Queensland Health

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Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry
2020 Annual Report
Interventional Cardiology Audit

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Queensland Government

Queensland Cardiac Outcomes Registry 2020 Annual Report

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1 Foreword

Dr John Wakefield PSM
Director-General
Queensland Health

I am pleased to present the Queensland Cardiac Outcomes Registry (QCOR) 2020 Annual Report. The Annual Report provides a detailed audit of six clinical services spanning cardiac and thoracic interventions and surgeries to outpatient services for patients dealing with this complex chronic disease.

The Report also analyses the effect of the COVID-19 pandemic on cardiac services. Whilst there have been many challenges, it is evident that the resilient nature of cardiac clinicians has shone through with service volumes continuing to experience growth or modest variation in case numbers. The report also begins to examine the positive impact of the implementation of the Networked Cardiac Care model for coordination and outreach services in regional and remote Queensland. We can now measure and monitor the effect and outcome of investment into preventative and specialist medical care provided close to home.

Queensland Health is committed to empowering our people to provide the best possible healthcare, to be transparent in our work and importantly use information to inform and improve the health outcomes of our patients. It is pleasing to see this Report evolve and adapt to the needs of its stakeholders year-on-year.

Clinical engagement has continued to extend beyond clinical practice, where procurement activities for clinical consumable items has resulted in significant cost savings. The utilisation of QCOR data has been at the crux of these initiatives, empowering clinicians and administrators to confidently negotiate better value for money for high-cost, high-volume prostheses.

QCOR data has allowed health services to be responsive to the needs of patients and community. It is actively used to inform how we improve the access, equity, safety, efficiency, and effectiveness of cardiac healthcare.

I would like to acknowledge the ongoing effort of the Statewide Cardiac Clinical Network and the ongoing commitment and dedication of our hard-working clinicians and teams across Queensland who have collaborated to produce this Annual Report.

2 Message from the SCCN Chair

This sixth QCOR Annual Report once again underpins the importance of data in ensuring quality outcomes in healthcare. The COVID-19 pandemic has also underscored how reliant we are on data to inform decision making and to monitor service delivery. To date, Queensland public health services have been spared in comparison to interstate and international services. Nonetheless, clinicians have collaborated to prepare for a staged, whole-system approach, should it be required, to ensure consistency of service delivery. QCOR data has supported these processes.

QCOR has continued to expand its breadth including a new module to support cardiac outreach services. Outreach services are an integral part of delivering quality care to patients for whom cardiac care is less accessible, due to their remoteness from traditional facility-based services. These models of care were embraced throughout the 2020 COVID-19 pandemic due to travel restrictions and lockdowns necessitating services to adapt to maintain high levels of clinical care. QCOR's analysis of this program highlights the investment and efforts of clinicians to ensure the best possible care is provided regardless of distance and location.

This year we welcome the contribution of quality data and outcomes from the Queensland Paediatric Cardiac Service. Initially focusing on paediatric cardiac surgery this small, highly specialised community perform high risk, low volume procedures requiring expert levels of evaluation and contextualisation. The database will provide a unique platform for population-based studies. It will also lay the foundation for long-term outcome studies in a local population.

It is again reassuring to see Queensland cardiac services performing strongly against, often-aspirational, targets, even in the face of an uncertain healthcare landscape. An unwavering commitment to clinical quality has seen the registry continue to evolve including the review and adjustment of clinical indicators across all areas of interest.

QCOR data has continued to underpin clinician-led, bulk purchase arrangements and subsequent savings for the purchase of cardiac prostheses. This data has informed the process and outcomes of the initiative resulting in over $3.8 million per annum savings across coronary stents and balloons, cardiac pacemakers, defibrillators and implantable loop recorders. The program has demonstrated the value of QCOR and its ability to not only support improved clinical outcomes but deliver significant efficiencies to the organisation that enable cost savings and reinvestment into front line services and new technologies. This program provides a template for other areas of the public health system to emulate.

The many dedicated staff involved in cardiac services throughout all of Queensland should be applauded, not only for their commitment to delivering quality clinical outcomes but for their willingness to collaborate, continually review, adapt and improve.

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

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

* Principal contact officer/QCOR program lead

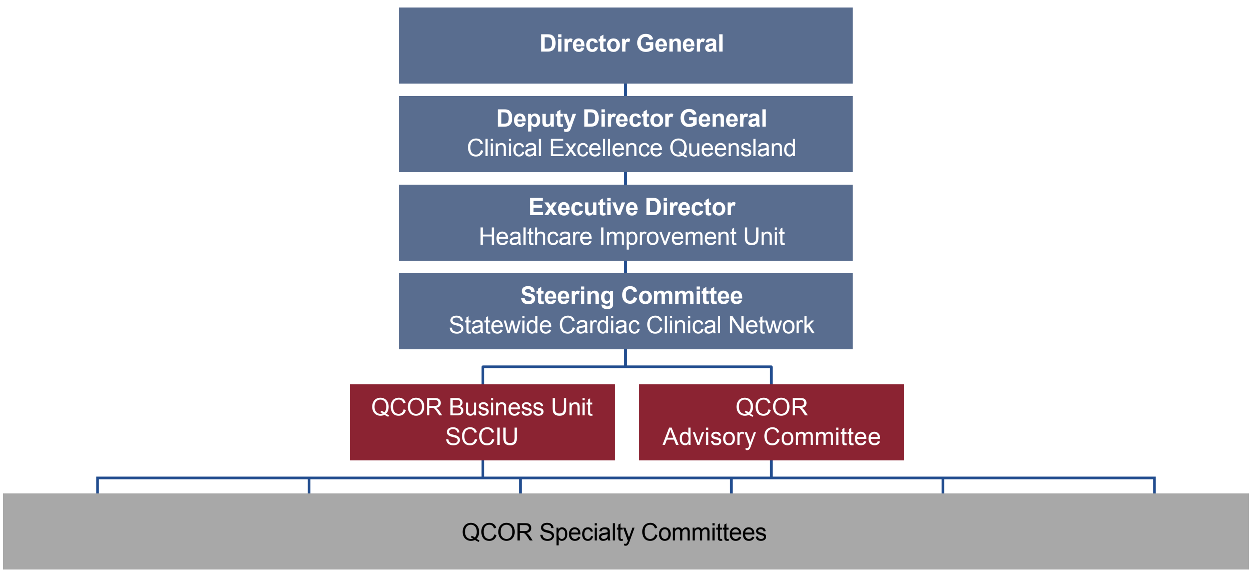


Figure 1: Governance structure

Queensland Cardiac Outcomes Registry

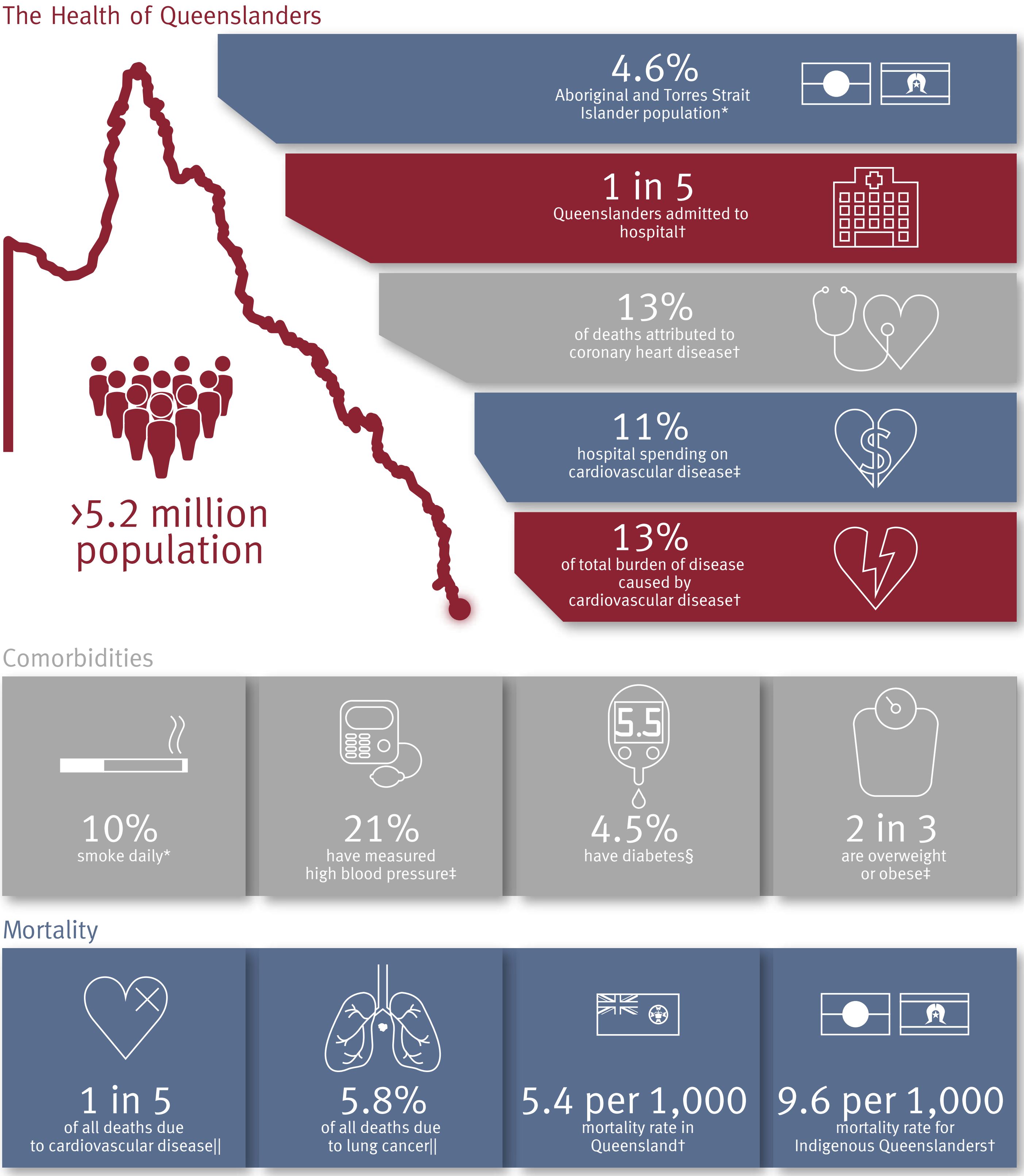


Figure 2: QCOR 2020 infographic

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

2020 Activity at a Glance

What's New?

- Paediatric cardiac surgery spotlight
- COVID-19 impact analysis
- STEMI <6 hours in and out of hours audit
- Expanded cardiac outreach reporting
- Expanded pre-hospital notification for PCI analysis
- Cardiac rehabilitation declined referral analysis

Interventional Cardiology

4,966
percutaneous coronary interventions

468
structural heart disease interventions

249
transcatheter aortic valve replacements

15,491
total coronary procedures

Cardiothoracic Surgery

2,651
adult cardiac surgeries

1,093
adult thoracic surgeries

Electrophysiology & Pacing

5,201
electrophysiology and pacing procedures

3,551
cardiac implantable electronic device procedures

Heart Failure Support Services

5,664
heart failure support services referrals

Cardiac Rehabilitation

11,177
cardiac rehabilitation referrals

Rheumatic Heart Disease

483
unknown rheumatic heart disease patients identified

Clinical Indicator Progress

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

0.2%
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

93%
of cardiac rehabilitation referrals within 3 days of discharge

1.4%
mortality rate for coronary artery bypass surgery at 30 days

QCOR Yearly Trends

Interventional Cardiology

15,491
coronary cases in 2020
– up from 15,293 in 2018

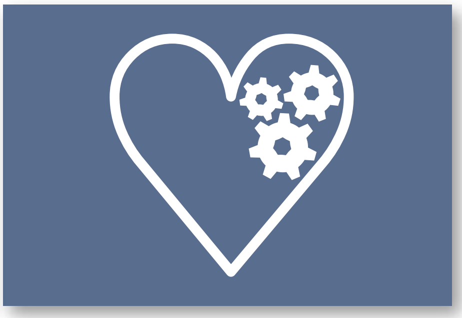
4,966
PCI cases in 2020
– up from 4,867 in 2018

5 minute
improvement in median time to reperfusion for STEMI PCI
– 2017 to 2020

11%
increase in primary PCI cases meeting 90 minute target for timely reperfusion
– 2017 to 2020

Cardiothoracic Surgery

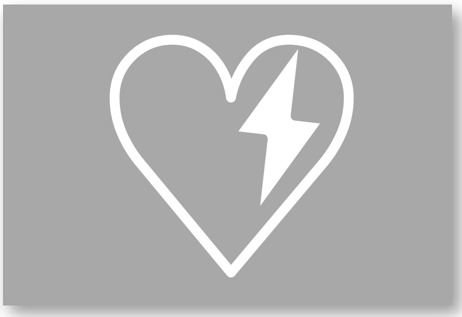
12%
increase in cardiac surgery cases
– 2017 to 2020



29%
increase in thoracic surgery cases
– 2017 to 2020

Electrophysiology & Pacing

16%
increase in cases
– up from 4,474 in 2018



67%
increase in complex EP cases
– 2018 to 2020

Outpatient Support Services

›34,000
cardiac rehabilitation referrals
– 2018 to 2020

25%
increase in HFSS referrals
– 2017 to 2020

4 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
- 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
- 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

5 Executive summary

This report comprises an account for cases performed in the eight cardiac catheterisation laboratories (CCL), nine electrophysiology and pacing (EP) facilities, along with five cardiothoracic surgery units operating across Queensland public hospitals in 2020. All referrals to heart failure support (HFSS) and cardiac rehabilitation (CR) services have also been included in this Annual Report.

- 15,491 diagnostic or interventional cases were performed across the eight public CCL facilities in Queensland hospitals. Percutaneous coronary intervention (PCI) was performed in 4,966 of these cases.
- Patient outcomes following PCI remain encouraging. The 30 day mortality rate following PCI was 1.5%, and of the 75 deaths observed, over two thirds (69%) 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 was 81 minutes, while the median time from arrival at PCI facility to reperfusion was measured at 40 minutes.
- For STEMI presenting within six hours of symptom onset the median time from arrival to PCI facility to reperfusion was 32 minutes for cases performed in working hours (8am to 6pm, Monday to Friday), while cases occurring out of hours had a median time of 44 minutes.
- STEMI cases presenting within six hours of symptom onset with no pre-hospital notification had a longer median time from arrival PCI facility to reperfusion compared to cases where the cardiologist was notified pre-hospital (81 minutes vs. 32 minutes).
- There were 468 structural heart interventions performed across participating CCL facilities, including 313 transcatheter valve procedures, and 249 transcatheter aortic valve replacement procedures. The all-cause 30 day mortality rate for all SHD interventions was 1.1%, ranging from 0.0% to 1.8% across participating centres.
- Across the four sites with a cardiac surgery unit, a total of 2,651 cases were performed including 1,581 cases involving coronary artery bypass grafting and 1,142 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.
- Across the period of 2016 to 2020, 1,372 children underwent cardiac surgery, including 279 children in 2020.
- There were 1,505 paediatric cardiac surgical procedures performed across 2016–2020, either with or without cardiopulmonary bypass (1,147 and 358 procedures respectively).
- Thirty day mortality after paediatric cardiac surgery was observed at 0.9% between 2016–2020.
- A total of 1,093 thoracic surgery (TS) cases were performed across the five public hospitals providing thoracic surgery services in 2020. Almost a quarter (24%) of surgeries followed a surgical indication of primary lung cancer, whereas pleural disease accounted for nearly a third of all cases (29%).
- The unadjusted all-cause 30 day mortality rate following TS was 0.7%, increasing to 1.9% at 90 days post surgery.
- At the nine public EP sites, a total of 5,201 cases were performed, which included 3,551 cardiac device procedures and 1,286 cardiac electrophysiology procedures.
- The EP clinical indicator audit identified a median wait time of 104 days for complex ablation procedures, and 36 days for elective implantable cardioverter defibrillator (ICD) implants. Meanwhile the median wait time for a standard ablation procedure was 99 days.
- There was a total of 11,177 referrals to public CR services in 2020. Three quarters of referrals followed an admission at a public hospital in Queensland.
- Nearly two thirds (64%) of CR referrals proceeded to pre assessment by a CR service. The most common reason this did not take place was that the patient declined or was not interested.
- The vast majority (93%) of referrals to CR were created within three days of the patient being discharged from hospital, while over half of patients went on to complete an initial assessment by CR within 28 days of discharge (58%). This result is consistent with performance data for 2019.
- There were 5,664 new referrals to a HFSS in 2020, a seven percent increase over the previous year.
- Upon discharge from hospital, the prescription of an ACEI, ARB or ARNI, beta blocker, and MRA for heart failure with reduced ejection fraction (HFrEF) patients was measured at 92%, 92% and 46% respectively.
- At the time of beta blocker titration review, 77% of HFrEF patients had achieved the guideline target or maximum tolerated beta blocker dosage.

6 Spotlight: Cardiac Outreach

The first stages of the Networked Cardiac Services (NCS) program has enabled significant and tangible system reform as well as improved healthcare for patients. From 2019 to present, cardiology services and their partners across the state have begun to adopt this integrated model of care, underpinned by strong regional capability and accountability.

In 2017/18, the Statewide Cardiac Clinical Network commissioned an investigative Report on the state of cardiac care and outreach services provided by Queensland Health. This led to the development of the Implementation Framework for Networked Cardiac Care and Outreach Services in Queensland (2018), written in partnership with the Aboriginal and Torres Strait Islander Division (then, Branch). In 2019, the Ministerial Rapid Results Program nominated to support, progressively fund, and implement the Framework (Networked Cardiac Services) across the state (Figure 1).

The initial investigative Report identified several key opportunities for improvement:

- Significant variations in health care and outcomes across Queensland. People living in rural and remote locations and Aboriginal and Torres Strait Islander people are admitted to hospital for cardiac-related conditions two to three times more than the broader population.
- Inequitable access to health care due to Queensland's vast geographical size and dispersed population.
- Lack of integration and continuity between and within health care sectors.
- Poor access to and/or use of technology.
- Limited or no data about or evaluation of existing services.
- Unreliable funding and disparate resource allocation.
- Historical models of care persist, whereby patients and clinicians travel past the closest health care facility, creating inefficiency, inequitable resource allocation, untapped potential, uncoordinated and potentially unsafe care.
- Successful, existing improvement initiatives in the field are not leveraged or spread to other jurisdictions.

In response, an implementation framework recommended the following improvements:

Improve access, equity, quality & safety, and efficiency

- **Care close to home, delivered by consistent, regional teams**

  It was identified that the eight cardiac tertiary hospital services spread along the east coast of Queensland and their adjacent healthcare services should be enabled and accountable for providing quality, cardiac care for their own communities – 'networked' or 'hub' and 'spoke' model of care.

  Restructure cardiac services to reflect natural patient flow and harness full potential of services i.e., eight cardiac specialist 'hubs' and adjacent 'spokes'.

  Build capability and capacity of regional teams to provide care for their own communities.
- **Coordination and integration**

  High-value, patient care-coordination model and shared care across health sectors (public and private, primary health, and Aboriginal and Torres Strait Islander health services).
- **Evidence, evaluation, and improvement**

  Evidence-based care informed by data.
- **Technology**

  Regional teams provided with and enabled to use technology to support healthcare.
- **Sustainable funding and resources**

  Funding model that resolves initial inequity and ongoing sustainability, including activity and value-based approaches.
- **Governance and accountability**

  Regions lead and are responsible for clinical and service outcomes via stakeholder engagement, formal governance arrangements and access to information.
- **Harness existing investments and programs**

  For exponential benefits and efficiency.

Since 2019, eight Hospital and Health Services (HHSs) have progressively implemented the roll-out of NCS. All remaining HHSs have participated in planning for and endorsed implementation of NCS, given financial support from the Queensland Department of Health (Table 1). Business Cases have been approved by the Rapid Results Cardiac Steering Committee. Funding for the remaining stages is yet to be identified.

Implementing quality improvements and sustainable change takes time and, therefore, full outcomes from the program are not anticipated to be seen until at least 12 months postimplementation.

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

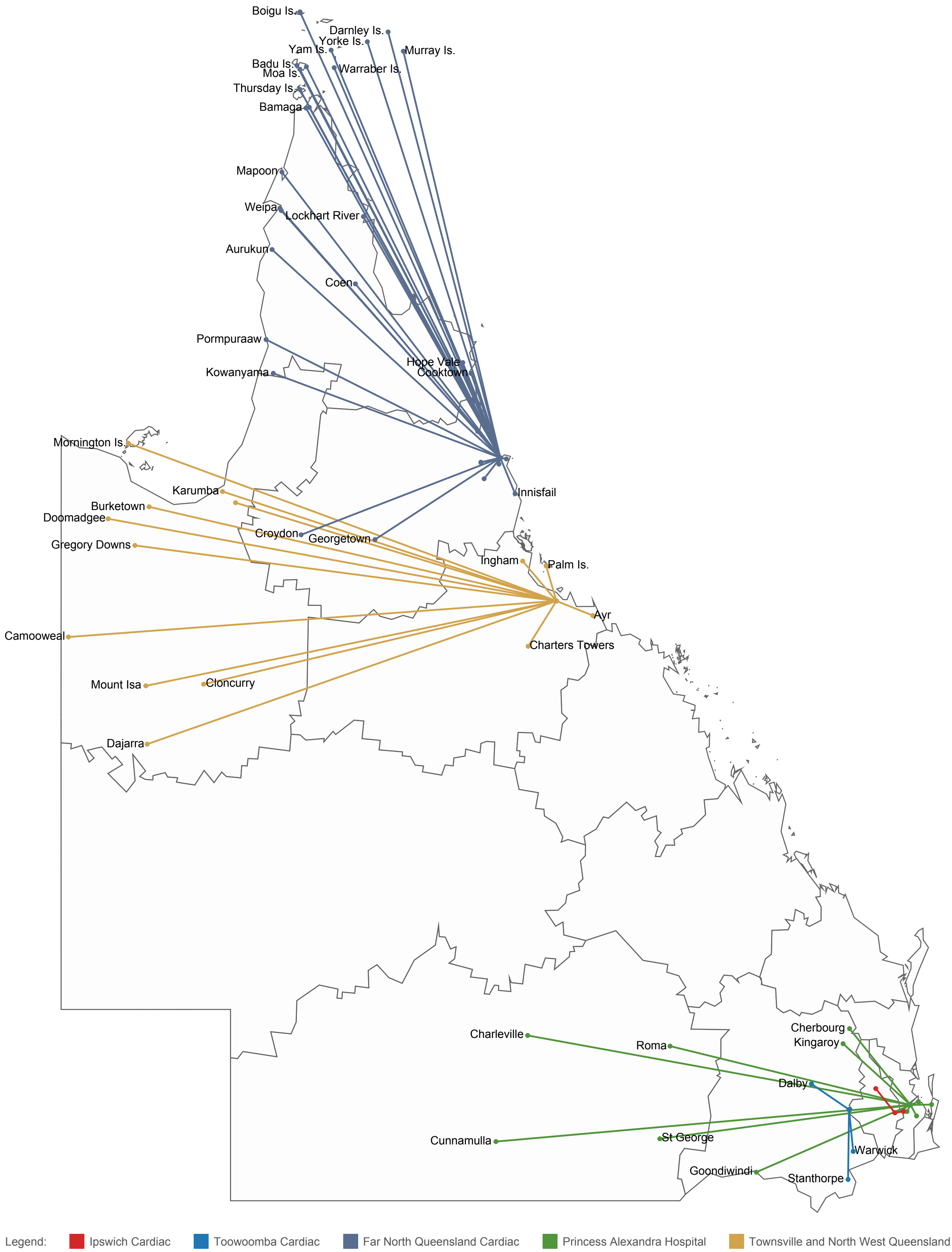


Figure 1: Cardiac outreach hub and spoke locations

Cardiac outreach units each have a responsibility to provide services to a differing number of spoke sites. Each spoke site has its own requirements and workflow which requires units to be agile and able to adapt to many different clinic environments. Spoke sites numbers may change over time with new services being identified based on need and the capacity for the hub units to provide services.

Table 2: Networked cardiac outreach – total spoke sites by outreach unit

Cardiac outreach unit	**All spokes n**
Far North Queensland Cardiac Outreach	33
Townsville and North West Queensland Cardiac Outreach	14
Princess Alexandra Hospital Cardiac Outreach	13
Toowoomba Hospital Cardiac Outreach	3
Ipswich Hospital Cardiac Outreach	2
Total	**65**

Over the course of 2020, there were 266 clinics operated through the NCS model. Not all units were operating at full capacity for the entire duration of the year which is reflected in Table 3 below. Some units took on clinic sites that were previously operated by other services whilst some units continued their previous work which were services offered for many years but transitioned to the NCS model.

Table 3: Networked cardiac outreach – participating outreach unit total clinics

Cardiac outreach unit	**All clinics* n**
Far North Queensland Cardiac Outreach	96
Townsville and North West Queensland Cardiac Outreach	84
Princess Alexandra Hospital Cardiac Outreach	67
Toowoomba Hospital Cardiac Outreach	9
Ipswich Hospital Cardiac Outreach	10
Total	**266**

* Note varying start dates of some services

There have been 3,396 total consults delivered as part of the NCS program. Larger and more established hub sites comprise of the greatest numbers which is also reflective of the higher number of clinics performed and number of spoke sites the unit is responsible for.

Table 4: Networked cardiac outreach total consults performed and total distinct patients per hub site

Cardiac outreach unit	**All consults n**	**All patients n**
Far North Queensland Cardiac Outreach	1,341	1,112
Townsville and North West Queensland Cardiac Outreach	901	775
Princess Alexandra Hospital Cardiac Outreach	1,053	899
Toowoomba Hospital Cardiac Outreach	69	62
Ipswich Hospital Cardiac Outreach	32	31
Total	**3,396**	**2,879**

There were 2,879 patients enrolled in the NCS outreach service since its inception. Of these patients 1,601 (59%) were male. The largest subgroup of this cohort were males aged between 60 years and 69 years and males aged between 70 years and 79 years. The largest proportion of females was in the cohort aged between 60 years and 69 years of age.

