (BMI≥35kg/m²) (%)	14.1	16.3
Moderate or severe LV dysfunction (LVEF<45%) (%)	22.2	23.4
Cardiogenic shock (%)	2.6	2.1
Out-of-hospital cardiac arrest (%)	2.9	3.0
Estimated glomerular filtration rate ≤30mls/min (%)	3.4	3.0

10.2 Clinical Presentation

A total of 3,091 cases (19% of the total cases) were performed out-of-hours with the majority being for STEMI (n=2,618, 85% of out-of-hours cases), see Figure 8. These results are consistent when compared to the 2021 Annual Status Report. A small proportion (3.3%) of non-ACS cases were performed out-of-hours.

Figure 8: Percentage of cases in-hours and out-of-hours by clinical presentation*

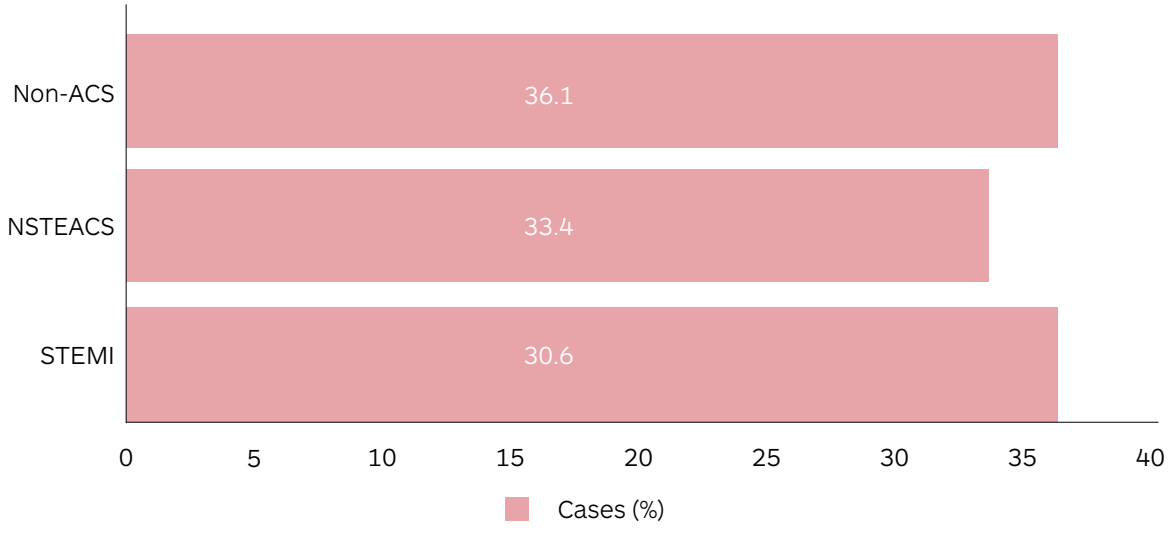


In-hours: 8.00am – 6.00pm (Mon – Fri). Out-of-hours: 6.00pm – 08.00am (Mon – Fri, national public holidays and weekends.

Just under two thirds of PCIs were performed in patients with an acute coronary syndrome (STEMI or NSTEACS), see Figure 9.

When examining clinical presentation by hospital characteristic (case volume, location region or CABG capability) the proportions of ACS cases were similar.

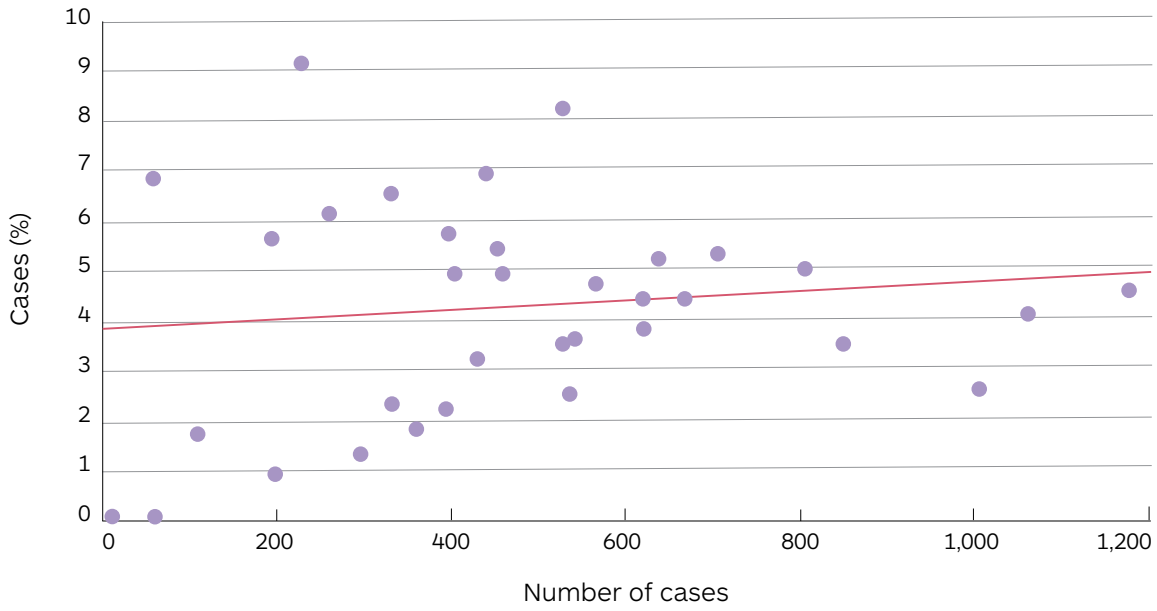
Figure 9: PCI cases by clinical presentation



10.3 Clinical presentation with cardiogenic shock and/or OHCA

The proportion of cases presenting with cardiogenic shock and/or OHCA by hospital volume is shown in Figure 10. These conditions accounted for 4.4% of hospitals' caseload on average (range 0-9.2%). Medium and high-volume PCI hospitals tended to have greater proportions of cases with shock and/or OHCA overall.

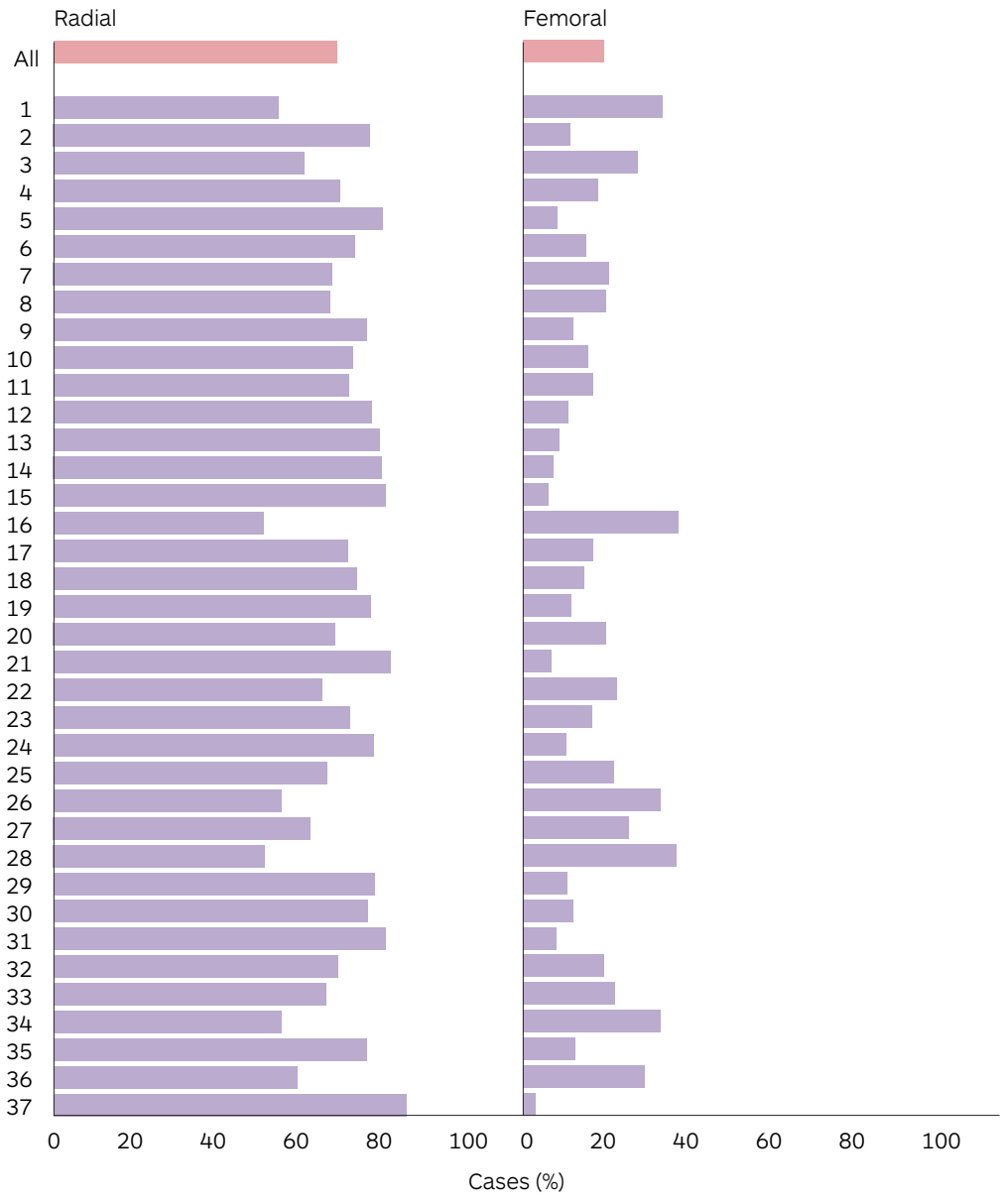
Figure 10: Shock and/or OHCA cases by hospital volume



10.4 Access site

The rates of radial and femoral vascular arterial access by hospital are shown in Figure 11. Radial access was the predominant site, with rates across hospitals ranging from 57% to 97% of total caseload. The use of a radial access site is recommended under the current clinical guidelines as it associated with decreased complications such as bleeding[18].

Figure 11: Arterial access route by hospital



The overall rate of radial vascular access was 77.6% of cases. The rate in males was 79% and lower in females at 73.3%. Rates of radial vascular access were similar in STEMI and NSTEACS patient groups and lower among patients with non-ACS (79.3% vs 79.8% vs 76.2% respectively). Higher rates of procedures for in-stent restenosis was observed in the NSTEACS and non-ACS patients compared with STEMI patients (4.9% vs 4.9% vs 2.4% respectively) with an overall rate of 4.2% across the cohort.

18 National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand (2016) Australian Clinical Guidelines for the Management of Acute Coronary Syndromes. Heart, Lung and Circulation, 25, 895–951. https://doi.org/10.1016/j.hlc.2016.06.789

10.5 Procedural Success

Procedural success, defined as lesion success and no major adverse cardiac events, was lowest in the STEMI cohort of patients. Left main lesions were most frequently treated in the non-ACS cohort (Table 3A). Procedural success rates were generally high, indicating consistency in this outcome across Australia.

Procedural data by hospital volume are presented in Table 3B. Low volume hospitals treated the lowest proportion of left main lesions and had the lowest use of mechanical ventricular support devices. Lesion and procedural success increased with volume and was highest in high volume hospitals.

Table 3A: Procedural data by clinical presentation

Procedural data	STEMI	NSTEACS	Non-ACS	All
	(N=4,981)	(N=5,444)	(N=5,877)	(N=16,302)
Radial access (%)	79.3	79.8	76.2	78.4
Femoral access (%)	20.6	19.9	23.3	21.3
Drug-eluting stent(s) (%)	92.2	94.1	93.4	93.3
In-stent restenosis (%)	2.4	4.9	4.9	4.2
Mechanical ventricular support required (%)	1.2	0.3	0.2	0.6
Lesion success (%)	95.2	96.1	95.4	95.5
Procedural success (%)	89.5	94.4	93.6	92.6
Left main lesion (%)	1.3	2.6	4.4	2.9

Table 3B: Procedural data by hospital volume

Procedural data	Low volume <250	Medium volume 250-500	High volume >500
	(N=858)	(N=4,556)	(N=10,888)
Radial access (%)	80.4	78.8	78.0
Femoral access (%)	19.2	20.8	21.7
Drug-eluting stent(s) (%)	94.3	93.5	93.1
In-stent restenosis (%)	3.4	3.0	4.7
Mechanical ventricular support required (%)	0.3	0.6	0.6
Lesion success (%)	92.7	95.7	95.7
Procedural success (%)	88.8	92.7	92.9
Left main lesion (%)	1.7	2.4	3.1

Hospitals without on-site surgery when compared to hospitals with on-site surgery had lower rates of left main lesions treated (Table 3C). This may reflect appropriate triage of high-risk PCI cases to centres with more direct access to urgent surgery. However, these data should be interpreted with caution due to the low number of cases treated in low-volume centres (n=858 cases).

When metropolitan and non-metropolitan hospitals were compared, there were no major differences seen among selected procedural characteristics (Table 3D).

Table 3C: Procedural data by on-site CABG vs off-site CABG hospitals

Procedural data	On-site CABG (N=8,574)	Off-site CABG (N=7,728)
Radial access (%)	74.5	82.6
Femoral access (%)	25.3	17.0
Drug-eluting stent(s) (%)	93.3	93.2
In-stent restenosis (%)	3.8	4.5
Mechanical ventricular support required (%)	0.7	0.5
Lesion success (%)	96.3	94.7
Procedural success (%)	93.3	91.9
Left main lesion (%)	3.4	2.3

Table 3D: Procedural data by metro vs non-metro hospitals

Procedural data	Metro (N=12,713)	Non-metro (N=3,589)
Radial access (%)	76.7	84.3
Femoral access (%)	23.2	14.9
Drug-eluting stent(s) (%)	93.4	92.7
In-stent restenosis (%)	4.2	4.1
Mechanical ventricular support required (%)	0.7	0.1
Lesion success (%)	95.3	96.5
Procedural success (%)	92.3	93.8
Left main lesion (%)	2.9	2.8

Local Reflection – Tasmania (TAS)

Tasmania is pleased to see the ongoing development of the National Cardiac Registry. Both major public hospitals are contributing data via the Victorian Cardiac Outcomes Registry and we are delighted to welcome Hobart Private Hospital to the registry.

Dr Andrew Black
Cardiologist, Tasmania

11. Percutaneous Coronary Intervention for Acute STEMI

Primary PCI is defined as a PCI performed as primary reperfusion therapy for STEMI patients presenting within 12 hours of symptom onset. There were 3,314 cases of primary PCI included from six of the eight jurisdictions. One jurisdiction did not yet have the appropriate systems in place to provide data for this reporting period and one jurisdiction did not yet have an established primary PCI program.

The two principal process measures used to assess performance in primary PCI were:

- time from door to PCI-mediated reperfusion,
- time from diagnostic ECG to PCI-mediated reperfusion.

These are timeframes from when a patient enters ED or receives a diagnostic ECG until the time blood flow is re-established. These are accepted measures for assessing the quality of hospital systems and processes which correlate with patient outcomes, with longer delays associated with increased 30- day and 12 month mortality[19].

Similarly, the time taken from diagnostic ECG to PCI-mediated reperfusion is a measure of system delay, but differs in that it also includes the pre-hospital phase for patients whose first medical contact is outside a hospital emergency department setting such as with a general practitioner or paramedic.

