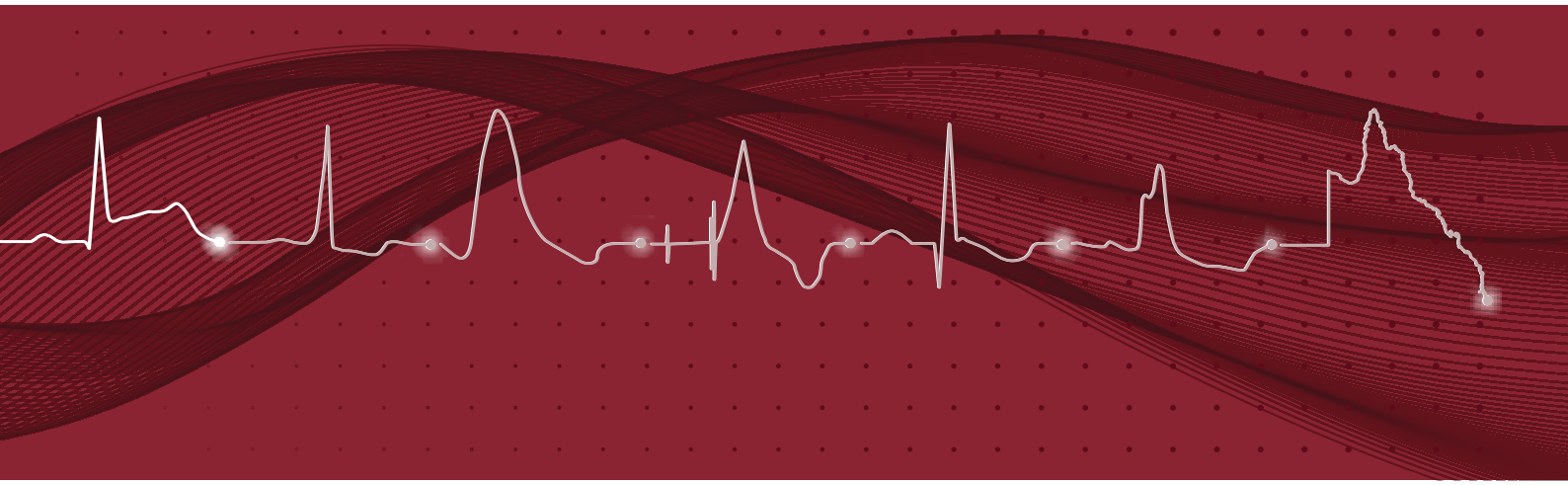
Queensland Cardiac Clinical Network

Queensland Cardiac Outcomes Registry
2021 Annual Report

Interventional Cardiology Audit



Queensland Cardiac Outcomes Registry
2021 Annual Report

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1 Message from the QCCN Chair

Evolution and growth have seen QCOR become far more than a clinical quality registry and fulfil many more roles and functions than traditional registries. In compiling this seventh QCOR Annual Report we can reflect on the key deliverables and impact that the Registry has across many domains of healthcare and the health system in Queensland.

Despite declines in measures of burden of disease, cardiovascular disease and coronary heart disease are conditions with the highest burden of disease and mortality rates for Queenslanders. With the relatively contemporary nature of many of the interventions used to treat cardiovascular disease many analyses, risk scores and quality assurance frameworks exist, allowing the treatment of cardiac disease to be closely monitored. This data rich environment sets it apart from many other medical fields.

In its seventh publication year, this wide-reaching quality and safety program now comprises of cumulative analysis of over 250,000 patient interactions with the Queensland public health system for cardiac disease.

As the program develops and grows, we are frequently asked what is exceptional about QCOR? The answers are compelling and far-reaching. It is the broadest cardiac clinical quality registry of its kind in Australia. It is underpinned by point of care clinical systems and applications that allow clinicians to perform their role at the highest level, knowing their daily activities are supported by quality improvement opportunities. It is a clinical quality program that offers tools, insights, benchmarking and clinical excellence initiatives. It offers the means to enact multimillion-dollar consumables savings programs allowing healthcare money to be reinvested into patient care. But most importantly it is a tool that offers transparent, meaningful clinician-led solutions that aim to improve the health outcomes for all Queenslanders.

In the third year of the global coronavirus pandemic, healthcare providers have faced new and continuing challenges that demand innovative solutions to support the provision of first-class healthcare. The current report confirms that those involved in managing heart and lung disease have delivered volumes of work similar to, or, exceeding those observed in the pre-pandemic era. More importantly, despite unprecedented system stress, the Queensland cardiac community has rallied to maintain high standards of care that are demonstrated in the 2021 outcomes analysis.

Looking forward, we keenly await the delivery of a contemporary statewide cardiovascular information system for diagnostic and interventional cardiology and echocardiography. Investment in such a forward-thinking, all-encompassing solution would not be possible without the collegiality and cooperation of cardiac clinicians throughout the state. Such collaboration is enabled by the platform laid by QCOR and its focus on clinician engagement, supported by our colleagues at eHealth Queensland.

For the public and healthcare consumers, this report provides confidence that the quality and consistency of cardiac procedural care is routinely reported to providers, supporting continuous service improvement.

As the 2021 QCOR Annual Report is finalised, all that is left is to commend the tireless work of the collegiate network of healthcare professionals that continue to uphold the highest clinical standards. We express a sincere wish that the scope of QCOR's activities will be expanded for the benefit of more Queenslanders over many years to come.

Dr Rohan Poulter and Dr Peter Stewart
Co-chairs, Queensland Cardiac Clinical Network

2 Acknowledgements

This collaborative report was produced by the SCCIU, audit lead for QCOR for and on behalf of the Queensland Cardiac Clinical Network. This would not be possible without the tireless work of clinicians in contributing quality data and providing quality patient care, while the contributions of QCOR committee members and others who had provided writing or other assistance with this year's Annual Report is also gratefully acknowledged.

QCOR Interventional Cardiology Committee

- Dr Sugeet Baveja, The Townsville Hospital
- Dr Yohan Chacko, Ipswich Hospital
- Dr Christopher Hammett, Royal Brisbane & Women's Hospital
- Dr Dale Murdoch, The Prince Charles Hospital
- A/Prof Atifur Rahman, Gold Coast University Hospital
- Dr Sam Sidharta, Rockhampton Hospital
- Dr Yash Singbal, Princess Alexandra Hospital
- Dr Gregory Starmer, Cairns Hospital
- Dr Michael Zhang, Mackay Base Hospital
- Dr Rohan Poulter, Sunshine Coast University Hospital (Chair)

QCOR Cardiothoracic Surgery Committee

- Dr Manish Mathew, Townsville University Hospital
- Dr Anil Prabhu, The Prince Charles Hospital
- Dr Morgan Windsor, Metro North Hospital and Health Service
- Dr Sylvio Provenzano, Gold Coast University Hospital
- Dr Christopher Cole, Princess Alexandra Hospital (Chair)

QCOR Cardiac Rehabilitation Committee

- Ms Michelle Aust, Sunshine Coast University Hospital
- Ms Maura Barnden, Metro North Hospital and Health Service
- Ms Wendy Fry, Cairns and Hinterland Hospital and Health Service
- Ms Emma Harmer, Metro South Hospital and Health Service
- Ms Helen Lester, Health Contact Centre – Self Management of Chronic Conditions Service
- Ms Rebecca Pich, Metro South Hospital and Health Service
- Ms Alexandra Samuels, Gold Coast Hospital and Health Service
- Ms Samara Phillips, Statewide Cardiac Rehabilitation Coordinator

Statewide Cardiac Clinical Informatics Unit

- Mr Michael Mallouhi
- Mr Marcus Prior
- Dr Ian Smith, PhD
- Mr William Vollbon

QCOR Electrophysiology and Pacing Committee

- Ms Simone Arthur, Toowoomba Hospital
- Vanessa Beattie, Gold Coast University Hospital
- Mr John Betts, The Prince Charles Hospital
- Mr Anthony Brown, Sunshine Coast University Hospital
- Mr Andrew Claughton, Princess Alexandra Hospital
- Dr Naresh Dayananda, Sunshine Coast University Hospital
- Dr Russell Denman, The Prince Charles Hospital
- Mr Braden Dinham, Gold Coast University Hospital
- Mr Nathan Engstrom, The Townsville Hospital
- A/Prof John Hill, Princess Alexandra Hospital
- Dr Paul Martin, Royal Brisbane & Women's Hospital
- Dr Caleb Mengel, Toowoomba Hospital
- Ms Sonya Naumann, Royal Brisbane & Women's Hospital
- Dr Sachin Nayyar, The Townsville Hospital
- Dr Kevin Ng, Cairns Hospital
- Dr Robert Park, Gold Coast University Hospital
- Mr Simon Townsend, The Prince Charles Hospital

QCOR Heart Failure Support Services Committee

- Mr Ben Shea, Redland Hospital
- Ms Angie Sutcliffe, Cairns Hospital
- Ms Deepali Gupta, Queen Elizabeth II Hospital
- Ms Helen Hannan, Rockhampton Hospital
- Ms Annabel Hickey, Statewide Heart Failure Services Coordinator
- Dr Rita Hwang, PhD, Princess Alexandra Hospital
- Ms Louvaine Wilson, Toowoomba Hospital
- Ms Melanie Burgess, Ipswich Hospital
- Ms Michelle Bertram, Gold Coast Hospital and Health Service
- Dr Wandy Chan, The Prince Charles Hospital
- Prof John Atherton, Royal Brisbane & Women's Hospital (Chair)

Queensland Ambulance Service

- Dr Tan Doan, PhD

3 Introduction

The Queensland Cardiac Outcomes Registry (QCOR) is an ever-evolving clinical registry and quality program established by the Queensland Cardiac Clinical Network (QCCN) in partnership with statewide cardiac clinicians and made possible through the funding and support of Clinical Excellence Queensland. QCOR provides access to quality, contextualised clinical and procedural data to inform and enhance patient care and support the drive for continual improvement of quality and safety initiatives across cardiac and cardiothoracic surgical services in Queensland.

QCOR is a clinician-led program, and the strength of the Registry would not be possible without this input. The Registry is governed by clinical committees providing direction and oversight over Registry activities for each cardiac and cardiothoracic specialty area, with each committee reporting to the QCCN and overarching QCOR Advisory Committee. Through the QCOR committees, clinicians are continually developing and shaping the scope of the Registry based on contemporary best practices and the unique requirements of each clinical domain.

Goals and mission

- Identify, through data and analytics, initiatives to improve the quality, safety and effectiveness of cardiac care in Queensland.
- Provide data, analysis expertise, direction and advice to the Department of Health and Hospital and Health Services concerning cardiac care-related service planning and emerging issues at the local, statewide and national levels.
- Provide decision support, expertise, direction and advice to clinicians caring for patients within the domain of cardiac care services.
- Develop an open and supportive environment for clinicians and consumers to discuss data and analysis relative to cardiac care in Queensland.
- Foster education and research in cardiac care best practice.

Registry data collections and application modules are maintained and administered by the Statewide Cardiac Clinical Informatics Unit (SCCIU), which forms the business unit of QCOR. The SCCIU performs data quality, audit and analysis functions, and coordinates individual QCOR committees, whilst also providing expert technical and informatics resources and subject matter expertise to support continuous improvement and development of specialist Registry application modules and reporting.

The SCCIU team consists of:

Mr Graham Browne, Database Administrator	Mr Michael Mallouhi, Clinical Analyst
Mr Marcus Prior, Informatics Analyst	Mr William Vollbon, Manager*
Dr Ian Smith, PhD, Biostatistician	Mr Karl Wortmann, Application Developer

* Principal contact officer/QCOR program lead

The application custodian for QCOR is the Executive Director, Healthcare Improvement Unit, CEQ, while data custodianship for the overarching data collection of QCOR is the Chair/s of the QCCN. The individual modular data collections are governed by the Chair of each of the individual QCOR specialty committees.

The QCOR Clinical specialty committees provide direction and oversight for each domain of the Registry. An overarching QCOR Advisory Committee provides collective oversight with each of these groups reporting to the QCCN. Through the QCOR committees, clinicians are continually developing and shaping the scope of the Registry based on contemporary best practices and the unique requirements of each clinical domain.

QCOR manages the Cardiothoracic Surgery Quality Assurance Committee which has been formed under Part 6, of the *Hospital and Health Boards Act 2011* to facilitate the participation of clinicians and administrators responsible for the management and delivery of cardiac services. This group enables the peer review of safety and quality of the cardiothoracic services delivered in Queensland and guides any service improvement activities that may be required.

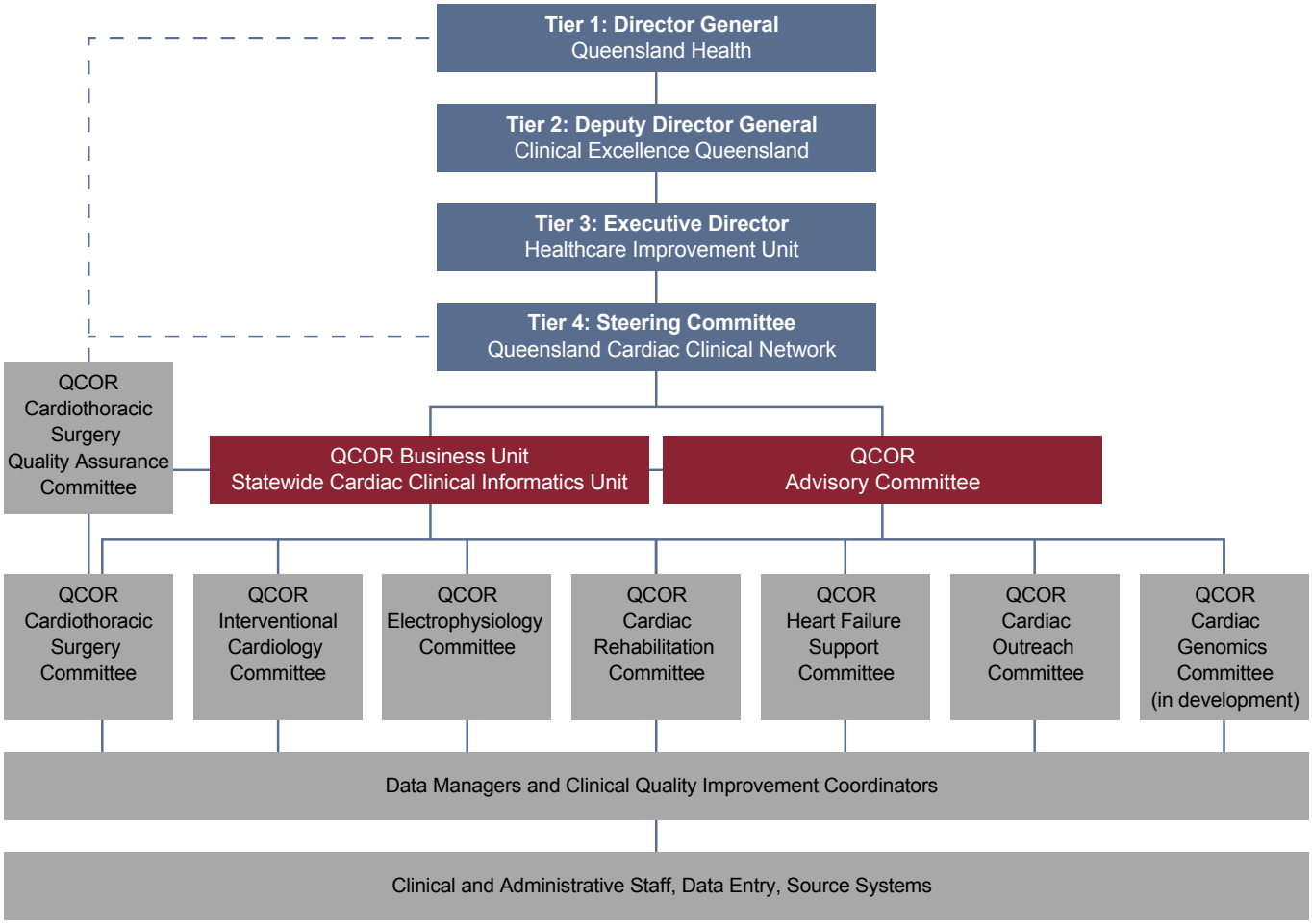


Figure 1: Governance structure

QCOR functions in line with the accepted and endorsed clinical quality registry feedback loop where improvements in clinical care through data-based initiatives and regular interaction with clinicians and stakeholders.

QCOR acts under a well-defined data custodianship model that ensures clearly defined processes and usage of the data collected. The operation of QCOR is guided by the principles outlined by the Australian Commission on Safety and Quality in Health Care in the Framework for Australian clinical quality registries.

The Registry data collection is a blend of clinician-entered data along with various data linkages activities as outlined above. The data is scrutinised using in-app data validations and automated routine data quality reporting. The data quality auditing processes aim to identify and resolve incomplete or inaccurate data to ensure clinician trust in the analysis and outcome reporting process, along with routine reporting and requests for information functions.

In 2014, the Australian Commission on Safety and Quality in Healthcare published a Framework for Australian clinical quality registries*. Since then, QCOR has worked to align itself with these guidelines and standards which form the basis of its quality and safety program. It is recognised that clinical quality registries collect, analyse and report back essential risk-adjusted clinical information to patients, consumers, frontline clinicians and government, with a focus on quality improvement.

The measurement of clinical indicators and benchmarks aims to support the feedback of safety and quality data to several levels of the health system, including consumers, clinicians, administrators and funders. Meaningful metrics are required to understand what the major safety issues are across the care continuum, proactively mitigate patient safety risks and stimulate improvement. Evidence demonstrates that safety and quality improve when clinicians and managers are provided with relevant and timely clinical information.

Through the availability of data insights, clinical reporting and clinical documentation produced by both patient-facing and technical solutions. QCOR has allowed the instantaneous delivery of clinical reports and documentation to clinicians via enterprise solutions. Data insights, performance measure and clinical indicator reporting is also made available in real time via dashboards and reports delivered to clinicians at a frequency and medium of their choosing. Access to real-time data enables key staff to plan and deliver more efficient care to more patients.

QCOR data and analytics have informed and supported statewide healthcare planning activities for capital expansion as well as made possible market share activities for procurement of high-cost clinical consumables resulting in multimillion dollar savings to the healthcare system.

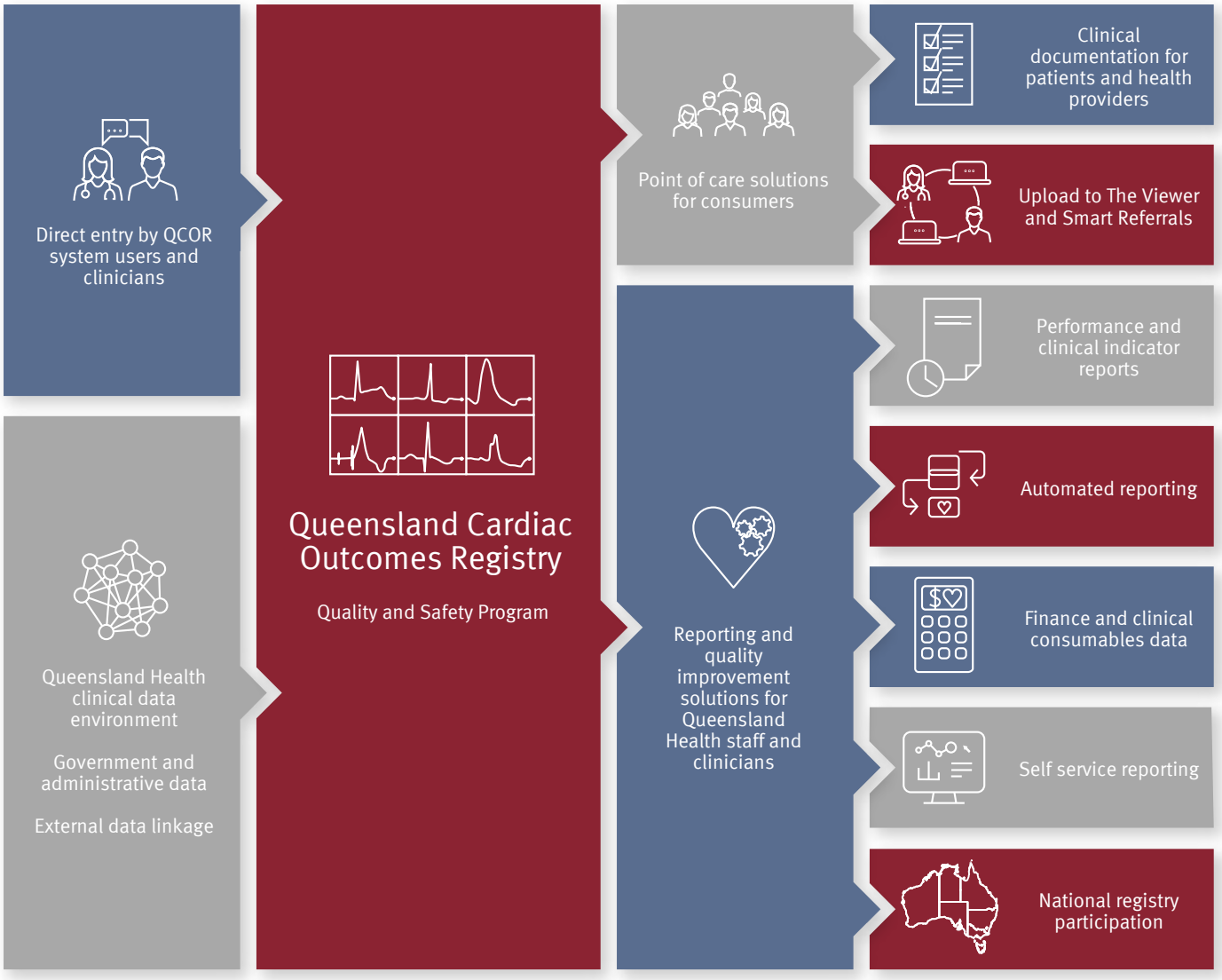
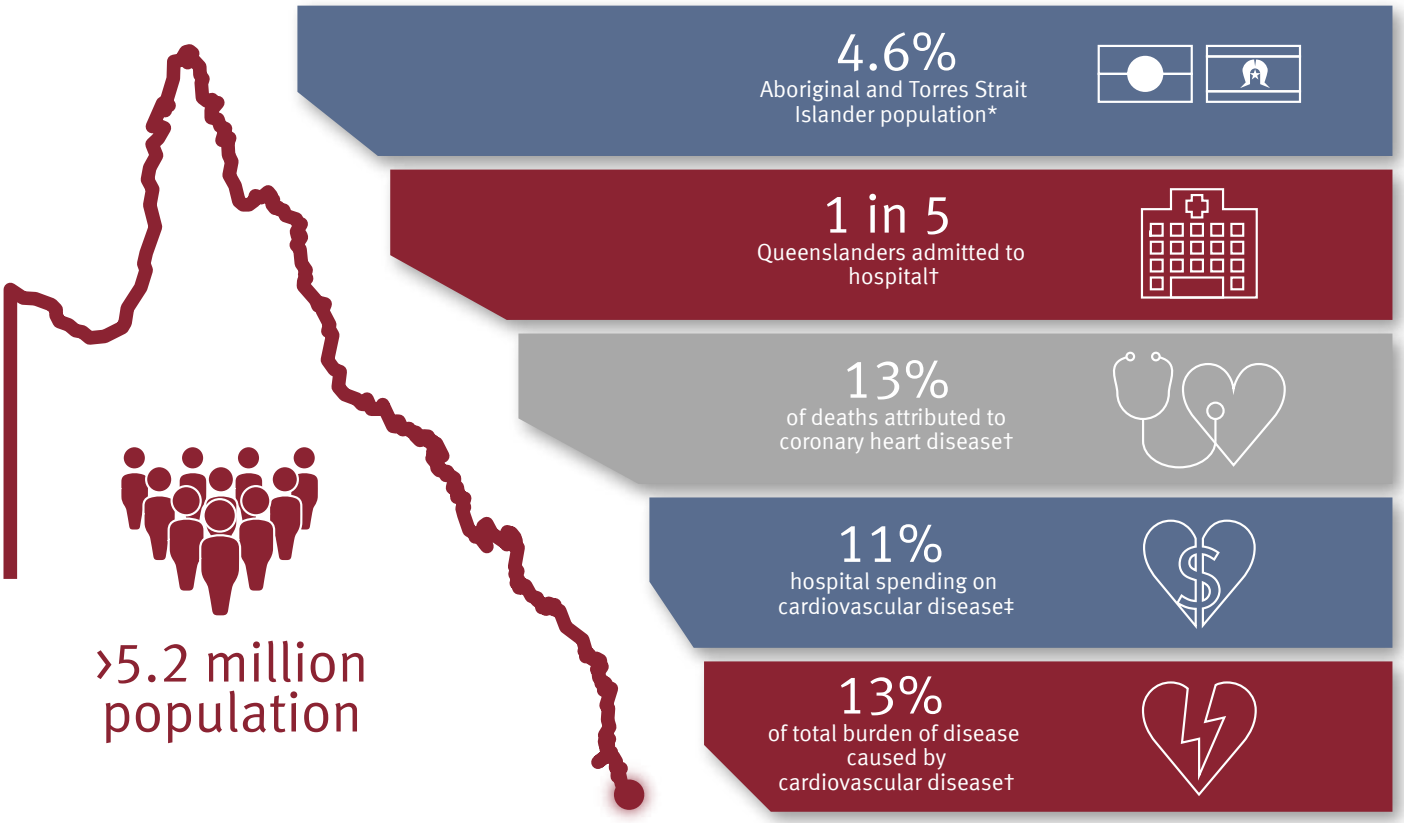


Figure 2: QCOR data flow

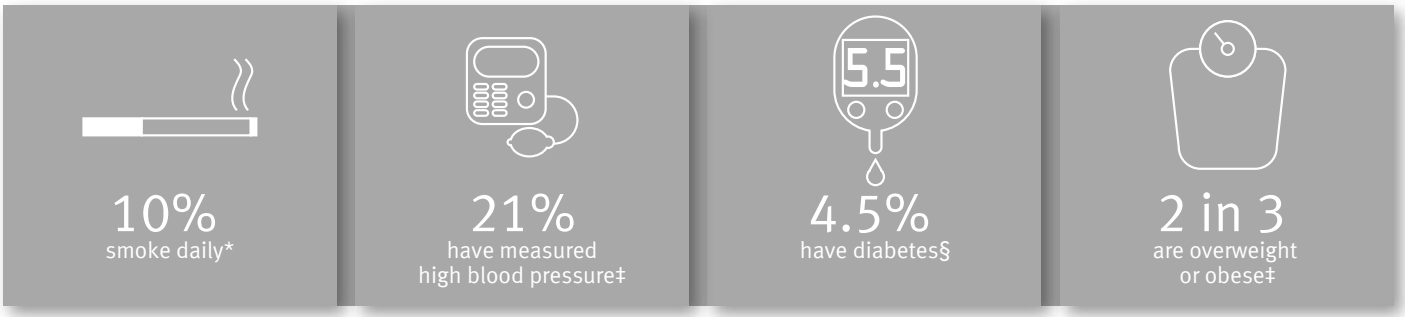
* The Australian Commission on Safety and Quality in Health Care (ACSQHC). Framework for Australian clinical quality registries. Sydney: ACSQHC; 2014.

Queensland Cardiac Outcomes Registry

The Health of Queenslanders



Comorbidities



Mortality

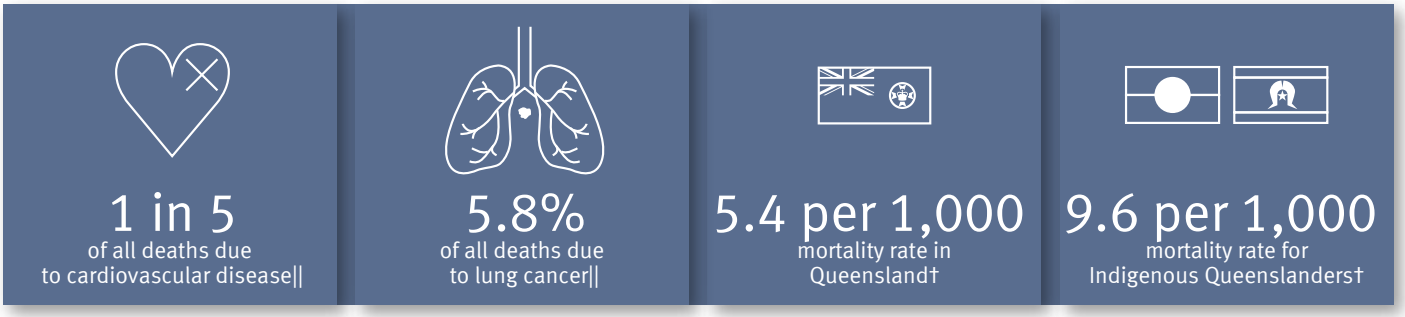


Figure 3: QCOR 2021 infographic

* Australian Bureau of Statistics. (2022, July 1). Queensland: Aboriginal and Torres Strait Islander population summary. ABS. https://www.abs.gov.au/articles/queensland-aboriginal-and-torres-strait-islander-population-summary

† Queensland Health. (2020). The health of Queenslanders 2020. *Report of the Chief Health Officer Queensland*. Queensland Government: Brisbane

‡ Australian Bureau of Statistics. (2019). *National health survey: first results, 2017-18*. Cat. no. 4364.0.55.001. ABS: Canberra.

