NATIONAL CARDIAC REGISTRY

ANNUAL STATUS REPORT 2021





This publication was produced on behalf of/by the National Cardiac Registry (The Registry).

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Foreword from the Heart Foundation

Professor Garry Jennings AO - Interim CEO, Heart Foundation

For more than 60 years, the Heart Foundation has been working towards a future free of heart disease. We are committed to saving and improving lives through work across research, support and care, and risk reduction, including initiatives that will help further improve patient outcomes. Since 1959, we have invested more than \$670 million (in today's dollars) into life-saving research projects.

Our prevention efforts support Australians to live heart healthy lives through accessible, understandable and practical



information and resources. We advocate to the government for increased heart health funding; raise awareness of heart disease through our campaigns; and importantly support health professionals to deliver best practice clinical care.

Heart disease remains the single leading cause of death and disease burden in Australia, which is why the Commonwealth Government and the Australian Commission on Safety and Quality in Health Care prioritised establishing the National Cardiac Registry (The Registry).

The Registry promises an exciting new phase for cardiac care. It builds on the valuable work of existing state and territory based cardiac registries (established and in development) in a federated data platform. With support from cardiac specialists, local health service providers, governments and health agencies the Registry will record information regarding cardiac procedures, devices, and other important undertakings in the treatment of heart disease to harness clinical insights that drive better outcomes for all Australians.

The Registry and its dynamic reporting platform leverage the latest cloud technologies to gain insights about best practice clinical care from national-scale big data.

This is why the Heart Foundation believes the Registry is an important addition to the fight against heart disease and will be a vital tool to assist efforts to prevent deaths and support patients.

We are pleased to support this important Commonwealth Government initiative and trust it will deliver on the promise to realise better cardiac care nationwide.

Message from the Chair of the Board

Dr Leo Mahar - Inaugural Chair of the National Cardiac Registry Limited Board

As the inaugural Board Chair of National Cardiac Registry Limited, it gives me great pleasure to present this first annual report for the Registry. This annual report represents the culmination of extensive work undertaken over the past three years by the Steering Committee to design and establish a national registry to identify and track outcome variance of Percutaneous Coronary Intervention (PCI) and pursue opportunities for excellence in the quality of cardiac health care across Australia.



The new Board has developed a close relationship with the Registry Steering Committee, currently chaired by Associate Professor Jeffrey Lefkovits. Together we are building on the Steering Committee's continued foresight, passion, and determination to 'never give up', an attitude which is to be commended on many levels.

Establishing the National Cardiac Registry Ltd. Board during COVID-19 times had its challenges, however we were fortunate to have key personnel, including the Treasurer, Executive Officer, Accountant, Auditor, Chair/Secretary and myself - all located in Adelaide. This allowed us to foster a strong establishment phase where the Company and the Board are now well-placed to govern the Registry into the future.

It is indeed exciting the Registry is now live and demonstrating its promise. Our plan over the next five years is to develop and drive our Strategic Directions, build on the Registry platform and engage all eligible hospitals. Securing their contribution to the Registry will realise the true benefits of a national registry not only for PCI, but with expanded modules to capture other cardiac conditions. From this, registry data analysis and reporting will be available to effect change in priority areas and feed back into each Australian state and territory, ultimately improving cardiac survival for all Australians, including Aboriginal and Torres Strait Islander people.

A big thank you to the NCR Ltd. Board members and Steering Committee - all volunteering their time to make the Registry a reality. In addition, I'd like to thank the Commonwealth of Australia as represented by the Department of Health, Monash University as experts in health registries, participating state and territory registries, engaged eligible hospitals, clinicians and of course, patients. Fittingly, patients are the heart of the registry, and it is the insights from their non-identifiable data where we will harness the perspective to drive better outcomes for all Australians.

Message from the Steering Committee

Associate Professor Jeff Lefkovits - Chair Dr Rohan Poulter - Deputy Chair

As the Chair and Deputy Chair of the Steering Committee, it gives us great pleasure to introduce the Registry's inaugural annual report.

Clinical quality registries (CQRs) are a critical component of the Commonwealth Government's efforts to continuously improve the nation's healthcare system. CQRs are now recognised as a vital tool for measuring, analysing and reporting health outcomes for patients receiving care for a particular condition - in this case ischaemic heart disease and in the future expanding to other cardiac areas. Fundamental to the design and successful operation of CQRs is the engagement of clinicians and key stakeholders, to ensure that measures are relevant and meaningful from the outset. The Registry is a fitting testament to this with clinicians from all states and territories willingly contributing their time and expertise to build this new registry in a collaborative federated structure.





While Australia has a lower rate of coronary heart disease deaths than the average across 'Organisation for Economic Co-operation

and Development (OECD) countries', this condition remains the single leading cause of death and disease burden for our nation. In 2018, an estimated 58,700 people aged 25 and over had an acute coronary event in the form of a heart attack or unstable angina, representing around 161 coronary events every day¹. This high burden of disease is why a national cardiac registry is so important and why its establishment was a Commonwealth priority.

The development of the Registry has turned out to be quite a complex undertaking and it has been an honour to lead that program. With the latest options available for the collection, storage and management of data, together with sophisticated security requirements to protect the privacy of individuals, it was necessary for the Registry to painstakingly investigate and learn to apply these new and emerging technologies. As a result of these pioneering endeavours, the Registry has a robust and future-proofed design that will support the contribution of high-quality meaningful and accurate clinical data by participating states and territories.

We want to express our sincere gratitude to all participating clinicians, hospitals and stakeholders for their commitment to realising the concept of a functional, national federated clinical quality registry aimed at improving the delivery of high-quality cardiovascular care to all Australians.

¹ Australian Institute of Health and Welfare (2021). Heart, stroke and vascular disease—Australian facts. Cat. no. CVD 92. Canberra: AIHW

Message from the Representative of the Aboriginal and Torres Strait Islander Peoples

Associate Professor Luke Burchill

The focus for Aboriginal and Torres Strait Islander people is shifting from the problem space to a solution space for Indigenous health². We can build the solution space by providing First Nations' people with the information they need to deliver culturally appropriate care to their communities, which means investing in research that generates solutions instead of merely describing 'the problem'. Access to accurate and reliable data is essential for nation-building, and a major focus for contemporary First Nations' communities in Australia.



Recognising 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.

I am proud to serve as the Aboriginal and Torres Strait Islander Peoples Steering Committee Representative. The Registry's Indigenous Committee provides strategic advice on how principles of Indigenous governance and data sovereignty can strengthen the work of the Registry, and is a highlight of the past year's achievements. By centring Indigenous knowledge and leadership across the Registry we are building a solution space for advancing cardiovascular health for all Australians including Aboriginal and Torres Strait Islander people.

I commend the Commonwealth Government for the development of the Registry, and look forward to its continued investment in this vital solution space.

Associate Professor Luke Burchill is Australia's first Aboriginal cardiologist. In 2020 he was awarded a National Health and Medical Research Council (NHMRC) Investigator Grant and the NHMRC Sandra Eades Award for Excellence in Research.

² Burchill L. (2021 May 23). OPINION: First Nations' voices must lead on the path to equity. The Sydney Morning Herald. https://www.smh.com.au/national/first-nations-voices-must-lead-on-the-path-to-equity-20210521-p57u1p.html

Message from the Steering Committee Consumer representative

David Gist

It's true what they say; it feels exactly like heartburn. After decades of public education and advertising campaigns, this specific description of a cardiac event is almost a cliché. But it is an accurate description. I know that now, and I wish I didn't.

This description and its accuracy also makes me aware of two things. Firstly, despite decades of education, cardiovascular disease, the blanket term that includes stroke, heart and blood vessel diseases, remains one of this country's largest health problems.



Secondly, cardiovascular disease accounts for one in four deaths in Australia, claiming the life of one person every 12 minutes, and someone is hospitalised for a cardiovascular condition every minute³.

\$5 billion is spent annually on providing health care services for cardiovascular disease, the bulk of which is spent on patient services. But this is just the impact we can put a price tag on.

The formation of a national cardiac registry brings a measure of optimism, to myself and other patients with cardiac disease. My awareness of what it's really like to suffer a cardiac event has also given me the opportunity to serve as Consumer Advocate for the Registry Steering Committee. The creation of the Registry is an initiative that will 'remove the blinkers' for those engaged in cardiovascular risk assessment and treatment. Assembling and comparing meaningful clinical data and linking this with data from other Commonwealth agencies means that the Registry has a significant contribution to make in improving the overall health outcomes for patients with cardiovascular disease, and patients-to-be. It is both a privilege and a thrill to share this experience with a group of professionals so committed to an issue that affects the lives of so many Australians, including me.

³ Heart Foundation: Key Statistics: Cardiovascular Disease. Accessed August 2021. https://www.heartfoundation.org.au/activities-finding-or-opinion/key-stats-cardiovascular-disease

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Executive Summary

In 2016, the Australian Commission on Safety and Quality in Health Care (the Commission) determined a prioritised list of clinical domains for clinical quality registry development; of which ischaemic heart disease was deemed the highest priority. In response, the Commonwealth Government provided funding to support the establishment of a national cardiac registry. The purpose is to document variation and identify opportunities for quality improvement within cardiac healthcare across Australia.

The Registry Steering Committee has successfully established the foundation for national data collection of cardiac outcomes and developed a state of the art digital platform to host a growing dataset. As the Registry matures it will become an effective tool to foster continuous quality improvement in the delivery of high quality and safe cardiovascular care. Each state and territory has shown a commitment to the establishment of the Registry through co-investment, recruitment and support of jurisdictional staff, strategic planning, review and expansion of existing data collections, practices and documentation, as well as the development of new databases. Each jurisdiction is in the process of implementing the necessary steps to achieve complete reporting at a national level.

The COVID-19 pandemic has impacted the progress of some of the Registry's activities. As a result of the postponement of the 2020 federal budget, there has been a delay in confirmation of further funding affecting operations due to stakeholder redeployment to COVID-19 related efforts. Despite the challenges of COVID-19, significant progress has been made in building the foundation of the Registry. The development of policy on corporate and data governance, data custodianship, access and privacy; have built a strong foundation of trust and shared understanding upon which continued evolution can take place.

This report presents the findings from the 2020 calendar year from pooled results aggregated from states that were able to provide data. Data were collected on 15,559 PCI cases, performed on 14,112 patients.

