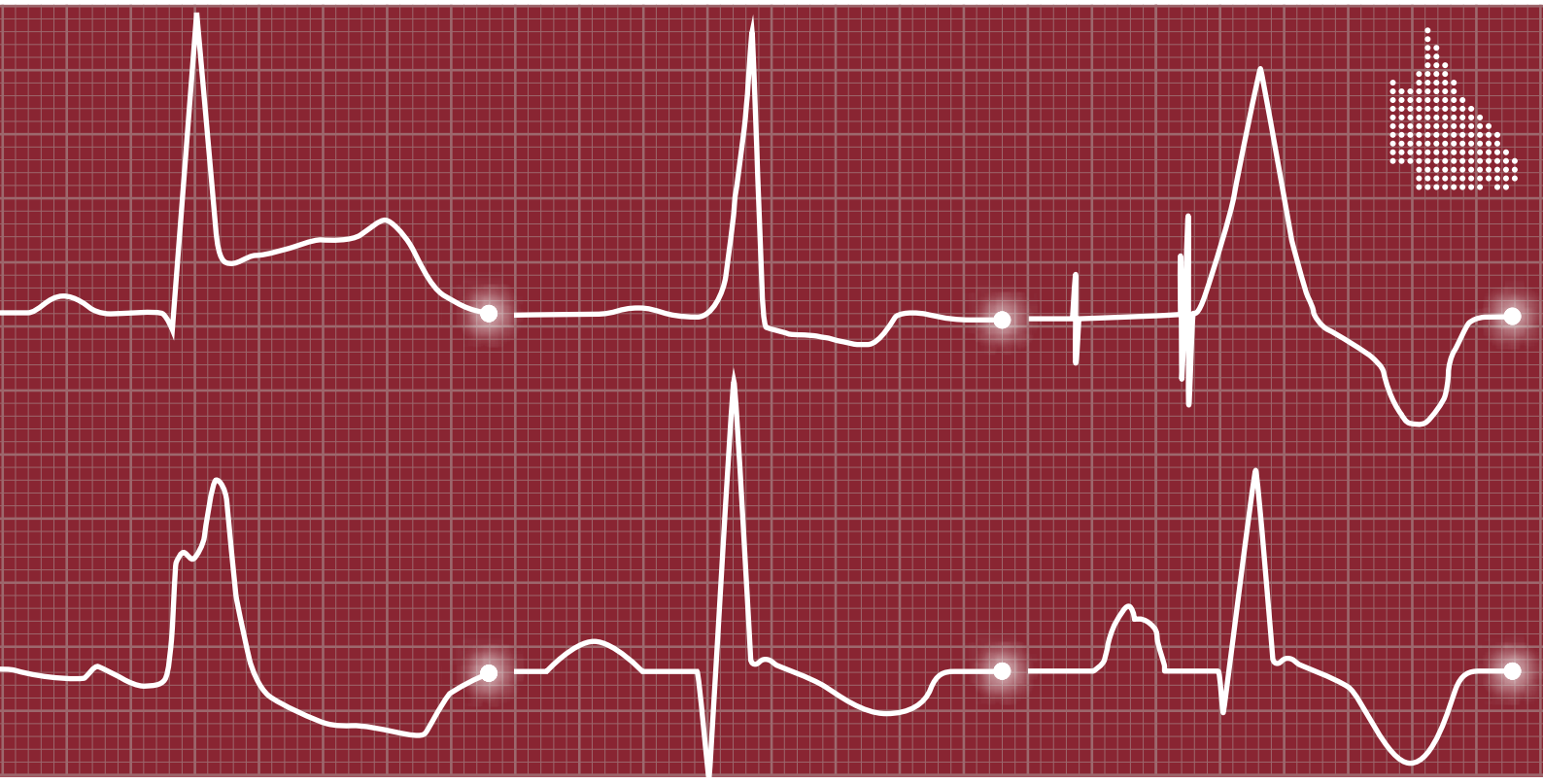
Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry

2019 Annual Report

Interventional Cardiology Audit



Queensland Cardiac Outcomes Registry
2019 Annual Report

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1 Message from the SCCN Chair

We are pleased to present the 2019 Queensland Cardiac Outcomes Registry (QCOR) Annual Report, which marks five years of publication. Yet again, the Report documents the world-class quality of care offered by practitioners within the Queensland public health system. The QCOR program is driven by the passion of Queensland's clinicians to not only report on the quality, performance and outcomes of cardiac services delivered to Queenslanders, but to enable and provide a comprehensive platform to directly support frontline cardiac services and be a driving force for continuous improvement. The result has been collaboration on a statewide scale, with QCOR directly supporting the efforts of hundreds of clinicians across often incredible distances.

The breadth of QCOR is highlighted by the development of a new module to support cardiac outreach services, starting with the Far North Queensland outreach unit in late 2019. Outreach services are an important part of delivering quality care to patients for whom cardiac care is less accessible, due to their remoteness from traditional facility-based services. This initial reporting will be expanded as additional units are established or come online over following years. This Report also shines a spotlight on the new partnership between QCOR and the Queensland Rheumatic Heart Disease (RHD) Registry. Despite being in its infancy, this collaboration has already led to the identification and development of specialised care plans for almost two hundred Queenslanders suffering from RHD. These are outcomes which are seldom linked to traditional research-focused registries and reflect a far greater vision at the core of this clinician-led initiative.

Clinical quality has again continued to be a focus of this report, with several new clinical indicators having been added to these audits for the new year to align with ever-changing international guidelines for the management and treatment of patients. As such, the registry continues to evolve and clinical indicators across all areas of interest will continue to be reviewed and expand accordingly over future years. It is yet again reassuring to see performance of Queensland services strong when compared to these often optimistic benchmarks and targets.

Investment in the collection of clinical data is now recognised as a valuable means of returning on investment and identifying areas of efficiency that subsequently enable cost savings and redirection of health funding to areas of need or emerging clinical technologies. QCOR data has underpinned bulk purchase arrangements and continues to demonstrate the ability to negotiate strongly with industry via commercial processes and ensure that each health funding dollar is spent wisely and carefully. Future processes now have the potential to increase in scope which will drive further financial realisation on investment that compound and grow over time.

The tireless work of Queensland cardiac clinicians and administrative staff must be recognised, not only for delivering high quality clinical outcomes but for their engagement, understanding and enthusiasm for quality clinical processes that are supported by quality data, and we look forward to future expansion that seeks to apply a similar scope and high standard of reporting to echocardiography and structural heart disease.

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

2 Introduction

The Queensland Cardiac Outcomes Registry (QCOR) is an ever-evolving clinical registry and quality program established by the Statewide Cardiac Clinical Network (SCCN) 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 improve patient care and support quality improvement activities 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 SCCN 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.

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 Marcus Prior, Informatics Analyst
Dr Ian Smith, PhD, Biostatistician
Mr William Vollbon, Manager*
Mr Michael Mallouhi, Clinical Analyst
Ms Bianca Sexton, Project Manager
Mr Karl Wortmann, Application Developer

* Principal contact officer/QCOR program lead

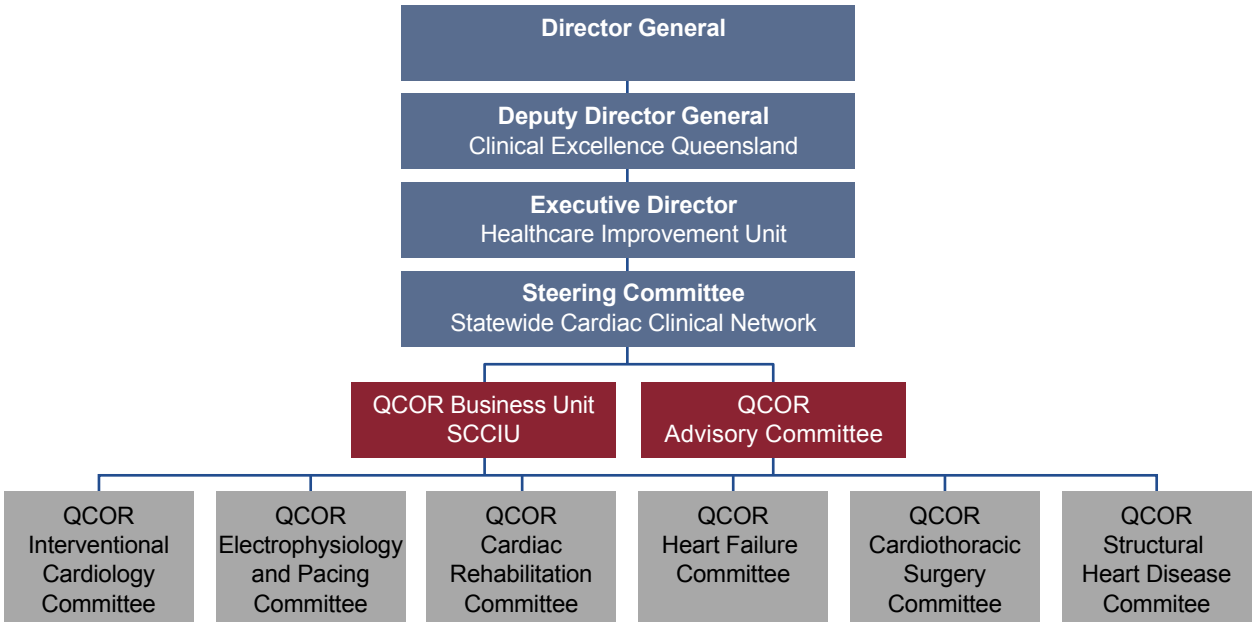
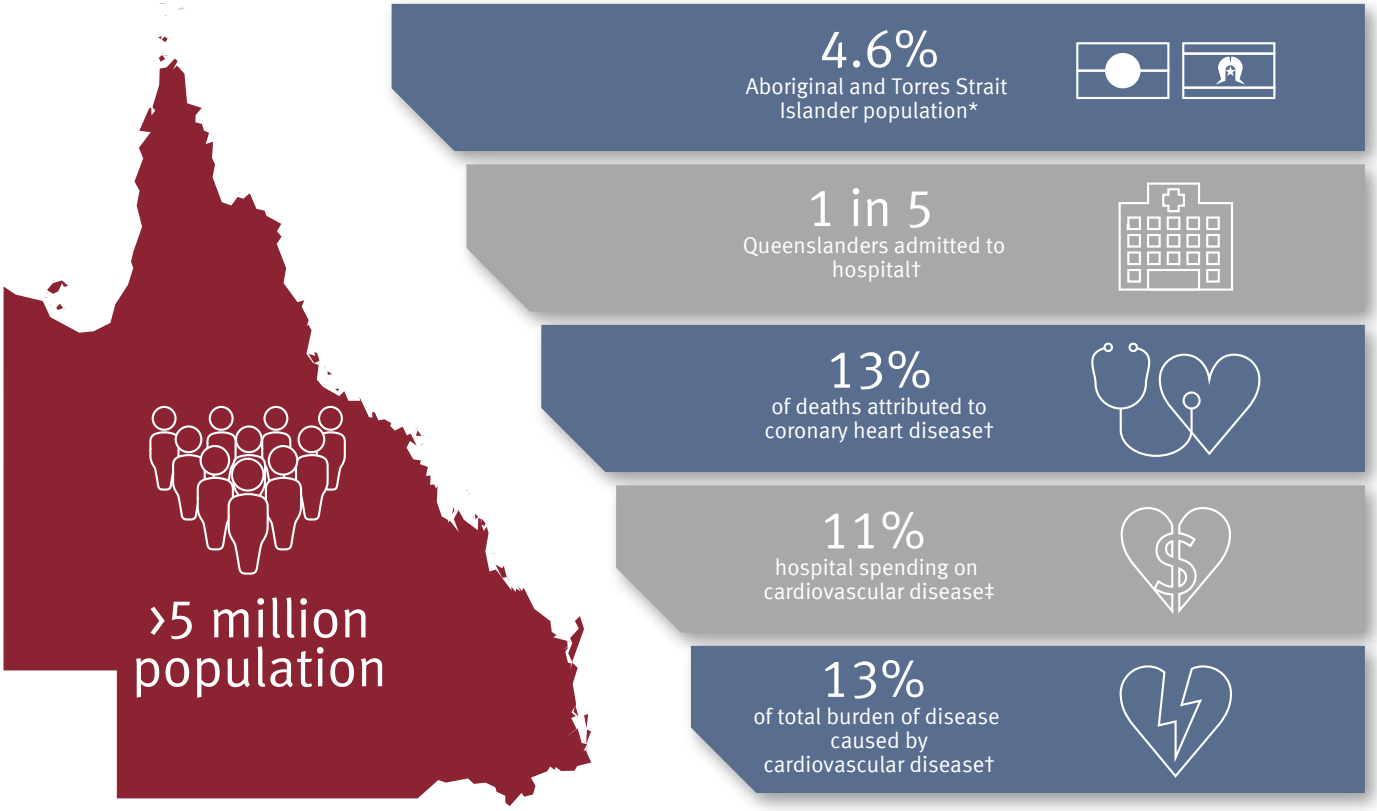


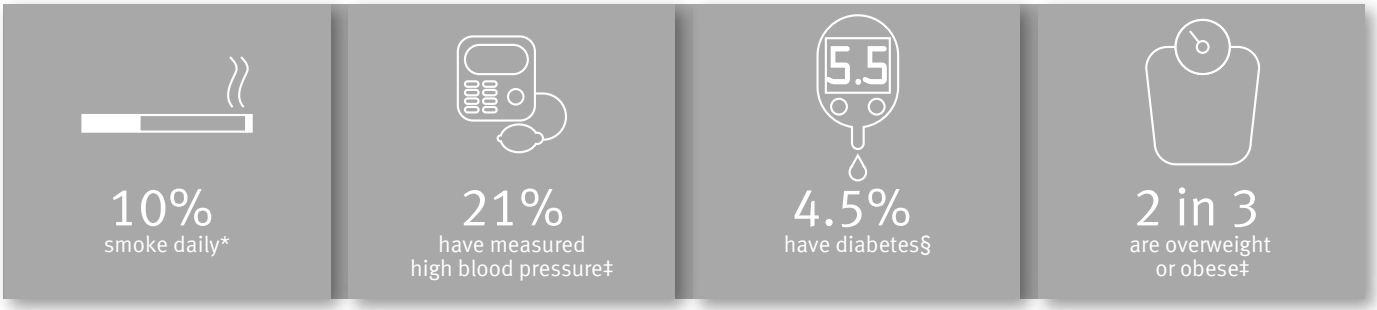
Figure 1: Governance structure

Queensland Cardiac Outcomes Registry

The Health of Queenslanders



Comorbidities



Mortality

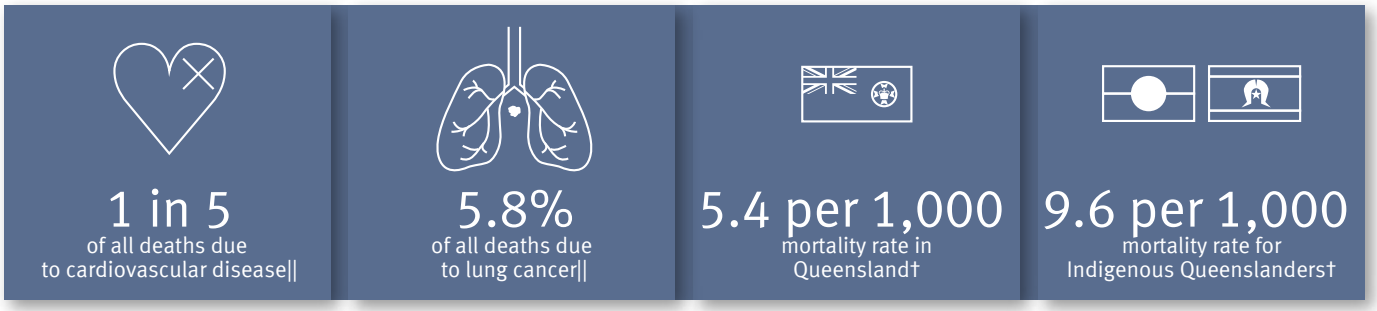


Figure 2: QCOR 2019 infographic

* Australian Bureau of Statistics. (2018). *Estimates of Aboriginal and Torres Strait Islander Australians*, June 2016. Cat. no 3238.055001. ABS: Canberra.

† 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 Bureau of Statistics. (2019). *Deaths, Australia, 2018*. Cat. no. 3302.0. ABS: Canberra.

2019 Activity at a Glance

What's New?

- Rheumatic heart disease, cardiac outreach and ECG Flash spotlights
- Expanded thrombolysis for STEMI analysis
- Cardiac surgery EuroSCORE II risk adjustment analysis
- Cardiac surgery remoteness investigation
- New timely non-acute assessments cardiac rehabilitation indicator
- New mineralocorticoid antagonist prescription heart failure indicator

Interventional Cardiology

5,002
percutaneous coronary interventions

477
structural heart disease interventions

249
transcatheter aortic valve replacements

15,615
all coronary procedures

Cardiothoracic Surgery

2,622
adult cardiac surgeries

1,042
adult thoracic surgeries

Electrophysiology & Pacing

4,654
electrophysiology and pacing procedures

3,189
cardiac implantable electronic device procedures

Heart Failure Support Services

5,304
heart failure support services referrals

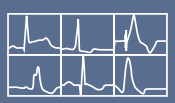
Cardiac Rehabilitation

11,547
cardiac rehabilitation referrals

Rheumatic Heart Disease

179
unknown RHD patients identified

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

92%
of patients referred to a heart failure support service on an ACEI, ARB or ARNI at discharge

94%
of cardiac rehabilitation referrals within 3 days of discharge

1.0%
mortality rate for coronary artery bypass surgery at 30 days

QCOR Yearly Trends

Interventional Cardiology

15,615
cases in 2019
– up from 15,293 in 2017

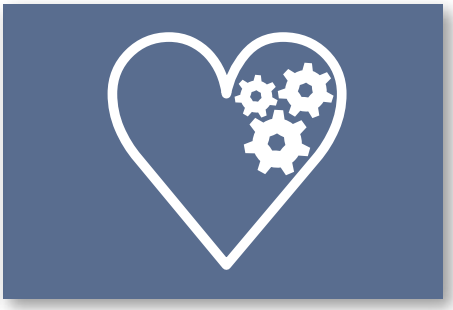
5,002
PCI cases in 2019
– up from 4,867 in 2018

3 minute
improvement in median time to reperfusion for STEMI PCI from 2017 to 2019

8%
increase in primary PCI cases meeting 90 minute target for timely reperfusion – 2017 to 2019

Cardiothoracic Surgery

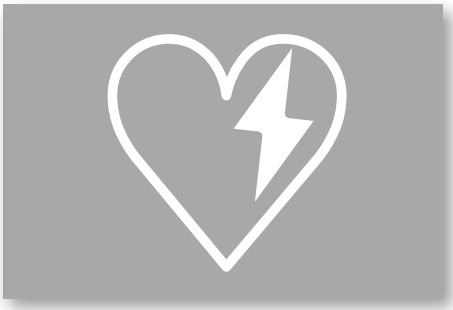
11%
increase in cardiac surgery cases
– 2017 to 2019



23%
increase in thoracic surgery cases
– 2018 to 2019

Electrophysiology & Pacing

4,654
cases in 2019
– up from 4,474 in 2018



22%
increase in complex EP cases
– 2018 to 2019

Outpatient Support Services

23,000+
cardiac rehabilitation referrals
– 2018 and 2019

17%
increase in new heart failure support services referrals
– 2017 to 2019

3 Acknowledgements

This collaborative report was produced by the SCCIU, audit lead for QCOR for and on behalf of the Statewide 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, Townsville University Hospital
- Dr Niranjan Gaikwad, The Prince Charles Hospital
- Dr Paul Garrahy, Princess Alexandra Hospital
- Dr Christopher Hammett, Royal Brisbane & Women's Hospital
- A/Prof Richard Lim, Princess Alexandra Hospital
- Dr Rohan Poulter, Sunshine Coast University Hospital
- A/Prof Atifur Rahman, Gold Coast University Hospital
- Dr Shantisagar Vaidya, Mackay Base Hospital
- Dr Gregory Starmer, Cairns Hospital (Chair)

QCOR Cardiothoracic Surgery Committee

- Dr Anil Prabhu, The Prince Charles Hospital
- Dr Pallav Shah, Townsville University Hospital
- Dr Andrie Stroebel, Gold Coast University Hospital
- Dr Morgan Windsor, Metro North Hospital and Health Service
- 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 Jacqueline Cairns, Cairns Hospital
- Ms Yvonne Martin, Chronic Disease Brisbane South
- Dr Johanne Neill, Ipswich Hospital
- Ms Samara Phillips, Statewide Cardiac Rehabilitation Coordinator
- Ms Madonna Prenzler, West Moreton Hospital and Health Service
- Ms Deborah Snow, Gold Coast Hospital and Health Service
- Ms Natalie Thomas, South West Hospital and Health Service
- Mr Gary Bennett, Health Contact Centre (Chair)

Statewide Cardiac Clinical Informatics Unit

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

QCOR Electrophysiology and Pacing Committee

- 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
- Ms Sanja Doneva, Princess Alexandra Hospital
- Mr Nathan Engstrom, Townsville University Hospital
- A/Prof John Hill, Princess Alexandra Hospital
- Dr Bobby John, Townsville University Hospital
- Dr Paul Martin, Royal Brisbane & Women's Hospital
- Ms Sonya Naumann, Royal Brisbane & Women's Hospital
- Dr Kevin Ng, Cairns Hospital
- Dr Robert Park, Gold Coast University Hospital

QCOR Heart Failure Support Services Committee

- Mr Ben Shea, Ipswich Hospital
- Ms Angie Sutcliffe, Cairns Hospital
- Ms Tina Ha, Princess Alexandra Hospital
- Ms Helen Hannan, Rockhampton Hospital
- Ms Annabel Hickey, Statewide Heart Failure Services Coordinator
- Dr Rita Hwang, PhD, Princess Alexandra Hospital
- Dr Kevin Ng, Cairns Hospital
- Ms Robyn Peters, Princess Alexandra Hospital
- Ms Serena Rofail, Royal Brisbane & Women's Hospital
- Dr Yee Weng Wong, The Prince Charles Hospital
- A/Prof John Atherton, Royal Brisbane & Women's Hospital (Chair)

Queensland Ambulance Service

- Dr Tan Doan, PhD
- Mr Brett Rogers

4 Executive summary

This report comprises an account for cases performed in the eight cardiac catheterisation laboratories (CCL) and nine electrophysiology and pacing (EP) facilities, along with five cardiothoracic surgery units operating across Queensland public hospitals in 2019. Referrals to the 21 heart failure support and 57 cardiac rehabilitation services for the management of heart disease have also been included in this Audit.

- 15,615 diagnostic or interventional cases were performed across the eight public CCL facilities in Queensland hospitals. Percutaneous coronary intervention (PCI) was performed in 5,002 of these cases.
- Patient outcomes following PCI remain encouraging. The 30 day mortality rate following PCI was 2.2%, and of the 108 deaths observed, 77% were classed as either salvage or emergency PCI.
- When analysing the ST segment elevation myocardial infarction (STEMI) patient cohort, the median time from first diagnostic electrocardiograph (ECG) to reperfusion and arrival at PCI facility to reperfusion was observed at 83 minutes and 42 minutes.
- Across the four sites with a cardiac surgery unit, a total of 2,622 cases were performed including 1,567 coronary artery bypass grafting (CABG) and 1,104 valve procedures.
- The observed rates for cardiac surgery mortality and morbidity are either within the expected range or better than expected, depending on the risk model used to evaluate these outcomes. This is consistent with the results of previous audits.
- Approximately 4% of all cardiac surgical patients resided in remote or very remote Australia.
- Patients in Outer Regional and Remote/Very Remote areas were two to four times more likely to have a postoperative length of stay >14 days (Outer Regional: OR 2.02, p<0.01), Remote/Very Remote: OR 4.05, p <0.001).
- Patients residing outside of a Major City of Australia had a higher likelihood of having a length of stay <6 days (Inner Regional: OR 1.61 p=0.009, Outer Regional: OR 1.45 p=0.044).
- A total of 1,042 thoracic surgery cases were performed across the five public hospitals providing thoracic surgery services in 2019. Almost a quarter (24%) of surgeries followed a preoperative diagnosis of primary lung cancer, whereas pleural disease accounted for nearly a third of all cases (32%).
- At the nine public Electrophysiology and Pacing (EP) sites, a total of 4,654 cases were performed, which included 3,189 cardiac device procedures and 1,058 electrophysiology procedures. This year's EP Audit sees the addition of Toowoomba Hospital, which began direct entry in November 2019.
- The EP clinical indicator audit identified a median wait time of 81 days for complex ablation procedures, and 32 days for elective implantable cardioverter defibrillator (ICD) implants. Meanwhile the median wait time for a standard ablation procedure was 117 days.
- There was a total of 11,547 referrals to one of the 57 public cardiac rehabilitation (CR) services in 2019. Almost three quarters of referrals (74%) followed an admission at a public hospital in Queensland.
- The vast majority of referrals to CR were created within three days of the patient being discharged from hospital (94%), while over half of patients went on to complete an initial assessment by CR within 28 days of discharge (56%). This performance measure is consistent with the data observed in 2018.
- There were 5,304 new referrals to a heart failure support service in 2019. Clinical indicator benchmarks were achieved for timely follow-up of referrals and appropriate medication prescriptions as per clinical guidelines for all medications except mineralocorticoid receptor antagonists.