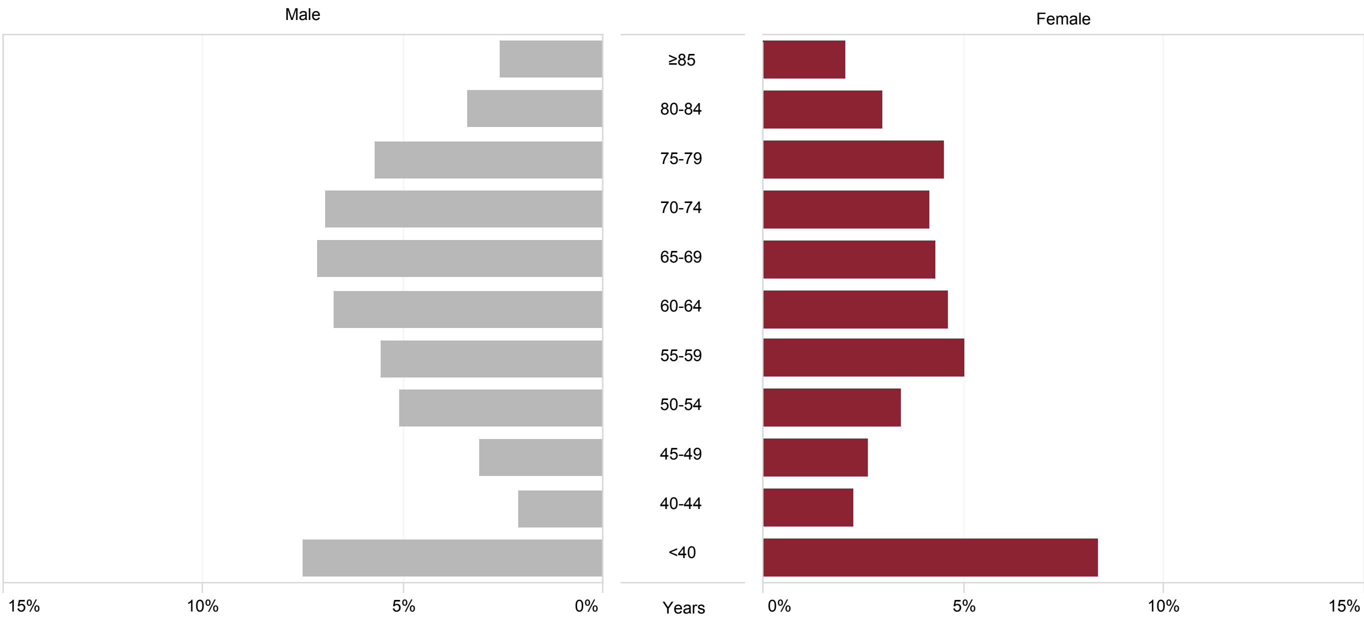


Figure 2: Proportion of outreach consults by age and gender

Table 5: Networked cardiac outreach number of patients by age group and gender at all sites

Gender	Age group	All patients n (%)
Male	‹40	227 (7.9)
	40–49	154 (5.3)
	50–59	305 (10.6)
	60–69	393 (13.7)
	70–79	355 (12.3)
	80–89	156 (5.4)
	≥90	14 (0.5)
Female	‹40	249 (8.6)
	40–49	149 (5.2)
	50–59	248 (8.6)
	60–69	257 (8.9)
	70–79	236 (8.2)
	80–89	130 (4.5)
	≥90	13 (0.5)
Total		**2,879 (100.0)**

Of the overall cohort enrolled in NCS outreach programs, 2,879 distinct patients were seen by teams. Aboriginal and Torres Strait Islander patients accounted for 39% of the group. This is considerably higher than the resident proportion of Aboriginal and Torres Strait Islander population of Queensland of 4.6%.

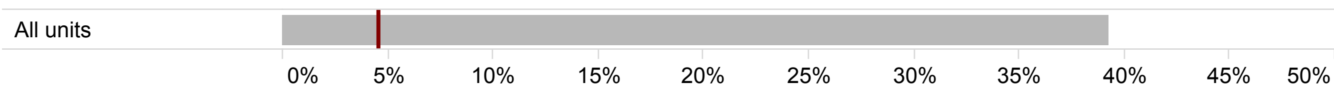


Figure 3: Proportion of Aboriginal and Torres Strait Islander patients seen in cardiac outreach

Patients who reside in the Torres and Cape HHS account for the largest proportion (20%) of patients seen. This is followed closely by the Cairns and Hinterland HHS (19%) and Darling Downs HHS (15%). A small proportion of patients resided interstate at the time of their encounter (1.3%). It should be noted that some patients may temporarily reside in one HHS but their permanent address is elsewhere but for the purpose of this analysis, permanent address is presented.

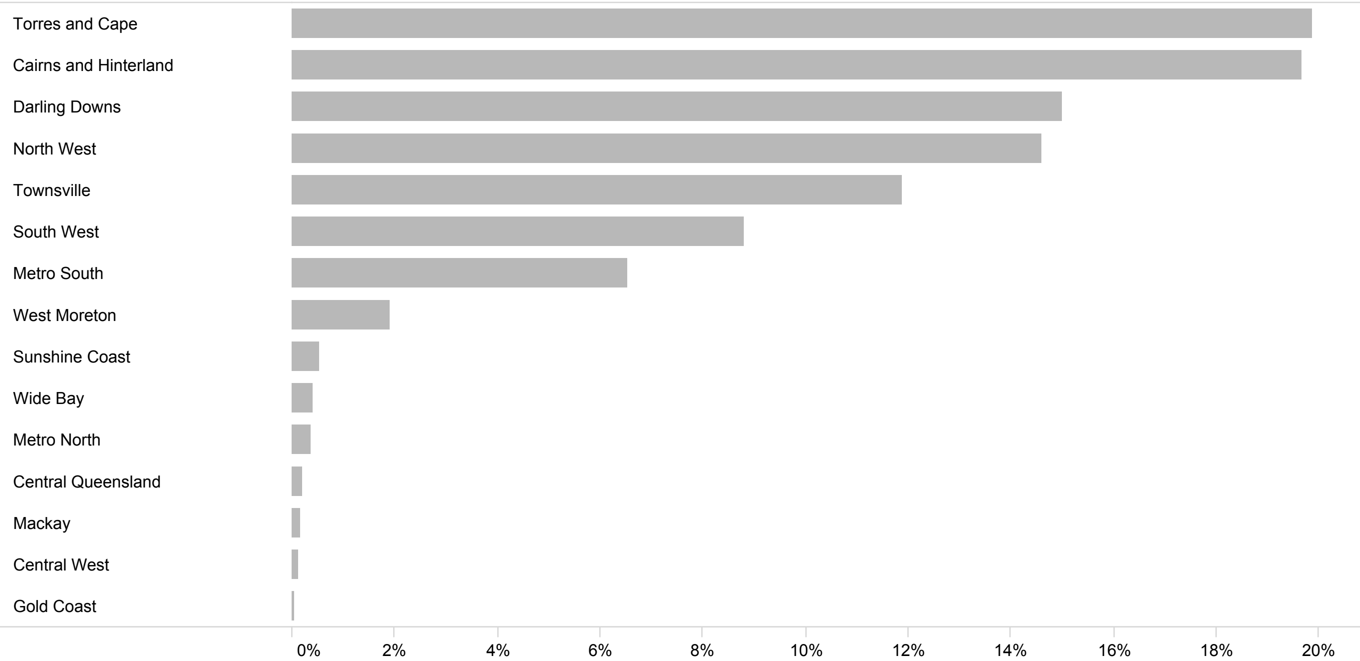


Figure 4: Proportion of patients by HHS of residence since commencement

Of the 3,396 total consults delivered as part of the NCS program, just under half of these consults were new encounters (45%), which represents a large volume of clinical work and focus to establish patient rapport, assess often complex medical history, and formulate a plan of treatment and management. It would be anticipated that over time, the proportion of new to review patients will shift, reflective of the fact that cardiac conditions are mostly a chronic disease.

Table 6: Number and proportion of new and review cardiac outreach consults

Consult type	n (%)
New	1,527 (45.0)
Review	1,869 (55.0)
ALL	**3,396 (100.0)**

Integrated outreach services are flexible and look to add value where opportunity presents. Opportunistic specialist review of inpatients while treating teams are in regional facilities allows for expert clinical treatment and efficient facilitation of treatment and escalation for transfer where appropriate (in person, non-clinic). NCS teams are also instrumental in the organisation and provision of telehealth consultations which are performed both in clinic and in other non-clinic locations such as GP practices and other healthcare facilities (telehealth, non-clinic). Due to the COVID-19 pandemic, larger than anticipated numbers of telehealth consultations were performed (29%).

Table 7: Number and proportion of in person and telehealth consults by clinic mode

Delivery mode	Clinic n (%)	Non-clinic n (%)	All n (%)
In person	2,350 (97.2)	67 (2.8)	2,417 (71.2)
Telehealth	551 (56.3)	428 (43.7)	979 (28.8)
Total	**2,901 (85.4)**	**495 (14.6)**	**3,396 (100.0)**

The majority of patients seen in outreach resided less than 50 kilometres from their consult location (80%), demonstrating that outreach services are meeting their objective to provide care closer to home. A smaller proportion of patients (8%) still needed to travel more than 150 kilometres to access specialist care, which highlights the barriers to care and travel distances faced by Queenslanders living in regional and remote locations.

Table 8: Number and proportions of patients by driving distance to consult

Driving distance – home to consult	n (%)
≤50 km	2,707 (79.7)
50 km–100 km	322 (9.5)
100 km–150 km	57 (1.7)
>150 km	276 (8.1)
Incomplete data	34 (1.0)
ALL	**3,396 (100.0)**

Outreach services offered large travel distance savings as a result of patients attending clinics at spoke sites instead of travelling to the hub site. These values are determined by calculating the difference in driving distance between the patient's place of residence to the hub site and the patient's place of residence to the spoke site. The largest travel distance savings were observed in the cohort residing furthest from the outreach unit hub.

Table 9: Median distance of patient address to hub sites

Distance category	Median distance km
>50 km–100 km	80
100 km–150 km	112
>150 km	474

The ability to perform cardiac investigations on site at the time the patient is in attendance at the outreach clinic further demonstrates savings in travel, increases treatment efficiency due to immediate availability of information and decreases complexity of investigations for patients who often have significant barriers to care. The most frequently performed investigation during outreach was 12 lead electrocardiography (ECG) followed by transthoracic echocardiography.

Table 10: Number of investigations performed in outreach clinics

Investigation	n
12 lead ECG	1,662
Transthoracic echocardiography	995
Cardiac implantable electronic device interrogation	29
Exercise stress test	19
24 hour Holter ECG monitor	3
Other	34
ALL	**2,742**

7 Spotlight: ECG Flash

ECG Flash is a Statewide Cardiac Clinical Network initiative that allows rural and remote clinicians 24/7 access to urgent specialist cardiology advice. When a patient presents at emergency or within a healthcare facility and an ECG is taken, the system lets clinicians send time-critical and 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 as a hub and spoke model of care where larger facilities with specialist staff cardiologists act as the hub to smaller regional and remote centres (spoke sites).

Spoke sites use a digitally enabled ECG cart that 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, urgent or technically challenging 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 2020, 55 rural sites were utilising the ECG Flash solution, with 229 time-sensitive ECGs escalated through to six receiving cardiology departments for clinical interpretation. These were often in the context of patients presenting in a critically unwell state. Further use of ECG Flash data to complement existing QCOR data collections will be a focus for future work.

Table 1: ECG Flash – participating tertiary sites

ECG Flash hub sites	Commenced date	Number of spoke sites
Thursday Island	January 2020	10
Cairns Hospital	September 2018	13
Townsville University Hospital	June 2019	7
Mackay Base Hospital	February 2019	7
Bundaberg Hospital	August 2019	8
Princess Alexandra Hospital	August 2018	10

Figure 1: ECG Flash hub and spoke locations as at November 2020

8 Spotlight: Rheumatic Heart Disease Program

8.1 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 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 delivery of secondary prophylaxis.

The program further delivers, advocates for, and supports primordial, primary and secondary prevention activities aimed at preventing, identifying, managing and treating acute rheumatic fever (ARF) and RHD.

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* 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.

8.2 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. Presentations are often subtle, clients typically present with a history of a sore throat and/or infected skin sores, pain and swelling in one or more joints, fever and chest pain. Chorea (jerky, uncoordinated movements of the hands, feet, tongue and face), skin and subcutaneous manifestations are uncommon but do appear to vary in frequency across populations, gender and age.* 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, sustained inflammation of the brain in clients with Sydenham's chorea can cause permanent damage and lead to the development of mental health and neurological sequalae. Similarly, the autoimmune response that inflames the heart can lead to permanent damage to the heart valves known as rheumatic heart disease (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 simple as a sore throat or skin infection which can be easily treated with common antibiotics, however if left untreated, it can lead to valve disease requiring cardiac surgery, stroke and sometimes death. 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.

* 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

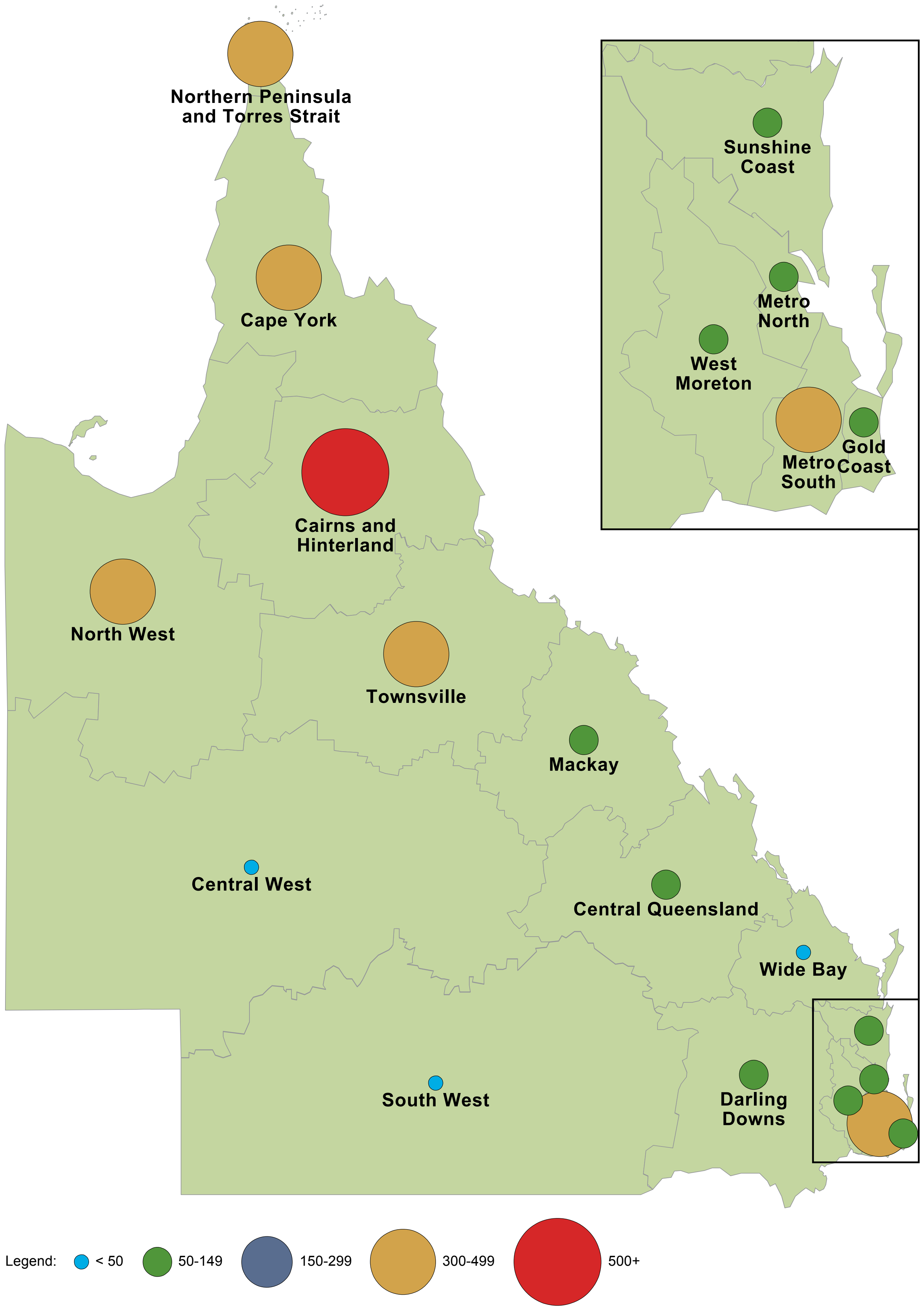


Figure 1: Rheumatic Heart Disease active clients by area of residence

8.3 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 Queensland, 2019 the rate of ARF cases was 41.6 per 100,000 Aboriginal and Torres Strait Islander Australians whereas for all Queenslanders the rate was 2.2 per 100,000.† The prevalence of RHD was 627.4 cases per 100,000 Aboriginal and Torres Strait Islander Australians whereas for Australians of other descent the rate was 15.9 per 100,000.†

8.4 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.

8.4.1 Human cost of RHD

ARF and RHD contribute to increased death and disability in Queensland. RHD accrues early in life, with 17% of people on the Queensland RHD Register under 18 years of age and 23% of all ARF and RHD clients having had or will require valvular surgery.

8.4.2 Financial cost of ARF and RHD

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

Table 1: 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

† Australian Institute of Health and Welfare (2020). *Acute rheumatic fever and rheumatic heart disease in Australia, 2015–2019*. Retrieved from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/acute-rheumatic-fever-and-rheumatic-heart-disease/data

‡ 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

8.5 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.

8.6 Queensland RHD Program and Queensland Cardiac Outcomes Registry

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.

Between 2020–2021 QCOR, reporting of positive RHD findings by echocardiography has resulted in 147 previously unknown clients with RHD being added to the Register.

Table 2: QCOR echocardiography module RHD notifications

	Positive RHD findings n	Unknown RHD clients identified n
Cairns	503	55
Townsville	206	60
Mackay	45	18
Rockhampton	26	14
Total	**780**	**147**

During 2020–2021 QCOR cardiac surgery RHD notification reports, 336 previously unknown clients requiring surgery for their RHD have been added to the RHD register.

Table 3: QCOR cardiac surgery module RHD notifications

	Positive RHD findings n	Unknown RHD clients identified n
Townsville	182	33
Gold Coast	59	44
Princess Alexandra Hospital	48	40
The Prince Charles Hospital	325	217
Total	**614**	**336**

9 Spotlight: COVID-19 pandemic

9.1 Introduction

Health services in the state of Queensland have been significantly impacted by restrictions and limitations related to the COVID-19 pandemic. The first case of COVID-19 in Queensland was detected in late January 2020, after which a series of public health measures subsequently followed that significantly changed the way that healthcare was delivered.

Following the declaration of a global pandemic by the World Health Organisation on 11 March 2020, Australia entered the first stage of a nationwide shutdown on 23 March 2020, which limited activity, travel and social interaction.

In preparation for a surge in patients requiring hospital treatment for COVID-19 infection, the provision of cardiac services changed with reductions to the number of elective admissions and procedures as well as diagnostic studies and outpatient consultations. The slowdown in activity associated with COVID-19 had several effects, one of which was a reduction in trauma admissions due to less social activity and a resultant increase in hospital bed availability. The view was postulated that a delay in diagnosis of patients with cardiac disease would result in more urgent and emergent cases, but these impacts appear to have been minimal.

The use of personal protective equipment and protocols set up by hospital emergency departments, catheterisation laboratories, operating theatres and cardiac wards collectively impacted processes involved in patient care – resulting in increased difficulties in assessing patients and delays in commencing and administering treatment.

Outpatient support services such as cardiac rehabilitation and heart failure support services were also affected. Some community health facilities pivoted to provide COVID-19 testing support while some outpatient programs were temporarily closed due to the redeployment of staff to other areas of healthcare, or the reclaiming of gym spaces to deliver pop up COVID-19 screening clinics and vaccination hubs. Public health directives also placed restrictions on outpatient programs by limiting the number of people per square metre and mandating the use of face masks. Outpatient programs responded to these challenges while maintaining service provision, and many adapted their services to deliver these via alternative means such as telehealth.

With all these effects plus the likely negative influence on patient presentations to medical facilities and under-utilisation of hospital resources, this special section was added to this year's Report, aiming to characterise the effects the pandemic had on cardiac services in Queensland in 2020.

9.2 Procedure volumes

In the Queensland public health system, the utilisation of most cardiac services declined during April 2020 more than expected based on seasonal variation alone. Similar findings have been well documented both nationally and internationally across many medical and surgical specialties, with particular impacts noted on the rates of hospitalisation for acute coronary syndromes.[*,†]

Interventional cardiology

An overall reduction in cardiac catheterisation laboratory cases was observed in April 2020. This is owed mainly to a decreased volume of elective procedures. Case volumes returned to pre-pandemic volumes by June 2020 and tapered toward the end of the year as is usual for that time of year due to Christmas period service closures.

Total case volumes for all of 2020 only decreased by 0.7% for PCI procedures, which is reassuring considering April 2020 volumes declined considerably. Similarly, case numbers for other diagnostic coronary procedures were stable with only a 0.8% decrease compared to the previous year.

Cardiac surgery

In 2020, there were 2,651 cardiac surgery procedures which was a marginal increase (1.1%) on 2019. Soon after the announcement of the global COVID-19 pandemic, cardiac surgery case volumes exhibited a marked decrease in April 2020. Case numbers had increased by June, and later reached a peak in September.

There was a reduction in valve surgeries and other procedures during April 2020, whilst CABG numbers remained steady in comparison to previous months. Aortic procedures and other cardiac surgeries were also scaled back during this time.

Thoracic surgery

There was a 4.9% increase in thoracic surgery cases performed in 2020 compared to 2019 despite the challenges of the COVID-19 pandemic. However, it was evident that during the peak month of April 2020 case numbers fell considerably. There was a notable decrease in operations for all other indications except primary lung cancer.

The decrease in surgical volume in September 2020, could be attributable to the larger than average cardiac surgical volumes in the same period, given this surgical specialty shares resources and clinicians. Reduced case volumes in December are consistent with usual variation in service capacity for this time of year.

Electrophysiology and pacing

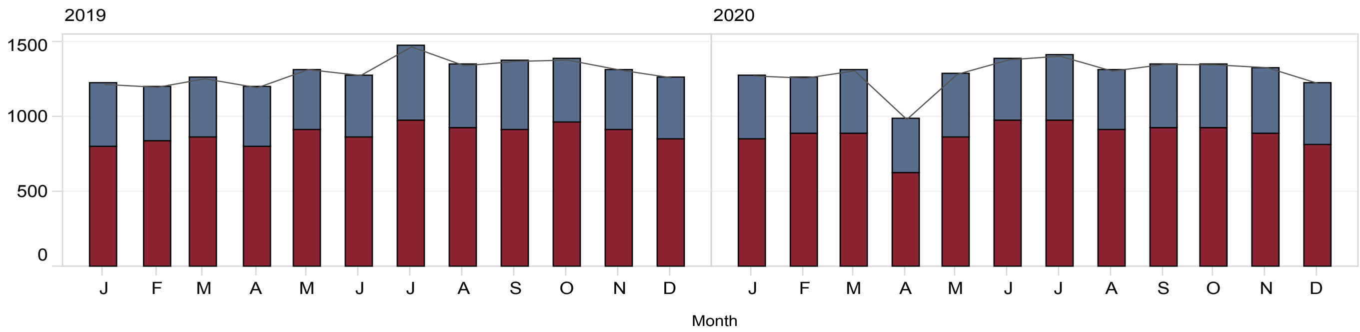
Electrophysiology and pacing services saw a 12% growth in cases from 2019 to 2020. A small portion of this growth can be attributed to extra case detail captured for Toowoomba Hospital (n=86). As exhibited across other service lines, there was a reduction in cases in April 2020 which saw most electrophysiology and ablation cases cease. The months following demonstrated an upward trend in case numbers, presumably related to cases which had been scheduled but not performed in April.

Table 1: Total cases for interventional cardiology, cardiac surgery, thoracic surgery and electrophysiology and pacing by year, 2019–2020

Service line	2019 n	2020 n
Interventional cardiology	5,002	4,966
Cardiac surgery	2,622	2,651
Thoracic surgery	1,042	1,093
Electrophysiology and pacing	4,654	5,201

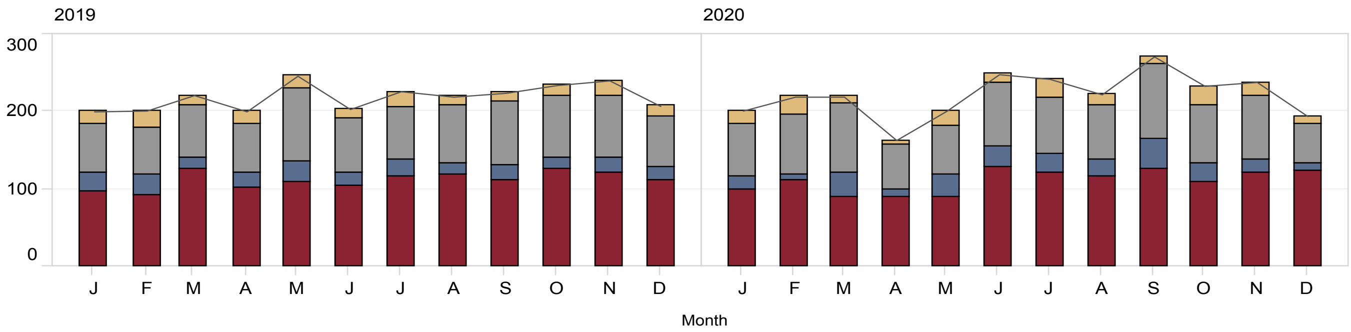
* Solomon, M.D., McNulty, E.J., Rana, J.S., Leong, T., Lee, C., Sung, S., … Go, A.S. (2020). The COVID-19 pandemic and the incidence of acute myocardial infarction. *N Engl J Med, 383*(1), 691-693. doi: 10.1056/NEJMc2015630.

† De Filippo, O., D'Ascenzo, F., Angelini, F., Bocchino, P.B., Conrotto, F., Saglietto, A., … De Ferrari, G. (2020). Reduced rate of hospital admissions for ACS during Covid-19 outbreak in northern Italy. *N Engl J Med, 383*(1), 88-89. doi: 10.1056/NEJMc2009166.