The findings demonstrate the effectiveness of a federated clinical quality registry to closely examine trends in practice, benchmark hospital performance and identify variations in the quality of care. As the Registry matures, it is envisaged that it will become one of the most effective tools to foster continuous quality improvement in the delivery of high quality and safe cardiovascular care.

The Registry has been established with a future-focussed reporting platform that provides dynamic visualisations of outcomes. The next steps are to prioritise the consolidation of this inaugural PCI module and explore the development of future modules.

Key findings are included in the following infographic.

Key Findings from the National Cardiac Registry



of cases were performed on males, whose **average age was 64 years**

The rate of **severe obesity** among PCI cases was more than twice the national average at



of PCI cases were performed out-of-hours - mostly related to emergency ST-Elevation Myocardial Infarction (STEMI).

PCI for **Acute Coronary Syndromes** (ACS) accounted for **two-thirds of the caseload**.

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

Procedural success rates were generally high, and were not influenced by the type of hospital (low, medium or high volume, whether there is onsite cardiac surgery or whether it is metropolitan or non-metropolitan based).

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



14%



A door to **PCI mediated reperfusion time** ≤90 minute was achieved in **78% of cases**. Pre-hospital notification was very effective in ensuring that cases met the ≤90 minute benchmark.

The overall rate of **referral to cardiac rehabilitation was 76%** but was found to be lower than average among medium and low volume centres, those without onsite coronary artery bypass grafting (CABG) and in non-metropolitan hospitals.





The **in-hospital mortality rate** was 1.9% for the overall cohort. The rate was higher among patients with STEMI (4.6%), and highest for patients with cardiogenic shock (37.3%). Excluding these two high-risk groups, the unadjusted in-hospital mortality rate for the non-ACS cohort was 0.7%.

Major adverse events rate including; death, new myocardial infarction, stent thrombosis, unplanned revascularisation or stroke was highest among STEMI patients at 6.9% compared to the overall cohort at 3.5%.



Local Reflection Australian Capital Territory (ACT)

Over the past 12 months the ACT has made significant progress in establishing the ACT Cardiac Outcomes Registry. The ACT Cardiac Outcomes Registry (ACTCOR) has successfully obtained ethics approval to collect data including the data set for the Registry. The project design including opt out methodology, protocols, governance and data solution has evolved over the past year and will continue to develop.

Data collection for the Registry commenced January 2021 at the Canberra Hospital and has been enthusiastically adopted into practice in cardiology at Canberra Health Service including positive participation rates by patients undergoing invasive and interventional cardiology procedures. Future expansion to include data from private cardiology providers in the ACT is underway to provide a complete reflection of cardiology within the ACT jurisdiction.

As with all new registries the ACTCOR still has much work to do to mature, including work around quality assurance, governance and reporting. The ACT looks forward to ongoing commitments from the federal and territory governments combining efforts to continue this important quality improvement activity.

Dr Ren Tan

Lead, ACT Cardiac Outcomes Registry

Sue Morberger

Assistant Director, ACT Cardiac Outcomes Registry

1. Background

".OUR BIGGEST CAUSE OF DEATH REMAINS THE SAME - WITH ONE IN EVERY 10 AUSTRALIANS DYING FROM HEART DISEASE."⁴

The Hon Greg Hunt MP, Minister for Health and Aged Care

1.1 Cardiovascular Disease in Australia

Cardiovascular disease (CVD) is a collective term used to describe different conditions affecting the heart and blood vessels. CVD remains a major cause of death and has the highest burden of disease. The most common and serious forms of cardiovascular disease are coronary heart disease (CHD), stroke, and heart failure.

Statistics from the Australian Institute for Health and Welfare (AIHW) report that one in four deaths in 2019 listed CVD as the underlying cause⁵. Of note, there has been a continued decline in the CVD related death rate over the last four decades, yet the rate of decline appears to be slowing in the most recent decade⁶.

The risk of CVD increases with age and data from 2018-19 demonstrates that over 80% of cardiovascular disease related hospitalisations were in those aged 55 and over, with this steadily increasing in each age bracket. The highest hospitalisation rates are seen in men and women aged 85 and over with more than three quarters of deaths in this age group attributable to CVD.

Successful management and treatment of CVD is dependent upon a highly organised and functional health care system. Skilled clinicians and their teams are vital to providing appropriate management and care across the patient journey and health system including:

- timely diagnosis and transportation during the pre-hospital phase
- efficient management in the emergency department
- a high-level of technical skill from the clinicians responsible for restoring blood flow to the heart
- effective, patient centred after-care and management

Inadequacies at any point during this sequence of care may result in poorer patient outcomes and additional cost to the health system.

⁴ The Hon Greg Hunt MP (29 September 2021) Health Portfolio Ministers. Australian suicide rates down during COVID-19 [Press release] 5 Australian Institute of Health and Welfare (2021). Heart Stroke and vascular disease: Australian facts. Cat. no: CVD 92. Canberra: AIHW 6 Australian Institute of Health and Welfare (2021). Australian Burden of Disease Study 2018: key findings. Australian Burden of Disease Study series 24. Cat. no. BOD 30. Canberra: AIHW

⁵ Australian Institute of Health and Welfare (2021). Heart Stroke and vascular disease: Australian facts. Cat. no: CVD 92. Canberra: AIHW

⁶ Australian Institute of Health and Welfare (2021). Australian Burden of Disease Study 2018: key fi ndings. Australian Burden of Disease Study series 24. Cat. no. BOD 30. Canberra: AIHW

1.2 The Burden of Cardiovascular Disease

Despite declining rates of death and hospitalisation, CVD still remains one of the most significant health problems in Australia. The latest data demonstrates that the disease generally has a greater impact on males, the elderly, Aboriginal and Torres Strait Islander people and people living in remote and socioeconomically disadvantaged areas. Key findings from the Australian Institute of Health and Wellbeing's 2018 Burden of Disease Study⁷ found that:

- the disease burden in 2015 could have been prevented by reducing exposure to modifiable risk factors
- five of the leading risk factors include tobacco use, being overweight (including obesity), dietary risks, high blood pressure, and alcohol use
- CVD account for 13% of overall disease burden in Australia
- total disease burden rates were around 1.4 times the national average in the Northern Territory
- remote areas experienced 1.4 times the rate of total burden when compared with major cities
- lowest socioeconomic groups experienced 1.6 times the rate of burden when compared with the highest socioeconomic groups

1.3 Coronary Heart Disease

The National Heart Foundation states that coronary heart disease (CHD) "occurs when a coronary artery clogs and narrows because of a build-up of plaque causing a decrease in blood supply... without enough blood supply, the heart is starved of the oxygen it needs to work properly. If the blood flow to the heart muscle is stopped, or the heart does not get enough blood flow, a heart attack can occur."⁸

In its 2020 Health Snapshot report, AIHW reported CHD as the leading single cause of death and disease burden in Australia $^{\circ}$

Amongst all CVD related deaths in 2019, CHD was the major cause of death across both males and females (Figure 1)¹⁰.



⁷ Australian Institute of Health and Welfare (2020). Australia's health 2020 data insights. Australia's health series no. 17. Cat. no. AUS 231. Canberra: AIHW

10 Australian Institute of Health and Welfare (2021). Heart Stroke and vascular disease: Australian facts. Cat. no: CVD 92. Canberra: AIHW

⁸ Australian Institute of Health and Welfare (2021). Australian Burden of Disease Study 2018: key findings. Australian Burden of Disease Study series 24. Cat. no. BOD 30. Canberra: AIHW

⁹ Heart Foundation. What is coronary heart disease? Accessed August 2021. (https://www.heartfoundation.org.au/conditions/coronaryheart-disease)

1.4 Management of Coronary Heart Disease

The management of CHD can involve lifestyle interventions, medication, or more invasive approaches including Percutaneous Coronary Intervention (PCI) or Coronary artery bypass graft surgery (CABG). A PCI is performed by a Cardiologists where as CABG is performed by a Cardiac Surgeon.

PCI is the implantation of a stent, which opens the narrowed or blocked arteries as illustrated in Figure 2^{10} .

PCIs can be grouped into two broad categories:

- 1. Acute Coronary Syndromes (ACS). Patients with ACS generally undergo a PCI in a short time frame from diagnosis, often as an emergency.
- 2. Non-ST-elevation ACS performed when the patient is stable and includes planned procedures.

In Australia, the Commission has developed clinical care standards for the treatment of ACS. These standards identify areas for quality improvement within the patient pathway and include some targets for specific ACS presentations. For example, presentations of ACS can be categorised as ST-Elevation* Myocardial Infarction (STEMI), Non-ST-Elevation Myocardial Infarction and Unstable Angina.

*ST-elevation refers to the pattern that is detected on an Electrocardiogram (ECG) that is abnormal.



PCI is a common procedure to treat CHD. In 2018-2019 PCI was approximately 3.7 times more frequently performed than CABG¹¹ (Table 1).

CVD Procedures	Males	Females	Persons
Diagnostic procedures			
Coronary Angiography	93,419	47,511	140,934
Echocardiography	31,830	15,121	46,951
Therapeutic procedures			
Percutaneous Coronary Intervention	34,770	11,162	45,934
Pacemaker Insertion	10,742	7,403	18,145
Coronary Artery Bypass Graft	10,399	2,161	12,560
Heart Valve Repair/Replacement	7,312	4,073	11,385
Cardiac Defibrillator Implant	3,132	867	3,999
Carotid Endarterectomy	1,518	531	2,049
Heart Transplant	78	45	123

Table 1. Procedures performed in Australia in 2018-19 to diagnose and treat cardiovascular disease 10

1.5 Clinical Quality Registry (CQR)

Clinical quality registries (CQRs) collect information in the healthcare setting about the care and treatment provided to patients for a particular disease, device or procedure. Information collected through CQRs systematically monitors the appropriateness and effectiveness of care provided to patients within specific clinical areas. Information is routinely collected, analysed and reported back to patients, clinicians, hospitals and government as part of a feedback loop. It is used to identify variations in treatment, compare the outcomes achieved between providers and highlight areas for potential improvement in the overall quality of care. This feedback loop, shown below, is critical to drive improvements in quality, safety and appropriateness of care.

When mature, CQRs can improve the quality of care by:

- Providing credible risk adjusted data
- Giving clinicians information about how their outcomes benchmark with others, both locally and internationally
- Identifying and investigating variation in clinical practice and outcomes
- Acting as an early warning system if quality of care deteriorates

Ultimately, the success of CQRs is dependent upon the engagement of clinicians who have the wisdom and expertise to determine meaningful measures of quality care. CQRs are critical in ensuring clinicians receive accurate and timely information to determine meaningful measures of quality care.