5 Cardiac Outreach Spotlight

The development and implementation of the QCOR Cardiac Outreach module is an initiative of the Statewide Cardiac Clinical Network in partnership with the Healthcare Improvement Unit and the Health Minister's 'Rapid Results Program'.

People living in rural and remote locations (such as North Queensland) and Aboriginal and Torres Strait Islander people are admitted to hospital for cardiac related conditions at two to three times the rate of the broader Queensland population*. Equitable access to health care across Queensland can be a challenge due to its vast size and dispersed population, which can require patients to travel significant distances to access cardiac care. Furthermore, due to the vast distances this patient cohort need to travel to access tertiary care, their healthcare journey is often fragmented contributing to poorer access and health outcomes. The foundation of this model is based on a coordinated approach which supports the patient journey by linking to services. Through the outreach model, patients in a remote setting can access support from a team of practitioners much closer to home including a specialist cardiologist, cardiac scientists, nurses and health workers.

As well as seeing a cardiologist for initial consultation, review or follow-up, patients attending a cardiac outreach clinic can have specialised tests such as echocardiograms and stress tests, as well as the potential for referral to tertiary care for more complex procedures. Close links with other Queensland Health outpatient services such as cardiac rehabilitation programs or heart failure support services are also an advantage of this model of care. These services are further supplemented by telehealth and remote cardiac testing capabilities.

Through 2018–2019, the SCCIU and Rapid Results Program collaborated with staff and subject matter experts across the various Queensland Health cardiac outreach units to develop a new QCOR module specifically oriented towards this work. The new QCOR Outreach Module establishes a foundation for cardiac outreach care coordination across the health system, and a reporting platform which allows an unprecedented amount of information to be available for an area otherwise characterised by relative paucity of data.

The QCOR Outreach Module provides Queensland Health practitioners with:

- Patient-centric clinical case management – tailored towards the outreach setting,
- Improved follow up and activity-based reporting for outreach patients and services,
- Reporting of outreach-specialty clinical indicators and other key performance measures, and
- Potential for future integration with other Queensland Health and QCOR systems.

The new QCOR Outreach Module was deployed from 2019 as part of a staggered rollout, with the Far North Queensland Outreach Unit as the first site commencing in November 2019. Further units have been added to the system over the following year as either new outreach programs are established or existing services transition to the system.

Table 1: QCOR cardiac outreach module – participating outreach units

Cardiac outreach unit	Hub facility	Commenced date
Far North Queensland Cardiac Outreach	Cairns Hospital	November 2019
Townsville and North West Queensland Cardiac Outreach	Townsville University Hospital	January 2020
Princess Alexandra Hospital Cardiac Outreach	Princess Alexandra Hospital	July 2020
Toowoomba Hospital Cardiac Outreach	Toowoomba Hospital	August 2020
Ipswich Hospital Cardiac Outreach	Ipswich Hospital	November 2020

* Australian Commission on Safety and Quality in Health Care (ACSQHC) and Australian Institute of Health and Welfare. (2017). The second Australian atlas of healthcare variation. Sydney: ACSQHC.

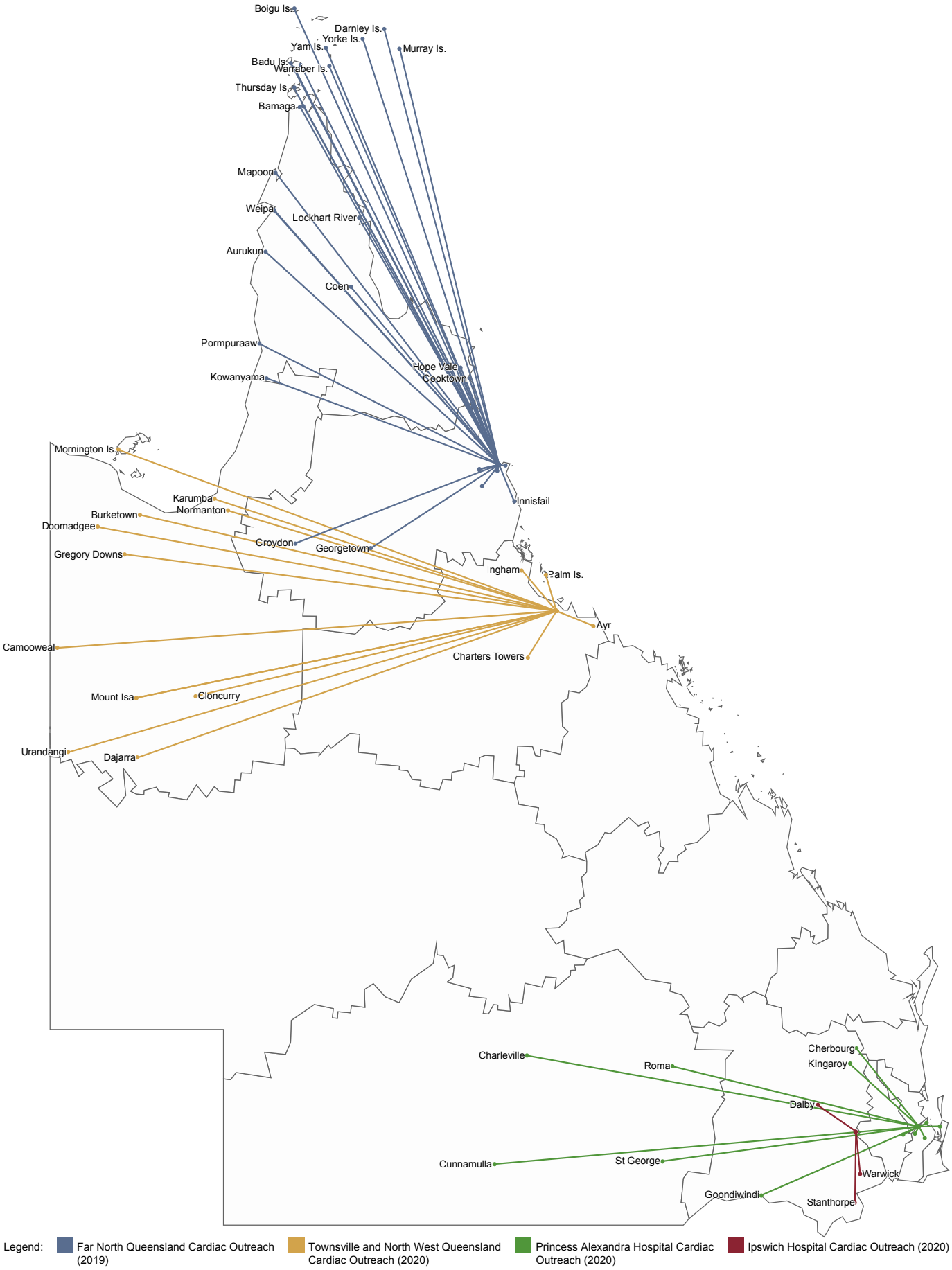


Figure 3: Cardiac outreach hub and spoke locations

6 ECG Flash Spotlight

ECG Flash, a Statewide Cardiac Clinical Network initiative, aims to give rural and remote clinicians 24/7 access to urgent specialist cardiology advice. When a patient presents at emergency and an ECG is taken, the system lets clinicians send time critical, difficult-to-interpret ECGs straight to an on call cardiologist for rapid analysis. The on call cardiologist receives a digital copy of the ECG to review and will call the treating clinician back to provide treatment advice. ECG Flash has been implemented to use a hub and spoke model of care where larger facilities with specialist staff cardiologists act as the hub to smaller regional and remote centres.

Regional and remote sites (spoke sites) use a digitally enabled ECG cart which automatically transmits all ECGs taken to an enterprise clinical data storage application. This digital storage solution for ECGs is available at each site and from there clinicians can selectively transmit time critical, difficult-to-interpret ECGs directly to the on call cardiologist at their referring tertiary hospital (hub site). They are also able to access ECGs taken at other participating hospitals within their HHS, allowing them to have access to patients' ECGs across multiple facilities.

In 2019, there were 30 rural sites utilising the ECG Flash solution and they sent 252 ECGs through to five receiving cardiology departments.

Implementation at an additional 51 rural sites and 3 hub sites is planned for 2020. Further use of ECG Flash data to complement existing QCOR data collections will be the focus for future work.

Table 2: ECG Flash – participating hub sites

ECG Flash hub	Commenced date	Number of spoke sites 2019	Number of spoke sites 2020
Princess Alexandra Hospital	August 2018	9	9
Cairns Hospital	September 2018	10	19
Mackay Base Hospital	February 2019	7	7
Townsville University Hospital	June 2019	4	6
Bundaberg Hospital	February 2020	–	8

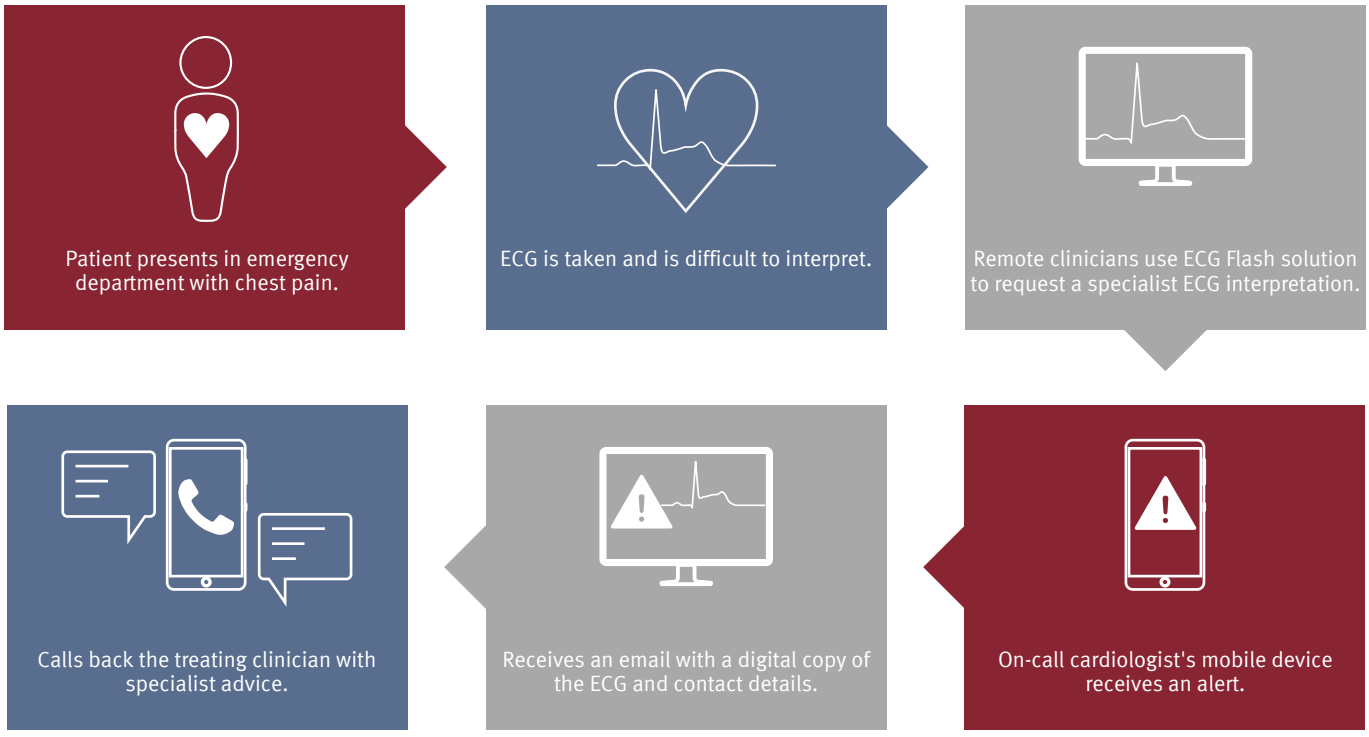


Figure 4: ECG Flash process flow

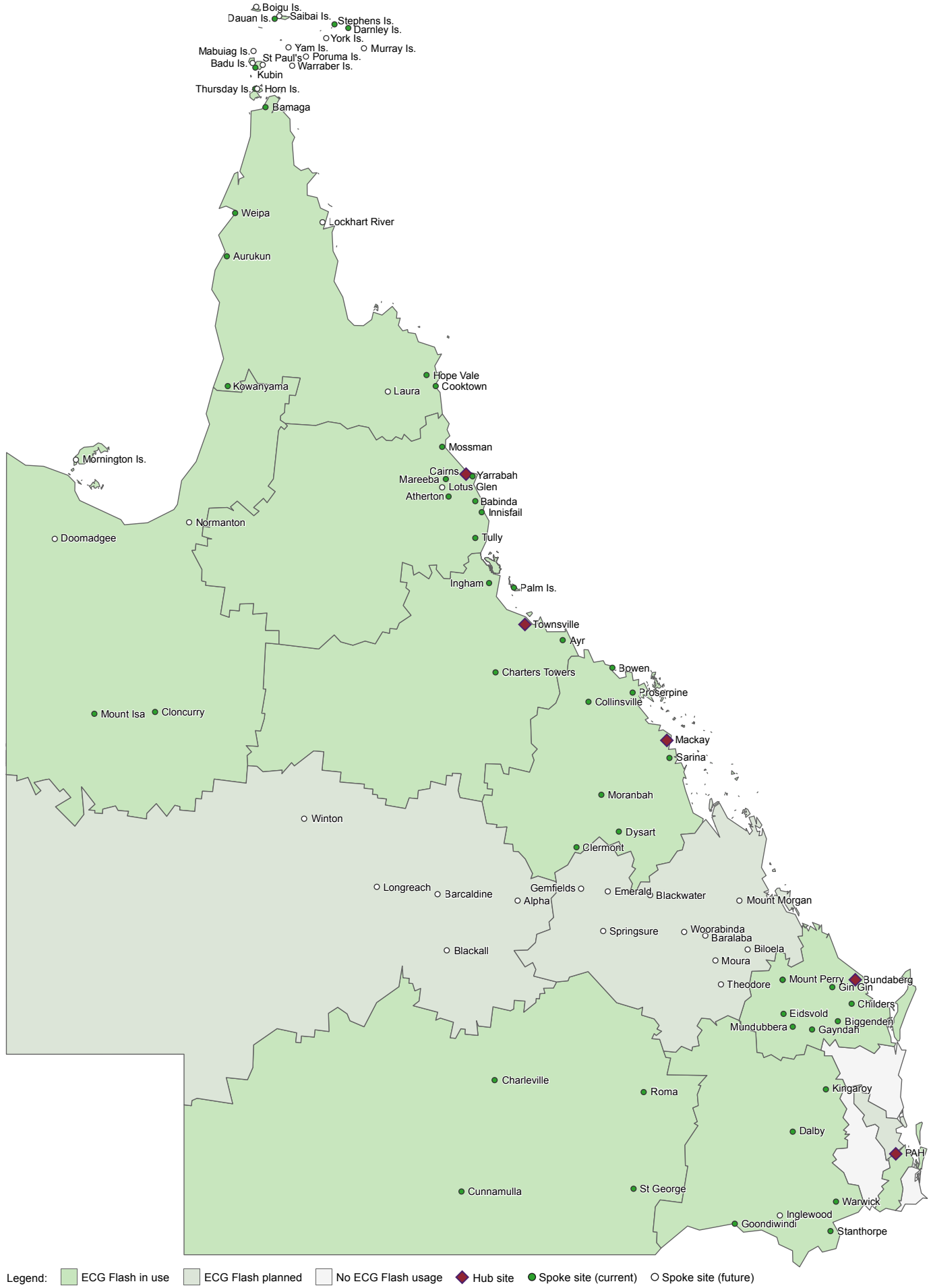


Figure 5: ECG Flash hub and spoke locations as at November 2020

7 RHD Spotlight

7.1 Background

The Queensland rheumatic heart disease register and control program (RHD Program) was established in 2009 to address rheumatic heart disease (RHD) as the leading cause of cardiovascular disparity between Aboriginal and Torres Strait Islander peoples and Australians of other descent. The program supports existing healthcare services with client care by maintaining a skilled health workforce, promoting culturally appropriate care, supporting education and health promotion for patients and communities, and working with patients and primary health care staff to optimise timely delivery of secondary prophylaxis.

The program further advocates for and supports activities aimed at preventing, identifying, managing and treating acute rheumatic fever (ARF) and RHD, and promotes primordial, primary and secondary prevention aimed at preventing initial episodes of ARF and development of RHD. This includes the development and distribution of ARF/RHD education and health promotion-focused resources such as client and family educational material to improve health literacy, and information on diversionary therapy aids and reward/incentive products.

Additional strategies are being undertaken to enhance the quality of support the program provides including, creation and distribution of reports for outreach clinics, HHS, service providers and health service planning managers. Individual client information and clinical advice is being provided to healthcare providers including, diagnostic criteria, notification process, treatment and follow-up requirements (point of care information).

The World Health Organization recommends a coordinated, public health approach in areas where there are substantial populations with ARF or RHD. The Australian Guideline for prevention, diagnosis and management of ARF and RHD (3rd edition)* states that 'Comprehensive RHD control programs which span action in the social and environmental determinants of health and primary and secondary prevention of ARF, can provide an effective approach to reducing the burden of RHD.' It is with this structure and suggested methodology that the Queensland RHD Program has been established.

7.2 The disease

ARF is an acute illness causing a generalised, autoimmune inflammatory response following repeated exposure to and infection with Group A Streptococcal bacteria. The inflammatory response occurs predominantly in the heart, joints, brain and skin. Clients typically present with a history of a sore throat and/or infected skin sores, pain and swelling in one or more joints, fever, malaise, a skin rash, chorea (jerky, uncoordinated movements of the hands, feet, tongue and face) and sometimes chest pain. Clinical investigations may identify prolonged atrioventricular junctional arrhythmias on an electrocardiogram, a heart murmur or carditis.

Once the initial acute illness has resolved, ARF leaves no lasting damage to the joints or skin however, any remaining damage to the brain can cause ongoing mental health and neurological issues. Similarly, anatomical changes occur affecting the heart valves with the ensuing clinical sequalae known as RHD. Repeated episodes of ARF inevitably lead to the development or worsening of RHD.

Severe RHD usually requires surgical intervention in the form of valve repair and/or replacement. Individuals receiving mechanical valves require lifelong anticoagulation. Every year, RHD kills people and devastates lives, particularly those of young Aboriginal and Torres Strait Islander Queenslanders. The disease process begins with symptoms as modest as a sore throat or skin infection which can be easily treated with common antibiotics, however if left untreated, it can lead to stroke and valve disease requiring cardiac surgery, often in an adolescent population. Efforts to prevent ARF and RHD currently centre on primary prevention (of the sore throat or skin infection), and secondary prevention via delivery of secondary prophylactic antibiotics to prevent recurrent episodes.

7.3 Disease demographics

Across Australia, sustained improvements to the conditions in which we are born, grow, live and work have permanently reduced the rates of preventable infectious diseases. Unfortunately, this progress is inequitable and Aboriginal and Torres Strait Islander people have not benefitted from the same improvements in health and living outcomes as the rest of Australia. Household disadvantage, poor-quality living conditions, poverty and overcrowding all contribute to health inequalities in at-risk populations.

ARF and RHD are diseases that exemplify the 'gap' between Aboriginal and Torres Strait Islander peoples and Australians of other descent. In 2017, there was a rate of 111 ARF cases per 100,000 Aboriginal and Torres Strait Islander Australians whereas for Australians of other descent the rate was 1 per 100,000. (Australian Institute of Health and Welfare (AIHW) 2019).† Between the ages of 5 years to 24 years, Aboriginal and Torres Strait Islander peoples are three times more likely to die from RHD than Australians of other descent.

7.4 The costs of ARF and RHD

Eliminating RHD means preventing all new cases of ARF. Preventing ARF is as simple as early diagnosis and treatment of a Streptococcal infection. This cost is negligible in comparison to the long term management of what would become chronic disease.

ARF and RHD contribute to increased death and disability in Queensland. RHD accrues early in life, with 20% of people on the Queensland RHD Register under 18 years of age and 26% of all ARF and RHD clients having had or will require valvular surgery.

The estimated financial costs of ARF and RHD diagnosis and management are outlined in Table 1.‡

Table 3: Costs of diagnosis and management of ARF and RHD

	Child $	Adult $
Management of Acute disease requiring hospitalisation		
ARF – Inpatient	12,075	12,912
RHD – Non-Surgical	11,798	9,787
RHD – Surgical	74,915	72,042
ARF/RHD Management (per year)		
ARF with/without mild RHD	2,048	2,048
Severe RHD	3,920	3,920

7.5 Disease prevention

Interventions to eradicate ARF and RHD in Australia require strategies that target the underlying economic, social and environmental conditions. These are structural and health system considerations that include moving away from a silo-based culture and transitioning towards functional multiagency, multidisciplinary teams. By actioning disparities in the environmental, social, cultural and economic determinants of health, primary and secondary prevention strategies for ARF and RHD can be developed. These then lend themselves to effective tertiary care which provides clients with high-quality medical and surgical management of their RHD.

* RHD Australia (ARF/RHD writing group) (2020). *The 2020 Australian guideline for prevention, diagnosis and management of acute rheumatic fever and rheumatic heart disease* (3rd edition). Retrieved from https://www.rhdaustralia.org.au/arf-rhd-guideline

† Australian Institute of Health and Welfare (2020). *Acute rheumatic fever and rheumatic heart disease in Australia, 2014–2018.* Retrieved from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/acute-rheumatic-fever/contents/summary

‡ Wyber, R., Noonan, K., Halkon, C., Enkel, S., Ralph, A., … Carapetis, J. (2020.). *The RHD Endgame Strategy: A Snapshot. The blueprint to eliminate rheumatic heart disease in Australia by 2031*. Perth: The END RHD Centre of Research Excellence, Telethon Kids Institute

7.6 Queensland RHD Program and QCOR

In September 2018, RHD became a notifiable condition in Queensland. Since April 2019, QCOR and the RHD program have collaborated to enhance the reporting of all RHD-identified echocardiograms to the RHD register for Cairns, Townsville, Mackay and Rockhampton hospitals. Interaction between the RHD Register and QCOR acts as a supporting notification mechanism, assisting to identify those patients who have not previously been or were escalated for notification of RHD at the time of their clinical encounter.

Through QCOR, reporting of positive RHD findings by echocardiography has resulted in 172 previously unknown clients with RHD being added to the Register.

Table 4: QCOR echocardiography module RHD notifications

	Positive RHD findings n	Unknown RHD clients identified n
Cairns	494	66
Townsville	150	62
Mackay	47	26
Rockhampton	28	18
Total	**719**	**172**

Through the QCOR cardiac surgery RHD notification reports, seven previously unknown clients requiring surgery for their RHD have been added to the RHD register since October 2019.