The cohort of 3,314 patients that underwent primary PCI represented 20% of the total PCI caseload of the 33 hospitals providing data. Figure 12 shows primary PCI case rates by hospital, ranging from 3% to 36% of hospitals' total PCI workload.

19 Foo CY, Bonsu KO, Nallamothu BK, Reid CM, Dhippayom T, Reidpath DD, Chaiyakunapruk N. Coronary intervention door-to-balloon time and outcomes in ST-elevation myocardial infarction: a meta-analysis. Heart. 2018 Aug;104(16):1362-1369. doi: 10.1136/heartjnl-2017-312517. Epub 2018 Feb 5. PMID: 29437704.

Figure 12: Primary PCI cases as a percentage of overall case numbers by hospital*

** Site 31 had no Primary PCI cases.*

Low volume hospitals had the lowest proportion of primary PCI cases among their workloads (14.4%). High volume hospitals undertook the majority of the cases overall (67% of the total caseload). The primary PCI case rate was similar among hospitals with and without on-site cardiac surgery. The majority of primary PCI cases were performed in metropolitan hospitals (78%) (Table 4).

Table 4: Primary PCI cases as a proportion of overall case numbers by hospital types

	Cases with data available	Primary PCI rate
Hospital types	N	N (%)
Low volume <250	800	115 (14.4)
Medium volume 250-500	4,556	974 (21.4)
High volume >500	10,888	2,225 (20.4)
On-site CABG	8,574	1,772 (20.7)
Off-site CABG	7,670	1,542 (20.1)
Metro	12,655	2,672 (21.1)
Non-metro	3,589	642 (17.9)
All	**16,244**	**3,314 (20.4)**

Note: Primary PCI (n=3,314) includes STEMI patients presenting within 12 hours of symptom onset and includes inter-hospital transfers and those who are already inpatients.

The benchmark target for door to PCI-mediated reperfusion used in this report was ≤90 minutes - in line with the participating registries own internal benchmarks. However, Australian and international guidelines have been shifting to a more stringent benchmark target of ≤60 minutes from first medical contact (rather than hospital arrival) to balloon inflation[20]. This shorter time delay has been linked with better survival rates including 30-day mortality[21].

The overall median door to PCI-mediated reperfusion time was 56 min (Table 5), similar to the time delay reported in our inaugural report in 2020. All but one hospital achieved a median door to PCI-mediated perfusion time of ≤90 minutes (Figure 13). When the best-practice treatment time frame was set only 18 out of 30 (60%) hospitals achieved a median door to PCI-mediated perfusion time of ≤60 minutes which is consistent with last year's data.

Table 5: Time from door to PCI mediated reperfusion for primary PCI cases*

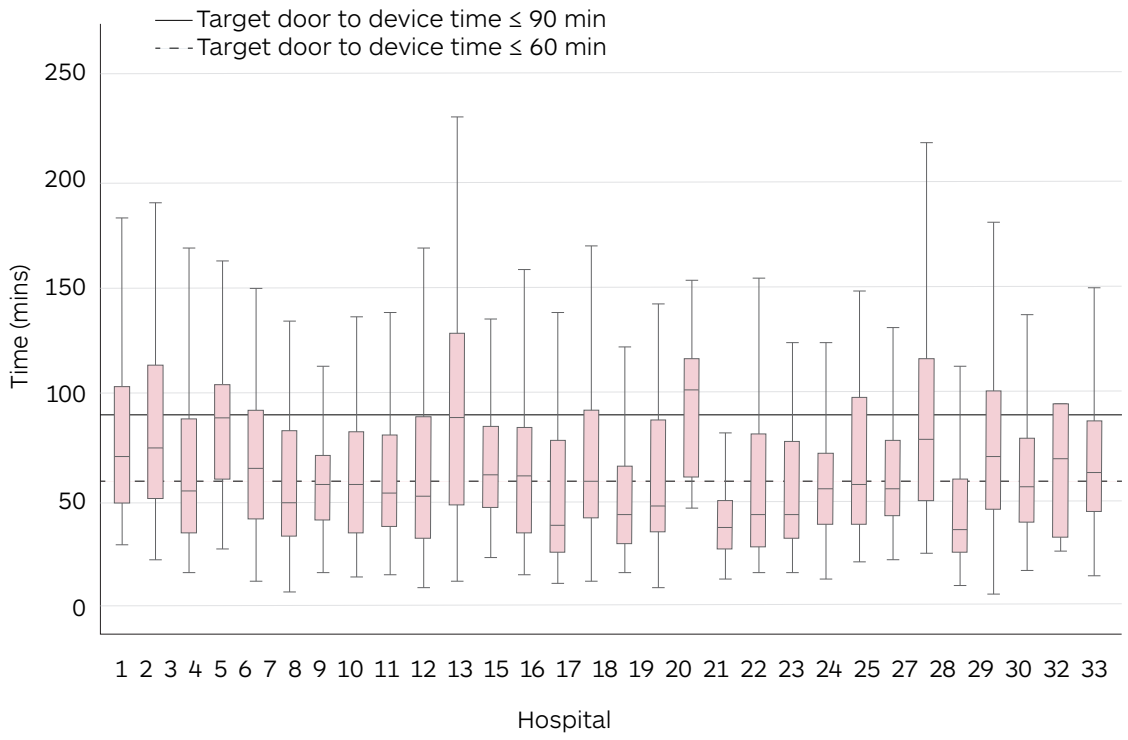
Door to PCI mediated reperfusion time	Primary PCI (all cases)
	N=2,816
Median - mins (IQR)	56 (37, 89)
Proportion of cases ≤90mins (%)	76.1
Proportion of cases ≤60mins (%)	54.7

**Primary PCI for STEMI presentations excluding all inter-hospital transfer and patients with STEMI onset whilst a current in-patient.*

20 National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand (2016) Australian Clinical Guidelines for the Management of Acute Coronary Syndromes. Heart, Lung and Circulation, 25, 895–951. https://doi.org/10.1016/j.hlc.2016.06.789

21 Chen FC, Lin YR, Kung CT, Cheng CI, Li CJ. The Association between Door-to-Balloon Time of Less Than 60 Minutes and Prognosis of Patients Developing ST Segment Elevation Myocardial Infarction and Undergoing Primary Percutaneous Coronary Intervention. Biomed Res Int. 2017; 2017:1910934. doi: 10.1155/2017/1910934. Epub 2017 Apr 4. PMID: 28473978; PMCID: PMC5394347.

Figure 13: Door-to-reperfusion time for primary PCI cases by hospital*



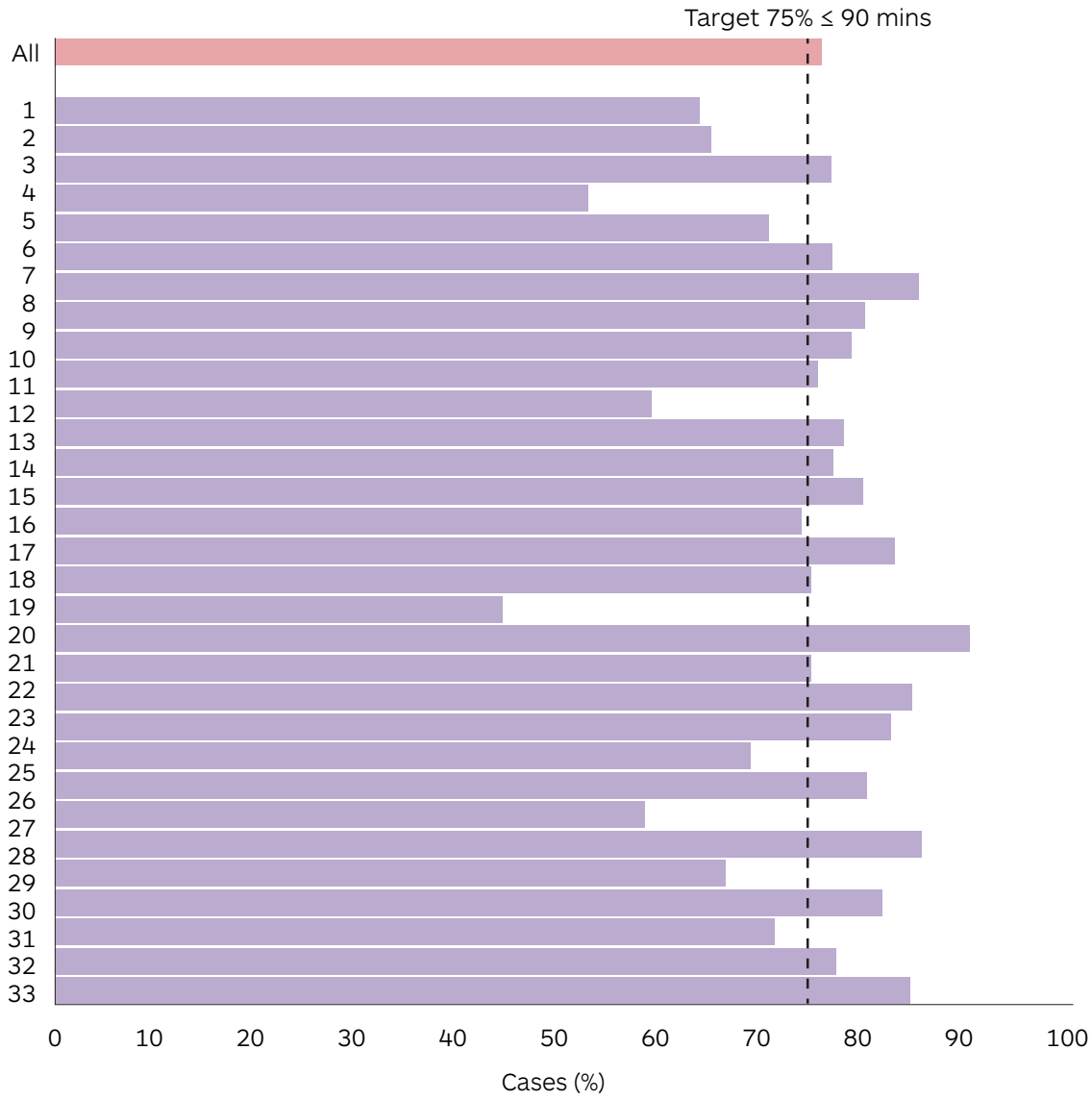
**Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient.*

Hospitals were also assessed on their compliance in achieving a door to PCI-mediated reperfusion time ≤90 min in at least 75% of cases, which is an internationally recognised performance benchmark[22]. Across all hospitals, a door to PCI-mediated reperfusion time ≤90 min was achieved in 78% of cases, with a range from 44% to 91% (Figure 14). The variation among hospitals is noteworthy, and suggests that there is scope for continuous quality improvement among hospitals whose rates fall below the >75% compliance benchmark.

Many factors are likely to have influenced these rates including the COVID-19 pandemic and increased pressure on the healthcare systems across the country. The data for this report were collected during the second year of the COVID-19 pandemic - which was known to result in delays in assessing and transferring patients presenting with acute STEMI. Interestingly, when the results from 2021 were compared with 2020 results, (>75% compliance rates varied from 29% - 100%), the amount of variation appeared greater in 2020, the first year of the pandemic, when new practices and requirements for personal protective equipment and infection control measures required for COVID-19 were still new and relatively unfamiliar. This improvement suggests that the Australian healthcare system was resilient and adapted to the pressures of the pandemic and changes in practice during this time.

22 American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines (2013) ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction: Executive Summary. Circulation, 127: 529-555.https://doi.org/10.1161/CIR.0b013e3182742c84

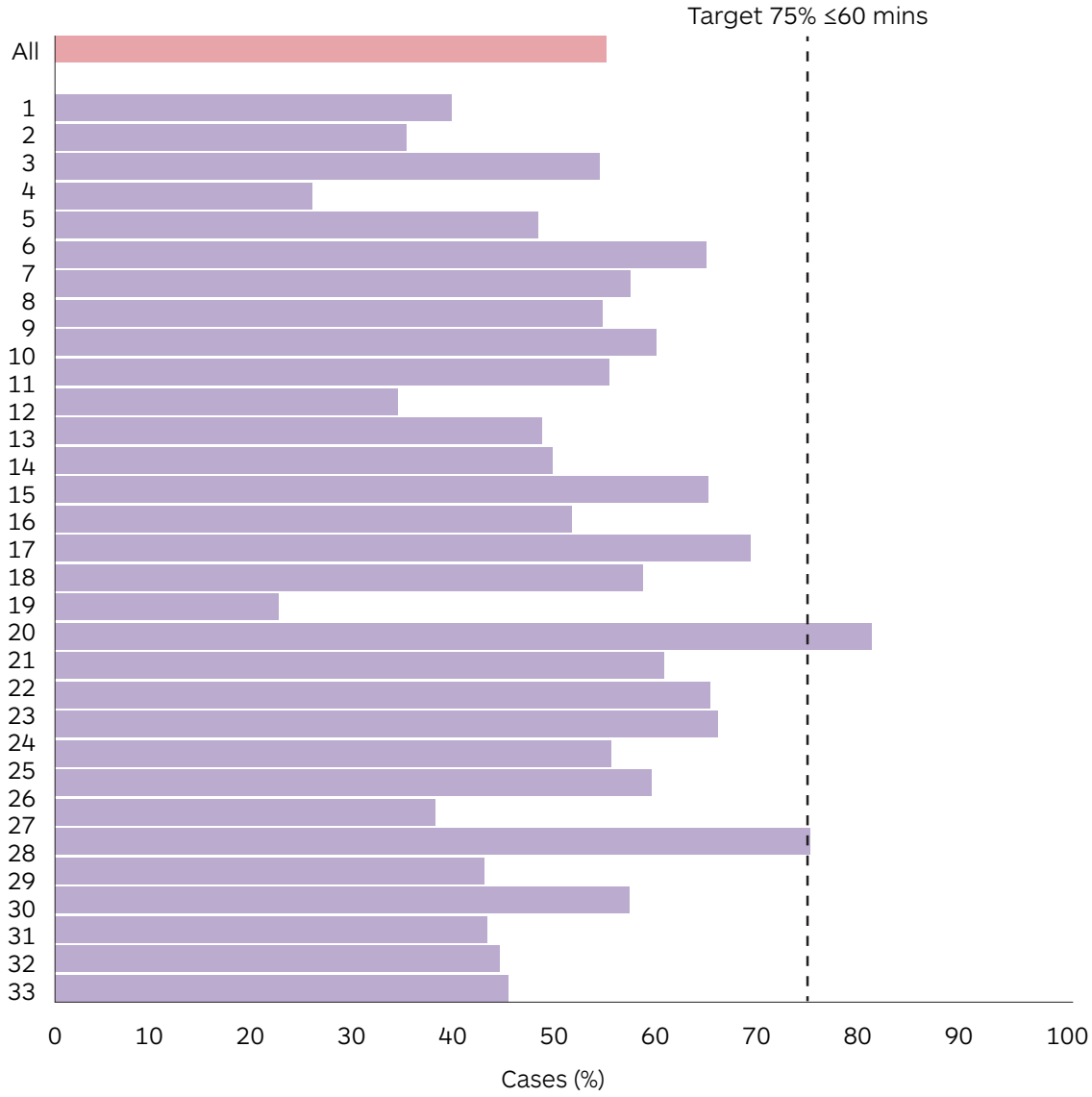
Figure 14: Percentage of primary PCI cases with door-to-device time of ≤90 min by hospital*



**Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient.*

19 hospitals (63%) achieved a door to PCI-mediated perfusion time of ≤90 min in greater than 75% of cases. When the best-practice treatment timeframe was set to ≤60 min, just two hospitals (6.7%) managed to achieve a >75% compliance rate (Figure 16). Effort is required to encourage hospitals across the country to respond to these benchmarking results and focus on methods and strategies to improve processes in relation to acute STEMI PCI.