¹² This graphic ' 'CQR Feedback Loop' ' was developed by the Australian Commission on Safety and Quality in Health Care (the Commission): Sydney.

Local Reflection New South Wales (NSW)

June 2020-June 2021 saw significant progress for The NSW Cardiac Outcome Registry (NSWCOR).

The Agency for Clinical Innovation (ACI) engaged every Local Health District (LHD) and Specialty Health Network (SHN) with a PCI facility to promote participation in NSWCOR.

The NSWCOR has strengthened partnerships with existing sites and continues to build rapport with the new sites. Partnerships with private hospitals have been explored, to progress future strategic planning and inclusion in the next phases of NSWCOR.

To date seven sites (Wollongong Hospital, Bankstown Hospital, Orange Hospital, St Vincent's Hospital Sydney, Nepean Hospital, Concord Hospital and Gosford Hospital) are actively participating, with a further four potential sites engaged. Sites have expressed that participation has brought positive change to the way data is collected, consolidating multi-platformed, paper-based datasheets into one secure platform. This has assisted local sites to drive care improvement in the PCI patient cohort.

Key NSWCOR staff are being redeployed to support the COVID-19 response, proving a challenge to ongoing establishment.

Additional achievements

- Agreements in place for data submission to the Registry for the inaugural annual report
- Training material and coaching provided to sites
- Enhancements to REDCap database tailored, site-specific data collection, improved business rules and data quality capabilities
- ACI has established The NSWCOR Community of Practice to foster experience exchange and to shape NSW activities

The electronic Clinical Quality Registry (eCQR) work is progressing to bring all NSW registries onto a mature platform. The vision of the eCQR platform is to reduce data entry labour, increase data quality, and enable systemic access at an individual, management and service level. The ACI would like to extend their appreciation to collaborating stakeholders who helped implement NSWCOR during this challenging time.

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

2. Prioritising the Registry

"THE INTEGRATION OF HEALTH OUTCOMES DATA WITH NATIONAL, STATE AND TERRITORY HEALTH CARE DATASETS WILL HELP DRIVE SYSTEMATIC IMPROVEMENTS IN CLINICAL PRACTICE AND ENSURE THE BEST VALUE CARE FOR ALL AUSTRALIANS."¹³

In response to the Commissions 2016 report "Prioritised list of clinical domains for clinical quality registry development" the Commonwealth Government, through the Department of Health provided funding to support the establishment of a National Cardiac Clinical Registry¹⁴.

The principles underpinning the decision to establish a national cardiac registry include:

- Evidence that a national registry of the management of CVD with reporting of risk adjusted outcomes will improve healthcare for Australians
- Recognition that cardiac devices have a risk of malfunction and that a national procedures and devices registry will provide a robust mechanism for monitoring outcomes following these procedures/devices
- Acknowledgement that procedures and treatments for cardiac conditions should be performed only when there is an appropriate indication for that form of treatment in each individual patient.

In 2018, a feasibility assessment was undertaken to understand data collection at a national level and identify a minimum data set for cardiac outcomes. In March 2019, the Department and the Cardiac Society of Australia and New Zealand (CSANZ) requested the Commission to provide options of governance models suitable to support the proposed National Cardiac Registry and led to the establishment of NCR Ltd.

This Commonwealth Government initiative has been designed to give consumers and families peace of mind that a cardiac registry is in place to transparently report on Australia's clinical, procedural and patient outcomes to clinicians, hospitals, government and community and ultimately drive better outcomes.

To work towards the realisation of the Registry, funding was provided to each state and territory to support them in their readiness to participate and report into the registry under the federated model.

As of 2021, each jurisdiction has either an established registry or are in the final stages of development to share their data through the purpose-built digital platform. The platform facilitates secure, anonymised and dynamic reporting and with maturation of the Registry will enable faster identification of best practice across a suite of cardiac interventions, identify variation and health outcomes.

¹³ Commonwealth of Australia, Department of Health (2020). National Clinical Quality Registry and Virtual Registry Strategy. Publications Number: 12732

¹⁴ The Australian Commission on Safety and Quality in Health Care (2016). Prioritised list of clinical domains for clinical quality registry development: Final report. Sydney: ACSQHC

3. National Cardiac Registry

3.1 Company

NCR Ltd is a not-for-profit organisation established in May 2020 for the charitable purpose of identifying outcome variance and areas for improvement in the quality of cardiac healthcare across Australia. The NCR Ltd Board has ultimate responsibility for the governance of the Registry and in addition to its fiduciary and other corporate duties, is required to act in good faith, and comply with all legislative requirements and legal framework relevant laws.

The NCR Ltd Board, together with an operational Steering Committee, govern the registry within a national collaborative structure with a close working relationship of the two groups.

3.2 Vision

To harness insights from national cardiac data to drive better outcomes for all Australians.

3.3 Purpose

To document outcome variance and opportunities for excellence in the quality of cardiac healthcare across Australia.

3.4 Objectives

- Utilise a collaborative, federated model for effective engagement, participation and support from stakeholders
- Provide a platform to import state and territory data and measure performance as determined by agreed quality indicators
- Transparently report on clinical, procedural and patient outcomes to hospitals, clinicians, government and community
- Provide national benchmarking of key quality performance measures for cardiac procedures and devices and secondary prevention

3.5 Governance Structure

The Registry utilises a collaborative model of governance and data collection that complements the established state-based registries continuing to deliver information and analyses specific to their state and territory.

The governance structure of the Registry is a demonstration of the achievements and expertise already in place at a state and territory level. Importantly, the Registry does not duplicate work already achieved by existing registries but rather adds critical value as the national lens with data submitted by participating cardiac registries.

The Registry is independent of those participating cardiac registries which are responsible for their own governance, processes and procedures with each having representation on the Steering Committee. The underlying principle in establishing this structure is to ensure that all states and territories are equally able to participate in, and contribute to, the Registry via their own state and territory based registry or database. All governance groups, Board, Steering Committee and Indigenous Advisory Committee, have representation from each state and territory.



3.6 Governance Groups

3.6.1 The NCR Board

Operating within a national collaborative structure, the NCR Ltd. Board consists of an independent Chair, representatives from each Australian state and territory and representation from two peak professional societies; the Australian & New Zealand Society of Cardiac & Thoracic Surgeons (ANZSCTS) and the Cardiac Society of Australia and New Zealand (CSANZ). The formation of the Board allows for all Australian jurisdictions to have a voice within the company, while ensuring a high level of skills, knowledge and expertise from within the Australian healthcare sector will lead the company into the future.

Table 2. National Cardiac Registry Limited Board

Dr Leo Mahar	Independent 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 AM	ANZSCTS representative
Cardiothoracic Surgeon, MonashHeart MMC Clayton and Chair of ANZSCTS Science and Education Committee	
Dr Dinesh Arya	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 Medical Services Royal Darwin and Palmerston Hospitals	
Executive Director, Patient Safety and Quality Improvement Service, Clinical Excellence Queensland Queensland Health	QED Board Director
Michele McKinnon	SA Board Director
Executive Director Provider Commissioning and Performance Commissioning and Performance Department for Health and Wellbeing, SA	
Hannah Paal	TAS Board Director
Statewide Manager, Acute Service Development and Enhancement Unit Tasmania Health	

Professor Andrew Wilson

Chief Medical Officer Safer Care Victoria

Dr Audrey Koay

WA Board Director

VIC Board Director

Executive Director, Patient Safety and Clinical Quality Department of Health Western Australia

3.6.2 The Registry Steering Committee

The Steering Committee is responsible for the operational aspects of the Registry, promoting participation in the Registry, overseeing data analyses and reporting to identify areas of variance. The Steering Committee consists of up to three representatives from each state and territory, a Commonwealth Government nominee, a consumer representative, an Aboriginal and Torres Strait Islander Peoples representative, and a cardiac surgeon.

Table 3. National Cardiac Registry Steering Committee

Associate Professor Jeff Lefkovits (Chair)	Cardiologist, Victoria
Dr Rohan Poulter (Deputy Chair)	Cardiologist, Queensland
Dr Ren Tan	Cardiologist, Australian Capital Territory
Dr Dinesh Arya (till July 2020)	Chief Medical Officer, ACT Health Directorate
Mrs Sue Morberger (from February 2021)	ACT Cardiac Outcomes Registry, ACT Health Directorate
Professor David Brieger	Cardiologist, New South Wales
Dr Lee Taylor (till May 2021)	Centre for Epidemiology and Evidence, NSW Health
Dr Catherine Francis (from May 2021)	Centre for Epidemiology and Evidence, NSW Health
Ms Melissa Tinsley	NSW Agency for Clinical Innovation
Dr Marcus Ilton	Cardiologist, Northern Territory
Mrs Margaret Williams (till September 2021)	Clinical Excellence and Patient Safety, NT Health
Ms Justine Williams (from September 2021)	Northern Territory Top End Coronary Database, Cardiac Expansion Unit Royal Darwin Hospital NT Health
Mr William Volbon	Queensland Cardiac Outcomes Registry, Statewide Cardiac Clinical Informatics Unit, Queensland Health
Associate Professor Chris Zeitz	Cardiologist, South Australia
Professor John Beltrame	Cardiologist, South Australia

Continued overpage

Associate Professor Rosanna Tavella	Coronary Angiogram Database of South Australia, University of Adelaide and Central Adelaide Local Health Network, SA Health
Ms Jennifer Garden	Clinical Quality, Clinical Governance Section, Tasmanian Department of Health
Dr Paul MacIntyre /	Cardiologist, Tasmania
Dr Umair Hayat (shared role)	Cardiologist, Tasmania
Tanya Murray	Service Development Unit (Acute), Health Planning Tasmanian Department of Health
Ms Angela Brennan	Victorian Cardiac Outcomes Registry, Monash University
Helen Rizzoli	Systems Safety and Assurance Partner, Safer Care Victoria
Dr Christina Bertilone	Office of Patient Safety and Clinical Quality, Clinical Services and Research, Department of Health Western Australia
Dr Jamie Rankin	Cardiologist, Western Australia
Professor Tom Briffa	Cardiovascular Research Group, School of Population and Global Health, University of Western Australia
Mr David Gist	Consumer representative
Associate Professor Luke Burchill (till September 2021)	Aboriginal and Torres Strait Islander Peoples representative
Associate Professor Jayme Bennetts	Surgeon, ANZSCTS representative
Ms Sally Rayner	Australian Government Department of Health
Mrs Oriana Wallace (till 20 August 2021)	Australian Government Department of Health

3.6.3 The Registry Indigenous Committee

The Registry Indigenous Committee is in the early phases of development and it is proposed it will report to the Steering Committee, ensuring a well-balanced model operates within the company.