Table 5: QCOR cardiac surgery module RHD notifications

	Positive RHD findings n	Unknown RHD clients identified n
Statewide cardiac surgery	14	7

8 Facility profiles

8.1 Cairns Hospital

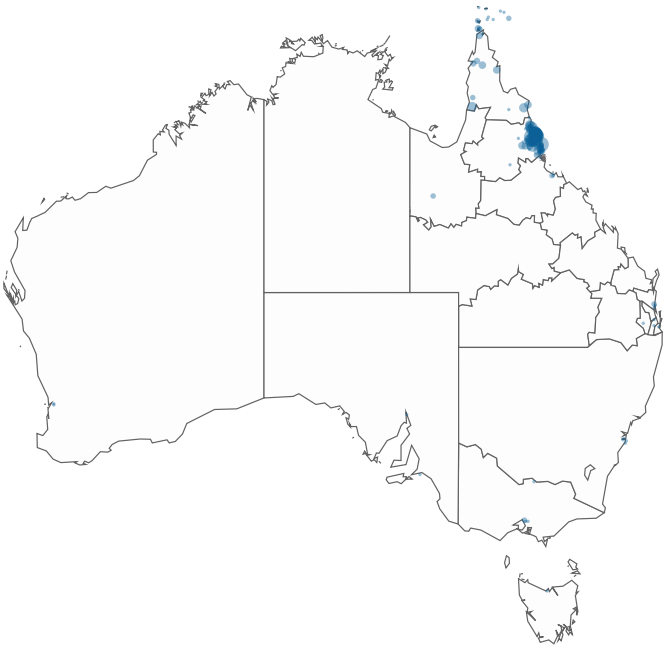


Figure 6: Cairns Hospital

- 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

8.2 Townsville University Hospital

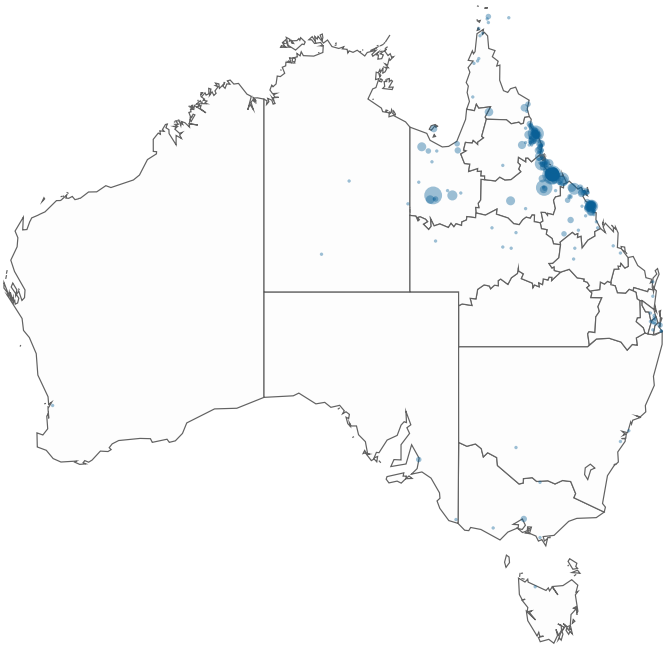


Figure 7: Townsville University Hospital

- 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

8.3 Mackay Base Hospital

Figure 8: 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

8.4 Sunshine Coast University Hospital

Figure 9: 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

8.5 The Prince Charles Hospital

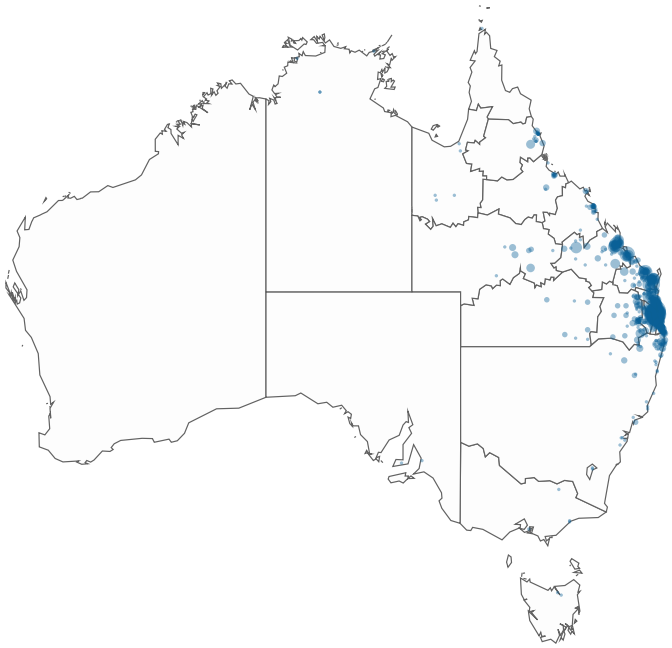


Figure 10: The Prince Charles Hospital

- 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 & 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

8.6 Royal Brisbane & Women's Hospital

Figure 11: 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 & Women's Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Thoracic surgery

8.7 Princess Alexandra Hospital

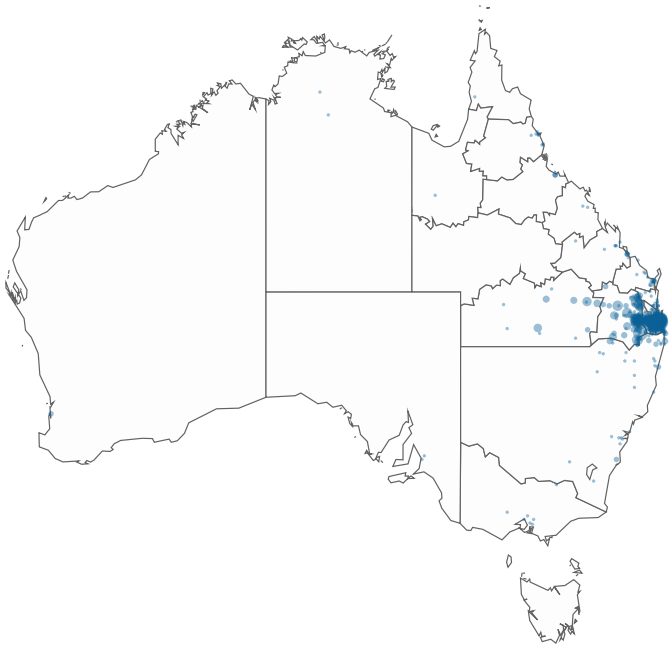


Figure 12: Princess Alexandra Hospital

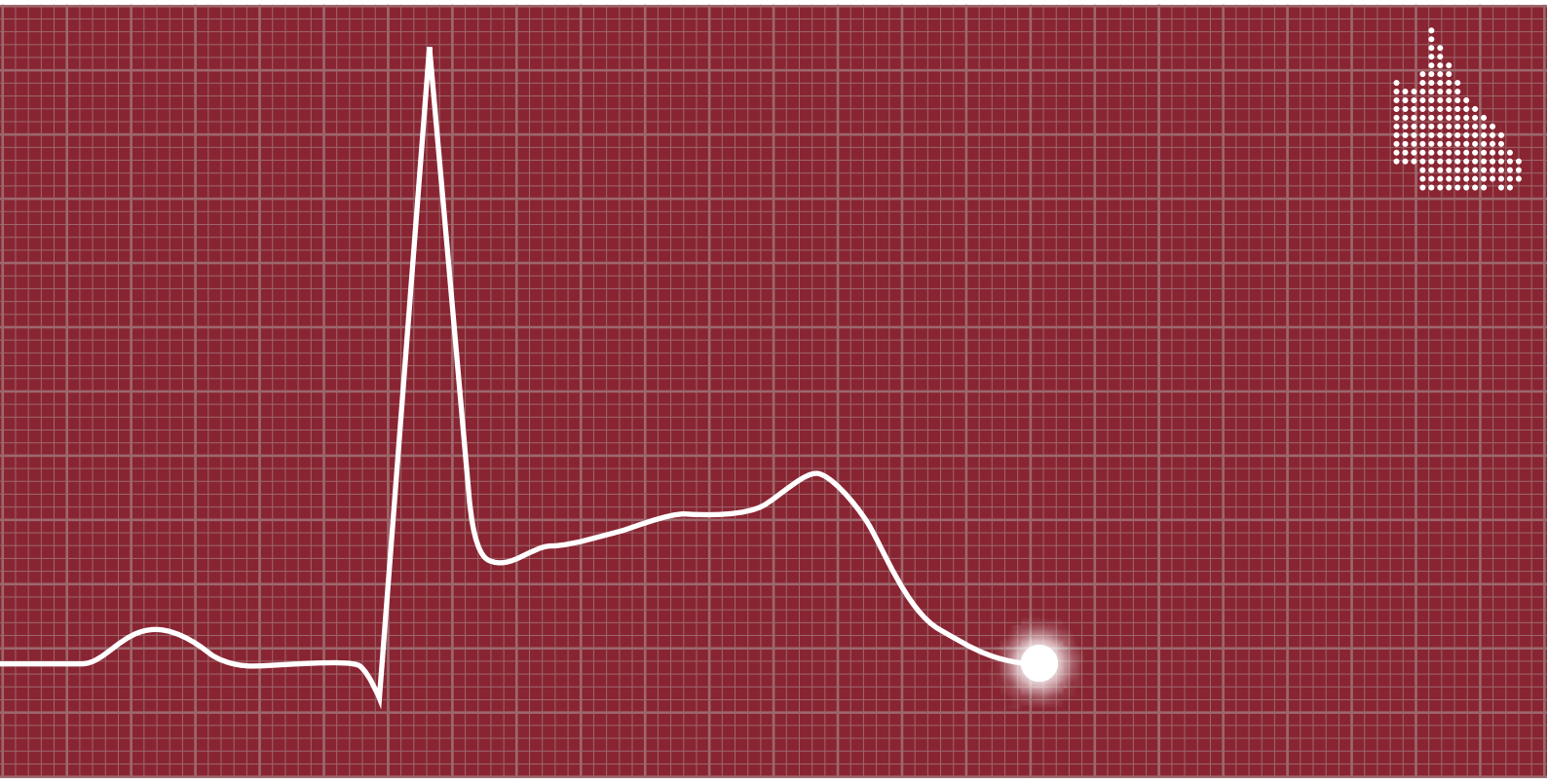
- Referral hospital for Metro South and South West Hospital and Health Services, serving a population of approximately 1,000,000
- Public tertiary level invasive cardiac services provided at the Princess Alexandra Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural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

8.8 Gold Coast University Hospital

Figure 13: 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

With the publication of the 2019 QCOR Interventional Cardiology Audit amidst probably the most significant global health event that any of us will encounter during our professional lifetime, I reflected on the challenges 2020 presented and the composed, yet purposeful and systematic manner, in which my colleagues from around the state united and planned, with the objective being the preservation of high quality cardiac care to those who needed it.

QCOR evolved from a similar desire from clinicians around Queensland to use high quality data to improve systems of care, process, and ultimately, outcomes. In 2014, a relatively modest Queensland Interventional Cardiology Audit was published, and from this, it is both pleasing and reassuring to present the 2019 Interventional Cardiology Report, with expanding data from all eight public Cardiac Catheter laboratories across Queensland. The goal of this report remains the same, to use data to improve outcomes for patients.

The 2019 Report provides in more in-depth analysis of the acute myocardial infarct (STEMI) population, in particular, initial treatment with thrombolysis rather than primary coronary intervention. This data provides an important link in this time-critical disease, and therefore further opportunity to reduce the time it takes to achieve a successful outcome. In many cases, this treatment is provided by the Queensland Ambulance Service paramedics with whom we work closely, and it is important to acknowledge their significant contribution to this body of work.

This report also again highlights the over-representation of Aboriginal and Torres Strait Islander peoples receiving cardiac procedures in Queensland, and sadly, also portrays a significant (11 year) age gap between Indigenous and non-Indigenous patients requiring procedural cardiac care.

The vast majority of patients were non-elective, that is, inpatients requiring cardiac care immediately or prior to discharge. This reflects the highly acute nature of the cardiac disease burden treated in Queensland's public hospitals, and the hospital care was generally prompt, of high quality, and amongst the safest in the world.

The last two years have also seen further development of the National Cardiac Registry (NCR). This takes the form of a "federated" model with state based registries, such as QCOR, responsible for producing a common dataset to contribute to the NCR. QCOR has been an active participant in this evolution, providing the NCR with key pilot analyses. We look forward to the next phase in maturation of this important concept.

Finally, I am reminded of a quote – "without data, you are just another person with an opinion", and I would like to acknowledge the exhaustive effort of the entire SCCIU team, under difficult circumstances this year, for their ongoing dedication to synthesising, analysing, and publishing cardiac data upon which we, as clinicians, can continue to provide high quality cardiac care to Queenslanders.

Dr Greg Starmer
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 2019.

Key findings include:

- 15,615 diagnostic coronary or interventional cases were performed across the eight cardiac catheterisation laboratory facilities in Queensland public hospitals, including 5,002 PCI cases.
- 76% of all PCI patients residing in Queensland had a place of residence within 50 km of the nearest PCI capable facility, while 11% of patients resided more than 150 km from the nearest facility.
- A large proportion of PCI patients (77%) were classed as having an unhealthy body mass index over 25 kg/m^2.
- The proportion of patients identified as Aboriginal and Torres Strait Islander (7.1%) 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 11 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.
- Drug eluting stents were used in 98% of cases, ranging from 95% to 100% across sites.
- There were 1,488 PCI cases following presentation with ST elevation myocardial infarction (STEMI), of which 53% were managed by primary PCI.
- There was a total of 498 thrombolysed STEMIs presenting for angiography, for whom the median time from first diagnostic ECG to the administration of thrombolysis was 35 minutes. The median time from thrombolysis to coronary angiography was 22 hours, with 52% 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 73 minutes to 98 minutes across sites).
- Median hospital door-to-device time for STEMI patients presenting within six hours of symptom onset was 42 minutes (range 37 minutes to 64 minutes across sites).
- PCI for non-ST elevation myocardial infarction (NSTEMI) represented 30% of all cases, with the median time to angiography of 60 hours. Patients presenting to a non-PCI capable facility have a median wait time to coronary angiography of 34 hours longer than those who present directly to a PCI capable facility (76 hours vs. 42 hours).
- Mortality within 30 days following PCI was 2.2% (108 deaths). Of these 108 deaths, 76% were classed as either salvage or emergency PCI.
- Of all cases, 0.72% recorded a major intra-procedural complication. Coronary artery perforation (0.52%) accounted for the majority of these events.
- Radiation doses were found to be under the high dose threshold in 99% of PCI cases across all sites and 99.6% of other coronary procedures.

3 Participating sites

There were eight public hospitals which offered cardiac catheter laboratory (CCL) services across both Metropolitan and regional Queensland.

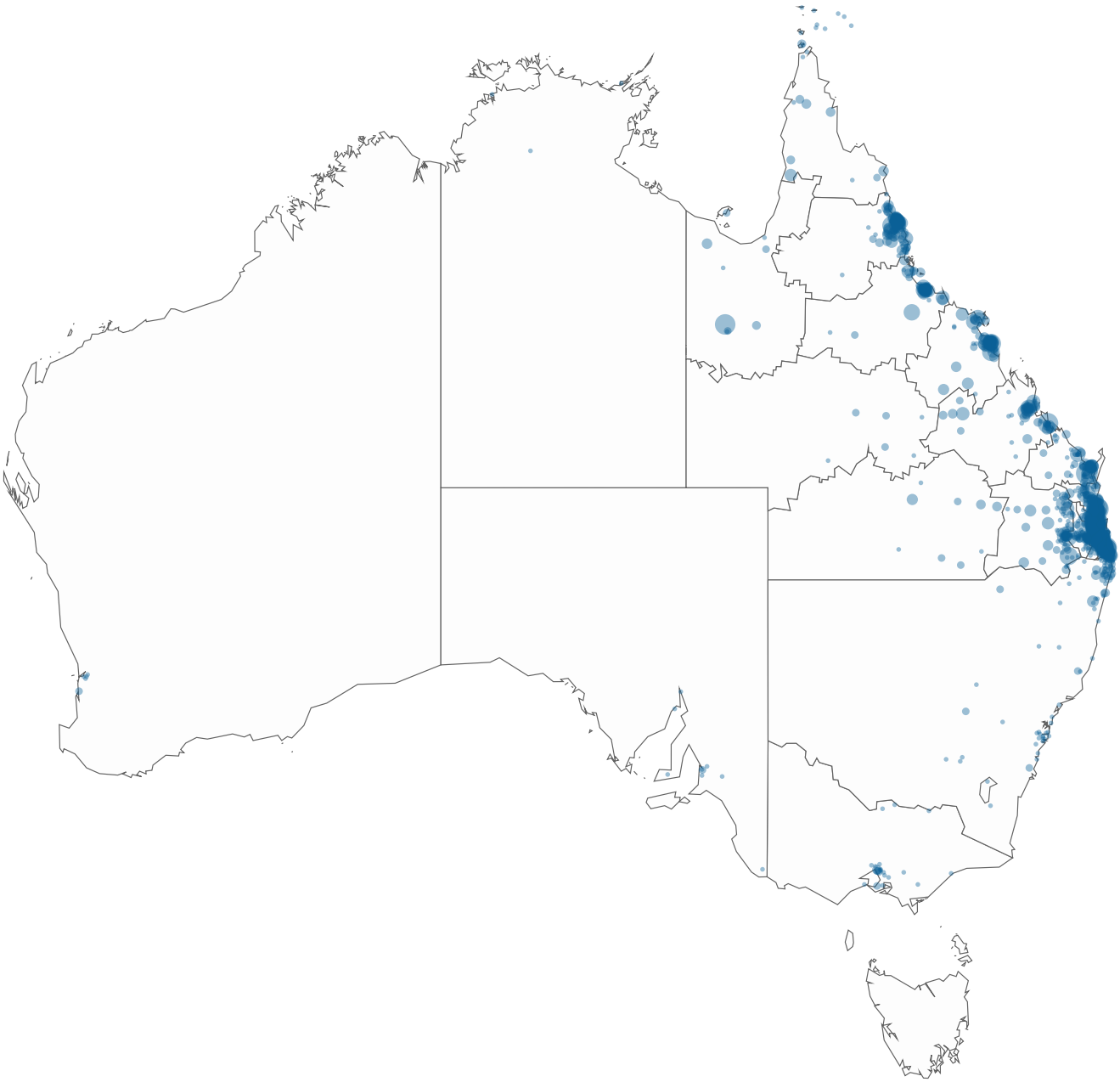


Figure 1: Statewide PCI cases by patient place of usual residence (by residential postcode)

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

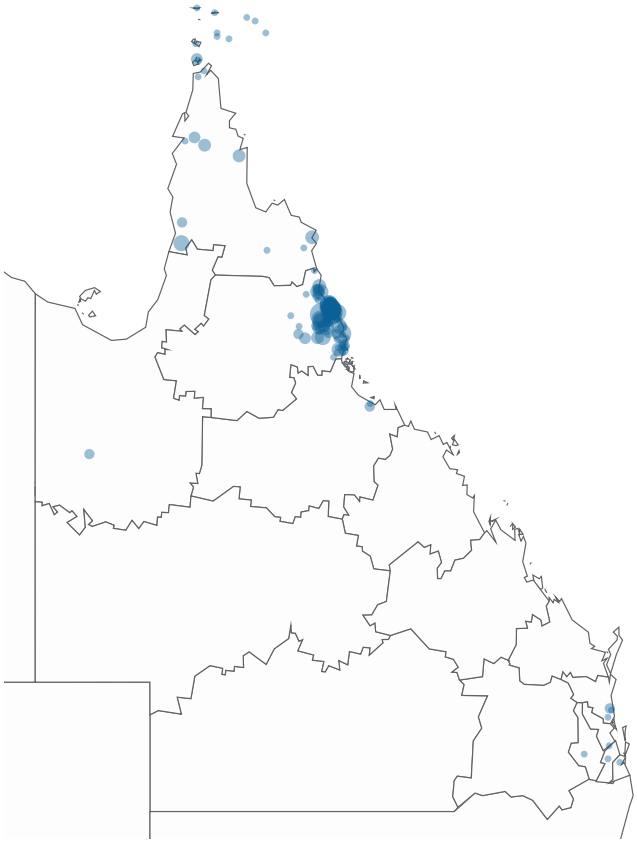


Figure 2: Cairns Hospital

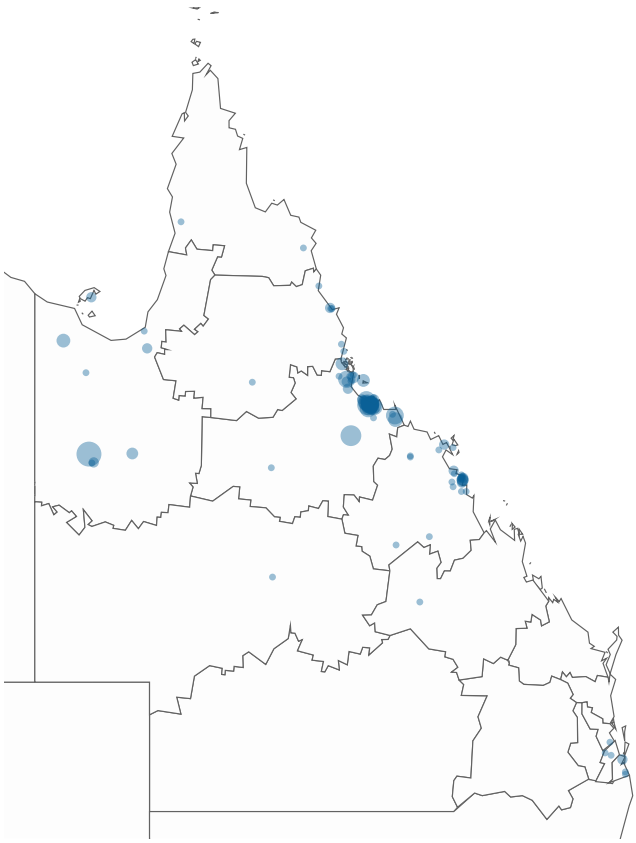


Figure 3: Townsville University Hospital

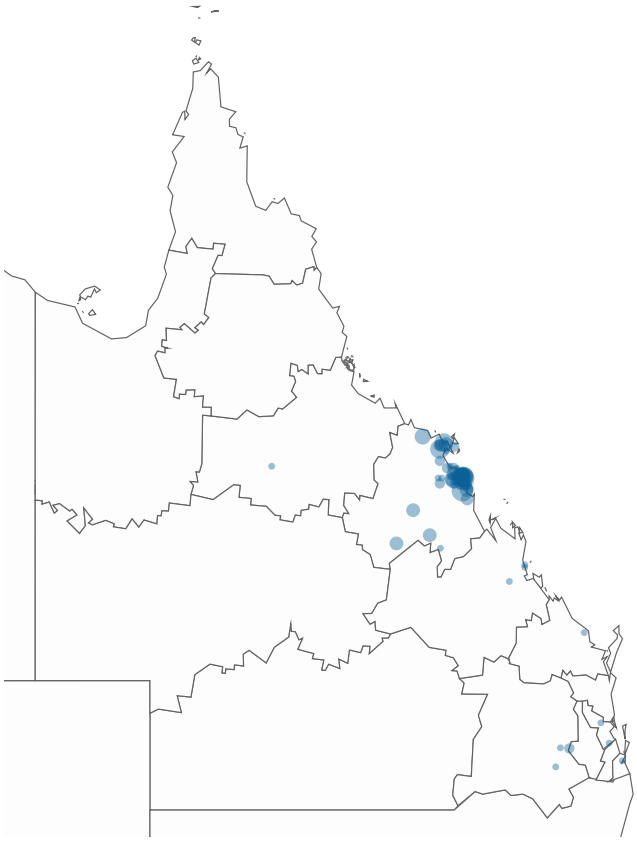


Figure 4: Mackay Base Hospital

Figure 5: Sunshine Coast University Hospital

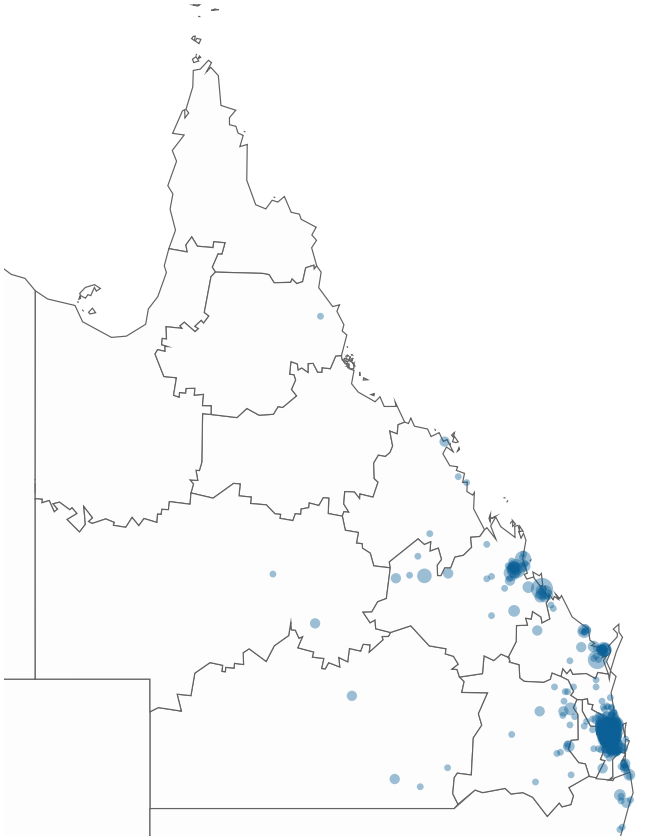


Figure 6: The Prince Charles Hospital

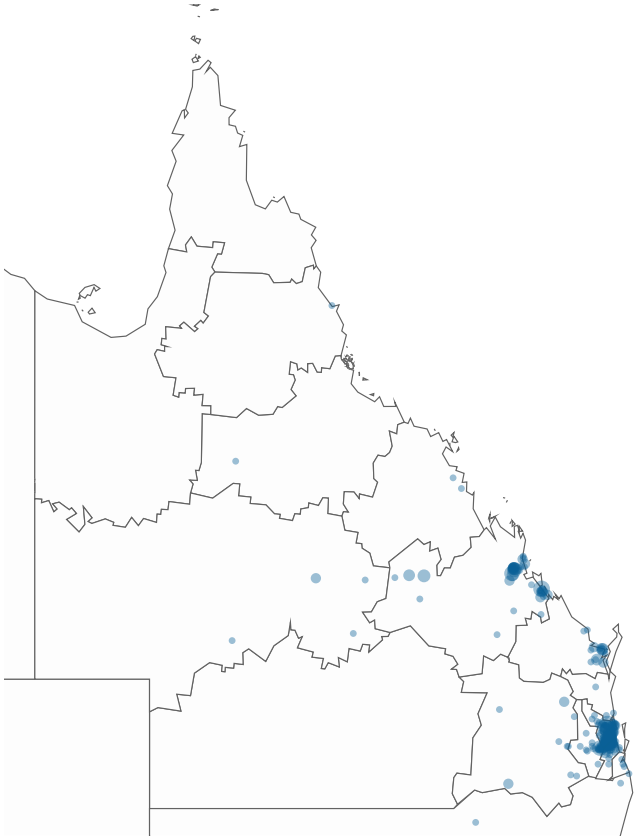


Figure 7: Royal Brisbane & Women's Hospital

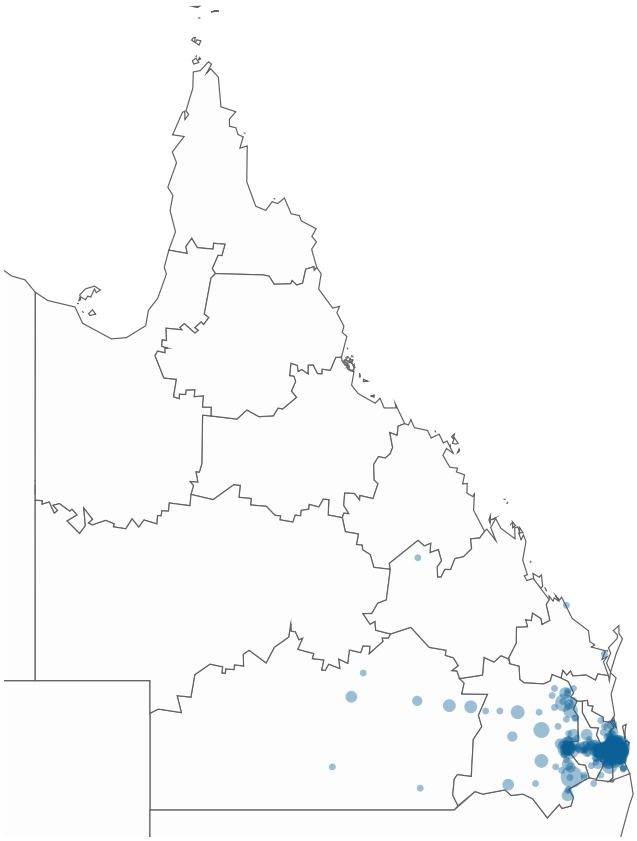


Figure 8: Princess Alexandra Hospital

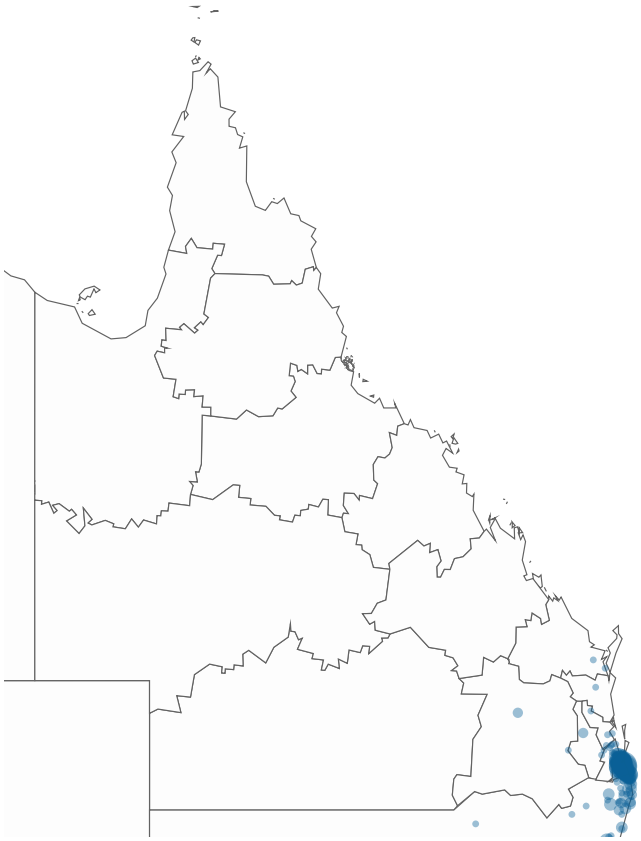


Figure 9: Gold Coast University Hospital

4 Total coronary cases

A total of 15,615 coronary cases were performed across the eight contributing cardiac catheterisation sites, with 5,002 patients (32%) undergoing a percutaneous coronary intervention (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 477 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.