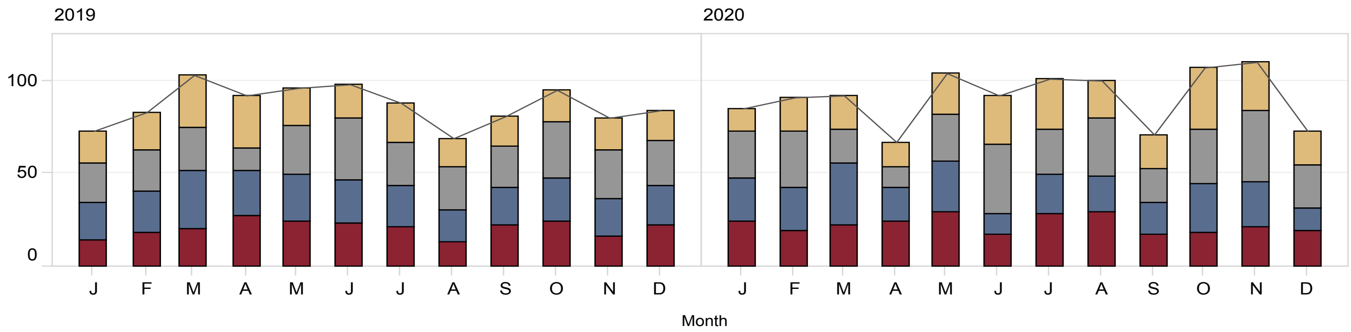
Legend: PCI procedures Other coronary procedures

Figure 1: Proportion of all diagnostic and interventional cardiology cases by case category and month, 2019–2020



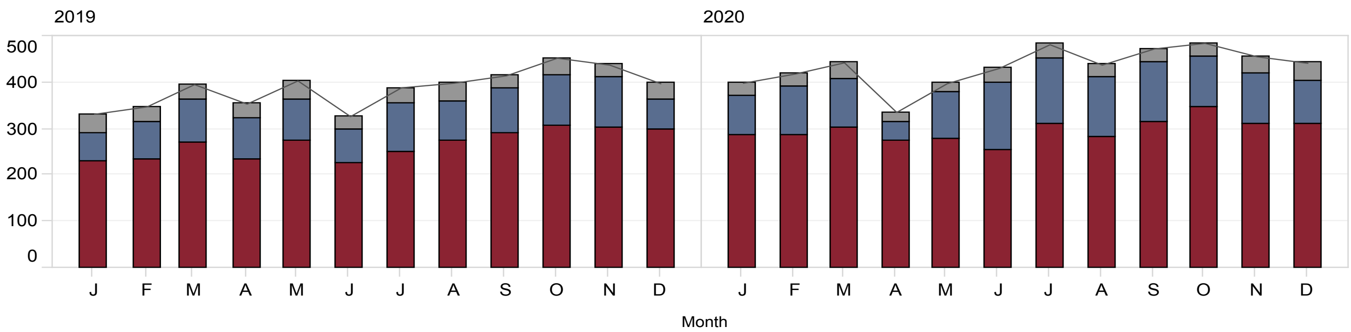
Legend: Any CABG CABG and Valve Valve Other

Figure 2: Proportion of all cardiac surgery cases by procedure category and month, 2019–2020



Legend: Primary lung cancer Other cancer Pleural disease Other

Figure 3: Proportion of all thoracic surgery cases by indication and month, 2019–2020



Legend: Device procedure EP/ablation procedure Other

Figure 4: Proportion of all electrophysiology and pacing cases by procedure category and month, 2019–2020

9.3 Interstate and international patients

When examining the place of residence for patients undergoing cardiac interventions between 2019 and 2020, a notable decrease in the proportion of interstate and overseas patients was observed. The proportion of interstate patients reduced from 5.7% to 4.5%, while the proportion of overseas patients was almost halved (0.7% to 0.4%). This is reflective of travel restrictions in place, limiting international and interstate travel for a large part of 2020.

Table 2: Patient place of residence at time of procedure, 2019–2020

Service line	2019	2020
Queensland, %	93.6	95.1
Interstate, %	5.7	4.5
Overseas, %	0.7	0.4

Excludes missing data (0.1%)

9.4 Admission status

There was a reduced proportion of elective procedures and category 3 procedures observed across all service lines from 2019 to 2020. The reduction in elective cases appears to be concentrated around April 2020, coinciding with the announcement of the COVID-19 pandemic. These findings are likely reflective of the redistribution of clinical services in response to the pandemic as well as public health directives leading to a reduction in elective procedure bookings.

Table 3: Procedure status for interventional cardiology, cardiac surgery, thoracic surgery and electrophysiology and pacing by year, 2019–2020

Service line	2019	2020
Interventional cardiology, n	5,002	4,966
Elective, %	1,094 (21.9)	1,059 (21.3)
Urgent, %	2,719 (54.3)	2,585 (52.1)
Emergent, %	1,104 (22.1)	1,252 (25.2)
Salvage, %	87 (1.7)	70 (1.4)
Cardiac Surgery, n	2,622	2,651
Elective, %	1,523 (58.1)	1,472 (55.5)
Urgent, %	913 (34.8)	990 (37.3)
Emergent, %	169 (6.4)	185 (7.0)
Salvage, %	17 (0.6)	4 (0.2)
Thoracic surgery, n	1,042	1,093
Elective, %	730 (70.1)	719 (65.8)
Urgent, %	254 (24.4)	282 (25.8)
Emergent, %	58 (5.6)	92 (8.4)
Electrophysiology and pacing, n	4,654*	5,201†
Category 1, %	2,636 (56.6)	3,051 (58.7)
Category 2, %	1,143 (24.6)	1,365 (26.2)
Category 3, %	548 (11.8)	459 (8.8)

Category 1: Clinically indicated within 30 days

Category 2: Clinically indicated within 90 days

Category 3: Clinically indicated within 365 days

* 7.0% missing data

† 6.3% missing data

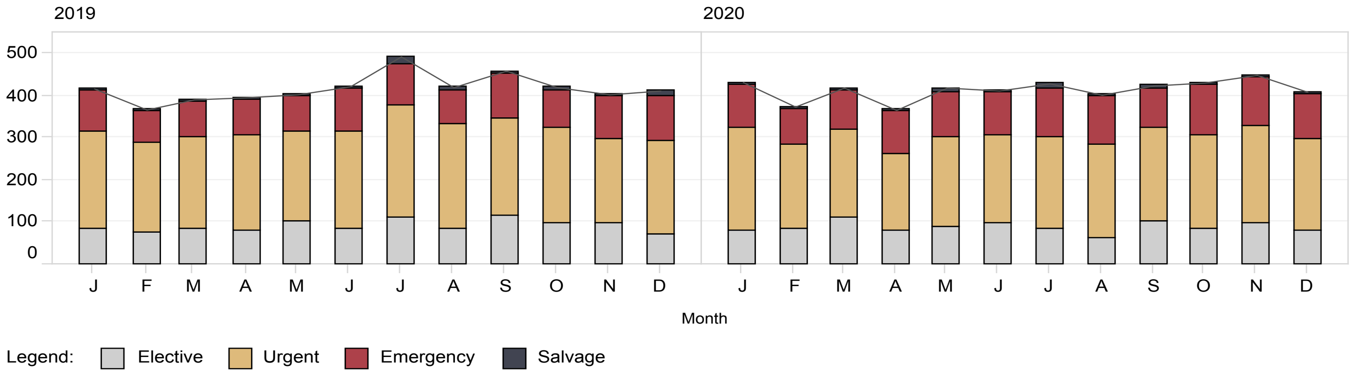


Figure 5: Proportion of all interventional cardiology cases by admission status and month, 2019–2020

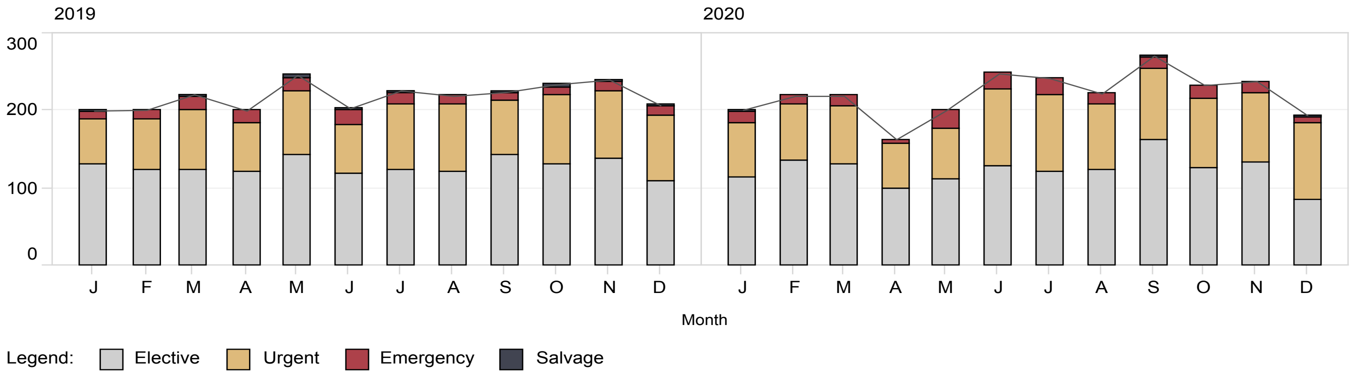


Figure 6: Proportion of all cardiac surgery cases by admission status and month, 2019–2020

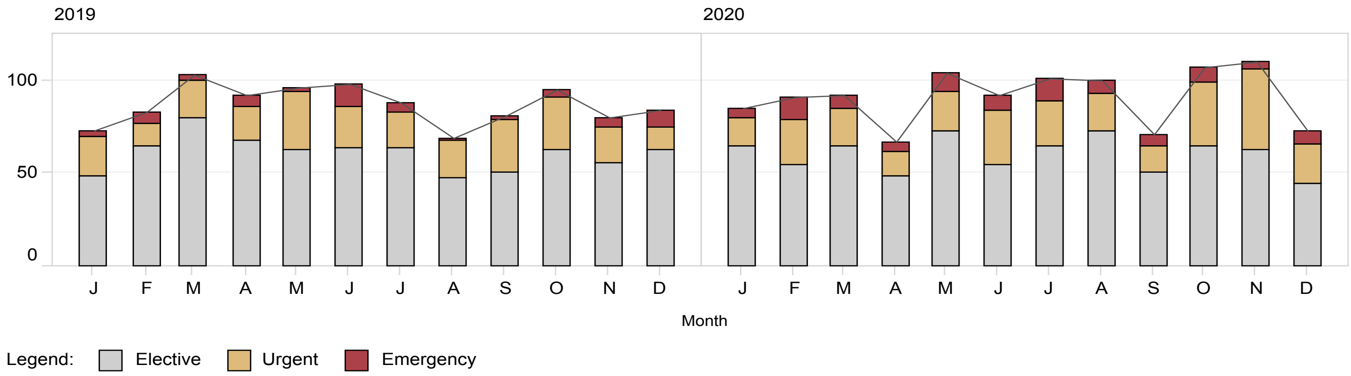
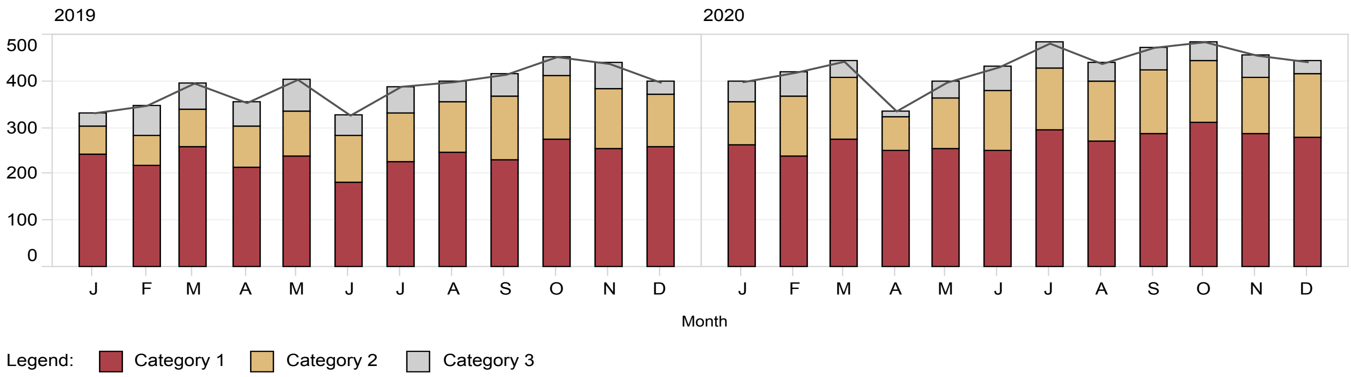


Figure 7: Proportion of all thoracic surgery cases by admission status and month, 2019–2020



Note: imputed missing data

Figure 8: Proportion of all electrophysiology and pacing cases by urgency status and month, 2019–2020

9.5 Outpatient support services

Cardiac rehabilitation services across the state were subject to disruption due to resources being redistributed to support the state's COVID-19 response. The overall number of referrals in 2020 was slightly less than 2019, with a total of 11,547 referrals vs. 11,177 referrals respectively. The greatest decline in incoming referrals was identified in April 2020 with a return to usual capacity over the following months.

Heart failure support services showed a 6.8% increase in referrals received in 2020 compared to 2019. As with most other cardiac services there was a decline in referrals in April 2020, followed by a steady increase in referrals through to December. The impacts on heart failure support services appear to have been limited.

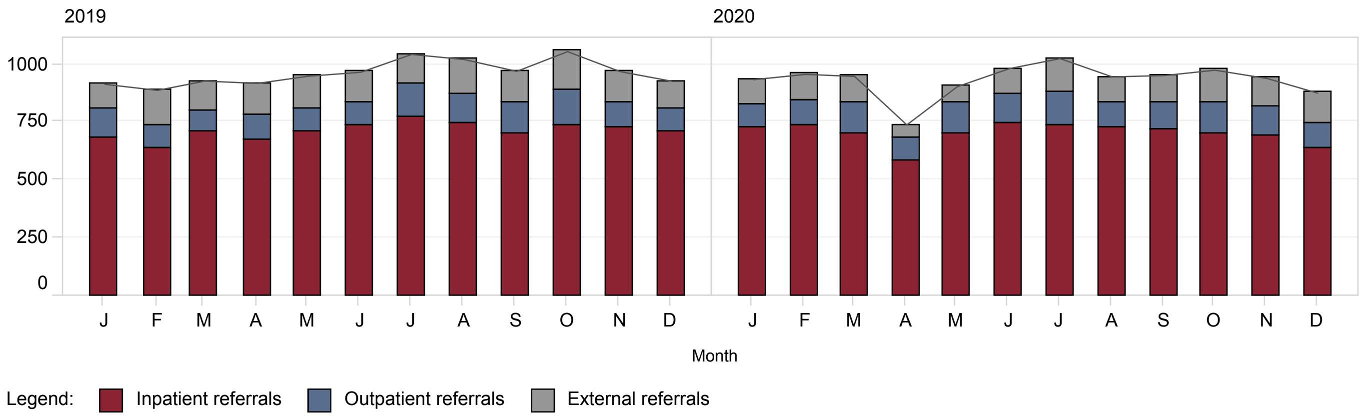


Figure 9: Cardiac rehabilitation referral source, 2019–2020

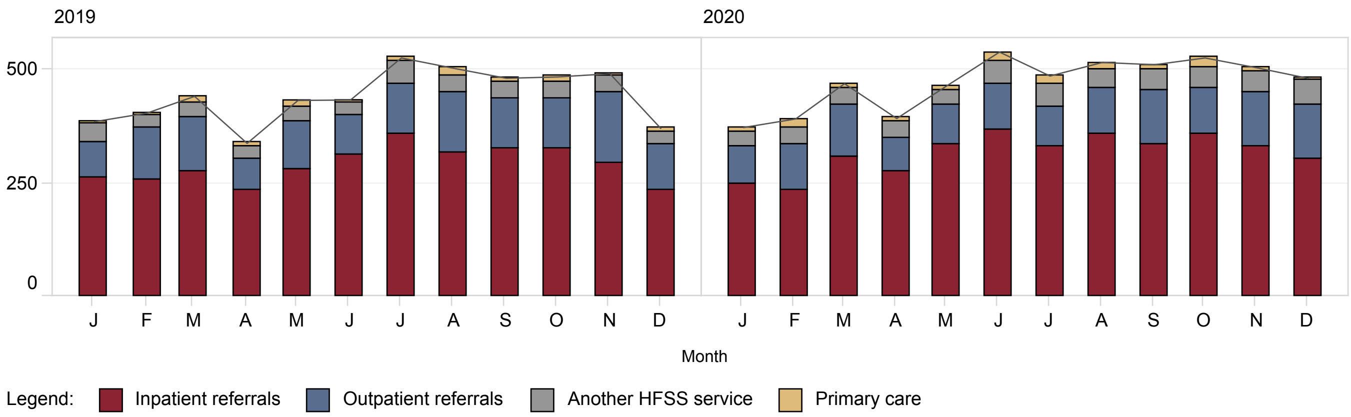


Figure 10: Heart failure support services referral source, 2019–2020

Table 4: Outpatient support services referral volumes, 2019–2020

Service line	2019 n	2020 n
Cardiac rehabilitation	11,547	11,177
Heart failure support services	5,304	5,664

9.6 Clinical performance indicators

Key clinical performance indicators for Queensland cardiac services in 2020 were largely improved compared to the previous year, though there were some areas where performance appears to have been negatively impacted by disruptions to scheduling and patient flow. It is difficult to draw conclusion as any impact is likely to be multifactorial. These issues are examined in more detail in the relevant sections of this report. However these results are suggestive that Queensland cardiac services have been largely insulated from significant impacts to service and performance as a result of the COVID-19 pandemic.

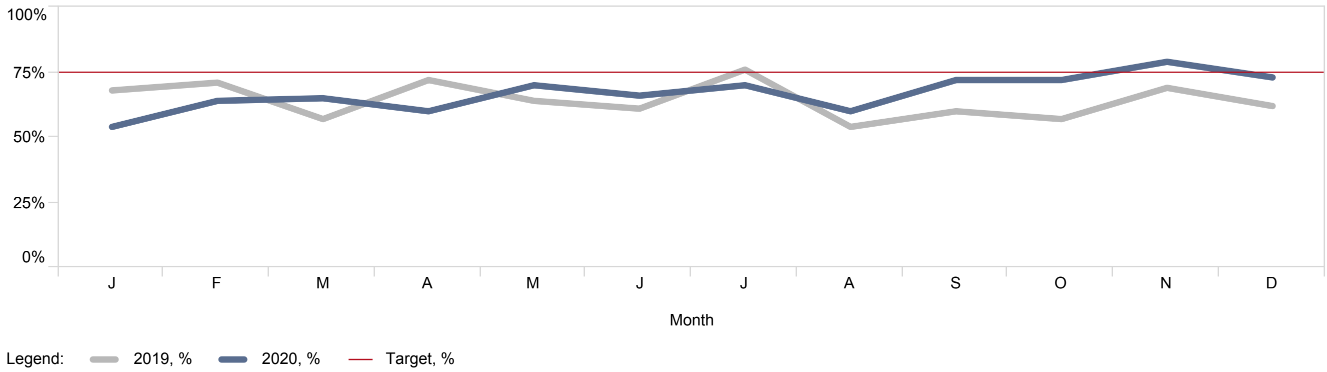


Figure 11: Proportion of ST-elevation myocardial infarction patients presenting within six hours of symptom onset who received an intervention within 90 minutes of first diagnostic electrocardiograph, 2019–2020

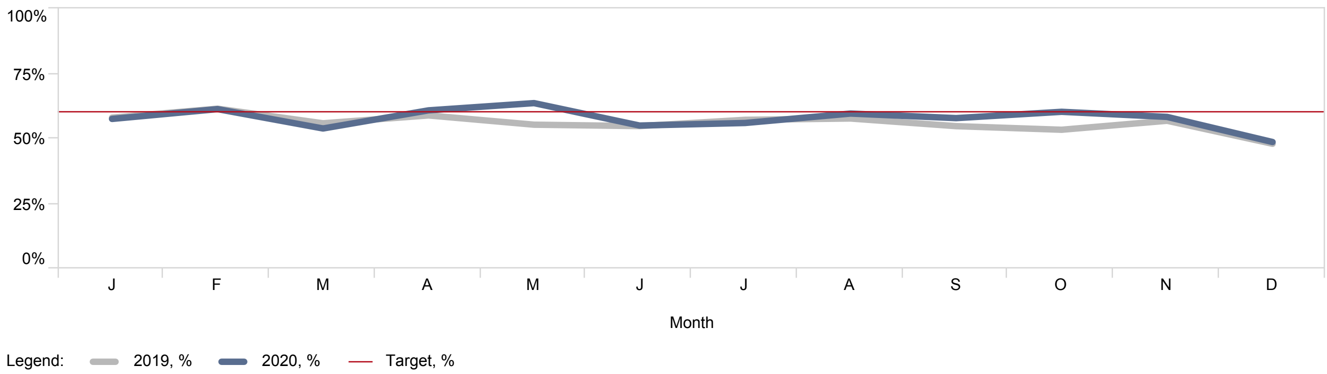


Figure 12: Cardiac rehabilitation performance measure, 2019–2020

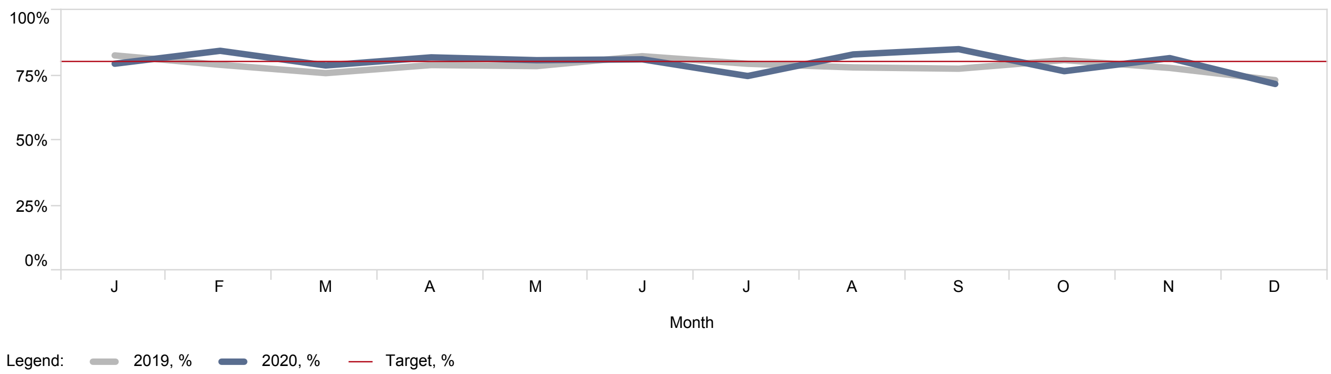


Figure 13: Heart failure support services clinical follow-up of acute patients within two weeks, 2019–2020

Table 5: Performance measures for interventional cardiology, electrophysiology and pacing, cardiac rehabilitation and heart failure support services by year, 2019–2020

Service line	2019	2020
Interventional cardiology		
Proportion of STEMI* patients presenting within six hours of symptom onset who received an intervention within 90 minutes of first diagnostic ECG (%)	65	67
Proportion of STEMI* patients with arrival at PCI facility to first device time less than 60 minutes (%)	70	70
Proportion of all NSTEMI† patients who received angiography within 72 hours of first hospital admission (%)	60	69
Electrophysiology and pacing		
Median wait time for elective pacemaker implantation (days)	21	3
Median wait time for elective ICD‡ implantation (days)	32	36
Median wait time for elective standard ablation (days)	117	99
Median wait time for elective complex ablation (days)	65	104
Cardiac rehabilitation		
Timely referral – documented referral to CR within three days of discharge (%)	94	93
Timely assessment (inpatients) – initial CR pre assessment completed within 28 days of discharge date (%)	59	62
Timely assessment (non acute patients) – proportion of CR patients completing a CR pre assessment within 28 days of referral date (%)	61	57
Timely journey (inpatients) – composite of timely referral and assessment (%)	56	58
Heart failure support services		
Follow-up of acute patients within two weeks (%)	79	80
Follow-up of non acute patients within four weeks (%)	82	84
Assessment of left ventricular ejection fraction within two years (%)	96	96
ACEI/ARB§ or ARNI‖ prescription at hospital discharge (%)	92	92
ACEI/ARB§ or ARNI‖ at first clinical review (%)	90	92
Beta blocker prescription at hospital discharge (%)	89	92
Beta blocker prescription at first clinical review (%)	91	92
Prescription of MRA# for HFrEF** at time of hospital discharge (%)	45	46
Prescription of MRA# for HFrEF†† at time of first HFSS clinical review (%)	43	46
Beta blocker titration status review at six months post referral (%)	67	75
Beta blocker achievement of guideline recommended target (%)	35	32
Beta blocker achievement of guideline recommended target dose or maximum tolerated dose (%)	75	77

* ST-elevation myocardial infarction

† Non-ST-elevation myocardial infarction

‡ Implantable cardioverter defibrillator

§ Angiotensin converting enzyme inhibitor/angiotensin II receptor blocker

‖ Angiotensin receptor-neprilysin inhibitor

Mineralocorticoid receptor antagonists

** Heart failure with reduced ejection fraction

†† Heart failure with preserved ejection fraction

10 Facility profiles

10.1 Cairns Hospital

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

10.2 Townsville University Hospital

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

10.3 Mackay Base Hospital

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

10.4 Sunshine Coast University Hospital

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

10.5 The Prince Charles Hospital

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

10.6 Royal Brisbane & Women's Hospital

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

10.7 Queensland Children's Hospital

- Children's Health Queensland is a specialist statewide Hospital and Health Service dedicated to caring for children and young people from across Queensland and northern New South Wales
- Public tertiary level invasive cardiac services provided at the Queensland Children's Hospital include:
  - Percutaneous congenital cardiac abnormality diagnostics and intervention
  - Electrophysiology
  - ICD and pacemaker implantation
  - Paediatric cardiac and thoracic surgery

10.8 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

10.9 Toowoomba Hospital

- Referral hospital for Darling Downs Hospital and Health Services, servicing a population of approximately 280,000
- Public invasive cardiac services provided at the Toowoomba Hospital include:
  - ICD, CRT and pacemaker implantation

10.10 Gold Coast University Hospital

- 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

It is a pleasure to present the 2020 Queensland Cardiac Outcomes Registry (QCOR) Interventional Cardiology Audit.

During the COVID-19 pandemic, we have been inundated with data like never before, and this data has been crucial in developing a public health response to the pandemic. This sentiment reminds us of the reasons we collect and analyse interventional cardiac data. Firstly, we rely upon this data for quality assurance. This enables early detection and resolution of problems to ensure that the health care we are delivering meets or exceeds the highest international standards. The data is also crucial for strategic planning, identifying possible efficiency gains and as well as infrastructure requirements for the future. Importantly, this data can also be used to reassure Queenslanders that their cardiac care is of the highest quality by global standards. And finally, high-quality data invites research, and 2020 saw a significant rise in requests for data from health care professionals, in particular junior doctors, with the ultimate goal of ongoing improvement in cardiac care.

It was noted early in 2020 that the nature of interventional cardiology, being predominantly an acute care speciality, meant that urgent and emergent care would have to continue to be delivered around the clock despite the unprecedented situation caused by COVID-19. In 2020, procedural volumes were maintained, with about 5,000 people benefitting from coronary stenting procedures in Queensland Public Hospitals, including a significant increase in the number of people requiring emergency interventional care. It was, and remains, heartening to see the strengthening of the cardiac network across the state, and in particular the focus on ensuring people living outside Metropolitan areas had reliable access to cardiac care.

Aboriginal and Torres Strait Islander Australians are once again over-represented in receiving cardiac procedures, and the age “gap” between Indigenous and non-Indigenous Australians presenting for interventional cardiac procedures remains significant at 10 years. Acknowledging this, it is hoped that the small reduction in this gap from 11 years in 2018–19 to 10 years in 2020 represents positive progress and it is pleasing to note the ongoing work in improving access to cardiac care in Queensland with the state’s Networked Cardiac Services (Outreach) program, and the statewide Rheumatic Heart Disease Action Plan also analysed in this QCOR 2020 Annual Report.