These governance arrangements are all designed to build and foster a solid foundation in preparation for growth to include other cardiac modules.

"EFFECTIVE GOVERNANCE PROVIDES A CLEAR STATEMENT OF INDIVIDUAL ACCOUNTABILITIES WITHIN THE ORGANISATION TO HELP ALIGN THE ROLES, INTERESTS AND ACTIONS OF THE DIFFERENT PARTICIPANTS IN THE ORGANISATION TO ACHIEVE THE ORGANISATION'S OBJECTIVES."

Australian Commission on Safety and Quality in Health Care 2020¹⁵

15 Australian Commission on Safety and Quality in Health Care (2020). National Clinical Trials Governance Framework -Guide for implementation. Sydney: ACSQHC



4. Timeline







5. Progress

Figure 5. Achievements to date

DATA SOLUTION

- Explored technical options available
- Determined specifications for the system
- Vendor procurement
- Design, build and test of the data solution
- Confirmed cloud hosting approach
- Penetration testing undertaken
- Data solution deployed
- Data imported to solution

DATA GOVERNANCE

- Learning from other registries
- Overarching data governance framework agreed
- Protocol, policies and procedures developed
- Ethics and approval processes commenced and gained
- Confirmation of data ownership, access and security arrangements
- Data sharing agreements negotiated and executed

CORPORATE GOVERNANCE

- Underpinned by a collaborative model
- Formation of Board, Steering Committee, The Registry Indigenous Committee and other specialty sub-committees
- Contract, budget and risk management functions undertaken

REGISTRY OUTPUTS

- Determined the scope of data collection
- Agreed on a meaningful set of Quality Indicators
- Developed a data dictionary and import template
- Design of the inbuilt benchmarking reports
- 2020 Status update
- 2021 Inaugural Annual Status Report

STAKEHOLDER ENGAGEMENT

- Regular Steering Committee and Project Management team meetings
- Working closely with Commonwealth Department of Health
- The Registry branding, website development
- Presentations, networking, interest groups
- Supporting state and territory readiness through allocation of funding for local projects

Successfully undertaking each requirement in the steps to establish the Registry to date has been achieved through the engagement, cooperation, trust, and a shared vision of members of the Steering Committee. Many of the steps required comprehensive investigation and extensive discussion to reach a consensus in line with the national collaborative model of the Registry.

Despite the impact and pressure on governments and healthcare resources relating to COVID-19 during this report period, management and Steering Committee meetings have continued to be strongly supported with attendance by state and territory clinicians, registry, government and project representatives. These efforts reflect the ongoing priority and determination to realise this critical project.

6. Registry Design

The Registry is designed on the principle that each participating state and territory registry has ownership, leadership and control of its local data and management processes. This principle led to the design of a digital platform.

Having the opportunity to build a digital platform enabled the use of exciting new technologies that offer interactive visualisations and allow states and territories to benchmark themselves against the national cohort. The dynamic reports will be enhanced over time as the dataset grows and true national insights can be gained through harnessing large data.

Given the inaugural nature of the Registry and the expectation for its success, development will occur in a series of modules, the first being PCI.

Some key practical features of the purpose build data system include:

- Browser-based
- User credentialing
- Multi-factor authentication
- Upload via CSV template
- · Anytime download of data (including additional derived variables)
- Dynamic reports based on the Registry quality indicators
- No patient or clinician identifiers stored in the system
- Cloud-hosting to allow for future flexibility, scalability and evolving functionality

The process of data flow into the platform can be seen in Figure 6. Beginning with data collection managed by each state and territory. This data is then de-identified and uploaded into the platform for analysis and reporting - both nationally and for states and territories. Closure of the feedback loop aids in driving quality improvement and outcomes and how this is realised will be further developed as the Registry matures. The platform began accepting data in mid-2021. Prior to data submission all regions ensured appropriate privacy and security arrangements were met and secured relevant approvals such as ethics committee approval.



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6.1 Percutaneous Coronary Intervention Module

Module one is designed to collect data on all PCIs performed across Australia.

6.2 Participants

Eligible participants for the PCI module include all patients meeting inclusion criteria who have had details of their procedure or treatment recorded within their state or territory cardiac registry. PCI module eligibility criteria:

- Aged 18 years of age and older
- Patients who present to hospital with cardiac symptoms and are treated with PCI
- Patients who receive PCI as a planned treatment for cardiac disease

The Registry operates with a waiver of consent model for the provision of patient data, with Human Research Ethics Committee (HREC) approval granted for this model. It is noted that participating registries have differing consent models and patients who do not consent to participating in the state and territory registry are excluded from the Registry by their respective state and territory registry.

6.3 Data Management

6.3.1 Data collection and the Registry platform

Data collection from the patient/hospital source is managed by the state and territory cardiac registries, under their governance and as per their local requirements. The Registry provides state and territory registries with a comma-separated values template to map their data together with a reference dictionary to ensure the data is consistent. The template is made up of variables including demographics, clinical presentation, treatment, complications, discharge details and some 30-day outcomes. These variables allow reporting on defined Quality Indicators.

In the process of mapping data to the template, state and territory registries undertake a de-identification process. This is managed by each jurisdiction, ensuring patient identifiers are retained within the state and territory registry and only a code is submitted to the platform. In the future the Registry hopes to utilise Privacy Preserving Record Linkage (PPRL) technology to support future data linkage activities¹⁶. PPRL will enable future linkage with external and internal data sources without requiring the submission of identifiable information. The Registry will provide participating state and territory registries with software to encrypt patient identifiers where only encrypted outputs will be used for linkage. The follow-up period for module one is limited to 30 days post discharge from hospital following a PCI, therefore the Registry data linkages activities will be important to connect the 'patient journey' and understand long-term outcomes for patients entering the cardiac health system.

State and Territory users will log into the platform via a browser-based portal, where they will be able to manage their data including; uploading new data, verifying it meets set data quality criteria, and downloading existing data.

As the Registry does not store any patient identifiers any patient wishing to access their data can contact their participating state and territory registry and follow their local requirements.

¹⁶ Randall SM, Ferrante AM, Boyd JH, et al. (2013) Privacy-preserving record linkage on large real world datasets. Journal of Biomedical Informatics. 50, pp 205-212. https://doi.org/10.1016/j.jbi.2013.12.003

6.3.2 Reporting

The digital platform includes access to live, automated, dynamic visualisations where users can interrogate their local data in comparison to the rest of the nation in predefined reports. National data is presented in an aggregated format so users are only able to identify their own data. We anticipate this reporting platform to be a significant asset to states and territories as it matures. Initial reports include analyses tied to the Quality Indicators (Figure 7), but as the Registry matures, the dataset grows and the insights from harnessing big data becomes more apparent it is expected these reports will evolve.

In addition to the live platform reports, data will be extracted for analysis and reporting. As the registry matures, annual reports will offer meaningful analyses and insights into the state of cardiac health care in Australia. This data will also be used to inform and improve care, closing the feedback loop to participating states and territories for them to gauge performance.

While CQRs have been the primary mechanism for addressing gaps in clinical quality outcomes to date, it is important to note that registries also offer opportunities to identify excellence in the quality of healthcare across Australia.

6.3.3 Hosting

The cloud computing space is a fast evolving environment where capacity is ever-increasing and new features are always being developed. After internal and external consultation, the decision was made for the digital platform to be developed and hosted in an Australian cloud. It offers ease of scalability to support the growth of the Registry, and agility where any new software or developments can be integrated into the platform and ready to use immediately. This will also improve efficiency and costing.

6.3.4 Data security

The Registry takes data security and participant privacy seriously. Information is managed according to policies covering privacy, data access, and governance. Rigorous testing has been conducted on the platform to ensure security. There are multiple layers of security and protection of an individual and state/territory's privacy.

6.3.4.1 Data

At the foundational level, the Registry does not store personal patient or clinician identifiers; instead, this data is encoded before submission.

6.3.4.2 Platform

The platform is only accessible by authorised users from the state and territory registries and the Registry. Principal investigators, from each state or territory, authorise access to the digital platform. States and territories can only identify their authorised data and cannot view other state or territory data, they can interrogate their own data but the rest of the country's data is either aggregated or non-identifiable.

Access to the platform is controlled with user verification and multi-factor authentication. Multi-factor authentication requires a user to present two or more pieces of evidence to access the platform for example, a password and an automated code accessible via phone.

The platform was subjected to penetration testing. Penetration testing (or ethical hacking) involves cyber-security experts trying to access (hack into) the platform externally but also trying to escalate their privileges from within the system for example, a state-based user accessing data they do not have permission to see.

6.3.4.3 Governance and agreements

Principal investigators designate the level of access to a nominated user which could be data management, reporting or both. Nominated users must sign a declaration around their access to the digital platform and comply with the Registry policies and Australian legislation.

Data sharing deeds have been negotiated with each participating state and territory registry that submits data which governs data management and protection in line with the Registry policies and Australian legislation. Contracts with platform development vendors also address security, protection of data and compliance with relevant Australian legislation.

6.3.4.4 Reporting

The Registry will exclude any reporting of data or analyses where actual numbers are insufficient for meaningful reporting, or where there is any risk of re-identification. Risks of re-identification may be due to what data are included or excluded, or in instances where a hospital or participating registry does not capture certain variables.

6.4 Ethics and Approvals

The provision of data to the Registry will depend on each state/territory registry having the appropriate approvals in place before data submission. In some cases, this will require approval from a HREC and in others it will be via data sharing deeds as per relevant state legislation or requirements.

The Registry has an overarching ethical approval via the National Mutual Acceptance (NMA) scheme¹⁷ for participation of public hospitals from all jurisdictions except the Northern Territory. The Northern Territory recently signed up to the NMA scheme and will be added to the Registry application in due course.