§ Diabetes Australia. (2018). *State statistical snapshot: Queensland*. As at 30 June 2018

|| Australian Institute of Health and Welfare (2021). MORT (Mortality Over Regions and Time) books: State and territory, 2015–2019. https://www.aihw.gov.au/getmedia/8967a11e-905f-45c6-848b-6a7dd4ba89cb/MORT_STE_2015_2019.xlsx.aspx

2021 Activity at a Glance

What's New?

- Cardiac surgery outcomes and mortality
- Cardiac genomics spotlight
- Cardiac surgery bleeding complications audit
- NSTEMI patients: Interhospital transfers analysis

Interventional Cardiology

4,894
percutaneous coronary interventions

485
structural heart disease interventions

239
transcatheter aortic valve replacements

15,443
total coronary procedures

Cardiothoracic Surgery

2,623
adult cardiac surgeries

1,067
adult thoracic surgeries

Electrophysiology & Pacing

5,269
electrophysiology and pacing procedures

3,500
cardiac implantable electronic device procedures

Heart Failure Support Services

6,326
heart failure support services referrals

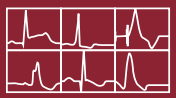
Cardiac Rehabilitation

10,647
cardiac rehabilitation referrals

Paediatric Cardiac Surgery

312
paediatric cardiac surgeries

Clinical Indicator Progress



83 mins
median first diagnostic ECG to reperfusion time for primary PCI

0.3%
procedural tamponade rate for cardiac device and electrophysiology procedures

91%
of patients referred to a heart failure support service on an ACEI, ARB or ARNI at discharge

93%
of cardiac rehabilitation referrals within 3 days of discharge

1.3%
mortality rate for coronary artery bypass surgery at 30 days

4 Facility profiles

4.1 Cairns Hospital

- Referral hospital for Cairns and Hinterland and Torres and Cape Hospital and Health Services, serving a population of approximately 280,000
- Public tertiary level invasive cardiac services provided at Cairns Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - ICD, CRT and pacemaker implantation
- Cardiac genomics clinics provider
- Networked cardiac services outreach hub for Cairns and Hinterland and Torres and Cape Hospital and Health Services

4.2 Townsville University Hospital

- Referral hospital for Townsville and North West Hospital and Health Services, serving a population of approximately 295,000
- Public tertiary level invasive cardiac services provided at Townsville University Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiothoracic surgery
- Networked cardiac services outreach hub for Townsville and North West Hospital and Health Services

4.3 Mackay Base Hospital

- Referral hospital for Mackay and Whitsunday regions, serving a population of approximately 182,000
- Public tertiary level invasive cardiac services provided at Mackay Base Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - ICD and pacemaker implants

4.4 Sunshine Coast University Hospital

- Referral hospital for Sunshine Coast and Wide Bay Hospital and Health Services, serving a population of approximately 563,000
- Public tertiary level invasive cardiac services provided at Sunshine Coast University Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation

4.5 The Prince Charles Hospital

- Referral hospital for Metro North, Wide Bay and Central Queensland Hospital and Health Services, serving a population of approximately 900,000 (shared referral base with the Royal Brisbane and Women's Hospital)
- Public tertiary level invasive cardiac services provided at The Prince Charles Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiothoracic surgery
  - Heart/lung transplant unit
  - Adult congenital heart disease unit
- Cardiac genomics clinics provider

4.6 Royal Brisbane & Women's Hospital

- Referral hospital for Metro North, Wide Bay and Central Queensland Hospital and Health Services, serving a population of approximately 900,000 (shared referral base with The Prince Charles Hospital)
- Public tertiary level invasive cardiac services provided at The Royal Brisbane and Women's Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Thoracic surgery
- Cardiac genomics clinics provider

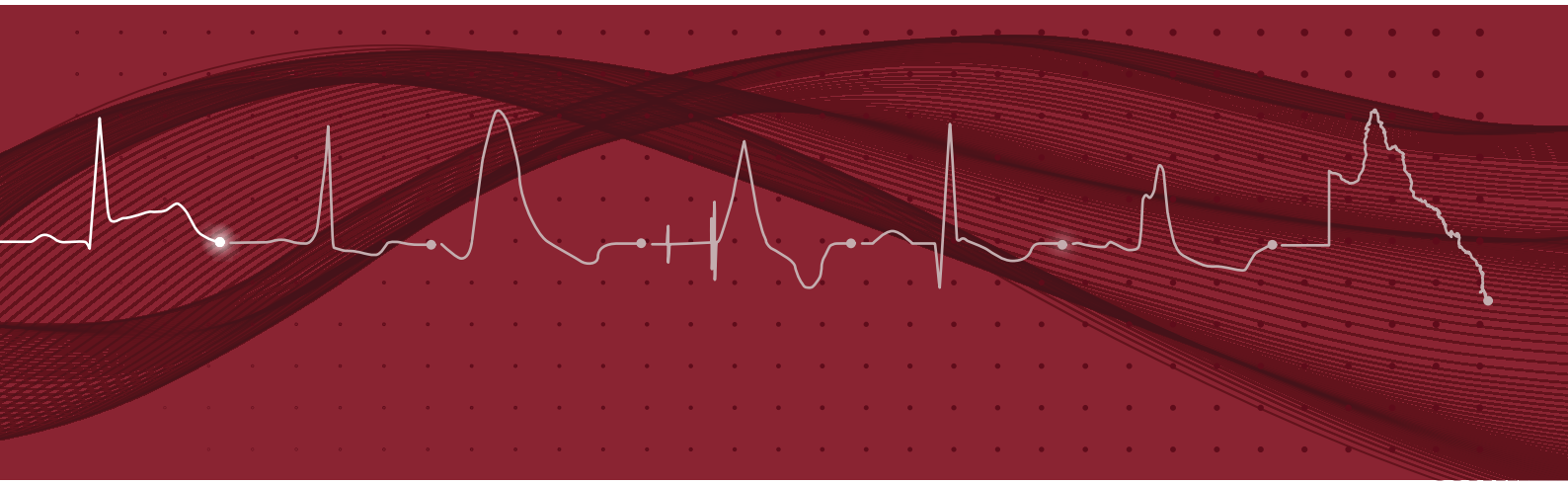
4.7 Princess Alexandra Hospital

- Referral hospital for Metro South and South West Hospital and Health Services, serving a population of approximately 1,000,000
- Public tertiary level invasive cardiac services provided at the Princess Alexandra Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiothoracic surgery
- Cardiac genomics clinics provider
- Networked cardiac services outreach hub for Metro South, Darling Downs and South West Hospital and Health Services

4.8 Gold Coast University Hospital

- Referral hospital for Gold Coast and northern New South Wales regions, serving a population of approximately 700,000
- Public tertiary level invasive cardiac services provided at the Gold Coast University Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiothoracic surgery

Interventional Cardiology Audit



1 Message from the Interventional Cardiology Committee Chair

I am proud to present the 2021 QCOR Interventional Cardiology Audit, the eighth of its kind and first as Chair of this committee. Following another challenging and extraordinary year for the provision of healthcare in Queensland, 2021 yet again demonstrated the quality of care that our health system is capable of delivering. The continuous and rapidly evolving effects of the COVID-19 pandemic has required cardiology departments across the state to operate with agility and react with varied approaches at times across Hospital and Health Services to care for Queenslanders. Nonetheless, it is reassuring to know that despite the pressures and challenges presented during the COVID-19 pandemic the provision of care to Queenslanders remains at an extremely high standard as clinical indicators and all outcome measures remain stable, are improving or exceeding benchmarks.

Interventional cardiology services exist in a dynamic and ever-changing environment, which is often pressured by the increasing needs of the community and challenged by a complex healthcare environment. With this challenge comes the opportunity to continue to embrace, drive and apply the use of data. By informing business cases for new services and assisting with future planning and future-proofing the health system, the various data presented in this, and previous reports have proved to be invaluable in moving Queensland public cardiology services forward.

Access to quality and real-time data has never been more relevant and important to the provision of healthcare. Through a concerted effort of clinicians, data managers and the QCOR team, the reporting of clinical quality and indicators of the process of care will be more readily available to stakeholders who are responsible for monitoring and improving care. Through an iterative approach that has quality and relevance as its core ethos, this new functionality will serve to further improve clinical care and performance.

In this Audit, QCOR has continued its work to explore interhospital transfer efficiency for patients with NSTEMI by reporting patient flow and time taken from a presentation at the originating facility to undergoing invasive investigation. By understanding where opportunities for improvement exist, we can better plan and work to implement strategies to improve care for this group of Queenslanders who often reside in regional and remote locations.

Looking forward, we keenly await the delivery of a contemporary statewide cardiovascular information system for diagnostic and interventional cardiology and echocardiography services. This project will be one of the largest generational opportunities for enhancing data collection for cardiology in Queensland and will enable the reporting of new quality metrics and indicators while providing a valuable clinical tool for information sharing and improving the quality of care.

These efforts outline a whole-of-system approach to achieving quality and safe cardiac care for all Queenslanders. We continue to partner with national registries to use the learnings in Queensland to assist with moving forward with these high-value initiatives. There are many synergies in this space that enable all participants to learn from others and apply those learnings to local jurisdictions.

Dr Rohan Poulter
Chair
QCOR Interventional Cardiology Committee

2 Key findings

The Interventional Cardiology Audit describes key aspects of the care and treatment of cardiac patients receiving percutaneous coronary interventions (PCI) during 2021.

Key findings include:

- 15,443 diagnostic coronary or interventional cases were performed across the eight cardiac catheterisation laboratory (CCL) facilities in Queensland public hospitals, including 4,894 PCI cases.
- 77% of all PCI patients residing in Queensland had a place of residence within 50 km of the nearest public PCI capable facility, while 11% of patients resided more than 150 km from the nearest facility.
- A large proportion of PCI patients (79%) were classed as having an unhealthy body mass index (BMI) over 25 kg/m^2.
- The proportion of patients identified as Aboriginal and Torres Strait Islander (7.4%) illustrates a stepwise gradient based on geographical area, with the highest proportions found in the north of the state and lower proportions in the South East corner. This is consistent with previous analyses. The median age of Aboriginal and Torres Strait Islander patients was 10 years younger than non Aboriginal and Torres Strait Islander patients.
- The majority of PCI cases (78%) were classed as urgent, emergent or salvage, highlighting the acute and often unstable patient cohort.
- There were 1,560 PCI cases following presentation with ST elevation myocardial infarction (STEMI), of which 58% were managed by primary PCI.
- There was a total of 401 thrombolysed STEMI presentations, for whom the median time from first diagnostic electrocardiograph (ECG) to the administration of thrombolysis was 34 minutes. The median time from thrombolysis to coronary angiography was 16 hours, with 70% of cases receiving angiography within 24 hours.
- Median time to reperfusion from first diagnostic ECG for STEMI patients presenting within six hours of symptom onset was 83 minutes (range 69 minutes to 90 minutes across sites).
- Median hospital door-to-device time for STEMI patients presenting within six hours of symptom onset was 39 minutes (range 32 minutes to 58 minutes across sites).
- PCI for non-ST elevation myocardial infarction (NSTEMI) represented 29% of all cases, with the median time to angiography of 46 hours. Patients presenting to a non PCI capable facility have a median wait time to coronary angiography of 32 hours longer than those who present directly to a PCI capable facility (63 hours vs. 31 hours).
- Mortality within 30 days following PCI was 1.8% (89 deaths). Of these 89 deaths, 76% were classed as either salvage or emergency PCI.
- Of all cases, 0.84% recorded a major intra-procedural complication. Coronary artery perforation (0.63%) accounted for the majority of these events.
- Radiation doses were found to be under the high dose threshold in 98.7% of PCI cases across all sites and 99.9% of other coronary procedures.

3 Participating sites

There were eight public hospitals which offered CCL services across metropolitan and regional Queensland.

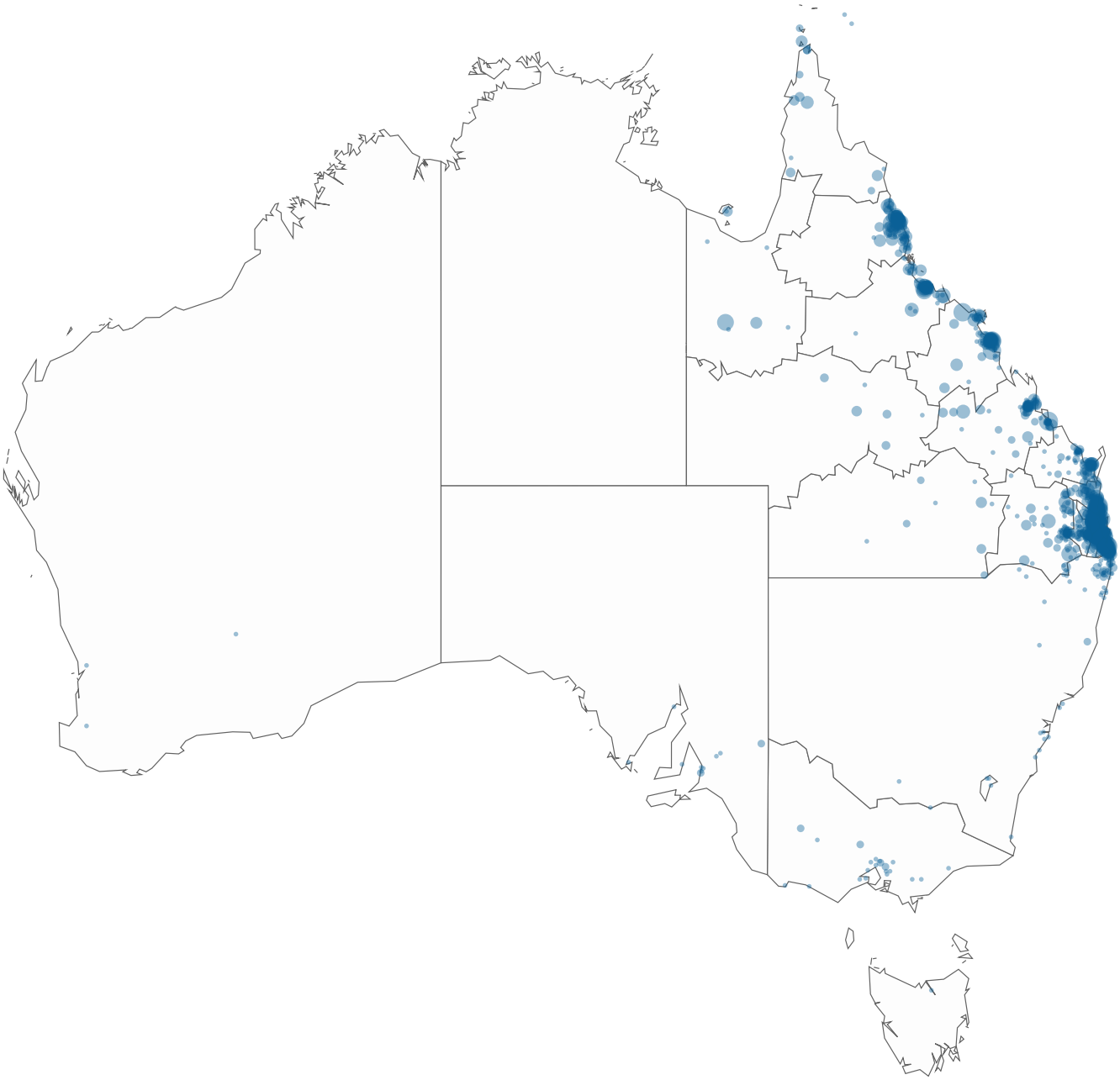


Figure 1: Statewide PCI cases by patient place of usual residence (by residential postcode)

Table 1: Participating sites

Acronym	Site name
CH	Cairns Hospital
TUH	Townsville University Hospital
MBH	Mackay Base Hospital
SCUH	Sunshine Coast University Hospital
TPCH	The Prince Charles Hospital
RBWH	Royal Brisbane & Women's Hospital
PAH	Princess Alexandra Hospital
GCUH	Gold Coast University Hospital

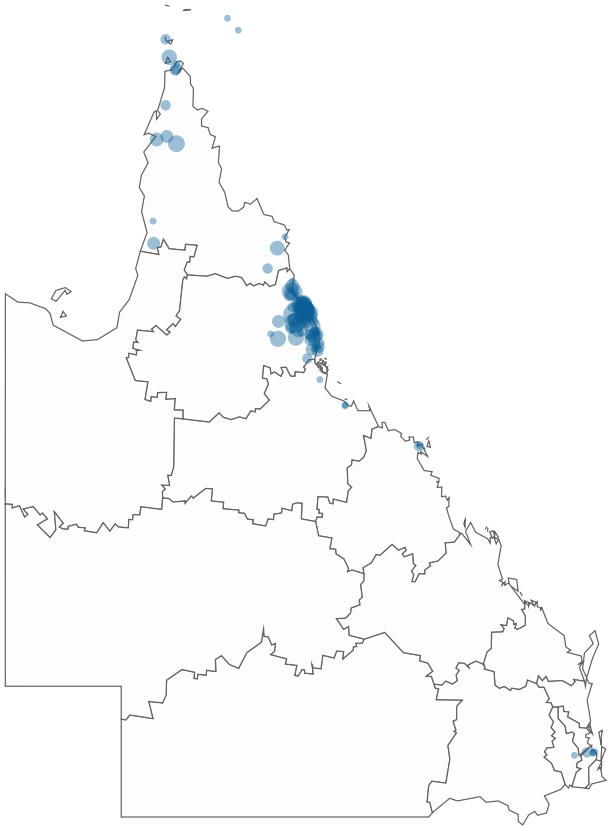


Figure 2: Cairns Hospital

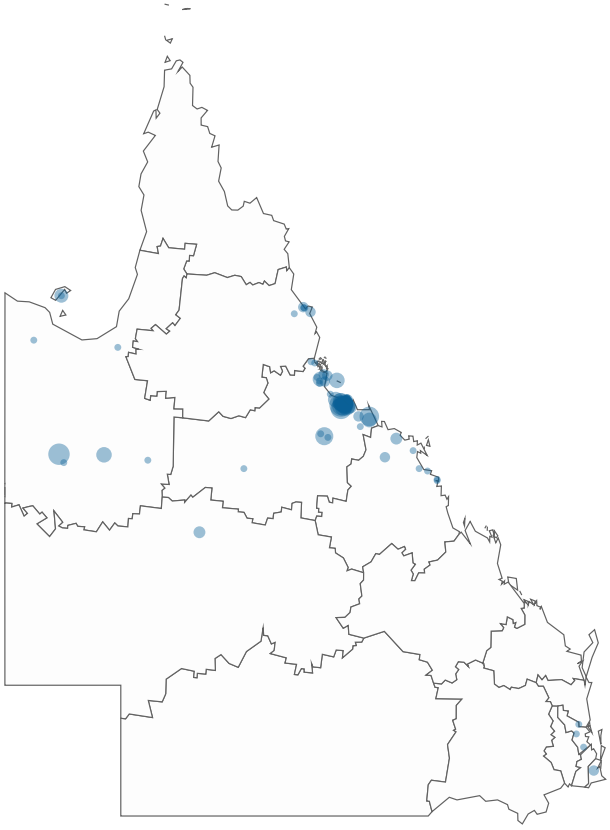


Figure 3: Townsville University Hospital

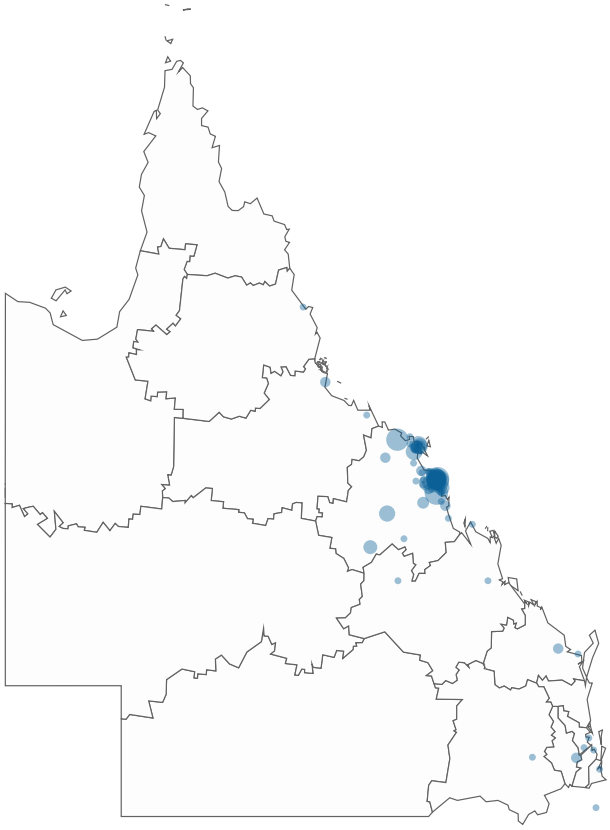


Figure 4: Mackay Base Hospital

Figure 5: Sunshine Coast University Hospital

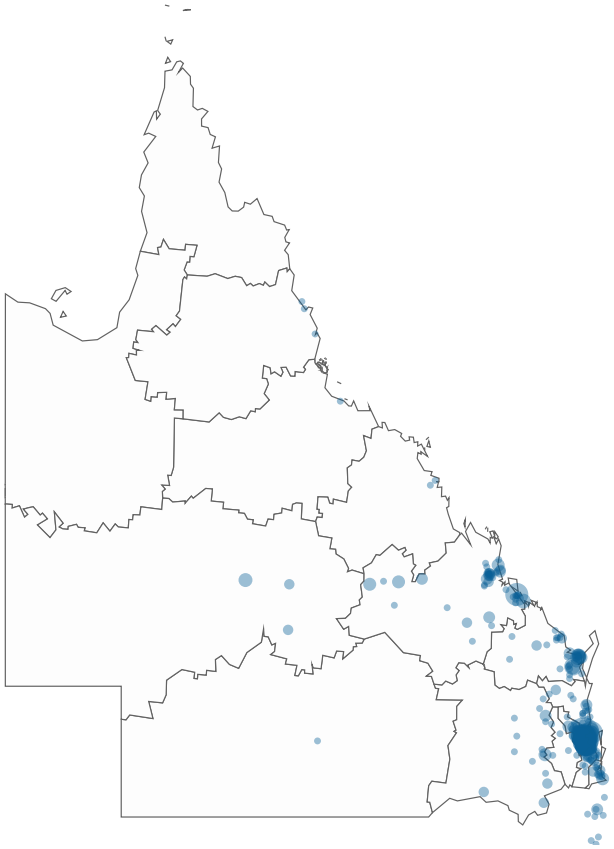


Figure 6: The Prince Charles Hospital

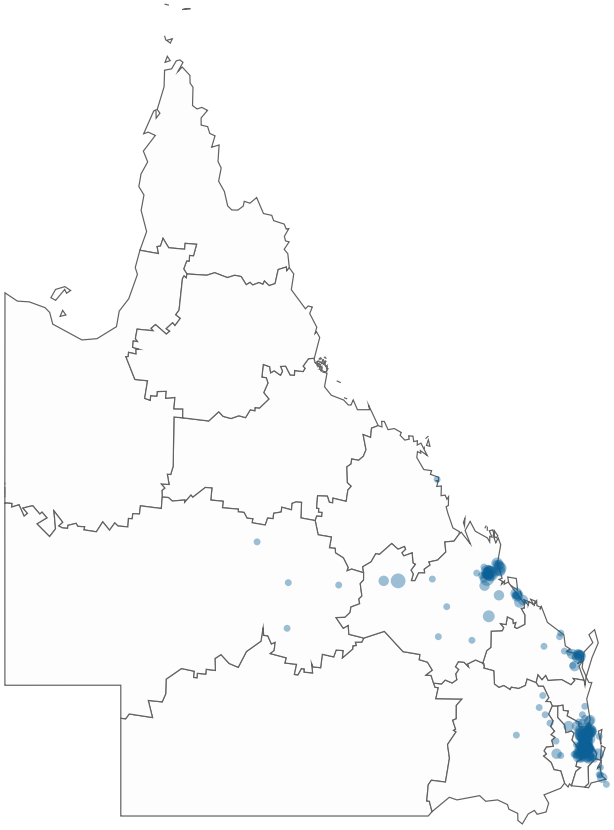


Figure 7: Royal Brisbane & Women's Hospital

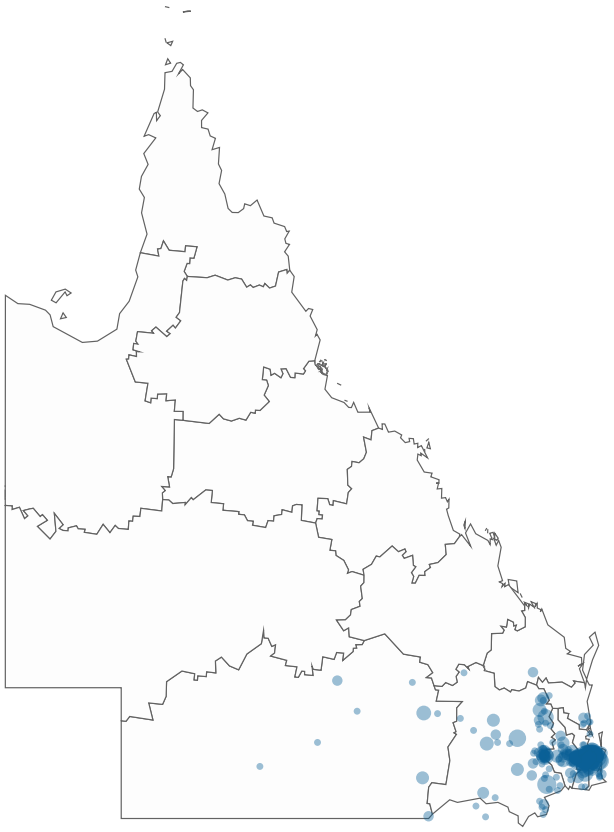


Figure 8: Princess Alexandra Hospital

Figure 9: Gold Coast University Hospital

4 Total coronary cases

A total of 15,443 coronary cases were performed across the eight contributing cardiac catheterisation sites, with 4,894 patients (32%) undergoing a PCI. These patients form the cohort at the centre of this Audit.

Since the focus of this report is a specialised subset of invasive cardiology cases performed in the CCL, non coronary procedures such as right heart catheterisation, right ventricular cardiac biopsy and peripheral intervention cases are excluded from analysis.

In addition, detail for 485 structural heart disease interventions including percutaneous valve replacement, valvuloplasty and device closure procedures is included as a supplement to this Audit. Furthermore, Queensland electrophysiology and pacing procedure activity is included in a separate Audit within the QCOR Annual Report.

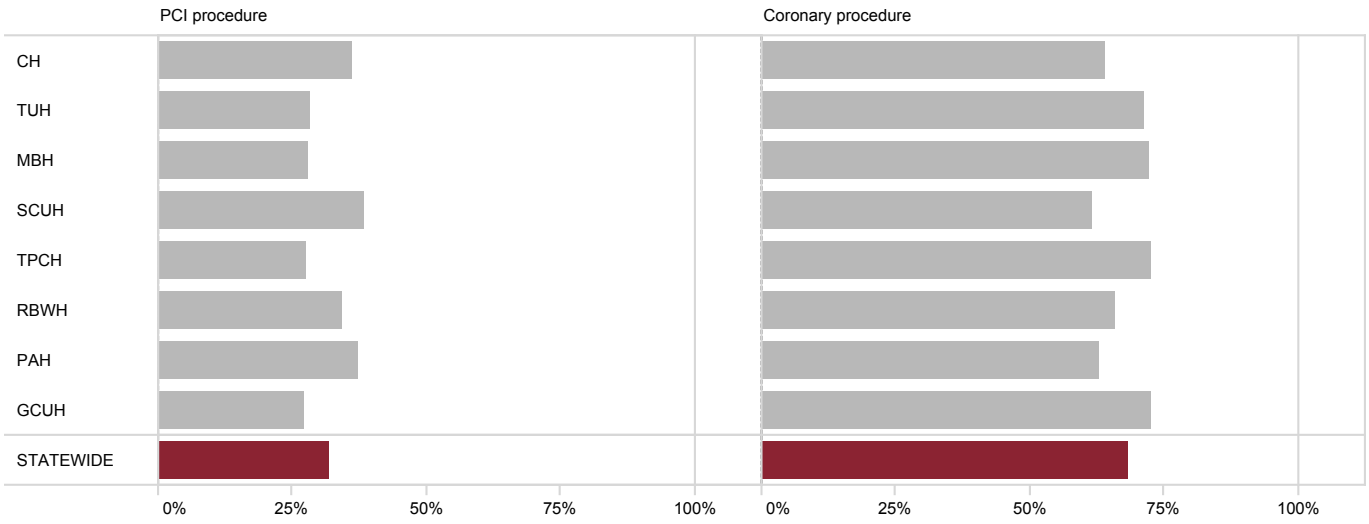


Figure 10: Proportion of cases by procedure category

Table 2: Total cases by procedure category

Site	PCI procedure* n (%)	Other coronary procedure† n (%)	Total coronary cases n
CH	536 (36.1)	950 (63.9)	1,486
TUH	361 (28.5)	906 (71.5)	1,267
MBH	332 (27.9)	856 (72.1)	1,188
SCUH	528 (38.5)	845 (61.5)	1,373
TPCH	1,007 (27.5)	2,657 (72.5)	3,664
RBWH	430 (34.1)	831 (65.9)	1,261
PAH	1,062 (37.1)	1,804 (62.9)	2,866
GCUH	638 (27.3)	1,700 (72.7)	2,338
STATEWIDE	**4,894 (31.7)**	**10,549 (68.3)**	**15,443**

* Includes balloon angioplasty, coronary stenting, PTCRA/atherectomy, coronary lithotripsy and thrombectomy of coronary arteries

† Includes coronary angiography, aortogram, coronary artery bypass graft study, left ventriculography, left heart catheterisation, coronary fistula embolisation, intravascular ultrasound, optical coherence tomography, and pressure derived indices for assessing coronary artery stenosis

4.1 Total cases by clinical presentation

Within the larger cohort, the most common presentation category was of NSTEMI, while STEMI cases represented 12% of all cases, and 32% of all PCI cases.