Figure 15: Percentage of primary PCI cases with door-to-device time of ≤60 min by hospital*



**Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient.*

11.1 Prehospital notification

Prenotification to hospitals (PHN) of an impending ambulance arrival of an acute STEMI patient allows hospitals to activate the cardiac catheterisation lab team and set up rapid transfer to the catheter lab, with the aim of minimising delays to commencement of the PCI. In 2021, PHN was used in 69.8% of primary PCI cases. Rates for door to PCI-mediated reperfusion time ≤90 min were higher in patients triaged with pre-hospital notification, with 88.4% achieving a door to PCI-mediated reperfusion time ≤90 min compared to 49.2% when there was no pre-hospital notification (Table 6). Last year, 78% of contributing hospitals were able to achieve the PCI-mediated reperfusion time of ≤90 min through pre-hospital notification systems. Similarly, this year, 75% of contributing hospitals achieved this benchmark when pre-hospital notification was received (Figure 16). The benefit of prenotification was more evident when hospital performance was benchmarked against the more stringent treatment time frame of ≤60 min. In the absence of PHN, just 21.3% of cases managed to achieve a door to PCI-mediated perfusion time within 60 minutes.

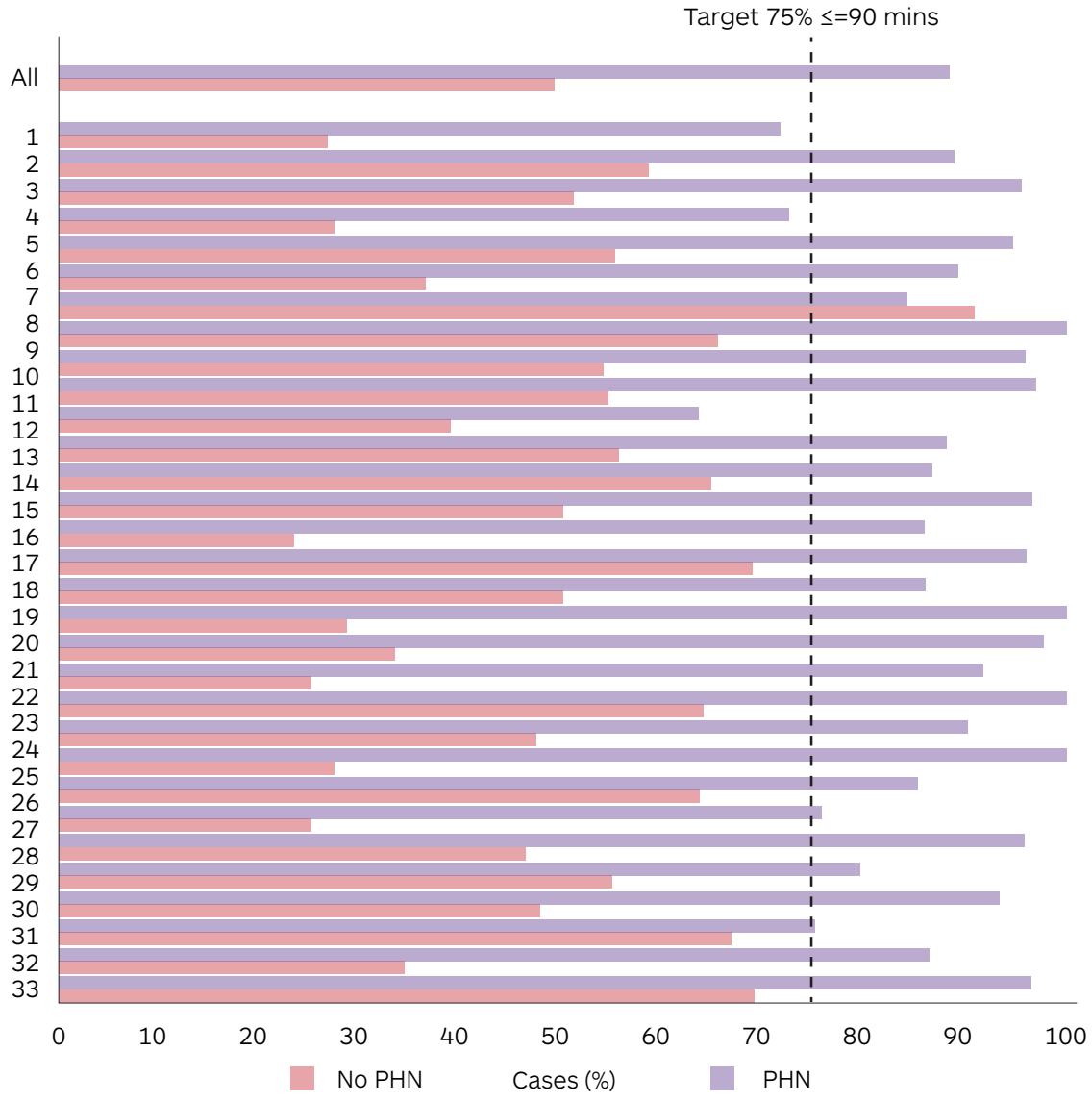
Table 6: Door-to-device times for primary PCI cases by prehospital notification status*

Door to PCI mediated reperfusion time	Primary PCI (all cases)	Primary PCI (PHN only†)	Primary PCI (no-PHN†)
	N=2,816	N=1,920	N=831
Median - mins (IQR)	56 (37, 85)	46 (33, 66)	92 (66, 123)
Proportion of cases ≤90mins (%)	76.1	88.4	49.2
Proportion of cases ≤60mins (%)	54.7	70.3	21.3

**Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient.*

†PHN data not supplied in 65 cases.

Figure 16: Percentage of primary PCI cases with door-to-device time ≤90 min by hospital - prehospital notification vs no prehospital notification*



**Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient.*

Local Reflection – Victoria (VIC)

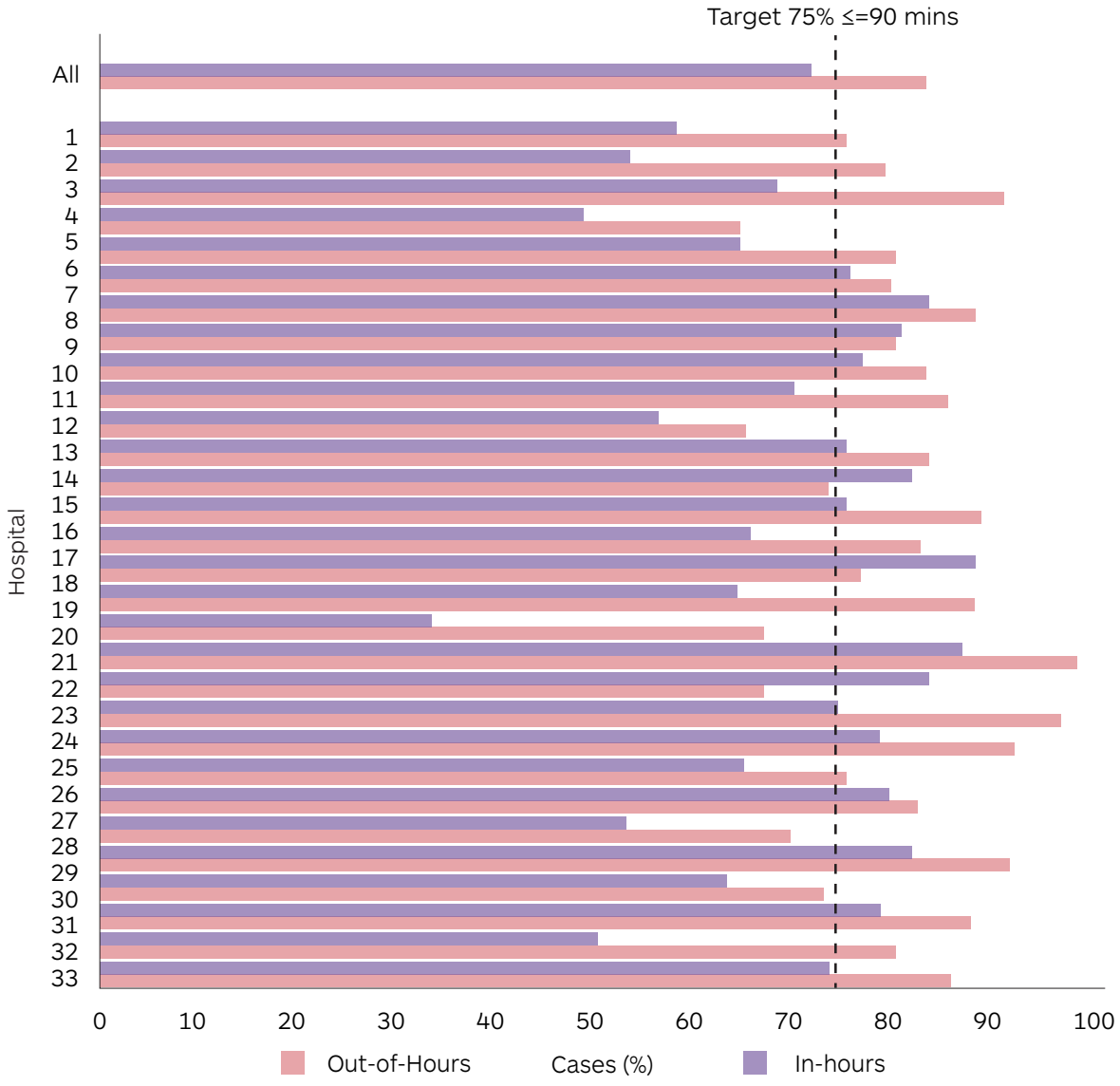
The Victorian Cardiac Outcomes Registry (VCOR) is looking forward to the insights that the NCR will provide on the state of cardiac care across Australia. As a leader in cardiac registries, VCOR was established in 2013, and collects data from all 15 public and 18 private hospitals in Victoria and holds data on 100,000+ PCI and 3,000+ CIED procedures. VCOR looks forward to utilising the NCR Platform to assess local practice and outcomes compared to the rest of Australia.

Professor Christopher M Reid
Coordinating Principal Investigator and Registry Custodian
Victorian Cardiac Outcomes Registry

11.2 In-Hours Versus Out-Of-Hours Presentation

Across all hospitals, 59.8% of STEMI cases were treated out-of-hours (range by hospital 29-73%). Most hospitals had longer door-to-balloon times after-hours, with just four hospitals performing better out-of-hours (Figure 17).

Figure 17: Percentage of primary PCI cases with door-to-device time of ≤90 min by hospital-in-hours vs out-of-hours presentation*



**Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient.*

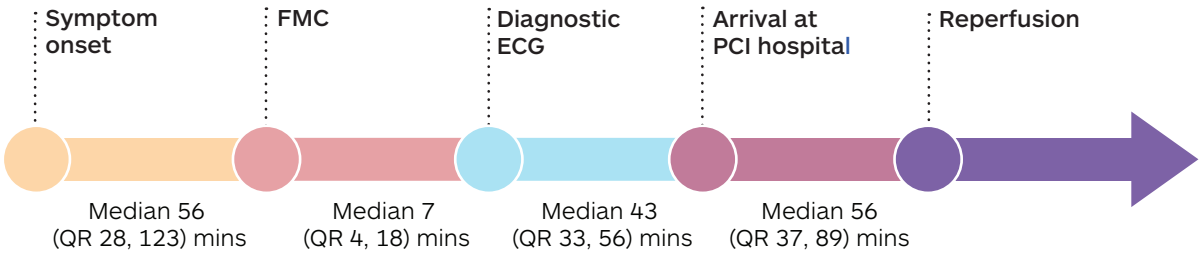
In-hours: 8.00am – 6.00pm (Mon – Fri). Out-of-hours: 6.00pm – 08.00am (Mon – Fri, national public holidays and weekends.

11.3 Times from symptom onset to first medical contact, diagnostic ECG and reperfusion

The various time components that contribute to the patient's total ischaemic time are shown in Figure 18. The median time from symptom onset to first medical contact (ambulance service, emergency department or GP) was 56 minutes (IQR: 28, 123). This time delay is primarily patient-dependent as it relies on the patient contacting the medical system and could be an indication of national health literacy relating to chest pain and cardiac symptoms. It is not considered a process measure of the systems involved in treating acute STEMI.

In contrast, the time from first medical contact to reperfusion could indicate system delay and is considered a measure of system quality and efficiency. The metric consists of the time from first medical contact (FMC) to diagnostic ECG, the time to transfer patients to a PCI-capable hospital after the diagnostic ECG and the time from hospital arrival to reperfusion.

Figure 18: Median times from symptom onset to PCI mediated reperfusion



In 2021, the overall median FMC to diagnostic ECG time was 7 minutes (IQR: 4, 18) (Figure 18, Table 7). Four hospitals did not meet the recommended benchmark of ≤10 minutes (Figure 18).[23,24] As with door to PCI-mediated perfusion time, FMC to diagnostic ECG time improved when pre-hospital notification (PHN) of the arriving STEMI patient was received from the ambulance service. The median FMC to diagnostic ECG time with PHN was 6 minutes (IQR: 4, 12), 5 minutes shorter than without PHN (11 minutes, IQR: 5, 37).

Table 7: Median times from symptom onset to reperfusion by prehospital notification status*

Sympton onset to reperfusion time	All Primary PCI*	Primary PCI (PHN only†)	Primary PCI (no-PHN†)
	(N=2,816)	(n=1,920)	(n=831)
Median Symptom onset to FMC - mins (IQR)	56 (28, 123)	51 (26, 112)	71 (32, 150)
Median FMC to Diagnostic ECG - mins (IQR)	7 (4, 18)	6 (4, 12)	11 (5, 37)
Median Diagnostic ECG to door - mins (IQR)	43 (33, 56)	44 (34, 57)	40 (26, 55)
Median Diagnostic ECG to reperfusion time - mins (IQR)	91 (73, 116)	92 (75, 114)	89 (66, 125)
Median FMC to reperfusion time - mins (IQR)	103 (84, 136)	100 (83, 126)	114 (84, 159)
Median Symptom onset to reperfusion time - mins (IQR)	177 (132, 257)	166 (128, 233)	202 (146, 303)

**Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient.*

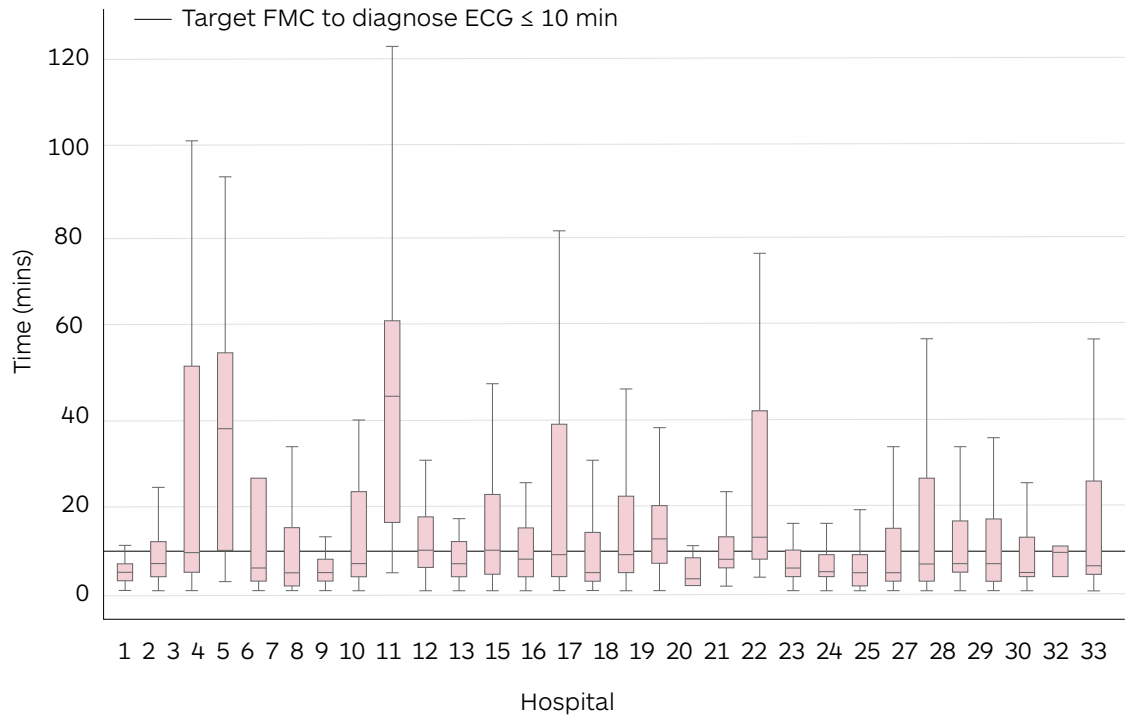
†PHN data not supplied in 65 cases.