¹⁷ Coordinating Office for Clinical Trial Research (2021), Victoria state government. National Mutual Acceptance. Accessed September 2021. https://www.clinicaltrialsandresearch.vic.gov.au/national-mutual-acceptance

Local Reflection Northern Territory (NT)

The opportunity afforded through funding provided by the Registry has enabled NT to invest in its health data capacity and collect local data for submission to the national dataset. Given the Territory's small size and unique situation it has required some navigation to determine the most appropriate and effective method for participation in the National Cardiac Registry.

To ensure success, and deliver the best cardiac outcome measures for the NT and enable NT Governance, a NT cardiac database has now been developed with NT HREC and NT Health Governance approval and data entry commenced August 2021. We have invested effort in carefully planning the cardiac database and have developed the database based on the Registry Requirements, Victoria Cardiac Outcomes Registry (VCOR), Coronary Angiogram Database of South Australia (CADOSA) and The American College of Cardiology National Cardiovascular Data Registry (NCDR).

Dr Marcus liton

Cardiologist and Director of Cardiology, Royal Darwin Hospital Director, NT Cardiac Pty Ltd. The Registry Steering Committee NT representatives


7. Quality Indicators

Quality indicators are quantitative tools that allow measurement of the quality of health care and serve as a foundation for quality improvement activities. Indicators offer a statistically validated way of organising large amounts of data to view and monitor performance, highlight variance and determine whether there has been an improvement or decline in performance over time.

According to the Australian Council on Healthcare Standards, "a well-designed indicator should 'screen', 'flag' or 'draw attention' to a specific clinical issue"¹⁸. The quality indicators selected to monitor national performance and outcomes for patients undergoing a PCI procedure were confirmed by the Steering Committee following review and consideration of existing national and international best practice guidelines and quality indicators for acute coronary syndrome and PCI.

The indicator sets reviewed included the:

- Australian Acute Coronary Syndromes Clinical Care Standard¹⁹
- Canadian Cardiovascular Society quality indicators for PCI²⁰
- European Society of Cardiology Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation²¹
- The Swedish Web-system for Enhancement and Development of Evidence-based care in Heart disease Evaluated According to Recommended Therapies (SWEDEHEART)²²
- The National Institute for Cardiovascular Outcomes Research audit programme (UK)²³
- The existing established Australian registries; namely The Coronary Angiogram Database of South Australia (CADOSA), the Queensland Cardiac Outcomes Registry (QCOR) and the Victorian Cardiac Outcomes Registry (VCOR)

It is relevant to note that quality indicators of interest change over time in line with new guidelines, treatments and our evolving understanding of what constitutes quality of care.

Eleven indicators will be measured through the Registry for PCI and include five indicators regarding the performance of the health service providing treatment, and six indicators regarding the quality of care provided, determined by the outcome for the patient following the procedure.

¹⁸ The Australian Council on Healthcare Standards (2020) ACHS 2021 Clinical Indicator Program Information. Sydney: ACHS

¹⁹ Australian Commission on Safety and Quality in Health Care (2019). Acute Coronary Syndromes Clinical Care Standard - 2019. Sydney: ACSQHC

²⁰ Canadian Cardiovascular Society (2015) Data Definitions and Quality Indicators; Quality Indicators for Percutaneous Coronary Intervention. Ontario: CCS

²¹ European Society of Cardiology (2017) ESC Guidelines on Acute Myocardial Infarction in patients presenting with ST-segment elevation; ESC clinical practice guidelines.

²² SWEDEHEART (2019) SWEDEHEART Annual report 2019 (English). Linköping

²³ National Institute for Cardiovascular Outcomes Research (2019) National Cardiac Audit Programme (NCAP). Adult Percutaneous Coronary Interventions (Angioplasty audit)

Figure 7. Th	e 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	L	
4.	In-hospital major bleeding		
5.	In-hospital mortality		
6.	30-day unplanned cardiac readmission rate af	ter PCI	
7.	Unplanned revascularisation within 30 days		
8.	30-day mortality after PCI		
9.	Patients without contraindication discharged o	on lipid-lowerin	ig therapy
10.	Patients referred to cardiac rehabilitation or ot prevention program	her secondary	,
11.	Proportion of patients, without a clear and doc for Aspirin and/or P2Y12 inhibitor, discharged o	cumented cont on DAPT	raindication

8. Participation

Participating state and territory registries have made important progress towards contributing data up to a National level. Jurisdictions who did not have an existing cardiac registry have undertaken significant work establishing their registries, processes and procedures to be able to contribute to the National Registry.

A meaningful way to understand participation is to follow the steps toward contributing data from approaching hospitals, to engagement, then collecting data. Data is submitted for the previous year so hospitals will be represented as collecting data before transitioning to contributing data. It is expected that newly-participating registries will need to establish data quality processes before they have confidence in their data to contribute to the national cohort.

As can be seen in the clinical findings (page 39) participating registries are still working towards the capture of the complete minimum dataset and efforts continue to address this to enable future reporting on all quality indicators of the Registry.



Local Reflection South Australia (SA)

It is with great enthusiasm and excitement that SA, through the established Coronary Angiogram Database of South Australia (CADOSA) Registry, participates in the Registry.

Our involvement from the onset has been a very positive and rewarding opportunity. The 'ground up' and 'all comers' approach has allowed the development of a framework that considers existing registry accomplishments across Australia whilst supporting other sites in establishing cardiac data collections. The Registry demonstrates the success of a federated approach. States with mature data collections have supported other sites in establishing data collection processes, governance and ethical arrangements, and clinician engagement. All contributors retain their autonomy whilst committing towards a national program. It has been a delight to engage with our interstate colleagues on a regular basis, albeit virtually.

We were very pleased to contribute CADOSA data for the first National public report in 2021. These data activities required us to transform our local CADOSA data to formats required for the Registry, which in turn provided us with the learnings to streamline our data submissions in the future.

In SA, CADOSA has continued ongoing PCI data collection at the major public hospitals and one private one. We have engaged the remaining private hospitals in Adelaide and are establishing arrangements to begin data capture into the CADOSA Registry. We are working through the ethical requirements for the private sites.

We look forward to transforming a federated model of data collection to a platform that will report trusted, reliable data to facilitate national benchmarking across a suite of cardiac indicators.

Associate Professor Rosanna Tavella

CADOSA Registry Manager, Adelaide Medical School, Faculty of Health Sciences, the University of Adelaide and Steering Committee, SA jurisdictional representative

9. Clinical Findings

The analyses and insights presented here represent the data from contributing hospitals in the Australian Capital Territory (ACT), New South Wales (NSW), South Australia (SA), Queensland (QLD), Victoria (VIC) and Tasmania (TAS). All of those participating are in different stages of development towards submitting complete data that will allow for comprehensive reporting. The contributing state and territory registries range in completeness of mapping to the Registry variables from 34-96% and all are undertaking work to comply with Registry requirements. Thus, not all indicators can be reported on at this time. A full calendar year of data was not available from three of the six states, therefore any inference from volume data should be done with this in mind. This report covers PCI activity in Australia for the 2020 calendar year from January 1 to December 31.

9.1 Patient characteristics

Thirty-three public hospitals from five states and one territory contributed data. In 2020, a total of 15,559 PCI cases were performed on 14,112 patients with 9% of patients (n=1,447) undergoing more than one procedure. The median age for males was 64 years (Interquartile range; IQR: 55, 72) and for females, 68 years (IQR: 59, 77). The distribution of cases by age and gender are shown in Figure 9. The peak frequency of PCI procedures occurred in the seventh decade for both males and females. Males accounted for 75% of cases overall.



Table 4A outlines selected patient demographic information for the 2020 cohort and a comparison by clinical presentation. Patients with non-ST-elevation acute coronary syndromes (NSTEACS) had more diabetes and prior ischaemic heart disease (defined as prior PCI and/or coronary artery bypass grafting, CABG). ST-elevation myocardial infarction (STEMI) patients had more cardiogenic shock, out-of-hospital cardiac arrests and were more likely to have moderately or severely reduced left ventricular ejection fraction (LVEF). In Australia, obesity is a major public health concern with an increasing proportion of the population classified as either overweight or obese²⁴. When examining the prevalence of severe obesity (BMI \geq 35kg/m²) among the cohort, the rate of severe obesity was more than twice the national average (14% vs 6%), with severe obesity more common in females than males (19% vs 13%).

Detient de ne de vistige	STEMI	NSTEACS	Non-ACS	All
Patient characteristics	(N=5,006)	(N=5,287)	(N=5,266)	(N=15,559)
Age - years (mean+/-SD)	62.6+/-12.4	64.6+/-12.4	66.1+/-11.3	64.5+/-12.2
Sex - female (%)	24.0	27.4	23.9	25.1
Diabetes (%)	21.2	28.8	31.6	27.3
Peripheral vascular disease* (%)	3.1	5.2	5.2	4.5
Previous PCI (%)	12.3	22.1	40.4	25.1
Previous CABG (%)	2.0	7.7	9.7	6.5
Severe obesity (BMI≥35kg/m²) (%)	11.8	16.0	14.7	14.2
Moderate or severe LV dysfunction (LVEF<45%) (%)	31.8	15.1	17.7	21.8
Cardiogenic shock (%)	6.5	0.6	1.0	2.7
Out-of-hospital cardiac arrest (%)	6.5	0.5	1.2	2.7
Estimated glomerular filtration rate ≤30mls/min (%)	3.2	3.7	3.9	3.6

Table 4A. Patient characteristics by clinical presentation

* Missing data (n=3,785)

Tables 4B-4D present demographic data by various categorisations of hospital type. Hospital sites were divided into low (<250 PCI cases per year), medium (250-500 PCI cases per year) and high volume (>500 PCI cases per year) sites, whether or not they had onsite cardiac surgery and whether they were metropolitan or non-metropolitan based. Patients in low volume centres had more diabetes and patients in medium to high volume hospitals were more likely to have moderately or severely reduced LVEF. Other results were consistent across all three categorisations with no major differences among the various hospital groupings.