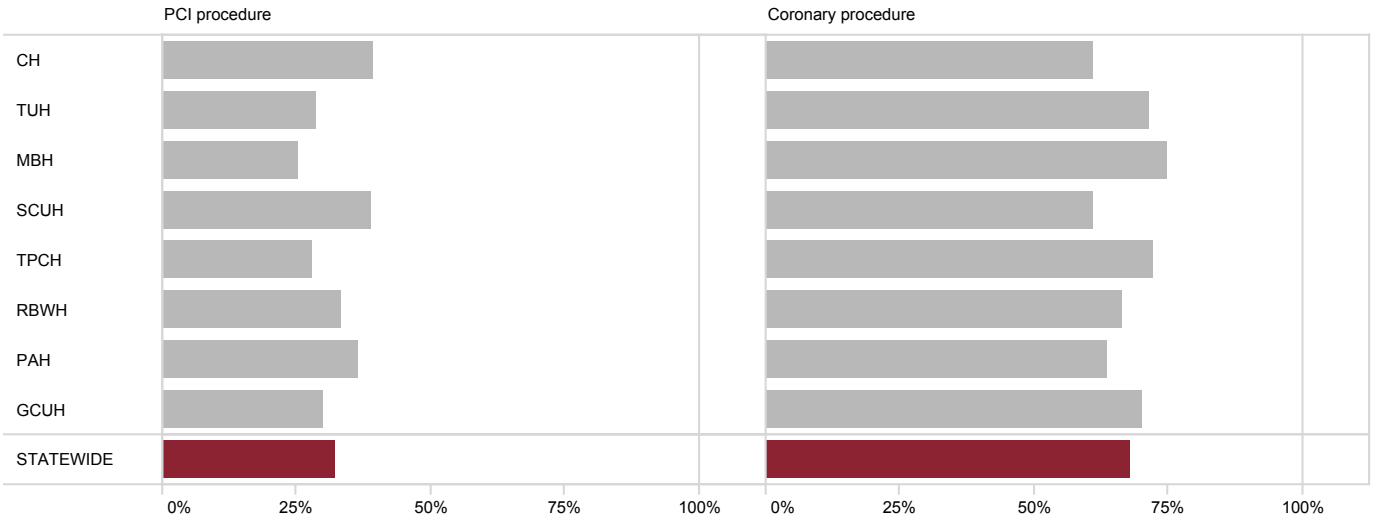


Figure 10: Proportion of cases by procedure category

Table 2: Total cases by procedure category

Site	PCI procedure* n (%)	Other coronary procedure† n (%)	Total coronary cases n
CH	535 (39.2)	829 (60.8)	1,364
TUH	372 (28.6)	928 (71.4)	1,300
MBH	291 (25.0)	871 (75.0)	1,162
SCUH	579 (38.9)	908 (61.1)	1,487
TPCH	1,078 (27.8)	2,794 (72.2)	3,872
RBWH	427 (33.5)	848 (66.5)	1,275
PAH	1,024 (36.3)	1,799 (63.7)	2,823
GCUH	696 (29.8)	1,636 (70.2)	2,332
STATEWIDE	**5,002 (32.0)**	**10,613 (68.0)**	**15,615**

* Includes balloon angioplasty, coronary stenting, PTCRA/atherectomy 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 non-ST elevation myocardial infarction (NSTEMI), while ST elevation myocardial infarction (STEMI) cases represented 12% of all cases, and 30% 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%). Almost two thirds of PCI procedures undertaken were categorised as either STEMI or NSTEMI (60%).

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	158 (11.6)	350 (25.7)	856 (62.8)
TUH	120 (9.2)	240 (18.5)	940 (72.3)
MBH	73 (6.3)	135 (11.6)	954 (82.1)
SCUH	290 (19.5)	330 (22.2)	867 (58.3)
TPCH	341 (8.8)	648 (16.7)	2,883 (74.5)
RBWH	139 (10.9)	333 (26.1)	803 (63.0)
PAH	503 (17.8)	808 (28.6)	1,512 (53.6)
GCUH	243 (10.4)	341 (14.6)	1,748 (75.0)
STATEWIDE	**1,867 (12.0)**	**3,185 (20.4)**	**10,563 (67.6)**

Table 4: PCI cases by clinical presentation category

Site	STEMI n (%)	NSTEMI n (%)	Other n (%)
CH	124 (23.2)	202 (37.8)	209 (39.1)
TUH	93 (25.0)	94 (25.3)	185 (49.7)
MBH	58 (19.9)	60 (20.6)	173 (59.5)
SCUH	232 (40.1)	147 (25.4)	200 (34.5)
TPCH	280 (26.0)	294 (27.3)	504 (46.8)
RBWH	106 (24.8)	173 (40.5)	148 (34.7)
PAH	385 (37.6)	374 (36.5)	265 (25.9)
GCUH	210 (30.2)	157 (22.6)	329 (47.3)
STATEWIDE	**1,488 (29.7)**	**1,501 (30.0)**	**2,013 (40.3)**

4.2 Place of residence

The vast majority of PCI patients (95%) had a usual place of residence within Queensland, with a smaller proportion originating from interstate (4%) and overseas (1%). For the Gold Coast University Hospital, over one fifth of PCI patients (21%) originated from outside of Queensland.

Patients came from a wide geographical area with a large proportion of patients residing on the Eastern Seaboard. More than half of all patients were seen inside their local Hospital and Health Service (HHS). Of those patients residing in Queensland, the majority (76%) 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	97.4	86.1	1.5	1.1
TUH	97.3	70.5	1.6	1.1
MBH	97.9	93.8	1.0	1.0
SCUH	95.9	69.4	3.1	1.0
TPCH	97.8	66.8	2.0	0.2
RBWH	94.6	48.2	2.4	3.1
PAH	97.4	61.2	1.4	1.3
GCUH	78.7	75.8	20.0	1.3
STATEWIDE	**94.5**	**69.6**	**4.4**	**1.1**

Excludes missing data (0.2%)

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	67.8	22.8	9.5
TUH	64.4	19.7	15.8
MBH	69.2	19.9	10.8
SCUH	68.3	22.9	8.8
TPCH	77.3	6.9	15.7
RBWH	67.3	8.0	24.8
PAH	78.1	16.9	5.0
GCUH	99.3	0.5	0.2
STATEWIDE	**75.6**	**13.8**	**10.6**

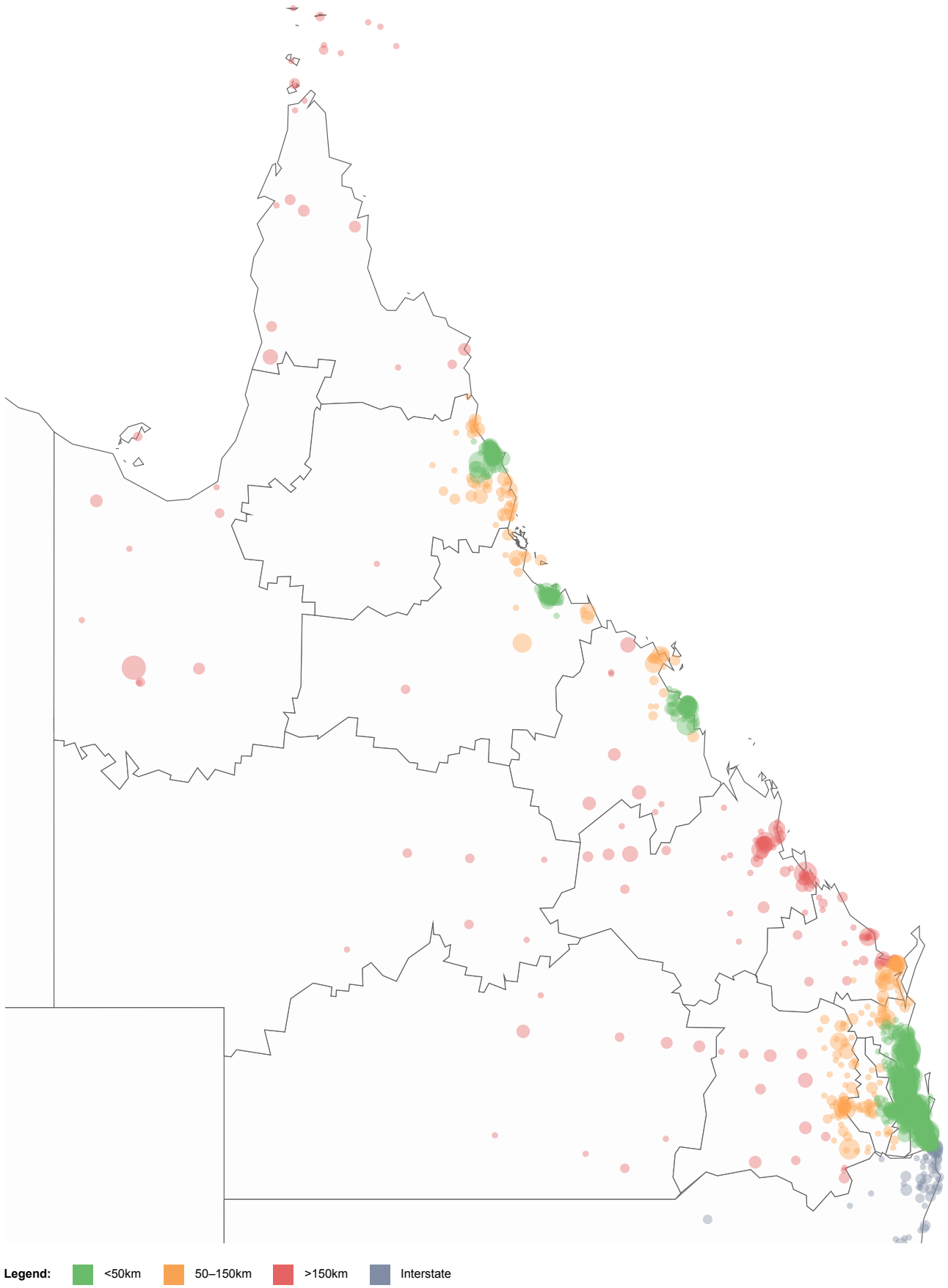


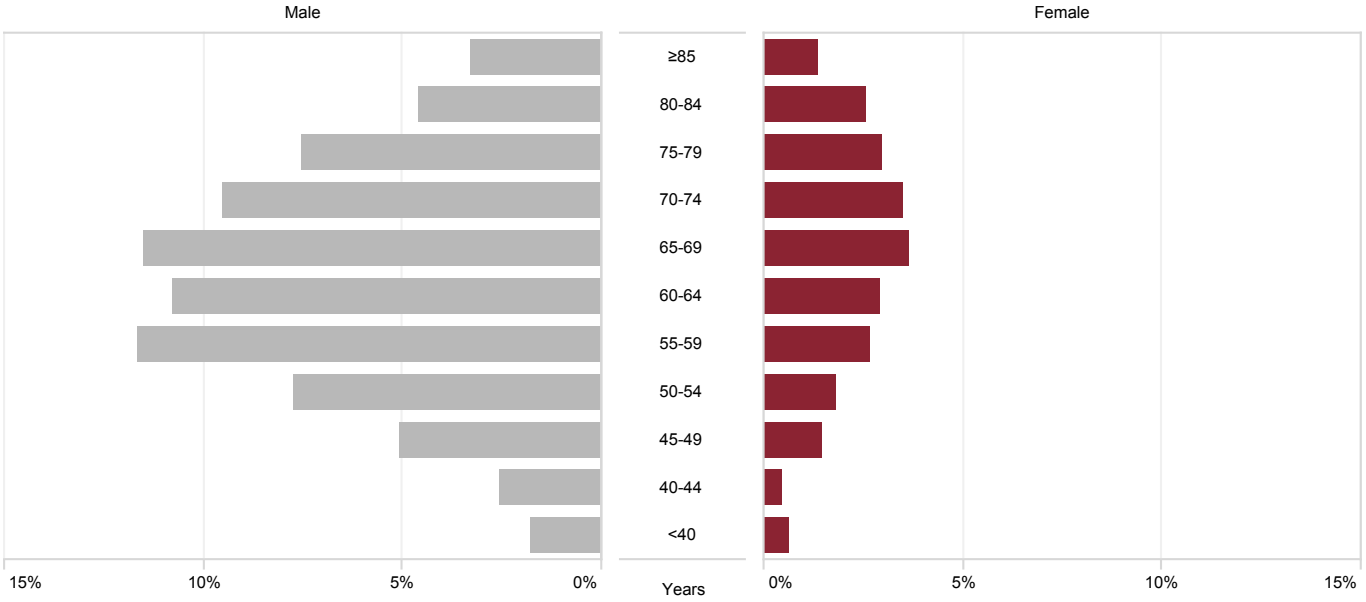
Figure 11: Queensland PCI cases by distance to nearest public PCI facility

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 59 years to 68 years across sites.

The majority of patients were male (76%), 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=5,002)

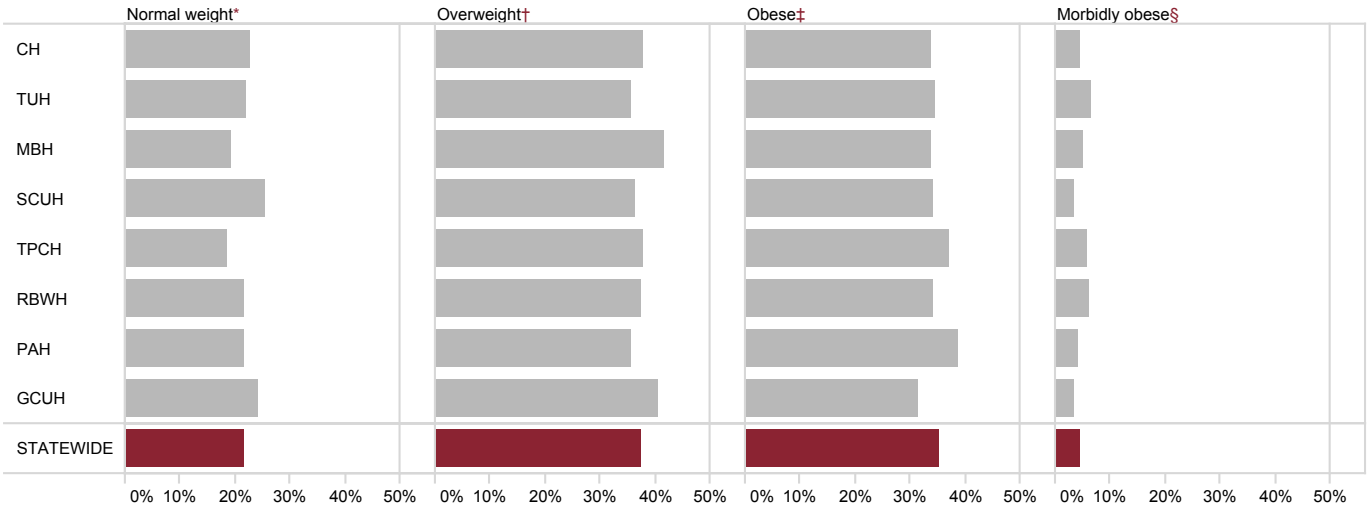
Figure 12: Proportion of all PCI cases by gender and age group

Table 7: Median PCI patient age by gender and site

Site	Male years	Female years	All years
CH	63	61	63
TUH	59	60	59
MBH	65	65	65
SCUH	67	72	68
TPCH	66	70	67
RBWH	64	69	65
PAH	62	65	63
GCUH	64	70	66
STATEWIDE	**64**	**68**	**65**

5.2 Body mass index

Patients across all sites displayed similar trends for body mass index (BMI), with less than one quarter of patients (22%) in the normal BMI range and 38%, 35% and 5% 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 (0.3%)

* 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 13: 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	8 (1.5)	120 (22.6)	201 (37.8)	179 (33.6)	24 (4.5)
TUH	6 (1.6)	81 (22.0)	130 (35.3)	127 (34.5)	24 (6.5)
MBH	3 (1.0)	56 (19.3)	120 (41.4)	97 (33.4)	14 (4.8)
SCUH	5 (0.9)	147 (25.4)	210 (36.3)	197 (34.1)	19 (3.3)
TPCH	11 (1.0)	200 (18.6)	406 (37.7)	399 (37.0)	61 (5.7)
RBWH	4 (0.9)	92 (21.6)	159 (37.3)	145 (34.0)	26 (6.1)
PAH	5 (0.5)	218 (21.4)	363 (35.6)	391 (38.4)	42 (4.1)
GCUH	7 (1.0)	167 (24.0)	282 (40.5)	217 (31.2)	23 (3.3)
STATEWIDE	**49 (1.0)**	**1,081 (21.7)**	**1,871 (37.5)**	**1,752 (35.1)**	**233 (4.7)**

Excludes missing/invalid data (0.3%)

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, 26% and TUH, 16%) is reflective of the resident population within these areas and should be noted for service provision and planning.

The proportion of identified Aboriginal and Torres Strait Islander patients requiring a PCI procedure across all sites (7.1%) exceeds the estimated proportion of Aboriginal and Torres Strait Islander people within Queensland (4.6%).[2]

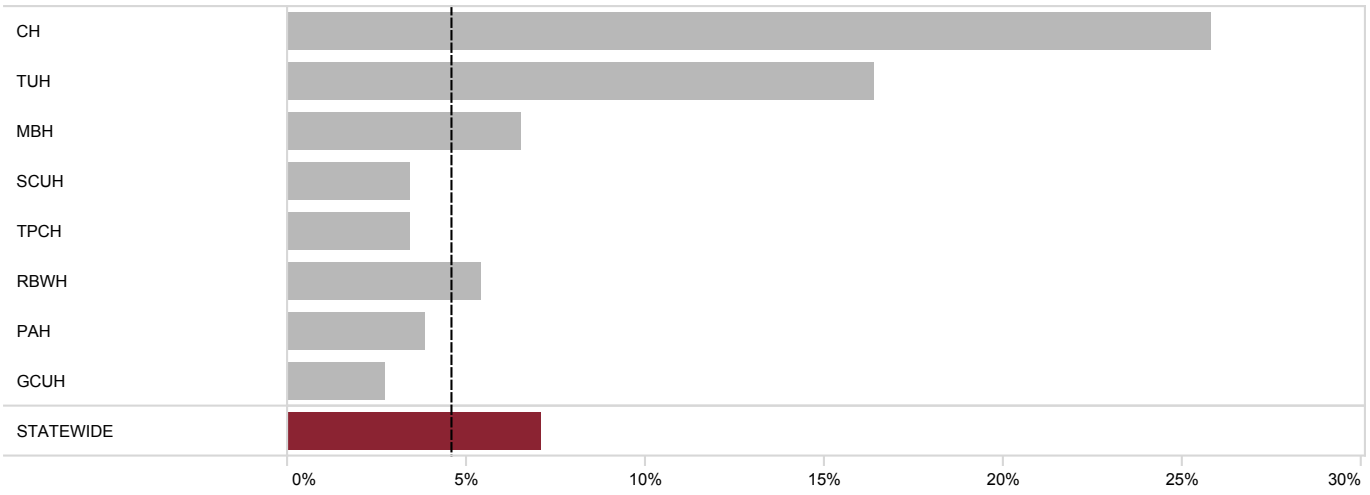


Figure 14: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

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. 66 years).

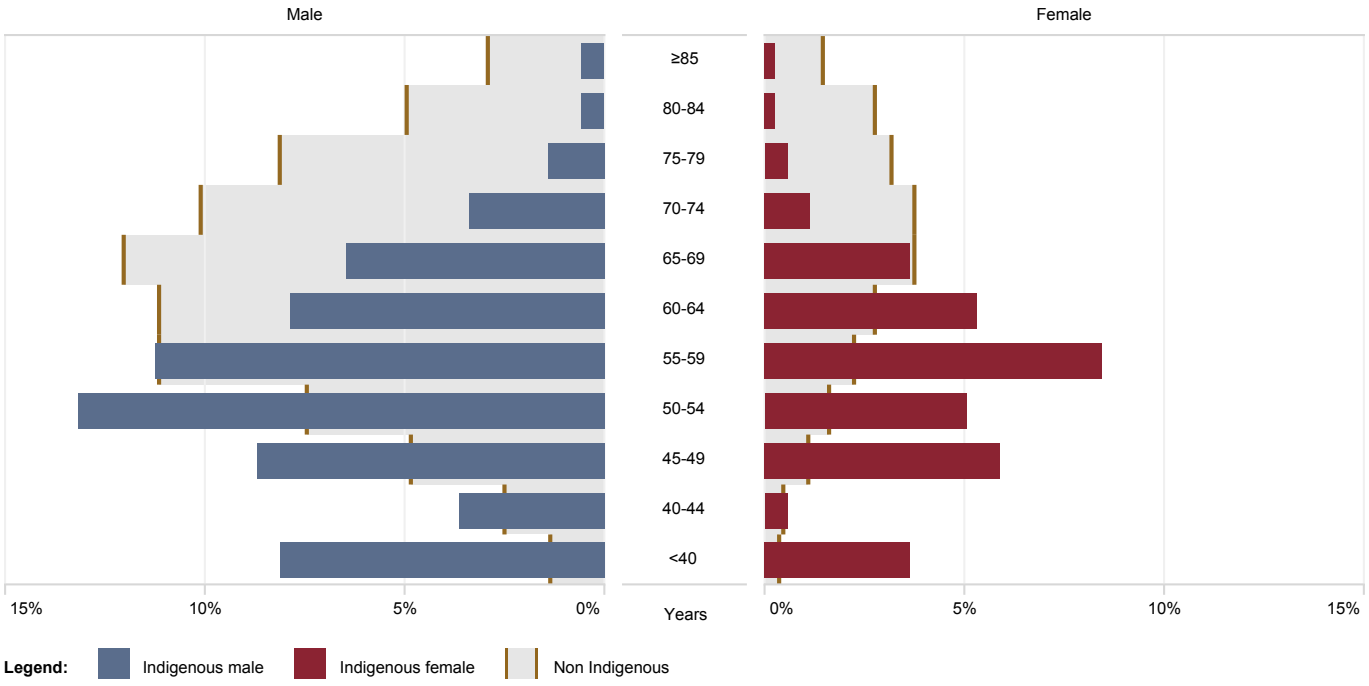


Figure 15: Proportion of all PCI cases by age group and Indigenous status

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

	Male years	Female years	All years
Aboriginal and Torres Strait Islander	54	57	55
Non Aboriginal and Torres Strait Islander	65	69	66
ALL	**64**	**68**	**65**

6 Care and treatment of PCI patients

6.1 Admission status

There were 5,002 PCI procedures performed in 2019 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]

For the 2019 cohort, 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, with CH and RBWH performing approximately 3% of their PCI cases in these exceptional and highly complex clinical scenarios.