23 Chew et al. National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand: Australian clinical guidelines for the management of acute coronary syndromes 2016.

24 Australian Commission on Safety and Quality in Health Care. Acute Coronary Syndromes Clinical Care Standard: ACSQHC, editor. Sydney 2019.

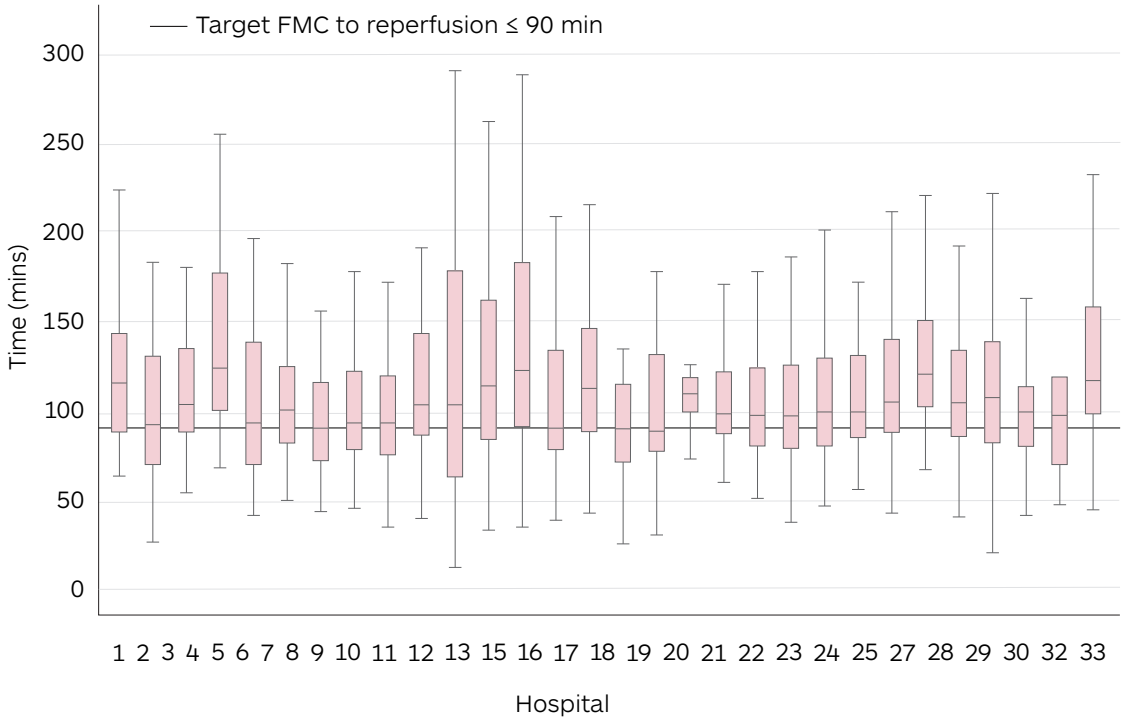
Australian guidelines,[25] recommend the time from FMC to reperfusion should be ≤90 min. The median FMC to reperfusion time for the cohort was 103 minutes (IQR: 84, 136) (Table 7). Only 4 hospitals were compliant with the recommended benchmark of a median FMC to reperfusion time ≤90 min (Figure 20). These data provide a valuable insight into the challenges faced by hospitals across the country in complying with increasingly stringent guideline recommendations. Currently, the overwhelming majority of PCI hospitals included in this report that perform primary PCI have not been able to achieve results meeting the latest treatment benchmarks. The benchmark of FMC to reperfusion of ≤90 min may be arduous in an Australian context with its decentralised hospital setup, greater distances between acute settings, design of our emergency medical services and overall levels of health literacy in the community. However, it is valid and appropriate to offer health providers an aspirational goal of best practice, with this report and further advocacy from the Registry acting as catalysts to promote continuous quality improvement among the nation's hospitals.

Figure 19: First medical contact to diagnostic ECG time for primary PCI cases by hospital



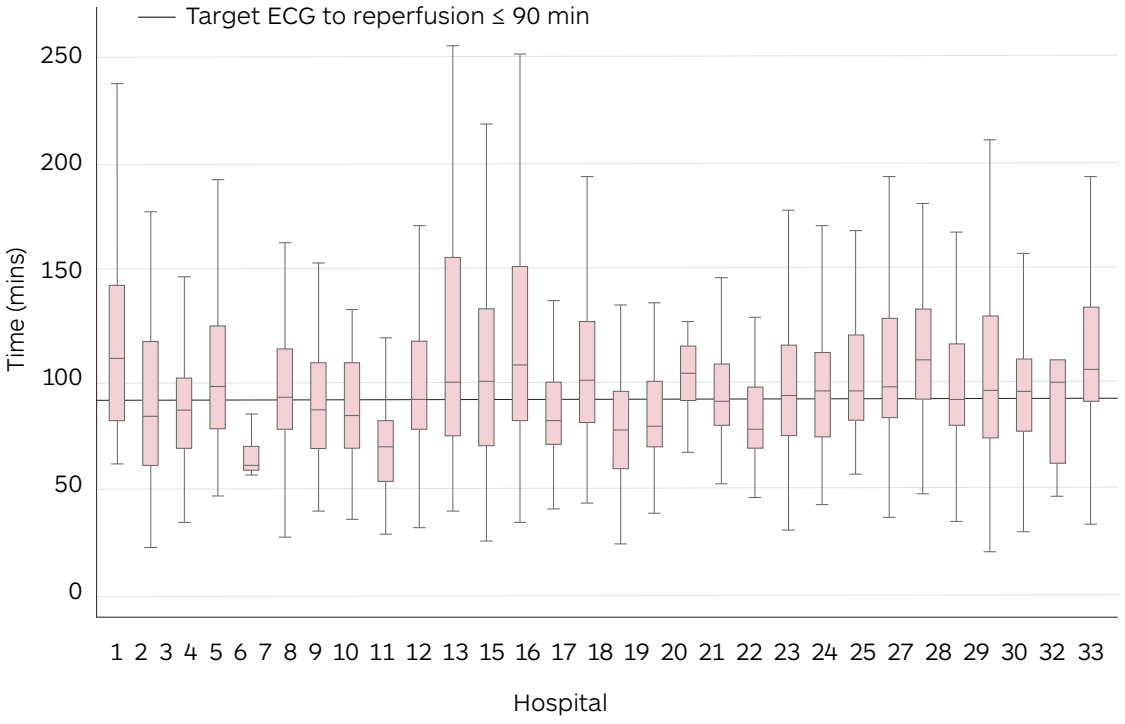
25 Chew et al. National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand: Australian clinical guidelines for the management of acute coronary syndromes 2016. Med J Aust, 2016.

Figure 20: First medical contact to PCI-mediated reperfusion time for primary PCI cases by hospital



We further assessed the time delays from diagnostic ECG to PCI-mediated reperfusion as an additional metric of system performance. The median ECG to reperfusion time for the cohort was 91 min (IQR: 73, 116) with variation among hospitals (Figure 21).

Figure 21: Diagnostic ECG to reperfusion by hospital

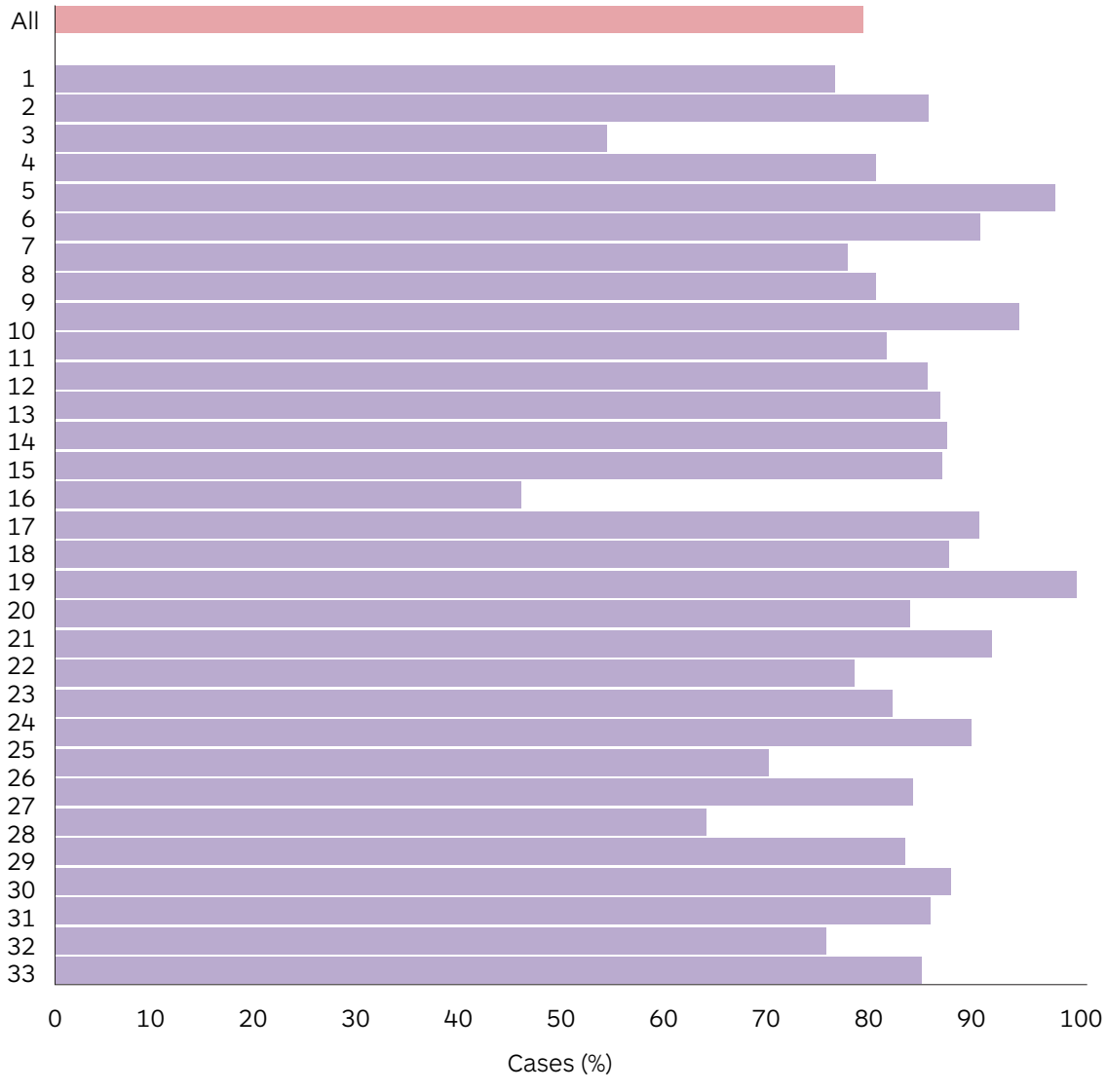


11.4 Radial Access In Primary PCI

In the last 5-10 years, radial access has emerged as the predominant arterial approach for PCI, although there is variation among hospitals in their utilisation of the radial technique. Radial artery utilisation is considered best practice in primary PCI, with improved clinical outcomes observed[26]. Radial access is associated with lower bleeding and vascular complications, and has been shown to improve measures of quality of life and reduce costs, particularly among patients with acute coronary syndromes[27].

For patients undergoing primary PCI for STEMI, radial artery access was used in 79.1% of cases. Radial access rates by hospital are shown in Figure 22, with rates varying from 45% to 100%. Just under three quarters of hospitals utilised the radial artery for vascular access in ≥80% cases. These benchmarking results help hospitals understand how their performance in this process measure compares with their peers at a national level and will encourage centres with lower rates to consider strategies to improve their uptake of radial access – especially in this clinical context where there is a strong evidence base for its use.

Figure 22: Radial access rate in primary PCIs by hospital



26 National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand (2016) Australian Clinical Guidelines for the Management of Acute Coronary Syndromes. Heart, Lung and Circulation, 25, 895–951. https://doi.org/10.1016/j.hlc.2016.06.789

27 Mitchell, Matthew D et al. "Systematic review and cost-benefit analysis of radial artery access for coronary angiography and intervention." Circulation. Cardiovascular quality and outcomes vol. 5,4 (2012): 454-62. doi:10.1161/CIRCOUTCOMES.112.965269

Local Reflection – Northern Territory (NT)

August 2021 saw significant progress for the NTTCD with the commencement of data collection for the Registry. NTTCD data is represented in the overall cohort within this annual status report, and we look forward to contributing in future reports. We are continuing to seek ongoing commitment and secured financial sustainability to support continued involvement in the NCR, as an important quality improvement activity.