²⁴ Australian Institute of Health and Welfare (2017) A picture of overweight and obesity in Australia 2017. Cat. no.PHE 216. Canberra: AIHW

Patient characteristics	Low volume <250	Medium volume 250-500	High volume >500
	(N=525)	(N=4,727)	(N=10,307)
Age -years (mean+/-SD)	64.9+/-11.7	64.5+/-12.2	64.4+/-12.2
Sex - female (%)	27.1	26.1	24.8
Diabetes (%)	35.2	25.6	27.6
Peripheral vascular disease* (%)	5.5	3.9	4.8
Previous PCI (%)	29.3	24.3	25.3
Previous CABG (%)	7.4	6.3	6.6
Severe obesity (BMI≥35kg/m²) (%)	14.4	15.6	13.6
Moderate or severe LV dysfunction (LVEF<45%) (%)	12.9	21.3	22.4
Cardiogenic shock (%)	1.3	2.8	2.6
Out-of-hospital cardiac arrest (%)	0	2.0	3.1
Estimated glomerular filtration rate ≤30mls/min (%)	4.8	2.6	4.1

Table 4B. Patient characteristics by hospital volume

Table 4C. Patient characteristics by on-site CABG vs off-site CABG hospitals On-site CABG Off-site CABG Age - years (mean+/-SD) 64.5+/-12.1 64.4+/-12.2 Sex - female (%) 24.7 25.6 Diabetes (%) 27.1 27.5 Peripheral vascular disease* (%) 4.5 4.5 Previous PCI (%) 24.1 26.2 Previous CABG (%) 6.3 6.8 Severe obesity (BMI≥35kg/m²) (%) 14.0 14.4 Moderate or severe LV dysfunction (LVEF<45%) (%) 22.8 20.8 Cardiogenic shock (%) 2.7 2.6 Out-of-hospital cardiac arrest (%) 3.0 2.4 Estimated glomerular filtration rate ≤30mls/min (%) 4.1 3.2 * Missing data (n=3785)

Detient obere stariation	Metro	Non-metro	
Patient characteristics	(N=12,276)	(N=3,283)	
Age -years (mean+/-SD)	64.5+/-12.2	64.4+/-12.1	
Sex - female (%)	25.0	25.7	
Diabetes (%)	27.4	27.0	
Peripheral vascular disease* (%)	4.3	6.1	
Previous PCI (%)	25.5	23.8	
Previous CABG (%)	6.4	6.9	
Severe obesity (BMI≥35kg/m²) (%)	14.0	14.8	
Moderate or severe LV dysfunction (LVEF<45%) (%)	21.7	22.4	
Cardiogenic shock (%)	3.0	1.6	
Out-of-hospital cardiac arrest (%)	3.0	1.7	
Estimated glomerular filtration rate ≤30mls/min (%)	3.8	2.0	

* Missing data (n=3785)

†Non-metropolitan hospitals are defined as those outside capital cities.

The burden of PCI activity undertaken out-of-hours was 20% of the cohort. Most of this work related to the treatment of STEMI, a time critical event generally performed as an emergency 24 hours a day. Just over half (54%) of STEMI cases were treated out-of-hours, while the percentage of NSTEACS and non-ACS cases treated out-of-hours was much lower, reflecting their less urgent nature (Figure 10).



9.2 Clinical presentation

Figure 11 shows the percentage of cases by the type of clinical presentation. Two-thirds of the PCIs were performed in patients with ACS - either STEMI or NSTEACS. When examining clinical presentation by hospital type (by volume, presence of onsite cardiac surgery and whether metropolitan-based), the percentages of ACS cases were all similar.



Figure 12 and the following tables (Table's 5A-5D) describe various procedural aspects, such as the percentage of the use of the radial artery, by the various clinical presentations.

Radial access was the predominant arterial approach across the cohort and accounted for over three quarters of all cases (78%). However, Figure 12 demonstrates that the use of the radial approach varied considerably among participating Registry sites, with some sites below 60% and others approaching 100% of cases. The radial technique was more frequently observed in the treatment of ACS and in hospitals without on-site CABG.



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Drug-eluting stents (DES) were used in 93% of cases (Table's 5A-5D), with some variation in use among hospitals (range 89-100%). The mean lesion success rate which is defined as treatment of a coronary lesion with a residual stenosis <10% following stenting or <50% following balloon angioplasty alone, was 96% (range across hospitals 82-100%). Procedural success requires both the successful treatment of all lesions and the absence of any major in-hospital complications. The mean procedural success rate was 93% (range across hospitals 82-100%), with success more frequently observed in NSTEACS and non-ACS patients.

Table 5A. Procedural data by clinical presentation

	STEMI	NSTEACS	Non-ACS	All
Procedural data	(N=5,006)	(N=5,287)	(N=5,266)	(N=15,559)
Radial access (%)	79.4	80.2	75.5	78.4
Femoral access (%)	20.3	19.5	24.3	21.3
Drug-eluting stent(s) (%)	92.8	94.1	92.7	93.2
In-stent restenosis (%)	1.4	4.4	4.7	3.5
Mechanical ventricular support required (%)	1.4	0.2	0.3	0.6
Lesion success (%)	95.7	95.8	95.9	95.8
Procedural success (%)	90.5	94.7	94.4	93.2

Procedural data	Low volume <250	Medium volume 250-500	High volume >500
	(N=525)	(N=4,727)	(N=10,307)
Radial access (%)	80.6	81.2	77.0
Femoral access (%)	19.0	18.6	22.6
Drug-eluting stent(s) (%)	94.5	93.6	93.0
In-stent restenosis (%)	3.0	2.6	4.0
Mechanical ventricular support required (%)	0.3	0.7	0.7
Lesion success (%)	94.5	95.1	96.2
Procedural success (%)	93.1	92.6	93.5

†Non-metropolitan hospitals are defined as those outside capital cities.

Table 5C. Procedural data by on-site CABG vs off-site CABG hospitals*

Dracadural data	On-site CABG	Off-site CABG	
Procedural data	(N=8,035)	(N=7,524)	
Radial access (%)	73.5	83.5	
Femoral access (%)	26.3	16.2	
Drug-eluting stent(s) (%)	93.5	92.9	
In-stent restenosis (%)	3.0	4.1	
Mechanical ventricular support required (%)	0.6	0.7	
Lesion success (%)	96.5	95.0	
Procedural success (%)	94.1	92.3	

*On-site CABG sites have the ability to perform Coronary artery bypass graft surgery. Off-site CABG sites would transfer patients to a hospital that performs Coronary artery bypass graft surgery (if required).

Table 5D. Procedural data by metropolitan vs non-metropolitan hospitals {}^{\dagger}

Dracadural data	Metro	Non-metro
Procedural data	(N=12,276)	(N=3,283)
Radial access (%)	77.6	81.1
Femoral access (%)	22.1	18.3
Drug-eluting stent(s) (%)	93.6	91.9
In-stent restenosis (%)	3.4	4.3
Mechanical ventricular support required (%)	0.8	0.1
Lesion success (%)	95.5	97.0
Procedural success (%)	92.6	95.5

†Non-metropolitan hospitals are defined as those outside capital cities.

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9.3 Percutaneous Coronary Intervention for acute STEMI

The Registry has defined two quality indicators for primary PCI; time from diagnostic electrocardiogram to PCI mediated reperfusion and time from door to PCI mediated reperfusion. For this report, there was insufficient data to evaluate the first indicator.

9.3.1 Time from door to PCI mediated reperfusion

Primary PCI is defined as PCI performed as primary reperfusion therapy for STEMI patients presenting within 12 hours of symptom onset. Among the cohort, 3,038 patients underwent primary PCI, representing 20% of the total PCI caseload. Figure 13 shows primary PCI case rates by hospital. Rates ranged from 0% to 38% of hospitals' total PCI workload.



	Cases with data available	Primary PCI rate
Hospital types	N	N (%)
Low volume <250	525	18 (3.4)
Medium volume 250-500	4,727	871 (18.4)
High volume >500	10,138	2,149 (21.2)
On-site CABG	7,866	1,585 (20.2)
Off-site CABG	7,524	1,453 (19.3)
Metro	12,107	2,501 (20.7)
Non-metro	3,283	537 (16.4)
All	15,390	3,038 (19.7)

Table 6. Primary PCI cases as a percentage of overall case numbers by hospital types

In primary PCI, the time taken from hospital arrival to PCI-mediated reperfusion is a standard quality process measure to assess health services' ability to deliver timely treatment. For this report, the Registry has used the benchmark target of door-to-device time of \leq 90 minutes - in line with most Australian hospitals that use this time interval in their own quality assurance programs. However, Australian and international guidelines are moving towards an "ideal" treatment target of \leq 60 minutes from first medical contact to balloon inflation²⁵, and future Registry reports will likely adopt the \leq 60 minutes target as this benchmark becomes more embedded in hospital quality assurance activities.

The median door-to-device time for the patient cohort was 56 minutes (Table 7). All hospitals except for one achieved a median door-to-device time of \leq 90 minutes (Figure 14), but only 18 hospitals achieved a median door-to-device time of \leq 60 minutes.

Table 7. Time from door to PCI mediated reperfusion for primary PCI cases *			
Door to PCI mediated reperfusion time**	Primary PCI (all cases)		
	N=2,657		
Median -mins (IQR)	56 (37, 85)		
Proportion of cases ≤90mins (%)	78.4		
Proportion of cases ≤60mins (%)	54.3		

* Sites=31.Two sites had no Primary PCI for STEMI cases.

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

²⁵ 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



In addition to median door-to-device time, hospitals were benchmarked by their ability to achieve a door-to-device time \leq 90 minutes in at least 75% of cases - an internationally recognised performance benchmark²⁶. Across all hospitals, a door-to-device time \leq 90 minutes was achieved in 78% of cases, but there was variation among hospitals (range by hospital 29-100%), see Figure 15. Eighteen hospitals (58%) achieved a door-to-device time of \leq 90 minutes in greater than 75% of cases. When the best-practice treatment time frame was reduced to \leq 60 minutes, just four hospitals (13%) managed to achieve 75% of this more stringent benchmark (Figure 16).

²⁶ 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



* Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient. Three hospitals had case volumes less than ten. 500 cases were missing key data and were excluded from the analysis



* Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient. Three hospitals had case volumes less than ten. 500 cases were missing key data and were excluded from the analysis.

9.3.2 Prehospital notification

Prenotification to hospitals (PHN) of the imminent ambulance arrival of an acute STEMI patient allows hospitals to activate the cardiac catheterisation laboratory team and set up rapid transfer from hospital entrance to catheter laboratory to minimise delays to commencement of the PCI. Rates for door-to-device time \leq 90 minutes were higher in patients triaged with pre-hospital notification, with 87.5% achieving door-to-device time \leq 90 minutes compared to 58% when there was no pre-hospital notification (Table 8). Most hospitals achieved door-to-device times \leq 90 minutes in more than 75% of their caseload when pre-hospital notification was received (Figure 17). The benefit of prenotification was more evident when hospital performance was benchmarked against the more stringent treatment timeframe of \leq 60mins. In the absence of PHN, just 23% of cases managed to achieve a door to device time in less than 60 minutes.