The application of the newly developed salvage definition to the 2019 patient cohort saw a slight rise in salvage case numbers compared to the 2018 audit (n=64, 1.3%). Thus, the modestly higher proportion of salvage cases noted during this audit period was to be expected.

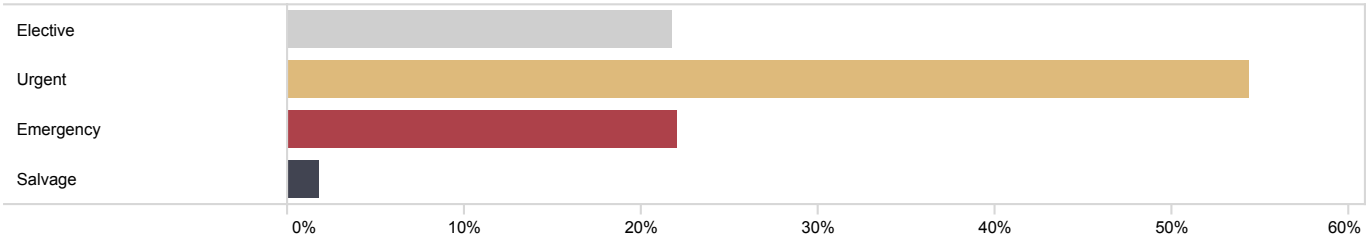


Figure 16: Proportion of all PCI cases by admission status

Table 11: PCI cases by site and admission status

	Elective n (%)	Urgent n (%)	Emergent n (%)	Salvage n (%)
CH	142 (26.5)	300 (56.1)	77 (14.4)	16 (3.0)
TUH	89 (23.9)	217 (58.3)	64 (17.2)	2 (0.5)
MBH	109 (37.2)	141 (48.1)	43 (14.7)	0 (0.0)
SCUH	95 (16.4)	328 (56.6)	149 (25.7)	7 (1.2)
TPCH	303 (28.1)	511 (47.4)	246 (22.8)	18 (1.7)
RBWH	61 (14.3)	269 (63.0)	81 (19.0)	16 (3.7)
PAH	148 (14.5)	607 (59.3)	258 (25.2)	11 (1.1)
GCUH	147 (21.1)	346 (49.7)	186 (26.7)	17 (2.4)
STATEWIDE	**1,094 (21.9)**	**2,719 (54.3)**	**1,104 (22.1)**	**87 (1.7)**

6.2 Access route

6.2.1 All PCI cases

The majority of PCI cases (93%) used a single access route, with 73% of all cases being via the radial approach and 34% 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 (41% to 94%).

Table 12: PCI access route by site

Site	Total PCI cases n	Radial approach %	Femoral approach %	Other approach %
CH	535	77.8	29.2	0.6
TUH	372	73.4	29.0	0.5
MBH	291	83.8	20.6	0.0
SCUH	579	93.8	10.9	1.0
TPCH	1,078	79.3	32.0	0.7
RBWH	427	79.4	32.1	0.2
PAH	1,024	41.4	62.5	0.3
GCUH	696	82.2	26.1	0.0
STATEWIDE	**5,002**	**73.3**	**33.8**	**0.5**

Totals >100% due to multiple access sites

Table 13: PCI total access routes by site

Site	Single approach %	Multiple approaches %
CH	92.5	7.5
TUH	97.0	3.0
MBH	95.5	4.5
SCUH	94.5	5.5
TPCH	88.4	11.6
RBWH	88.3	11.7
PAH	96.0	4.0
GCUH	91.7	8.3
STATEWIDE	**92.6**	**7.4**

There was minimal difference observed in the overall cohort when the STEMI presenting within six hours of symptom onset cohort was examined. However, individual site proportions varied with some sites opting to utilise the femoral approach more frequently and vice versa.

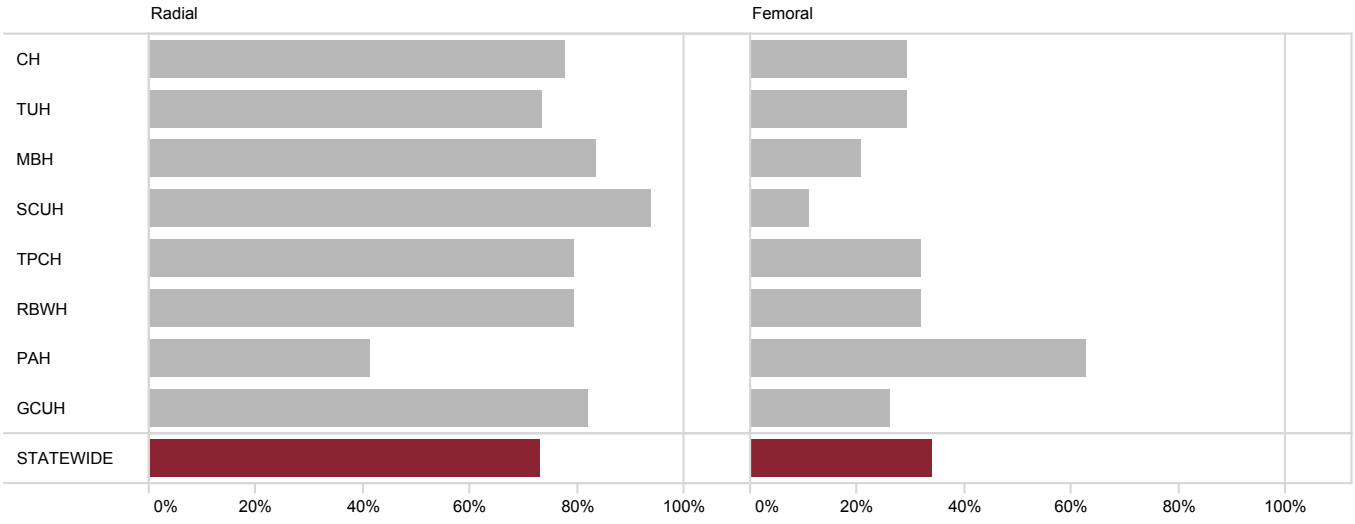


Figure 17: Proportion of PCI cases using radial and femoral access routes by site

6.2.2 Access route for STEMI presenting within six hours of symptom onset

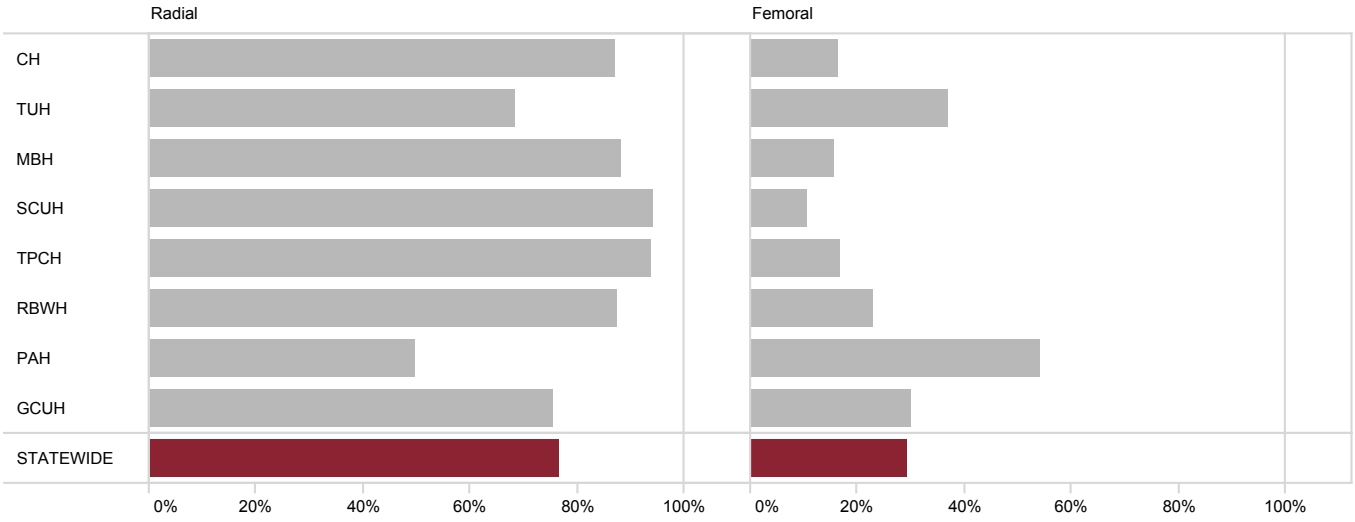


Figure 18: Proportion of STEMI presenting within six hours PCI cases using radial and femoral access routes by site

6.3 Vessels treated

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

Of the vessels treated, 43% of cases involved the left anterior descending coronary artery (LAD), followed by the right coronary artery (RCA) at 38%, the circumflex coronary artery (LCx) at 24% and the left main coronary artery (LMCA) at 3%.

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

Table 14: Grafts and vessels treated by site

Site	LAD %	LMCA %	LCx %	RCA %	Graft %
CH	43.4	1.9	23.4	33.5	5.0
TUH	42.7	2.2	22.6	33.1	5.6
MBH	44.7	1.7	24.6	32.1	2.7
SCUH	45.6	5.0	28.2	36.4	2.9
TPCH	45.8	4.2	23.7	39.9	3.2
RBWH	43.6	1.9	26.2	38.4	2.6
PAH	43.6	3.1	25.0	38.8	2.2
GCUH	44.1	1.9	20.4	40.4	3.3
STATEWIDE	**44.3**	**3.0**	**24.2**	**37.5**	**3.3**

Table 15: Total native vessels treated by site

Site	Single vessel n (%)	Two vessel n (%)	Three vessel n (%)
CH	475 (93.5)	30 (5.9)	3 (0.6)
TUH	332 (94.6)	18 (5.1)	1 (0.3)
MBH	266 (94.0)	17 (6.0)	0 (0.0)
SCUH	476 (84.7)	69 (12.3)	17 (3.0)
TPCH	883 (84.7)	146 (14.0)	14 (1.3)
RBWH	371 (89.2)	42 (10.1)	3 (0.7)
PAH	885 (88.4)	105 (10.5)	11 (1.1)
GCUH	608 (90.3)	59 (8.8)	6 (0.9)
STATEWIDE	**4,296 (88.8)**	**486 (10.0)**	**55 (1.1)**

Excludes any graft PCI (n=165)

Table 16: Grafts treated by site

Site	Graft only n (%)	Graft and one native vessel n (%)
CH	25 (92.6)	2 (7.4)
TUH	20 (95.2)	1 (4.8)
MBH	8 (100.0)	0 (0.0)
SCUH	14 (82.4)	3 (17.6)
TPCH	29 (82.9)	6 (17.1)
RBWH	11 (100.0)	0 (0.0)
PAH	22 (95.7)	1 (4.3)
GCUH	23 (100.0)	0 (0.0)
STATEWIDE	**152 (92.1)**	**13 (7.9)**

6.4 Stent type

There were four different stent types utilised in coronary artery PCI – drug-eluting stents (DES), bare metal stents (BMS), bioresorbable vascular scaffolds (BVS) and covered stents.

Across all centres, there was an average of 1.5 stents used for each of the 4,658 PCI cases involving stent deployment. DES were used in 98% of cases, with some sites using DES exclusively. The proportion of cases utilising DES has increased from previous years (93% and 85% in 2018 and 2017 respectively).

BMS were used in 2% of cases and a BVS or covered stent was used in less than 1% of cases. The remaining 344 PCI cases did not involve stent deployment.

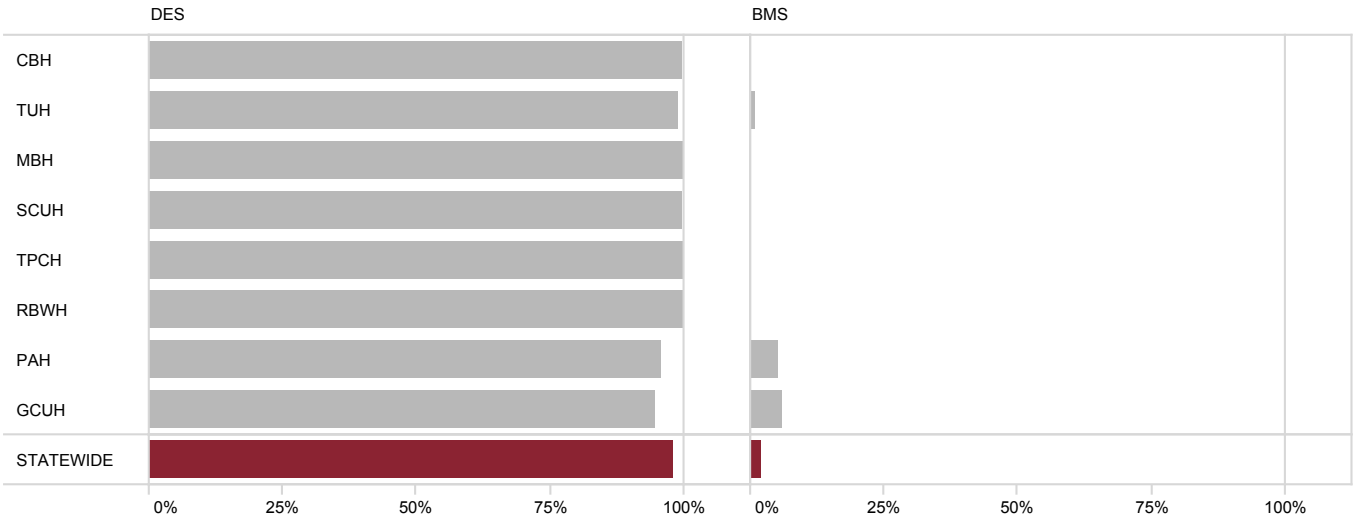


Figure 19: Proportion of stenting cases using DES and BMS

Table 17: PCI cases including at least one stent deployed by site and stent type

	Total cases n	DES %	BMS %	BVS %	Covered stent %	Stents per case mean
CH	461	94.4	0.0	5.4	0.2	1.5
TUH	338	98.8	0.9	0.0	0.3	1.4
MBH	257	100.0	0.0	0.0	0.0	1.3
SCUH	550	99.8	0.0	0.0	0.4	1.7
TPCH	1,006	100.0	0.0	0.0	0.6	1.5
RBWH	407	100.0	0.0	0.0	0.0	1.5
PAH	991	95.8	4.9	0.0	0.1	1.6
GCUH	648	94.8	5.9	0.0	0.3	1.4
STATEWIDE	**4,658**	**97.7**	**1.9**	**0.5**	**0.3**	**1.5**

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 1,488 documented STEMI PCI cases, with over half (53%) presenting as primary PCI cases and 11% presenting after 12 hours (late presenters).

Almost one quarter (24%) of patients had received thrombolysis (lysis) 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 lysis n (%)	Rescue PCI (failed lysis) n (%)
CH	17 (13.7)	55 (44.4)	6 (4.8)	15 (12.1)	23 (18.5)	8 (6.5)
TUH	7 (7.5)	35 (37.6)	4 (4.3)	14 (15.1)	23 (24.7)	10 (10.8)
MBH	2 (3.4)	26 (44.8)	2 (3.4)	8 (13.8)	14 (24.1)	6 (10.3)
SCUH	29 (12.5)	87 (37.5)	18 (7.8)	20 (8.6)	62 (26.7)	16 (6.9)
TPCH	39 (13.9)	130 (46.4)	28 (10.0)	42 (15.0)	35 (12.5)	6 (2.1)
RBWH	12 (11.3)	57 (53.8)	5 (4.7)	11 (10.4)	14 (13.2)	7 (6.6)
PAH	50 (13.0)	176 (45.7)	15 (3.9)	32 (8.3)	86 (22.3)	26 (6.8)
GCUH	23 (11.0)	134 (63.8)	14 (6.7)	14 (6.7)	19 (9.0)	6 (2.9)
STATEWIDE	**179 (12.0)**	**700 (47.0)**	**92 (6.2)**	**156 (10.5)**	**276 (18.5)**	**85 (5.7)**

6.5.2 First medical contact

Most patients with STEMI presented via the Queensland Ambulance Service (QAS) (70%), 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 15% respectively). The remaining 6% presented to other health facilities such as GP clinics, community health centres or any other outpatient setting.

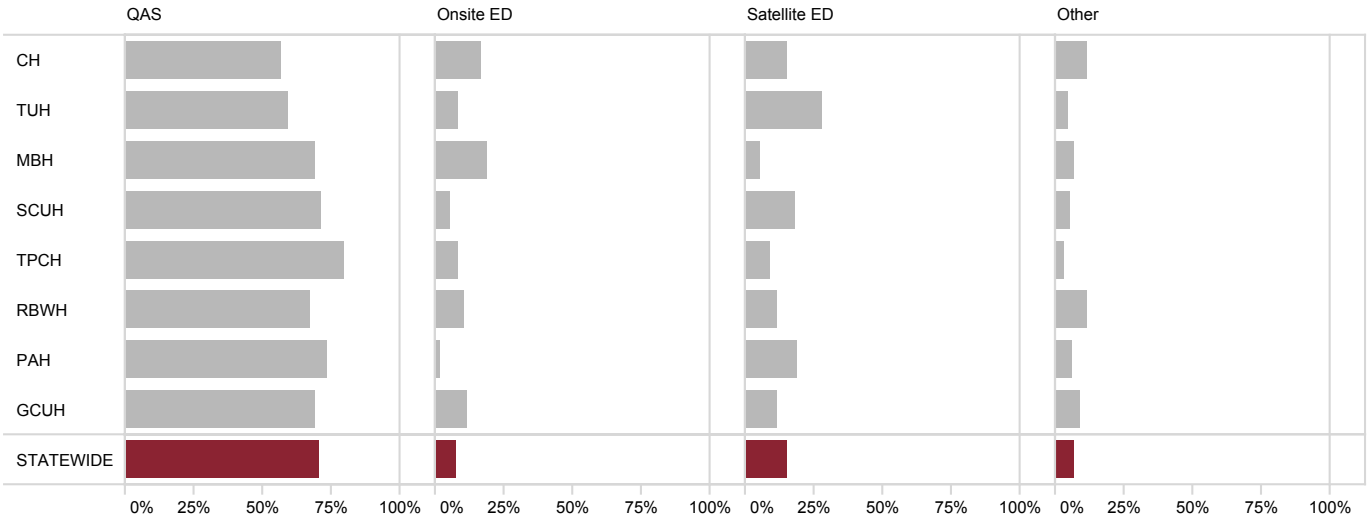


Figure 20: Proportion of STEMI cases by first medical contact

6.5.3 Admission pathway

After first medical contact, 66% of STEMI PCI patients were admitted directly to the treating centre.

As expected, admission pathway varied considerably by STEMI presentation. For lysed and rescue PCI, there were 82% and 73% admitted via interhospital transfer respectively, whereas a large proportion (94%) of the STEMI presenting within six hours of symptom onset cohort presented directly to a PCI facility.

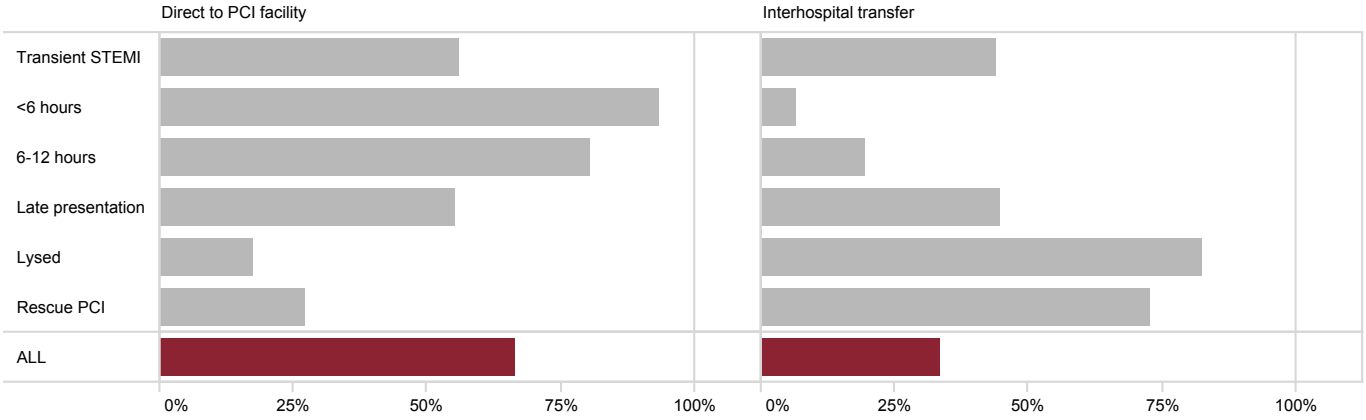


Figure 21: Proportion of STEMI cases by admission pathway and clinical presentation

6.5.4 Thrombolysed patients

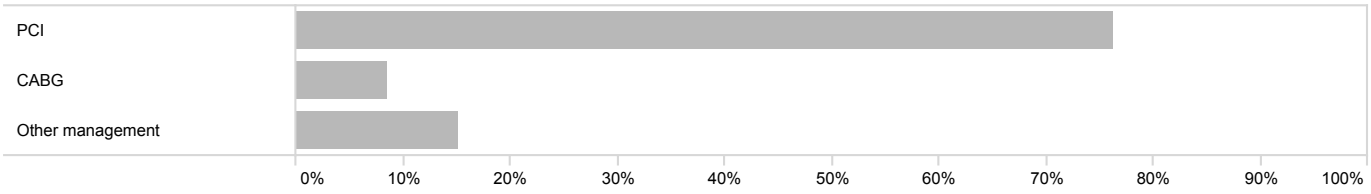
As mentioned above, the method of reperfusion depends on many factors which together determine the treatment method most appropriate for the particular presentation.

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 498 thrombolysed STEMI presentations with the majority (73%) receiving a PCI, which increased to 77% when accounting for subsequent staged interventions within 90 days (Table 20). A smaller proportion (9%) went on to receive coronary artery bypass graft surgery (CABG) at a Queensland Health facility within 90 days.

Table 19: Total lysed STEMI cases by tertiary cardiac centre

Site	Total lysed STEMIs n	Receiving a PCI n (%)	Proportion of all PCI cases %
CH	44	31 (70.5)	5.8
TUH	44	33 (75.0)	8.9
MBH	28	20 (71.4)	6.8
SCUH	111	78 (70.3)	13.5
TPCH	52	41 (78.8)	3.8
RBWH	32	21 (65.6)	4.9
PAH	154	112 (72.7)	10.9
GCUH	33	25 (75.8)	3.6
STATEWIDE	**498**	**361 (72.5)**	**7.2**



PCI and CABG revascularisation not displayed (0.2%)

Figure 22: Proportion of lysed patients by clinical management

Table 20: Total lysed patients by revascularisation method within 90 days

	PCI %	CABG %	PCI + CABG %	Other management* %
CH	72.1	14.0	0.0	14.0
TUH	78.6	7.1	0.0	14.3
MBH	84.6	0.0	0.0	15.4
SCUH	75.7	7.2	0.0	17.1
TPCH	76.9	7.7	1.9	13.5
RBWH	71.0	3.2	0.0	25.8
PAH	76.9	12.2	0.0	10.9
GCUH	75.8	3.0	0.0	21.2
ALL	**76.3**	**8.5**	**0.2**	**15.1**

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

Overall, there were 498 lysed STEMI patients who reached a public hospital CCL site in 2019. Substantially improved data quality this year sees 75% of this cohort eligible for analysis compared to 54% in 2018.

Reassuringly, the median time from FdECG to thrombolysis was similar across the patients receiving pre-hospital thrombolysis by QAS and the patients who presented directly to the thrombolysis facility (34 minutes vs. 36 minutes).

The patients in the other thrombolysis group took a median of 79 minutes from FdECG to thrombolysis. This included a median 41 minute travel component, representative of the time taken to arrive at the thrombolysis facility.