Dr Marcus Ilton
Cardiologist and Director of Cardiology, Royal Darwin and Palmerston Hospital

Justine Williams
Northern Territory Top End Coronary Database, Cardiac Expansion Unit, NT Health

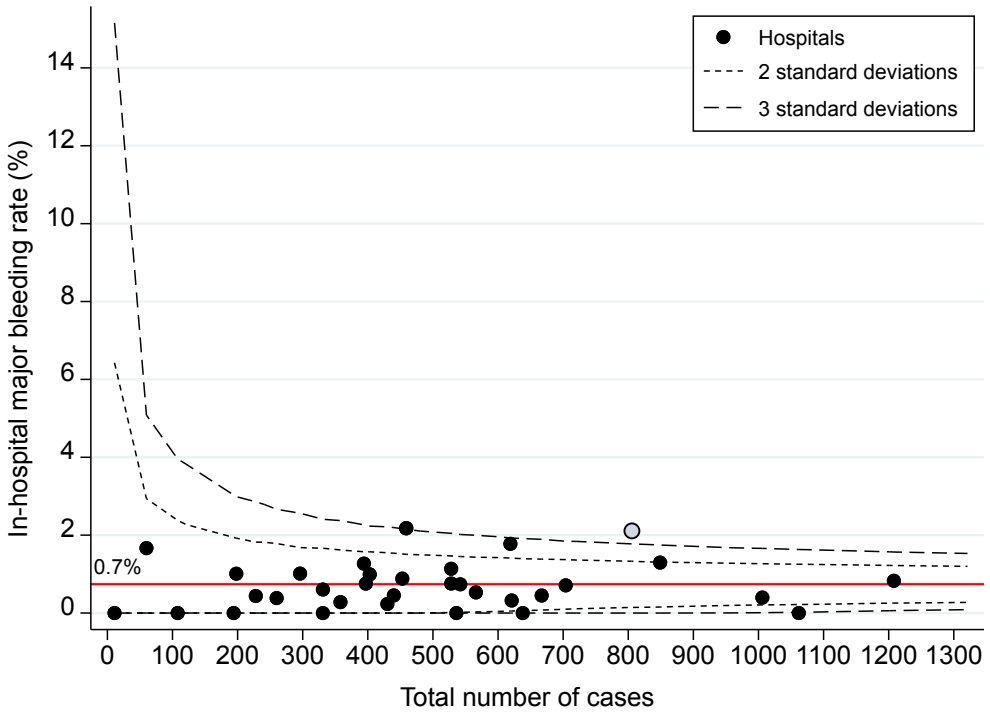
12. In-Hospital Outcomes following PCI

Procedural success rates were generally high and consistent across the various hospital categories. There were no major differences in success rates by hospital volume (low, medium or high volume) or the presence of onsite cardiac surgery or hospital location (metropolitan vs regional/rural).

12.1 In-hospital mortality

The overall in-hospital mortality rate in 2021 was 2.0%. All participating hospitals were within control limits (Figure 23). When the high-acuity cases of cardiogenic shock and/or out-of-hospital cardiac arrest that are known to have high mortality were excluded from the analysis, the mortality rate was 0.8%. These results are similar to our first year of data collection in 2020, and provide a strong evidence base that PCI patients across the country are receiving effective and safe care without substantial unwanted variation in the quality of that care.

Figure 23: In-hospital mortality rate by hospital*



14 cases with multiple procedures were excluded to avoid mortality being counted more than once.

Table 8A: In-hospital mortality rates for selected patient group

Patient category	Total	In-hospital mortality rate
	N	N (%)
All PCI patients	16,287	321 (2.0)
STEMI patients	4,978	233 (4.7)
Cardiogenic shock and/or OHCA patients	720	204 (28.3)
NSTEACS	5,443	45 (0.8)
Non-ACS	5,866	43 (0.7)

Table 8A provides in-hospital mortality data for selected clinical groups. Mortality for cardiogenic shock and/or out-of-hospital cardiac arrest was higher than the rest of the cohort at 28%.

The highest in-hospital mortality rates were seen among patients with cardiogenic shock and/or OHCA treated in low-volume hospitals. Death rates for non-ACS cases were also highest in low volume centres (Table 8B). While these findings suggest a potential relationship between case volume and procedural outcomes, it is noteworthy that the number of cases performed in low volume hospitals was itself quite low. As a result, small changes in outcome events can result in relatively large differences to overall rates as expressed as a percentage. When outcomes were analysed by other hospital characteristics (presence of onsite cardiac surgery and hospital location) in-hospital mortality rates were broadly similar (Tables 8C and 8D). The potential association between hospital volume and outcomes is an important area for further analysis and study and will be a focus in future reports.

Table 8B: In-hospital mortality rates by hospital volume

Patient category	Total	Low volume <250	Medium volume 250-500	High volume >500
	N	n/N (%)	n/N (%)	n/N (%)
All PCI patients	16,287	19/857(2.2)	87/4,552 (1.9)	215/10,878 (2.0)
STEMI patients	4,978	11/209 (5.3)	68/1,384 (4.9)	154/3,385(4.5)
Cardiogenic shock and/or OHCA patients	720	15/40 (37.5)	64/202 (31.7)	125/478 (26.2)
NSTEACS	5,443	2/311(0.6)	10/1511 (0.7)	33/3,621 (0.9)
Non-ACS	5,866	6/337 (1.8)	9/1,657 (0.5)	28/3,872(0.7)

Table 8C: In-hospital mortality rates by on-site CABG vs off-site CABG centres

Patient category	Total	On-site CABG	Off-site CABG
	N	n/N (%)	n/N (%)
All PCI patients	16,287	176/8,566 (2.1)	145/7,721 (1.9)
STEMI patients	4,978	135/2,674 (5.0)	98/2,304 (4.3)
Cardiogenic shock and/or OHCA patients	720	103/378 (27.2)	101/342 (29.5)
NSTEACS	5,443	21/2,785 (0.8)	24/2,658 (0.9)
Non-ACS	5,866	20/3107 (0.6)	23/2,759 (0.8)

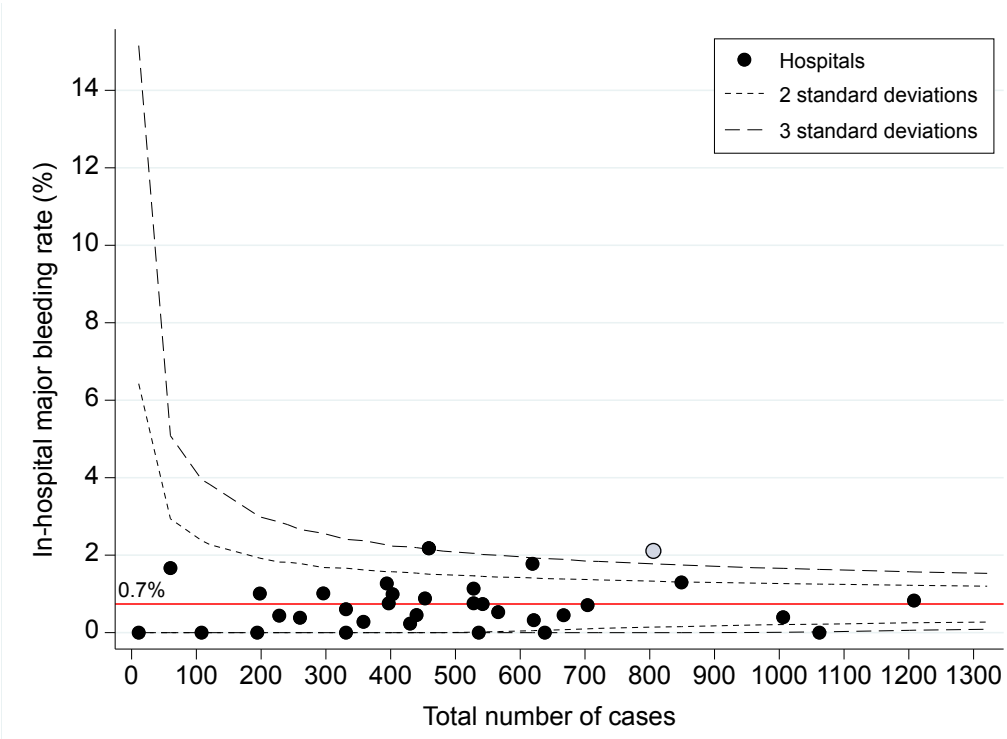
Table 8D: In-hospital mortality rates by metro vs non-metro hospitals

Patient category	Total	Metro	Non-metro
	N	n/N (%)	n/N (%)
All PCI patients	16,287	251/12,701 (2.0)	70/3,586 (2.0)
STEMI patients	4,978	189/3,827 (4.9)	44/3,586 (2.0)
Cardiogenic shock and/or OHCA patients	720	157/565 (27.8)	47/155 (30.3)
NSTEACS	5,443	33/4,361 (0.8)	12/1,082 (1.1)
Non-ACS	5,866	29/4,513 (0.6)	14/1,353 (1.0)

12.2 In-Hospital Major Bleeding

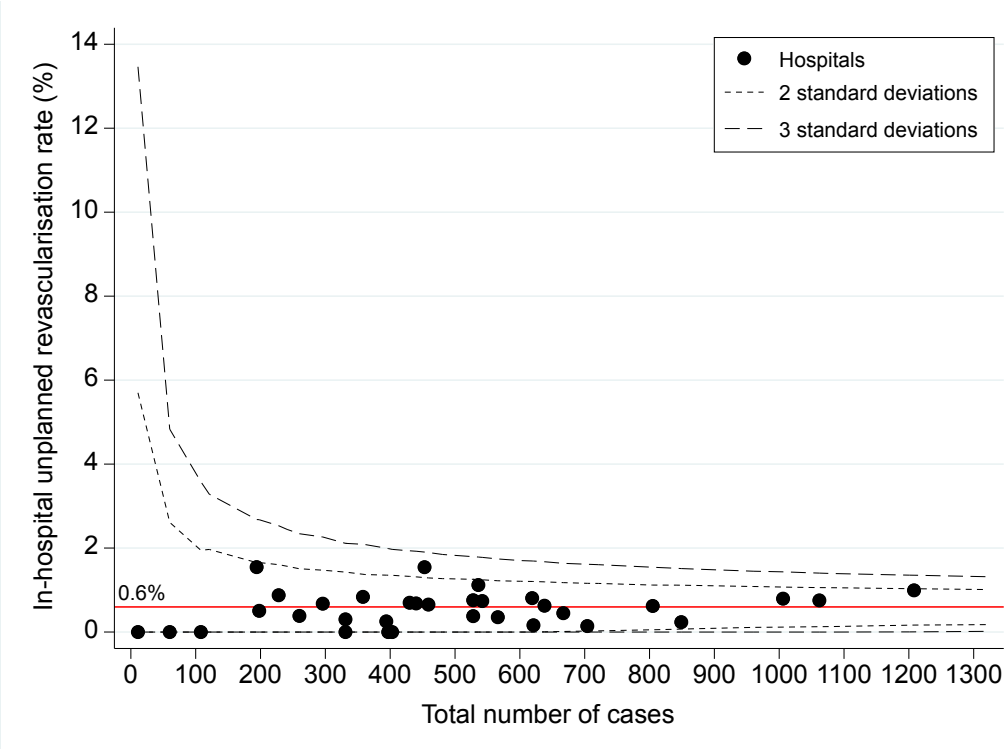
The rate of in-hospital major bleeding for the overall cohort was 0.8%. All but one hospital was within 3 standard deviations of the mean. Highest bleeding rates are seen among patients presenting with acute STEMI - a group that frequently require blood thinning medications such as antiplatelet and anticoagulants as part of their care and increases the risk of bleeding following a PCI. In-hospital major bleeding outcomes were lower among patients who underwent PCI via the radial approach rather than a femoral approach.

Figure 24: In-hospital major bleeding rate by hospital



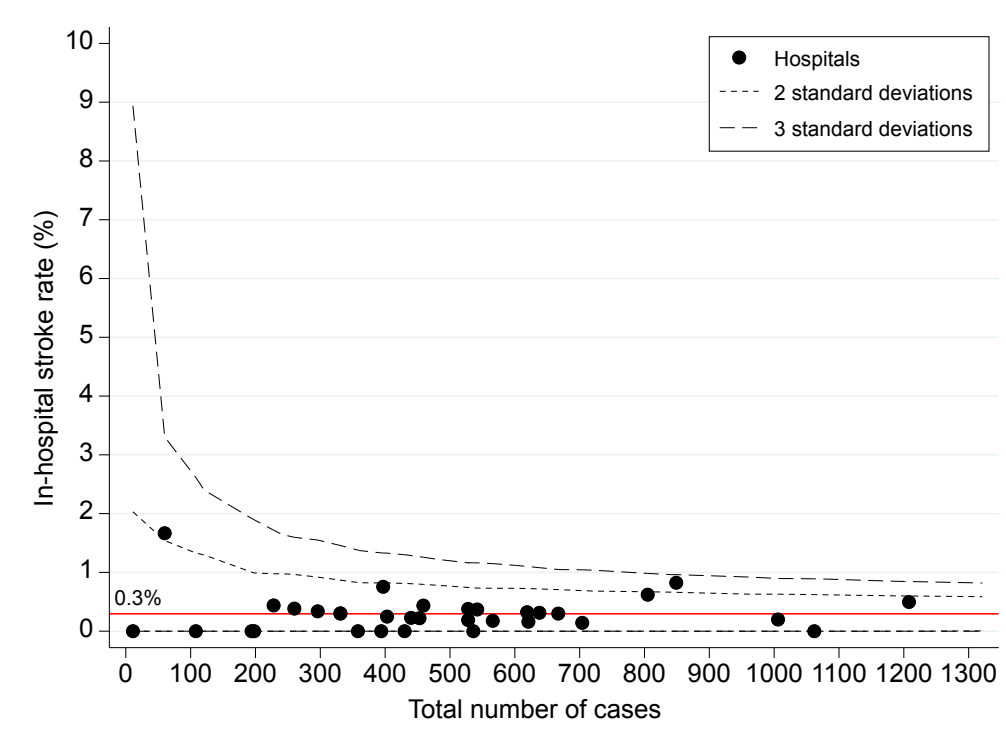
The metric of in-hospital unplanned revascularisation is defined as any unexpected revascularisation procedure following the index PCI that occurs during the same admission. This includes repeat PCI or CABG surgery and is usually undertaken because a complication of the first PCI has occurred, such as acute stent thrombosis, extensive coronary dissection or perforation. The rate of in-hospital unplanned revascularisation for 2021 was 0.6%. All sites had rates of unplanned revascularisation within control limits (Figure 25).

Figure 25: In-hospital unplanned revascularisation rate by hospital



The overall rate of the complication of in-hospital stroke after PCI was 0.3% and all hospitals were within control limits (Figure 26).

Figure 26: In-hospital stroke rate by hospital



12.3 Outcomes by Clinical Presentation and Hospital Characteristics

Rates of in-hospital adverse events by clinical presentation are presented in table 9A. Major bleeding and in-hospital stroke rates were most common among patients presenting with acute STEMI. The composite endpoint of major adverse cardiac and/or cerebrovascular events (MACCE) was defined as the rate of total death, new myocardial infarction, stent thrombosis, unplanned revascularisation or stroke. The in-hospital MACCE rate was 3.3% overall and highest in the STEMI cohort at 7.5%.

Table 9A: In-hospital outcomes by clinical presentation

In hospital outcomes	Total	STEMI	NSTEACS	Non-ACS
	(N=16,287)	(N=4,978)	(N=5,443)	(N=5,866)
Major bleeding (%)	0.7	1.1	0.4	0.7
Myocardial infarction (%)	0.4	0.6	0.4	0.3
Stroke (%)	0.3	0.5	0.2	0.2
Stent thrombosis (%)	0.2	0.5	0.1	0.1
Unplanned revascularisation (%)	0.6	1.1	0.5	0.2
MACE† (%)	3.0	7.0	1.6	1.2
MACCE (%)	3.3	7.5	1.7	1.3
Median length of stay (Days)	3.0	3.0	3.0	1.0

† MACE = major adverse event.

In-hospital outcomes were also examined by hospital characteristics (case volume, presence of on-site surgery and hospital location). Post-procedure myocardial infarction was more common in low volume centres and MACCE rates were higher in non-metropolitan hospitals (Tables 9B-9D).

Table 9B: In-hospital outcomes by hospital volume

In hospital outcomes	Low volume <250	Medium volume 250-500	High volume >500
	(N=857)	(N=4,552)	(N=10,878)
Major bleeding (%)	0.5	0.8	0.7
Myocardial infarction (%)	1.2	0.4	0.4
Stroke (%)	0.2	0.3	0.3
Stent thrombosis (%)	0.5	0.2	0.2
Unplanned revascularisation (%)	0.8	0.5	0.6
MACE† (%)	4.0	3.0	3.0
MACCE (%)	4.1	3.2	3.3
Median length of stay (Days)	3.0	3.0	3.0

† MACE = major adverse event.