This report reveals care across the key indicators have all improved and are world-class. Time to intervention for acute myocardial infarction or ST elevation myocardial infarction (STEMI) has again improved with a median time from first diagnostic ECG to reperfusion of 81 minutes. Once a patient hits the hospital with a STEMI, the median time to intervention was only 40 minutes, which includes cases performed out of hours where the on call team had to arrive from off-site. The 30 day mortality was 1.5%, remarkably low by any standards, and more than two thirds of these deaths were classified as emergent or salvage. The complication rate for interventional procedures remains at less than 1%, reassuring Queenslanders of the safety of these procedures in the state’s public cardiac catheter labs.

Reflecting on the difficulty of the last 12 months, I cannot express enough my gratitude and appreciation to my colleagues around the state, and the QCOR clinical informatics and business team for delivering this report. Every analysis, project, and publication is undertaken with professionalism and efficiency and is performed on behalf of all Queenslanders who share a passion for quality clinical data and cardiac care.

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 2020.

Key findings include:

- 15,491 diagnostic coronary or interventional cases were performed across the eight cardiac catheterisation laboratory facilities in Queensland public hospitals, including 4,966 PCI cases.
- 78% 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 (78%) 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 (7.0%) illustrates a stepwise gradient based on geographical area, with the highest proportions found in the north of the state and lower proportions in the South East corner. This is consistent with previous analyses. The median age of Aboriginal and Torres Strait Islander patients was 10 years younger than non Aboriginal and Torres Strait Islander patients.
- The majority of PCI cases (79%) were classed as urgent, emergent or salvage, highlighting the acute and often unstable patient cohort.
- There were 1,600 PCI cases following presentation with ST elevation myocardial infarction (STEMI), of which 58% were managed by primary PCI.
- There was a total of 411 thrombolysed STEMI presentations, for whom the median time from first diagnostic ECG to the administration of thrombolysis was 37 minutes. The median time from thrombolysis to coronary angiography was 17 hours, with 64% 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 81 minutes (range 75 minutes to 90 minutes across sites).
- Median hospital door-to-device time for STEMI patients presenting within six hours of symptom onset was 40 minutes (range 31 minutes to 69 minutes across sites).
- PCI for non-ST elevation myocardial infarction (NSTEMI) represented 30% of all cases, with the median time to angiography of 48 hours. Patients presenting to a non PCI capable facility have a median wait time to coronary angiography of 32 hours longer than those who present directly to a PCI capable facility (65 hours vs. 33 hours).
- Mortality within 30 days following PCI was 1.5% (75 deaths). Of these 75 deaths, 69% were classed as either salvage or emergency PCI.
- Of all cases, 0.95% recorded a major intra-procedural complication. Coronary artery perforation (0.61%) accounted for the majority of these events.
- Radiation doses were found to be under the high dose threshold in 99.2% of PCI cases across all sites and 99.9% of other coronary procedures.

3 Participating sites

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

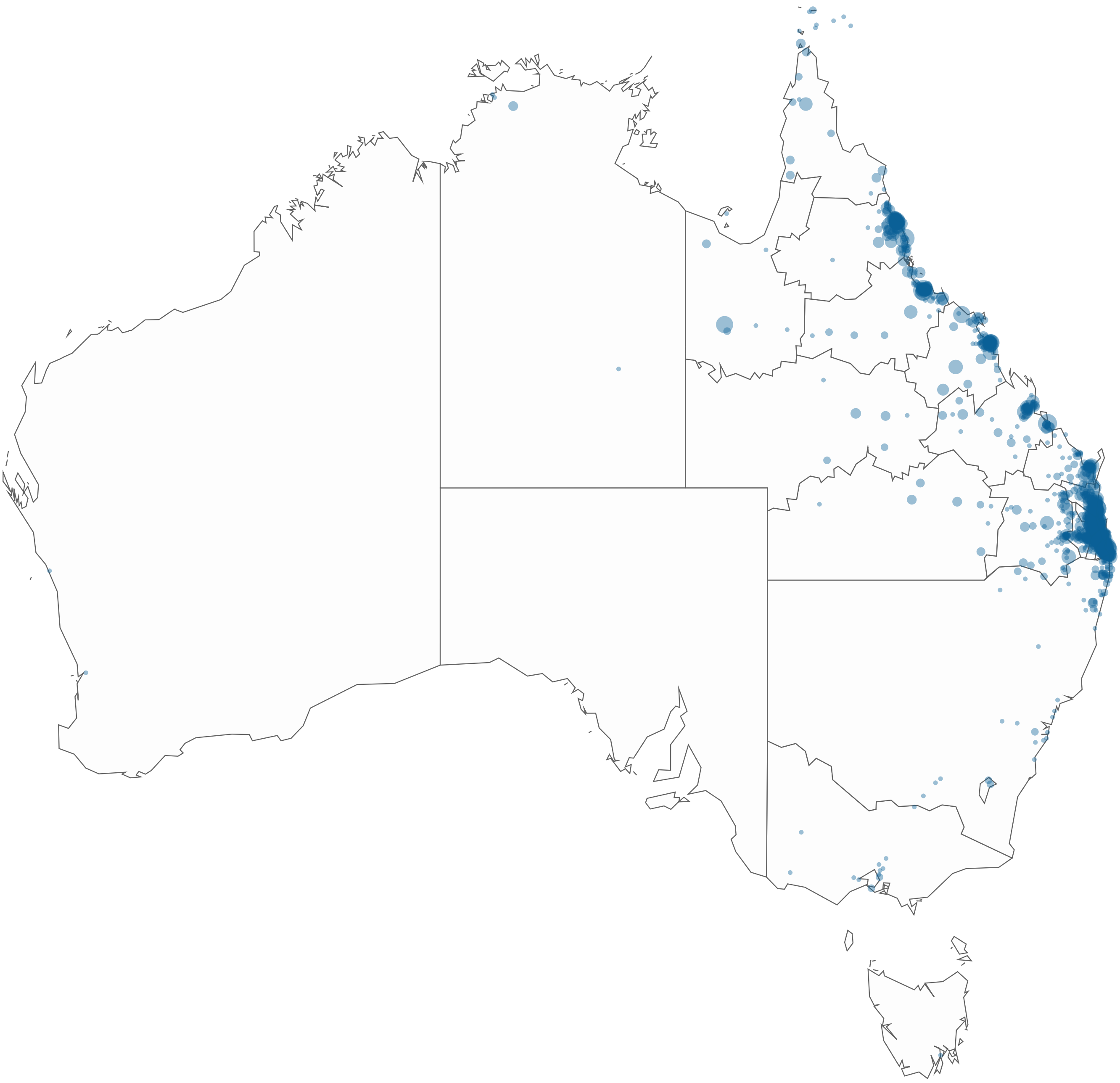


Figure 1: Statewide PCI cases by patient place of usual residence (by residential postcode)

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

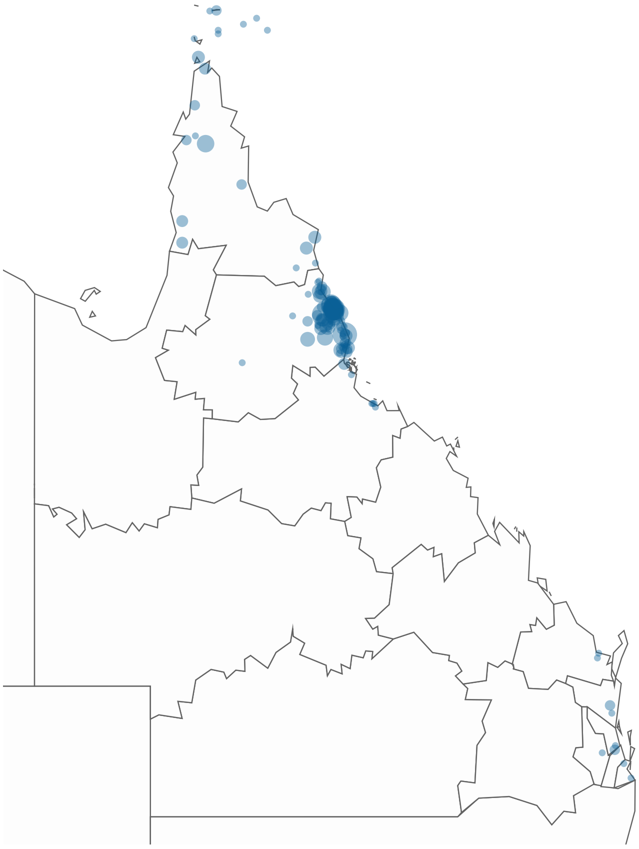


Figure 2: Cairns Hospital

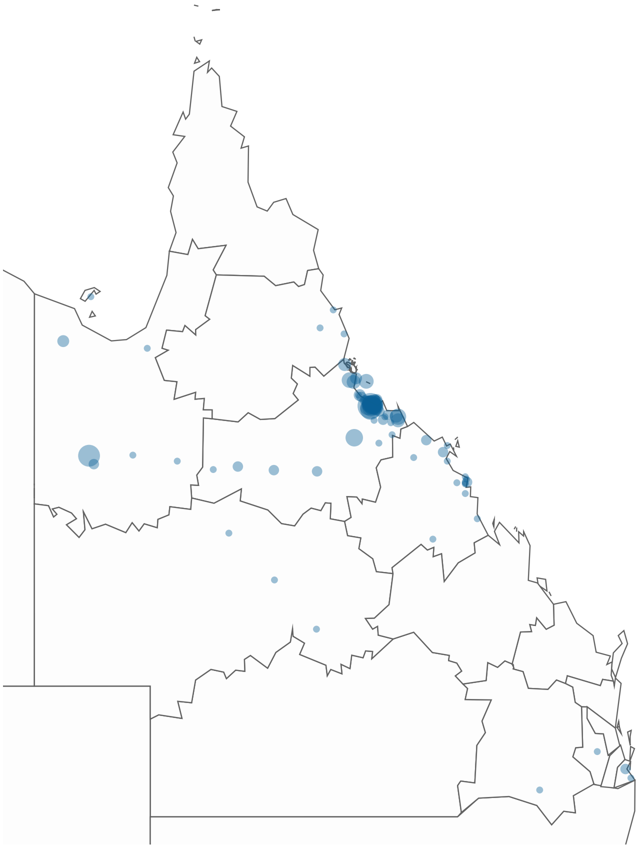


Figure 3: Townsville University Hospital

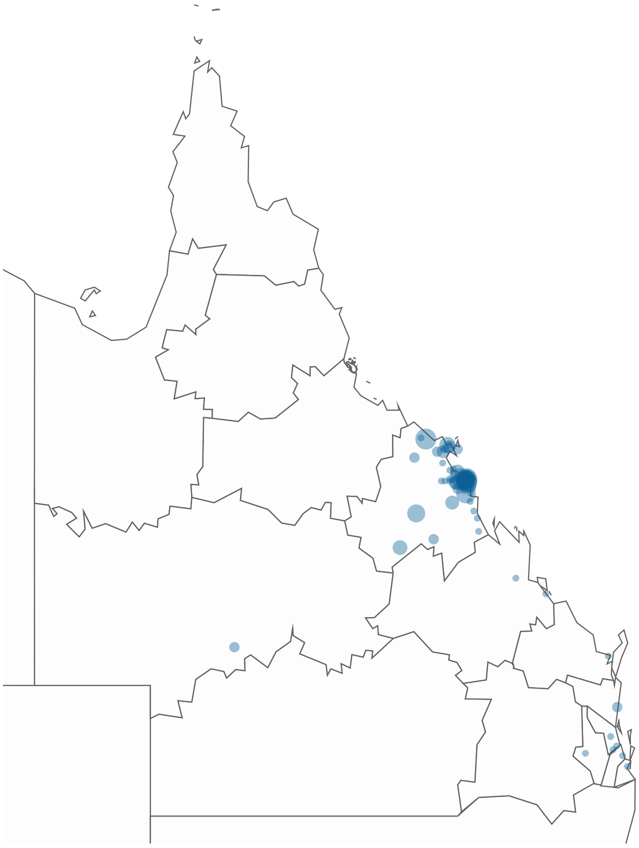


Figure 4: Mackay Base Hospital

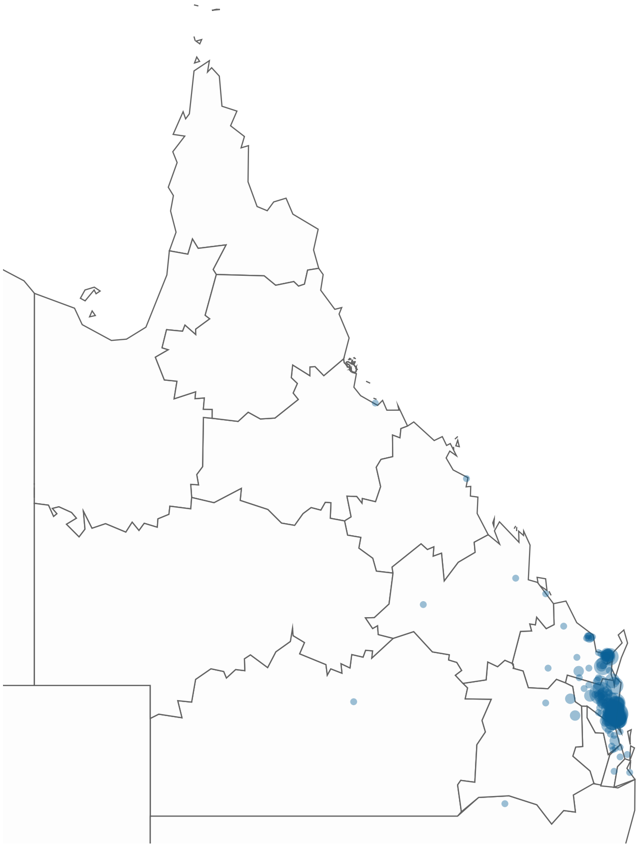


Figure 5: Sunshine Coast University Hospital

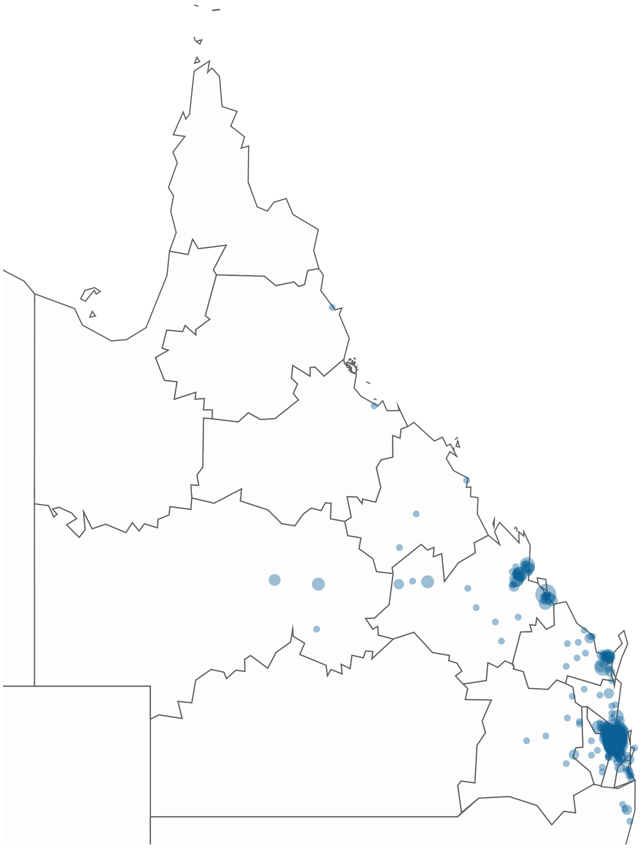


Figure 6: The Prince Charles Hospital

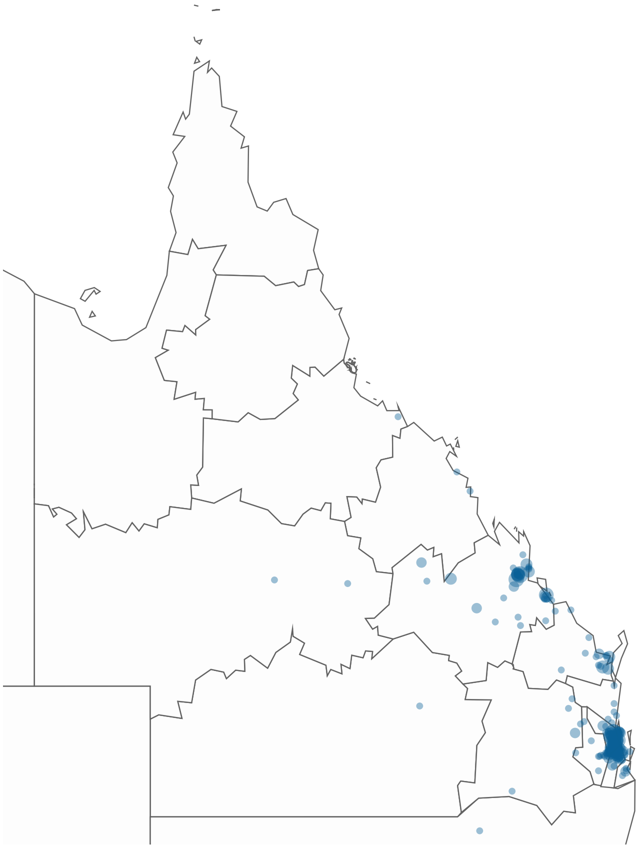


Figure 7: Royal Brisbane & Women's Hospital

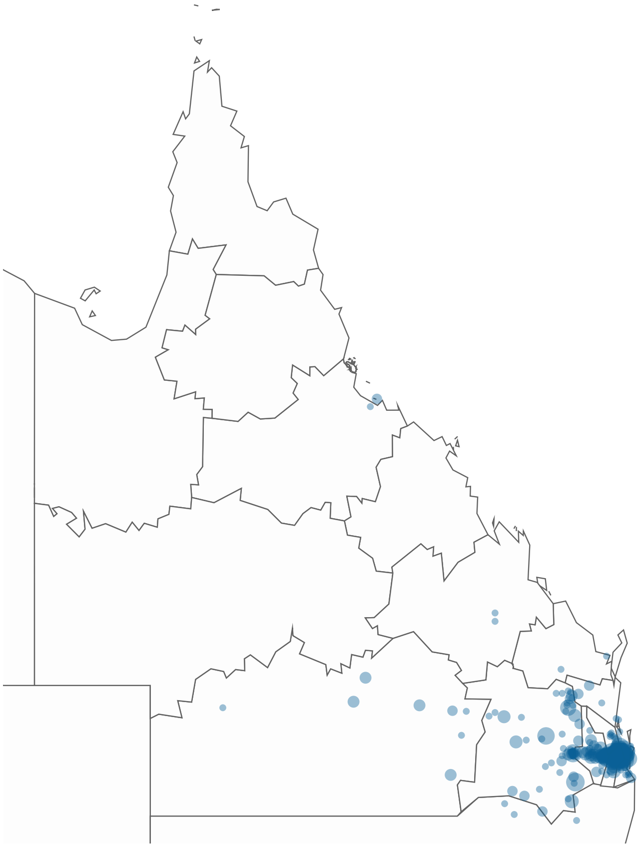


Figure 8: Princess Alexandra Hospital

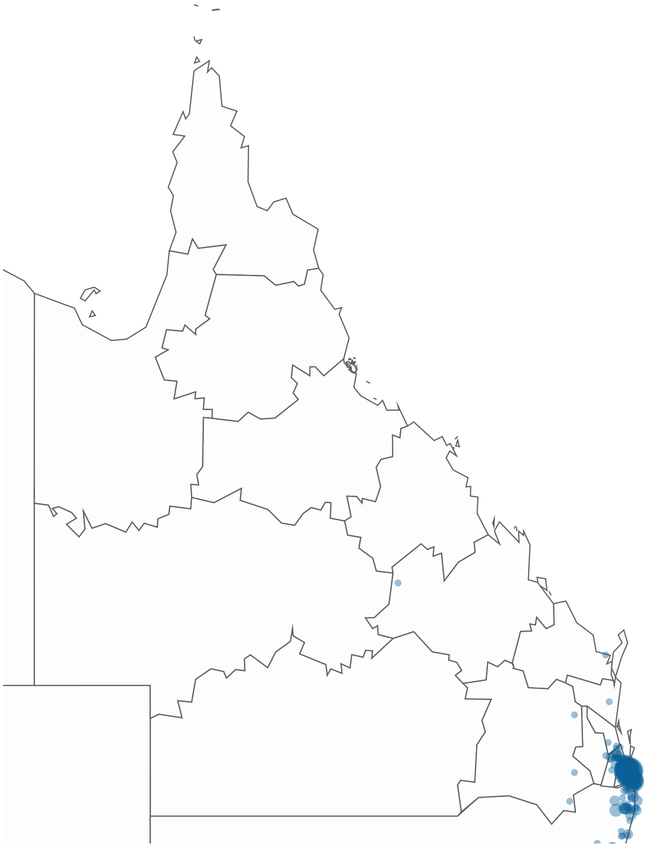


Figure 9: Gold Coast University Hospital

4 Total coronary cases

A total of 15,491 coronary cases were performed across the eight contributing cardiac catheterisation sites, with 4,966 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 468 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.

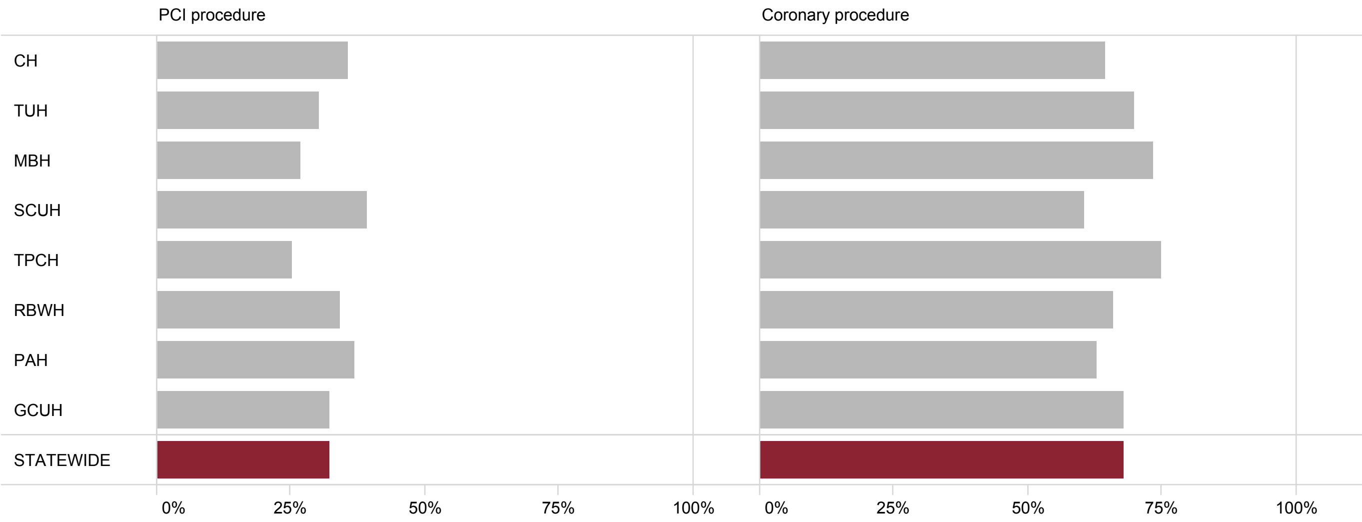


Figure 10: Proportion of cases by procedure category

Table 2: Total cases by procedure category

Site	PCI procedure* n (%)	Other coronary procedure† n (%)	Total coronary cases n
CH	550 (35.7)	992 (64.3)	1,542
TUH	370 (30.3)	851 (69.7)	1,221
MBH	280 (26.8)	764 (73.2)	1,044
SCUH	560 (39.3)	864 (60.7)	1,424
TPCH	934 (25.3)	2,758 (74.7)	3,692
RBWH	431 (34.0)	835 (66.0)	1,266
PAH	1,022 (37.0)	1,741 (63.0)	2,763
GCUH	819 (32.3)	1,720 (67.7)	2,539
STATEWIDE	**4,966 (32.1)**	**10,525 (67.9)**	**15,491**

* 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 13% 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 (33%). Almost two thirds of PCI procedures undertaken were categorised as either STEMI or NSTEMI (62%).

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 (10.2)	330 (21.4)	1,054 (68.4)
TUH	112 (9.2)	233 (19.1)	876 (71.7)
MBH	67 (6.4)	150 (14.4)	827 (79.2)
SCUH	263 (18.5)	323 (22.7)	838 (58.8)
TPCH	357 (9.7)	626 (17.0)	2,709 (73.4)
RBWH	151 (11.9)	356 (28.1)	759 (60.0)
PAH	511 (18.5)	773 (28.0)	1,479 (53.5)
GCUH	322 (12.7)	390 (15.4)	1,827 (72.0)
STATEWIDE	**1,941 (12.5)**	**3,181 (20.5)**	**10,369 (66.9)**

Table 4: PCI cases by clinical presentation category

Site	STEMI n (%)	NSTEMI n (%)	Other n (%)
CH	135 (24.5)	209 (38.0)	206 (37.5)
TUH	91 (24.6)	83 (22.4)	196 (53.0)
MBH	53 (18.9)	66 (23.6)	161 (57.5)
SCUH	214 (38.2)	141 (25.2)	205 (36.6)
TPCH	285 (30.5)	258 (27.6)	391 (41.9)
RBWH	118 (27.4)	183 (42.5)	130 (30.2)
PAH	420 (41.1)	348 (34.1)	254 (24.9)
GCUH	284 (34.7)	205 (25.0)	330 (40.3)
STATEWIDE	**1,600 (32.2)**	**1,493 (30.1)**	**1,873 (37.7)**

4.2 Place of residence

The vast majority of PCI patients (96%) 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, almost one fifth of PCI patients (18%) originated from outside of Queensland.