Table 8. 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=2,657	N=1,784	N=740
Median -mins (IQR)	56 (37, 85)	47 (33, 69)	83 (63, 113)
Proportion of cases ≤90mins (%)	78.4	87.5	58
Proportion of cases ≤60mins (%)	54.3	67.9	22.7

* Sites=31. Two sites had no Primary PCI for STEMI cases.

† PHN data - Data not supplied in 133 cases.



* Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient. Three hospitals had case volumes less than ten. 500 cases were missing key data and were excluded from the analysis.

t Two sites had 100% PHN cases and one site had 0% of cases (without PHN) with a door-to-device time \leq 90 minutes.

Local Reflection Tasmania (TAS)

The Tasmanian Health Service has embraced the Registry initiative. We have overcome challenges posed by COVID-19 pandemic and service restructures to recruit two part time project nurses based in Launceston and Hobart. The project nurse positions have provided support and coordination to their Cardiology Departments, enabling the development of formal processes and systems to ensure Tasmania can effectively contribute high quality data to the National Cardiac Registry via the Victorian Cardiac Outcomes Registry (VCOR).

Despite delays in the recruitment of the project nurses, the team has undertaken important groundwork over the last 12 months. It has delivered extensive, state-wide education about Clinical Quality Registries (CQR's); developed operational protocols and guidelines to ensure accurate data entry; conducted regular Registry development updates to the key stakeholders and established governance frameworks for analysis and reporting through the Tasmanian Cardiac Network.

To ensure complete state-wide participation, engagement and consultation is underway with Tasmanian private hospitals. To date one Southern Tasmanian Private Hospital has formally joined and commenced data entry.

Clinical Quality Registries provide essential information regarding care delivery and identify areas for improvement to optimise patient outcomes. The Tasmanian Health Service is excited to be involved in this important national initiative and ongoing collaboration with our interstate colleagues to enable richer insights for the benefit of health services and patients across Australia.

Dr Andrew Black

Tasmanian National Cardiac Registry Principal Investigator

Tanya Murray

ADON Service Development Unit, Health Planning Unit, Department of Health

Jenna Lumley

Project Nurse (CNC), Health Planning Unit, Department of Health

9.3.3 In-hours versus out-of-hours presentation

The majority of hospitals showed an increase in door-to-device time outside normal working hours. There are many potential reasons for these time delays such as increases in the time taken to transfer patients to the cardiac catheter laboratory after hours, or additional time taken to stabilise sicker patients. However, this system delay represents an opportunity for further investigation in order to reduce the delay and meet best practice clinical guidelines. Among the 62% of STEMI cases treated out-of-hours (range by hospital 0-86%), most hospitals had longer delays to the commencement of the procedure after-hours. However, three hospitals actually performed better out-of-hours (Figure 18).



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

t Primary PCI for STEMI presentations excluding all inter-hospital arrivals and patients with STEMI onset whilst a current in-patient. Three hospitals had case volumes less than ten. 500 cases were missing key data and were excluded from the analysis.

9.3.4 Radial access

The rate of radial vascular access is an especially important performance indicator in primary PCI because of the strong evidence base for improved outcomes with its use in this clinical context²⁷. Among the cohort, radial access was utilised in 78% of STEMI PCIs. A comparison of radial access rates in STEMI PCI among hospitals shows that there was variation across sites (41%-100%), with over three-fifths of hospitals managing to use the radial artery ≥80% cases (Figure 19).



²⁷ Karrowni W, Vyas A, Giacomino B, et al. (2013) Radial versus femoral access for primary percutaneous interventions in ST-segment elevation myocardial infarction patients: a meta-analysis of randomized controlled trials. JACC: Cardiovascular Interventions, 6, 8:814-823. https://doi.org/10.1016/j.jcin.2013.04.010

9.4 Referral to cardiac rehabilitation

Referral to cardiac rehabilitation and/or secondary prevention programs following admission with acute coronary syndrome is strongly recommended by Australian guidelines²⁸. The overall rate for referral to cardiac rehabilitation following PCI was 76%. Referral rates varied with clinical presentation, with ACS cases more often referred than non-ACS cases (Table 9). When examining referrals to cardiac rehabilitation by hospital type, rates were lower in low volume centres, those without onsite CABG and in metropolitan hospitals.

	Cases with data available	Rehabilitation referral rate	Referral status 'unknown'
Clinical presentation	N	%	%
STEMI	4,669	82.7	8.9
NSTEACS	5,071	76.4	10.6
Non-ACS	4,859	70.4	9.3
Hospital types	N	%	%
Low volume <250	291	41.2	52.9
Medium volume 250-500	4,406	70.6	7.7
High volume >500	9,902	80.1	9.2
On-site CABG	7,492	81.2	4.8
Off-site CABG	7,107	71.4	14.7
Metro	11,443	75.4	10.7
Non-metro	3,156	80.3	5.5
All	14,599	76.4	9.6

Table 9. Rates of referral to cardiac rehabilitation by clinical presentation and hospital type

²⁸ 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

9.5 Compliance with guideline recommended discharge medications

There are a number of medications strongly recommended for use in coronary disease by Australian guidelines²⁹, with dual anti-platelet therapy (DAPT) and lipid-lowering therapy (LLT) indicated for virtually all patients undergoing PCI. Compliance is never complete due to factors such as contra-indications, allergy or drug intolerance. For this reporting period, prescription of DAPT and LLT were generally high at 95% and 96% respectively (Table 10) with no differences among the various clinical groups or hospital types.

	Discharged on DAPT (%)	Discharged on LLT (%)
STEMI (N=3,138)	95.6	98.1
NSTEACS (N=3,547)	95.3	97.1
Non-ACS (N=2,967)	95.2	93.6
Low volume <250 (N=291)	97.3	94.8
Medium volume 250-500 (N=3,274)	95.3	96.8
High volume >500 (N=6,238)	95.3	96.1
On-site CABG (N=4,538)	96.5	97.0
Off-site CABG (N=5,265)	94.3	95.7
Metro (N=9,137)	95.4	96.3
Non-metro (N=666)	94.7	97.0
All cases (N=9,803)*	95.3	96.3

Table 10. Rates of prescription of DAPT and LLT by clinical presentation and hospital type

9.6 Outcomes following Percutaneous Coronary Intervention

9.6.1 In-hospital mortality

The overall in-hospital mortality rate was 1.9%. Figure 20 demonstrates that all participating hospitals were within control limits with no outliers, an outlier is defined as being more than 3 standard deviations from the mean. When cardiogenic shock cases were excluded from the analysis, the mortality rate for the PCI cohort was 0.9%. Mortality rates that exclude shock are analysed because shock has a very high mortality rate and hospitals that have proportionately higher numbers of these cases may appear to have mortality rates greater than the average. All participating hospitals were within control limits with no outliers for the reporting period (Figure 21). As expected, the death rate of cases of cardiogenic shock was much higher than for any other clinical group. Table 11A provides in-hospital mortality data for selected clinical groups.

In-hospital mortality was slightly higher overall among medium to high volume centres. However, this needs to be interpreted cautiously, as casemix (proportions of high and low acuity patients) is often quite different among hospitals with high and low volumes. In-hospital mortality for patients in the non-ACS group was notably higher in medium to high volume centres (Table 11B). The overall in-hospital mortality trend was higher among metropolitan hospitals and in the STEMI group (Table 11D). Death rates were not influenced by whether there was onsite cardiac surgery available (Table 11C).

²⁹ 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





Table 11A: In-hospital mortality rates for selected patient group

Patient category	Total	In-hospital mortality rate
	N	N(%)
All PCI patients	15,559	299 (1.9)
STEMI patients	5,006	228 (4.6)
Shock patients	407	152 (37.3)
NSTEACS	5,287	34 (0.6)
Non-ACS	5,266	37 (0.7)

Table 11B. 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	15,559	2/525(0.4)	87/4,727 (1.8)	210/10,307 (2.0)
STEMI patients	5,006	2/33 (6.1)	68/1,388 (4.9)	158/3,585(4.4)
Shock patients	407	2/7 (28.6)	49/127 (38.6)	101/273 (37.0)
NSTEACS	5,287	0/217(0)	8/1,661 (0.5)	26/3,409 (0.8)
Non-ACS	5,266	0/275 (0)	11/1,678 (0.7)	26/3,313(0.8)

Table 11C. 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	15,559	165/8,035 (2.1)	134/7,524 (1.8)
STEMI patients	5,006	126/2,664 (4.7)	102/2,342 (4.4)
Shock patients	407	77/208 (37.0)	75/199 (37.7)
NSTEACS	5,287	15/2,528 (0.6)	19/2,759 (0.7)
Non-ACS	5,266	24/2,843 (0.8)	13/2,423 (0.5)

Table 11D. In-hospital mortality rates by metropolitan vs non-metropolitan hospitals

Patient category	Total	Metro	Non-metro
	N	n/N (%)	n/N (%)
All PCI patients	15,559	258/12,776 (2.1)	41/3,283 (1.2)
STEMI patients	5,006	201/3,995 (5.0)	27/1,011 (2.7)
Shock patients	407	139/356 (39.0)	13/51 (25.5)
NSTEACS	5,287	31/4,279 (0.7)	3/1,008 (0.3)
Non-ACS	5,266	26/4,002 (0.6)	11/1,264 (0.9)

9.6.2 Other in-hospital outcomes

Table 12A provides in-hospital outcome data for selected clinical groups. The rate of in-hospital major bleeding for the overall cohort was 0.8%. The highest bleeding rates were seen in patients presenting with acute STEMI; an expected finding given this patient cohort generally receives the most intensive anti-platelet and anti-coagulant therapies.

The rate of in-hospital (peri-PCI) stroke for the overall cohort was 0.3%. All participating hospitals were within control limits with no outliers for the reporting period (Figure 22).

In-hospital unplanned revascularisation refers to any unexpected revascularisation procedure (either PCI or CABG surgery) following the index PCI, and with the same admission. In 2020, the overall rate of in-hospital unplanned revascularisation was 0.6%. All participating hospitals had rates of unplanned revascularisation within control limits (Figure 23).