Table 9C: In-hospital outcomes by on-site CABG vs off-site CABG centres

In hospital outcomes	On-site CABG (N=8,566)	Off-site CABG (N=7,721)
Major bleeding (%)	0.9	0.6
Myocardial infarction (%)	0.3	0.5
Stroke (%)	0.4	0.2
Stent thrombosis (%)	0.2	0.2
Unplanned revascularisation (%)	0.6	0.6
MACE† (%)	3.0	3.1
MACCE (%)	3.4	3.2
Median length of stay (Days)	3.0	3.0

† *MACE = major adverse event.*

Table 9D: In-hospital outcomes by metro vs non-metro hospitals

In hospital outcomes	Metro (N=12,701)	Non-metro (N=7,721)
Major bleeding (%)	0.9	0.3
Myocardial infarction (%)	0.4	0.3
Stroke (%)	0.3	0.3
Stent thrombosis (%)	0.2	0.1
Unplanned revascularisation (%)	0.6	0.8
MACE† (%)	2.9	4.0
MACCE (%)	3.2	4.3
Median length of stay (Days)	3.0	3.0

† *MACE = major adverse event.*

13. Discharge Medications and Secondary Prevention Programs

Australian guidelines recommend that patients undergoing PCI – particularly those who present with an ACS – should be treated with dual antiplatelet therapy (DAPT) for up to 12 months and receive lipid lowering therapy to achieve a low-density lipoprotein level <1.8mmol/L and preferably <1.4mmol/L. They should also receive an individualised care plan identifying the lifestyle modifications and medications needed to manage their risk factors, address their psychosocial needs and be referred to an appropriate cardiac rehabilitation or other secondary prevention program. Cardiac rehabilitation is a key component in the prevention of mortality and recurrent cardiac events[28].

13.1 Compliance With Discharge Medication Prescribing

In 2021, compliance with the prescription of DAPT (95.5%) and lipid lowering therapy (96.4%) was high overall and consistent among the various clinical presentations and hospital characteristics (Table 10).

Table 10: Rates of prescription of DAPT and lipid lowering therapy by clinical presentation and hospital type

	Discharged on DAPT (%)	Discharged on LLT (%)
STEMI (N=3,200)	94.9	97.3
NSTEACS (N=3,866)	96.0	97.6
Non-ACS (N=4,033)	95.4	94.4
Low volume <250 (N=836)	96.2	97.5
Medium volume 250-500 (N=3,327)	95.9	96.0
High volume >500 (N=6,936)	95.2	96.4
On-site CABG (N=5,361)	95.4	97.0
Off-site CABG (N=5,738)	95.6	95.8
Metro (N=9,951)	95.5	96.5
Non-metro (N=1,148)	95.7	95.0
All cases (N=11,099)	**95.5**	**96.4**

28 Woodruffe S, Neubeck L, Clark RA, Gray K, Ferry C, Finan J, Sanderson S, Briffa TG. Australian Cardiovascular Health and Rehabilitation Association (ACRA) core components of cardiovascular disease secondary prevention and cardiac rehabilitation 2014. Heart, Lung and Circulation. 2015 May 1;24(5):430-41.

13.2 Referral to Cardiac Rehabilitation

There is strong evidence demonstrating the positive impact cardiac rehabilitation has on long term outcomes for patients following PCI and referral to outpatient cardiac rehabilitation is recommended under the Australian Clinical Guidelines for the Management of Acute Coronary Syndrome for all patients[29]. The overall rate for referral to cardiac rehabilitation following PCI was 77.0% (Table 11). The rate of referral when compared to last year has increased significantly from 41.2% to 66.3%.

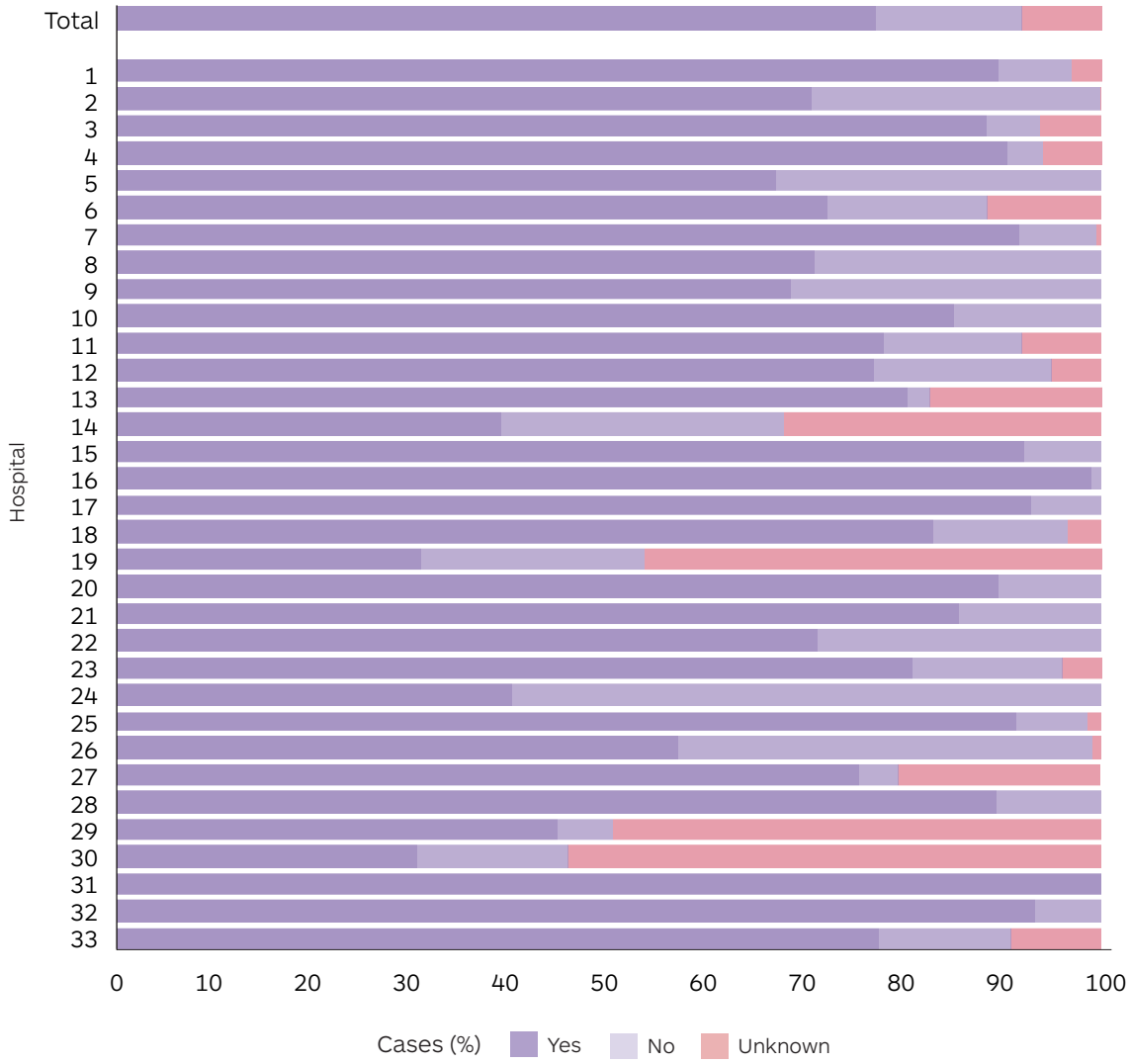
Referral rates were higher for patients with acute coronary syndromes than those with non-ACS presentations. Low volume hospitals had lower referral rates than larger volume hospitals. Hospitals with on-site surgery had higher referral rates. Notably, referral to cardiac rehab occurred with greater frequency in non-metropolitan hospitals compared with metropolitan hospitals. In the future when 30-day outcomes are more comprehensively collected, relationships between cardiac rehab and longer-term outcomes can be assessed.

Table 11: Rates of referral to cardiac rehabilitation by clinical presentation and hospital type

	Cases with data available	Rehabilitation referral rate	Referral status 'unknown'
Clinical presentation	N	%	%
STEMI	4,746	82.8	7.6
NSTEACS	5,399	77.3	9.0
Non-ACS	5,828	71.9	8.3
Hospital types	N	%	%
Low volume <250	838	66.3	18.1
Medium volume 250-500	4,467	76.9	5.4
High volume >500	10,668	77.8	8.8
On-site CABG	8,394	81.9	3.7
Off-site CABG	7,579	71.5	13.5
Metro	12,456	75.8	9.8
Non-metro	3,517	81.0	3.1
All	**15,973**	**77.0**	**8.3**

29 Cartledge S, Driscoll A, Dinh D, O'Neil A, Thomas E, Brennan AL, Liew D, Lefkovits J, Stub D. Trends and Predictors of Cardiac Rehabilitation Referral Following Percutaneous Coronary Intervention: A Prospective, Multi-Site Study of 41,739 Patients From the Victorian Cardiac Outcomes Registry (2017-2020). Heart Lung Circ. 2022 Sep;31(9):1247-1254. doi: 10.1016/j.hlc.2022.04.050. Epub 2022 May 25. PMID: 35643797.

Figure 27: Referral to cardiac rehabilitation rate by hospital



Local Reflection – Queensland (QLD)

The NCR is a valuable tool in enabling benchmarking and quality monitoring across the country. As an established quality and safety program, QCOR has a primary role in reporting to hospitals and Queensland Health for the purposes of quality improvement and patient safety. With the NCR complementing these processes and enabling additional insight, further improvements and collaboration can be fostered. The transformation to a federated model of data collection and a platform that will enable trusted, reliable analysis is a positive step in improving the quality of care for patients with heart disease.

Rohan Poulter
Cardiologist, QLD

William Vollbon
Queensland Cardiac Outcomes Registry, State wide Cardiac Clinical Informatics Unit, Queensland Health

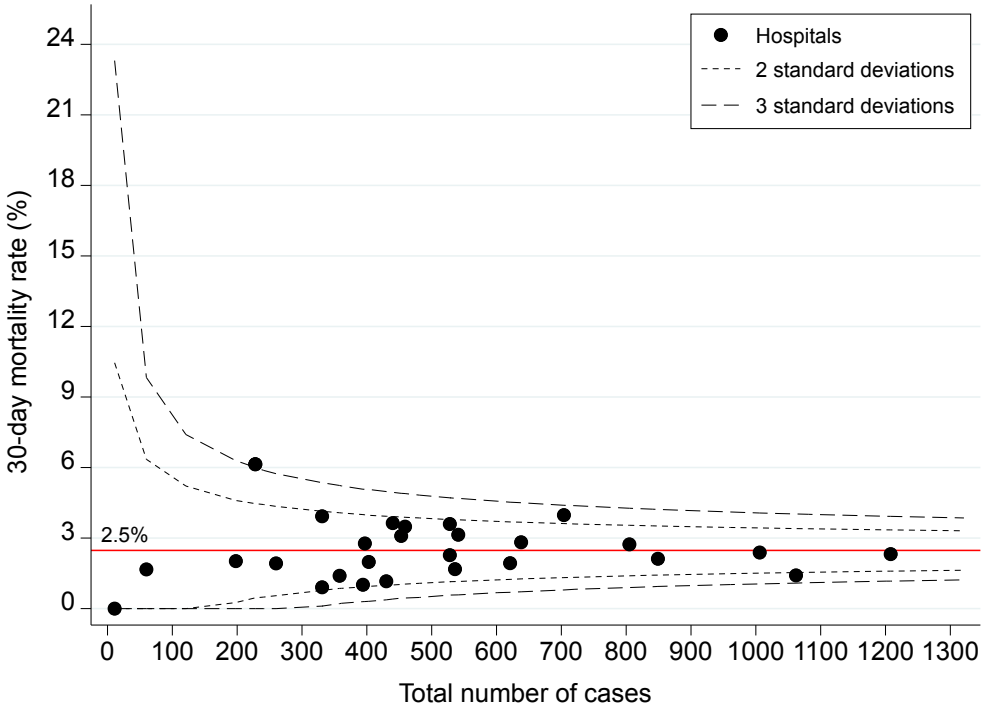
14. 30-Day Outcomes

The measurement of outcomes at 30 days (post discharge) has become a standard approach in clinical quality assessment and provides important information regarding performance and quality of care that adds to and complements in-hospital outcomes assessment. Collection of these data can be resource intensive and a number of the contributing registries were at different stages with respect to the scope and capacity of their 30-day follow up processes. Not all jurisdictions were able to provide complete data sets of all 30-day endpoints utilised in this report. Six of the eight jurisdictions provided data on 30-day mortality and 30-day unplanned cardiac readmissions and five registries provided data on 30-day unplanned revascularisation. For the set of 30-day outcomes being assessed, the number of contributing sites ranged from 19 to 27, out of a possible total of 33 hospitals.

14.1 30-Day Mortality

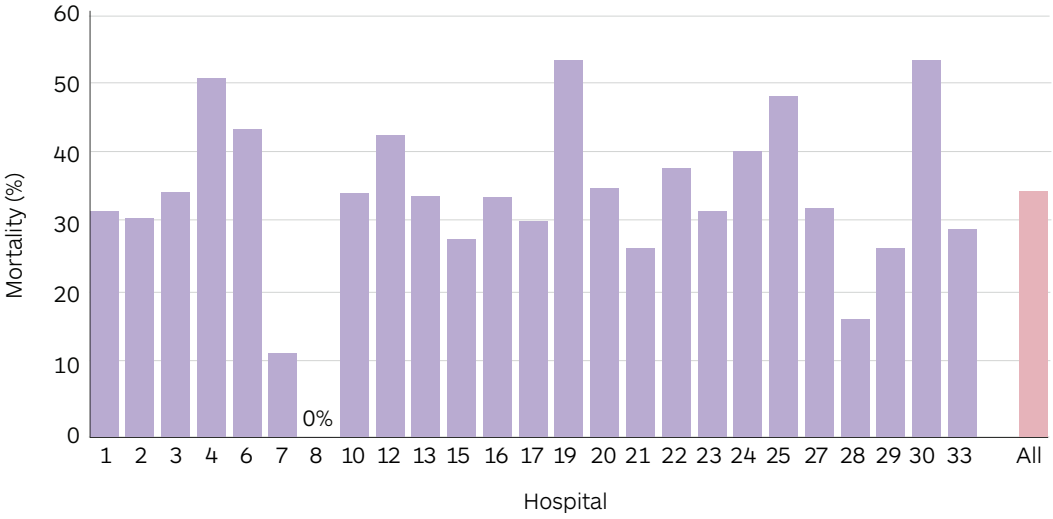
The overall unadjusted 30-day mortality rate following PCI was 2.5% and all participating hospitals were within control limits (Figure 28). When cardiogenic shock and/or out-of-hospital cardiac arrest cases were excluded, the mortality rate for the PCI cohort was 1.1% with all hospitals within control limits. As cases with cardiogenic shock and/or out-of-hospital cardiac arrest have much higher mortality rates, the exclusion of these 615 cases provides a better perspective on hospitals' mortality rates for non-critical cases.