The most common clinical presentation across all cases was acute coronary syndrome (ACS), which accounted for approximately one third of all cases (32%). The majority of PCI procedures undertaken were categorised as either STEMI or NSTEMI (61%).

Clinical presentation is derived from the procedural indication and reflects the diagnosis made with respect to the findings of the investigation/procedure. It must be acknowledged that there is some degree of variation in practice across sites which is a focus for future work.

Table 3: Total coronary cases by clinical presentation category

Site	STEMI n (%)	NSTEMI n (%)	Other n (%)
CH	171 (11.5)	303 (20.4)	1,012 (68.1)
TUH	108 (8.5)	233 (18.4)	926 (73.1)
MBH	78 (6.6)	163 (13.7)	947 (79.7)
SCUH	259 (18.9)	306 (22.3)	808 (58.8)
TPCH	339 (9.3)	592 (16.2)	2,733 (74.6)
RBWH	156 (12.4)	342 (27.1)	763 (60.5)
PAH	517 (18.0)	779 (27.2)	1,570 (54.8)
GCUH	287 (12.3)	373 (16.0)	1,678 (71.8)
STATEWIDE	**1,915 (12.4)**	**3,091 (20.0)**	**10,437 (67.6)**

Table 4: PCI cases by clinical presentation category

Site	STEMI n (%)	NSTEMI n (%)	Other n (%)
CH	143 (26.7)	185 (34.5)	208 (38.8)
TUH	85 (23.5)	79 (21.9)	197 (54.6)
MBH	68 (20.5)	59 (17.8)	205 (61.7)
SCUH	210 (39.8)	128 (24.2)	190 (36.0)
TPCH	281 (27.9)	260 (25.8)	466 (46.3)
RBWH	116 (27.0)	181 (42.1)	133 (30.9)
PAH	422 (39.7)	380 (35.8)	260 (24.5)
GCUH	235 (36.8)	164 (25.7)	239 (37.5)
STATEWIDE	**1,560 (31.9)**	**1,436 (29.3)**	**1,898 (38.8)**

4.2 Place of residence

The vast majority of PCI patients (97%) had a usual place of residence within Queensland, with a smaller proportion originating from interstate (3%) and overseas (<1%). For the Gold Coast University Hospital, 14% of cases originated from outside of Queensland.

Patients came from a wide geographical area with a large proportion of patients residing on the Eastern Seaboard. Almost three quarters (74%) of all patients were seen inside their local Hospital and Health Service (HHS). Of those patients residing in Queensland, the majority (77%) had a usual place of residence within 50 kilometres of the nearest public PCI facility. While this proportion is high, it must be acknowledged that access to PCI services for a large number of Queenslanders involves considerable distance and travel.

Table 5: PCI cases by place of usual residence category

Site	Queensland %	Within HHS %	Interstate %	Overseas %
CH	96.8	85.4	3.2	–
TUH	97.8	80.3	2.2	–
MBH	99.7	94.6	0.3	–
SCUH	99.1	83.1	0.8	0.2
TPCH	98.7	69.9	1.3	–
RBWH	98.4	50.2	1.4	0.2
PAH	99.1	63.2	0.8	0.1
GCUH	86.5	80.8	13.3	0.2
STATEWIDE	**97.0**	**73.7**	**2.9**	**0.1**

Excludes missing data (<0.1%)

Table 6: Queensland PCI cases by distance from usual place of residence to nearest public PCI facility

Site	<50 km %	50–150 km %	>150 km %
CH	65.3	25.1	9.7
TUH	70.0	17.0	13.0
MBH	70.4	17.2	12.4
SCUH	73.3	18.8	7.9
TPCH	78.0	5.1	16.9
RBWH	67.6	3.1	29.3
PAH	80.3	13.6	6.0
GCUH	99.3	0.4	0.4
STATEWIDE	**77.0**	**11.7**	**11.3**

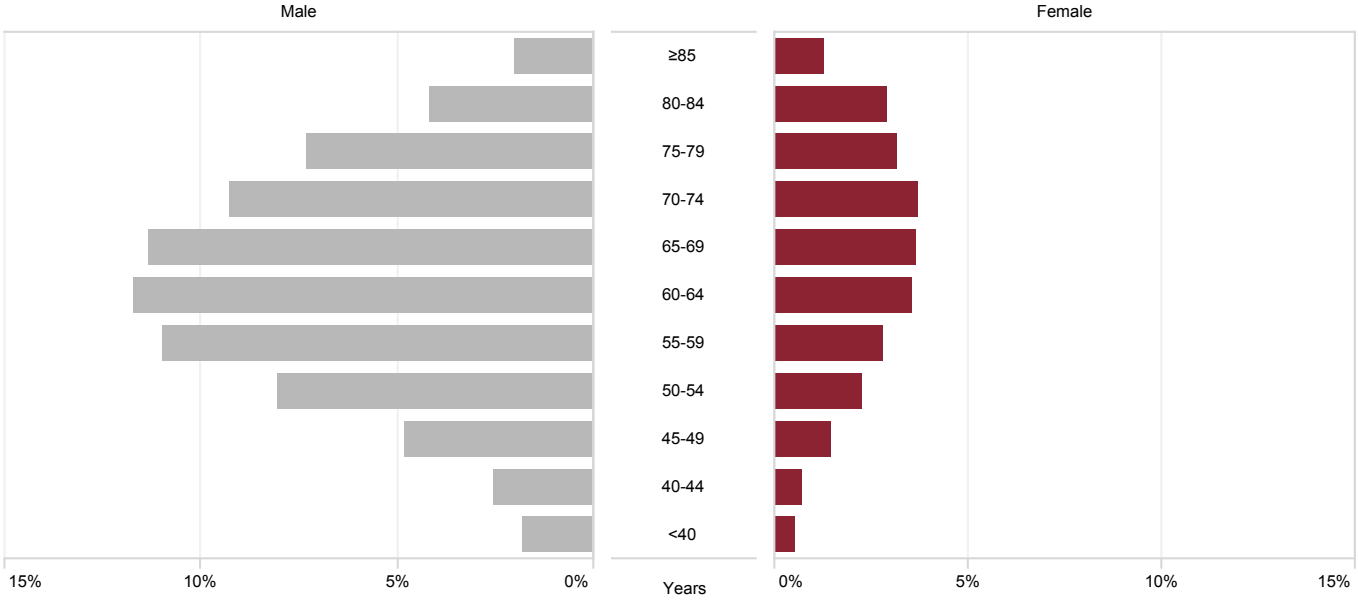
Excludes missing data (0.3%)

5 Patient characteristics

5.1 Age and gender

Age is a well described risk factor in the development of cardiovascular disease. The median age of patients undergoing PCI was 65 years of age and ranged from 62 years to 67 years across sites.

The majority of patients were male (74%), which reflects the increased risk of cardiovascular disease by gender. The median age for females was also higher than for males (68 years vs. 64 years).



% of total PCI (n=4,894)

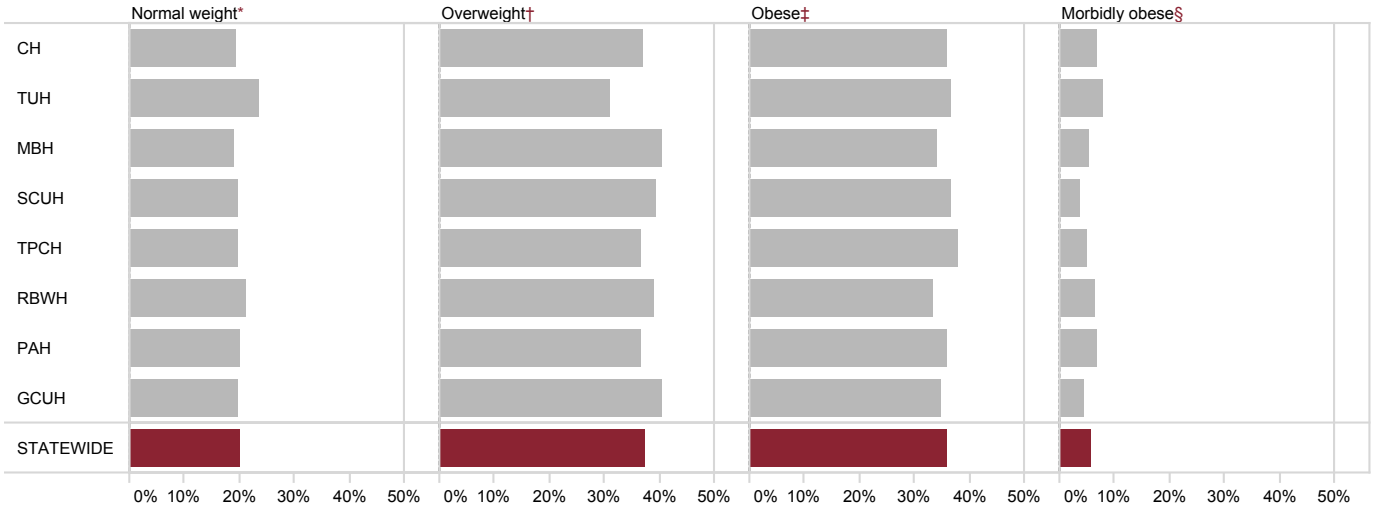
Figure 11: Proportion of all PCI cases by gender and age group

Table 7: Median PCI patient age by gender and site

Site	Male years	Female years	All years
CH	63	64	64
TUH	62	63	63
MBH	66	70	67
SCUH	65	70	66
TPCH	65	72	67
RBWH	62	61	62
PAH	62	64	63
GCUH	65	69	66
STATEWIDE	**64**	**68**	**65**

5.2 Body mass index

Patients across all sites displayed similar trends for BMI, with one fifth of patients (20%) in the normal BMI range and 38%, 36% and 6% classified as overweight, obese and morbidly obese respectively. There were 1% of cases classified as underweight (BMI <18.5 kg/m²).



Excludes missing/invalid data (0.2%)

* BMI 18.5–24.9 kg/m²

† BMI 25.0–29.9 kg/m²

‡ BMI 30.0–39.9 kg/m²

§ BMI ≥40.0 kg/m²

Figure 12: Proportion of all PCI cases by body mass index category

Table 8: All PCI cases by body mass index category

Site	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
CH	9 (1.7)	102 (19.1)	197 (36.8)	191 (35.7)	36 (6.7)
TUH	4 (1.1)	84 (23.3)	112 (31.0)	132 (36.6)	29 (8.0)
MBH	4 (1.2)	63 (19.0)	134 (40.4)	113 (34.0)	18 (5.4)
SCUH	5 (0.9)	103 (19.5)	208 (39.4)	193 (36.6)	19 (3.6)
TPCH	9 (0.9)	197 (19.6)	367 (36.6)	379 (37.8)	51 (5.1)
RBWH	1 (0.2)	91 (21.2)	168 (39.1)	143 (33.3)	27 (6.3)
PAH	4 (0.4)	213 (20.1)	388 (36.6)	381 (35.9)	74 (7.0)
GCUH	6 (0.9)	124 (19.5)	256 (40.3)	221 (34.8)	28 (4.4)
STATEWIDE	**42 (0.9)**	**977 (20.0)**	**1,830 (37.5)**	**1,753 (35.9)**	**282 (5.8)**

Excludes missing data (0.2%)

5.3 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of health with a particular impact on the development of cardiovascular disease. It is recognised that the Aboriginal and Torres Strait Islander people experience high levels of health inequality resulting in a higher incidence and prevalence of coronary artery disease.[1]

The increased proportion of identified Aboriginal and Torres Strait Islander patients undergoing PCI in the northern HHSs (CH, 23% and TUH, 20%) is reflective of the resident population within these areas and should be noted for service provision and planning.

Despite accounting for only 4.6% of the Queensland population[2], Aboriginal and Torres Strait Islander patients are overrepresented in the PCI cohort across all sites (7.6%).

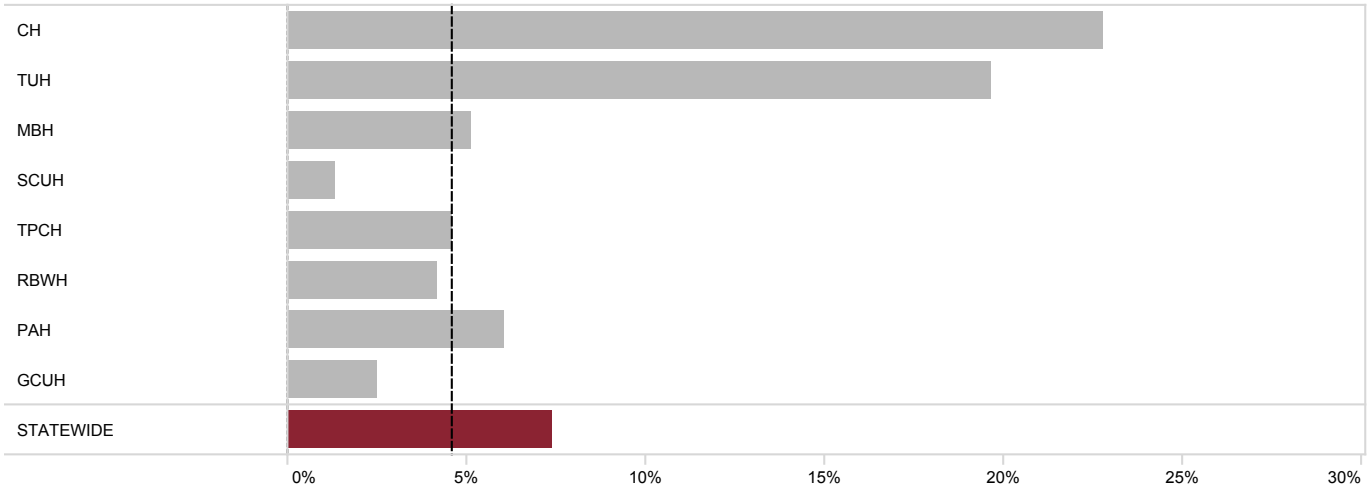


Figure 13: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

The median age of Aboriginal and Torres Strait Islander patients undergoing PCI was lower than that of non Aboriginal and Torres Strait Islander patients (55 years vs. 65 years).

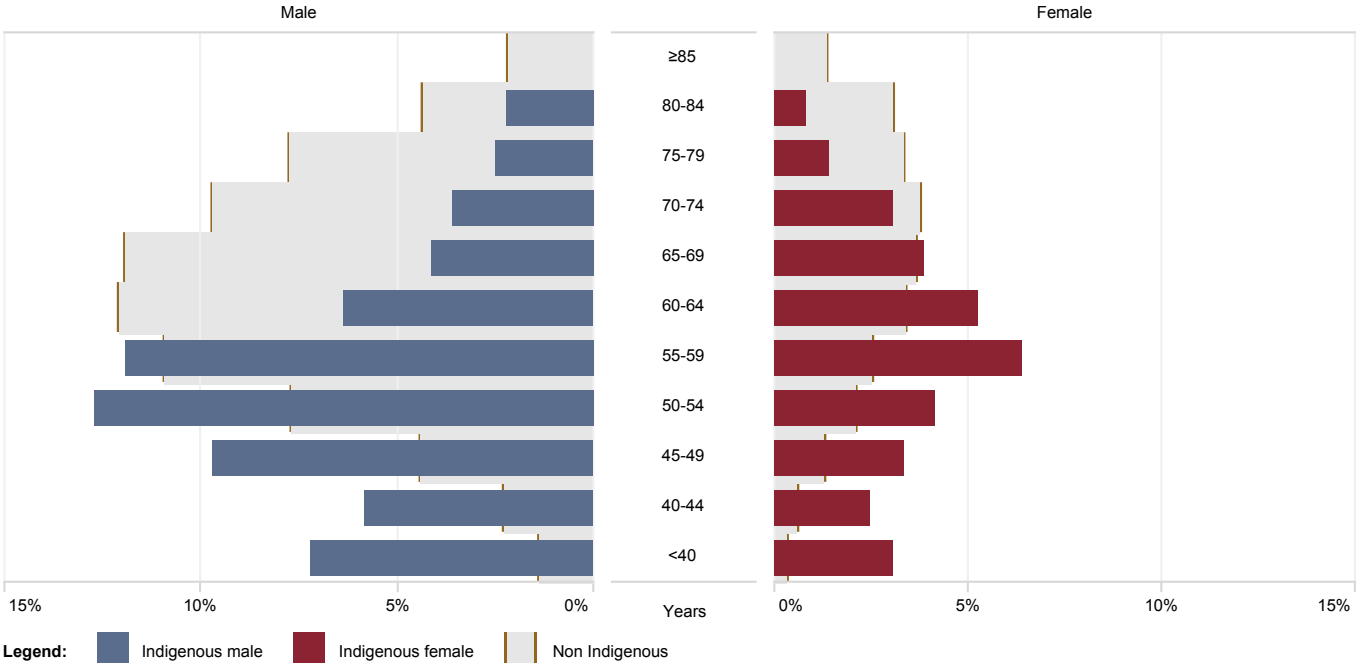


Figure 14: Proportion of all PCI cases by age group and Indigenous status

Table 9: PCI cases median patient age by gender and Indigenous status

	Male years	Female years	Total years
Aboriginal and Torres Strait Islander	54	58	55
Non Aboriginal and Torres Strait Islander	64	68	65
All	**64**	**68**	**65**

6 Care and treatment of PCI patients

6.1 Admission status

There were 4,894 PCI procedures performed in 2021 by the eight public sites across Queensland. Patients are categorised by admission status, with elective, urgent and emergency categories defined according to the National Cardiovascular Data Registry (NCDR) as stated below.[3]

From 2019, a contemporary definition of the salvage status was developed by the QCOR Interventional Cardiology Committee in order to best describe this subset of acutely ill patients who presented to Queensland public CCL services.

This definition expands on the previous NCDR classification to include the subset of patients who did not fit the strict salvage inclusion criteria but were indeed on a trajectory for a poor clinical outcome regardless of intervention.

Table 10: Diagnostic coronary angiography status

Status	Definition
Elective	The procedure can be performed on an outpatient basis or during a subsequent hospitalisation without significant risk of infarction or death. For stable inpatients, the procedure is being performed during this hospitalisation for convenience and ease of scheduling and not because the patient's clinical situation demands the procedure prior to discharge.
Urgent	The procedure is being performed on an inpatient basis and prior to discharge because of significant concerns that there is risk of ischaemia, infarction and/or death. Patients who are outpatients or in the emergency department at the time the cardiac catheterisation is requested would warrant an admission based on their clinical presentation.
Emergency	The procedure is being performed as soon as possible because of substantial concerns that ongoing ischaemia and/or infarction could lead to death. "As soon as possible" refers to a patient who is of sufficient acuity that you would cancel a scheduled case to perform this procedure immediately in the next available room during business hours, or you would activate the on call team were this to occur during off hours.
Salvage	The procedure is performed on a critically unwell patient with a high risk of imminent death from either a cardiac or non cardiac cause, and it is recognised that PCI may not change the outcome AND; The patient is in cardiogenic shock (SCAI Class C or greater[4]) when the PCI begins (i.e. at the time of the first guidewire or intracoronary device introduction into a coronary artery or bypass graft for the purpose of mechanical revascularisation) AND/OR; The patient has also received active cardiopulmonary resuscitation within the last ten minutes prior to the start of the case or during the diagnostic portion of the case, OR; The patient has been on unanticipated extracorporeal circulatory support (e.g. extracorporeal mechanical oxygenation) OR cardiopulmonary support that includes non elective intubation.

Urgent and emergent cases accounted for the majority (78%) of PCI cases, reflecting the acute and often complex case mix flowing to Queensland public hospitals.

Salvage cases varied between institutions, however these exceptional and highly complex clinical scenarios accounted for less than 2% of statewide PCI volume, ranging from 0.4% to 4.2% across sites.

Continued monitoring of the application of the recently developed salvage definition demonstrates a return to similar numbers to the 2018 audit (n=64, 1.3%), prior to the definition change.

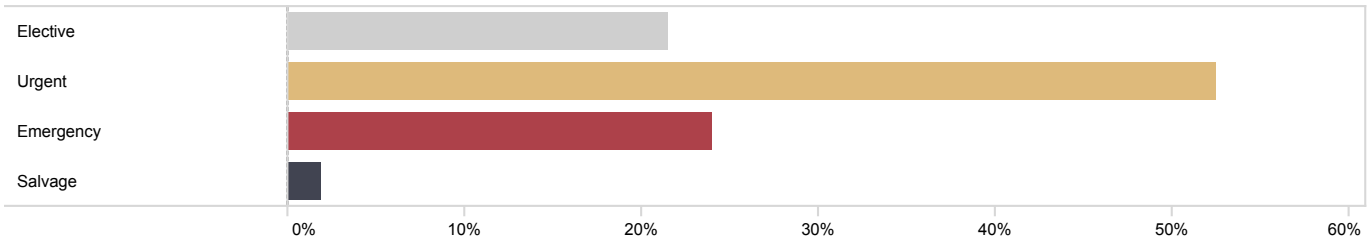


Figure 15: Proportion of all PCI cases by admission status

Table 11: PCI cases by site and admission status

Site	Elective n (%)	Urgent n (%)	Emergent n (%)	Salvage n (%)
CH	125 (23.3)	315 (58.8)	85 (15.9)	11 (2.1)
TUH	75 (20.8)	198 (54.8)	86 (23.8)	2 (0.6)
MBH	150 (45.2)	129 (38.9)	51 (15.4)	2 (0.6)
SCUH	102 (19.3)	272 (51.5)	152 (28.8)	2 (0.4)
TPCH	294 (29.2)	473 (47.0)	229 (22.7)	11 (1.1)
RBWH	63 (14.7)	269 (62.6)	85 (19.8)	13 (3.0)
PAH	143 (13.5)	620 (58.4)	276 (26.0)	23 (2.2)
GCUH	107 (16.8)	294 (46.1)	210 (32.9)	27 (4.2)
STATEWIDE	**1,059 (21.6)**	**2,570 (52.5)**	**1,174 (24.0)**	**91 (1.9)**

6.2 Stent usage

The majority of PCI cases (93%) involved the deployment of one or more stents, which ranged from 90% to 96% of PCI cases between centres. The mean number of stents deployed for each case was 1.5.

Table 12: Mean number of stents used for PCI cases by site

Site	Total stenting cases n	Proportion of PCI cases %	Mean stents per case n
CH	484	90.3	1.49
TUH	346	95.8	1.39
MBH	299	90.1	1.37
SCUH	500	94.7	1.80
TPCH	921	91.5	1.39
RBWH	405	94.2	1.57
PAH	998	94.0	1.53
GCUH	586	91.8	1.41
STATEWIDE	**4,539**	**92.7**	**1.50**

6.3 Access route

The majority of PCI cases (93%) used a single access route, with 80% being via the radial approach and 26% femoral. Another access route including brachial or ulnar was utilised in less than 1% of cases. The use of the radial approach varied between different PCI centres (61% to 94%) which is a smaller range than observed in previous years and consistent with a trend toward increased radial access use.

Table 13: PCI access route by site

Site	Total PCI cases n	Radial approach %	Femoral approach %	Other approach %
CH	536	83.4	21.1	0.2
TUH	361	78.9	23.8	1.4
MBH	332	90.4	12.7	0.6
SCUH	528	94.1	7.8	2.7
TPCH	1,007	82.3	28.8	0.2
RBWH	430	78.8	28.8	0.9
PAH	1,062	61.4	44.7	0.1
GCUH	638	85.7	18.8	0.5
STATEWIDE	**4,894**	**79.6**	**26.4**	**0.7**

Totals >100% due to multiple access sites

Table 14: PCI total access routes by site

Site	Single approach %	Multiple approaches %
CH	95.3	4.7
TUH	95.8	4.2
MBH	96.4	3.6
SCUH	95.6	4.4
TPCH	88.7	11.3
RBWH	91.4	8.6
PAH	93.8	6.2
GCUH	95.0	5.0
STATEWIDE	**93.4**	**6.6**

There was minimal variation observed between access routes in the overall PCI cohort and the STEMI presenting within six hours of symptom onset cohort (26.4% vs. 25.5% respectively).

The trend towards utilising the radial approach for patients with STEMI presenting within six hours of symptom onset continues from previous years.

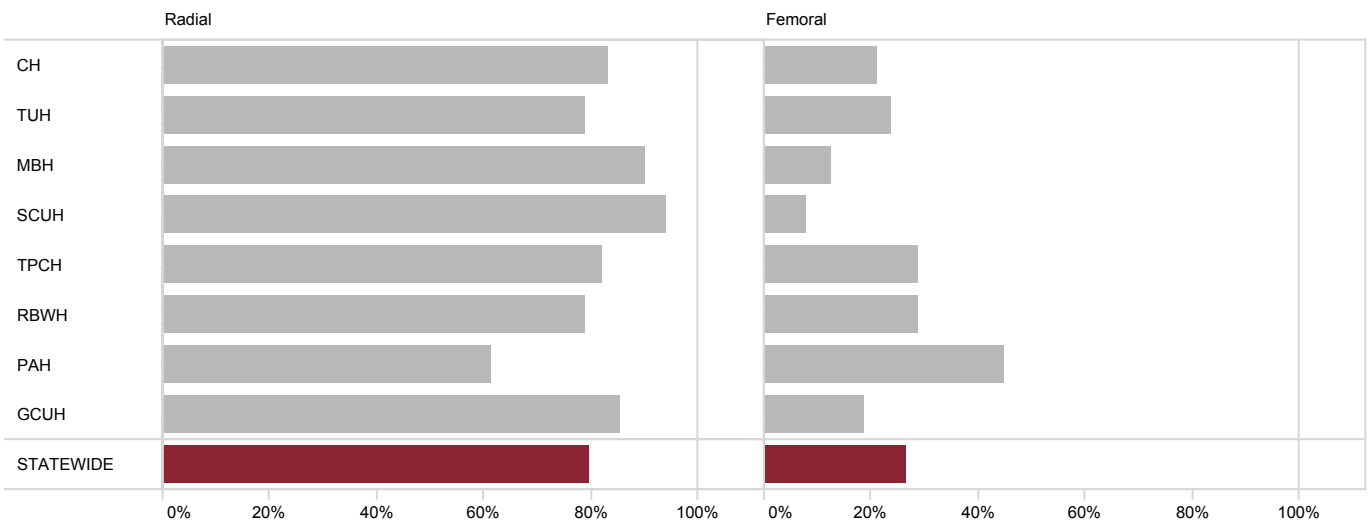


Figure 16: Proportion of PCI cases using radial and femoral access routes by site

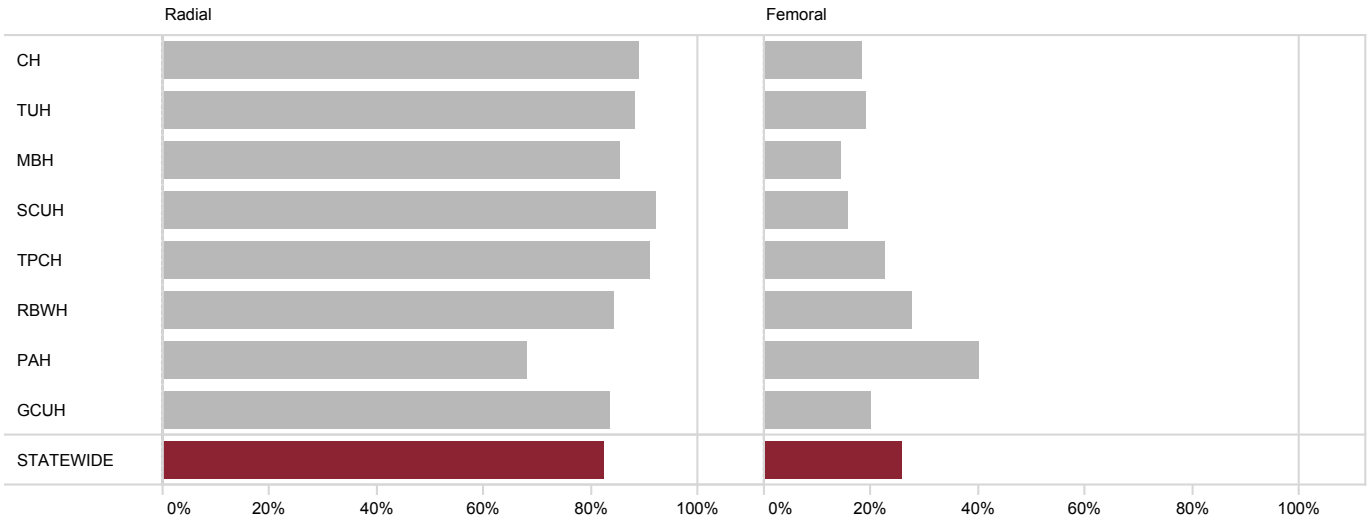


Figure 17: Proportion of STEMI presenting within six hours PCI cases using radial and femoral access routes by site

6.4 Vessels treated

The vast majority of vessels treated were native vessels with coronary bypass graft PCI accounting for less than 3% of interventions.