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 lysed STEMI cases by thrombolysis administration pathway

	Total lysed STEMIs n	Total analysed n	Median FdECG to thrombolysis minutes	Interquartile range minutes
QAS pre-hospital thrombolysis	168	160	33.5	26–43
Presented and lysed at ED	179	130	31	22–50
Other pre-hospital thrombolysis*	10	0	N/A	N/A
All others†	141	83	70	36–100
ALL	**498**	**373**	**35**	**25–55**

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

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

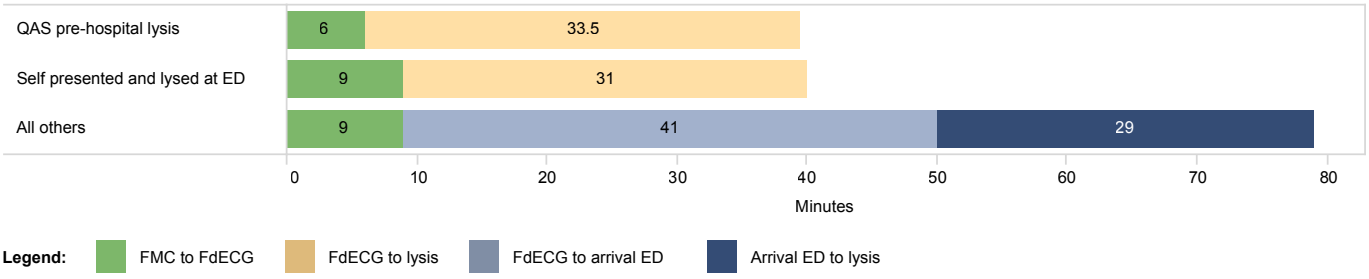


Figure 23: Time delays to thrombolysis therapy by administration pathway

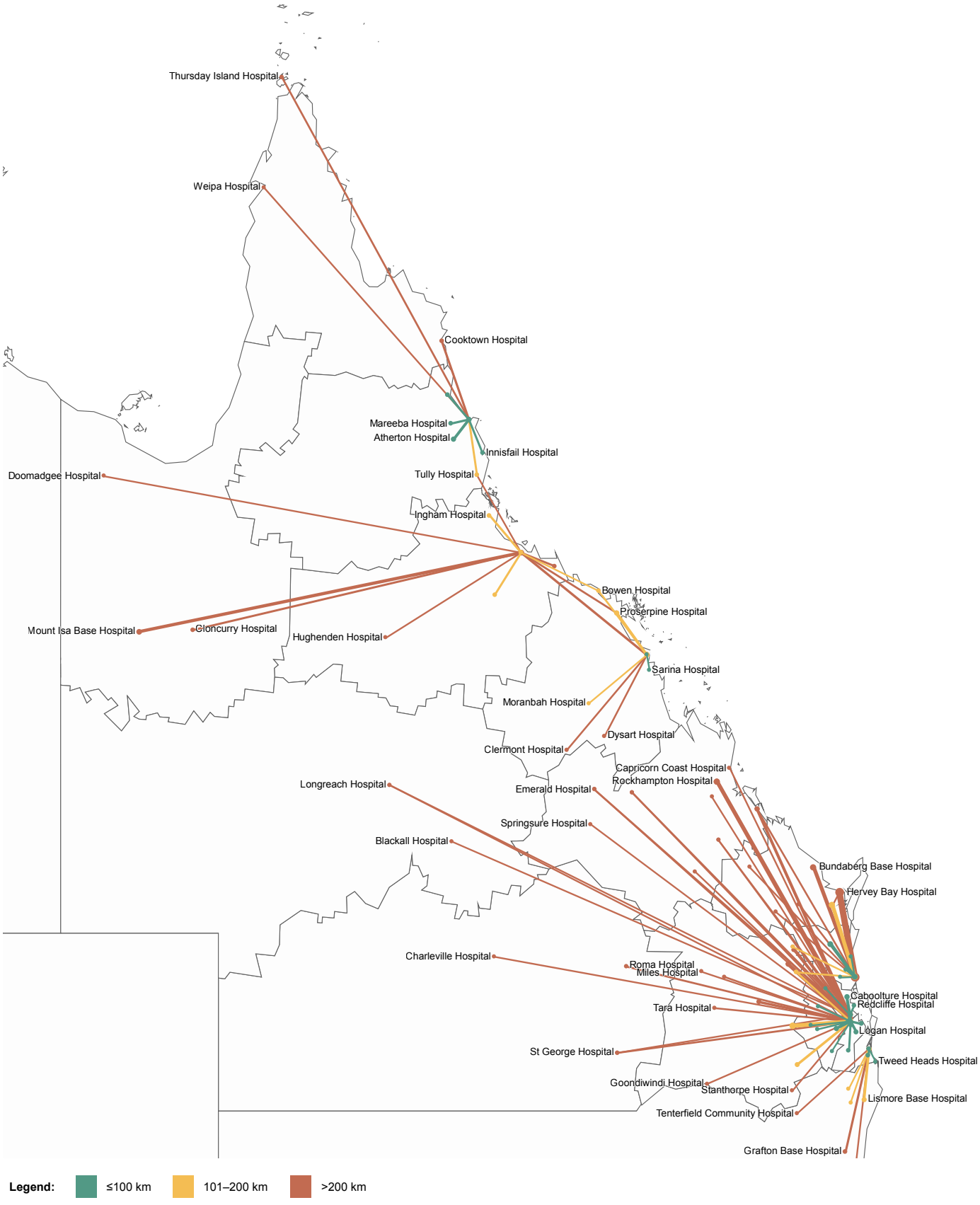
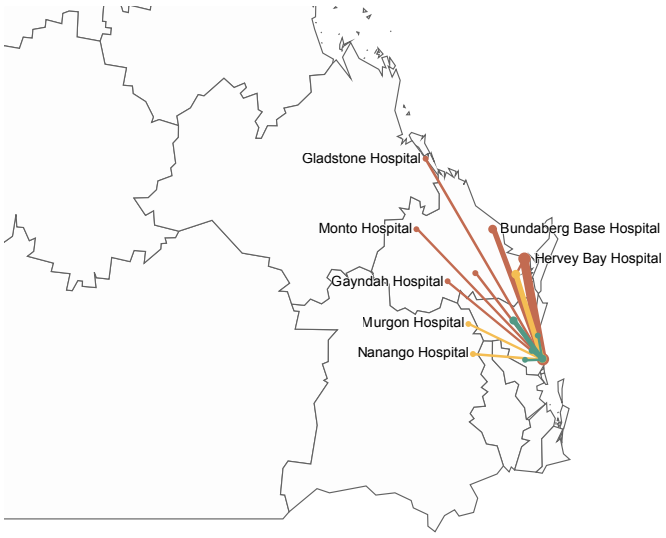
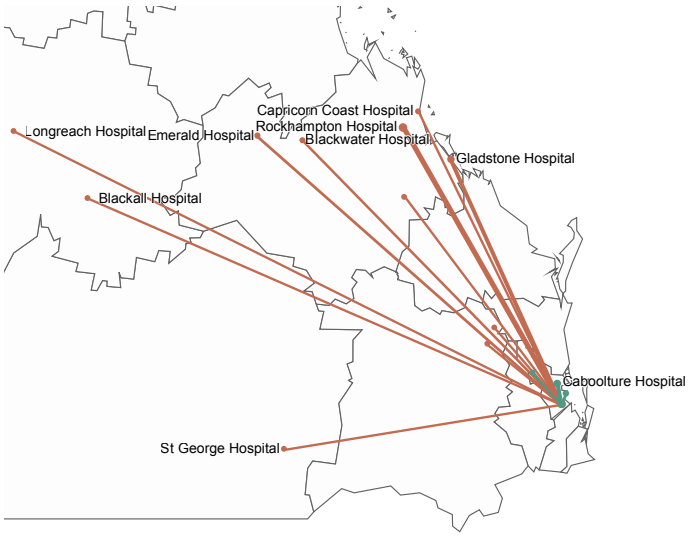


Figure 24: Thrombolysed STEMI interhospital transfers by estimated distance to transfer

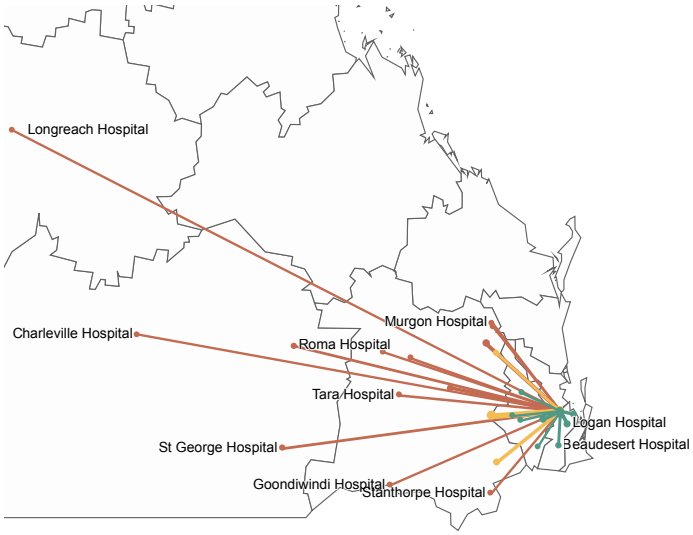


Inset A: Sunshine Coast University Hospital

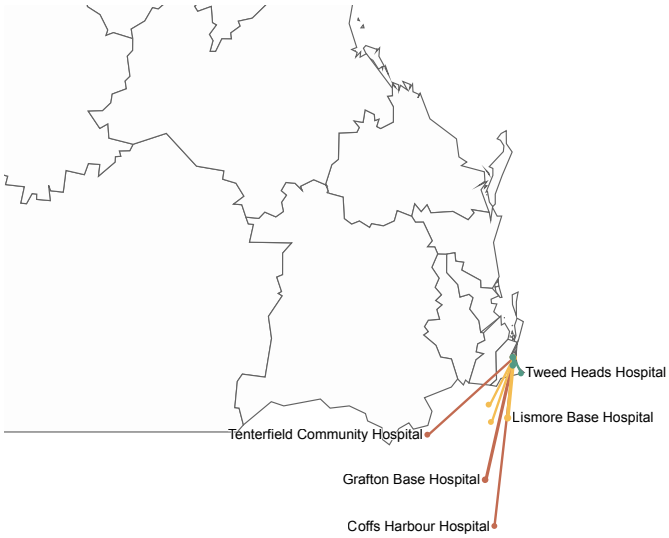


Inset B: The Prince Charles Hospital

Inset C: Royal Brisbane & Women's Hospital



Inset D: Princess Alexandra Hospital



Inset E: Gold Coast University Hospital

Approximately one quarter (28%) of lysed STEMI patients were not indicated for pre-hospital thrombolysis. Most commonly, these patients had been located within close proximity to a hospital (46%). A smaller proportion were contraindicated for pre-hospital thrombolysis due to advanced age (›75 years) (18%), significant other comorbidity or complex clinical presentation (Table 23).

For the cohort of thrombolysed patients, the median time to angiography was 22 hours post thrombolysis with 52% of patients undergoing coronary angiography within 24 hours. The unadjusted all-cause mortality rate within 30 days for STEMI patients receiving thrombolysis is 2.2%.

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

	n (%)
Close proximity to hospital	63 (46.0)
Patient age (›75 years)	25 (18.2)
Hypertensive	13 (9.5)
No consistent ST elevation	9 (6.6)
Prolonged pain duration ›6 hours	6 (4.4)
Patient pain free	5 (3.6)
GCS* ‹15	4 (2.9)
CPR ›10 minutes	3 (2.2)
Head trauma	2 (1.5)
Suspected aortic dissection	1 (0.7)
Blood clotting disorder	1 (0.7)
Recent surgery	1 (0.7)
Other	4 (2.9)
ALL	**137 (100.0)**

Excludes missing data (n=4)

* 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	44	44	21	7–31	52.3
TUH	44	34	22	5–52	40.9
MBH	28	26	16	7–25	67.9
SCUH	111	108	19	6–28	66.7
TPCH	52	30	24	12–32	32.7
RBWH	32	28	22	10–31	46.9
PAH	154	153	25	10–44	48.7
GCUH	33	26	14	5–24	54.5
STATEWIDE	**498**	**449**	**22**	**7–35**	**52.0**

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

	Total cases n	Total salvage n (%)	In lab death n	In hospital death n	Total mortality n (%)
Lysed	413	6 (1.5)	1	3	4 (1.0)
Rescue PCI	85	6 (7.1)	1	8	7 (8.2)
ALL	**498**	**12 (2.4)**	**2**	**9**	**11 (2.2)**

6.6 NSTEMI presentations

Of all PCI and coronary cases performed in CCLs during 2019, there were 3,185 coded with a procedural indication of NSTEMI. These cases accounted for 30% of all PCI cases across all centres, with site variation ranging from 21% to 41%. These figures are similar across the previous 2018 cohort of patients.

Of patients presenting with NSTEMI, 47% were revascularised via PCI, which increased to 51% when accounting for staged interventions within 90 days of index presentation (Table 27). A further 16% 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	350	202 (57.7)	37.8
TUH	240	94 (39.2)	25.3
MBH	135	60 (44.4)	20.5
SCUH	330	147 (44.5)	25.4
TPCH	648	294 (45.4)	27.3
RBWH	333	173 (52.0)	40.5
PAH	808	374 (46.3)	36.5
GCUH	341	157 (46.0)	22.6
STATEWIDE	**3,185**	**1,501 (47.1)**	**30.0**

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

Site	PCI revascularisation %	CABG revascularisation %	PCI + CABG revascularisation %	Other management* %
CH	62.0	14.7	1.3	22.0
TUH	43.9	13.2	0.4	42.5
MBH	49.2	10.6	0.0	40.2
SCUH	49.7	16.8	0.6	32.9
TPCH	48.4	13.0	0.3	38.2
RBWH	57.5	10.2	0.3	31.9
PAH	50.1	21.3	0.3	28.3
GCUH	49.4	12.7	0.0	37.9
STATEWIDE	**51.2**	**15.2**	**0.4**	**33.2**

* 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 (54% and 46% 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 this Audit.

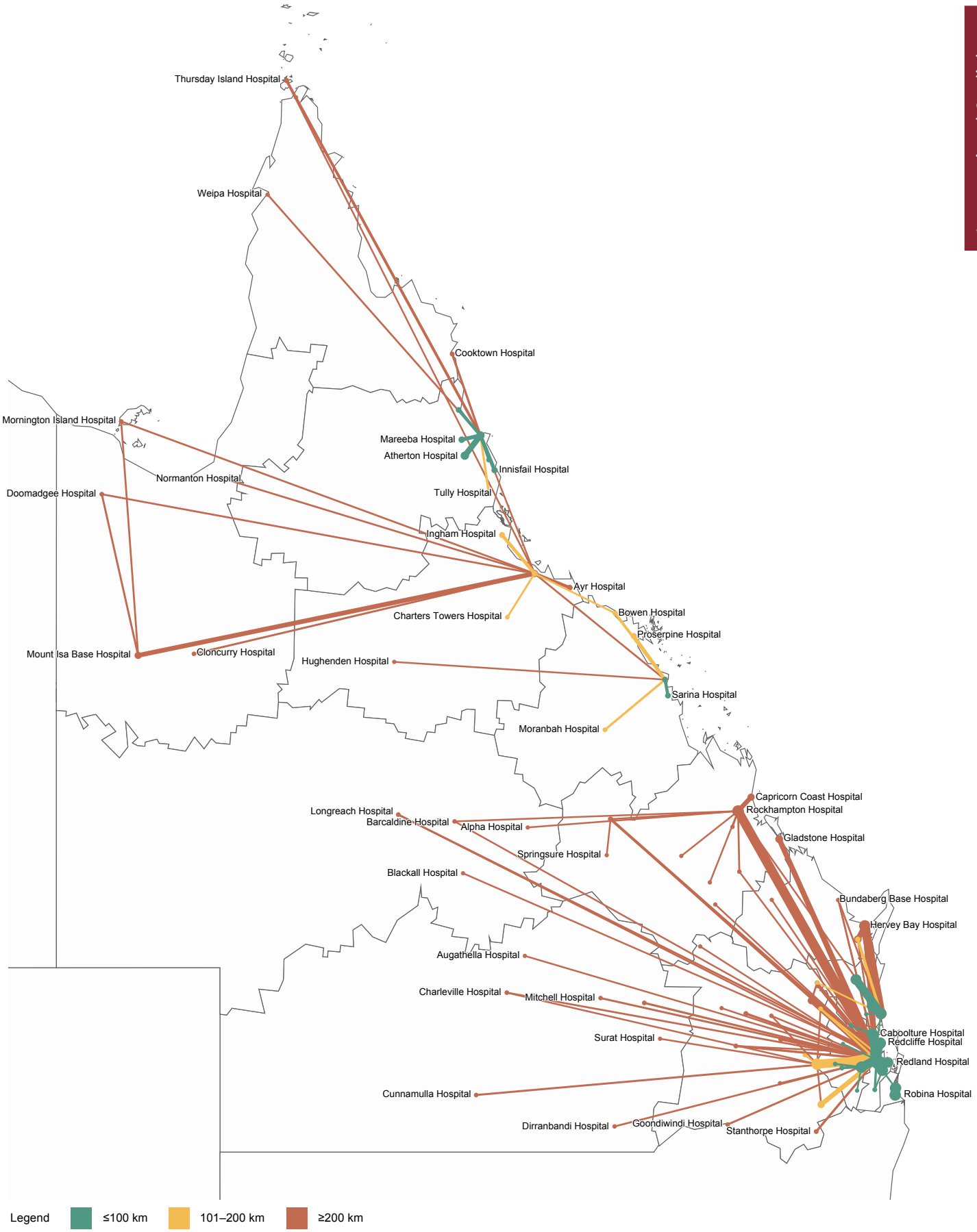
Considerable variation was observed between sites, with the proportion of interhospital transfers for NSTEMI ranging from 35% to 72%, largely explained by catchment area. Where higher volumes and larger median distances to PCI centres exist, it is reasonable to expect that the proportion of cases meeting targets would be smaller. Table 29 and Figure 25 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	218 (62.3)	132 (37.7)
TUH	155 (64.6)	85 (35.4)
MBH	85 (63.0)	50 (37.0)
SCUH	146 (44.2)	184 (55.8)
TPCH	336 (51.9)	312 (48.1)
RBWH	103 (30.9)	230 (69.1)
PAH	229 (28.3)	579 (71.7)
GCUH	198 (58.1)	143 (41.9)
STATEWIDE	**1,470 (46.2)**	**1,715 (53.8)**

Table 29: NSTEMI interhospital transfers by estimated distance to transfer

Site	Total analysed n	Median kilometres	Interquartile range kilometres
CH	99	93	75–93
TUH	61	779	199–901
MBH	38	125	36–191
SCUH	156	93	30–209
TPCH	257	82	39–535
RBWH	201	281	45–611
PAH	466	40	24–122
GCUH	78	17	17–17
STATEWIDE	**1,356**	**90**	**27–240**



Excludes interstate transfers due to incomplete referring facility data

Figure 25: NSTEMI interhospital transfers by estimated distance to transfer

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 2019 was 2.2%. This result compares favourably with the 30 day mortality rate of 2.8% presented by the British Cardiovascular Interventional Society (BCIS) in their review of PCI outcomes for the 2014 calendar year (chosen as the comparator as BCIS reports in subsequent years have given in-hospital rather than 30 day mortality).[5]

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 48% 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	535	0 (0.0)	5 (1.7)	2 (2.6)	8 (50.0)	15 (2.8)
TUH	372	0 (0.0)	1 (0.5)	2 (3.1)	1 (50.0)	4 (1.1)
MBH	291	0 (0.0)	1 (0.7)	1 (2.3)	–	2 (0.7)
SCUH	579	0 (0.0)	4 (1.2)	8 (5.4)	5 (71.4)	17 (2.9)
TPCH	1,078	0 (0.0)	5 (1.0)	8 (3.3)	9 (50.0)	22 (2.0)
RBWH	427	0 (0.0)	4 (1.5)	1 (1.2)	8 (50.0)	13 (3.0)
PAH	1,024	0 (0.0)	3 (0.5)	13 (5)	4 (36.4)	20 (2.0)
GCUH	696	0 (0.0)	3 (0.9)	5 (2.7)	7 (41.2)	15 (2.2)
STATEWIDE	**5,002**	**0 (0.0)**	**26 (1.0)**	**40 (3.6)**	**42 (48.3)**	**108 (2.2)**

Figure 26 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.[6] 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 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 0.0%–3.7% 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 27 presents the observed and expected mortality rates excluding salvage.

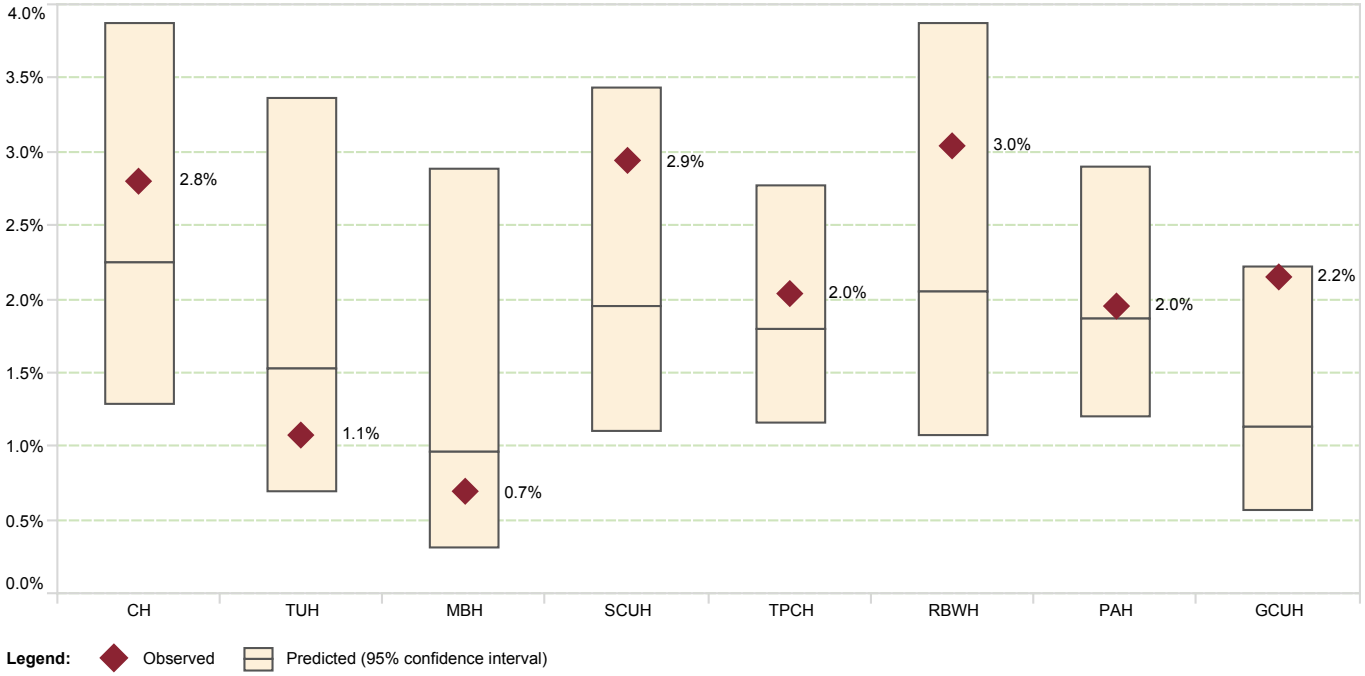
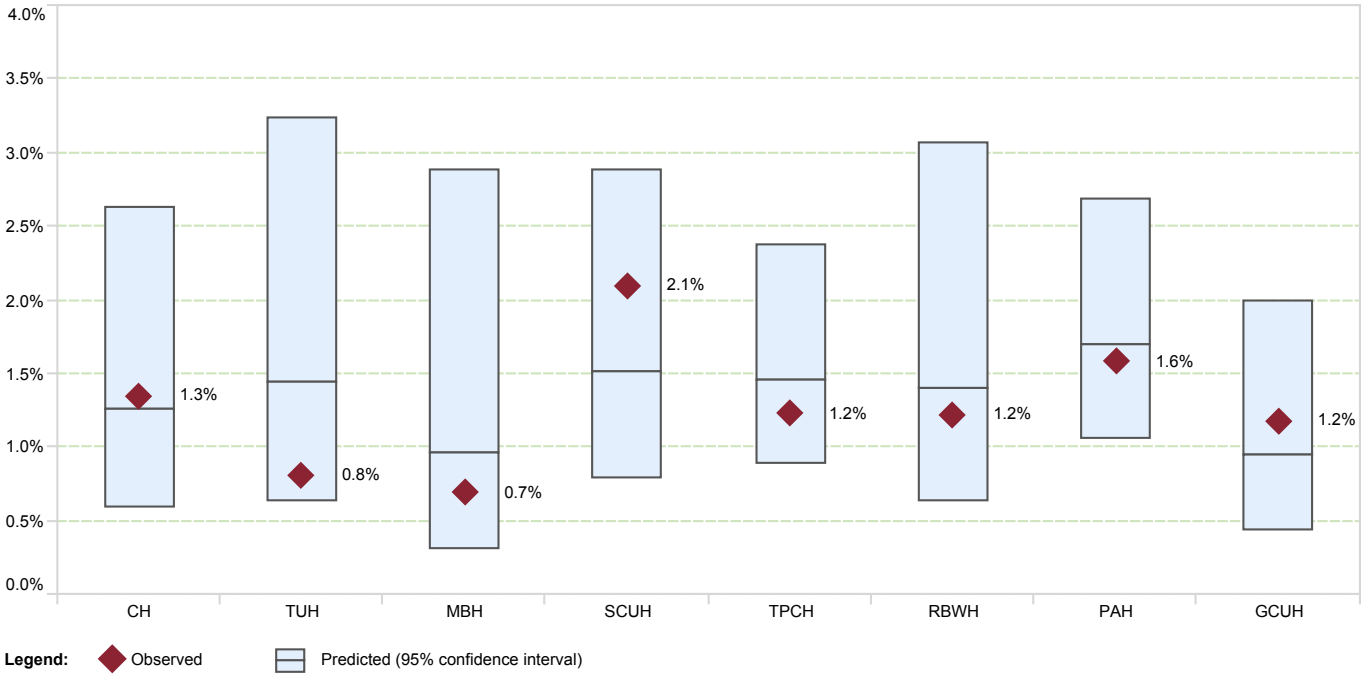


Figure 26: Comparison of observed and predicted mortality rates by site

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[8]. 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=87)

Figure 27: 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 1,867 documented STEMI cases in 2019, 1,488 cases (80%) 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 1.7% to 4.0% between participating centres with a statewide rate of 2.9%. Of these 1,429 patients analysed, a total of 42 mortalities were identified with the majority (79%) 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	2	1	110	3 (2.7)
TUH	0	2	0	91	2 (2.2)
MBH	0	1	0	58	1 (1.7)
SCUH	0	7	2	226	9 (4.0)
TPCH	0	8	1	270	9 (3.3)
RBWH	0	1	1	97	2 (2.1)
PAH	0	9	1	375	10 (2.7)
GCUH	1	3	2	202	6 (3.0)
STATEWIDE	**1**	**33**	**8**	**1,429**	**42 (2.9)**

* Excluding salvage cases (n=59)

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 3.2%.