Figure 28: 30-day mortality rate by hospital



The 30-day mortality rates for shock and/or OHCA cases by hospital are shown in Figure 29. The mean rate was 31.9%, with considerable variation observed among hospitals (0% to 50%). It is important to note that the number of cases overall and per hospital were quite small and therefore caution is needed to avoid over-interpreting the significance of apparent differences in mortality across hospitals. The data do however confirm that the 30-day mortality after PCI associated with cardiogenic shock and OHCA is substantially greater than other clinical categories of PCI and suggest that measures to reduce the mortality associated with these high acuity presentations should be a high priority for further clinical research and development.

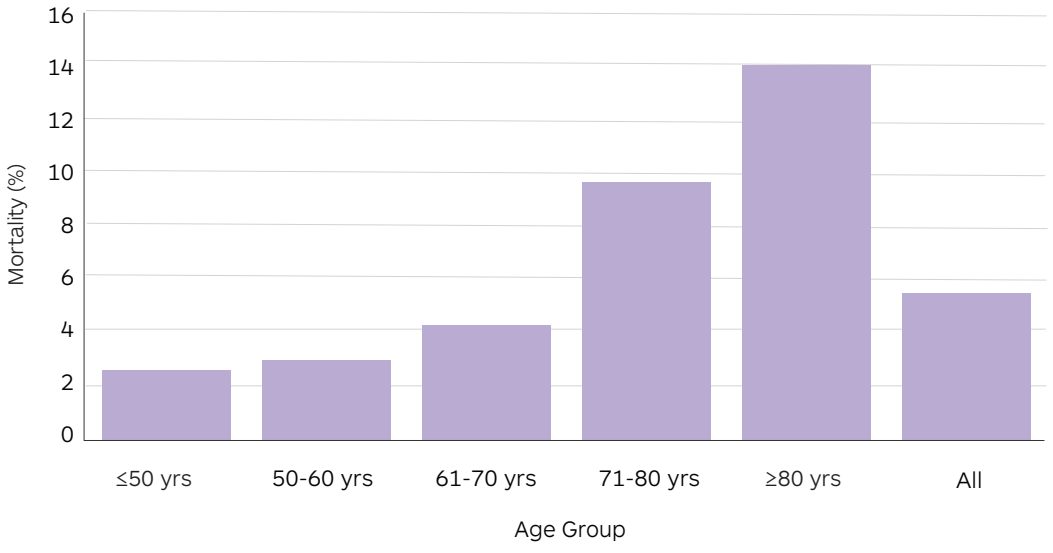
Figure 29: 30-day mortality rate for cardiogenic shock and/or OHCA cases by hospital



Hospital	1	2	3	4	6	7	8	10	12	13	15	16	17	19	20	21	22	23	24	25	27	28	29	30	33	All
Cases (N)	23	31	40	21	22	9	7	34	20	25	19	44	14	2	27	16	14	20	8	31	23	45	24	38	58	615

For patients who presented with STEMI, the overall 30-day mortality rate was 5.5%. Figure 30 shows a comparison of 30-day mortality rates for STEMI by age. The highest mortality rate (14.1%) was seen in the ≥80 years group.

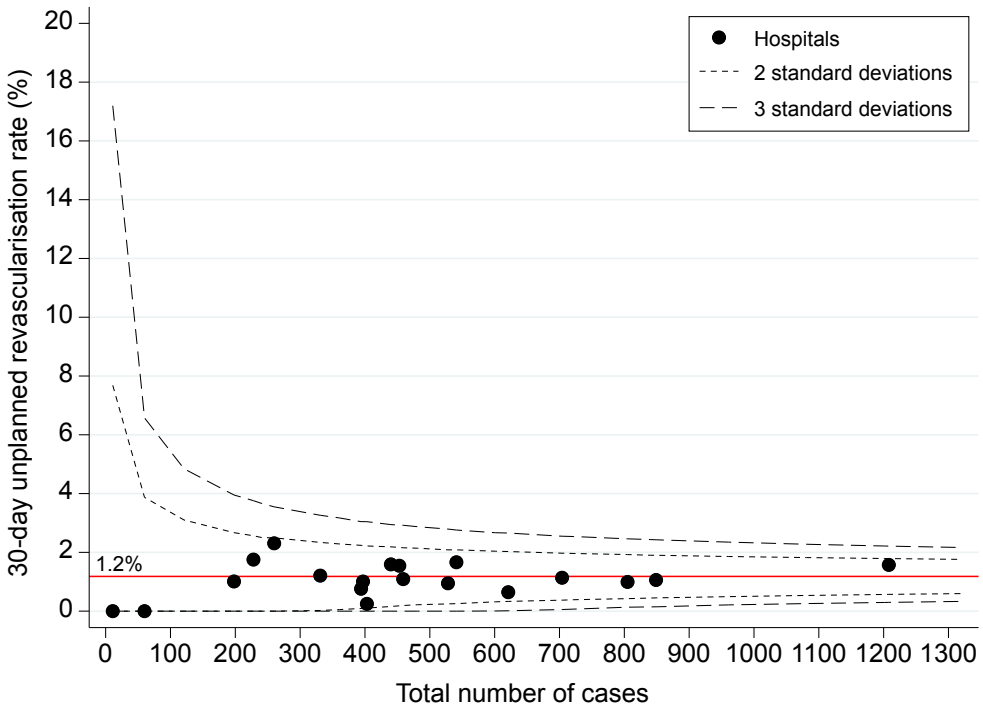
Figure 30: 30-day mortality rate for STEMI cases by age groups



14.2 30-day Unplanned Revascularisation

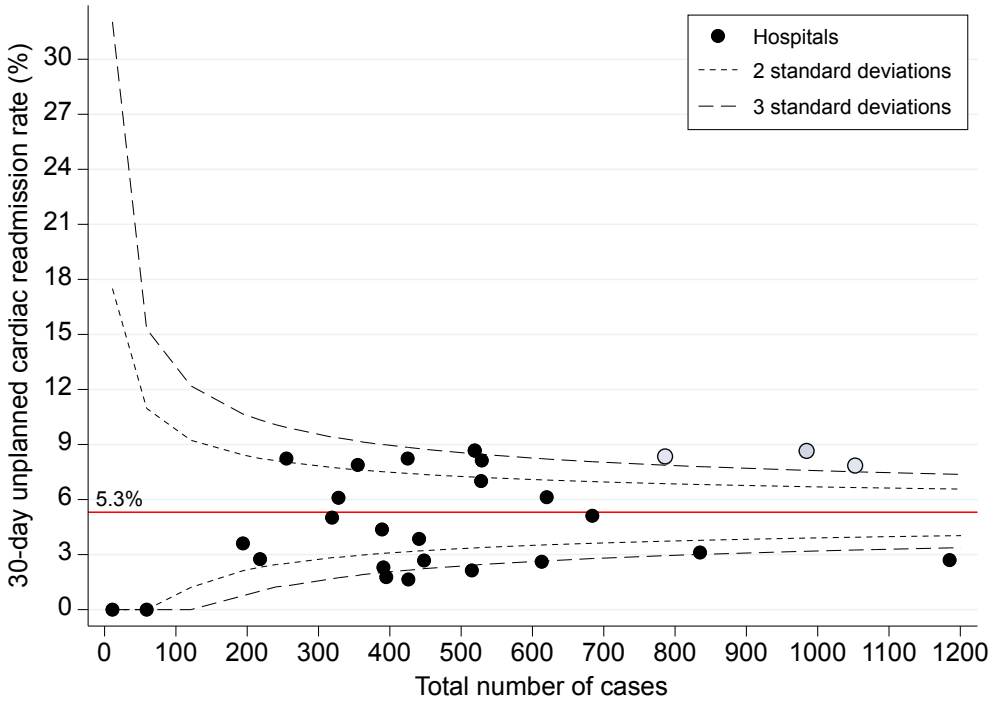
As with in-hospital unplanned revascularisation, this endpoint reflects the rate of revascularisation procedures (PCI and/or CABG surgery) that are performed for unexpected events – usually recurrent ischaemia or as a result of a complication that occurred with the index PCI. Although most acute complications are usually dealt with in the same admission, certain adverse events such as stent thrombosis can occur a number of weeks after the initial procedure and therefore this 30-day outcome measure provides additional information on performance. The mean rate of unplanned revascularisation at 30 days was 1.2%. Benchmarking hospital performance demonstrated that all participating hospitals were within control limits (Figure 31).

Figure 31: 30-day unplanned revascularisation rate by hospital



The rates of unplanned cardiac readmission by hospital are shown in Figure 32. The mean rate was 5.3% with a range of 0% to 8.7%. Of the 27 hospitals contributing data for this outcome measure, three hospitals had rates of 30-day unplanned cardiac readmission that were >3 standard deviations beyond the mean. Notably, these hospitals were all high-volume sites. The implications of these findings are still uncertain, although they may reflect case mix and differences in case acuity and complexity between larger and smaller PCI centres. When rates of 30-day unplanned cardiac readmission were analysed by alternate categorisations, including the presence of on-site cardiac surgery and by hospital location, no major differences in rates were seen. The rate of unplanned cardiac readmissions is recognised as a useful and informative measure of hospital performance and the quality of the care delivered. Further effort will be made to characterise the factors that influence unplanned cardiac readmission rates in future reports.

Figure 32: 30-day unplanned cardiac readmission rate by hospital



Local Reflection – South Australia (SA)

The Coronary Angiogram Database of South Australia (CADOSA) has accomplished 10 years of operation in 2022. We are delighted to contribute CADOSA data for the second NCR annual report this year. With the support of NCR, we have successfully commenced data capture in a second private hospital in 2022 and look forward to facilitating national benchmarking across the private hospitals in due course.

Associate Professor Rosanna Tavella
CADOSA Registry Manager, Adelaide Medical School, Faculty of Health Sciences, The University of Adelaide and Steering Committee SA jurisdictional representative

15. Conclusions and Future Plans

This report demonstrates the solid foundations laid and momentum gained for the Registry to deliver on its intent and objectives. The Registry is well-placed for success and is forging ahead in providing comprehensive, meaningful, transparent feedback to hospitals, clinicians, decision makers and the community through data that is risk-adjusted and benchmarked against the national pool. Next steps include the consolidation of this PCI module which will involve; building on the interactive reporting suite, further development of variation management infrastructure and supporting participating registries in their pursuit of complete representative data.

Future steps include the exploration of synergies with other national registries with a view to collaborate and identify opportunities for efficiency and effectiveness. It is envisaged that when mature, the Registry will also interact with international cardiac registries and seek opportunities to learn from examples of excellence and comparison of health care systems. The next module relating to cardiac implantable electronic devices is an important area of work, with which the Registry is best placed to develop based on experience from existing registries' work in this space. This year the Registry approved affiliate status for the NHMRC Synergy SOLVE-CHD investigators who are supporting the role-out and collection of national quality indicators for cardiac rehabilitation. Establishing a secondary prevention module is a recognised objective of the Registry.

It has been encouraging to witness the engagement, interest and commitment of NCR Board members and directors. The contribution of their collective expertise is a valuable asset to the Registry. Similarly, the establishment of the Indigenous Committee ensures the Registry has robust Indigenous governance and sovereignty practices and is respected as an authentic and impactful data source with the potential to improve cardiovascular health access and outcomes for Indigenous people.

COVID-19 continues to have an ongoing impact on this work with the delayed federal budget and full availability of stakeholders. Despite this, steady progress continues and the time commitment of involved parties is testament to their dedication to this cause. COVID-19 Pandemic has demonstrated and inadvertently increased awareness, appetite and recognition of the value of registry data insights in providing intelligence for safety and quality purposes; an opportunity which the Registry intends to leverage.

Data linkage is key to the Registry's ability to connect patient treatment outcomes across the entire continuum of cardiovascular disease care. Long term, the Registry looks forward to making use of emerging analytical methods to draw wisdom from national patient data on cardiac procedures and devices that foster improved quality, appropriateness and effectiveness of care for patients, no matter where they reside or are treated.

Ultimately, the expectation from all stakeholders is for data from clinical quality registries to translate into practice improvements and better outcomes for patients on a national scale. As an example, through VCOR, Victoria can report that the system of care for patients experiencing acute STEMI has improved year on year over the past four years, evidencing that timeliness of treatment in many hospitals now surpasses the international benchmark target.

Further funding for the coming years will enable the the Registry to explore and realise the possibilities of large data to harness insights from national cardiac information and drive better outcomes for all Australians.

Development of the Registry has been in harmony with the National Strategy for Clinical Quality Registries and Virtual Registries, a 10-year guide with a vision to integrate national clinical quality outcomes data into Australia's health care information systems. The vision will ahead of systematically drive patient centred improvements in the quality and value of healthcare and patient outcomes, across the national health care system.

A 2022 five-year strategic plan and roadmap for the National Cardiac Registry provides a link between the strategy and upcoming implementation phase to articulate intentions and be a key enabler to the realisation of the NCR's potential.

16. Acknowledgements

The Registry would not be possible without the participation of thousands of Australian patients and their families who have contributed to the registries and shared their data to improve health outcomes for all Australians.

We thank our dedicated Committee members, and participating registries that continue to invest their valuable time and expertise to support the analysis and benchmarking of performance and outcomes in cardiovascular care to ensure high quality care is available to all Australians.

The Registry has been successful in progressing data collection and contribution despite ongoing challenges of COVID-19. The Project Management Team along with the NCR Ltd Board, chaired by Dr Leo Mahar who has been well-supported by the Company's Executive Officer Megan Schoder and have worked tirelessly to support this progress and provide meaningful feedback to our stakeholders, clinicians and patients.

The Registry thanks the Commonwealth Department of Health for its on-going commitment to this important work.