Patients came from a wide geographical area with a large proportion of patients residing on the Eastern Seaboard. Almost three quarters (74%) of all patients were seen inside their local Hospital and Health Service (HHS). Of those patients residing in Queensland, the majority (78%) 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	98.5	86.0	0.7	0.7
TUH	98.9	83.7	0.8	0.3
MBH	99.3	94.6	0.7	–
SCUH	98.7	77.6	1.1	0.2
TPCH	98.2	72.1	1.7	0.1
RBWH	97.4	54.8	1.4	1.2
PAH	98.8	62.3	0.7	0.5
GCUH	82.3	77.4	17.0	0.7
STATEWIDE	**95.8**	**73.7**	**3.7**	**0.5**

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	66.9	23.5	9.6
TUH	70.9	17.3	11.8
MBH	71.5	13.0	15.5
SCUH	68.4	20.5	11.1
TPCH	79.4	4.2	16.4
RBWH	72.2	4.5	23.2
PAH	81.0	12.8	6.2
GCUH	99.1	0.3	0.6
STATEWIDE	**78.1**	**11.1**	**10.8**

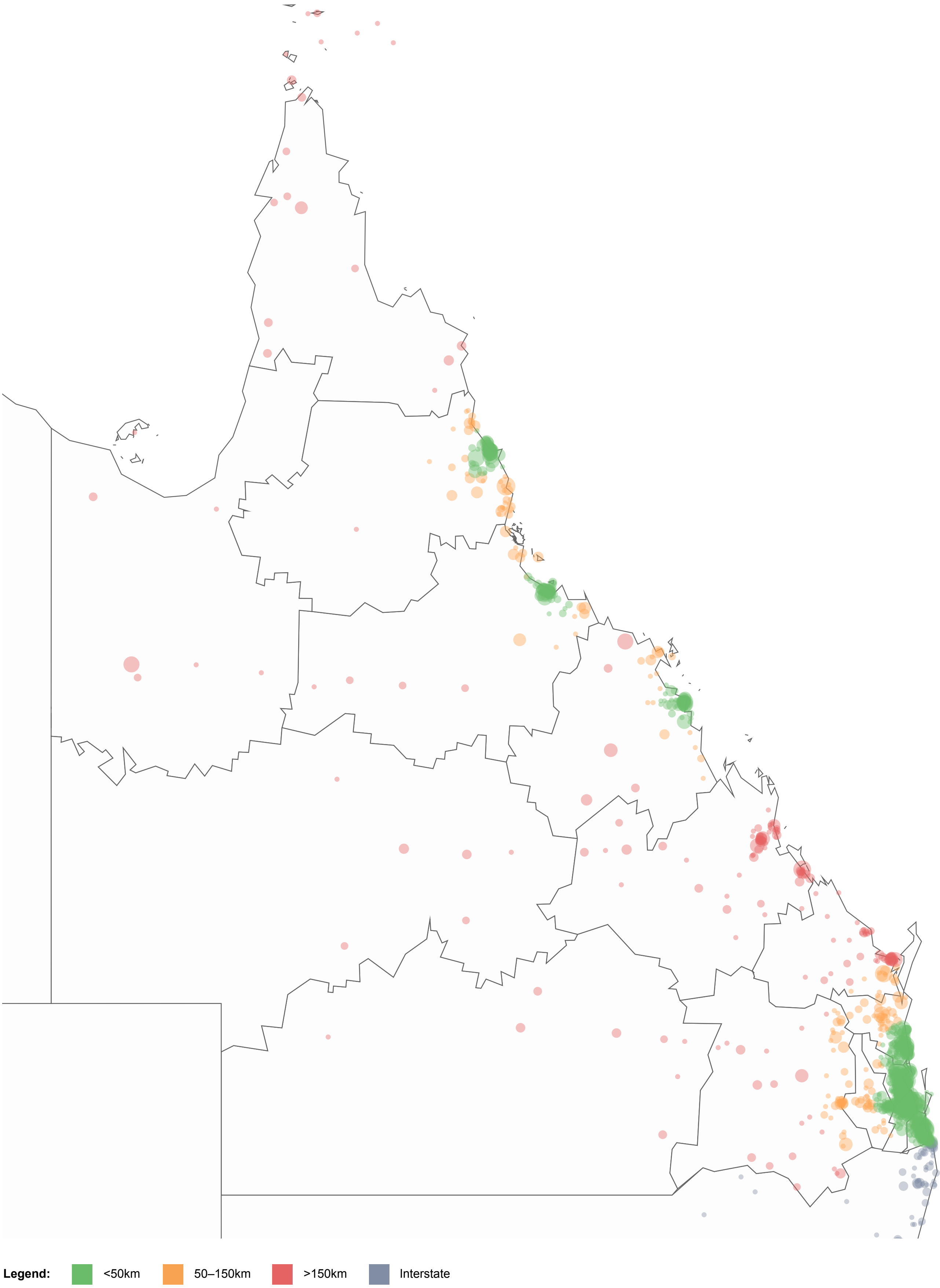


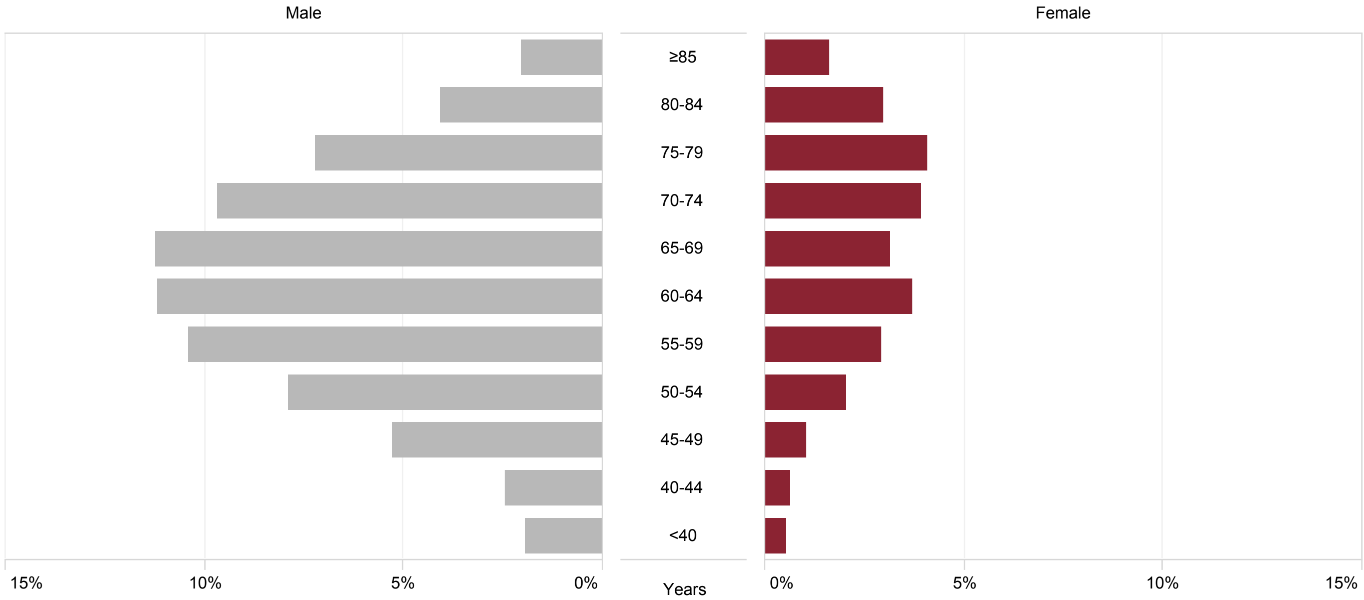
Figure 11: Queensland PCI cases by distance to nearest public PCI facility

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 63 years to 67 years across sites.

The majority of patients were male (73%), which reflects the increased risk of cardiovascular disease by gender. The median age for females was also higher than for males (69 years vs. 64 years).



% of total PCI (n=4,966)

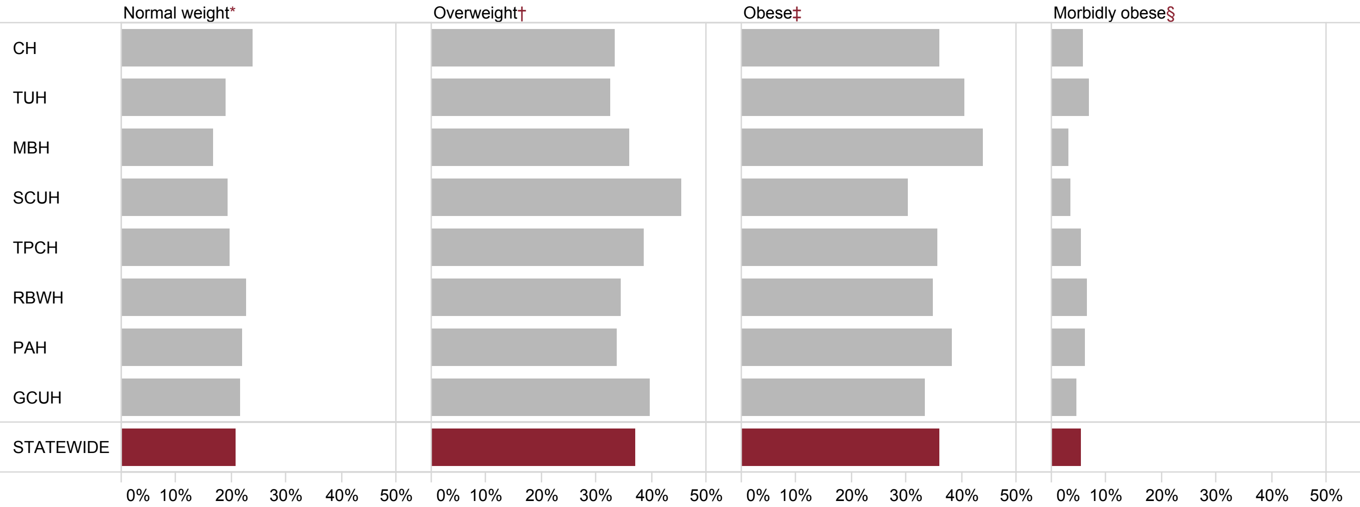
Figure 12: Proportion of all PCI cases by gender and age group

Table 7: Median PCI patient age by gender and site

Site	Male years	Female years	All years
CH	65	68	65
TUH	63	63	63
MBH	64	70	65
SCUH	66	67	66
TPCH	66	70	67
RBWH	60	72	63
PAH	63	66	63
GCUH	64	73	67
STATEWIDE	**64**	**69**	**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 (21%) in the normal BMI range and 37%, 36% 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/m^2

† BMI 25.0–29.9 kg/m^2

‡ BMI 30.0–39.9 kg/m^2

§ BMI ≥40.0 kg/m^2

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)	131 (23.9)	181 (33.1)	196 (35.8)	31 (5.7)
TUH	6 (1.6)	69 (18.8)	119 (32.4)	148 (40.3)	25 (6.8)
MBH	2 (0.7)	47 (16.8)	100 (35.7)	123 (43.9)	8 (2.9)
SCUH	9 (1.6)	108 (19.4)	253 (45.3)	169 (30.3)	19 (3.4)
TPCH	6 (0.6)	184 (19.7)	361 (38.7)	331 (35.5)	51 (5.5)
RBWH	8 (1.9)	98 (22.7)	148 (34.3)	149 (34.6)	28 (6.5)
PAH	7 (0.7)	222 (21.8)	343 (33.6)	387 (37.9)	61 (6.0)
GCUH	9 (1.1)	176 (21.5)	324 (39.7)	271 (33.2)	37 (4.5)
STATEWIDE	**55 (1.1)**	**1,035 (20.9)**	**1,829 (36.9)**	**1,774 (35.8)**	**260 (5.2)**

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, 25% and TUH, 19%) 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 (7.0%) exceeds the estimated proportion of Aboriginal and Torres Strait Islander people within Queensland (4.6%).[2]

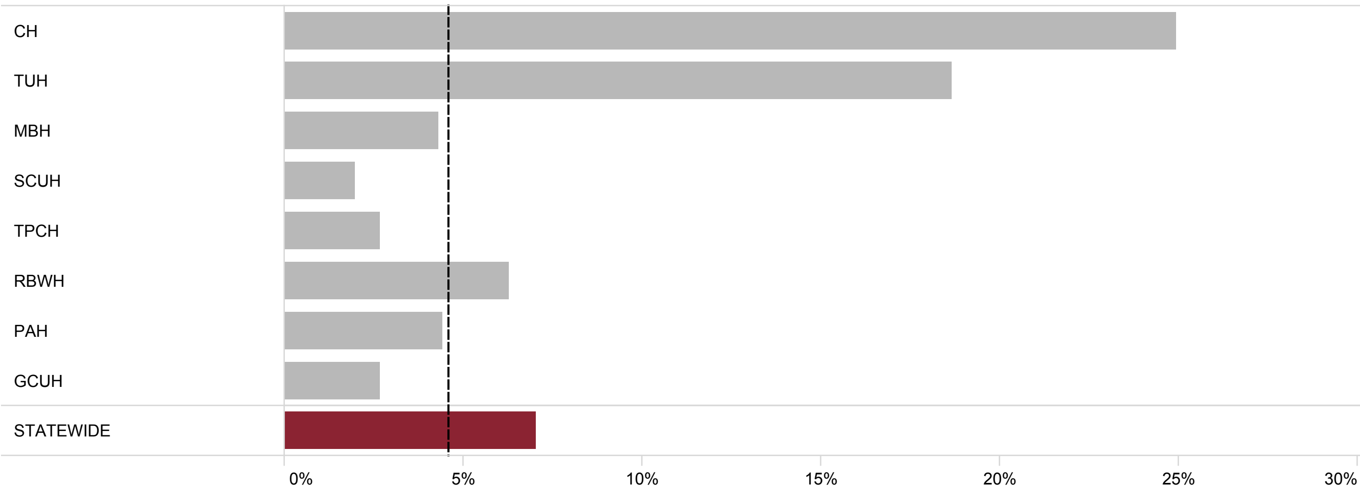


Figure 14: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

The median age of Aboriginal and Torres Strait Islander patients undergoing PCI was lower than that of non Aboriginal and Torres Strait Islander patients (56 years vs. 66 years).

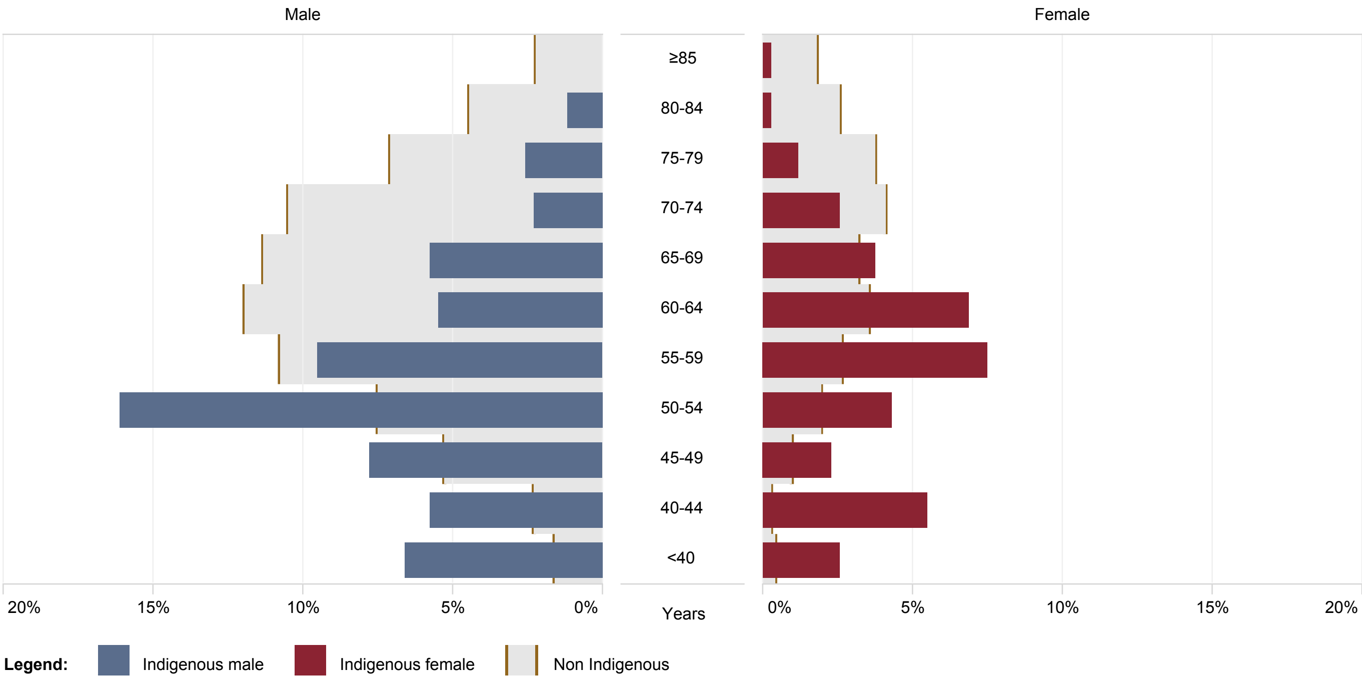


Figure 15: Proportion of all PCI cases by age group and Indigenous status

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

	Male years	Female years	All years
Aboriginal and Torres Strait Islander	55	57	56
Non Aboriginal and Torres Strait Islander	64	70	66
Total	**64**	**69**	**65**

6 Care and treatment of PCI patients

6.1 Admission status

There were 4,966 PCI procedures performed in 2020 by the eight public sites across Queensland. Patients are categorised by admission status, with elective, urgent and emergency categories defined according to the National Cardiovascular Data Registry (NCDR) as stated below.[3]

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

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

Table 10: Diagnostic coronary angiography status

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

Urgent and emergent cases accounted for the majority (77%) of PCI cases, reflecting the acute and often complex case mix flowing to Queensland public hospitals.

Salvage cases varied between institutions, however these exceptional and highly complex clinical scenarios accounted for less than 2% of any site's PCI volume.

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

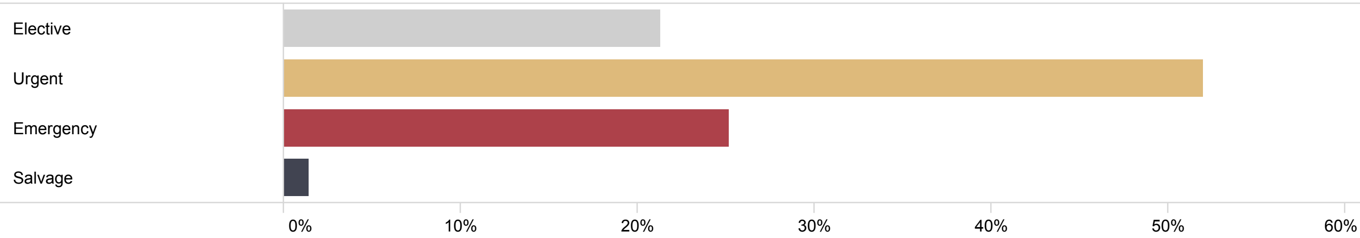


Figure 16: Proportion of all PCI cases by admission status

Table 11: PCI cases by site and admission status

Site	Elective n (%)	Urgent n (%)	Emergent n (%)	Salvage n (%)
CH	127 (23.1)	325 (59.1)	88 (16.0)	10 (1.8)
TUH	92 (24.9)	205 (55.4)	70 (18.9)	3 (0.8)
MBH	120 (42.9)	114 (40.7)	45 (16.1)	1 (0.4)
SCUH	99 (17.7)	300 (53.6)	159 (28.4)	2 (0.4)
TPCH	237 (25.4)	423 (45.3)	262 (28.1)	12 (1.3)
RBWH	60 (13.9)	274 (63.6)	89 (20.6)	8 (1.9)
PAH	139 (13.6)	578 (56.6)	286 (28.0)	19 (1.9)
GCUH	185 (22.6)	366 (44.7)	253 (30.9)	15 (1.8)
STATEWIDE	**1,059 (21.3)**	**2,585 (52.1)**	**1,252 (25.2)**	**70 (1.4)**

6.2 Access route

The majority of PCI cases (93%) used a single access route, with 78% being via the radial approach and 28% 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 (58% to 94%) which is a smaller range than observed in previous years.

Table 12: PCI access route by site

Site	Total PCI cases n	Radial approach %	Femoral approach %	Other approach %
CH	550	80.4	24.0	0.4
TUH	370	76.2	27.8	0.8
MBH	280	90.0	17.1	0.0
SCUH	560	93.8	9.1	2.3
TPCH	934	81.0	29.3	0.2
RBWH	431	85.4	23.0	0.5
PAH	1,022	57.7	49.1	0.0
GCUH	819	82.3	24.1	0.2
STATEWIDE	**4,966**	**78.3**	**28.3**	**0.5**

Totals >100% due to multiple access sites

Table 13: PCI total access routes by site

Site	Single approach %	Multiple approaches %
CH	95.3	4.7
TUH	95.1	4.9
MBH	92.9	7.1
SCUH	94.8	5.2
TPCH	89.5	10.5
RBWH	91.2	8.8
PAH	93.2	6.8
GCUH	93.4	6.6
STATEWIDE	**92.9**	**7.1**

There was minimal differences in access route observed in the overall cohort when the STEMI presenting within six hours of symptom onset cohort was examined. The STEMI cohort had a marginally smaller rate of femoral access (26% vs. 28%). Unlike in 2019, all sites utilised the radial approach more regularly for patients with STEMI presenting within six hours of symptom onset.

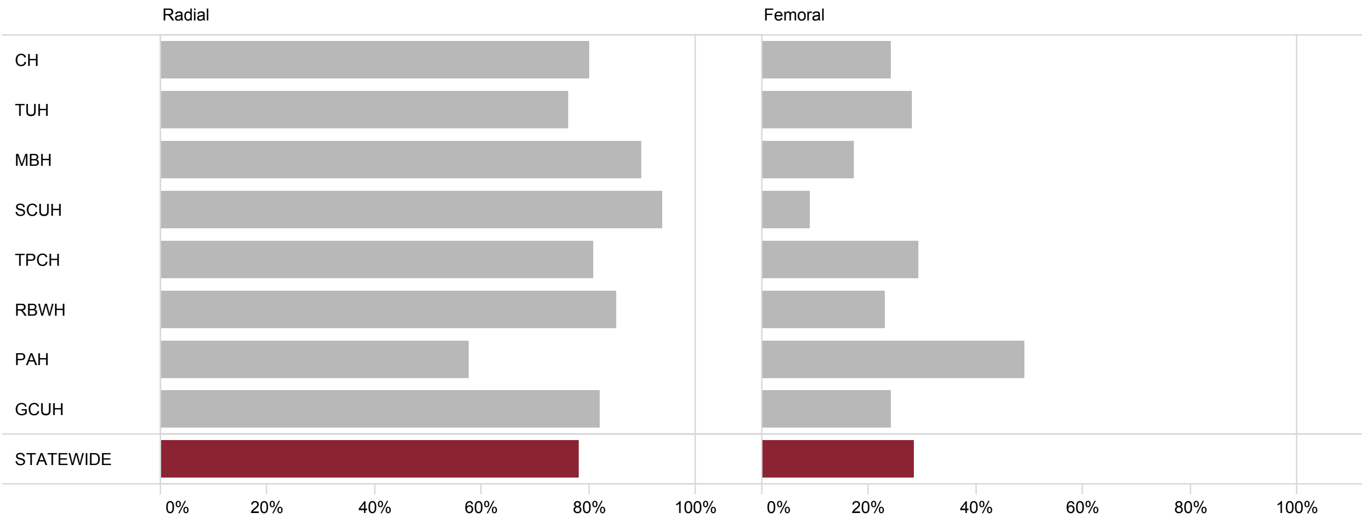


Figure 17: Proportion of PCI cases using radial and femoral access routes by site

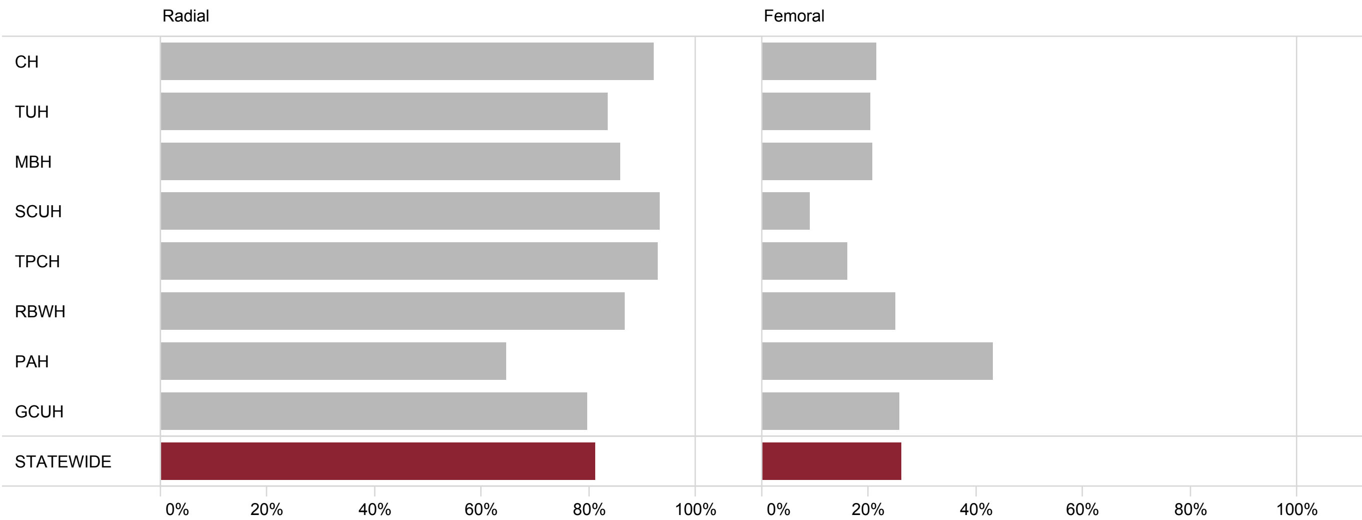


Figure 18: Proportion of STEMI presenting within six hours PCI cases using radial and femoral access routes by site

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, 46% of cases involved the left anterior descending coronary artery (LAD), followed by the right coronary artery (RCA) at 37%, 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 10% of cases.

Table 14: Grafts and vessels treated by site

Site	LAD %	LMCA %	LCx %	RCA %	Graft %
CH	51.6	2.2	23.5	34.7	3.3
TUH	44.6	3.8	24.9	39.7	3.5
MBH	39.3	1.8	30.0	27.5	3.9
SCUH	46.8	5.9	25.7	39.6	1.8
TPCH	43.6	3.2	24.0	37.5	5.1
RBWH	43.9	2.6	25.3	40.8	2.1
PAH	43.6	3.1	22.8	40.0	2.6
GCUH	51.8	2.7	24.1	34.2	2.7
STATEWIDE	**46.1**	**3.2**	**24.4**	**37.3**	**3.2**

Table 15: Total native vessels treated by site

Site	Single vessel n (%)	Two vessel s n (%)	Three or more vessels n (%)
CH	486 (91.4)	40 (7.5)	6 (1.1)
TUH	312 (92.3)	25 (7.4)	1 (0.3)
MBH	262 (97.4)	7 (2.6)	–
SCUH	461 (83.8)	71 (12.9)	18 (3.3)
TPCH	775 (87.8)	98 (11.1)	10 (1.1)
RBWH	391 (92.7)	30 (7.1)	1 (0.2)
PAH	896 (90.1)	79 (7.9)	20 (2.0)
GCUH	711 (89.2)	78 (9.8)	8 (1.0)
STATEWIDE	**4,294 (89.7)**	**428 (8.9)**	**64 (1.3)**

Excludes any graft PCI (n=158)

Table 16: Grafts treated by site

Site	Graft only n (%)	Graft and native vessel n (%)
CH	17 (94.4)	1 (5.6)
TUH	13 (100.0)	–
MBH	11 (100.0)	–
SCUH	6 (60.0)	4 (40.0)
TPCH	39 (81.3)	9 (18.8)
RBWH	9 (100.0)	–
PAH	24 (88.9)	3 (11.1)
GCUH	21 (95.5)	1 (4.5)
STATEWIDE	**140 (88.6)**	**18 (11.4)**

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 4,624 PCI cases involving stent deployment. DES were used in 99.6% of cases, with some sites using DES exclusively. The proportion of cases utilising DES has increased from previous years (98% and 93% in 2019 and 2018 respectively).