Of the vessels treated, 46% of cases involved the left anterior descending coronary artery (LAD), followed by the right coronary artery (RCA) at 36%, the circumflex coronary artery (LCx) at 25% and the left main coronary artery (LMCA) at 4%.

Multi-vessel PCI to native coronary arteries was performed in 11% of cases.

Table 15: Grafts and vessels treated by site

Site	LAD %	LMCA %	LCx %	RCA %	Graft %
CH	48.7	2.2	24.4	31.7	2.2
TUH	49.3	3.3	23.5	29.6	1.4
MBH	45.5	3.0	25.9	28.0	2.1
SCUH	46.6	5.1	26.5	38.4	1.3
TPCH	46.9	4.7	21.9	38.0	4.8
RBWH	43.7	0.5	30.5	34.2	1.6
PAH	41.9	5.1	25.8	38.3	2.1
GCUH	46.6	3.1	21.2	36.5	3.0
STATEWIDE	**45.7**	**3.8**	**24.6**	**35.6**	**2.6**

Table 16: Total native vessels treated by site

Site	Single vessel n (%)	Two vessels n (%)	Three or more vessels n (%)
CH	479 (91.4)	40 (7.6)	5 (1.0)
TUH	329 (93.5)	20 (5.7)	3 (0.9)
MBH	309 (95.1)	15 (4.6)	1 (0.3)
SCUH	448 (86.0)	56 (10.7)	17 (3.3)
TPCH	820 (85.7)	120 (12.5)	17 (1.8)
RBWH	382 (90.3)	38 (9.0)	3 (0.7)
PAH	925 (88.9)	92 (8.8)	23 (2.2)
GCUH	564 (91.1)	46 (7.4)	9 (1.5)
STATEWIDE	**4,256 (89.4)**	**427 (9.0)**	**78 (1.6)**

Excludes any graft PCI (n=127)

Table 17: Grafts treated by site

Site	Graft only n (%)	Graft and native vessel/s n (%)
CH	12 (100.0)	–
TUH	5 (100.0)	–
MBH	7 (100.0)	–
SCUH	5 (71.4)	2 (28.6)
TPCH	36 (75.0)	12 (25.0)
RBWH	6 (85.7)	1 (14.3)
PAH	21 (95.5)	1 (4.5)
GCUH	17 (89.5)	2 (10.5)
STATEWIDE	**109 (85.8)**	**18 (14.2)**

6.5 PCI following presentation with STEMI

Acute STEMI is a recognised medical emergency in which time to treatment is critical to both short and long term patient outcomes. PCI capable hospitals have therefore developed rapid triage and transfer strategies to fast-track STEMI patients into the CCL for rapid mechanical revascularisation (primary PCI).

Choice of reperfusion method depends on many factors including the timeliness of treatment, individual patient characteristics and access to interventional facilities. Given the time-critical nature of this condition, ongoing improvement and honing of hospital and pre-hospital processes is vital to meet the recommended timeframes for reperfusion in STEMI patients.

It is important to recognise there remains a group of STEMI patients who do not present to hospital or are conservatively managed, however this element of care is outside the scope of this procedure-based registry.

6.5.1 Clinical presentation

There were 1,560 documented STEMI PCI cases, with over half (58%) presenting as primary PCI cases and 12% presenting after 12 hours (late presenters).

Less than one fifth (19%) of patients had received thrombolysis prior to invasive coronary revascularisation including 6% requiring rescue PCI as thrombolysis had been unsuccessful.

Table 18: Proportion of STEMI PCI cases by presentation

Site	Transient STEMI n (%)	STEMI <6 hours n (%)	STEMI 6–12 hours n (%)	Late presentation n (%)	Post successful thrombolysis n (%)	Rescue PCI (failed thrombolysis) n (%)
CH	25 (17.5)	55 (38.5)	5 (3.5)	13 (9.1)	30 (21.0)	15 (10.5)
TUH	5 (5.9)	52 (61.2)	2 (2.4)	10 (11.8)	12 (14.1)	4 (4.7)
MBH	4 (5.9)	35 (51.5)	1 (1.5)	12 (17.6)	10 (14.7)	6 (8.8)
SCUH	32 (15.2)	91 (43.3)	9 (4.3)	23 (11.0)	35 (16.7)	20 (9.5)
TPCH	22 (7.8)	147 (52.3)	17 (6.0)	48 (17.1)	40 (14.2)	7 (2.5)
RBWH	11 (9.5)	65 (56.0)	4 (3.4)	19 (16.4)	11 (9.5)	6 (5.2)
PAH	56 (13.3)	219 (51.9)	26 (6.2)	34 (8.1)	60 (14.2)	27 (6.4)
GCUH	15 (6.4)	148 (63.0)	31 (13.2)	26 (11.1)	7 (3.0)	8 (3.4)
STATEWIDE	**170 (10.9)**	**812 (52.1)**	**95 (6.1)**	**185 (11.9)**	**205 (13.1)**	**93 (6.0)**

6.5.2 Admission pathway

After first medical contact, 69% of STEMI PCI patients were admitted directly to the treating centre.

As expected, admission pathway varied considerably by STEMI presentation. For thrombolysed and rescue PCI, there were 84% and 73% admitted via interhospital transfer respectively, whereas a large proportion (93%) of the STEMI presenting within six hours of symptom onset cohort presented directly to a PCI facility.

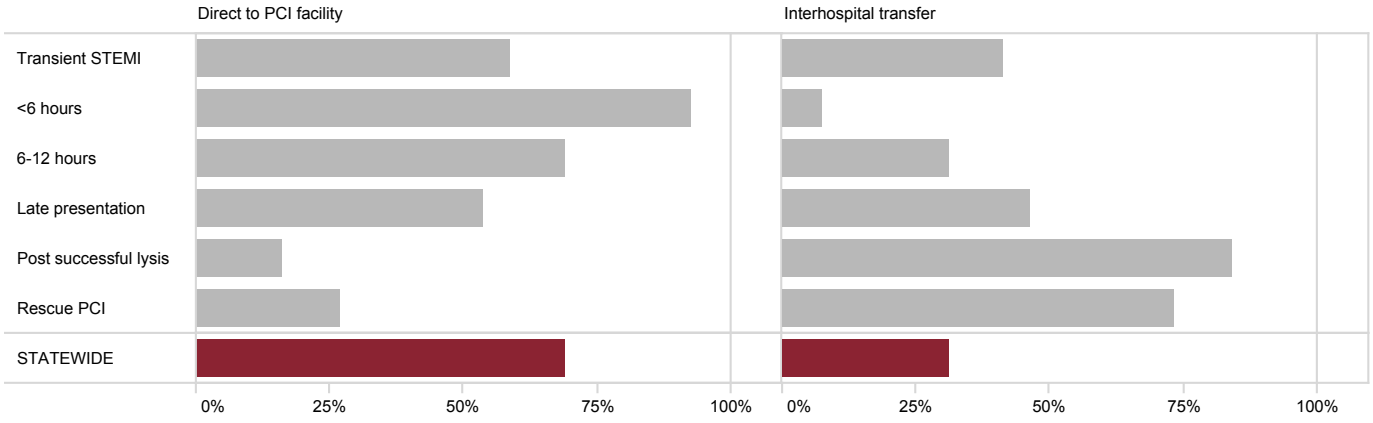


Figure 18: Proportion of STEMI PCI cases by admission pathway and clinical presentation

6.5.3 First medical contact

For STEMI cases presenting for PCI within six hours of symptom onset, most patients presented via the Queensland Ambulance Service (QAS) (83%), while a smaller proportion self-presented to the emergency department (ED) of either a PCI (on-site ED) or non PCI capable (satellite ED) facility (8% and 5% respectively). The remaining 4% presented to other health facilities such as GP clinics, community health centres or any other outpatient setting.

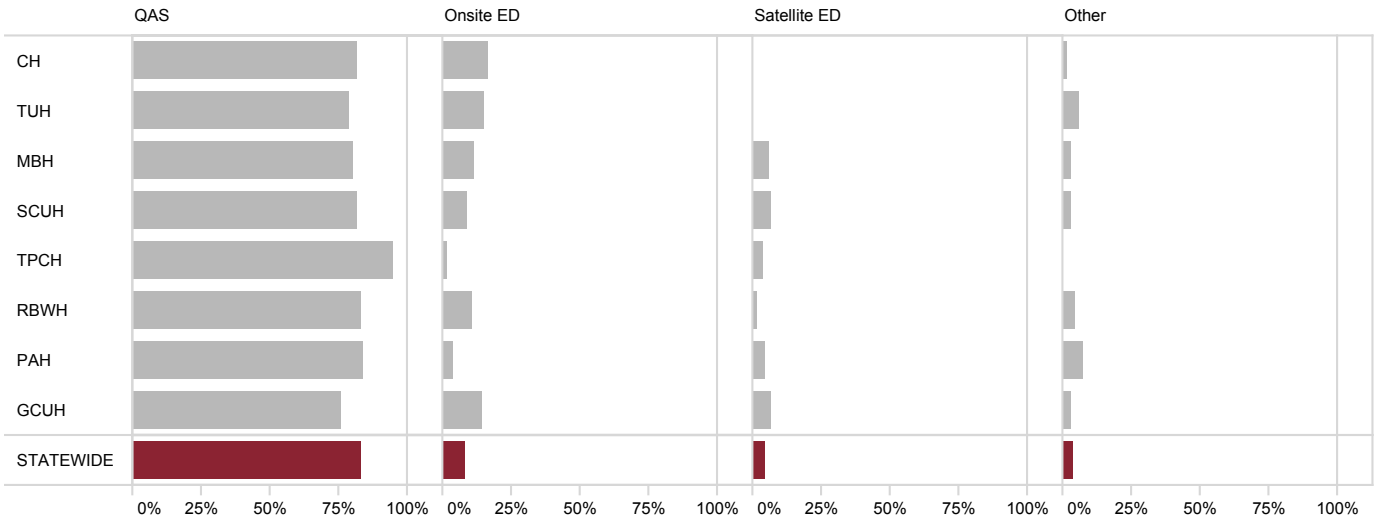


Figure 19: Proportion of STEMI PCI cases presenting within six hours of symptom onset by first medical contact

6.5.4 Thrombolysed patients

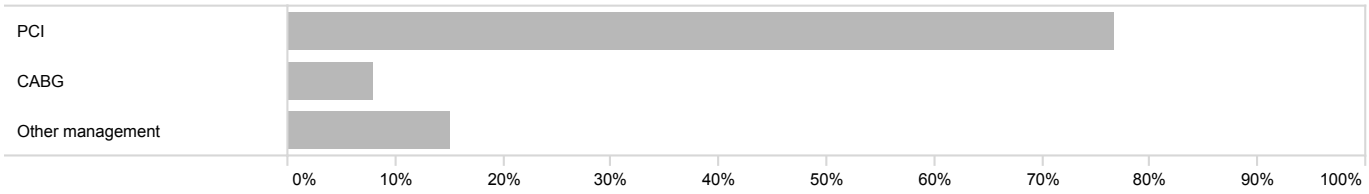
As mentioned above, the method of reperfusion depends on many factors which together determine the treatment method most appropriate for the particular presentation.

For patients presenting out of range of a PCI facility, thrombolytic therapy is highly effective and, unless medically contraindicated, is able to be administered in the field by attending paramedics or clinicians at a non PCI capable hospital.

There was a total of 401 thrombolysed STEMI presentations with the majority (74%) receiving a PCI, which increased to 77% when accounting for subsequent staged interventions within 90 days (Table 20). A smaller proportion (8%) went on to receive coronary artery bypass graft surgery (CABG) at a Queensland Health facility within 90 days.

Table 19: Total thrombolysed STEMI cases by tertiary cardiac centre

Site	Total thrombolysed STEMIs n	Receiving a PCI n (%)	Proportion of all PCI cases %
CH	59	45 (76.3)	8.4
TUH	24	16 (66.7)	4.4
MBH	20	16 (80.0)	4.8
SCUH	69	55 (79.7)	10.4
TPCH	59	47 (79.7)	4.7
RBWH	37	17 (45.9)	4.0
PAH	115	87 (75.7)	8.2
GCUH	18	15 (83.3)	2.4
STATEWIDE	**401**	**298 (74.3)**	**6.1**



PCI and CABG revascularisation not displayed (0.3%)

Figure 20: Proportion of thrombolysed patients by clinical management

Table 20: Thrombolysed patients by revascularisation method within 90 days

Site	PCI %	CABG %	PCI + CABG %	Other management* %
CH	81.5	7.4	1.9	9.3
TUH	70.8	8.3	0.0	20.8
MBH	80.0	0.0	0.0	20.0
SCUH	84.1	1.4	0.0	14.5
TPCH	80.4	5.4	0.0	14.3
RBWH	52.8	13.9	0.0	33.3
PAH	75.4	13.2	0.0	11.4
GCUH	83.3	5.6	0.0	11.1
STATEWIDE	**76.7**	**7.9**	**0.3**	**15.1**

* Includes medical management and transfer to a private or interstate facility

Overall, there were 401 thrombolysed STEMI patients who reached a public hospital CCL site in 2021. Substantially improved data quality this year sees 97% of this cohort eligible for analysis compared to 54% in 2018, 75% in 2019 and 85% in 2021.

Reassuringly, the median time from first diagnostic ECG (FdECG) to thrombolysis was similar across the patients receiving pre-hospital thrombolysis by QAS paramedics and the patients who presented directly to the thrombolysis facility (31 minutes vs. 32 minutes).

The patients in the other hospital thrombolysis group took a median of 52 minutes from FdECG to thrombolysis. The extended time delay likely representative of the travel time taken to arrive at a thrombolysis facility, noting Queensland's vast geography and rural and remote population.

Table 21: Definitions for STEMI time to thrombolysis

Time	Definition
First medical contact	The timestamp when the patient is initially assessed by a trained medical professional who can obtain and interpret an ECG and deliver initial interventions such as defibrillation. First medical contact (FMC) may occur in the hospital or pre-hospital setting.
First diagnostic ECG	First diagnostic ECG (FdECG) refers to the timestamp when the ECG shows ST-segment elevation. The interpretation of FdECG may be undertaken by ambulance personnel, general practitioner (GP) or hospital-based medical staff.
Time thrombolysis administered	The timepoint when thrombolytic therapy had been administered to the patient, which may be pre-hospital or in hospital.

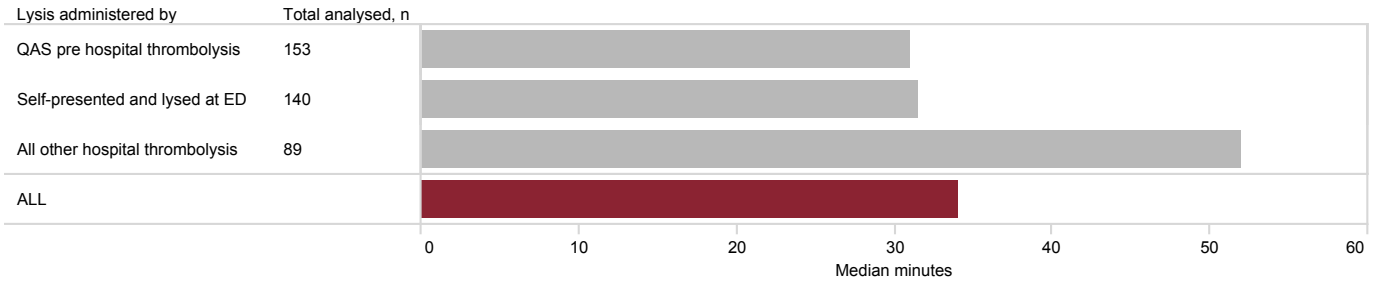
Table 22: Total thrombolysed STEMI cases by thrombolysis administration pathway

	Total thrombolysed STEMIs n	Total analysed n	Median FdECG to thrombolysis minutes	Interquartile range minutes
QAS pre-hospital thrombolysis	153	153	31	25–42
Self-presented and lysed at ED	147	140	32	21–58
Other pre-hospital thrombolysis*	5	5	N/A	N/A
All other hospital thrombolysis†	96	89	52	32–80
All	**401**	**387**	**34**	**24–56**

NA: Not displayed due to <20 cases for analysis

* Thrombolysed by Royal Flying Doctor Service or primary health care centre

† Includes initial presentation to QAS or GP and subsequent thrombolysis in hospital



Excludes other pre-hospital thrombolysis (n=5)

Figure 21: Median time from first diagnostic ECG to thrombolysis therapy by administration pathway

Figure 22: Thrombolysed STEMI interhospital transfers by estimated distance to transfer

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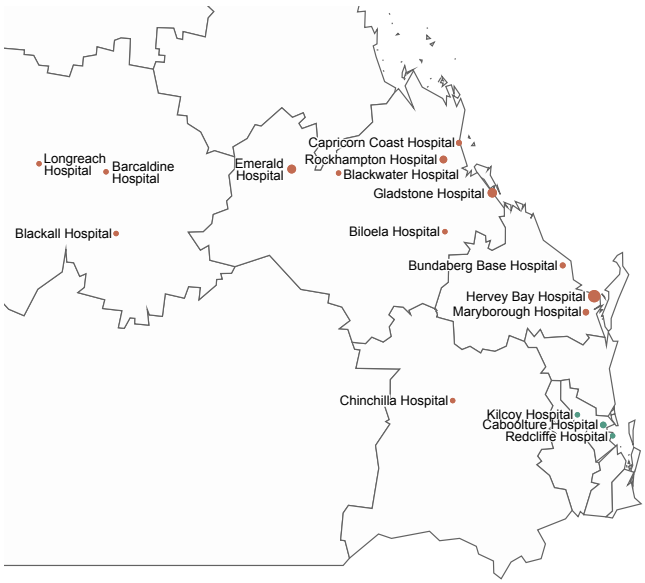
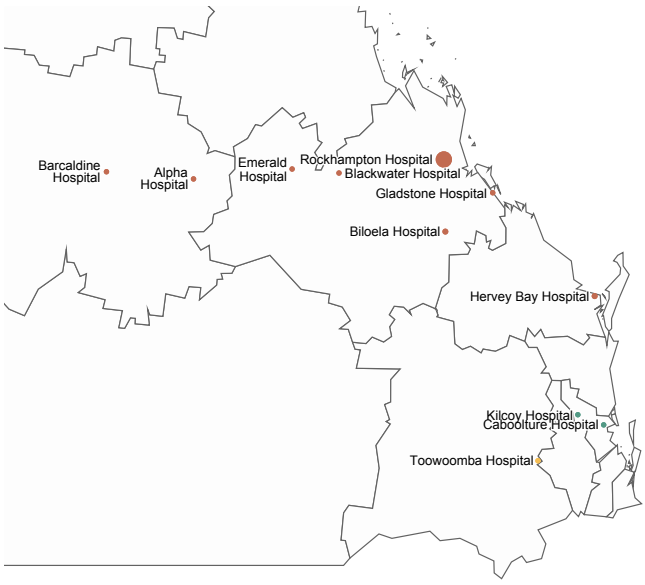
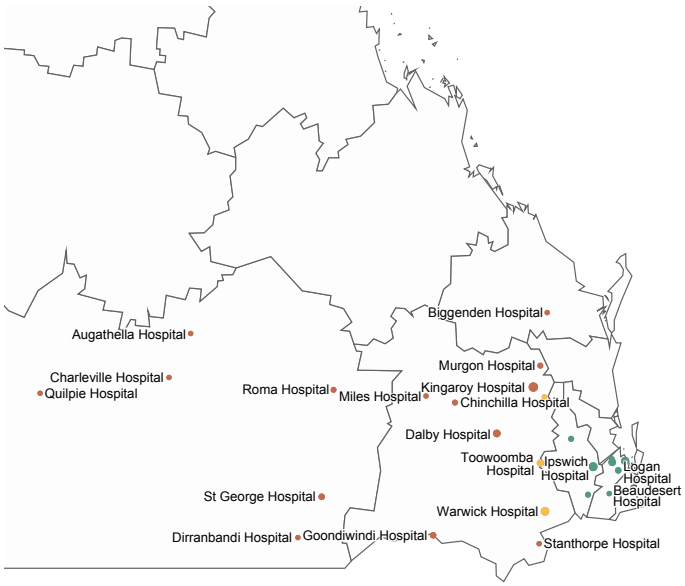


Inset B: The Prince Charles Hospital



Inset C: Royal Brisbane & Women's Hospital



Inset D: Princess Alexandra Hospital

Inset E: Gold Coast University Hospital

QAS has a well-defined set of contraindications for the administration of pre-hospital thrombolysis. There were 96 thrombolysed STEMI patients (24%) who were not indicated for pre-hospital thrombolysis based on QAS criteria but were subsequently eligible for thrombolysis based on Queensland public hospital guidelines. The most common reason for this was that the patient had been located within close proximity to a hospital (63%). A smaller proportion had been contraindicated for pre-hospital thrombolysis due to advanced age (16%), other comorbidity or complex clinical presentation (Table 23).

For the cohort of thrombolysed patients, the median time to angiography was 16 hours post thrombolysis with 70% of patients undergoing coronary angiography within 24 hours. The unadjusted all-cause mortality within 30 days for STEMI patients receiving thrombolysis was 2.2%.

Table 23: Thrombolysed patients not indicated for pre-hospital thrombolysis

	n (%)
Close proximity to hospital	60 (62.5)
Advanced age >75 years	15 (15.6)
Hypertensive	6 (6.3)
Prolonged pain duration >6 hours	5 (5.2)
GCS* <15	3 (3.1)
Recent surgery	2 (2.1)
Other	5 (5.2)
All	**96 (100.0)**

* Glasgow Coma Scale

Table 24: Median time from thrombolysis to angiography by site

Site	Total cases n	Total analysed n	Median time to angiography hours	Interquartile range hours	Met 24 hours target %
CH	59	49	15	4–29	69.4
TUH	24	24	12	4–18	83.3
MBH	20	20	8	4–19	75.0
SCUH	69	69	17	5–28	66.7
TPCH	59	57	12	6–22	86.0
RBWH	37	33	20	8–27	60.6
PAH	115	113	18	6–38	60.2
GCUH	18	18	8	4–20	77.8
STATEWIDE	**401**	**383**	**16**	**5–27**	**69.5**

Table 25: Unadjusted all-cause thrombolysed STEMI mortality within 30 days of procedure

	Total cases n	Total salvage n (%)	In-lab death n	In hospital death n	Post discharge to 30 days n	Total mortality n (%)
Post successful lysis	308	8 (2.6)	0	7	0	7 (2.3)
Rescue PCI	93	7 (7.5)	0	2	0	2 (2.2)
All	**401**	**15 (3.7)**	**0**	**9**	**0**	**9 (2.2)**

6.6 NSTEMI presentations

Of all PCI and coronary cases performed in CCLs during 2021, there were 3,091 coded with a procedural indication of NSTEMI. These cases accounted for 29% of all PCI cases across all centres, with site variation ranging from 18% to 42%. These figures are similar across the previous 2019 and 2020 patient cohorts.

Of patients presenting with NSTEMI, 47% were revascularised via PCI, which increased to 52% when accounting for staged interventions within 90 days of index presentation (Table 27). A further 15% underwent CABG, while the remainder were medically managed or referred outside of Queensland Health.

6.6.1 Case load

Table 26: NSTEMI cases by site

Site	Total NSTEMI cases n	NSTEMI receiving PCI n (%)	Proportion of all PCI cases %
CH	303	185 (61.1)	34.5
TUH	233	79 (33.9)	21.9
MBH	163	59 (36.2)	17.8
SCUH	306	128 (41.8)	24.2
TPCH	592	260 (43.9)	25.8
RBWH	342	181 (52.9)	42.1
PAH	779	380 (48.8)	35.8
GCUH	373	164 (44.0)	25.7
STATEWIDE	**3,091**	**1,436 (46.5)**	**29.3**

Table 27: NSTEMI patients by site and revascularisation method within 90 days

Site	PCI revascularisation %	CABG revascularisation %	PCI + CABG revascularisation %	Other management* %
CH	64.8	9.9	1.1	24.2
TUH	40.7	17.2	0.0	42.1
MBH	44.0	10.7	0.0	45.3
SCUH	51.9	14.0	0.3	33.8
TPCH	47.0	13.8	0.7	38.5
RBWH	56.0	12.7	0.9	30.4
PAH	53.2	16.3	0.1	30.4
GCUH	46.4	16.1	0.5	36.9
STATEWIDE	**51.0**	**14.3**	**0.5**	**34.2**

* Medical management or referred outside of Queensland Health

6.6.2 Admission source

Overall and similar to previous years, there were more NSTEMI cases where the patient was transferred from another facility than those presenting directly to the PCI centre (52% and 48% respectively). This presents many challenges for guideline adherence with many logistical considerations making target adherence for invasive coronary angiography difficult. These issues are explored further in the clinical indicators section of the Audit.

Considerable variation was observed between sites, with the proportion of interhospital transfers for NSTEMI ranging from 28% to 74%, largely explained by catchment area. Where higher volumes and larger median distances to PCI centres exist, it is reasonable to expect that the proportion of cases meeting targets would be smaller. Table 29 and Figure 23 provide perspective based on cases where geographical data were available.