17. The Registry Project Management Team

Clinical Lead	A/Prof Jeff Lefkovits
Program Manager	Angela Brennan
Senior Research Fellow	Dr Diem Dinh
Team lead – Health data services	Mark Lucas
Senior Research Officer	Harriet Carruthers
Project Manager	Rhiannon Jeffery
Project Manager	Jasmine Pyyvaara
Data Visualisation Analyst	Milinda Abayawardana

18. Acronyms

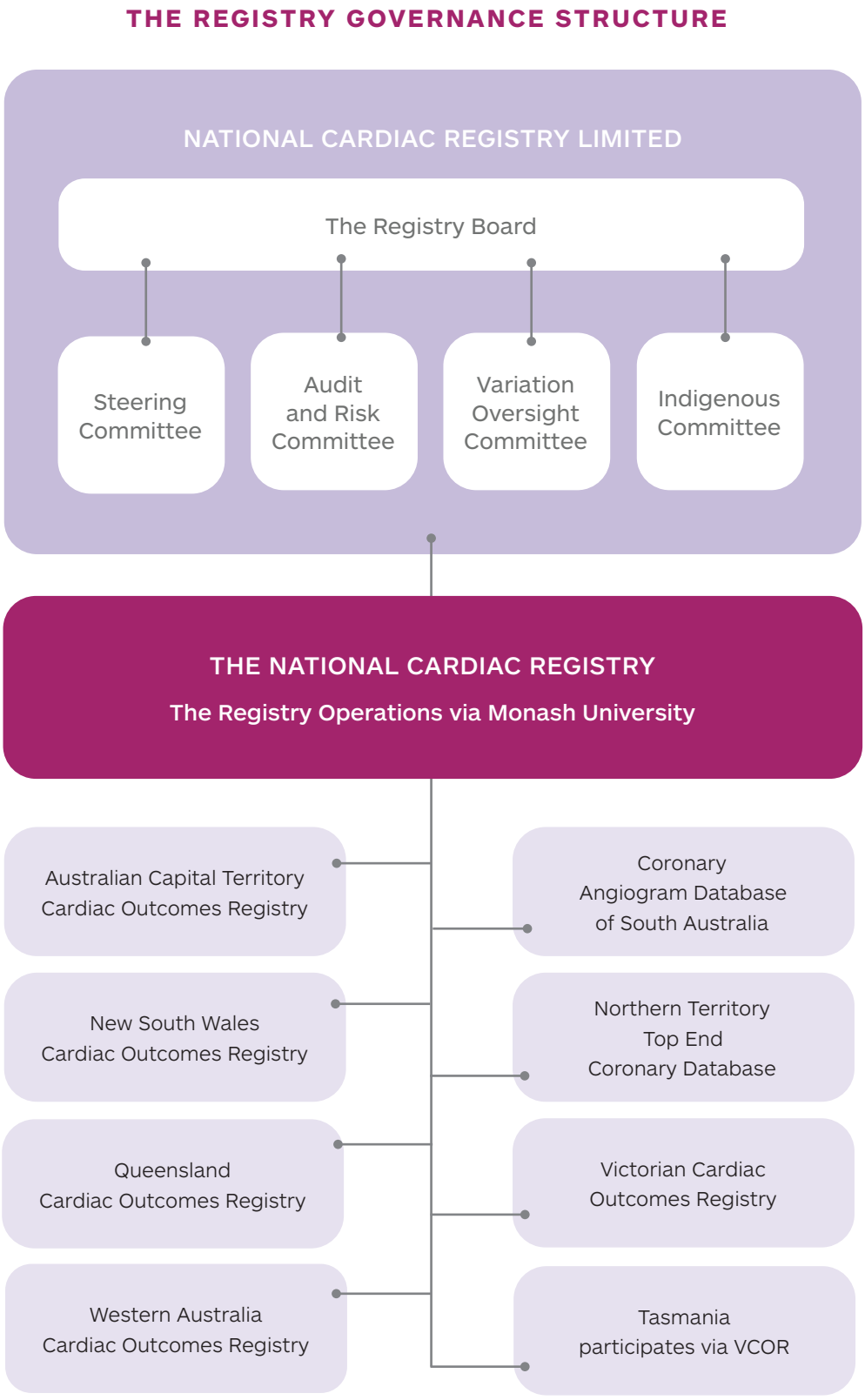
ACS	Acute coronary syndrome
ACTCOR	The ACT Cardiac Outcomes Registry
AIHW	The Australian Institute of Health and Welfare
ANZSCTS	The Australian & New Zealand Society of Cardiac & Thoracic Surgeons
CABG	Coronary artery bypass graft
CADOSA	The Coronary Angiogram Database of South Australia
CHD	Coronary heart disease
CIED	Cardiac Implantable Electronic Devices
CQR	Clinical Quality Registry
CSANZ	The Cardiac Society of Australia and New Zealand
CSV	Comma-separated values file: a common form of spreadsheet
CVD	Cardiovascular disease
DAPT	Dual antiplatelet therapy
DES	Drug eluting stent
ECG	Electrocardiogram
HREC	Human Research Ethics Committee
IQR	Interquartile range
LLT	Lipid lowering therapy
LVEF	Left ventricular ejection fraction
MACCE	Major adverse cardiac and cerebrovascular events
MACE	Major adverse cardiac events
NCR	National Cardiac Registry – The Registry
NCR Ltd.	National Cardiac Registry Limited; the company established to oversee the Registry
NHMRC	National Health and Medical Research Council
NMA	National mutual acceptance: a national scheme for the mutual acceptance of Human Research Ethics Committee review for multi-centre studies conducted in publicly funded health service.
NSTEMI	Non-ST Elevation Myocardial Infarction
NTTCD	Northern Territory Top End Coronary Database
OECD	Organisation for Economic Co-operation and Development
OHCA	Out of Hospital Cardiac Arrest
PCI	Percutaneous Coronary Intervention
PHN	Pre-hospital notification:
PPRL	Privacy Preserving Record Linkage
PVD	Peripheral Vascular Disease
QCOR	Queensland Cardiac Outcomes Registry
SD	Standard Deviation
STEMI	ST-Elevation Myocardial Infarction
The Commission	Australian Commission on Safety and Quality in Health Care
TVR	Target Vessel Revascularisation
UAP	Unstable Angina Pectoris
VCOR	Victorian Cardiac Outcomes Registry
WACOR	Western Australia Cardiac Outcomes Registry

19. Glossary

CABG Hospital	Defined as a hospital that performs Coronary artery bypass graft surgery on-site
Clinical Quality Registry	A registry that monitors the quality of health care in a clinical domain by collecting, analysing and reporting health-related information for the purpose of quality improvement
Collecting	The site has started collecting Data for submission to the National Cardiac Registry
Comma-separated values file	A common form of spreadsheet
Contributing	The site is contributing Data to the National Cardiac Registry platform
Coronary Revascularisation	Coronary revascularisation is when blood flow is restored to coronary arteries/vessels after it has been reduced or blocked
Interquartile range	Quartiles divide a rank-ordered dataset into four equal parts. The values that divide each part are called the first, second and third quartiles. First, second and third quartiles correspond to the observation at the 25th, 50th and 75th percentiles, respectively. The period between the 25th percentile to the 75th percentile is referred to as the interquartile range
Metro hospital	A hospital within an Australian capital city
Non-Metro hospital	A hospital outside an Australian capital city
Percutaneous Coronary Intervention	A minimally invasive procedure to open narrowed or blocked arteries
Pre-hospital notification	When ambulance or emergency clinicians notify a hospital in advance that a patient is enroute for treatment
Privacy Preserving Record Linkage	Record linkage that allows the matching of records without the need for personal identifiers
Site	A public or private hospital within Australia that offers a Percutaneous Coronary Intervention (PCI) service

20. Governance Structure

Figure 33. The Registry Governance Structure



20.1 National Cardiac Registry Audit and Risk Committee

The Audit and Risk Committee has been established to provide technical advice and support to the Board in relation financial management, risk and auditing.

Table 12. National Cardiac Registry Audit and Risk Committee

Member	Role within Committee	Substantive role
Hannah Paal	Acting Chair	Director Health Planning, Department of Health Tasmania
Dr Audrey Koay	Member	Executive Director, Patient Safety and Clinical Quality Department of Health Western Australia
Dr Dinesh Arya	Member	Chief Medical Officer ACT Health

20.2 National Cardiac Registry Indigenous Committee

The Indigenous Advisory Committee has been established to provide expert advice and input to help shape the Registry for the benefit of Aboriginal and Torres Strait Islander people with member representation from across Australia.

The functions of the Indigenous Committee are to:

- Provide advice on effective engagement with Indigenous state and territory leaders, community members and the Aboriginal Community Controlled Health Sector
- Guide the use of Registry findings to support the learning and knowledge translation to support the improvement of access, treatment and outcomes in health for Aboriginal and Torres Strait Islander people
- Provide advice on specific analyses and reporting required to capture critical information on treatment and outcomes for Aboriginal & Torres Strait Islander people with cardiovascular disease
- Guide governance and data sovereignty arrangements for the Registry datasets containing Indigenous data

Table 13. National Cardiac Registry Indigenous Committee

Member	Role within Committee	Substantive role
Mr David Follent	Chair and NSW Representative	Senior Project Officer, CCAP
Miss Wendy Ah Chin	Deputy Chair and QLD Representative	Executive Director of Aboriginal and Torres Strait Islander Health
Mr Bob Buffington	ACT Representative	Aboriginal Health Clinician
Tanya Schramm	TAS Representative	Senior Lecturer, Aboriginal & Torres Strait Islander Health Education, University of Tasmania
Mrs Christine Ingram	VIC Representative	Team Leader & Outreach Worker Integrated Team Care Program
Ms Nola Naylon	WA Representative	South Metropolitan Health Service Director of Aboriginal Health Strategy, WA Health

20.3 National Cardiac Registry Variation Oversight Committee

The Variation Oversight Committee is currently being established and will provide a mechanism for the reporting of variation in collaboration with participating registries. A core function of established clinical quality registries is to ensure that unwanted variation is addressed in a timely manner and communicated to relevant stakeholders.

Table 14. National Cardiac Registry Variation Oversight Committee

Member	Role within Committee	Substantive role
Dr Leo Mahar	Chair	Cardiologist
Associate Professor Andrew Cochrane	Member	Cardiothoracic Surgeon, Monash Heart Monash Medical Centre Clayton and Chair of ANZSCTS Science and Education Committee
Dr Nigel Lyons	Member	Deputy Secretary, Health System Strategy and Planning NSW Health
Professor Andrew Wilson VIC Board Director	Member	Chief Medical Officer, Safer Care Victoria

20.4 National Cardiac Registry Steering Committee

The steering committee has been established to implement the strategic direction of the Registry, manage and report program operations and outcomes, review the performance of the registry, and establish governance arrangements for collection, use and disclosure of data held within the Registry.

Its core functions are to:

- Engage with States and Territories to promote participation
- Design registry outputs and oversee data analysis and reporting
- Oversee the operational aspects of the registry
- Report progress against deliverables into the Registry Board

The Registry steering committee is comprised of Australian state and territory, clinicians, government representatives, subject matter experts, an Australian government nominee, a consumer representative, an Aboriginal and Torres Strait Islander Peoples representative, and a cardiac surgeon.

Table 15. National Cardiac Registry Steering Committee

Member	Role within Committee	Substantive role
Associate Professor Jeff Lefkovits	Chair	Interventional Cardiologist and Clinical Lead for the Victorian Cardiac Outcomes Registry and Interventional Cardiologist
Dr Rohan Poulter	Deputy Chair	Director of Cardiology, Sunshine Coast University Hospital and Chair of the Queensland Cardiac Outcome Registry Interventional Steering Committee
Dr Ren Tan	ACT Clinical expert	Senior Cardiologist, Division of Cardiology, Canberra Health Services
Mrs Sue Morberger	ACT Gov Representative	Assistant Director, ACT Cardiac Outcomes Registry, Clinical System Governance Unit, ACT Health Directorate

Table 15. National Cardiac Registry Steering Committee

Member	Role within Committee	Substantive role
Professor David Breiger	NSW Clinical expert	Interventional Cardiologist and Head of Cardiology, Concord Hospital
Ms Melissa Tinsley	NSW Gov Representative	Associate Director, Integrated Digital Enablement Accelerator, Agency for Clinical Innovation
Dr Catherine Francis	NSW Registry Representative	Senior Medical Advisor, Centre for Epidemiology and Evidence, NSW Health
Dr Marcus Ilton	NT Clinician Expert	Cardiologist and Director of Cardiology, Royal Darwin Hospital
Ms Justine Williams	NT Gov Representative	Cardiology Research Coordinator and Cardiac Quality Nurse, Cardiac Expansion Unit, Royal Darwin Hospital
Mr William Vollbon	QLD Gov Representative	Senior Cardiac Physiologist, State-wide Cardiac Clinical Informatics Unit, Queensland Health
Associate Professor Chris Zeitz	SA Gov Representative	CADOSA Steering Committee Member, A/Prof of Rural & Indigenous Cardiovascular Health, Adelaide Medical School, University of Adelaide Director of Cardiology, The Queen Elizabeth Hospital, Central Adelaide Local Health Network
Professor John Beltrame	SA Clinical Expert	CADOSA Data Custodian, Michell Professor, Adelaide Medical School, University of Adelaide, Senior Cardiologist, Central Adelaide Local Health Network, Director of Research, Central Adelaide Local Health Network
Associate Professor Rosanna Tavella	SA Registry Representative	CADOSA Registry Manager, Clinical Data Manager, Central Adelaide Local Health Network Affiliate A/Professor, Adelaide Medical School, University of Adelaide
Ms Jennifer Garden	TAS Gov. Representative	RN BTeach MN, Assistant Director of Nursing-Clinical Quality, Clinical Quality, Regulation and Accreditation (CQRA), Tasmanian Department of Health
Dr Andrew Black	TAS Clinical expert	Cardiologist and Staff Specialist in Cardiology at Royal Hobart Hospital
Ms Angela Brennan	VIC Registry Expert	Program Manager, Cardiac Registries at CCRET, School of Public Health and Preventive Medicine, Monash University

Table 15. National Cardiac Registry Steering Committee

Member	Role within Committee	Substantive role
Ms Felicity Loxton	VIC Gov. Representative	Director, Centre of Clinical Excellence, Safer Care Victoria
Professor Tom Briffa	WA Clinical Expert	Cardiovascular Research Group, School of Population and Global Health, University of Western Australia
Dr Jamie Rankin	WA Clinical Expert	Cardiologist, Western Australia
Dr Christina Bertilone	WA Gov. Representative	Patient Safety and Clinical Quality Directorate, Department of Health Western Australia (till April 2022)
Dr Ben Hartmann	WA Gov. Representative	Patient Safety and Clinical Quality Directorate, Department of Health Western Australia (from April 2022 till August 2022)
Mr Ben Weber	WA Gov. Representative	Patient Safety and Clinical Quality Directorate, Department of Health Western Australia (from August 2022)
Mr David Gist	Consumer Representative	Cardiovascular disease consumer
Dr Dorothy Morrison	National Aboriginal and Torres Strait Islander Representative	National Cardiac Registry Aboriginal and Torres Strait Islander Peoples Committee Chair (till August 2022)
Mr David Follent	National Aboriginal and Torres Strait Islander Representative	Senior Project Officer, CCAP (from Sept 2022)
Ms Sally Rayner	Department of Health Representative	Director – Clinical Quality Registries

20.5 The NCR Board

The NCR Limited Board is made up of representatives from each jurisdiction, the Cardiac Society of Australia and New Zealand (CSANZ), Australian and New Zealand Society of Cardiac and Thoracic Surgeons (ANZSCTS), and an independent Chair.

Table 16. National Cardiac Registry Limited Board

Member	Role with Board	Substantive role
Dr Leo Mahar	Chair	Cardiologist
Professor John Atherton	CSANZ representative	Director of Cardiology, Royal Brisbane and Women's Hospital, Professor, School of Clinical Medicine, Royal Brisbane Clinical Unit, Faculty of Medicine, University of Queensland Adjunct Professor, School of Biomedical Sciences, Faculty of Health, Queensland University of Technology
Associate Professor Andrew Cochrane	ANZSCTS representative	Cardiothoracic Surgeon, MonashHeart Monash Medical Centre Clayton and Chair of ANZSCTS Science and Education Committee
Dr Dinesh Arya	Treasurer and ACT Board Director	Chief Medical Officer ACT Health
Dr Nigel Lyons	NSW Board Director	Deputy Secretary, Health System Strategy and Planning NSW Health
Dr Sara Watson	NT Board Director	Director of Medical Services, Royal Darwin and Palmerston Hospitals, NT Health
Kirstine Sketcher-Baker	QLD Board Director	Executive Director at Patient Safety and Quality Improvement Service, Clinical Excellence Division, Queensland Health
Michele McKinnon	SA Board Director	Executive Director, Quality, Information and Performance, SA Health
Hannah Paal	TAS Board Director	State Wide Manager, Acute Service Development and Enhancement Unit Tasmania Health
Professor Andrew Wilson	VIC Board Director	Chief Medical Officer, Safer Care Victoria
Dr Audrey Koay	WA Board Director	Executive Director, Patient Safety and Clinical Quality Department of Health Western Australia

National Cardiac Registry Limited
ABN 75 640 959 226
PO Box 3161, North Adelaide SA 5006
https://nationalcardiacregistry.org.au