BMS were used less than 1% of cases. BVS or covered stents were also used in less than 1% of cases. The remaining 348 PCI cases did not involve stent deployment.

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	507	98.6	0.0	1.4	0.0	1.5
TUH	351	100.0	0.0	0.0	0.0	1.4
MBH	248	100.0	0.0	0.0	0.0	1.3
SCUH	529	99.5	0.0	0.0	0.5	1.8
TPCH	868	100.0	0.0	0.0	0.0	1.4
RBWH	409	100.0	0.0	0.0	0.0	1.5
PAH	969	99.3	0.4	0.0	0.3	1.5
GCUH	737	99.6	0.4	0.0	0.0	1.4
STATEWIDE	**4,618**	**99.6**	**0.1**	**0.1**	**0.1**	**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 1,600 documented STEMI PCI cases, with over half (58%) presenting as primary PCI cases and 10% presenting after 12 hours (late presenters).

Less than one quarter (19%) 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	22 (16.3)	51 (37.8)	3 (2.2)	18 (13.3)	22 (16.3)	19 (14.1)
TUH	5 (5.5)	49 (53.8)	5 (5.5)	8 (8.8)	21 (23.1)	3 (3.3)
MBH	1 (1.9)	29 (54.7)	3 (5.7)	8 (15.1)	7 (13.2)	5 (9.4)
SCUH	33 (15.4)	90 (42.1)	9 (4.2)	16 (7.5)	48 (22.4)	18 (8.4)
TPCH	37 (13.0)	162 (56.8)	20 (7.0)	25 (8.8)	27 (9.5)	14 (4.9)
RBWH	14 (11.9)	60 (50.8)	7 (5.9)	11 (9.3)	20 (16.9)	6 (5.1)
PAH	55 (13.1)	232 (55.2)	19 (4.5)	39 (9.3)	59 (14.0)	16 (3.8)
GCUH	34 (12.0)	174 (61.3)	20 (7.0)	30 (10.6)	14 (4.9)	12 (4.2)
STATEWIDE	**201 (12.6)**	**847 (52.9)**	**86 (5.4)**	**155 (9.7)**	**218 (13.6)**	**93 (5.8)**

6.5.2 Admission pathway

After first medical contact, 71% 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 76% and 77% 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.

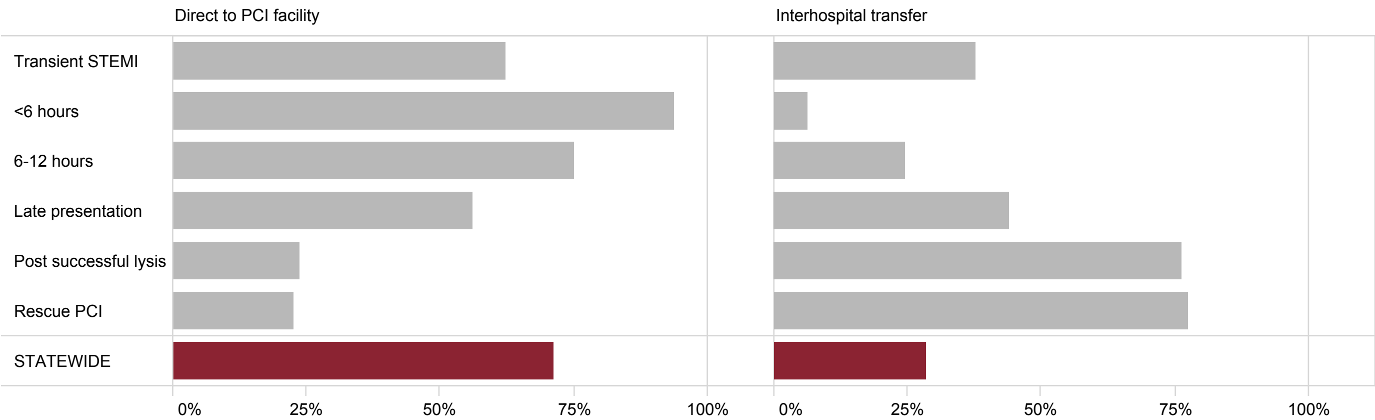


Figure 19: Proportion of STEMI PCI cases by admission pathway and clinical presentation

6.5.3 First medical contact

For STEMI cases presenting for PCI within six hours of symptom onset, most patients presented via the Queensland Ambulance Service (QAS) (82%), 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 4% respectively). The remaining 6% presented to other health facilities such as GP clinics, community health centres or any other outpatient setting.

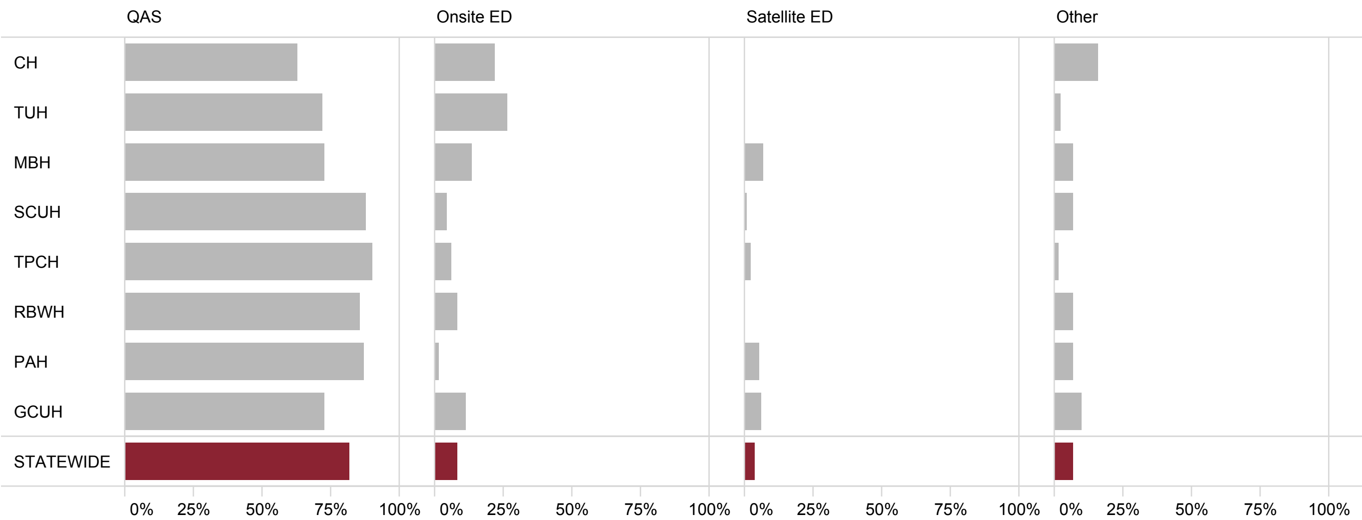


Figure 20: Proportion of STEMI PCI cases presenting within six hours of symptom onset by first medical contact

6.5.4 Thrombolysed patients

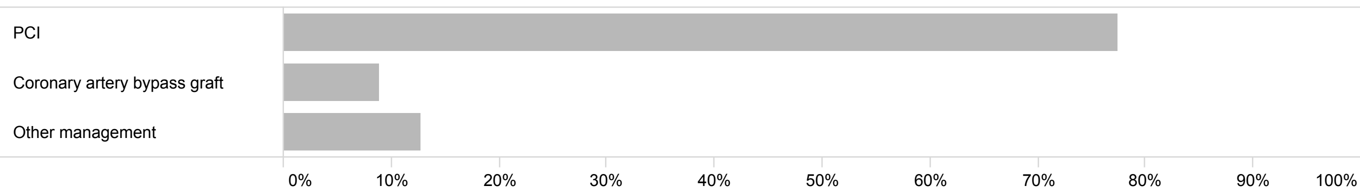
As mentioned above, the method of reperfusion depends on many factors which together determine the treatment method most appropriate for the particular presentation.

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

There was a total of 411 thrombolysed STEMI presentations with the majority (76%) 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	56	41 (73.2)	7.5
TUH	32	24 (75.0)	6.5
MBH	16	12 (75.0)	4.3
SCUH	84	66 (78.6)	11.8
TPCH	58	41 (70.7)	4.4
RBWH	34	26 (76.5)	6.0
PAH	98	75 (76.5)	7.3
GCUH	33	26 (78.8)	3.2
STATEWIDE	**411**	**311 (75.7)**	**6.3**



PCI and CABG revascularisation not displayed (1.0%)

Figure 21: Proportion of lysed patients by clinical management

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

Site	PCI %	CABG %	PCI + CABG %	Other management* %
CH	71.0	10.9	3.6	14.5
TUH	78.1	6.3	0.0	15.6
MBH	81.3	0.0	0.0	18.7
SCUH	82.9	7.3	0.0	9.8
TPCH	70.7	13.8	0.0	15.5
RBWH	82.4	2.9	2.9	11.8
PAH	78.4	10.3	0.0	11.3
GCUH	75.8	9.1	3.0	12.1
STATEWIDE	**77.4**	**8.8**	**1.0**	**12.8**

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

Overall, there were 411 lysed STEMI patients who reached a public hospital CCL site in 2020. Substantially improved data quality this year sees 85% of this cohort eligible for analysis compared to 54% in 2018 and 75% in 2019.

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 (31 minutes vs. 36 minutes).

The patients in the other lysis group took a median of 62 minutes from FdECG to thrombolysis. The extended time delay likely representative of the travel time taken to arrive at a thrombolysis facility, noting Queensland's vast geography and rural and remote population.

Table 21: Definitions for STEMI time to thrombolysis

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

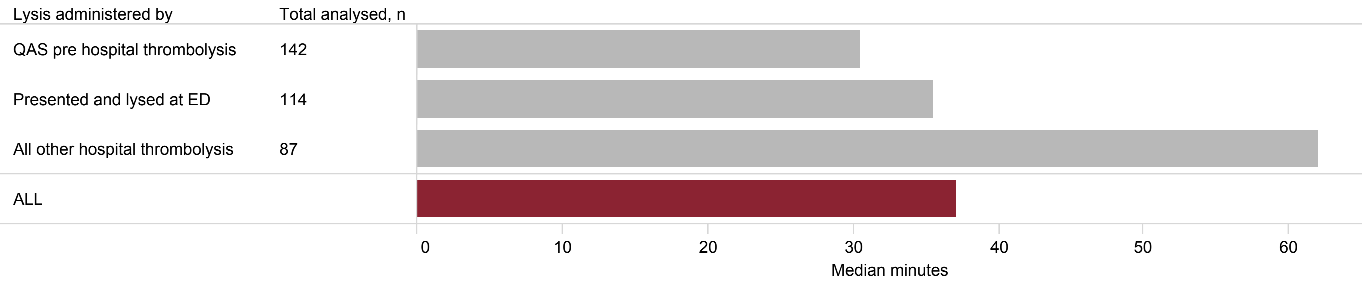
Table 22: Total lysed STEMI cases by thrombolysis administration pathway

	Total lysed STEMIs n	Total analysed n	Median FdECG to lysis minutes	Interquartile range minutes
QAS pre-hospital thrombolysis	150	142	31	23–42
Presented and lysed at ED	140	114	36	23–50
Other pre-hospital thrombolysis*	7	6	N/A	N/A
All other hospital lysis†	114	87	62	39–92
All	**411**	**349**	**37**	**25–56**

NA: Not displayed due to <20 cases for analysis

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

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



Excludes other pre-hospital thrombolysis (n=7)

Figure 22: Median time from first diagnostic ECG to thrombolysis therapy by administration pathway

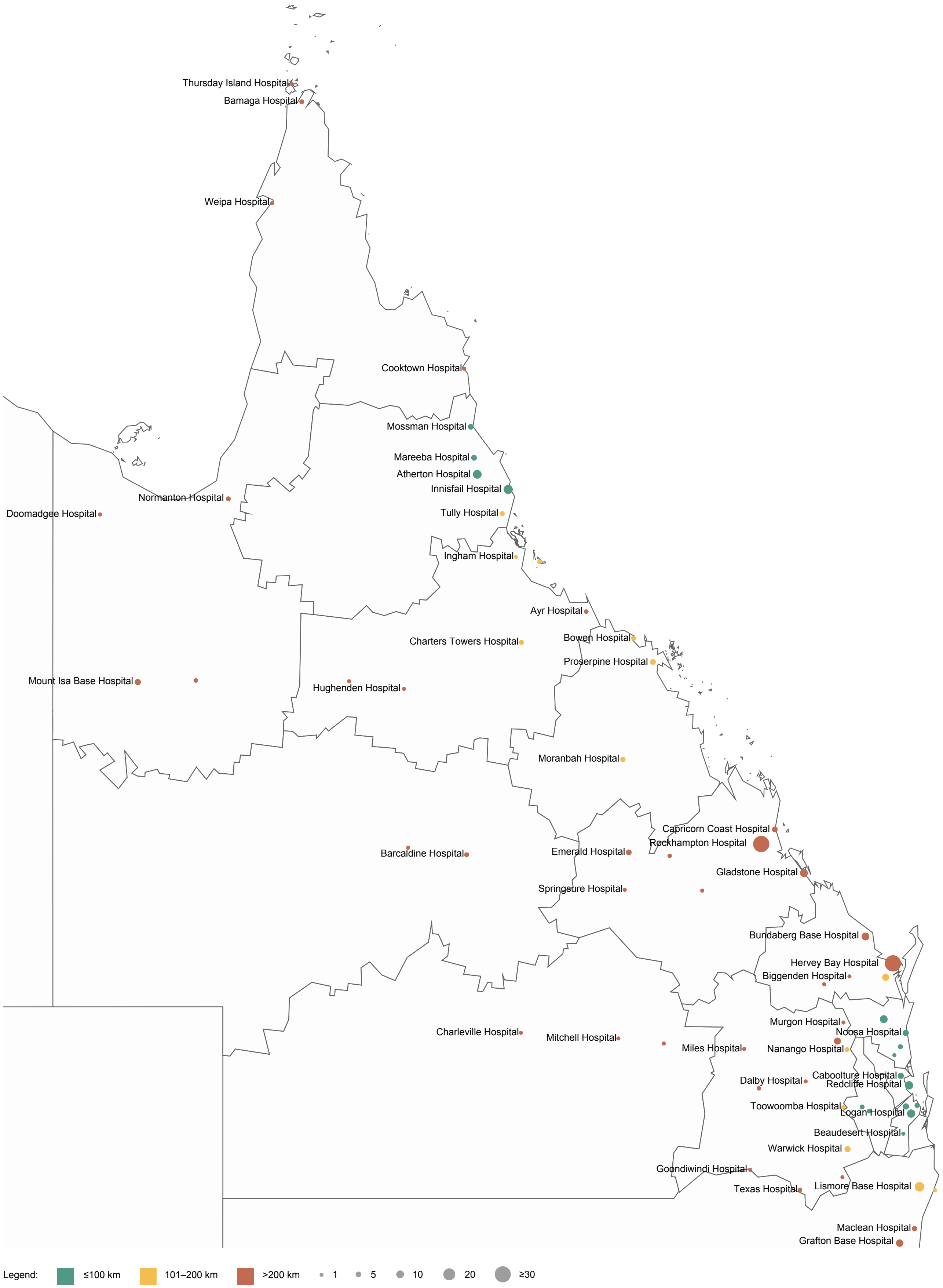
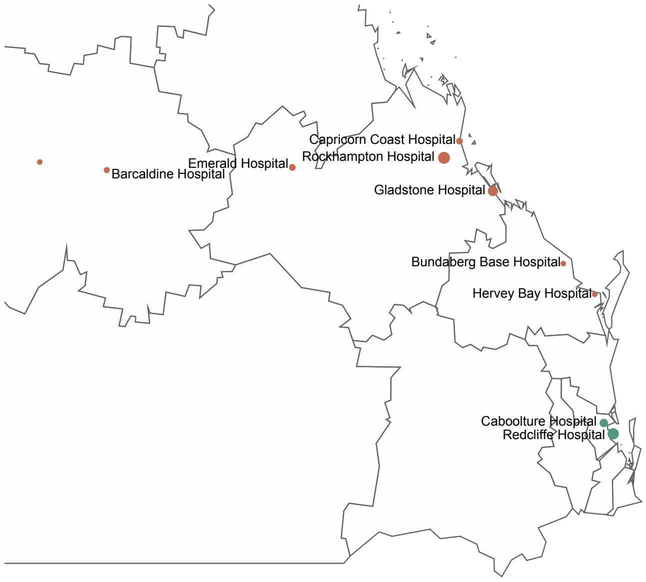
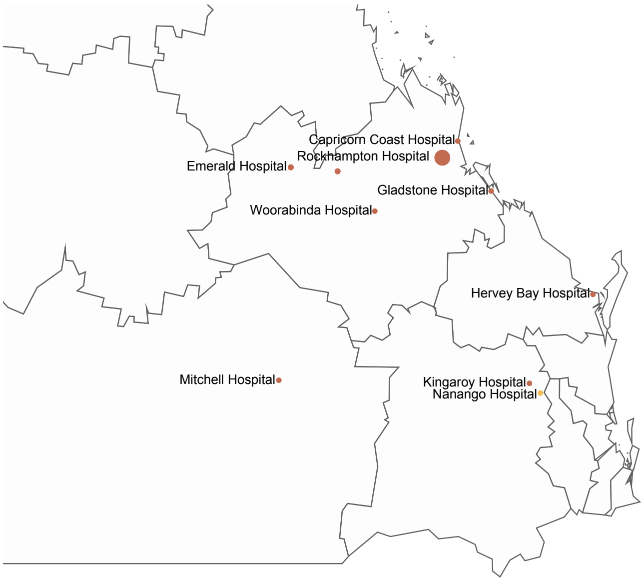


Figure 23: Thrombolysed STEMI interhospital transfers by estimated distance to transfer

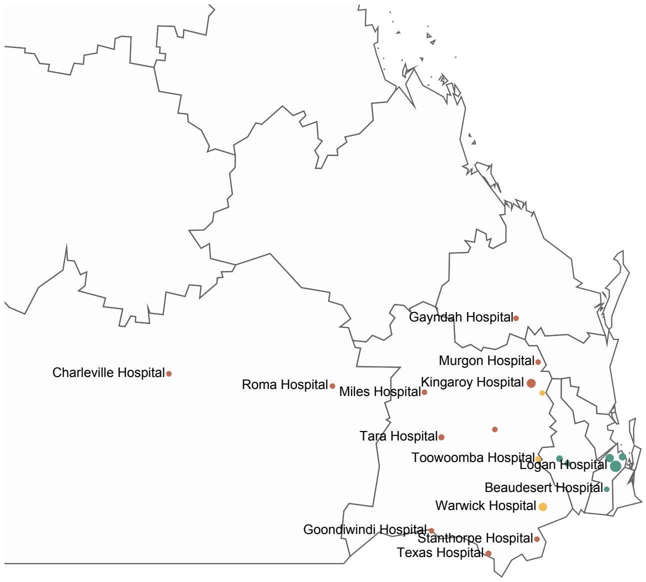
Inset A: Sunshine Coast University Hospital



Inset B: The Prince Charles Hospital



Inset C: Royal Brisbane & Women's Hospital



Inset D: Princess Alexandra Hospital

Inset E: Gold Coast University Hospital

QAS has a well-defined set of contraindications for the administration of pre-hospital thrombolysis. There were 114 (28%) of lysed STEMI patients who were not indicated for pre-hospital thrombolysis based on QAS criteria but were subsequently eligible for thrombolysis based on Queensland public hospital guidelines. The most common reason for this was that the patient had been located within close proximity to a hospital (57%). A smaller proportion had been contraindicated for pre-hospital thrombolysis due to advanced age (14%), significant other comorbidity or complex clinical presentation (Table 23).

For the cohort of thrombolysed patients, the median time to angiography was 17 hours post thrombolysis with 64% of patients undergoing coronary angiography within 24 hours. The unadjusted all-cause mortality within 30 days for STEMI patients receiving thrombolysis was 2.4%.

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

	n (%)
Close proximity to hospital	65 (57.0)
Advanced age (≥75 years)	16 (14.0)
Hypertensive	9 (7.9)
GCS* ‹15	6 (5.3)
Current anticoagulants/antiplatelets	5 (4.4)
Prolonged pain duration ›6 hours	4 (3.5)
No consistent ST-elevation	2 (1.8)
Patient pain free	2 (1.8)
Recent surgery	1 (0.9)
Other	4 (3.5)
ALL	**114 (100.0)**

* Glasgow Coma Scale

Table 24: Median time from thrombolysis to angiography by site

Site	Total cases n	Total analysed n	Median time to angiography hours	Interquartile range hours	Met 24 hours target %
CH	56	54	8	3–26	66.7
TUH	32	32	20	5–40	56.3
MBH	16	16	13	5–28	75.0
SCUH	84	82	17	5–27	68.3
TPCH	58	57	11	6–22	78.9
RBWH	34	34	19	11–28	61.8
PAH	98	97	23	8–37	50.5
GCUH	33	30	16	5–48	66.7
STATEWIDE	**411**	**402**	**17**	**5–29**	**63.9**

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	Post discharge to 30 days n	Total mortality n (%)
Post successful lysis	312	1 (0.3)	0	4	1	5 (1.6)
Rescue PCI	99	3 (3.0)	1	3	1	5 (5.1)
ALL	**411**	**3 (0.7)**	**1**	**7**	**2**	**10 (2.4)**

6.6 NSTEMI presentations

Of all PCI and coronary cases performed in CCLs during 2020, there were 3,181 coded with a procedural indication of NSTEMI. These cases accounted for 30% of all PCI cases across all centres, with site variation ranging from 22% to 43%. These figures are similar across the previous 2018 and 2019 patient cohorts.

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 15% underwent CABG, while the remainder were medically managed or referred outside of Queensland Health.

6.6.1 Case load

Table 26: NSTEMI cases by site

Site	Total NSTEMI cases n	NSTEMI receiving PCI n (%)	Proportion of all PCI cases %
CH	330	209 (63.3)	38.0
TUH	233	83 (35.6)	22.4
MBH	150	66 (44.0)	23.6
SCUH	323	141 (43.7)	25.2
TPCH	626	258 (41.2)	27.6
RBWH	356	183 (51.4)	42.5
PAH	773	348 (45.0)	34.1
GCUH	390	205 (52.6)	25.0
STATEWIDE	**3,181**	**1,493 (46.9)**	**30.1**

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

Site	PCI revascularisation %	CABG revascularisation %	PCI + CABG revascularisation %	Other management* %
CH	71.3	8.2	0.0	20.5
TUH	41.3	15.1	0.0	43.6
MBH	47.2	10.7	0.0	42.1
SCUH	53.5	15.0	0.3	31.2
TPCH	44.0	14.4	0.0	41.6
RBWH	55.6	13.7	0.3	30.4
PAH	48.1	19.6	0.3	32.0
GCUH	55.3	13.6	0.3	30.8
STATEWIDE	**51.3**	**14.8**	**0.2**	**33.7**

* Medical management or referred outside of Queensland Health

6.6.2 Admission source

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

Considerable variation was observed between sites, with the proportion of interhospital transfers for NSTEMI ranging from 37% to 71%, 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	187 (56.7)	143 (43.3)
TUH	148 (63.5)	85 (36.5)
MBH	91 (60.7)	59 (39.3)
SCUH	164 (50.8)	159 (49.2)
TPCH	333 (53.2)	293 (46.8)
RBWH	122 (34.3)	234 (65.7)
PAH	226 (29.2)	547 (70.8)
GCUH	245 (62.8)	145 (37.2)
STATEWIDE	**1,516 (47.7)**	**1,665 (52.3)**

Table 29: NSTEMI interhospital transfers by estimated distance to transfer

Site	Total analysed n	Median kilometres	Interquartile range kilometres
CH	143	93	75–143
TUH	85	302	133–901
MBH	59	125	36–192
SCUH	159	93	30–93
TPCH	286	39	39–505
RBWH	234	46	45–611
PAH	534	27	24–122
GCUH	91	17	17–17
STATEWIDE	**1,591**	**46**	**27–217**