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	1	46	1 (2.2)
TUH	0	2	0	34	2 (5.9)
MBH	0	1	0	26	1 (3.8)
SCUH	0	0	1	84	1 (1.2)
TPCH	0	4	0	124	4 (3.2)
RBWH	0	1	0	53	1 (1.9)
PAH	0	7	1	172	8 (4.7)
GCUH	1	2	0	127	3 (2.4)
STATEWIDE	**1**	**17**	**3**	**666**	**21 (3.2)**

* Excluding salvage cases (n=34)

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[9]. 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 84% 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.

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

Site	Total cases n	Proportion of total cases %
CH	9	1.7
TUH	6	1.6
MBH	4	1.4
SCUH	11	1.9
TPCH	18	1.7
RBWH	10	2.3
PAH	40	3.9
GCUH	22	3.2
STATEWIDE	**120**	**2.4**

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	**120**	**4**	**14**	**1**	**19 (15.8)**

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 first diagnostic ECG (FdECG)-to-device time as an important modifiable and objective measure of overall STEMI system performance.[10]

Both the European and American STEMI guidelines recommend a target FdECG-to-device time less than 90 minutes.[10,11] 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 cardiac catheter laboratory, 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

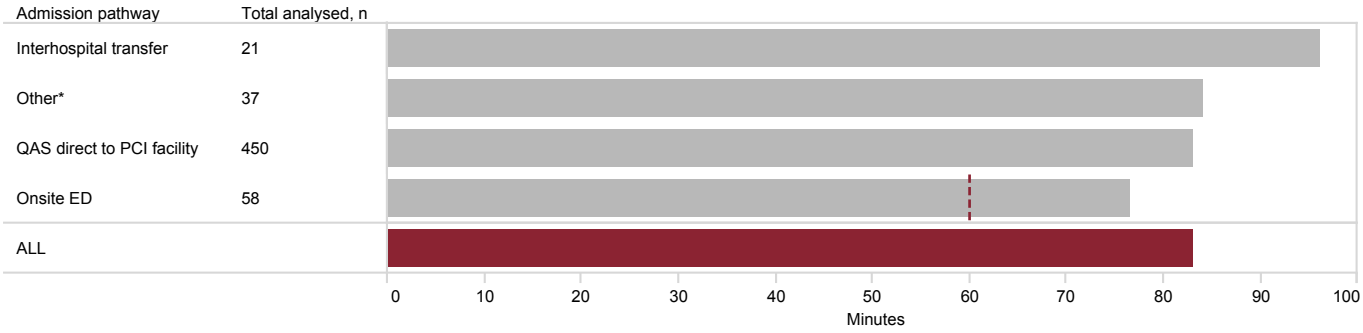
Time	Definition
First diagnostic ECG	First diagnostic ECG refers to the timestamp when the ECG shows ST-segment elevation (or equivalent) and can be regarded as time zero in the therapeutic pathway. The interpretation of the first diagnostic ECG may be undertaken by ambulance personnel, general practitioners 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) 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)[12]

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

In total, there were 700 STEMI primary PCI cases presenting within six hours of symptom onset. Of these, there were 134 cases which had been excluded per the criteria in Table 37 leaving 566 cases which are eligible for the following analysis.

As observed in previous annual reports, there was considerable variation in time from first diagnostic ECG to reperfusion depending on the admission pathway to the treating facility, ranging from 96 minutes to 58 minutes for interhospital transfers and PCI facility on site ED respectively.



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

Figure 28: 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	34
Out-of-hospital arrest	33
Thrombolysis contraindicated	21
Previous coronary artery bypass graft surgery	12
Significant comorbidities/frailty	12
Unsuccessful PCI	10
Intubation	6
Shock/acute pulmonary oedema	4
Missing data	2
Total ineligible	**134**

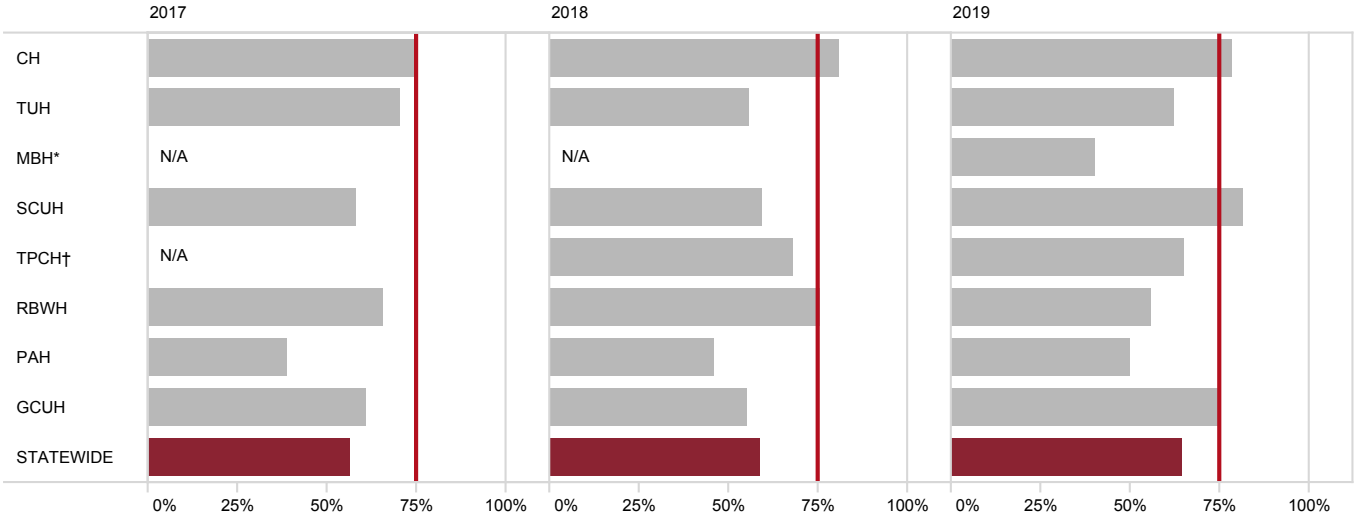
7.2.1 Time from first diagnostic ECG to first device

The all-site median time from first diagnostic ECG to reperfusion was 83 minutes, with median individual site times ranging from 73 minutes to 98 minutes. These results indicate that overall Queensland public facilities are approaching the ambitious benchmark of 90 minutes from time of first diagnostic ECG to first device. However, only 65% of patients analysed receive timely reperfusion per current guidelines (FdECG to reperfusion)[11], 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	42	73	63–89	78.6
TUH	35	24	75	70–118	62.5
MBH	26	25	98	79–125	40.0
SCUH	87	66	79	68–86	81.8
TPCH	130	113	84	75–99	65.5
RBWH	57	50	85	68–101	56.0
PAH	176	134	91	75–106	50.0
GCUH	134	112	79	68–90	75.0
STATEWIDE	**700**	**566**	**83**	**71–99**	**64.5**



* MBH results are not displayed for 2017 and 2018 due to less than 20 cases for analysis

† TPCH data collection extended to include first diagnostic ECG timestamps in 2018

Figure 29: Proportion of STEMI cases (presenting within six hours of symptom onset) where time from first diagnostic ECG to reperfusion met 90 min target, 2017–2019

7.2.1.1 Pre-hospital notification processes

The QAS has a well-established process for the management of STEMI in the pre hospital setting. All QAS paramedics are skilled in STEMI identification and pre-hospital reperfusion treatment. Advanced Care Paramedics (ACPs) are trained in 12-lead ECG acquisition and interpretation, decision-supported direct referral for pPCI, and decision supported administration of pre-hospital fibrinolysis. Critical Care Paramedics (CCPs) are authorised to perform direct pPCI referral and pre-hospital thrombolysis administration autonomously.

On recognition of prehospital STEMI that may be eligible for pPCI, paramedics utilise a dedicated telephone line to make direct contact with the on-call interventional cardiologist at the receiving PCI hospital to refer the patient. A pre-hospital treatment plan is agreed upon and, if pPCI is appropriate, the CCL is activated.

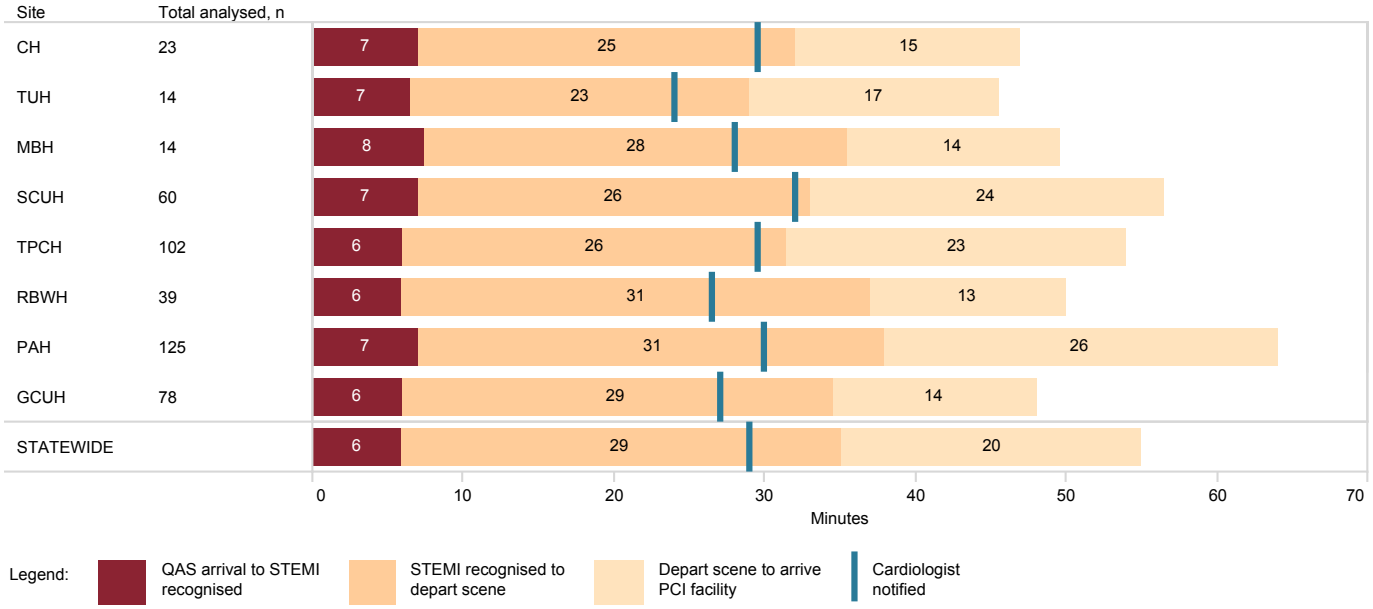


Figure 30: STEMI presenting within six hours of symptom onset pre-hospital component breakdown – QAS direct to PCI facility

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.

Although differing processes may explain some variation, this would appear to have minimal impact. When exploring door-to-device times in the following section, all sites were similar in the time taken to treat patients once they arrived at the PCI capable facility.

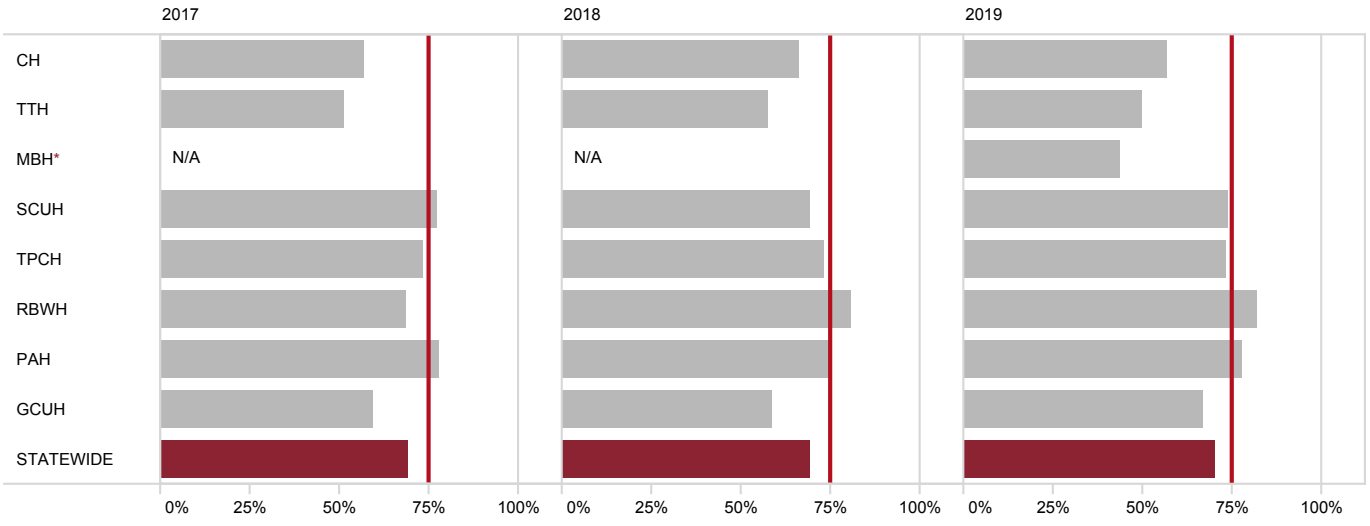
7.2.2 Time from arrival PCI capable facility to first device

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.[10,11]

Results demonstrate that for over two thirds of cases (71%), participating PCI facilities are meeting a target door-to-device time of less than 60 minutes, with an overall statewide median time of 42 minutes (ranging from 37 minutes to 64 minutes across sites).

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	42	54	31–80	57.1
TUH	35	24	59	32–88	50.0
MBH	26	25	64	40–104	44.0
SCUH	87	66	38	29–62	74.2
TPCH	130	113	39	29–61	73.5
RBWH	57	50	43	29–57	82.0
PAH	176	134	37	27–55	78.4
GCUH	134	112	45	32–79	67.0
STATEWIDE	**700**	**566**	**42**	**29–69**	**70.7**



* MBH results are not displayed for 2017 and 2018 due to less than 20 cases for analysis

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, 2017–2019

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.[13]

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 achieving this target is the time taken to transfer patients from non PCI capable facilities to the accepting PCI centre. Multiple reasons for delays include capacity constraints and patient transfer logistics in a large geographic area. Many of these factors are more complicated to improve than changes in practice or departmental efficiency. Overall, the figures for 2017 and 2018 (when high sensitivity troponin assays were increasingly used) are broadly similar, suggesting only a minor impact on clinicians' approach to truly high-risk cases.

Table 40 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 40: NSTEMI time to angiography – cases excluded from analysis

	n
Planned or staged PCI	153
Admitted with an unrelated principal diagnosis	148
Transferred from an interstate hospital	55
Coronary angiography not performed at index admission	41
Transferred from a private hospital	36
Stable non admitted patients transferred directly to lab for planned angiography	12
Incomplete data	94
Total ineligible	**539**

Patients presenting directly to a PCI capable facility had a median wait to coronary angiography time of 42 hours and were more likely to have angiography performed within the target timeframe of 72 hours compared with interhospital transfers (74% vs. 46%).

For direct presenters, the wide range of 20 hours to 73 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 2018, there was for direct presenters (Table 41) a modest increase in analysable NSTEMI cases (1,290 vs. 1,227) and a similar proportion meeting target (74%). While for interhospital transfers (Table 42), there was an increase in analysable cases (1,356 vs. 1,251) and slight reduction in the proportion meeting target (46% vs. 50%).

Table 41: Time to angiography – direct to PCI facility

SITE	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	218	178	63	27–107	55.6
TUH	155	141	46	24–68	75.9
MBH	85	78	37	17–57	87.2
SCUH	146	133	43	21–67	78.2
TPCH	336	303	31	16–65	80.5
RBWH	103	82	28	19–57	82.9
PAH	229	191	46	20–83	69.6
GCUH	198	184	43	22–77	72.8
STATEWIDE	**1,470**	**1,290**	**42**	**20–73**	**74.2**

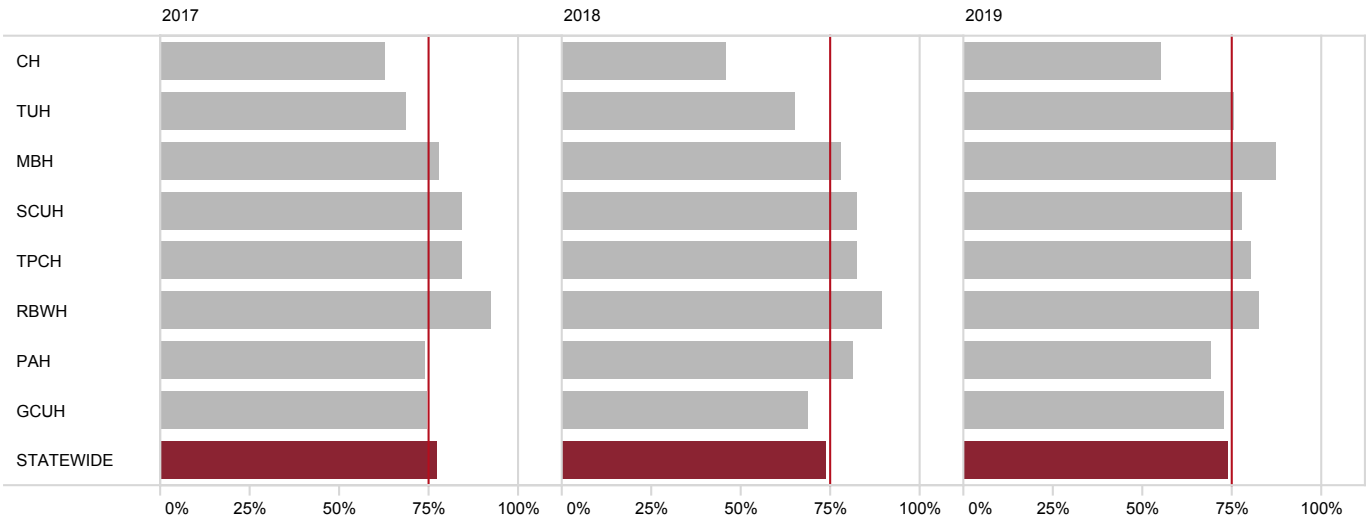


Figure 32: Proportion of NSTEMI direct presenters receiving angiography within 72 hours, 2017–2019

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.

Table 42: Time to angiography – interhospital transfers

Site	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	132	99	88	57–124	38.4
TUH	85	61	67	39–96	55.7
MBH	50	38	39	25–64	78.9
SCUH	184	156	48	29–71	76.9
TPCH	312	257	98	57–157	34.6
RBWH	230	201	89	54–122	38.3
PAH	579	466	83	50–125	40.3
GCUH	143	78	65	41–93	65.4
STATEWIDE	**1,715**	**1,356**	**76**	**45–121**	**46.2**

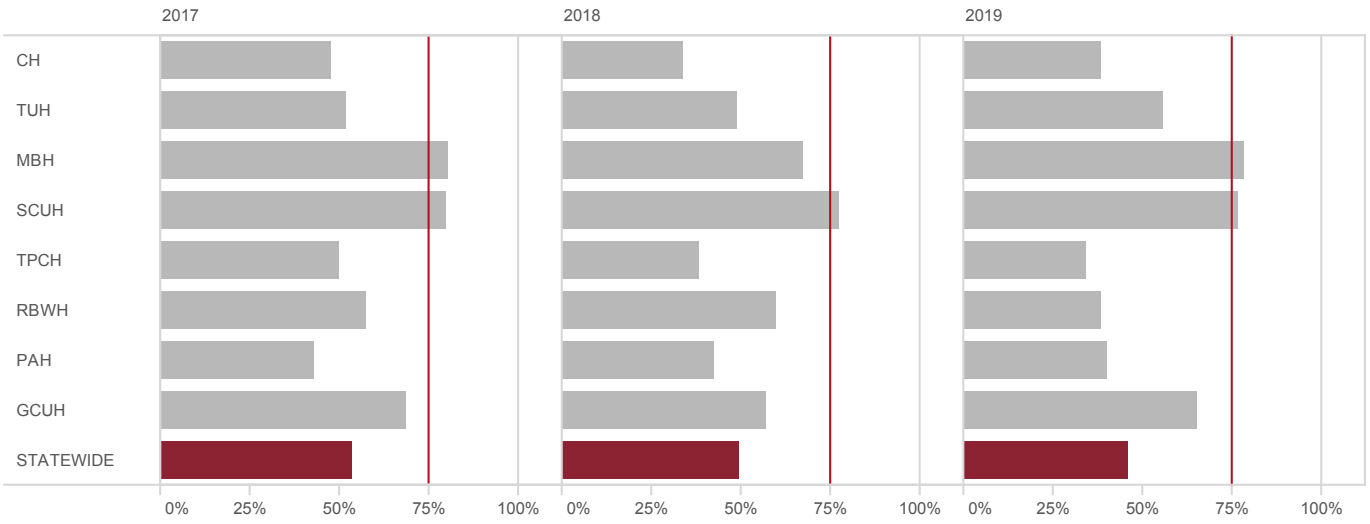


Figure 33: Proportion of NSTEMI interhospital transfers receiving angiography within 72 hours, 2017–2019

Of the 3,185 total NSTEMI cases, 54% were interhospital transfers and 48% received PCI. The median time to angiography with or without PCI was 60 hours.

Table 43: 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	350	277	37.7	72	37–117	49.5
TUH	240	202	35.4	48	27–83	69.8
MBH	135	116	37.0	38	19–58	84.5
SCUH	330	289	55.8	45	25–70	77.5
TPCH	648	560	48.1	59	24–109	59.5
RBWH	333	283	69.1	71	36–114	51.2
PAH	808	657	71.7	73	42–116	48.9
GCUH	341	262	41.9	48	25–82	70.6
STATEWIDE	**3,185**	**2,646**	**53.8**	**60**	**30–99**	**59.9**

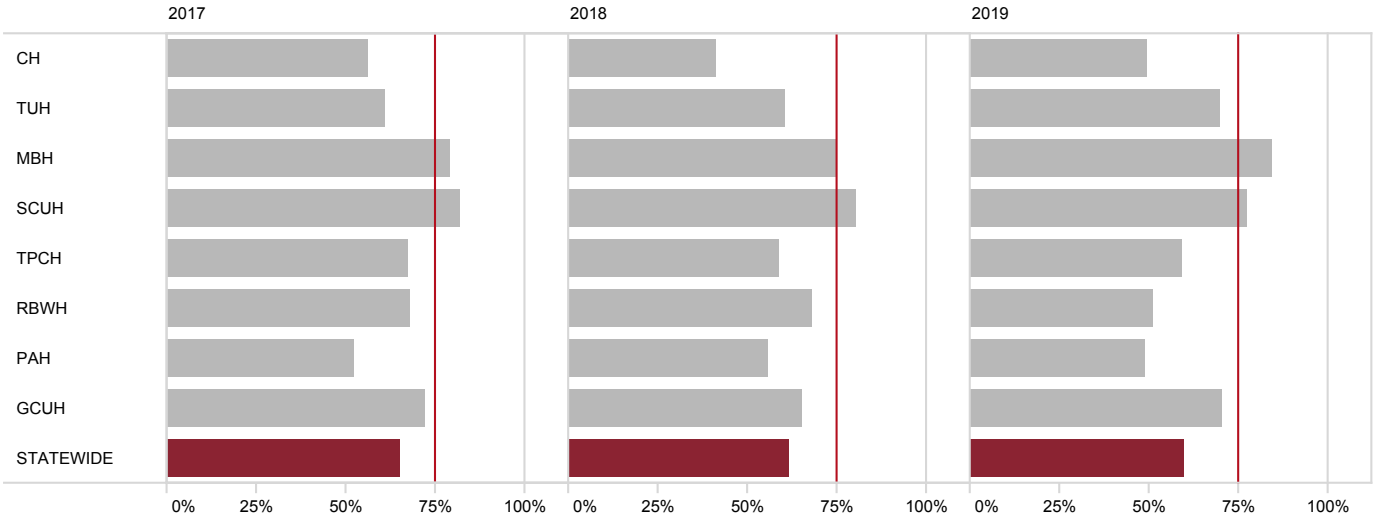


Figure 34: Proportion of NSTEMI cases meeting time to angiography target of 72 hours, 2017–2019

7.4 Major procedural complications

This quality indicator examines in-lab intra-procedural complications. In 2019, 36 cases (0.72%) 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.