Table 28: NSTEMI admission source to treating facility

Site	Direct to PCI facility n (%)	Interhospital transfer n (%)
CH	188 (62.0)	115 (38.0)
TUH	160 (68.7)	73 (31.3)
MBH	112 (68.7)	51 (31.3)
SCUH	154 (50.3)	152 (49.7)
TPCH	308 (52.0)	284 (48.0)
RBWH	90 (26.3)	252 (73.7)
PAH	211 (27.1)	568 (72.9)
GCUH	268 (71.8)	105 (28.2)
STATEWIDE	**1,491 (48.2)**	**1,600 (51.8)**

Table 29: NSTEMI interhospital transfers by estimated distance to transfer

Site	Total analysed n	Median kilometres	Interquartile range kilometres
CH	102	90	75–143
TUH	62	302	133–901
MBH	47	125	36–191
SCUH	144	35	30–93
TPCH	229	39	33–505
RBWH	220	231	45–567
PAH	521	27	24–122
GCUH	76	17	17–17
STATEWIDE	**1,401**	**45**	**27–192**

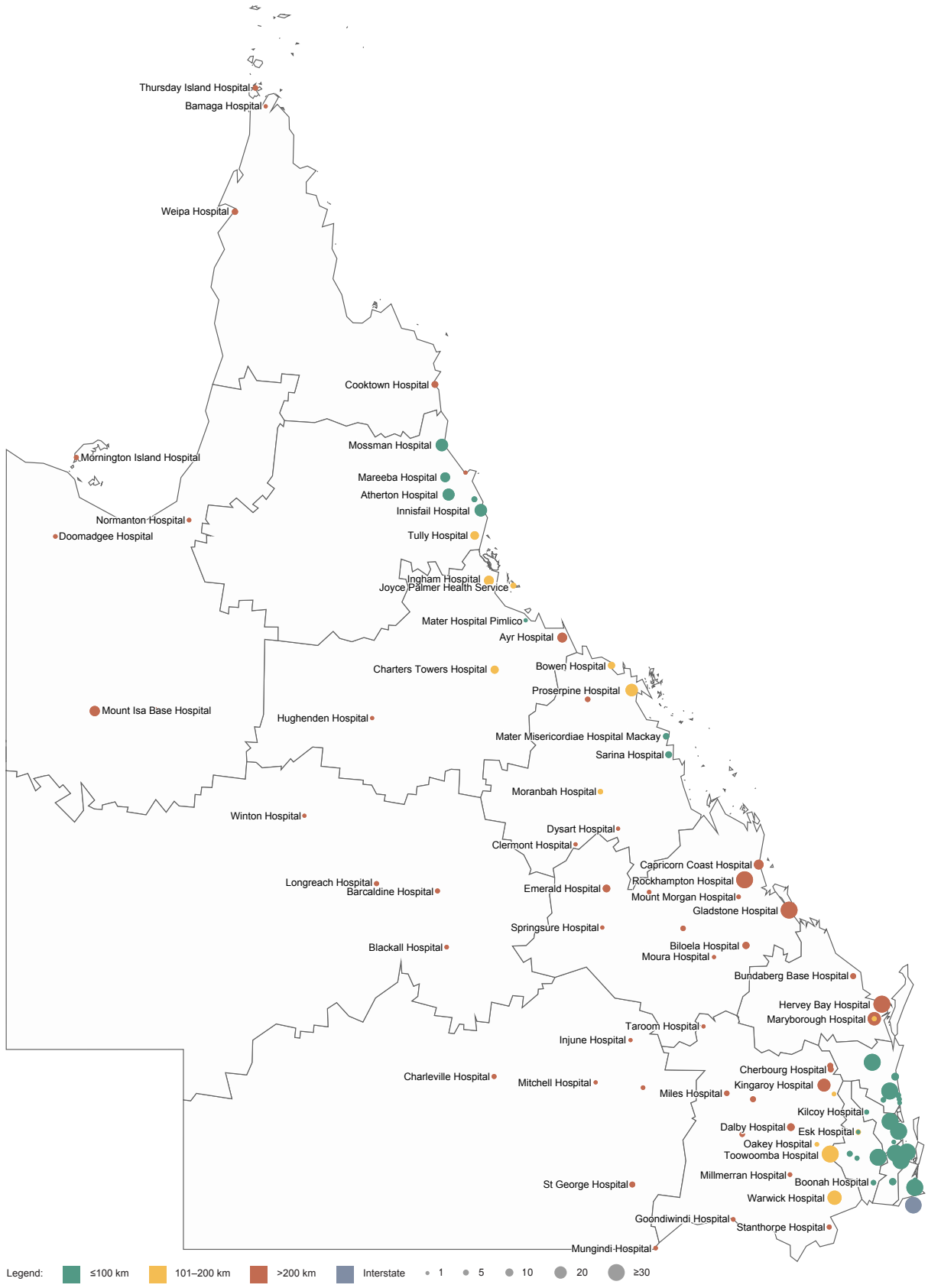
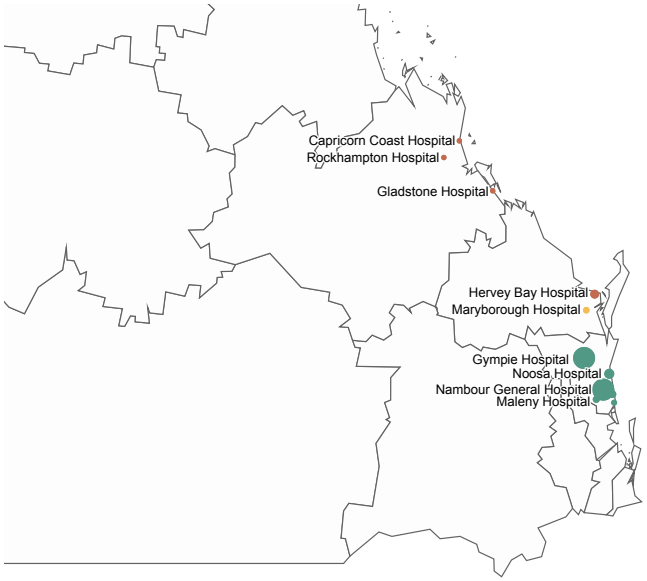
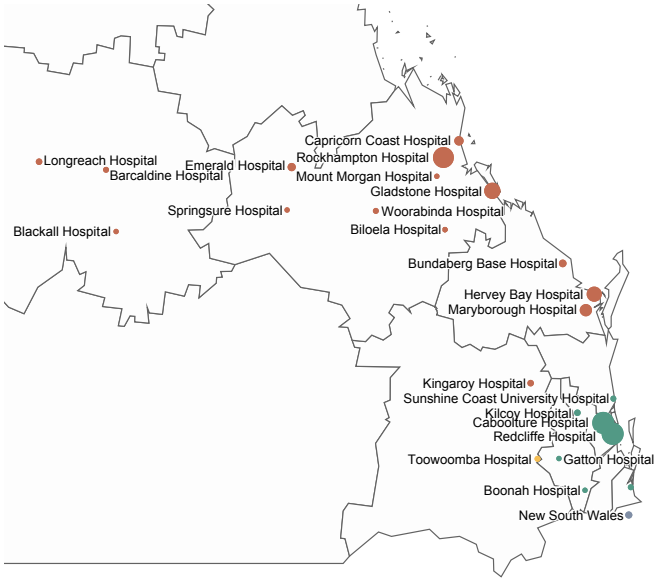


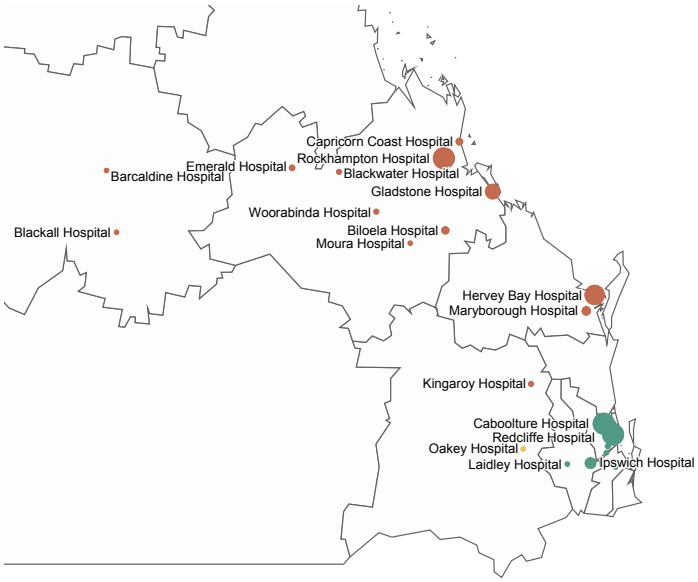
Figure 23: NSTEMI interhospital transfers by estimated distance to transfer



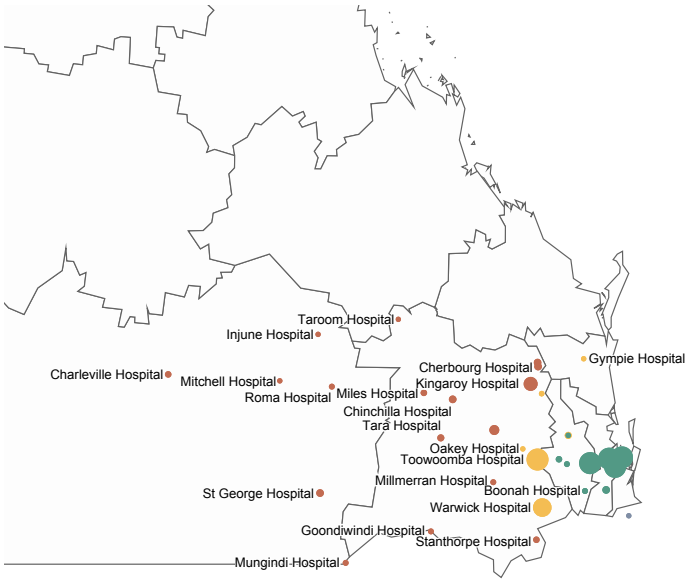
Inset A: Sunshine Coast University Hospital



Inset B: The Prince Charles Hospital



Inset C: Royal Brisbane & Women's Hospital



Inset D: Princess Alexandra Hospital

Inset E: Gold Coast University Hospital

7 Clinical indicators

The clinical indicator program is a valuable focus of QCOR. Many key guidelines advise the use of defined and validated quality indicators as a means of measuring and improving patient care. An indicator that is clinically relevant and useful should highlight specific issues that may require attention or signal areas for improvement.

The clinical quality and outcome indicators included in this Interventional Cardiology Audit have been selected after consideration of international PCI and ACS treatment guidelines and are in line with contemporary best practice recommendations. There is emerging recognition that a capacity to evaluate and report on quality is a critical building block for system-wide improvement of healthcare delivery and patient outcomes.

The quality and safety indicators which have been nominated by the QCOR Interventional Cardiology Committee are outlined in Table 30.

Table 30: Diagnostic and interventional cardiology clinical indicators

Clinical indicator	Description
1	Risk adjusted all-cause 30 day mortality post PCI
2	Proportion of STEMI patients presenting within six hours of symptom onset who received an intervention within 90 minutes of first diagnostic ECG
3	Proportion of all NSTEMI patients who received angiography within 72 hours of first hospital admission
4	Proportion of major in-lab events post PCI (coronary artery perforation, death, tamponade, emergency coronary artery bypass graft or cerebrovascular accident-stroke)
5	Proportion of cases where total entrance dose exceeded the high dose threshold (5Gy)

7.1 Mortality outcomes

7.1.1 Risk adjusted all-cause 30 day mortality post PCI

This clinical indicator includes all patient mortalities within 30 days of a PCI procedure. It does not necessarily indicate a causal relationship between the PCI procedure and the subsequent death. Overwhelmingly, death in these patients occurs from the underlying condition for which PCI is being done despite successful PCI being performed.

The overall 30 day unadjusted mortality rate for patients undergoing PCI procedures at Queensland public hospitals for 2021 was 1.8%. This result compares favourably with the 30 day mortality rate of 2.2% for the 2020 Victoria, Australia PCI cohort[6] and 2.8% presented by the British Cardiovascular Interventional Society (BCIS) in their review of PCI outcomes for the 2014 calendar year. This metric is chosen as the comparator as BCIS reports in subsequent years have given in-hospital rather than 30 day mortality.[7]

Table 31 presents unadjusted mortality according to admission status. As should be expected, the risk of death increases according to the severity of the patient's condition (admission status). 30 day mortality was 45% in the critically ill patients who underwent salvage PCI.

Table 31: All-cause unadjusted mortality within 30 days post PCI by admission status (% of total cases by presentation and site)

Site	Total cases n	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)	Total deaths n (%)
CH	536	0 (0.0)	3 (1.0)	0 (0.0)	5 (45.5)	8 (1.5)
TUH	361	0 (0.0)	1 (0.5)	4 (4.7)	0 (0.0)	5 (1.4)
MBH	332	0 (0.0)	3 (2.3)	0 (0.0)	0 (0.0)	3 (0.9)
SCUH	528	3 (2.9)	2 (0.7)	5 (3.3)	2 (100.0)	12 (2.3)
TPCH	1,007	2 (0.7)	5 (1.1)	10 (4.4)	7 (63.6)	24 (2.4)
RBWH	430	0 (0.0)	0 (0.0)	0 (0.0)	5 (38.5)	5 (1.2)
PAH	1,062	0 (0.0)	2 (0.3)	3 (1.1)	10 (43.5)	15 (1.4)
GCUH	638	0 (0.0)	0 (0.0)	5 (2.4)	12 (44.4)	17 (2.7)
STATEWIDE	**4,894**	**5 (0.5)**	**16 (0.6)**	**27 (2.3)**	**41 (45.1)**	**89 (1.8)**

Figure 24 presents the observed mortality rates by site, superimposed on the predicted mortality rates (with 95% confidence interval) calculated using the Victorian Cardiac Outcomes Registry (VCOR) risk adjustment model[9]. This analysis used an imputed dataset accounting for any missing data.

Reassuringly, observed mortality rates from all sites are within the expected range for their respective risk adjusted mortality rates. This is despite the limited risk adjustment model, which only adjusts for six factors – ACS, age, LAD coronary artery involvement, eGFR, LVEF, and cardiogenic shock. Other critical presentations with very high mortality risk, such as out of hospital ventricular fibrillation (VF) arrest with uncertain neurological recovery, are not adjusted for and therefore the model is likely to underestimate true mortality risk. This is relevant in our dataset where there were marked differences between hospitals in the proportion of high risk salvage patients taken for PCI (ranging from 0.4%–4.2% of PCI volume).

There were also considerable differences in salvage case mortality rates across different hospitals (Table 31). This variation may relate to differences in case mix at different hospitals, differences in the threshold for performing PCI in critically ill unstable patients, differences in classification of admission status, or a combination of all three factors. Given this variation, and the inability of the current risk prediction model to accurately predict expected mortality in the extreme risk salvage category, Figure 25 presents the observed and expected mortality rates excluding salvage.

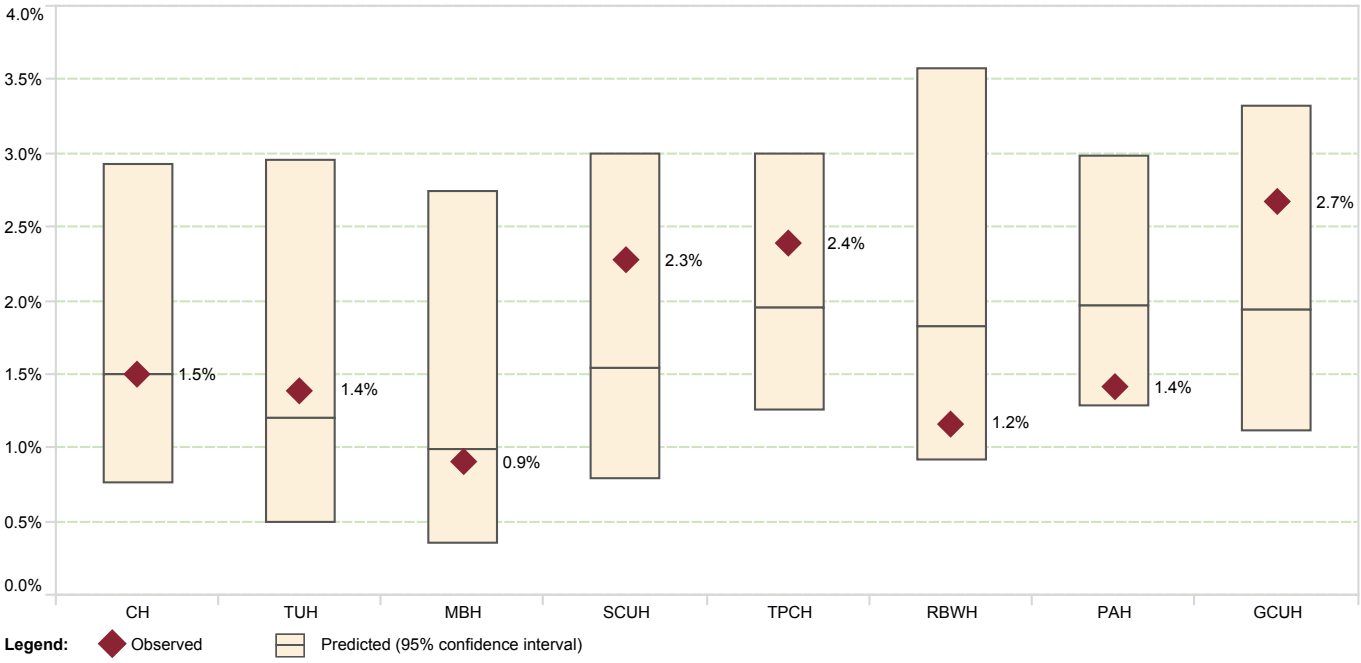
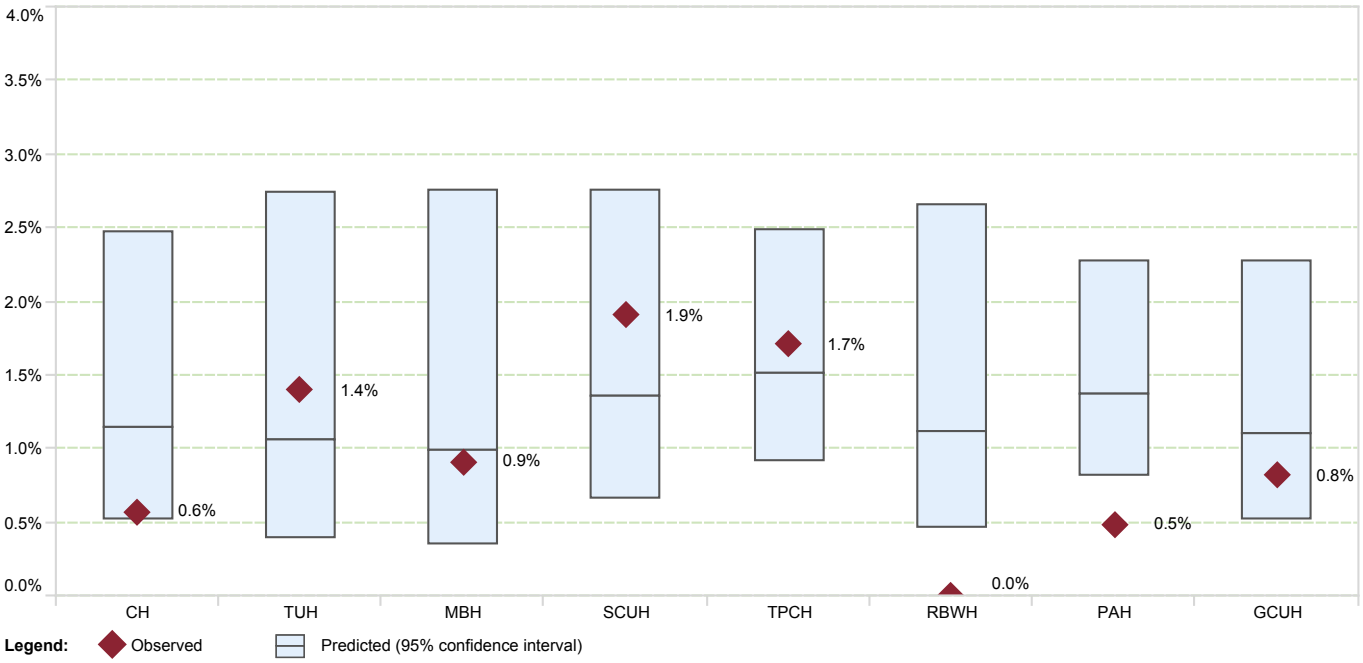


Figure 24: Comparison of observed and predicted mortality rates by site

As was outlined in previous QCOR reports, poorly calibrated risk adjustment is known to introduce bias into the monitoring process. Great care, therefore, needs to be exercised in the choice and use of risk adjustment tools to ensure they are relevant and have adequate performance for the patient cohort under scrutiny. Unfortunately, there are very few universally accepted risk models in interventional cardiology. We determined the VCOR model for risk adjustment of 30 day mortality to have the greatest utility for our current dataset, compared to other models such as those of the BCIS[7], and the American College of Cardiology (ACC) CathPCI registry.[10] These models are critically dependant on completeness of data elements.

With an expanded dataset of reliable data, a more thorough evaluation of international PCI risk adjustment models can be explored. This would allow for recalibration and the option to adapt one of these models to the specific characteristics of the QCOR dataset, or develop a new, locally relevant model. The variation in salvage cases between different hospitals highlights the importance of this. Some of these cases are STEMI complicated by out of hospital VF arrest, where there is a high yet uncertain chance of dying from a non cardiac cause (hypoxic brain injury). Small differences in the caseload of such patients, or variation in the likelihood of taking such cases for PCI, would have an undue effect on mortality rates, and yet there is no adjustment for this in the risk prediction model being applied.

In the ideal model, factors which are known to impact on patient outcomes, and which are beyond the control of the clinician or service being monitored, are either controlled for in the analysis or excluded. In measuring performance outcomes, it is important to maintain focus on the process under scrutiny (PCI outcomes), without distortion by uncorrected bias.



Excluding salvage cases (n=91)

Figure 25: Comparison of observed and predicted mortality rates by site, excluding salvage

7.1.2 STEMI mortality

A separate analysis was performed to assess mortality in patients presenting with STEMI. Of the 1,915 documented STEMI cases in 2021, 1,560 cases (81%) included a PCI intervention and are the subject of the following outcomes analyses. For this analysis, patients presenting as salvage are excluded, allowing focus to be retained on the measurement of PCI outcomes.

The outcomes for cohort of STEMI patients who underwent primary PCI remain encouraging. All-cause mortality rates at 30 days varied from 0% to 4.8% between participating centres with a statewide rate of 1.5%. Of these 1,493 patients analysed, a total of 23 mortalities were identified with the majority (70%) occurring in hospital.

Table 32: STEMI mortality up to 30 days in patients who underwent primary PCI

Site	In-lab n	In hospital n	Post discharge to 30 days n	Total cases* n	Total mortality n (%)
CH	0	0	0	136	0 (0.0)
TUH	0	2	2	83	4 (4.8)
MBH	0	0	0	67	0 (0.0)
SCUH	0	3	2	208	5 (2.4)
TPCH	0	7	0	272	7 (2.6)
RBWH	0	0	0	107	0 (0.0)
PAH	0	1	3	406	4 (1.0)
GCUH	0	3	0	214	3 (1.4)
STATEWIDE	**0**	**16**	**7**	**1,493**	**23 (1.5)**

* Excluding salvage cases (n=67)

7.1.3 STEMI presentation within 6 hours from symptom onset

Further analysis of the STEMI cohort who underwent primary PCI within six hours of symptom onset demonstrates a statewide all-cause 30 day mortality rate of 1.7%.

For this analysis, patients presenting as high risk salvage cases have been excluded.

Table 33: STEMI mortality up to 30 days for patients who underwent a primary PCI and presented within six hours of symptom onset

Site	In-lab n	In hospital n	Post discharge to 30 days n	Total cases* n	Total mortality n (%)
CH	0	0	0	50	0 (0.0)
TUH	0	1	0	51	1 (2.0)
MBH	0	0	0	35	0 (0.0)
SCUH	0	3	1	89	4 (4.5)
TPCH	0	2	0	141	2 (1.4)
RBWH	0	0	0	58	0 (0.0)
PAH	0	1	2	209	3 (1.4)
GCUH	0	3	0	133	3 (2.3)
STATEWIDE	**0**	**10**	**3**	**766**	**13 (1.7)**

* Excluding salvage cases (n=46)

7.1.4 Out of hospital cardiac arrest

Out of hospital cardiac arrest (OOHCA) is associated with very poor prognosis. It has been reported that only 12% of all OOHCA with attempted resuscitation survive to hospital discharge or 30 days following the arrest.[11] Furthermore, where the presumed cause of arrest is cardiac in nature and the case is not witnessed by emergency services, survival to hospital discharge or 30 days is also 12%. It is therefore recognised that patients who present with OOHCA have a guarded prognosis and any attempt to revascularise these patients may ultimately still result in death as a result of other factors or clinical pathology such as poor neurological recovery.

With this in mind, it is imperative that these cases be interpreted with caution noting that the outcomes reflect an 79% survival rate to 30 days which is markedly better than the larger OOHCA with resuscitation group. This is reassuring and indicates that patient selection for PCI in this high-risk, critically unwell group is appropriate.

Variation exists among sites with OOHCA accounting for 1.3% to 4.1% of total PCI cases and a statewide proportion of 2.5%. In this group, death within 30 days of the PCI procedure in 2021 almost exclusively occurred in hospital with a small number post discharge.

Table 34: Total out of hospital cardiac arrest cases by site

Site	Total cases n	Proportion of PCI cases %
CH	7	1.3
TUH	6	1.7
MBH	5	1.5
SCUH	19	3.6
TPCH	22	2.2
RBWH	7	1.6
PAH	32	3.0
GCUH	26	4.1
STATEWIDE	**124**	**2.5**

Table 35: Out of hospital cardiac arrest mortality up to 30 days post procedure

	Total cases n	In-lab n	In hospital n	Post discharge to 30 days n	Total deaths n (%)
STATEWIDE	**124**	**0**	**24**	**2**	**26 (21.0)**

7.2 STEMI less than six hours from symptom onset – time to reperfusion

The most critical factor influencing outcome for patients who experience a STEMI is the total ischaemic time, defined as the time interval from symptom onset to successful reperfusion. The exact time of symptom onset is often difficult to ascertain, and the time between symptom onset and call for help is primarily a patient dependent factor.

Therefore, STEMI guidelines worldwide now advocate FdECG-to-device time as an important modifiable and objective measure of overall STEMI system performance.[12]

Both the European and American STEMI guidelines recommend a target FdECG-to-device time less than 90 minutes.[12,13] It is widely recognised that these targets are ambitious and difficult to achieve in real-world practice as primary PCI becomes more available to larger catchment populations.

Achieving these times requires efficient coordination of care within and between the ambulance service and transferring/receiving hospitals. Accepted strategies to improve reperfusion times include pre-hospital activation of the CCL, an immediate response of the on call PCI team to be operational within 30 minutes of alert and bypass of the emergency department.

Table 36: Definitions for STEMI time to reperfusion

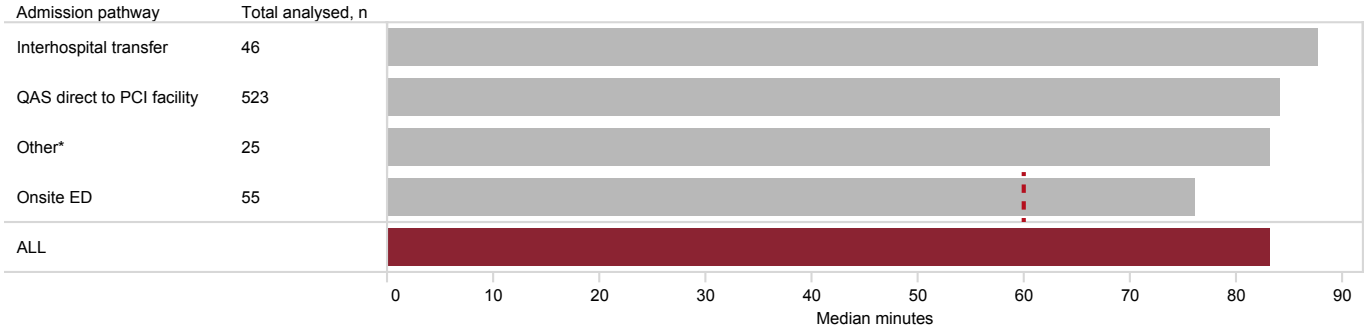
Time	Definition
First diagnostic ECG	First diagnostic ECG refers to the timestamp when the ECG shows ST-segment elevation (or equivalent) and can be regarded as time zero in the therapeutic pathway. The interpretation of the first diagnostic ECG may be undertaken by ambulance personnel, general practitioners or hospital based medical staff.
Door time	Door time refers to the timestamp when the patient presents to the PCI hospital and can be regarded as time zero in the therapeutic pathway for patients presenting via this method.
First device time	The first device time, as a surrogate for reperfusion, is the first timestamp recorded of the earliest device used: • first balloon inflation, or • first stent deployment, or • first treatment of lesion (thrombectomy/aspiration device, rotational atherectomy or coronary lithotripsy) If the lesion cannot be crossed with a guidewire or device (and thus none of the above applies), the time of guidewire introduction is used. If there is already TIMI 3* flow observed on initial angiography, that timestamp is used instead of first device time.

* Grade 3 (complete perfusion)[14]

The QCOR Interventional Cardiology Committee established the benchmark target of 75% of patients to receive timely reperfusion measured from FdECG to reperfusion, as well as from arrival at PCI facility to reperfusion.

In total, there were 812 STEMI primary PCI cases presenting within six hours of symptom onset. Of these, there were 163 cases which had been excluded per the criteria in Table 37 leaving 649 cases which are eligible for the following analysis.

As observed in previous annual reports, there was considerable variation in time from FdECG to reperfusion depending on the admission pathway to the treating facility, ranging from 88 minutes to 76 minutes for interhospital transfers and PCI facility onsite ED respectively.



* First medical contacts excluding QAS or ED, such as GP and community health

Figure 26: STEMI presenting within six hours of symptom onset – median first diagnostic ECG to first device time by admission pathway

Table 37: STEMI presenting within six hours of symptom onset cases ineligible for analysis

Summary	n (%)
Salvage	46 (28.2)
Out of hospital arrest	30 (18.4)
Previous CABG	23 (14.1)
Thrombolysis contraindicated	20 (12.3)
Unsuccessful PCI	15 (9.2)
Significant comorbidities/frailty	10 (6.1)
Intubation	4 (2.5)
Shock/acute pulmonary oedema	4 (2.5)
Incomplete data	11 (6.7)
Total	**163 (100.0)**

7.2.1 Time from first diagnostic ECG to first device

The all-site median time from FdECG to reperfusion was 83 minutes, with median individual site times ranging from 69 minutes to 90 minutes. These results indicate that overall Queensland public facilities are approaching the ambitious benchmark of 90 minutes from time of FdECG to first device. However, only 63% of patients analysed receive timely reperfusion per current guidelines (FdECG to reperfusion)[7], supporting the view that the current target is idealistic.

FdECG to reperfusion is a multi layered metric with the involvement of QAS, emergency and cardiology physicians and, along with the large geographical variations across Queensland, presents a clinical and logistical challenge for all involved. Nonetheless, the measure of time to reperfusion remains a useful tool for monitoring processes and efficiencies and demonstrates the potential for improvement or maintenance of system and hospital performance.

Table 38: First diagnostic ECG (FdECG) to reperfusion for STEMI presenting within six hours of symptom onset

Site	Total cases n	Total analysed n	Median minutes	Interquartile range minutes	Met 90 min target %
CH	55	41	69	54–95	68.3
TUH	52	41	75	64–94	70.7
MBH	35	30	90	80–107	50.0
SCUH	91	71	77	67–90	77.5
TPCH	147	130	87	76–101	59.2
RBWH	65	49	82	68–110	59.2
PAH	219	175	86	76–106	59.4
GCUH	148	112	84	73–99	63.4
STATEWIDE	**812**	**649**	**83**	**71–101**	**62.9**

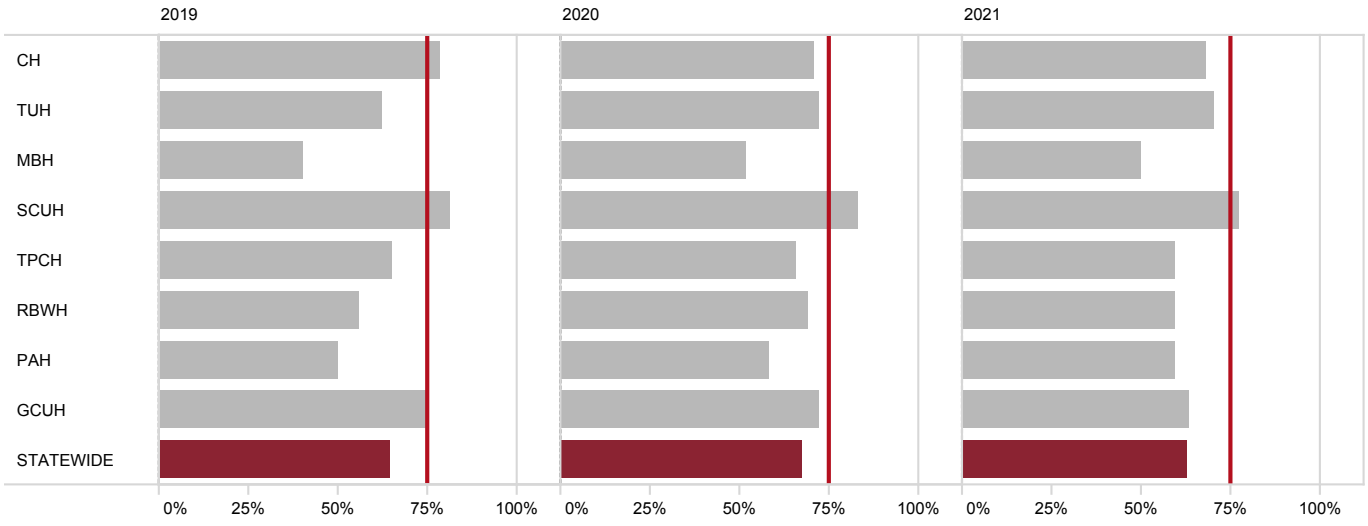


Figure 27: Proportion of STEMI cases (presenting within six hours of symptom onset) where time from first diagnostic ECG to reperfusion met 90 min target, 2019–2021

7.2.1.1 Pre-hospital notification processes

Pre-hospital emergency care is provided to the state's population by the QAS. Pre-hospital STEMI identification, pre-hospital reperfusion therapy, field activation of CCL, and rapid transport are integral parts of the treatment cascade for pre-hospital STEMI patients in Queensland.[8]

For STEMI, the QAS uses a two-tiered response model that consists of Advanced Care Paramedics (ACP) and Critical Care Paramedics (CCP). A typical response to a pre-hospital STEMI involves the concurrent deployment of ACPs and CCPs, where CCP resources are available.