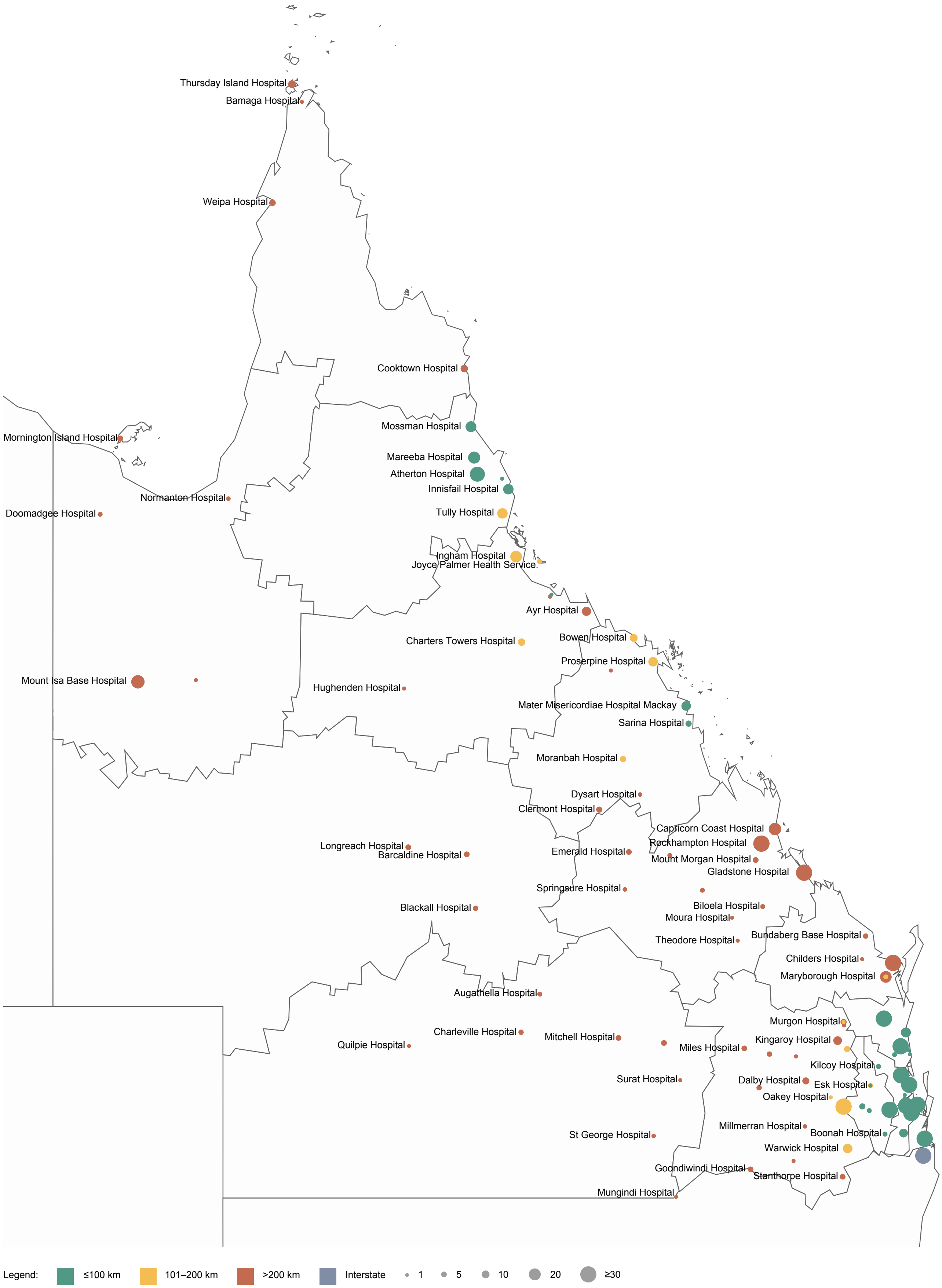
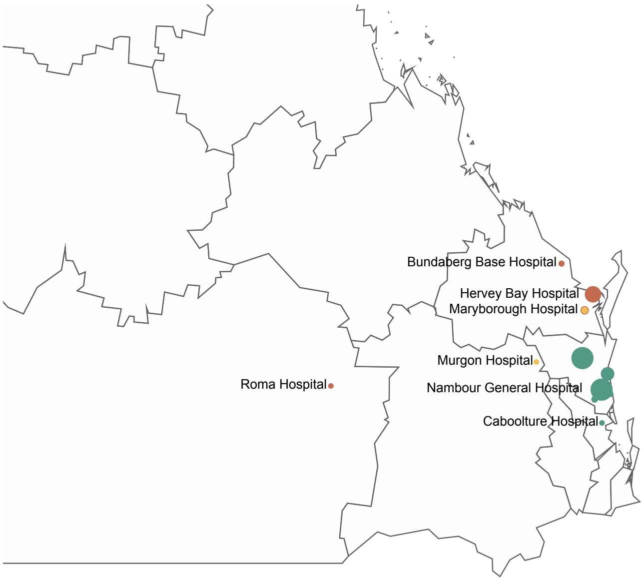
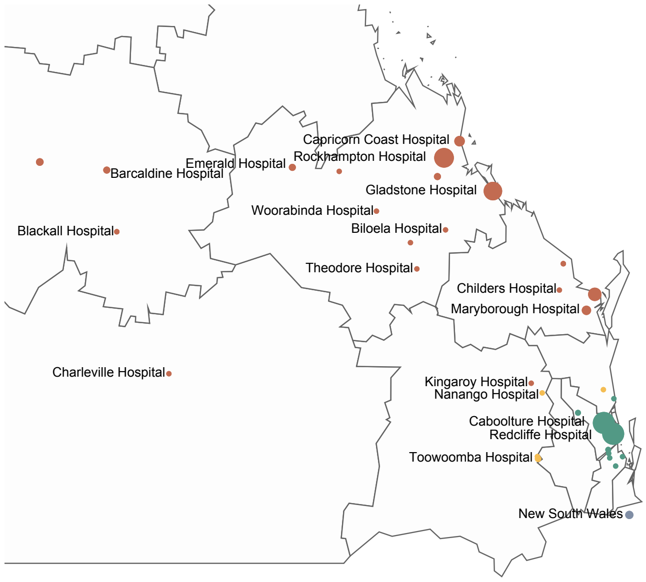


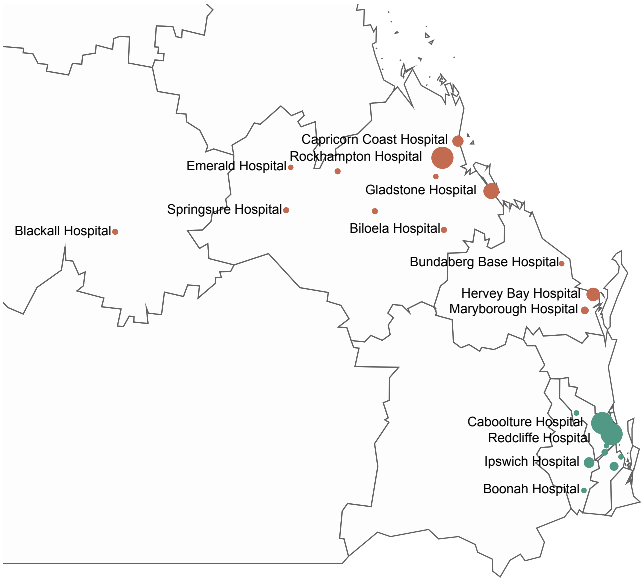
Figure 24: NSTEMI interhospital transfers by estimated distance to transfer



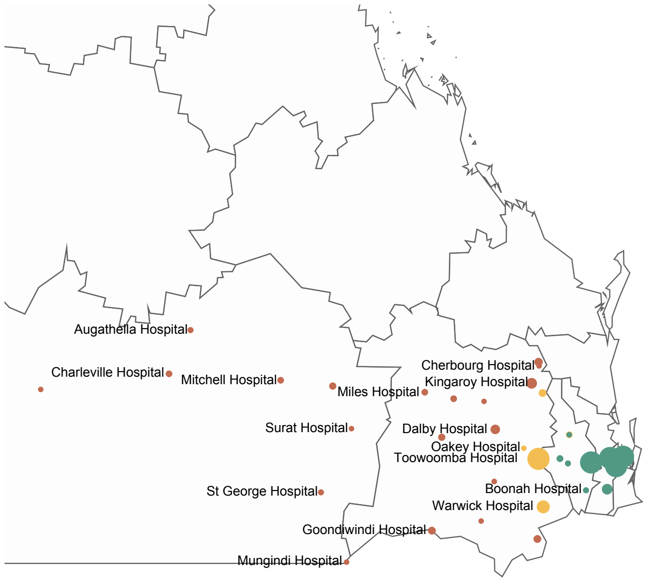
Inset A: *Sunshine Coast University Hospital*



Inset B: *The Prince Charles Hospital*



Inset C: *Royal Brisbane & Women's Hospital*



Inset D: *Princess Alexandra Hospital*

Inset E: *Gold Coast University Hospital*

7 Clinical indicators

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

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

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

Table 30: Diagnostic and interventional cardiology clinical indicators

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

7.1 Mortality outcomes

7.1.1 Risk adjusted all-cause 30 day mortality post PCI

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

The overall 30 day unadjusted mortality rate for patients undergoing PCI procedures at Queensland public hospitals for 2020 was 1.5%. This result compares favourably with the 30 day mortality rate of 2.2% for the 2020 Victoria, Australia PCI cohort[6] and 2.8% presented by the British Cardiovascular Interventional Society (BCIS) in their review of PCI outcomes for the 2014 calendar year. This metric is chosen as the comparator as BCIS reports in subsequent years have given in-hospital rather than 30 day mortality.[7]

Table 31 presents unadjusted mortality according to admission status. As should be expected, the risk of death increases according to the severity of the patient's condition (admission status). 30 day mortality was 36% 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	550	0 (0.0)	3 (0.9)	4 (4.5)	2 (20.0)	9 (1.6)
TUH	370	0 (0.0)	2 (1.0)	2 (2.9)	2 (66.7)	6 (1.6)
MBH	280	0 (0.0)	1 (0.9)	2 (4.4)	0 (0.0)	3 (1.1)
SCUH	560	0 (0.0)	3 (1.0)	3 (1.9)	1 (50.0)	7 (1.3)
TPCH	934	1 (0.4)	5 (1.2)	4 (1.5)	5 (41.7)	15 (1.6)
RBWH	431	0 (0.0)	1 (0.4)	3 (3.4)	3 (37.5)	7 (1.6)
PAH	1,022	0 (0.0)	4 (0.7)	6 (2.1)	8 (42.1)	18 (1.8)
GCUH	819	0 (0.0)	3 (0.8)	3 (1.2)	4 (26.7)	10 (1.2)
STATEWIDE	**4,966**	**1 (0.1)**	**22 (0.9)**	**27 (2.2)**	**25 (35.7)**	**75 (1.5)**

Figure 25 presents the observed mortality rates by site, superimposed on the predicted mortality rates (with 95% confidence interval) calculated using the Victorian Cardiac Outcomes Registry (VCOR) risk adjustment model[9]. This analysis used an imputed dataset accounting for any missing data.

Reassuringly, observed mortality rates from all sites are within the expected range for their respective risk adjusted mortality rates. This is despite the limited risk adjustment model, which only adjusts for six factors – ACS, age, LAD coronary artery involvement, eGFR, LVEF, and cardiogenic shock. Other critical presentations with very high mortality risk, such as out of hospital ventricular fibrillation arrest with uncertain neurological recovery, are not adjusted for and therefore the model is likely to underestimate true mortality risk. This is relevant in our dataset where there were marked differences between hospitals in the proportion of high risk salvage patients taken for PCI (ranging from 0.4%–1.9% 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 26 presents the observed and expected mortality rates excluding salvage.

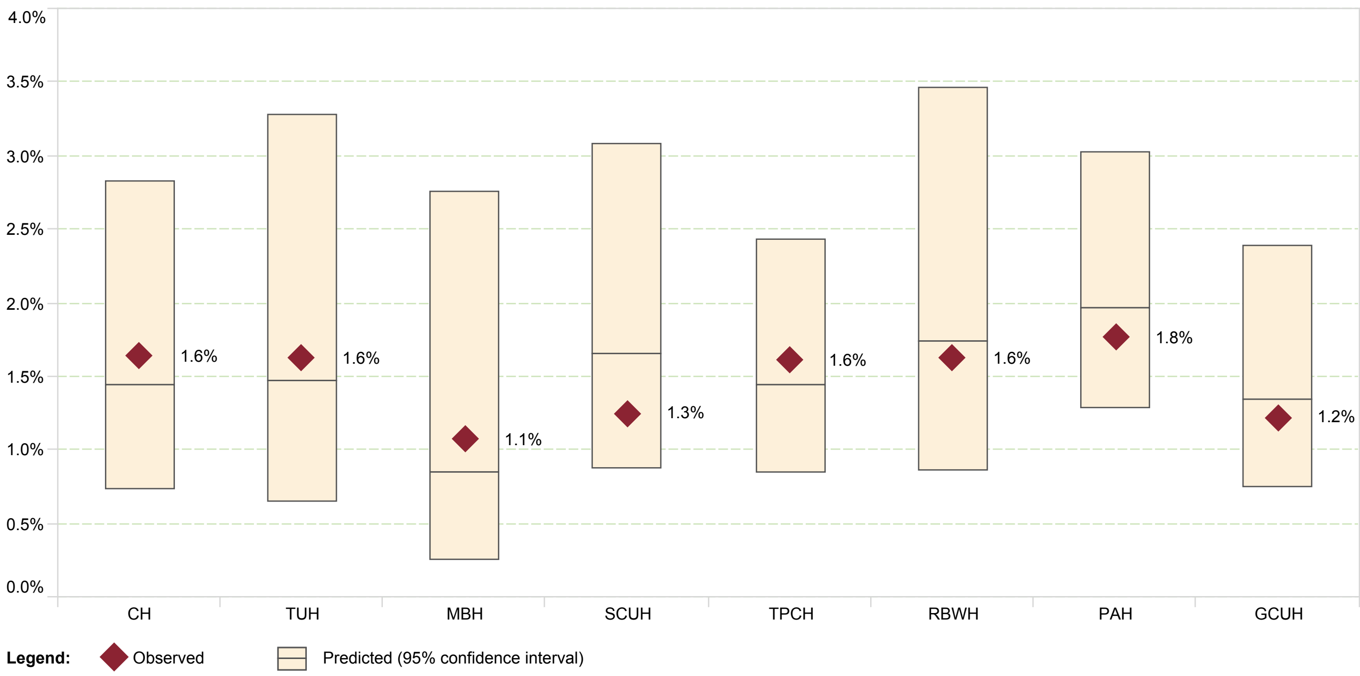
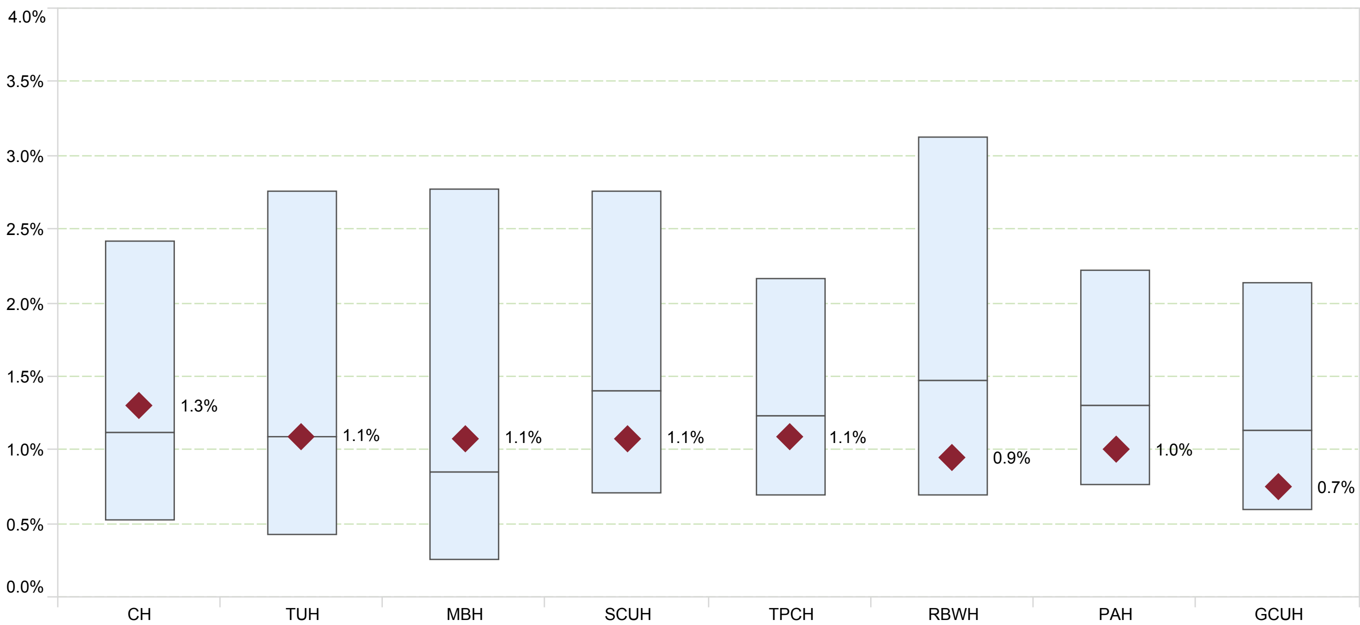


Figure 25: Comparison of observed and predicted mortality rates by site

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

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

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



Excluding salvage cases (n=70)

Figure 26: 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 1,941 documented STEMI cases in 2020, 1,600 cases (82%) 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 1.4% to 4.8% between participating centres with a statewide rate of 2.1%. Of these 1,543 patients analysed, a total of 32 mortalities were identified with the majority (66%) 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	4	126	6 (4.8)
TUH	0	3	0	88	3 (3.4)
MBH	0	1	1	52	2 (3.8)
SCUH	0	2	1	212	3 (1.4)
TPCH	0	4	0	277	4 (1.4)
RBWH	0	3	0	112	3 (2.7)
PAH	2	4	1	403	7 (1.7)
GCUH	0	2	2	273	4 (1.5)
STATEWIDE	**2**	**21**	**9**	**1,543**	**32 (2.1)**

* Excluding salvage cases (n=57)

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 2.5%.

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	2	45	2 (4.4)
TUH	0	2	0	47	2 (4.3)
MBH	0	1	1	29	2 (6.9)
SCUH	0	2	1	89	3 (3.4)
TPCH	0	2	0	156	2 (1.3)
RBWH	0	3	0	57	3 (5.3)
PAH	1	3	0	220	4 (1.8)
GCUH	0	1	1	168	2 (1.2)
STATEWIDE	**1**	**14**	**5**	**811**	**20 (2.5)**

* Excluding salvage cases (n=36)

7.1.4 Out of hospital cardiac arrest

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

With this in mind, it is imperative that these cases be interpreted with caution noting that the outcomes reflect an 85% survival rate to 30 days which is markedly better than the larger OOHCA with resuscitation group. This is reassuring and indicates that patient selection for PCI in this high-risk, critically unwell group is appropriate.

Variation exists among sites with OOHCA accounting for 0.9% to 3.0% of total PCI cases and a statewide proportion of 2.0%. In this group, death within 30 days of the PCI procedure in 2020 exclusively occurred in hospital.

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

Site	Total cases n	Proportion of total cases %
CH	5	0.9
TUH	4	1.1
MBH	2	0.7
SCUH	9	1.6
TPCH	23	2.5
RBWH	4	0.9
PAH	31	3.0
GCUH	21	2.6
STATEWIDE	**99**	**2.0**

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	**99**	**1**	**14**	**0**	**15 (15.2)**

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.[12]

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

Achieving these times requires efficient coordination of care within and between the ambulance service and transferring/receiving hospitals. Accepted strategies to improve reperfusion times include pre-hospital activation of the 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

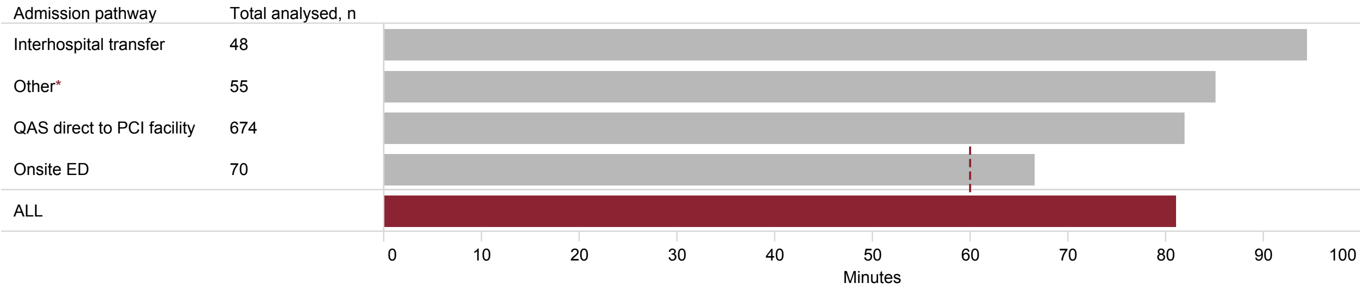
Time	Definition
First diagnostic ECG	First diagnostic ECG refers to the timestamp when the ECG shows ST-segment elevation (or equivalent) and can be regarded as time zero in the therapeutic pathway. The interpretation of the first diagnostic ECG may be undertaken by ambulance personnel, general practitioners 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)[14]

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 847 STEMI primary PCI cases presenting within six hours of symptom onset. Of these, there were 127 cases which had been excluded per the criteria in Table 37 leaving 720 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 95 minutes to 67 minutes for interhospital transfers and PCI facility onsite ED respectively.



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

Figure 27: 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	36 (28.3)
Out of hospital arrest	26 (20.5)
Previous CABG	15 (11.8)
Thrombolysis contraindicated	12 (9.4)
Significant comorbidities/frailty	11 (8.7)
Unsuccessful PCI	10 (7.9)
Intubation	5 (3.9)
Shock/acute pulmonary oedema	4 (3.1)
Transferred during significant non cardiac illness	1 (0.8)
Incomplete data	7 (5.5)
ALL	**127 (100.0)**

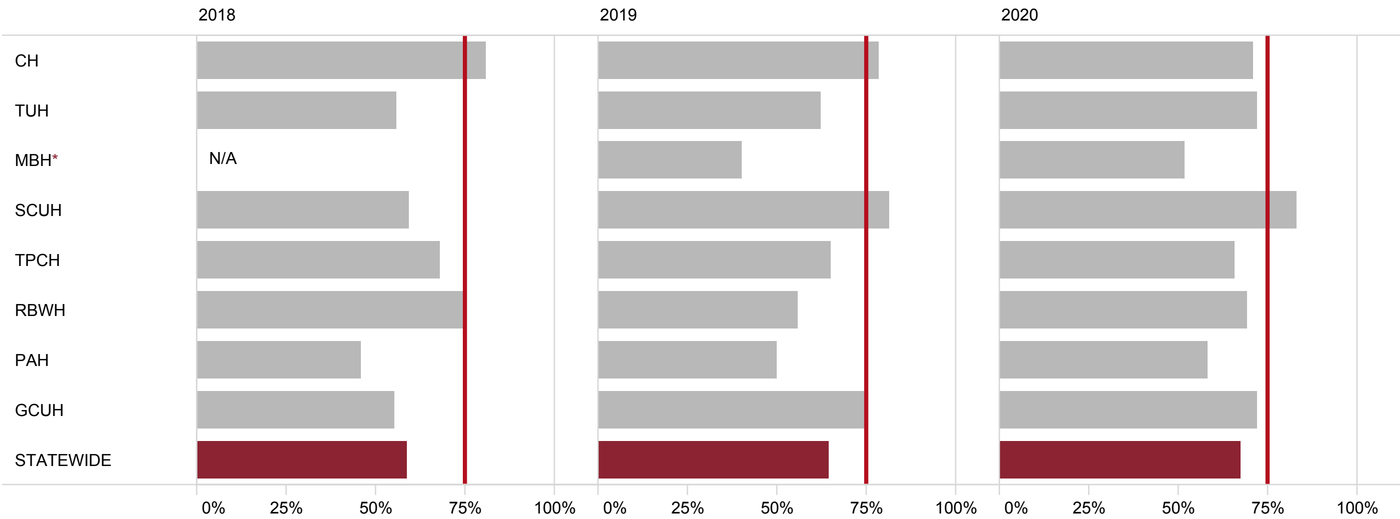
7.2.1 Time from first diagnostic ECG to first device

The all-site median time from first diagnostic ECG to reperfusion was 81 minutes, with median individual site times ranging from 75 minutes to 90 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 67% of patients analysed receive timely reperfusion per current guidelines (FdECG to reperfusion), 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	51	42	76	66–98	71.4
TUH	49	40	78	73–94	72.5
MBH	29	25	90	75–113	52.0
SCUH	90	77	75	62–86	83.1
TPCH	162	137	81	71–97	65.7
RBWH	60	52	77	62–101	69.2
PAH	232	197	87	75–108	58.4
GCUH	174	150	82	68–93	72.0
STATEWIDE	**847**	**720**	**81**	**69–98**	**67.4**



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

Figure 28: Proportion of STEMI cases (presenting within six hours of symptom onset) where time from first diagnostic ECG to reperfusion met 90 min target, 2018–2020

7.2.1.1 Pre-hospital notification processes

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

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

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

Some patients do not receive pre-hospital reperfusion therapy due to being contraindicated within the QAS reperfusion guidelines, and/or close proximity to a hospital, with some exceptions when patients refuse treatment.

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

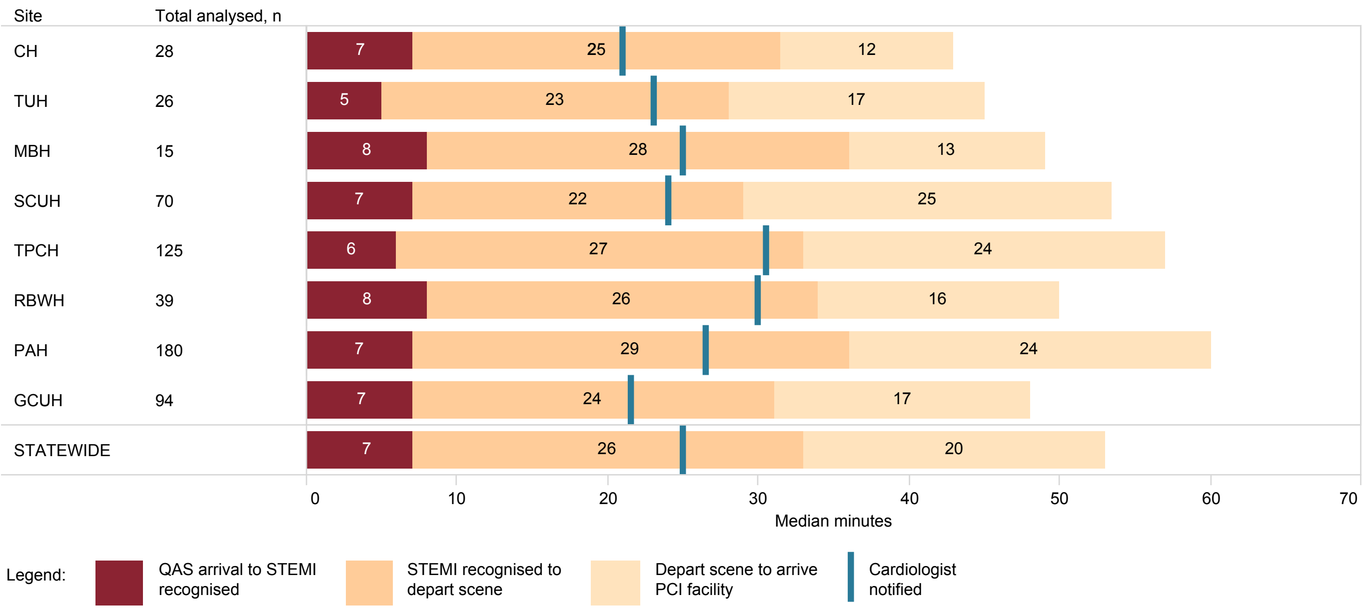


Figure 29: STEMI presenting within six hours of symptom onset pre-hospital component breakdown – QAS direct to PCI facility

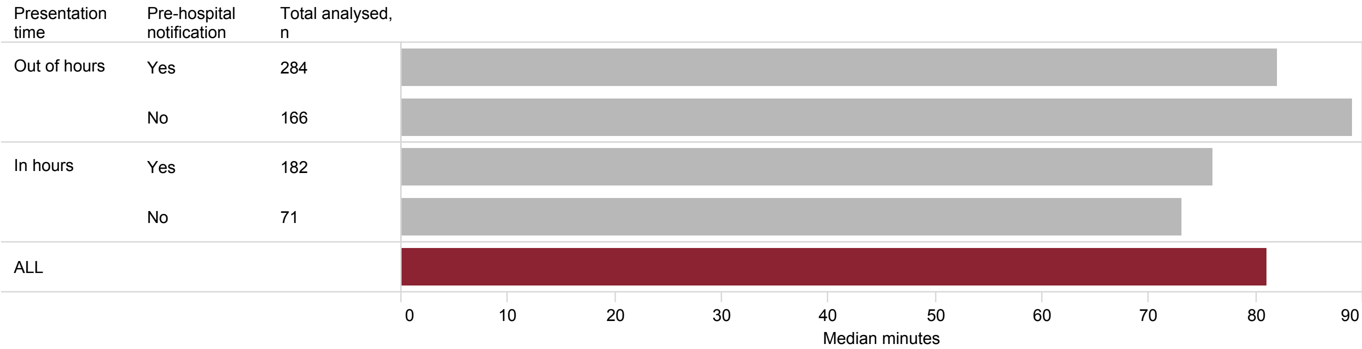
7.2.1.2 Hospital processes

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

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

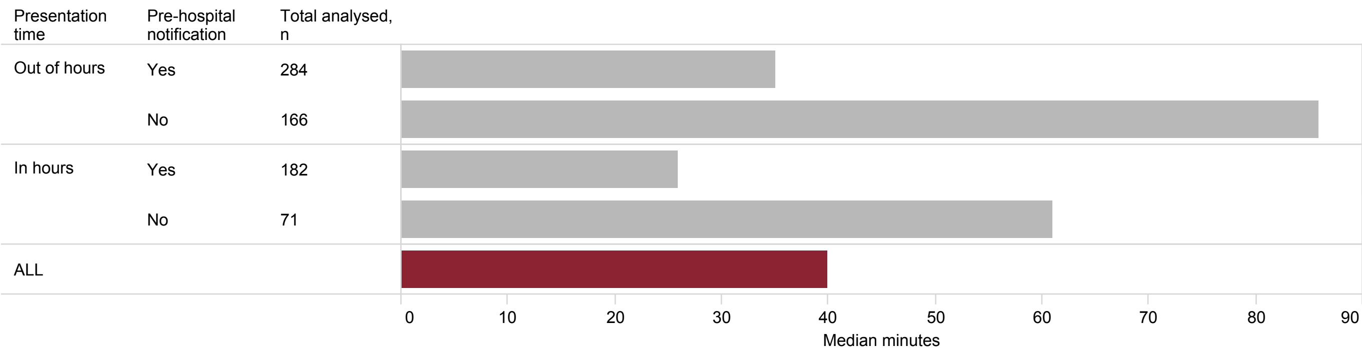
Total time to reperfusion was lowest in the in hours cohort. There was slight variation in median time to reperfusion when pre-hospital notification was examined. A small cohort size may explain the counterintuitive finding that patients without pre-hospital notification have a swifter time to reperfusion. An explanation for this could be the higher likelihood that pre-hospital notification is not utilised in cases where the patient is already in close proximity to the PCI facility, in which case the notification is provided to the PCI facility's onsite ED rather than the cardiologist. Another explanation may be that CCL resources are more often working at full capacity during regular business hours, resulting in delays.