The numbers of reported events remain low, rendering further comment difficult other than to state that it is reassuring.

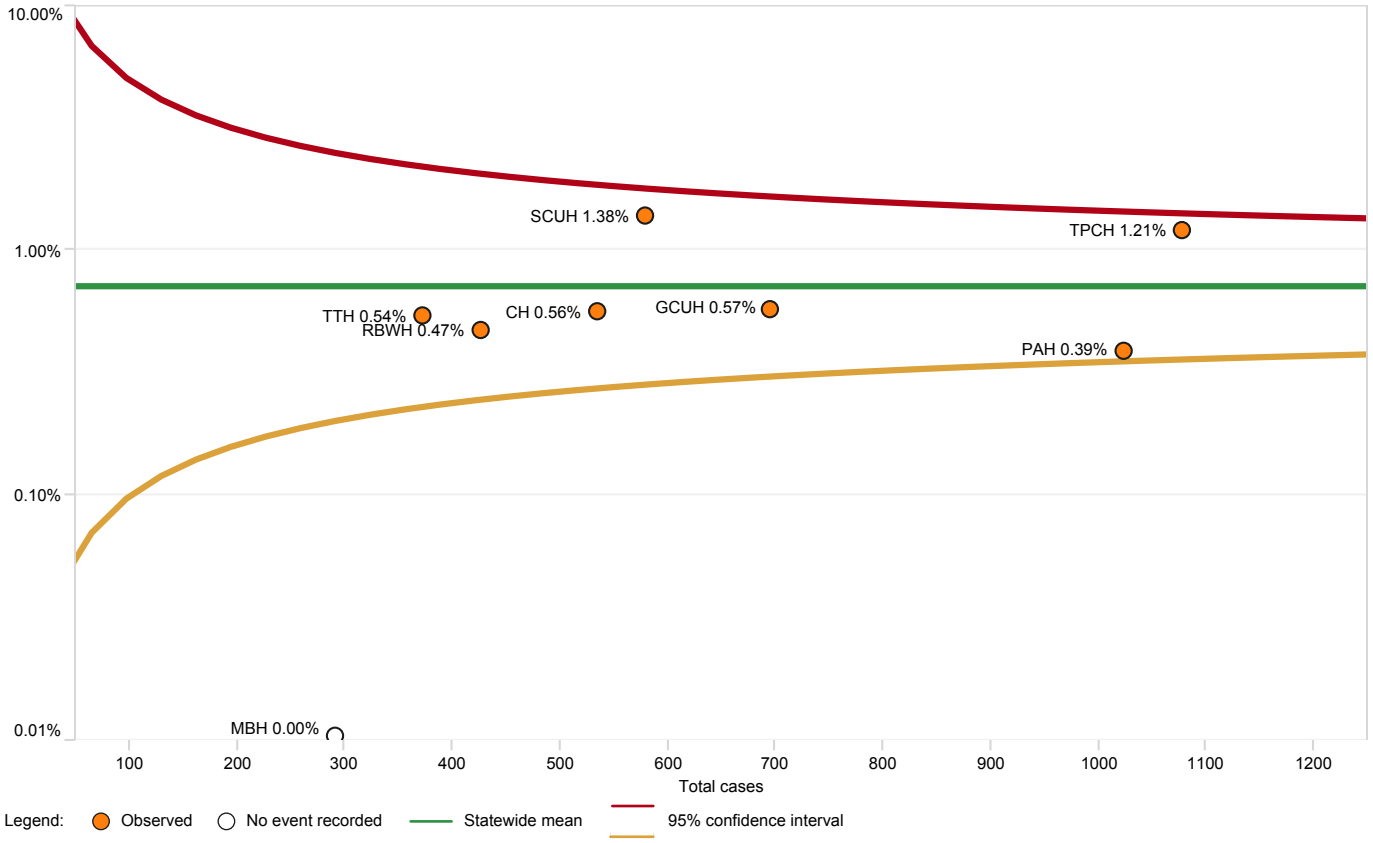


Figure 35: Proportion of PCI cases with immediate major procedure complication by site

Table 44: All PCI cases by immediate major procedural complication type

Complication type	Case n	%
Major intra-procedural complication	**36**	**0.72**
Coronary artery perforation	26	0.52
Tamponade	5	0.10
CVA	2	0.04
In-lab death*	2	0.04
Emergency CABG	1	0.02
No immediate major procedural complication	4,965	99.28
Total	**5,002**	

* Excluding salvage deaths

7.5 Safe radiation doses

Staff and patients are exposed to ionising radiation during the majority of all procedures performed in the cardiac catheter laboratory. Whilst ionising radiation is known to cause both delayed and immediate effects, the probability of effect is thought to be dose related.

Fortunately, conservative thresholds are applied and monitored throughout Queensland. 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.

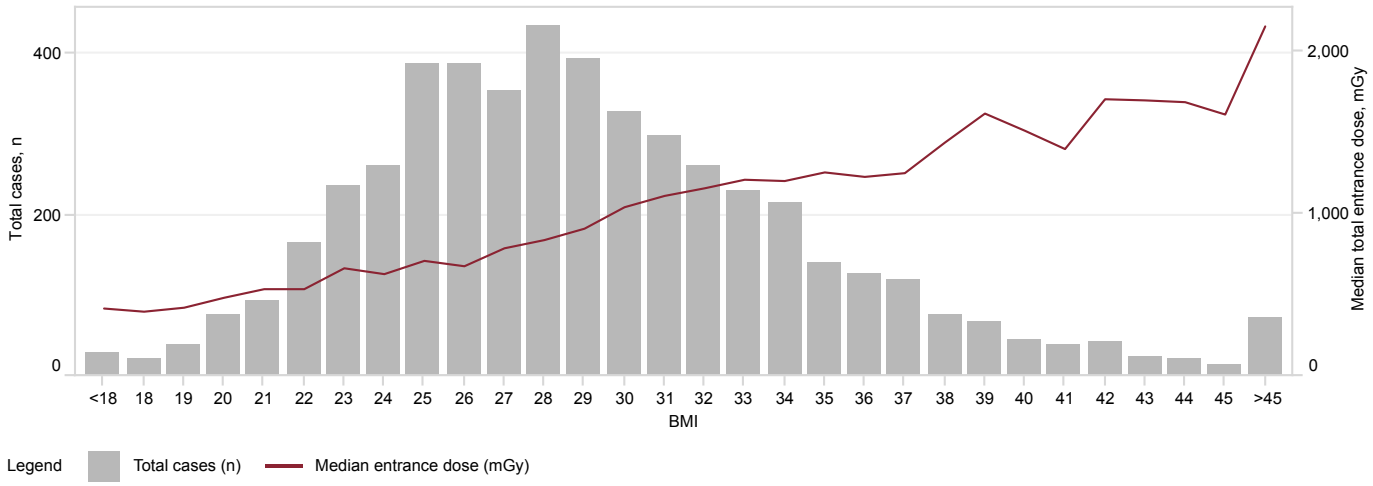


Figure 36: All coronary and PCI procedures median total entrance dose by body mass index

Table 45: Proportion of cases meeting the safe dose threshold by case type

Site	PCI procedures %	Other coronary procedures %
CH	99.6	99.7
TUH	98.4	99.5
MBH	100.0	100.0
SCUH	98.8	99.5
TPCH	99.2	99.7
RBWH	99.5	99.8
PAH	97.8	99.2
GCUH	99.9	99.9
STATEWIDE	**99.0**	**99.6**

8 Conclusions

This year's Interventional Cardiology Audit has once again expanded in scope and driven forward quality improvement activities across the state. With the expanded analysis of patients receiving thrombolysis, new insight can be gained relating to patient outcomes in this cohort. The contribution of the QAS has been invaluable in getting to this point and we look forward to ongoing future collaboration.

Year on year improvements have been made with a three minute improvement in the time from first diagnostic ECG to reperfusion for patients undergoing PCI for STEMI from 2017–2019. Similarly, there has been an 8% increase in the number of patients reaching the 90 minute reperfusion target time for primary PCI since 2017. QCOR data has enabled individual departments to monitor their own progress with this metric to initiate changes to internal processes.

The addition of an out-of-hospital cardiac arrest analysis has shown sobering but reassuring mortality rates for this extremely unwell patient group who, on presentation, have an extremely guarded prognosis.

The introduction of a new definition for salvage PCI in this year's report saw a modest increase in the number of patients categorised this way. By removing these patients from mortality analysis, better clarity of PCI safety is gained. It is encouraging to see that even with this change in definition that overall rates appear steady when compared to previous years.

Work can still be done to explore alternate or locally developed risk adjustment models for those patients undergoing PCI. This has been a goal for some time, and with improved access to other datasets and the increasingly high quality data from within QCOR, this goal is becoming more achievable than ever.

Structural heart disease interventions continue to increase in volume across the state, in particular, TAVR. With a new application nearing completion and implementation, the level of data available for analysis will be unprecedented. By embedding this new application within the established workflow for these complex interventions, clinical, as well as data collection benefits can be realised.

The role of QCOR data has once again exceeded the analysis performed in this Report. Through partnership with other Queensland Health divisions, PCI data which relates to device usage has enabled significant cost savings to date, and established a platform for continued cost efficiencies to be realised.

Further to work in expanding data collection and analysis, QCOR has also been actively involved in establishing and contributing to national registries though working closely with the newly established National Cardiac Registry (NCR). The NCR is a Commonwealth funded clinical quality registry which operates using a federated model where each state-based registry acts as the conduit for contributing data. This initiative is being followed closely by Queensland cardiac clinicians with the hope that it can provide valuable functions that have quality assurance at their crux. We look forward to future involvement in the design and direction of this new clinical quality registry for PCI.

9 Supplement: Structural heart disease

This year's structural heart disease (SHD) supplement contains data for procedures including cardiac defect closures and transcatheter aortic valve replacement (TAVR) procedures, among others, that took place in the seven Queensland public hospital cardiac catheterisation laboratories.

A new bespoke QCOR module for SHD interventions, led by clinicians throughout its development, will be deployed across most public sites offering such procedures in Queensland through 2021. The QCOR SHD module has been developed to provide a procedural reporting solution for the point of care in addition to capturing case data for registry purposes. The new module allows data to be recorded across the patient journey, from the preoperative phase up to one year post discharge, and will provide a platform to enable seamless participation in national quality and patient safety registries.

The new module will streamline participation of Queensland public facilities in the Australasian Cardiac Outcomes Registry transcatheter aortic valve implantation registry, which forms the basis for institution and operator credentialing within Australia.

The QCOR SHD sub-committee and the Statewide Cardiac Clinical Network continue to work towards extending registry participation to private healthcare facilities in the future.

9.1 Participating sites

A total of 477 SHD interventions were performed across the seven Queensland public cardiac catheterisation laboratories. Two thirds (68%) of cases were valvular interventions including percutaneous valve replacement and valvuloplasty procedures.

Table 1: Total SHD cases by participating site

Site	Total cases n	Device closure* n (%)	Valvular intervention† n (%)	Other‡ n (%)
CH	19	16 (84.2)	2 (10.5)	1 (5.3)
TUH	25	10 (40.0)	15 (60.0)	–
SCUH	21	12 (57.1)	9 (42.9)	–
TPCH	248	31 (12.5)	207 (83.5)	10 (4.0)
RBWH	21	17 (81.0)	4 (19.0)	–
PAH	88	29 (33.0)	57 (64.8)	2 (2.3)
GCUH	55	22 (40.0)	31 (56.4)	2 (3.6)
STATEWIDE	**477**	**137 (28.7)**	**325 (68.1)**	**15 (3.1)**

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

† Percutaneous valve replacement and valvuloplasty

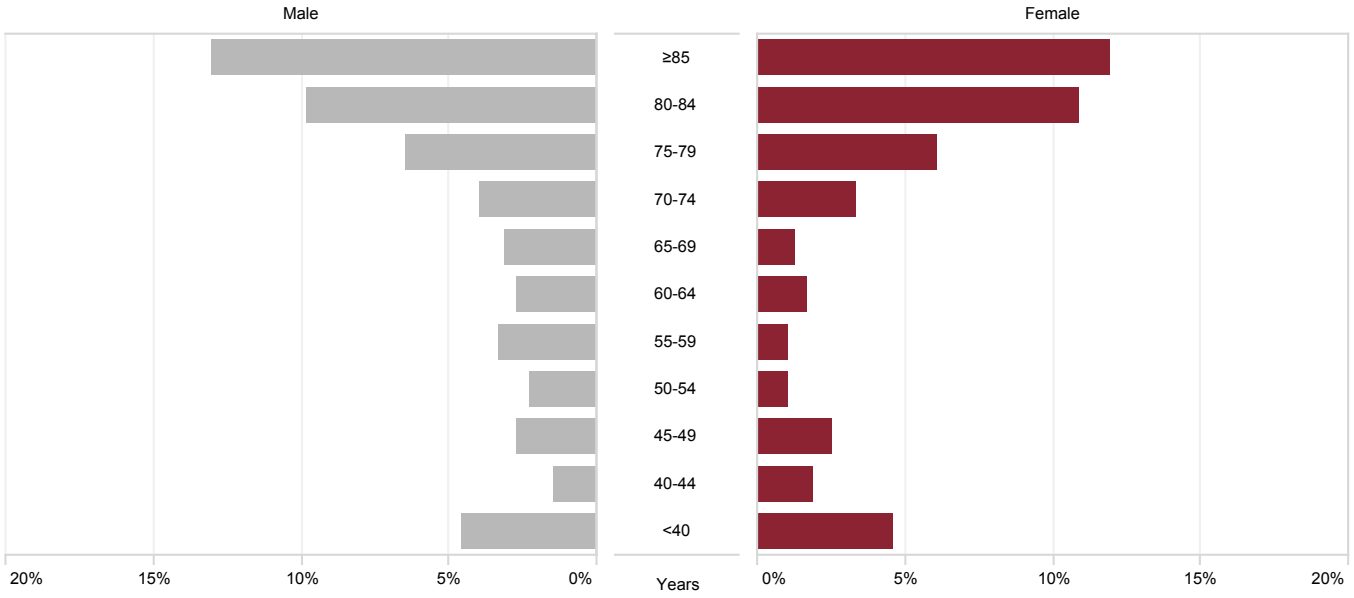
‡ Myocardial septal ablation and renal denervation

9.2 Patient characteristics

9.2.1 Age and gender

Patients undergoing an SHD intervention were distributed between genders at 54% male and 46% female. One quarter 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 83 years compared to 49 years for device closure procedures.



% of total (n=477)

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

Table 2: Median age by gender and procedure category

	Male years	Female years	All years
Device closures	50	46	49
Valvular intervention	83	83	83
Other	70	70	70
ALL	**77**	**80**	**79**

9.3 Care and treatment of SHD patients

9.3.1 Device closures

There was a total of 137 device closures performed across the seven participating centres. The majority of device closure procedures were for the correction of a patent foramen ovale (PFO), followed by atrial septal defect (ASD), at 73% and 17% of case volumes respectively.

Table 3: Device closure procedures by participating site

Site	Total cases n	PFO* n (%)	ASD† n (%)	PDA‡ n (%)	LAA§ n (%)	Para-valvular leak n (%)	Other‖ n (%)
CH	16	16 (100.0)	–	–	–	–	–
TUH	10	7 (70.0)	–	–	–	2 (20.0)	1 (10.0)
SCUH	12	10 (83.3)	1 (8.3)	1 (8.3)	–	–	–
TPCH	31	16 (51.6)	5 (16.1)	1 (3.2)	6 (19.4)	2 (6.5)	1 (3.2)
RBWH	17	15 (88.2)	2 (11.8)	–	–	–	–
PAH	29	16 (55.2)	13 (44.8)	–	–	–	–
GCUH	22	20 (90.9)	2 (9.1)	–	–	–	–
STATEWIDE	**137**	**100 (73.0)**	**23 (16.8)**	**2 (1.5)**	**6 (4.4)**	**4 (2.9)**	**2 (1.5)**

* Patent foramen ovale

† Atrial septal defect

‡ Patent ductus arteriosus

§ Left atrial appendage

‖ Includes closure of cardiac collateral vessel and arteriovenous malformation

9.3.2 Valvular interventions

The total number of valvular interventions performed across the seven participating sites was 325, comprising of transcatheter valvuloplasty (Table 6) and transcatheter valve replacement (Table 7) procedures.

The aortic valve was the most common valve requiring intervention, accounting for 91% of overall cases.

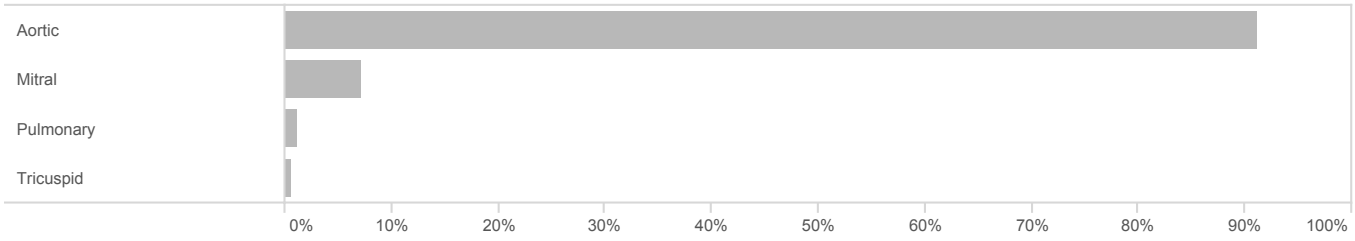


Figure 2: Proportion of all transcatheter valvular interventions by valve type

Table 4: Transcatheter valvular interventions by cardiac valve

Site	Total cases n	Aortic n (%)	Mitral n (%)	Pulmonary n (%)	Tricuspid n (%)
CH	2	2 (100.0)	–	–	–
TUH	15	15 (100.0)	–	–	–
SCUH	9	9 (100.0)	–	–	–
TPCH	207	178 (86.0)	23 (11.1)	4 (1.9)	2 (1.0)
RBWH	4	4 (100.0)	–	–	–
PAH	57	57 (100.0)	–	–	–
GCUH	31	31 (100.0)	–	–	–
STATEWIDE	**325**	**296 (91.1)**	**23 (7.1)**	**4 (1.2)**	**2 (0.6)**

Table 5: Transcatheter valvular interventions by type

Site	Total cases n	Transcatheter valvuloplasty n (%)	Transcatheter valve replacement n (%)
CH	2	2 (100.0)	–
TUH	15	2 (13.3)	13 (86.7)
SCUH	9	9 (100.0)	–
TPCH	207	41 (19.8)	166 (80.2)
RBWH	4	4 (100.0)	–
PAH	57	3 (5.3)	54 (94.7)
GCUH	31	5 (16.1)	26 (83.9)
STATEWIDE	**325**	**66 (20.3)**	**259 (79.7)**

Transcatheter valve replacement procedures constitute a relatively new and highly sophisticated approach to treating patients with conditions often otherwise reliant on conventional cardiac surgery. There were four sites which offered transcatheter valve replacement procedures in 2019, while the number of procedures performed by those sites (n=259) was increased considerably from the previous year (n=151).

Table 6: Transcatheter valvuloplasty procedures

Site	Balloon aortic valvuloplasty n (%)	Mitral leaflet clip n (%)	Balloon tricuspid valvuloplasty n (%)
CH	2 (100.0)	–	–
TUH	2 (100.0)	–	–
SCUH	9 (100.0)	–	–
TPCH	22 (53.7)	18 (43.9)	1 (2.4)
RBWH	4 (100.0)	–	–
PAH	3 (100.0)	–	–
GCUH	5 (100.0)	–	–
STATEWIDE	**47 (71.2)**	**18 (26.9)**	**1 (1.5)**

Table 7: Transcatheter valve replacement procedures

Site	TAVR* n (%)	TMVR† n (%)	TTVR‡ n (%)	TPVR§ n (%)
TUH	13 (100.0)	–	–	–
TPCH	156 (94.0)	5 (3.0)	1 (0.6)	4 (2.4)
PAH	54 (100.0)	–	–	–
GCUH	26 (100.0)	–	–	–
STATEWIDE	**249 (96.1)**	**5 (1.9)**	**1 (0.4)**	**4 (1.6)**

* Transcatheter aortic valve replacement/implantation

† Transcatheter mitral valve replacement

‡ Transcatheter tricuspid valve replacement

§ Transcatheter pulmonary valve replacement

Table 8: Other structural heart disease interventions

Site	Myocardial septal ablation n (%)	Renal denervation n (%)
CH	–	1 (100.0)
TPCH	–	10 (100.0)
PAH	2 (100.0)	–
GCUH	–	2 (100.0)
STATEWIDE	**2 (13.3)**	**13 (86.7)**

9.4 Patient outcomes

9.4.1 All-cause 30 day mortality

Across the seven public cardiac catheter labs in Queensland offering SHD intervention, the all-cause unadjusted 30 day mortality rate was 2.7%.

Table 9: 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	19	0 (0.0)	1 (50.0)	0 (0.0)	1 (5.3)
TUH	25	0 (0.0)	0 (0.0)	–	0 (0.0)
SCUH	21	0 (0.0)	0 (0.0)	–	0 (0.0)
TPCH	248	1 (3.2)	9 (4.3)	0 (0.0)	10 (4.0)
RBWH	21	0 (0.0)	0 (0.0)	–	0 (0.0)
PAH	88	0 (0.0)	1 (1.8)	0 (0.0)	1 (1.4)
GCUH	55	0 (0.0)	1 (3.2)	0 (0.0)	1 (2.0)
STATEWIDE	**477**	**1 (0.7)**	**12 (3.7)**	**0 (0.0)**	**13 (2.7)**

9.4.2 All TAVR cases

2019 cases

Of the four sites performing TAVR in 2019, the overall all-cause unadjusted mortality rate within 30 days of the procedure was 2.0%.

Table 10: All-cause unadjusted 30 day mortality post TAVR by site

Site	Total cases n	30 day mortality n (%)
TUH	13	0 (0.0)
TPCH	156	5 (3.2)
PAH	54	0 (0.0)
GCUH	26	0 (0.0)
STATEWIDE	**249**	**5 (2.0)**

2018 and 2017 cases

Of the four sites performing TAVR in 2018, the overall all-cause unadjusted mortality rate within 30 days of the procedure was 1.4%, and 9.5% at 365 days. For the three sites performing TAVR in 2017, the overall all-cause unadjusted mortality rate at two years post procedure was 18.8%.

These figures should be interpreted with caution as many of the patients within this cohort were of advanced age at the time of their procedure and were also likely to have been unsuitable for surgical valve replacement due to comorbidities and risk factors.

Table 11: All-cause unadjusted 30 day and 1 year mortality post TAVR by site (2018 cohort)

Site	Total cases n	30 day mortality n (%)	1 year mortality n (%)
TUH	3	0 (0.0)	0 (0.0)
TPCH	93	1 (1.1)	8 (8.6)
PAH	33	1 (3.0)	5 (15.2)
GCUH	19	0 (0.0)	1 (5.3)
STATEWIDE	**148**	**2 (1.4)**	**14 (9.5)**

Table 12: All-cause unadjusted mortality up to 2 years post TAVR by site (2017 cohort)

Site	Total cases n	30 day mortality n (%)	1 year mortality n (%)	2 year mortality n (%)
TPCH	103	4 (3.9)	15 (14.6)	21 (20.4)
PAH	21	0 (0.0)	2 (9.5)	3 (14.3)
GCUH	4	0 (0.0)	0 (0.0)	0 (0.0)
STATEWIDE	**128**	**4 (3.1)**	**17 (13.3)**	**24 (18.8)**

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Interventional Cardiology Audit

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Glossary

6MWT	Six Minute Walk Test
ACC	American College of Cardiology
ACEI	Angiotensin Converting Enzyme Inhibitor
ACP	Advanced Care Paramedic
ACS	Acute Coronary Syndromes
AEP	Accredited Exercise Physiologist
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
APC	Argon Plasma Coagulation
AQoL	Assessment of Quality of Life
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
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
FdECG	First Diagnostic Electrocardiograph
FTR	Failure to Rescue
GAD	Generalized Anxiety Disorder
GCCH	Gold Coast Community Health
GCUH	Gold Coast University Hospital
GLH	Gladstone Hospital
GP	General Practitioner
GYH	Gympie Hospital
HBH	Hervey Bay Hospital (includes Maryborough)
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
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
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
NOAC	Non Vitamin K Antagonist Oral Anticoagulants
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
QAS	Queensland Ambulance Service
QCOR	Queensland Cardiac Outcomes Registry
QEII	Queen Elizabeth II Jubilee Hospital
QHAPDC	Queensland Hospital Admitted Patient Data Collection
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
SCCN	Statewide Cardiac Clinical Network
SCUH	Sunshine Coast University Hospital
SHD	Structural Heart Disease
STEMI	ST-Elevation Myocardial Infarction
STS	Society of Thoracic Surgery
TAVR	Transcatheter Aortic Valve Replacement
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
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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