The composite endpoint of major adverse cardiac and/or cerebrovascular events (MACCE) is defined as all cases of death, new myocardial infarction, stent thrombosis, unplanned revascularisation or stroke. The MACCE rate was 3.5% overall and notably higher in the ACS cohort. No differences were seen when hospitals were analysed according to hospital volumes, the presence or absence of onsite surgery or whether they were metropolitan or non-metropolitan based (Tables 12A-12D).

Length of stay in hospital varied by clinical presentation (Table 12A) and was longest among patients with acute coronary syndromes.

In hospital outcomes	Total	STEMI	NSTEACS	Non-ACS
m-nospital outcomes	(N=15,111)	(N=4949)	(N=5165)	(N=4953)
Major bleeding (%)*	0.8	1.3	0.4	0.7
Myocardial infarction (%)	0.5	0.7	0.3	0.5
Stroke (%)	0.3	0.6	0.2	0.2
Stent thrombosis (%)**	0.3	0.6	0.1	0.2
Unplanned revascularisation (%)	0.6	1.2	0.4	0.3
MACE† (%)***	3.2	6.9	1.3	1.5
MACCE (%)***	3.5	7.4	1.5	1.7
Median length of stay (Days)	3.0	3.0	3.0	1.0

Table 12A. In-hospital outcomes by clinical presentation

*Missing data (N=6,084)

**Missing data (N=4,516)

***Missing data (N=4,964)

† MACE = major adverse cardiac event

Local Reflection Western Australia (WA)

Over the past 12 months, the Western Australia Cardiac Outcomes Registry (WACOR) has gained significant traction. We now have all public and private hospitals within WA engaged in the project and data is already being collected from our three tertiary hospitals. This has resulted in the formation of a Governance Working Group, with broad representation from the WA cardiology community, as well as the development of additional collection tools to facilitate data collection on patients presenting with Acute Coronary Syndrome.

The data currently being collected is being collated in dashboards and will be used to provide information on both data completeness and clinical endpoints to catheterization laboratory staff. In addition, we are progressing data sharing agreements and ethics/governance requirements for WA's participation in the Registry. There is widespread engagement in the project from the WA cardiology community and other relevant stakeholders, who all support both WACOR and the Registry.

Dr Natalie Ward

WACOR Registry Coordinator, University of Western Australia







Table 12B. In-hospital outcomes by hospital volume

In-hospital outcomes	Low volume <250	Medium volume 250-500	High volume >500	
	(N=292)	(N=4,512)	(N=10,307)	
Major bleeding (%)*	0.7	0.8	0.7	
Myocardial infarction (%)	1.0	0.6	0.4	
Stroke (%)	0.3	0.4	0.2	
Stent thrombosis (%)**	0.2	0.3	0.3	
Unplanned revascularisation (%)	0.3	0.5	0.7	
MACE (%)***	1.7	3.1	3.4	
MACCE (%)***	2.1	3.5	3.6	
Median length of stay (Days)	2.0	3.0	3.0	
Median length of stay (Days) *Missing data (N=6,084)	2.0	3.0	3.0	
**Missing data (N=4,516)				
***Missing data (N=4,964)				

Table 12C. In-hospital outcomes by on-site CABG vs off-site CABG centres

On-site CABG	Off-site CABG	
(N=7,820)	(N=7,291)	
0.7	0.9	
0.4	0.6	
0.3	0.3	
0.2	0.4	
0.7	0.5	
3.4	3.1	
3.7	3.4	
3.0	3.0	
	On-site CABG (N=7,820) 0.7 0.4 0.3 0.2 0.7 3.4 3.7 3.0	

Table 12D. In-hospital outcomes by metro vs non-metro hospitals

	Metro	Non-metro (N=3,283)	
In-nospital outcomes	(N=11,828)		
Major bleeding (%)*	0.7	1.6	
Myocardial infarction (%)	0.6	0.2	
Stroke (%)	0.3	0.2	
Stent thrombosis (%)**	0.3	0.0	
Unplanned revascularisation (%)	0.6	0.5	
MACE (%)***	3.3	2.0	
MACCE (%)***	3.6	2.3	
Median length of stay (Days)	3.0	3.0	
*Missing data (N=6,084)			
**Missing data (N=4,516)			
***Missing data (N=4,964)			

Local Reflection Queensland (QLD)

Queensland welcomes the development and introduction of the Registry. The most recent phase of growth and progress is a result of intense efforts to consult with key stakeholders, clinicians, and state representatives; which has led to a well-founded, quality platform to build on for future success. Queensland stakeholders support the decision for state-based registries to act as the conduit for both public and private facilities to the Registry, and look forward to aligning with the vision and direction to ensure a collaborative approach for all cardiac facilities within Queensland as a whole.

With a maturing clinical quality registry across many fields and the focus of cardiology and cardiac services within Queensland, we have been well situated to assist in the establishment and development of the Registry.

Queensland intends to expand data collection to encompass all elements of the National Cardiac Registry clinical quality indicator programme as well as exploring the ability of the Queensland state-based registries to provide data from private facilities to the National Cardiac Registry. It is encouraging to see how clinicians from all over the country can work towards a common objective whilst operating toward the goals of various Commonwealth Government strategies for quality and safety in healthcare and at the same time promoting the development of useful tools that promote patient-centred care.

William Vollbon

Manager, Statewide Cardiac Clinical Informatics Unit, Queensland Health, Queensland Government

Dr Rohan Poulter

Director of Cardiology, Sunshine Coast University Hospital

10. 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, developing an approach to variation management and supporting participating registries in their pursuit of complete representative data.

Future steps include the exploration of synergies with other national cardiac 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 rehabilitation³⁰. 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 Ltd. 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 Aboriginal and Torres Strait Islander 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. The 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.

³⁰ Gallagher R, Thomas E, Astley C, Foreman R, Ferry C, Zecchin R & Woodruffe S. (2020) Cardiac Rehabilitation Quality in Australia: Proposed National Indicators for Field-Testing. Heart, Lung and Circulation, https://doi.org/10.1016/j.hlc.2020.02.014

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 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. This will systematically drive patient centred improvements in the quality and value of healthcare and patient outcomes, across the national healthcare system.

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

Local Reflection Victoria (VIC)

As an established Clinical Quality Registry (CQR), the Victorian Cardiac Outcomes Registry (VCOR) fully supports the Registry and the federated model of delivery of an Australia-wide cardiac focussed CQR that will ultimately encompass all states and territories.

VCOR began data collection in 2013 and currently the PCI module contains over 80,000 case records. VCORs primary role is reporting to hospitals and the government for the purposes of quality improvement. In this context VCOR is very keen to see the Registry supported to realise its full potential as it will allow for additional insights into the delivery of care in Victoria, beyond that which VCOR can currently do.

Professor Christopher M Reid

Coordinating Principal Investigator and Registry Custodian Victorian Cardiac Outcomes Registry
11. Acknowledgements

The achievements to date would not have been possible without the significant support from all of the Registry stakeholders.

Steering Committee members representing all states and territories, consumers, Aboriginal and Torres Strait Islander Peoples and the Department of Health have worked tremendously well together and taken a unified approach to the progress of this initiative. The achievements outlined in this inaugural annual report have been made possible due to the funding support, expertise and significant in kind contributions provided by these individuals and groups. The Registry appreciates the expertise and ongoing commitment of busy clinicians and jurisdictional representatives involved in this committee to establish the registry.

The Registry is fortunate to have the leadership of inaugural Board chair, Dr Leo Mahar who brings a wealth of valuable experience. Dr Mahar and the Board have been well-supported by the Registry's Executive Officer, Megan Schoder.

The participating registries have invested significant time, knowledge and experience to ensure the Registry's development towards realising its vision, purpose and objective. They include:

- Australian Capital Territory Cardiac Outcomes Registry ACTCOR
- Coronary Angiogram Database of South Australia CADOSA
- New South Wales Cardiac Outcomes Registry NSWCOR
- Northern Territory Top End Coronary Database NTTCD
- Queensland Cardiac Outcomes Registry QCOR
- Victorian Cardiac Outcomes Registry VCOR
- Western Australia Cardiac Outcomes Registry WACOR

The Registry project team is employed through the Department of Epidemiology and Preventive Medicine at Monash University and has been encouraged to take advantage of Monash's extensive registry expertise. This has been invaluable to the progression of the registry and fed the team's dedication to undertake what has often been vastly complex ground-breaking work.

CSANZ and ANZSCTS supported the establishment of NCR Ltd via engagement of the Cardiac Accreditation Services Limited to support the implementation and roll out of the Registry.

The Registry is indebted to those patients that have generously shared their information to improve the outcomes of cardiac patients in Australia.

Thank you to Monash University for the provision of images used in this report.

This report and analyses within would not have been possible without the in-kind contributions made by the ACT Health Directorate, NSW Agency for Clinical Innovation, Queensland Health, University of Adelaide and Monash University.

12. The Registry Project Team

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Senior Project Officer	Jasmine Pyyvaara

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14. Glossary

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
The Commission	Australian Commission on Safety and Quality in Health Care
CQR	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
CSANZ	The Cardiac Society of Australia and New Zealand
CVD	Cardiovascular disease
DAPT	Dual antiplatelet therapy
DES	Drug eluting stent
ECG	Electrocardiogram
HREC	Human Research Ethics Committee
IQR	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 as the interquartile range
LLT	Lipid-lowering therapy
LVEF	Left ventricular ejection fraction
MACE	Major adverse cardiac events
MACCE	Major adverse cardiac and cerebrovascular events
The Registry	National Cardiac 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 services
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: a minimally invasive procedure to open narrowed or blocked arteries

Penetration testing	A test to challenge the security of a computer system, also known as ethical hacking, where an individual tries to access a system they do not have permissions or credentials in place to do so
PHN	Pre-hospital notification: when ambulance or emergency clinicians notify a hospital in advance that a patient is en-route for treatment
PPRL	Privacy Preserving Record Linkage: record linkage that allows the matching of records without the need for personal identifiers
PVD	Peripheral Vascular Disease
QCOR	Queensland Cardiac Outcomes Registry
Revascularisation	Coronary revascularisation is when blood flow is restored to coronary arteries and vessels after it has been reduced or blocked
SD	Standard Deviation
STEMI	ST-Elevation Myocardial Infarction
TVR	Target Vessel Revascularisation
VCOR	Victorian Cardiac Outcomes Registry
WACOR	Western Australia Cardiac Outcomes Registry

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