On recognition of pre-hospital STEMI, paramedics fast-track treatment by either directly referring the patient to a specialist cardiac hospital for primary PCI or by administering pre-hospital fibrinolysis. Direct PCI referral is considered when the patient is located less than 60 minutes total transport time from STEMI identification to a PCI-capable hospital, has a Glasgow Coma Scale (GCS) of 15, and has classic ongoing ischaemic chest pain less than 12 hours in duration. Pre-hospital fibrinolysis is considered when the patient is located more than 60 minutes total transport time from STEMI identification to a PCI-capable hospital, has a GCS of 15, has classic ongoing ischaemic chest pain less than 6 hours in duration and is less than 75 years of age.

Some patients do not receive pre-hospital reperfusion therapy due to being contraindicated within the QAS reperfusion guidelines, and/or close proximity to a hospital, with some exceptions when patients refuse treatment. These patients were still identified for pre-notification to the receiving facility to ensure rapid assessment and treatment upon arrival.

When direct PCI referral is the selected pre-hospital reperfusion treatment pathway, a dedicated telephone line is utilised to make direct contact with the on call interventional cardiologist at the receiving PCI hospital to refer the patient and confer regarding pre-hospital management. If the patient is accepted, the CCL is activated by the receiving hospital staff, concomitant antiplatelet therapy and anticoagulant therapy are given in the field by paramedics, as requested by the cardiologist, and the patient is rapidly transported directly to the hospital for primary PCI.

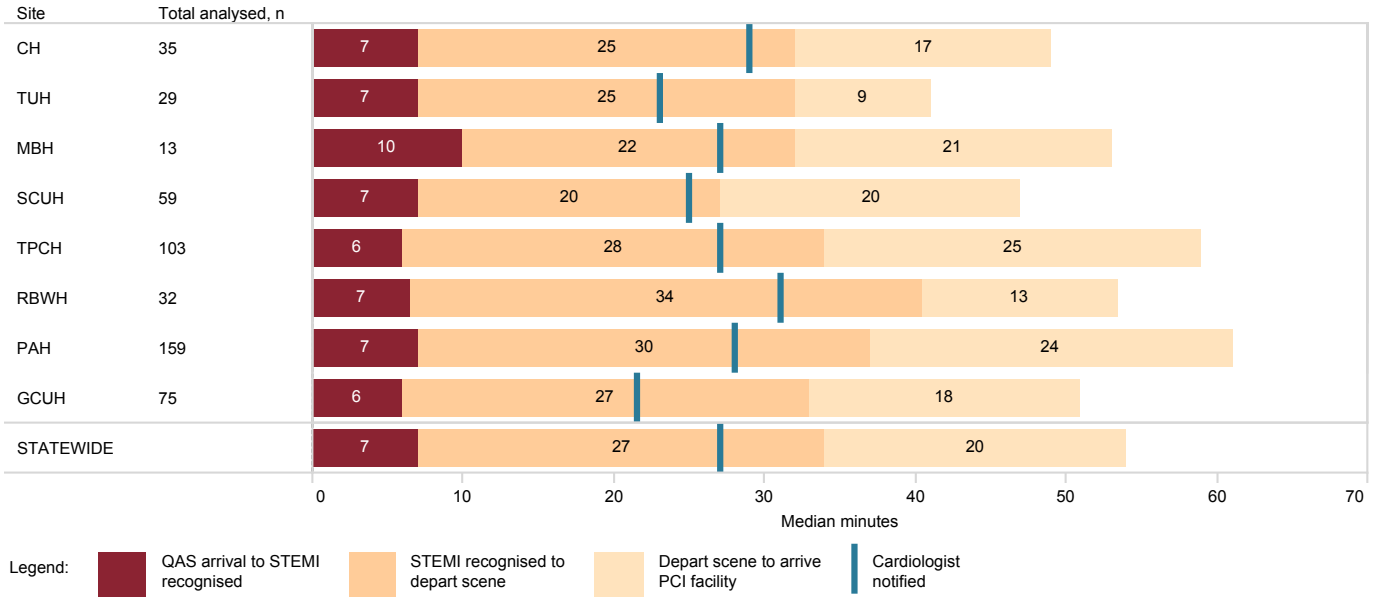


Figure 28: STEMI presenting within six hours of symptom onset pre-hospital component breakdown – QAS direct to PCI facility

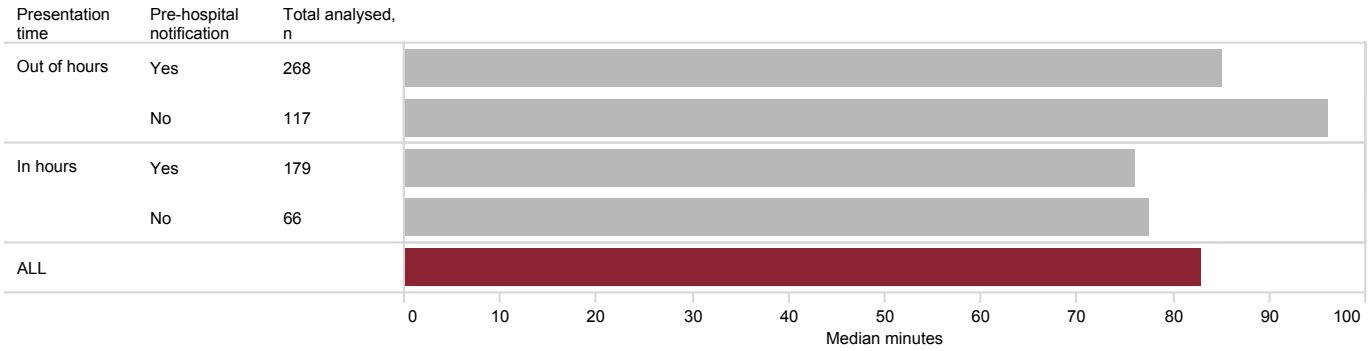
7.2.1.2 Hospital processes

All hospitals have established pathways for notification of and receiving STEMI patients. Some hospital processes vary across the state depending on factors including the time of day or the local requirement of some patients to transit via the ED.

Pre-hospital notification plays an important role in readying CCL teams for incoming patients with acute myocardial infarction. Different processes and protocols are in place depending on whether the patient presents within business hours or out of hours. For the purpose of this analysis, in hours was defined as 8am–6pm, Monday to Friday, excluding public holidays.

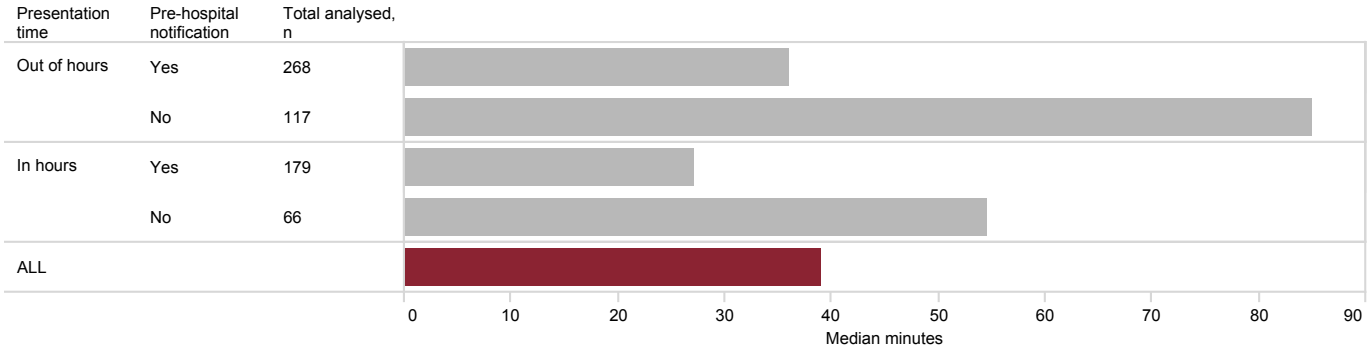
Total time to reperfusion was lowest in the in hours cohort where pre-hospital notification occurred. Even when pre-hospital notification was not a factor, in hours cases had a swifter time to reperfusion than those taking place out of hours. It is important to note that the out of hours cohort accounts for the larger proportion of cases (385 out of hours vs. 245 in hours), meaning particular attention can be paid to this group for future quality improvement activities.

When examining arrival at PCI facility to reperfusion, pre-hospital notification resulted in marked differences in system performance. Pre-hospital notification was associated with a 28 minute improvement for in hours cases and a 49 minute improvement for out of hours cases. These findings support the importance of pre-hospital notification and the effect it has on providing an efficient, systematic approach to patient care.



In hours: 8am–6pm Monday to Friday, excluding public holidays

Figure 29: STEMI presenting within six hours of symptom onset – first diagnostic ECG to reperfusion by presentation time and pre-hospital notification



In hours: 8am–6pm Monday to Friday, excluding public holidays

Figure 30: STEMI presenting within six hours of symptom onset – arrival PCI facility to reperfusion by presentation time and pre-hospital notification

7.2.2 Time from arrival PCI capable facility to first device

The time between PCI hospital arrival and reperfusion ('door-to-device time') is currently the accepted measure of PCI hospital system performance in STEMI. Historically, hospitals have worked to a goal of less than 90 minutes, although more recent guidelines have shortened this target time to less than 60 minutes.[12,13]

In 2021, COVID-19 has caused significant disruption of the usual in-hospital journey of a STEMI patient. Some Hospital and Health Services mandated rapid antigen testing of all patients presenting to the emergency department. Despite best efforts, the mandate will have prolonged treatment time and ultimately the time to reperfusion. Longer delays were experienced by patients who tested positive for COVID-19 as this required staff to don appropriate personal protective equipment and adhere to strict infection control guidelines both prior to and following the procedure.

Results demonstrate that for almost three quarters of cases (74%), participating PCI facilities are meeting a target door-to-device time of less than 60 minutes, with an overall statewide median time of 39 minutes (ranging from 32 minutes to 58 minutes across sites). These results demonstrate incremental improvement over previous years (2019 median – 42 minutes, 2020 median – 40 minutes), and two sites meeting the 75% benchmark target.

Table 39: Arrival at PCI hospital to first device for STEMI presenting within six hours of symptom onset

Site	Total cases n	Total analysed n	Median minutes	Interquartile range minutes	Met 60 min target %
CH	55	41	43	32–67	65.9
TUH	52	41	51	35–72	61.0
MBH	35	30	58	39–100	53.3
SCUH	91	71	35	24–62	73.2
TPCH	147	130	36	27–44	86.2
RBWH	65	49	38	29–68	71.4
PAH	219	175	32	25–50	81.1
GCUH	148	112	48	27–81	63.4
STATEWIDE	**812**	**649**	**39**	**27–62**	**74.0**

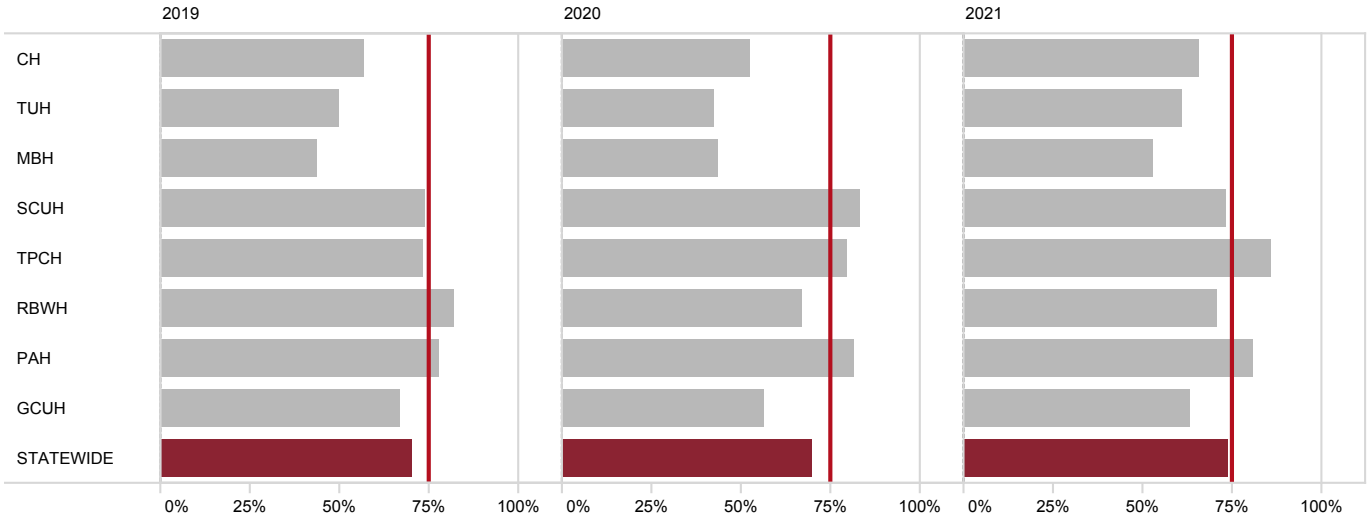


Figure 31: Proportion of cases where arrival at PCI hospital to first device ≤60 minutes was met for STEMI presenting within six hours of symptom onset, 2019–2021

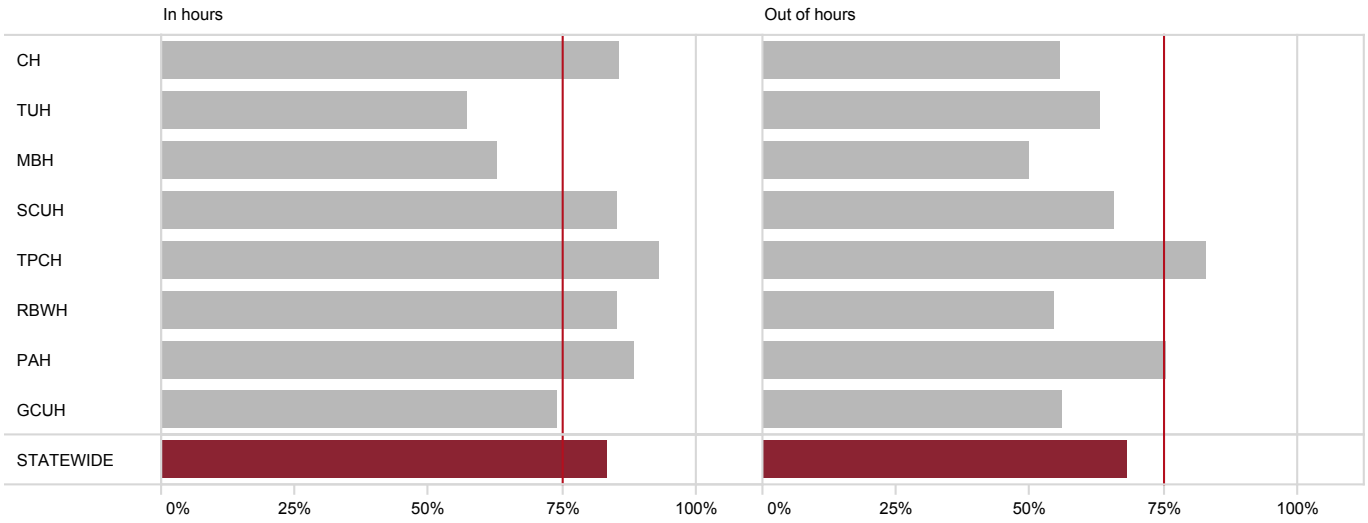
7.2.2.1 In hours versus out of hours presentation

The majority of cases (61%) presented out of hours. For the purpose of this analysis, business hours were defined as 8am–6pm, Monday to Friday, excluding public holidays. This high proportion of out of hours cases demonstrates the frequency at which teams are required to respond to these medical emergencies. Each out of hours case has its own logistical challenges and requires a whole-of-system approach to ensuring timely intervention. It is important to note that this analysis does not include all out of hours work performed by CCL teams with a wide and varied case mix regularly encountered.

When examining PCI hospital arrival and reperfusion, patient presentation in hours was associated with better performance. Over three quarters (83%) of cases met the door-to-device time target of 60 minutes in hours compared to 68% out of hours.

Table 40: STEMI presenting within six hours of symptom onset – arrival PCI facility to reperfusion by site and time of presentation

Site	Total analysed n	Proportion out of hours %	In hours median minutes	Out of hours median minutes	In hours target met %	Out of hours target met %
CH	41	65.9	38	47	85.7	55.6
TUH	41	65.9	59	48	57.1	63.0
MBH	30	73.3	39	62	62.5	50.0
SCUH	71	62.0	26	39	85.2	65.9
TPCH	130	67.7	33	37	92.9	83.0
RBWH	49	44.9	33	57	85.2	54.5
PAH	175	56.0	29	36	88.3	75.5
GCUH	112	58.9	38	51	73.9	56.1
STATEWIDE	**649**	**60.7**	**32**	**42**	**83.1**	**68.0**



In hours: 8am–6pm Monday to Friday, excluding public holidays

Figure 32: STEMI presenting within six hours of symptom onset – proportion of cases where arrival at PCI hospital to first device ≤60 minutes by time of presentation and site

7.2.2.2 Pre-hospital notification

Pre-hospital notification was utilised in two thirds (71%) of cases, with considerable variation observed among sites. Achievement of the benchmark of 75% of cases meeting the 60 minute target was achieved at all sites where pre-hospital notification was utilised. Statewide, the 60 minute timeframe was achieved in 92% of cases where there was pre-hospital notification compared to 34% without pre-hospital notification.

This further supports the importance of pre-hospital notification and the need for effective synergies between hospital departments and emergency services.

Table 41: STEMI presenting within six hours of symptom onset – arrival PCI facility to reperfusion by pre-hospital notification and site

Site	Total analysed n	Proportion with pre-hospital notification %	Pre-hospital notification median minutes	No pre-hospital notification median minutes	Pre-hospital notification target met %	No pre-hospital notification target met %
CH	41	58.5	36	67	95.8	23.5
TUH	41	61.0	36	78	84.0	25.0
MBH	29	55.2	45	100	87.5	15.4
SCUH	71	64.8	28	66	97.8	28.0
TPCH	123	87.0	35	80	94.4	43.8
RBWH	49	63.3	32	80	87.1	44.4
PAH	175	81.1	30	81	93.0	30.3
GCUH	101	55.4	38	81	87.5	44.4
STATEWIDE	**630**	**71.0**	**33**	**78**	**92.2**	**33.9**

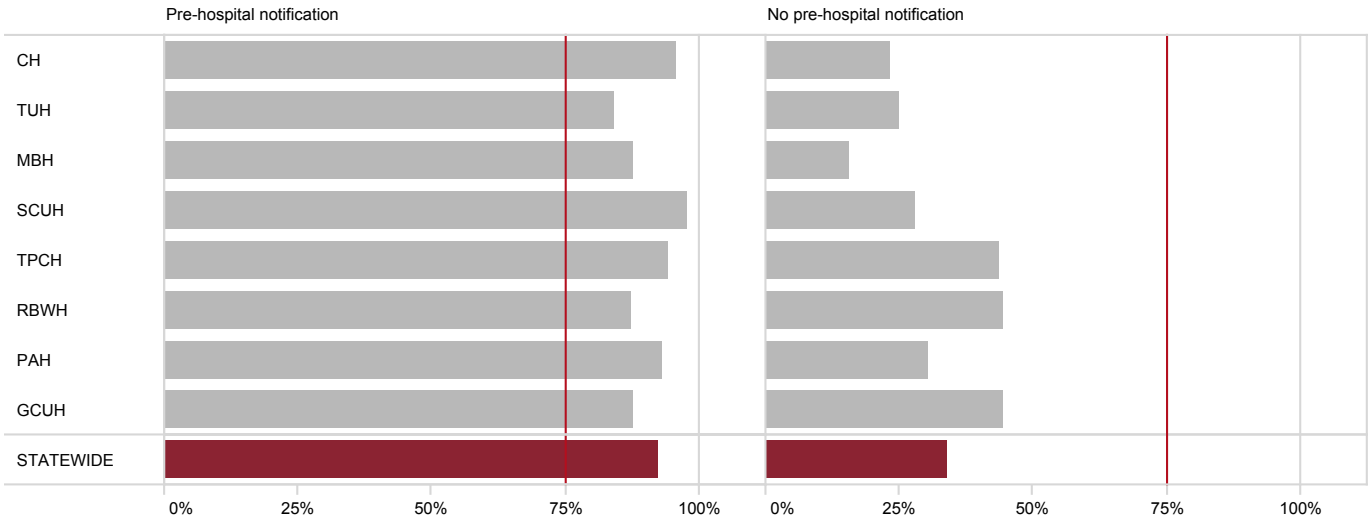


Figure 33: STEMI presenting within six hours of symptom onset – proportion of cases where arrival at PCI hospital to first device ≤60 minutes by site and pre-hospital notification

7.3 NSTEMI – time to angiography

Time to coronary angiography for patients presenting to hospital with a NSTEMI remains a key clinical quality indicator for QCOR. Coronary angiography is necessary to determine the severity of coronary disease with both quality of life and prognostic implications for patients presenting with NSTEMI. National and international guidelines recommend coronary angiography should be performed within 72 hours of diagnosis. This duration is reduced to 24 hours for those deemed to be at high risk of major cardiac events.[5]

For this indicator, the QCOR committee recommended that the treatment timeframe for analysis should remain 72 hours in order to capture all-comers with the working diagnosis of NSTEMI.

A major barrier to early angiography is the time taken to transfer patients from non PCI capable facilities to the accepting PCI centre. Multiple reasons for delays include prolonged time to tertiary facility referral, capacity constraints at the ambulance and hospital level as well as patient transfer logistics in a large geographic area. In addition, several patient factors such as anaemia, renal impairment, language barriers and other delays to a patient's readiness for care can introduce further barriers to accessing timely angiography. It is hoped this may be able to be examined in detail in subsequent QCOR Audits.

In 2021, COVID-19 caused significant lengthening of the patient journey from admission to angiography. Low risk NSTEACS patients who were tested positive to COVID-19, or were close contacts and subject to isolation measures, had their angiogram procedure delayed in accordance with CSANZ guidelines.

Table 42 lists the cases excluded from analysis and the reasons for exclusion. These often relate to the clinical status of the patient at the time of their myocardial infarct or the course of events leading to their admission to a Queensland public interventional facility.

Table 42: NSTEMI time to angiography – cases excluded from analysis

	n
Planned or staged PCI	142
Admitted with an unrelated principal diagnosis	126
Coronary angiography not performed at index procedure	31
Stable non admitted patients transferred directly to lab for planned angiography	31
Transferred from an interstate hospital	30
Transferred from a private hospital	28
Incomplete data	17
Total ineligible	**405**

Patients presenting directly to a PCI capable facility had a median wait to coronary angiography time of 31 hours and were more likely to have angiography performed within the target timeframe of 72 hours compared with interhospital transfers (80% vs. 59%).

For direct presenters, the wide range of 23 hours to 46 hours before angiography is influenced by several factors including patient demographics, clinical case mix and competing caseloads. The centres with ‹75% meeting target had the widest interquartile ranges, providing opportunity to review local factors that may be modifiable to promote time efficiencies.

Across the state, in comparison with 2020, there was for direct presenters (Table 43) a comparable number of analysable NSTEMI cases (1,313 vs. 1,343) and a similar proportion meeting target (80% vs. 80%). While for interhospital transfers (Table 44), there was a slight increase in analysable cases (1,373 vs. 1,343) and a reassuring increase in the proportion meeting the target (59% vs. 57%).

Table 43: Time to angiography – direct to PCI facility

Site	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	188	157	30	16–50	85.4
TUH	160	145	34	19–62	84.1
MBH	112	102	29	19–56	90.2
SCUH	154	137	29	18–50	85.4
TPCH	308	282	24	12–47	84.0
RBWH	90	77	23	17–45	88.3
PAH	211	171	37	19–80	72.5
GCUH	268	242	46	24–91	66.5
STATEWIDE	**1,491**	**1,313**	**31**	**17–62**	**80.4**

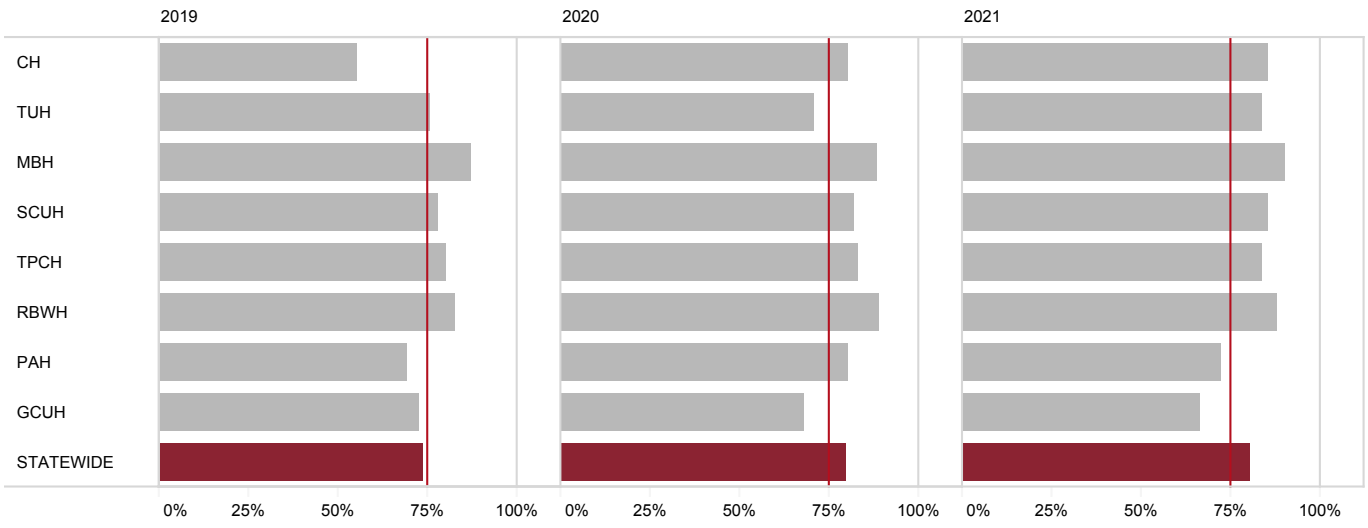


Figure 34: Proportion of NSTEMI direct presenters receiving angiography within 72 hours, 2019–2021

These data highlight the ongoing potential for overall system improvement and need to review statewide and local strategies to deal with two distinct cohorts – direct presenters and interhospital transfers. Encouragingly, the median time to angiography in this group continues to demonstrate improvement over previous years, decreasing from 65 hours in 2020 and 76 hours in 2019.

Table 44: Time to angiography – interhospital transfers

Site	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	115	102	41	25–60	83.3
TUH	73	61	55	32–81	70.5
MBH	51	41	29	21–59	80.5
SCUH	152	130	42	23–68	77.7
TPCH	284	228	67	41–118	53.1
RBWH	252	218	64	39–93	57.8
PAH	568	517	78	48–111	46.4
GCUH	105	76	50	27–81	71.1
STATEWIDE	**1,600**	**1,373**	**63**	**38–96**	**58.5**

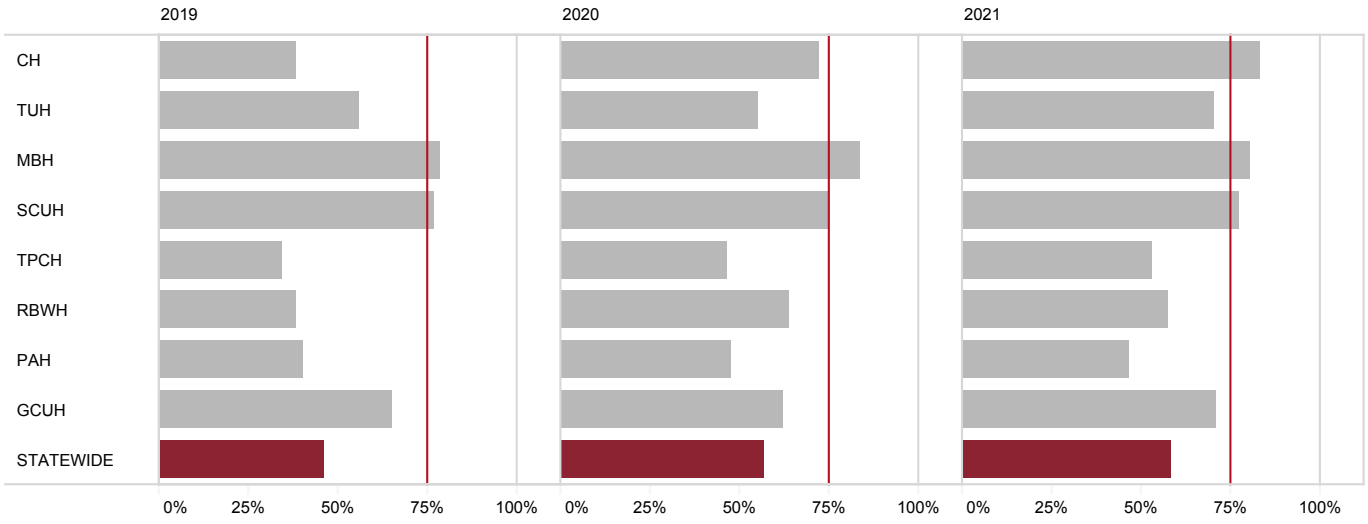


Figure 35: Proportion of NSTEMI interhospital transfers receiving angiography within 72 hours, 2019–2021

7.3.1 NSTEMI interhospital transfers – time to transfer to PCI facility

The median time to transfer NSTEMI patients to the PCI-capable facility for angiography was 32 hours, ranging from 8 hours to 51 hours by institution. This includes time spent at referring hospital prior to notification of PCI capable facility.

The trend towards increased time to transfer NSTEMI patients within the Metropolitan areas is likely attributable to referring facilities having a higher capacity to hold and monitor NSTEMI patients prior to being transferred.

Once transferred to the PCI facility the median time from arrival to angiography being performed was 31 hours. This analysis excludes interhospital transfers originating interstate, with a larger effect on GCUH given the facility's proximity to the New South Wales border.

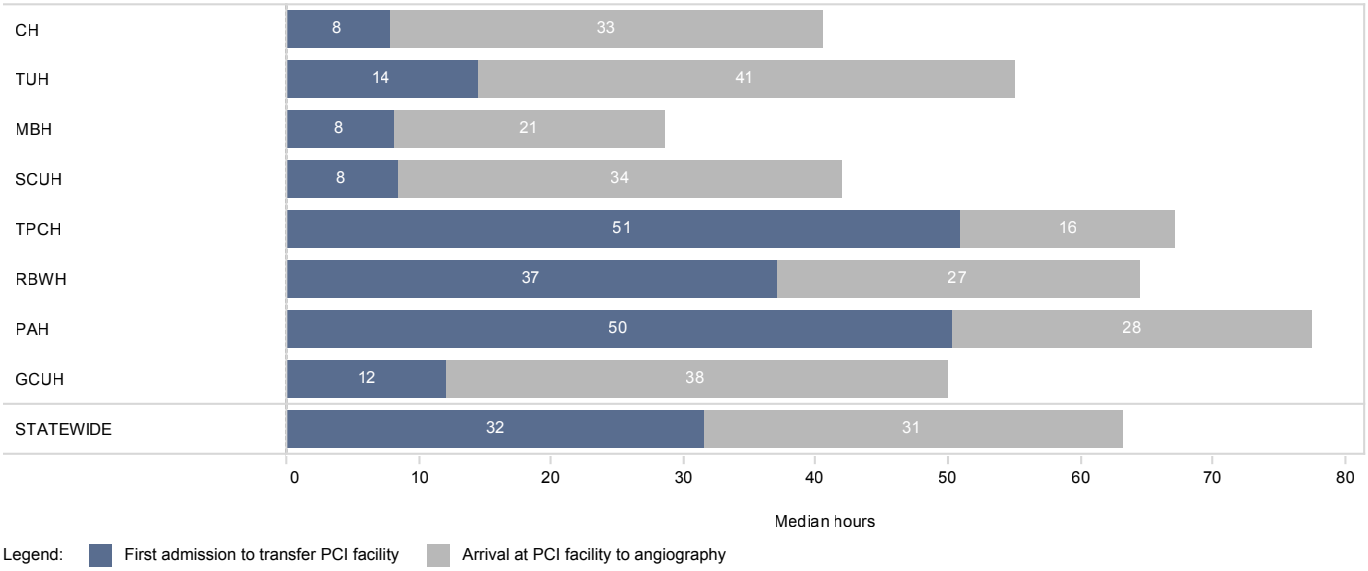
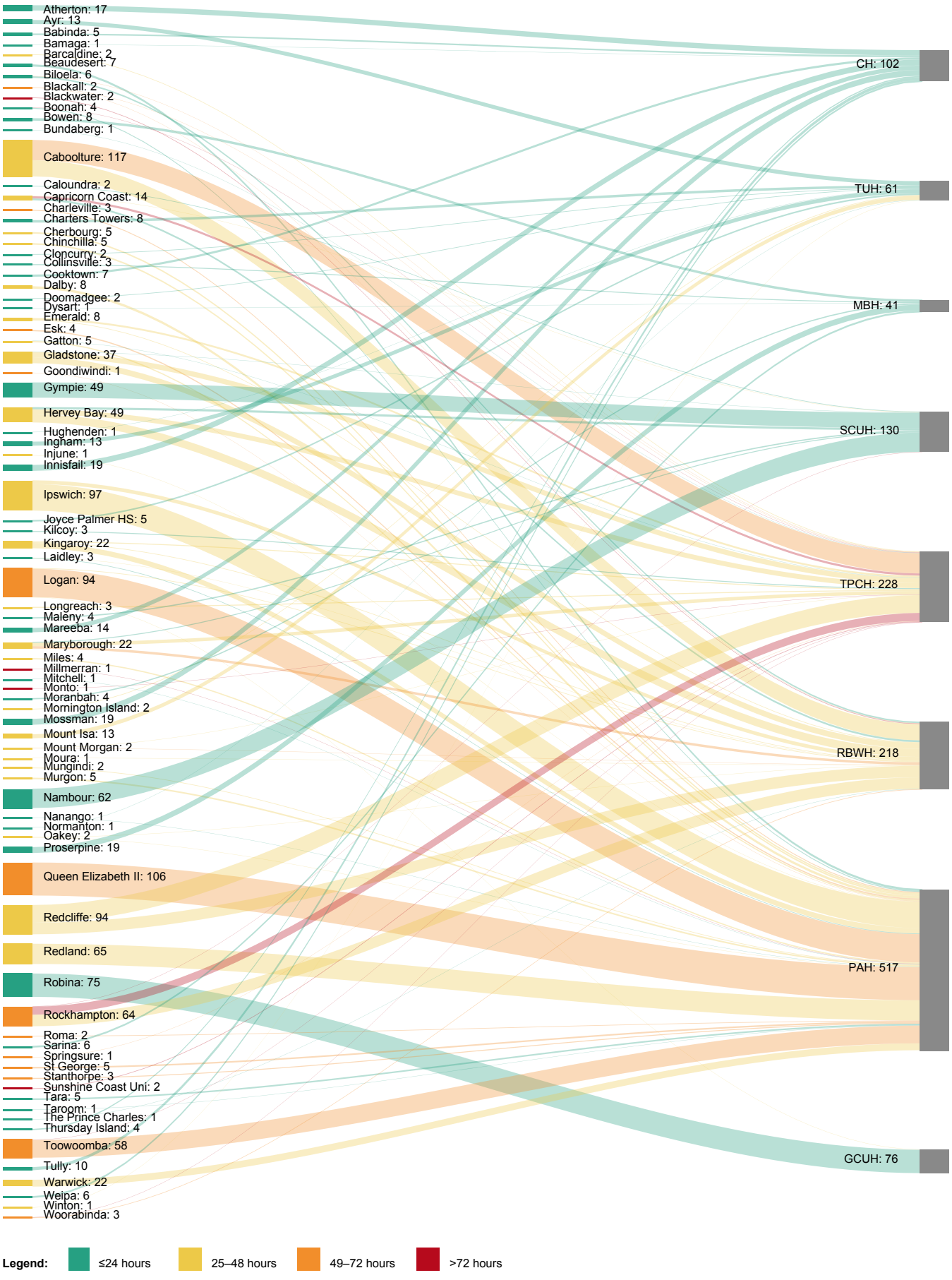


Figure 36: Median duration to transfer to PCI facility for angiography, NSTEMI interhospital transfers

Table 45: Median times to transfer to PCI facility for angiography, NSTEMI interhospital transfers

Site	Total cases n	Total analysed n	Median (IQR) distance transferred kilometres	Median time to transfer to PCI facility hours	Median overall time to angiography hours
CH	115	102	90 (75–143)	8	41
TUH	73	61	302 (133–901)	14	55
MBH	51	41	125 (36–191)	8	29
SCUH	152	130	35 (30–93)	8	42
TPCH	284	228	39 (33–505)	51	67
RBWH	252	218	231 (45–567)	37	64
PAH	568	517	27 (24–122)	50	78
GCUH*	105	76	17 (17–17)	12	50
STATEWIDE	**1,600**	**1,373**	**45 (27–192)**	**32**	**63**

* Excludes interhospital transfers originating in New South Wales



* Excludes interhospital transfers originating in New South Wales

Figure 37: Median times to transfer to PCI facility for angiography by transferring facility

Of the 3,091 total NSTEMI cases, 52% were interhospital transfers and 47% received PCI. The median time to angiography with or without PCI was 47 hours. This represents a small improvement on 2020 outcomes where the median time to angiography was 48 hours.

Table 46: NSTEMI time to angiography by site

Site	Total NSTEMI cases n	Total analysed n	Interhospital transfers %	Median hours	Interquartile range hours	Met 72 hour target %
CH	303	259	38.0	33	18–56	84.6
TUH	233	206	31.3	40	21–66	80.1
MBH	163	143	31.3	29	19–57	87.4
SCUH	306	267	49.7	35	20–61	81.6
TPCH	592	510	48.0	42	18–82	70.2
RBWH	342	295	73.7	54	28–85	65.8
PAH	779	688	72.9	68	40–102	52.9
GCUH	373	318	28.2	48	25–90	67.6
STATEWIDE	**3,091**	**2,686**	**51.8**	**46**	**23–83**	**69.2**

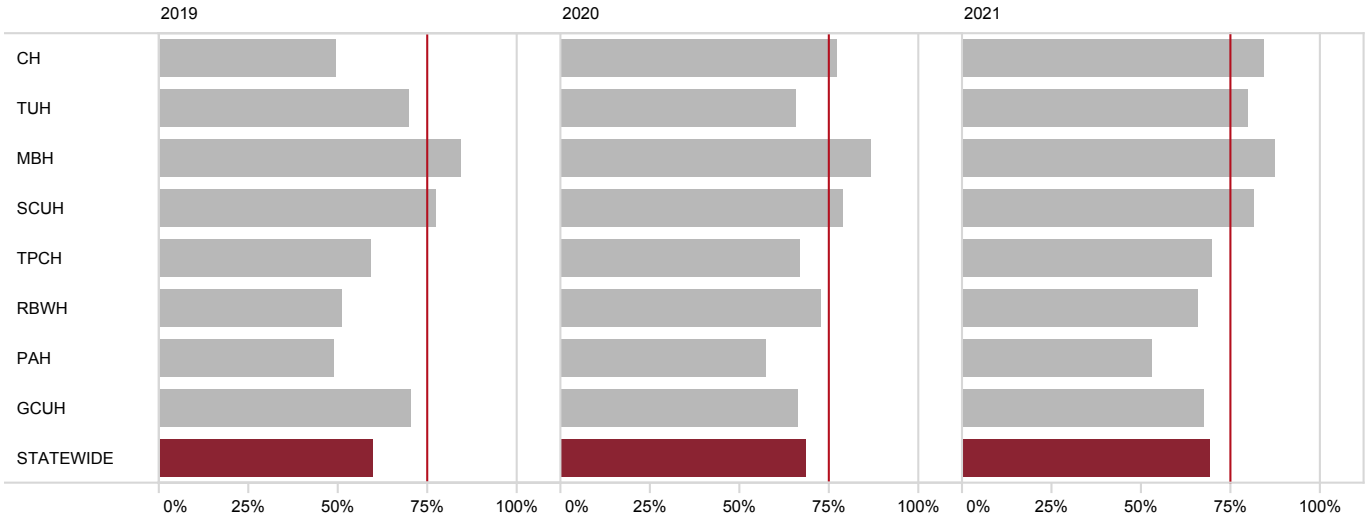


Figure 38: Proportion of NSTEMI cases meeting time to angiography target of 72 hours, 2019–2021

7.4 Major procedural complications

This quality indicator examines in-lab intra-procedural complications. In 2021, 41 cases (0.84%) recorded an immediate major procedural complication.

Events included in this analysis are coronary artery perforation, in-lab death, cerebrovascular accident (CVA), pericardial tamponade and emergency CABG. Processes are in place to ensure data integrity relating to these events. Limitations exist with using administrative datasets and intra-registry data linkage to examine complication rates, however these do assist with examining cases where complications occurred during the patient admission or encounter.

While the use of data linkage provides a means of verification and quality assurance, this indicator remains dependant on high-quality data being entered by clinicians in the first instance and as a result a degree of participation bias may exist. The numbers of reported events remain low, rendering further comment difficult other than to state that it is reassuring.

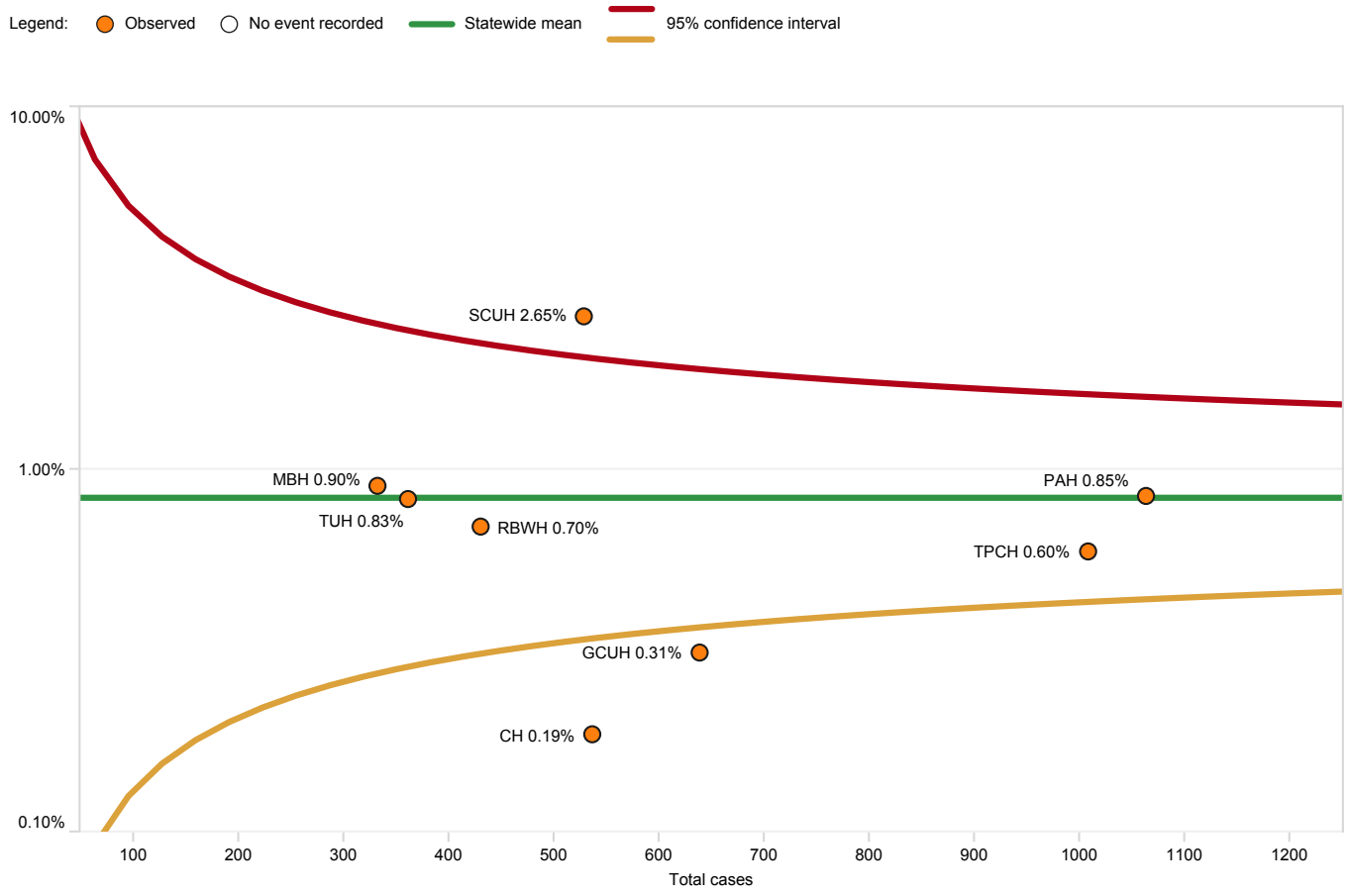


Figure 39: Proportion of PCI cases with immediate major procedure complication by site

Table 47: All PCI cases by immediate major procedural complication type

Complication type	Case n	%
Major intra-procedural complication	**41**	**0.84**
Coronary artery perforation	31	0.63
CVA	4	0.08
Tamponade	4	0.08
Emergency CABG	1	0.02
In-lab death*	1	0.02
No immediate major procedural complication	4,853	99.16
Total	**4,894**	**100.0**

* Excluding salvage deaths

7.5 High radiation doses

Staff and patients are exposed to ionising radiation during the majority of all procedures performed in the CCL. Ionising radiation is known to cause both delayed (stochastic) and immediate (deterministic) effects. The main stochastic effect is cancer, with the probability of experiencing the effect presumed to be proportional to the dose received (with no minimum threshold). For deterministic effects (such as erythema, epilation and desquamation), there is believed to be a threshold dose below which no effect is likely to occur but above which the severity of the effect is linked to the dose received.

Fortunately, conservative thresholds are applied and monitored throughout Queensland to maximise the benefit received by the patient while minimising the risk of experiencing any determinist effects. However, as the complexity of procedural work undertaken by interventional cardiologists increases, along with an increase in patients with a large body mass, it is increasingly important to remain vigilant about radiation hygiene. This indicator examines the proportion of cases exceeding the high dose threshold of 5 Gy that has been set to identify patients at risk of developing deterministic effects.

Patients exceeding this threshold are proactively managed by the individual units to ensure that any deterministic effects that may subsequently arise are identified and treated appropriately.

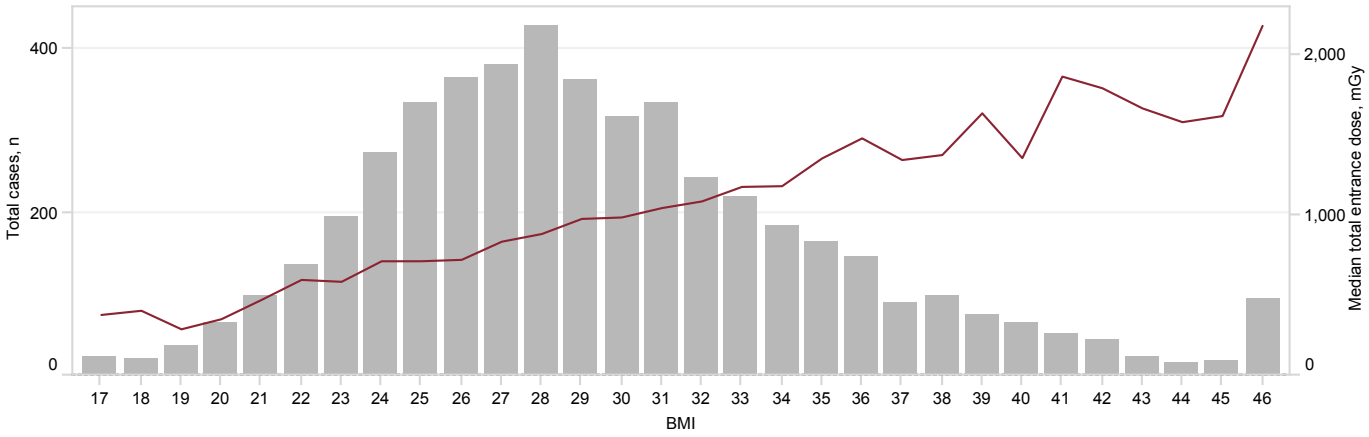


Figure 40: All coronary and PCI procedures median total entrance dose by body mass index

Table 48: Proportion of cases meeting the safe dose threshold by case type

Site	PCI procedures %	Other coronary procedures %
CH	99.6	99.9
TUH	99.4	99.8
MBH	100.0	99.9
SCUH	99.1	99.5
TPCH	99.4	100.0
RBWH	99.8	100.0
PAH	95.6	99.8
GCUH	100.0	99.9
STATEWIDE	**98.7**	**99.9**

8 Supplement: Structural heart disease

Queensland public hospitals provide care to patients with wide and varied structural heart diseases (SHD) including interventions such as cardiac defect closure and transcatheter valvuloplasty and replacement.

The ability to collect quality SHD intervention data and participate in national registries relating to this specialty area has been a longstanding focus for Queensland cardiac clinicians. Procedures such as transcatheter aortic valve replacement (TAVR), also referred to as transcatheter aortic valve implantation, offer an alternative to surgical interventions, often for patients with many comorbidities and complex chronic diseases. TAVR has emerged as a first-line treatment in preference to traditional open aortic valve surgery for growing population patients owing to a growing randomised controlled trial evidence base.

Queensland clinicians have collaborated with QCOR to develop and implement a bespoke application for SHD interventions, allowing data to be recorded across the patient journey – from the pre-procedural phase and up to one year post discharge and with data-fields that align with the mandatory Australian Cardiac Outcomes Registry for TAVR procedures. As of 2022, the QCOR SHD application has been deployed in five of the seven public hospitals offering SHD interventions. The new system has enabled enhanced data collection, as well as allowing clinicians to produce clinically relevant and encompassing documentation to form part of the patient medical record.

Future work is focused on expanding the scope of these analyses, and to continue to explore avenues to contextualise and report on the quality of outcomes for this group of patients.

Table 1: QCOR SHD application go live dates

Site	Application go live date
Cairns Hospital	17 December 2020
Townsville University Hospital	28 August 2021
Sunshine Coast University Hospital	In progress
The Prince Charles Hospital	In progress
Royal Brisbane & Women's Hospital	5 February 2021
Princess Alexandra Hospital	13 January 2021
Gold Coast University Hospital	8 March 2021

8.1 Participating sites

A total of 485 SHD interventions were performed across the seven Queensland public cardiac catheterisation laboratories. Two thirds (67%) of cases were valvular interventions including percutaneous valve replacement and valvuloplasty procedures.

Table 2: Total SHD cases by participating site

Site	Total cases n	Device closure* n (%)	Valvular intervention† n (%)	Other‡ n (%)
CH	22	18 (81.8)	4 (18.2)	–
TUH	28	13 (46.4)	15 (53.6)	–
SCUH	22	20 (90.9)	2 (9.1)	–
TPCH	237	26 (11.0)	200 (84.4)	11 (4.6)
RBWH	22	19 (86.4)	3 (13.6)	–
PAH	102	31 (30.4)	70 (68.6)	1 (1.0)
GCUH	52	20 (38.5)	32 (61.5)	–
STATEWIDE	**485**	**147 (30.3)**	**326 (67.2)**	**12 (2.5)**

* Includes percutaneous closure of ASD, PFO, PDA, LAA and paravalvular leak

† Percutaneous valve replacement and valvuloplasty

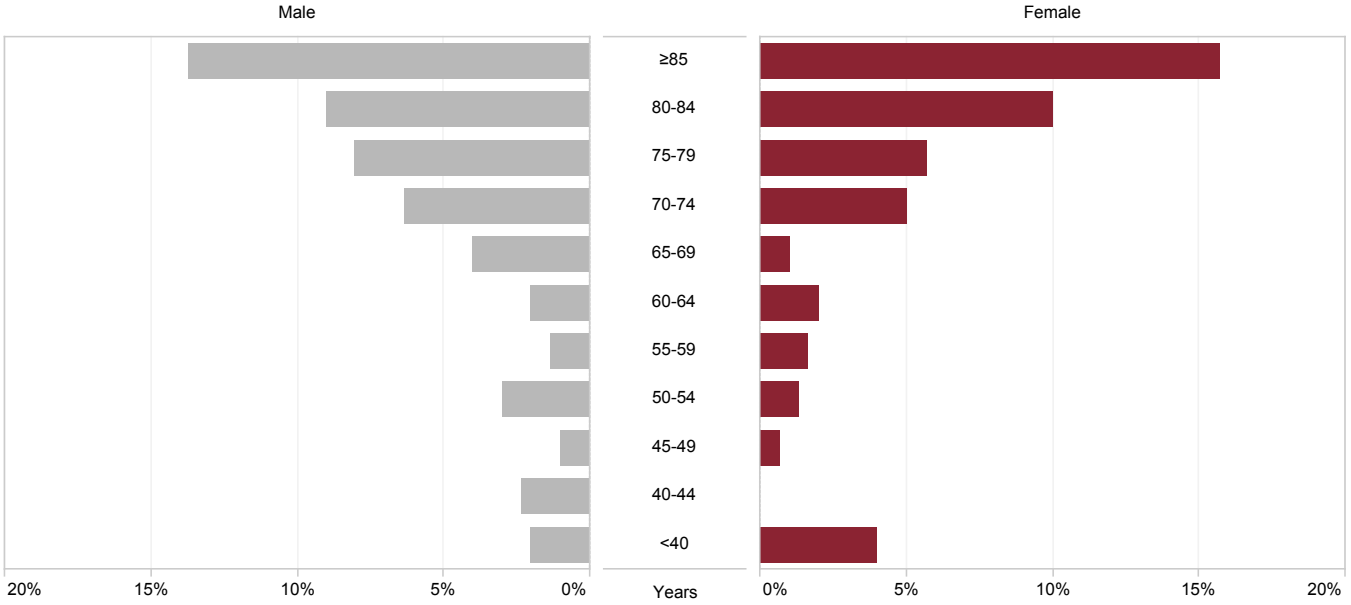
‡ Myocardial septal ablation, renal denervation and percutaneous insertion of pulmonary arterial pressure monitoring device

8.2 Patient characteristics

8.2.1 Age and gender

Gender of patients undergoing an SHD intervention were closely distributed with 53% male and 47% female. Almost one third (30%) of all procedures were performed on patients aged 85 years and older.

Age varied considerably by procedure category, with patients undergoing a valvular intervention having an overall median age of 82 years compared to 50 years for device closure procedures.



% of total (n=485 patients)

Figure 1: Proportion of all SHD cases by gender and age group

Table 3: Median age by gender and procedure category

	Male years	Female years	Total years
Device closures	50	50	50
Valvular intervention	82	83	82
Other	66	72	70
All	**76**	**78**	**77**

8.3 Care and treatment of SHD patients

8.3.1 Device closures

There were 147 device closures performed across the seven participating centres. The majority of procedures involved atrial septal closure devices for the correction of a patent foramen ovale (PFO) and atrial septal defect (ASD), at 71% and 20% of case volumes respectively. A smaller proportion of cases were for left atrial appendage closure and interventions to address prosthetic valve paravalvular leaks.

Table 4: Device closure procedures by participating site

Site	Total cases n	PFO* n (%)	ASD† n (%)	PDA‡ n (%)	LAA§ n (%)	Paravalvular leak n (%)	VSD‖ n (%)
CH	18	15 (83.3)	3 (16.7)	–	–	–	–
TUH	13	13 (100.0)	–	–	–	–	–
SCUH	20	18 (90.0)	2 (10.0)	–	–	–	–
TPCH	26	6 (23.1)	7 (26.9)	1 (3.8)	9 (34.6)	3 (11.5)	–
RBWH	19	16 (84.2)	3 (15.8)	–	–	–	–
PAH	31	21 (67.7)	9 (29.0)	–	–	–	1 (3.2)
GCUH	20	15 (75.0)	5 (25.0)	–	–	–	–
STATEWIDE	**147**	**104 (70.7)**	**29 (19.7)**	**1 (0.7)**	**9 (6.1)**	**3 (2.0)**	**1 (0.7)**

* Patent foramen ovale

† Atrial septal defect

‡ Patent ductus arteriosus

§ Left atrial appendage

‖ Ventricular septal defect

8.3.2 Valvular interventions

The total number of valvular interventions performed across the seven participating sites was 326, comprising of transcatheter valve replacement (77%) and transcatheter valvuloplasty (23%) procedures.

The aortic valve was the most common valve involving intervention, accounting for 88% of cases.

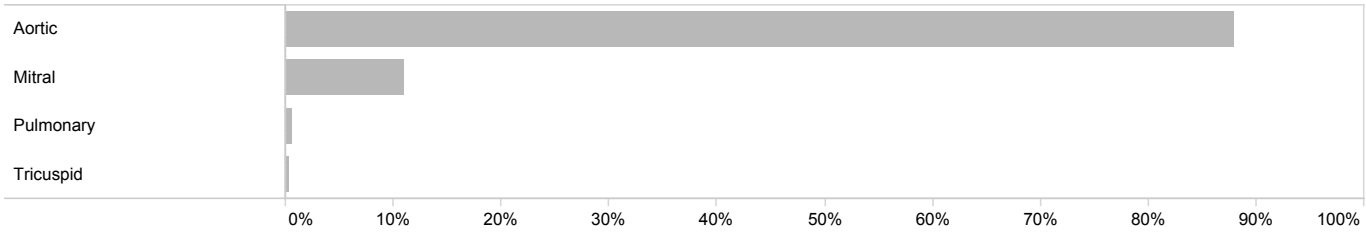


Figure 2: Proportion of all transcatheter valvular interventions by valve type

Table 5: Transcatheter valvular interventions by cardiac valve

Site	Total cases n	Aortic n (%)	Mitral n (%)	Pulmonary n (%)	Tricuspid n (%)
CH	4	4 (100.0)	–	–	–
TUH	15	13 (86.7)	2 (13.3)	–	–
SCUH	2	2 (100.0)	–	–	–
TPCH	200	166 (83.0)	31 (15.5)	2 (1.0)	1 (0.5)
RBWH	3	2 (66.7)	1 (33.3)	–	–
PAH	70	68 (97.1)	2 (2.9)	–	–
GCUH	32	32 (100.0)	–	–	–
STATEWIDE	**326**	**287 (88.0)**	**36 (11.0)**	**2 (0.6)**	**1 (0.3)**

Table 6: Transcatheter valvular interventions by type

Site	Total cases n	Transcatheter valve replacement n (%)	Transcatheter valvuloplasty n (%)
CH	4	–	4 (100.0)
TUH	15	13 (86.7)	2 (13.3)
SCUH	2	–	2 (100.0)
TPCH	200	147 (73.5)	53 (26.5)
RBWH	3	–	3 (100.0)
PAH	70	63 (90.0)	7 (10.0)
GCUH	32	28 (87.5)	4 (12.5)
STATEWIDE	**326**	**251 (77.0)**	**75 (23.0)**

The rapid evolution of transcatheter based technology has meant that transcatheter valve replacement procedures have become an increasing common approach for treating patients with conditions often otherwise reliant on cardiac surgery. There were four sites that offered transcatheter aortic valve replacement procedures where the vast majority were transcatheter aortic valve replacement (95%).

Table 7: Transcatheter valvuloplasty procedures

Site	Balloon aortic valvuloplasty n (%)	Balloon mitral valvuloplasty n (%)	Mitral leaflet clip n (%)	Balloon tricuspid valvuloplasty n (%)
CH	4 (100.0)	–	–	–
TUH	–	2 (100.0)	–	–
SCUH	2 (100.0)	–	–	–
TPCH	30 (56.6)	3 (5.7)	19 (35.8)	1 (1.9)
RBWH	2 (66.7)	1 (33.3)	–	–
PAH	6 (85.7)	1 (14.3)	–	–
GCUH	4 (100.0)	–	–	–
STATEWIDE	**48 (64.0)**	**7 (9.3)**	**19 (25.3)**	**1 (1.3)**

Table 8: Transcatheter valve replacement procedures

Site	TAVR* n (%)	TMVR† n (%)	TTVR‡ n (%)	TPVR§ n (%)
TUH	13 (100.0)	–	–	–
TPCH	136 (92.5)	9 (6.1)	1 (0.7)	1 (0.7)
PAH	62 (98.4)	1 (1.6)	–	–
GCUH	28 (100.0)	–	–	–
STATEWIDE	**239 (95.2)**	**10 (4.0)**	**1 (0.4)**	**1 (0.4)**

* Transcatheter aortic valve replacement/implantation

† Transcatheter mitral valve replacement

‡ Transcatheter tricuspid valve replacement

§ Transcatheter pulmonary valve replacement

Table 9: Other structural heart disease interventions

Site	Myocardial septal ablation n (%)	Percutaneous insertion of pulmonary arterial pressure monitoring device n (%)	Renal denervation n (%)
TPCH	–	4 (36.4)	7 (63.6)
PAH	1 (100.0)	–	–
STATEWIDE	**1 (8.3)**	**4 (33.3)**	**7 (58.3)**

8.4 Patient outcomes

8.4.1 All-cause 30 day mortality

Thirty day mortality rates typically reflect the success of the procedural or technical component of any intervention. Across the seven public cardiac catheterisation laboratories in Queensland that offer SHD interventions, the all-cause, unadjusted 30 day mortality rate for all SHD procedures was 1.2%. Further descriptions of longer term outcomes for TAVR cohorts from previous years are discussed further in the subsequent analysis.

Table 10: All-cause unadjusted 30 day mortality post SHD intervention by procedure category and site

Site	Total cases n	Device closure n (%)	Valvular intervention n (%)	Other n (%)	Total mortality n (%)
CH	24	0 (0.0)	2 (50.0)	–	2 (9.1)
TUH	28	0 (0.0)	0 (0.0)	–	0 (0.0)
SCUH	22	0 (0.0)	0 (0.0)	–	0 (0.0)
TPCH	237	0 (0.0)	2 (1.0)	0 (0.0)	2 (0.8)
RBWH	22	0 (0.0)	0 (0.0)	–	0 (0.0)
PAH	102	1 (3.2)	0 (0.0)	0 (0.0)	1 (1.0)
GCUH	52	0 (0.0)	1 (3.1)	–	1 (1.9)
STATEWIDE	**487**	**1 (0.7)**	**5 (1.5)**	**0 (0.0)**	**6 (1.2)**

8.4.2 Transcatheter aortic valve replacement cases

Patients who undergo TAVR are typically of relatively advanced age and usually present with multiple comorbidities and risk factors that result in a transcatheter therapy being a more suitable procedure than a traditional open surgical aortic valve replacement (SAVR). Patient selection is based on a large volume of published randomised control trial data. Multiple data-sets have indicated overall comparable short and longer-term outcomes with TAVR and SAVR but with shorter length of stay and a trend to a lower risk of major complications, greater patient satisfaction and lower mortality.[15,16,17,18] Longer term data is so far showing an apparent equivalent valve durability between TAVR and SAVR bio-prostheses although longer term and larger data-sets are required.[17] The age of patients undergoing TAVR is also falling and this is in-line with and supported by large randomised trial data in addition to international guidelines reflecting this data.[19] There is also an apparent growing role for TAVR as treatment for degenerated previously implanted SAVR bio-prostheses as lower risk management strategy.[20]

2021 cases

Of the four sites performing TAVR in 2021, the all-cause unadjusted mortality rate within 30 days of the procedure for the statewide cohort was 0.8%.

Table 11: All-cause unadjusted 30 day mortality post TAVR by site

Site	Total cases n	30 day mortality n (%)
TUH	13	0 (0.0)
TPCH	136	1 (0.7)
PAH	62	0 (0.0)
GCUH	28	1 (3.6)
STATEWIDE	**239**	**2 (0.8)**

2020 and 2019 cases

Of the four sites performing TAVR in 2020, the overall all-cause unadjusted mortality rate within 30 days of the procedure was 1.2%, and 9.2% at one year. For the TAVR procedures performed in 2019, the overall all-cause unadjusted mortality rate at two years post procedure was 18.9%. This is in-line with similarly age and risk matched international cohorts from high-volume TAVR centres.[21,22,23] It is recognised that all-cause mortality, especially beyond 30 days, include patient factors not necessarily related to the procedure or intervention in this older and often comorbid patient group.

Table 12: All-cause unadjusted 30 day and 1 year mortality post TAVR by site (2020 cohort)

Site	Total cases n	Median age at procedure years	Interquartile range years	30 day mortality n (%)	1 year mortality n (%)
TUH	21	84	82–86	0 (0.0)	4 (19.0)
TPCH	150	81	76–86	2 (1.3)	16 (10.7)
PAH	55	81	76–84	1 (1.8)	2 (3.6)
GCUH	23	81	78–83	0 (0.0)	1 (4.3)
STATEWIDE	**249**	**81**	**76–85**	**3 (1.2)**	**23 (9.2)**

Table 13: All cause unadjusted mortality up to 2 years post TAVR by site (2019 cohort)

Site	Total cases n	Median age at procedure years	Interquartile range years	30 day mortality n (%)	1 year mortality n (%)	2 year mortality n (%)
TUH	13	83	76–87	0 (0.0)	5 (38.5)	6 (46.2)
TPCH	156	83	78–87	5 (3.2)	22 (14.1)	33 (21.2)
PAH	54	82	78–84	0 (0.0)	3 (5.6)	6 (11.1)
GCUH	26	84	80–87	0 (0.0)	0 (0.0)	2 (7.7)
STATEWIDE	**249**	**83**	**78–86**	**5 (2.0)**	**30 (12.0)**	**47 (18.9)**

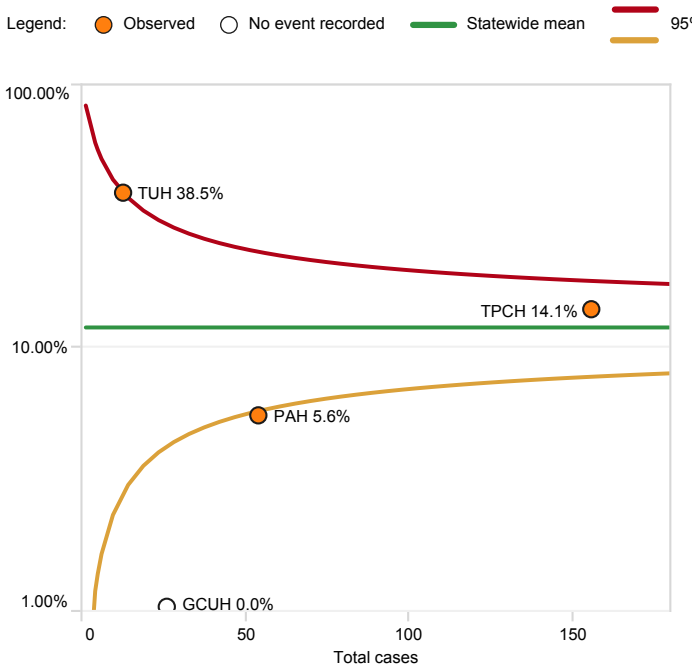


Figure 3: One year mortality post TAVR by site (2019 cohort)

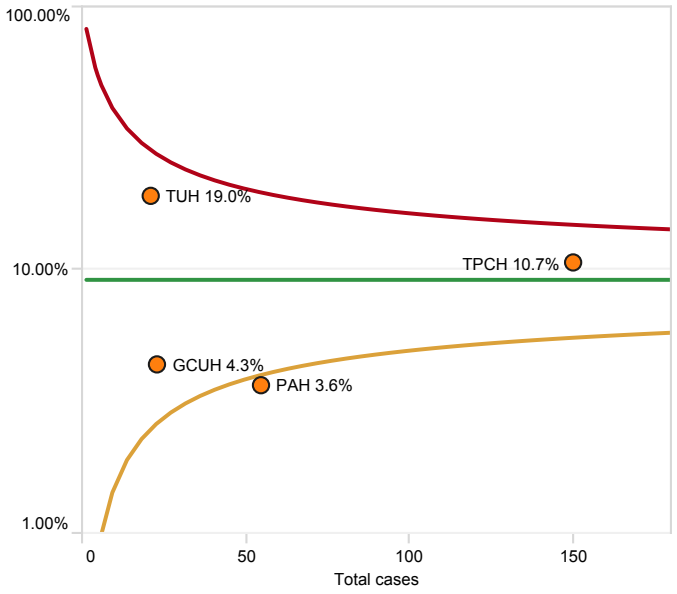


Figure 4: One year mortality post TAVR by site (2020 cohort)

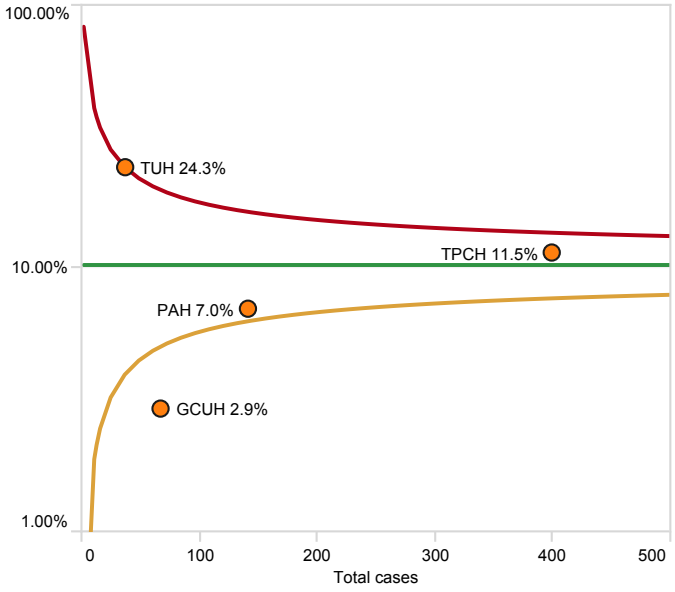


Figure 5: One year mortality post TAVR by site (2018–2020 cohort)

References

Interventional Cardiology Audit

1 Australian Institute of Health and Welfare (2015). *The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples*. Cat. No. AIHW 147. Canberra: Australian Institute of Health and Welfare.

2 Australian Bureau of Statistics. (2021). *Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians*. ABS. https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/census-population-and-housing-counts-aboriginal-and-torres-strait-islander-australians/latest-release (viewed October 2022).

3 National Cardiovascular Data Registry. CathPCI Data Coder's Dictionary. (2011). Retrieved September 27, 2021, from: https://www.ncdr.com/webncdr/cathpci/home/datacollection

4 Baran, D. A., Grines, C. L., Bailey, S., Burkhoff, D., Hall, S. A., Henry, T. D., Hollenberg, S. M., Kapur, N. K., O'Neill, W., Ornato, J. P., Stelling, K., Thiele, H., Diepen, S., & Naidu, S. S. (2019). SCAI clinical expert consensus statement on the classification of Cardiogenic Shock. *Catheterization and Cardiovascular Interventions*. https://doi.org/10.1002/ccd.28329

5 Chew, D. P., Scott, I. A., Cullen, L., French, J. K., Briffa, T. G., Tideman, P. A., Woodruffe, S., Kerr, A., Branagan, M., & Aylward, P. E. G. (2017). Corrigendum to 'National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand: Australian clinical guidelines for the management of Acute Coronary Syndromes 2016' Heart Lung and Circulation volume 25, (2016) 898 - 952. *Heart, Lung and Circulation, 26*(10), 1117. https://doi.org/10.1016/j.hlc.2017.08.004

6 Lefkovits, J., Brennan, A., Dinh, D., Carruthers, H., Doyle, J., Scanlon, P., Lucas, M., and Reid, C. on behalf of the Victorian Cardiac Outcomes Registry (VCOR). *The Victorian Cardiac Outcomes Registry Annual Report 2020*. Monash University, School of Public Health and Preventive Medicine. August 2021, Report No 8, page 56.

7 McAllister, K. S. L., Ludman, P. F., Hulme, W., de Belder, M. A., Stables, R., Chowdhary, S., Mamas, M. A., Sperrin, M., & Buchan, I. E. (2016). A contemporary risk model for predicting 30-day mortality following percutaneous coronary intervention in England and Wales. *International Journal of Cardiology, 210*, 125–132. https://doi.org/10.1016/j.ijcard.2016.02.085

8 Doan, T. N., Prior, M., Vollbon, W., Rogers, B., Rashford, S., & Bosley, E. (2021). Survival after resuscitated out-of-hospital cardiac arrest in patients with paramedic-identified ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention. *Prehospital Emergency Care, 26*(6), 764–771. https://doi.org/10.1080/10903127.2021.1992054

9 Andrianopoulos, N., Chan, W., Reid, C., Brennan, A. L., Yan, B., Yip, T., Clark, D. J., New, G., Ajani, A. E., & Duffy, S. J. (2014). PW245 Australia's first PCI registry-derived logistic and additive risk score calculations predicting post-procedural adverse outcomes. *Global Heart, 9*(1). https://doi.org/10.1016/j.gheart.2014.03.2340

10 Hannan, E. L., Farrell, L. S., Walford, G., Jacobs, A. K., Berger, P. B., Holmes, D. R., Stamato, N. J., Sharma, S., & King, S. B. (2013). The New York State Risk Score for predicting in-hospital/30-day mortality following percutaneous coronary intervention. *JACC: Cardiovascular Interventions, 6*(6), 614–622. https://doi.org/10.1016/j.jcin.2013.02.015

11 Beck, B., Bray, J., Cameron, P., Smith, K., Walker, T., Grantham, H., Hein, C., Thorrowgood, M., Smith, A., Inoue, M., Smith, T., Dicker, B., Swain, A., Bosley, E., Pemberton, K., McKay, M., Johnston-Leek, M., Perkins, G. D., Nichol, G., & Finn, J. (2018). Regional variation in the characteristics, incidence and outcomes of out-of-hospital cardiac arrest in Australia and New Zealand: Results from the Aus-ROC Epistry. *Resuscitation, 126*, 49–57. https://doi.org/10.1016/j.resuscitation.2018.02.029

12 O'Gara, P. T., Kushner, F. G., Ascheim, D. D., Casey, D. E., Chung, M. K., de Lemos, J. A., Ettinger, S. M., Fang, J. C., Fesmire, F. M., Franklin, B. A., Granger, C. B., Krumholz, H. M., Linderbaum, J. A., Morrow, D. A., Newby, L. K., Ornato, J. P., Ou, N., Radford, M. J., Tamis-Holland, J. E., … Zhao, D. X. (2013). 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: Executive summary. *Circulation, 127*(4), 529–555. https://doi.org/10.1161/cir.0b013e3182742c84

13 Ibanez, B., James, S., Agewall, S., Antunes, M. J., Bucciarelli-Ducci, C., Bueno, H., Caforio, A. L., Crea, F., Goudevenos, J. A., Halvorsen, S., Hindricks, G., Kastrati, A., Lenzen, M. J., Prescott, E., Roffi, M., Valgimigli, M., Varenhorst, C., Vranckx, P., Widimský, P., … Gale, C. P. (2017). 2017 ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. *European Heart Journal, 39*(2), 119–177. https://doi.org/10.1093/eurheartj/ehx393

14 Chesebro, J. H., Knatterud, G., Roberts, R., Borer, J., Cohen, L. S., Dalen, J., Dodge, H. T., Francis, C. K., Hillis, D., & Ludbrook, P. (1987). Thrombolysis in myocardial infarction (TIMI) trial, phase I: A comparison between intravenous tissue plasminogen activator and intravenous streptokinase. clinical findings through hospital discharge. *Circulation, 76*(1), 142–154. https://doi.org/10.1161/01.cir.76.1.142

Supplement: Structural heart disease

[15] Makkar, R. R., Thourani, V. H., Mack, M. J., Kodali, S. K., Kapadia, S., Webb, J. G., Yoon, S.-H., Trento, A., Svensson, L. G., Herrmann, H. C., Szeto, W. Y., Miller, D. C., Satler, L., Cohen, D. J., Dewey, T. M., Babaliaros, V., Williams, M. R., Kereiakes, D. J., Zajarias, A., … Leon, M. B. (2020). Five-year outcomes of transcatheter or surgical aortic-valve replacement. *New England Journal of Medicine, 382*(9), 799–809. https://doi.org/10.1056/nejmoa1910555

[16] Arnold, S. V., Chinnakondepalli, K. M., Magnuson, E. A., Reardon, M. J., Deeb, G. M., Gleason, T., Yakubov, S. J., & Cohen, D. J. (2020). Five-year health status after self-expanding transcatheter or surgical aortic valve replacement in high-risk patients with severe aortic stenosis. *JAMA Cardiology*. https://doi.org/10.1001/jamacardio.2020.4397

[17] Jørgensen, T. H., Thyregod, H. G., Ihlemann, N., Nissen, H., Petursson, P., Kjeldsen, B. J., Steinbrüchel, D. A., Olsen, P. S., & Søndergaard, L. (2021). Eight-year outcomes for patients with aortic valve stenosis at low surgical risk randomized to transcatheter vs. surgical aortic valve replacement. *European Heart Journal, 42*(30), 2912–2919. https://doi.org/10.1093/eurheartj/ehab375

[18] Burrage, M., Moore, P., Cole, C., Cox, S., Lo, W. C., Rafter, A., Garlick, B., Garrahy, P., Mundy, J., & Camuglia, A. (2017). Transcatheter aortic valve replacement is associated with comparable clinical outcomes to open aortic valve surgery but with a reduced length of in-patient hospital stay: A systematic review and meta-analysis of Randomised Trials. *Heart, Lung and Circulation, 26*(3), 285–295. https://doi.org/10.1016/j.hlc.2016.07.011

[19] Vahanian, A., Beyersdorf, F., Praz, F., Milojevic, M., Baldus, S., Bauersachs, J., Capodanno, D., Conradi, L., De Bonis, M., De Paulis, R., Delgado, V., Freemantle, N., Gilard, M., Haugaa, K. H., Jeppsson, A., Jüni, P., Pierard, L., Prendergast, B. D., Sádaba, J. R., … Sharipov, I. (2021). 2021 ESC/EACTS Guidelines for the management of Valvular Heart Disease. *European Heart Journal, 43*(7), 561–632. https://doi.org/10.1093/eurheartj/ehab395

[20] Dauerman, H. L., Deeb, G. M., O'Hair, D. P., Waksman, R., Yakubov, S. J., Kleiman, N. S., Chetcuti, S. J., Hermiller, J. B., Bajwa, T., Khabbaz, K., de Marchena, E., Salerno, T., Dries-Devlin, J. L., Li, S., Popma, J. J., & Reardon, M. J. (2019). Durability and clinical outcomes of transcatheter aortic valve replacement for failed surgical bioprostheses. *Circulation: Cardiovascular Interventions, 12*(10). https://doi.org/10.1161/circinterventions.119.008155

[21] Reardon, M. J., Van Mieghem, N. M., Popma, J. J., Kleiman, N. S., Søndergaard, L., Mumtaz, M., Adams, D. H., Deeb, G. M., Maini, B., Gada, H., Chetcuti, S., Gleason, T., Heiser, J., Lange, R., Merhi, W., Oh, J. K., Olsen, P. S., Piazza, N., Williams, M., … Kappetein, A. P. (2017). Surgical or transcatheter aortic-valve replacement in intermediate-risk patients. *New England Journal of Medicine, 376*(14), 1321–1331. https://doi.org/10.1056/nejmoa1700456

[22] Bekeredjian, R., Szabo, G., Balaban, Ü., Bleiziffer, S., Bauer, T., Ensminger, S., Frerker, C., Herrmann, E., Beyersdorf, F., Hamm, C., Beckmann, A., Möllmann, H., Karck, M., Katus, H. A., & Walther, T. (2018). Patients at low surgical risk as defined by the society of thoracic surgeons score undergoing isolated interventional or surgical aortic valve implantation: In-hospital data and 1-year results from the German Aortic Valve Registry (GARY). *European Heart Journal, 40*(17), 1323–1330. https://doi.org/10.1093/eurheartj/ehy699

[23] Leon, M. B., Smith, C. R., Mack, M. J., Makkar, R. R., Svensson, L. G., Kodali, S. K., Thourani, V. H., Tuzcu, E. M., Miller, D. C., Herrmann, H. C., Doshi, D., Cohen, D. J., Pichard, A. D., Kapadia, S., Dewey, T., Babaliaros, V., Szeto, W. Y., Williams, M. R., Kereiakes, D., … Webb, J. G. (2016). Transcatheter or surgical aortic-valve replacement in intermediate-risk patients. *New England Journal of Medicine, 374*(17), 1609–1620. https://doi.org/10.1056/nejmoa1514616

Glossary

6MWT	Six Minute Walk Test
ACC	Aristotle Comprehensive Complexity
ACEI	Angiotensin Converting Enzyme Inhibitor
ACP	Advanced Care Paramedic
ACS	Acute Coronary Syndromes
AEP	Accredited Exercise Physiologist
ANZCORS	Australia and New Zealand Congenital Outcomes Registry for Surgery
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
AQoL	Assessment of Quality of Life
AUC	Area Under Curve
ARB	Angiotensin II Receptor Blocker
ARF	Acute Rheumatic Fever
ARNI	Angiotensin Receptor-Neprilysin Inhibitors
ASD	Atrial Septal Defect
AV	Atrioventricular
AVNRT	Atrioventricular Nodal Re-entry Tachycardia
BCIS	British Cardiovascular Intervention Society
BiV	Biventricular
BMI	Body Mass Index
BMS	Bare Metal Stent
BNH	Bundaberg Hospital
BSSLTx	Bilateral Sequential Single Lung Transplant
BVS	Bioresorbable Vascular Scaffold
CABG	Coronary Artery Bypass Graft
CAD	Coronary Artery Disease
CBH	Caboolture Hospital
CCL	Cardiac Catheter Laboratory
CCP	Critical Care Paramedic
CH	Cairns Hospital
CI	Clinical Indicator
CIED	Cardiac Implantable Electronic Device
COVID-19	Coronavirus disease 2019
CPB	Cardiopulmonary Bypass
CR	Cardiac Rehabilitation
CRT	Cardiac Resynchronisation Therapy
CS	Cardiac Surgery
CVA	Cerebrovascular Accident
DAOH	Days Alive and Out of Hospital
DES	Drug Eluting Stent
DOSA	Day of Surgery Admission
DSWI	Deep Sternal Wound Infection
ECG	12 lead Electrocardiograph
ECMO	Extracorporeal membrane oxygenation
ED	Emergency Department
eGFR	Estimated Glomerular Filtration Rate
EP	Electrophysiology
EuroSCORE	European System for Cardiac Operative Risk Evaluation
EWMA	Exponentially Weighted Moving Average
FdECG	First Diagnostic Electrocardiograph
FMC	First Medical Contact
FTR	Failure to Rescue
GAD	Generalized Anxiety Disorder
GCCH	Gold Coast Community Health
GCS	Glasgow Coma Scale
GCUH	Gold Coast University Hospital
GLH	Gladstone Hospital
GP	General Practitioner
GYH	Gympie Hospital
HB	Haemoglobin
HBH	Hervey Bay Hospital (includes Maryborough)
HCC	Health Contact Centre
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HFSS	Heart Failure Support Service
HHS	Hospital and Health Service
H-L	Hosmer–Lemeshow Test Statistic
HOCM	Hypertrophic Obstructive Cardiomyopathy
HSQ	Health Support Queensland
IC	Interventional Cardiology
ICD	Implantable Cardioverter Defibrillator
IE	Infective Endocarditis
IHT	Inter-hospital Transfer
IPCH	Ipswich Community Health
IVDU	Intravenous Drug Use
LAA	Left Atrial Appendage
LAD	Left Anterior Descending Artery
LCX	Circumflex Artery
LGH	Logan Hospital
LOS	Length Of Stay
LV	Left Ventricle
LVEF	Left Ventricular Ejection Fraction
LVOT	Left Ventricular Outflow Tract
MBH	Mackay Base Hospital
MI	Myocardial Infarction

MIH	Mt Isa Hospital
MKH	Mackay Base Hospital
MRA	Mineralocorticoid Receptor Antagonists
MSSA	Methicillin Susceptible Staphylococcus Aureus
MTHB	Mater Adult Hospital, Brisbane
NCDR	The National Cardiovascular Data Registry
NCR	National Cardiac Registry
NCS	Networked Cardiac Services
NP	Nurse Practitioner
NRBC	Non-Red Blood Cells
NSTEMI	Non ST Elevation Myocardial Infarction
OR	Odds Ratio
OOHCA	Out of Hospital Cardiac Arrest
ORIF	Open Reduction Internal Fixation
PAH	Princess Alexandra Hospital
PAPVD	Partial Anomalous Pulmonary Venous Drainage
PCI	Percutaneous Coronary Intervention
PDA	Patent Ductus Arteriosus
PFO	Patent Foramen Ovale
PHQ	Patient Health Questionnaire
PICU	Paediatric intensive care unit
PROMS	Patient Reported Outcome Measures
QAS	Queensland Ambulance Service
QCCN	Queensland Cardiac Clinical Network
QCOR	Queensland Cardiac Outcomes Registry
QEII	Queen Elizabeth II Jubilee Hospital
QHAPDC	Queensland Hospital Admitted Patient Data Collection
QPCR	Queensland Paediatric Cardiac Research
RBC	Red Blood Cells
RBWH	Royal Brisbane & Women's Hospital
RCA	Right Coronary Artery
RDH	Redcliffe Hospital
RHD	Rheumatic Heart Disease
RKH	Rockhampton Hospital
RLH	Redland Hospital
SCCIU	Statewide Cardiac Clinical Informatics Unit
SCUH	Sunshine Coast University Hospital
SHD	Structural Heart Disease
SMoCC	Self Management of Chronic Conditions
STEMI	ST-Elevation Myocardial Infarction
STS	Society of Thoracic Surgery
TAVR	Transcatheter Aortic Valve Replacement
TIMI	Thrombolysis in Myocardial Infarction
TMVR	Transcatheter Mitral Valve Replacement
TNM	Tumour, Lymph Node, Metastases
TPCH	The Prince Charles Hospital
TPVR	Transcatheter Pulmonary Valve Replacement
TUH	Townsville University Hospital
TWH	Toowoomba Hospital
TXA	Tranexamic Acid
VAD	Ventricular Assist Device
VATS	Video Assisted Thoracic Surgery
VCOR	Victorian Cardiac Outcomes Registry
VF	Ventricular Fibrillation
VSD	Ventricular Septal Defect

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