When examining arrival at PCI facility to reperfusion, pre-hospital notification resulted in marked differences in system performance. Pre-hospital notification was associated with a 31 minute improvement for in hours cases and a 51 minute improvement for out of hours cases. These findings support the importance of pre-hospital notification and an efficient, systematic approach to patient care.



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

Figure 30: STEMI presenting within six hours of symptom onset – first diagnostic ECG to reperfusion by presentation time and pre-hospital notification



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

Figure 31: STEMI presenting within six hours of symptom onset – arrival PCI facility to reperfusion by presentation time and pre-hospital notification

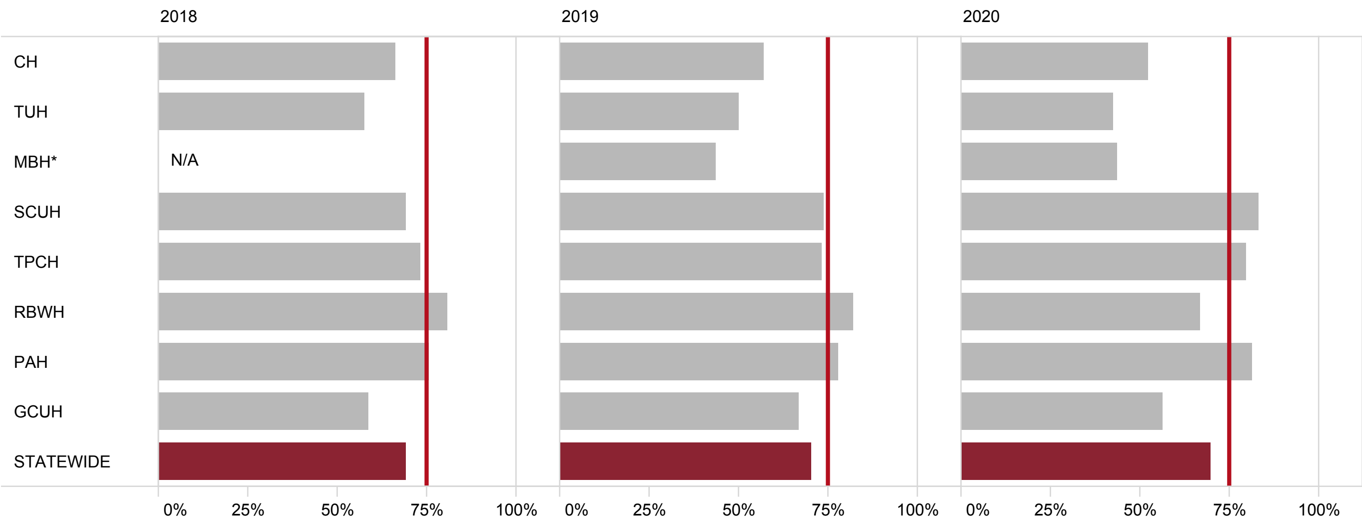
7.2.2 Time from arrival PCI capable facility to first device

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

Results demonstrate that for over two thirds of cases (70%), participating PCI facilities are meeting a target door-to-device time of less than 60 minutes, with an overall statewide median time of 40 minutes (ranging from 31 minutes to 69 minutes across sites). These results demonstrate incremental improvement over previous years (2019 median – 42 minutes), and three sites meeting the 75% benchmark target.

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

Site	Total cases n	Total analysed n	Median minutes	Interquartile range minutes	Met 60 min target %
CH	51	42	57	25–77	52.4
TUH	49	40	69	42–88	42.5
MBH	29	25	64	47–100	44.0
SCUH	90	77	31	21–43	83.1
TPCH	162	137	36	25–51	79.6
RBWH	60	52	37	27–68	67.3
PAH	232	197	34	26–50	81.7
GCUH	174	150	56	36–90	56.7
STATEWIDE	**847**	**720**	**40**	**27–67**	**70.0**



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

Figure 32: Proportion of cases where arrival at PCI hospital to first device ≤60 minutes was met for STEMI presenting within six hours of symptom onset, 2018–2020

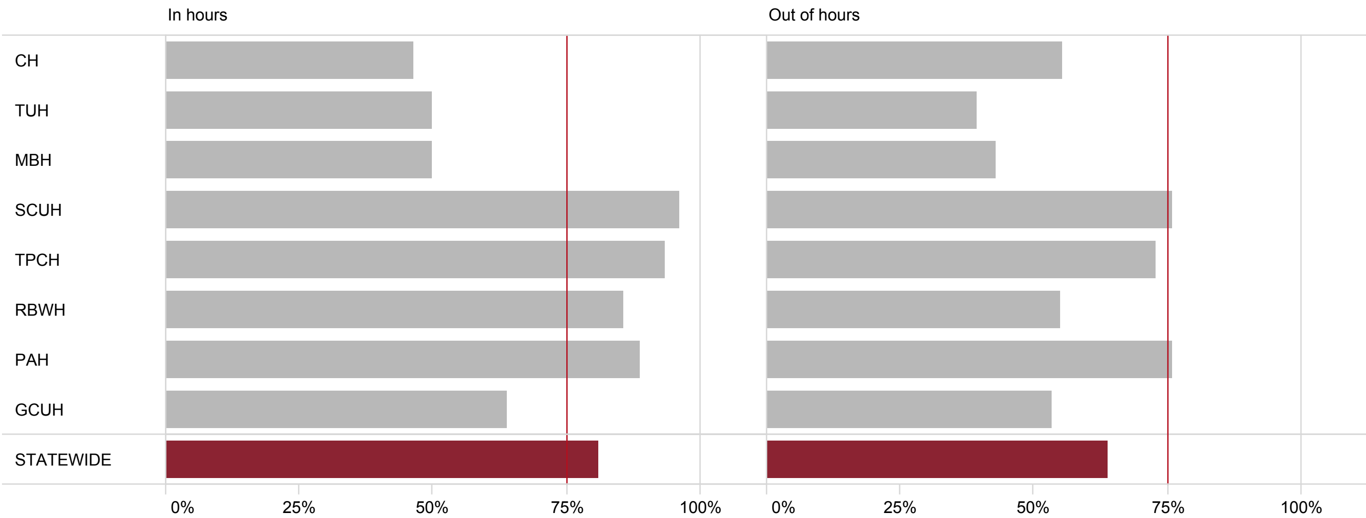
7.2.2.1 In hours versus out of hours presentation

The majority of cases (64%) presented out of hours. For the purpose of this analysis, business hours were defined as 8am–6pm, Monday to Friday, excluding public holidays. This high proportion of out of hours cases demonstrates the frequency at which teams are required to respond to these medical emergencies. Each out of hours case has its own logistical challenges and requires a whole-of-system approach to ensuring timely intervention. It is important to note that this analysis does not include all out of hours work performed by CCL teams with a wide and varied case mix regularly encountered.

When examining PCI hospital arrival and reperfusion, patient presentation in hours was associated with better performance. Over three quarters (81%) of cases met the door-to-device time target of 60 minutes in hours compared to 64% out of hours.

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

Site	Total analysed n	Proportion out of hours %	In hours median minutes	Out of hours median minutes	In hours target met %	Out of hours target met %
CH	42	69.0	61	54	46.2	55.2
TUH	40	70.0	64	74	50.0	39.3
MBH	25	84.0	51	66	50.0	42.9
SCUH	77	64.9	24	32	96.3	76.0
TPCH	137	67.2	27	38	93.3	72.8
RBWH	52	59.6	27	47	85.7	54.8
PAH	197	54.8	32	37	88.8	75.9
GCUH	150	68.7	42	57	63.8	53.4
STATEWIDE	**720**	**64.2**	**32**	**44**	**81.0**	**63.9**



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

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

7.2.2.2 Pre-hospital notification

Pre-hospital notification was utilised in two thirds (66%) of cases, with considerable variation observed among sites. Achievement of the benchmark of 75% of cases meeting the 60 minute target was achieved at all sites where pre-hospital notification was utilised. Statewide, the 60 minute timeframe was achieved in 93% of cases where there was pre-hospital notification compared to 27% without pre-hospital notification.

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

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

Site	Total analysed n	Proportion with pre-hospital notification %	Pre-hospital notification median minutes	No pre-hospital notification median minutes	Pre-hospital notification target met %	No pre-hospital notification target met %
CH	41	43.9	24	76	94.4	17.4
TUH	40	32.5	39	83	84.6	22.2
MBH	25	52.0	48	106	76.9	8.3
SCUH	76	81.6	28	80	98.4	21.4
TPCH	134	76.9	30	78	96.1	25.8
RBWH	52	65.4	31	76	91.2	22.2
PAH	197	79.2	31	77	93.6	36.6
GCUH	138	48.6	43	84	85.1	31.0
STATEWIDE	**703**	**66.3**	**32**	**81**	**92.7**	**26.6**

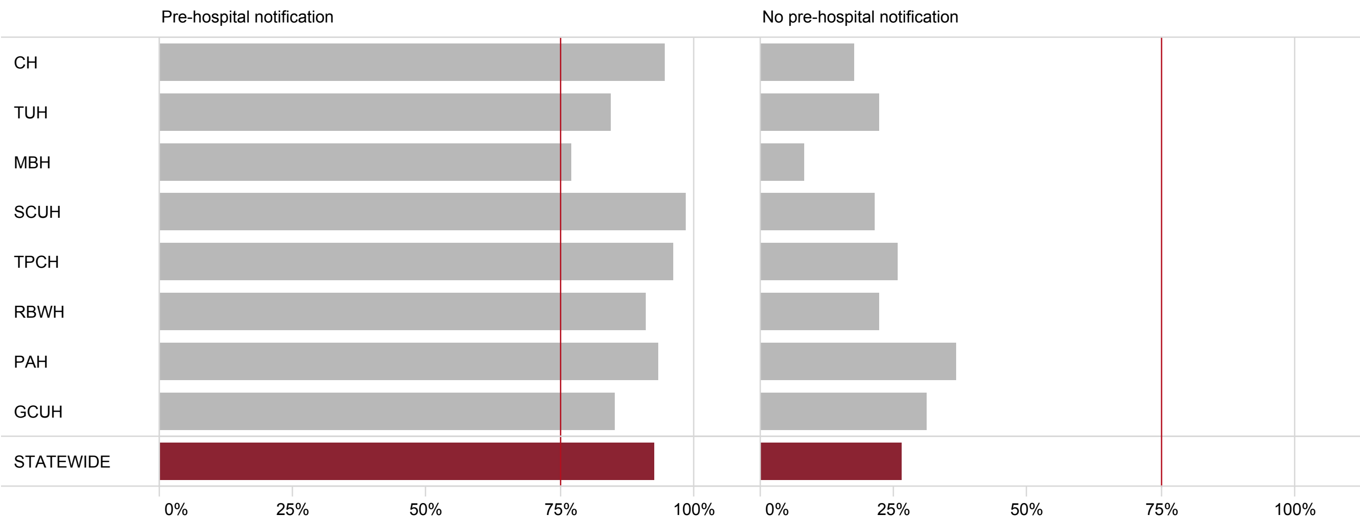


Figure 34: STEMI presenting within six hours of symptom onset – proportion of cases where arrival at PCI hospital to first device ≤60 minutes by site and pre-hospital notification

7.3 NSTEMI – time to angiography

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

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

A major barrier to 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 delay in referral to tertiary facility, capacity constraints and patient transfer logistics in a large geographic area. Many of these factors are more complicated to improve than changes to local practice or departmental efficiency.

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

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

	n
Planned or staged PCI	146
Admitted with an unrelated principal diagnosis	140
Transferred from an interstate hospital	48
Transferred from a private hospital	45
Stable non admitted patients transferred directly to lab for planned angiography	43
Coronary angiography not performed at index admission	28
Incomplete data	71
ALL	**521**

Patients presenting directly to a PCI capable facility had a median wait to coronary angiography time of 33 hours and were more likely to have angiography performed within the target timeframe of 72 hours compared with interhospital transfers (80% vs. 57%).

For direct presenters, the wide range of 21 hours to 50 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 2019, there was for direct presenters (Table 43) a sizeable increase in analysable NSTEMI cases (1,343 vs. 1,290) and an improved proportion meeting target (80% vs. 74%). While for interhospital transfers (Table 44), there was a slight decrease in analysable cases (1,343 vs. 1,356) but a reassuring increase in the proportion meeting the target (57% vs. 46%).

Table 43: Time to angiography – direct to PCI facility

Site	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	187	160	33	17–54	80.6
TUH	148	129	50	22–75	71.3
MBH	91	79	22	14–40	88.6
SCUH	164	159	31	17–61	82.4
TPCH	333	293	27	15–56	83.6
RBWH	122	103	21	13–40	89.3
PAH	226	195	33	18–62	80.5
GCUH	245	225	48	22–84	68.4
STATEWIDE	**1,516**	**1,343**	**33**	**17–65**	**79.7**

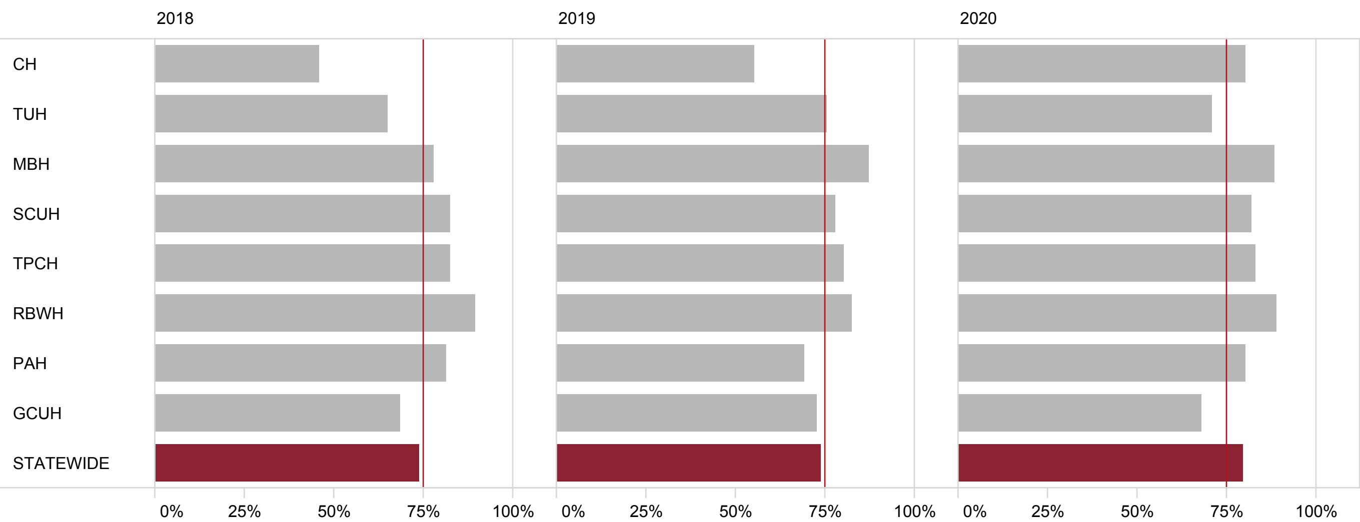


Figure 35: Proportion of NSTEMI direct presenters receiving angiography within 72 hours, 2018–2020

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

Table 44: Time to angiography – interhospital transfers

Site	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	143	102	47	31–75	72.5
TUH	85	63	66	42–96	55.6
MBH	59	43	32	24–50	83.7
SCUH	159	130	41	23–70	75.4
TPCH	293	242	78	48–128	46.7
RBWH	234	198	59	38–86	64.1
PAH	547	452	74	48–109	47.8
GCUH	145	87	53	29–105	62.1
STATEWIDE	**1,665**	**1,317**	**65**	**40–99**	**57.2**

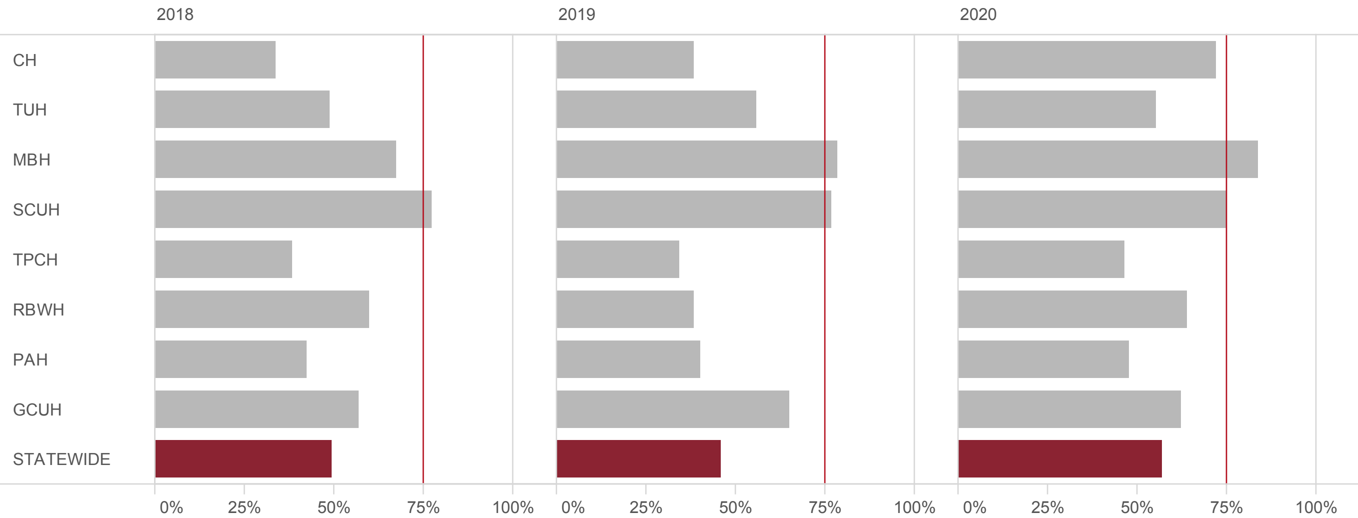


Figure 36: Proportion of NSTEMI interhospital transfers receiving angiography within 72 hours, 2018–2020

7.3.1 NSTEMI interhospital transfers – time to transfer to PCI facility

The median time to transfer NSTEMI patients to the PCI-capable facility for angiography was 35 hours, ranging from 6 hours to 56 hours by institution.

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

Once transferred to the PCI facility the median time from arrival to angiography being performed was 30 hours.

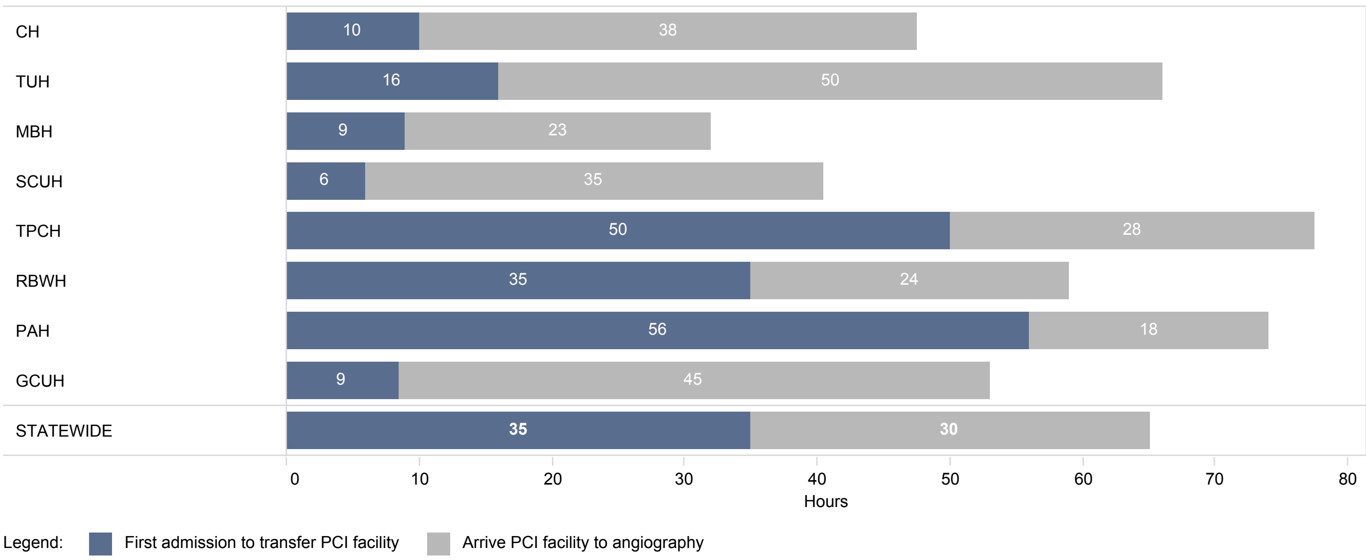


Figure 37: Median duration to transfer to PCI facility for angiography, NSTEMI interhospital transfers

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

Site	Total cases n	Total analysed n	Median (IQR) distance transferred kilometers	Median time to transfer to PCI facility hours	Median overall time to angiography hours
CH	143	102	93 (75–143)	10	47
TUH	85	63	302 (133–901)	16	66
MBH	59	43	125 (36–192)	9	32
SCUH	159	130	93 (30–93)	6	41
TPCH	293	242	39 (39–505)	50	78
RBWH	234	198	46 (45–611)	35	59
PAH	547	452	27 (24–122)	56	74
GCUH	145	87	17 (17–17)	9	53
STATEWIDE	**1,665**	**1,317**	**46 (27–217)**	**35**	**65**

Of the 3,181 total NSTEMI cases, 52% were interhospital transfers and 47% received PCI. The median time to angiography with or without PCI was 48 hours. This represents a considerable improvement on 2019 outcomes where the median time to angiography was 60 hours.

Table 46: NSTEMI time to angiography by site

Site	Total NSTEMI cases n	Total analysed n	Interhospital transfers %	Median hours	Interquartile range hours	Met 72 hour target %
CH	330	262	43.3	40	21–68	77.5
TUH	233	192	36.5	57	29–87	66.1
MBH	150	122	39.3	25	18–44	86.9
SCUH	323	289	49.2	35	20–63	79.2
TPCH	626	535	46.8	48	22–91	66.9
RBWH	356	301	65.7	47	23–75	72.8
PAH	773	647	70.8	63	38–99	57.7
GCUH	390	312	37.2	48	25–87	66.7
STATEWIDE	**3,181**	**2,660**	**52.3**	**48**	**24–83**	**68.5**

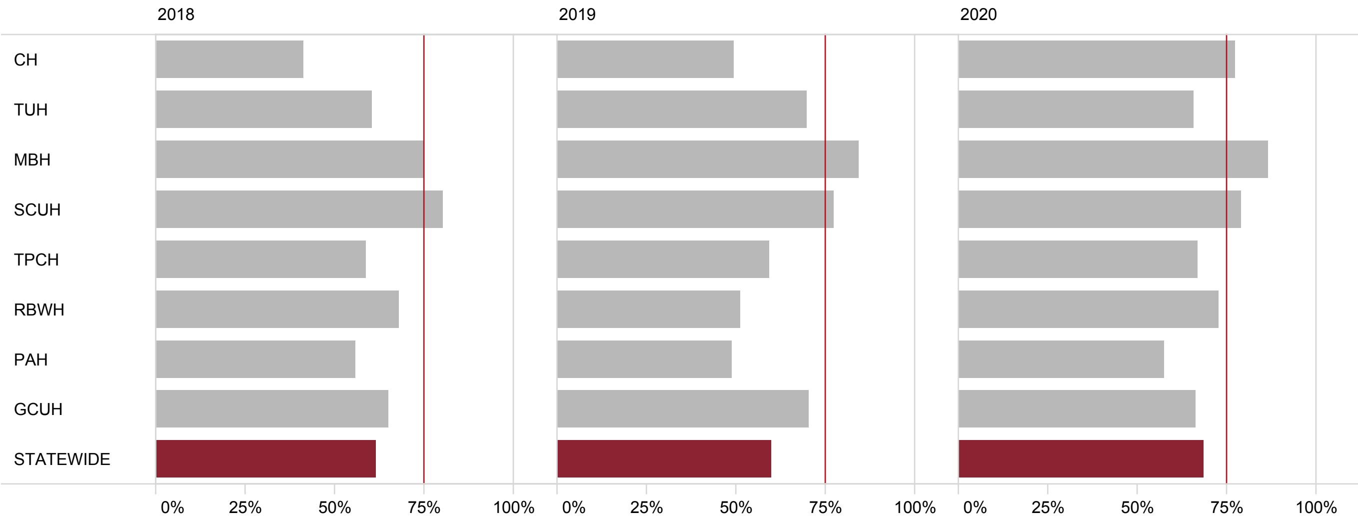


Figure 38: Proportion of NSTEMI cases meeting time to angiography target of 72 hours, 2018–2020

7.4 Major procedural complications

This quality indicator examines in-lab intra-procedural complications. In 2020, 47 cases (0.95%) recorded an immediate major procedural complication.

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

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

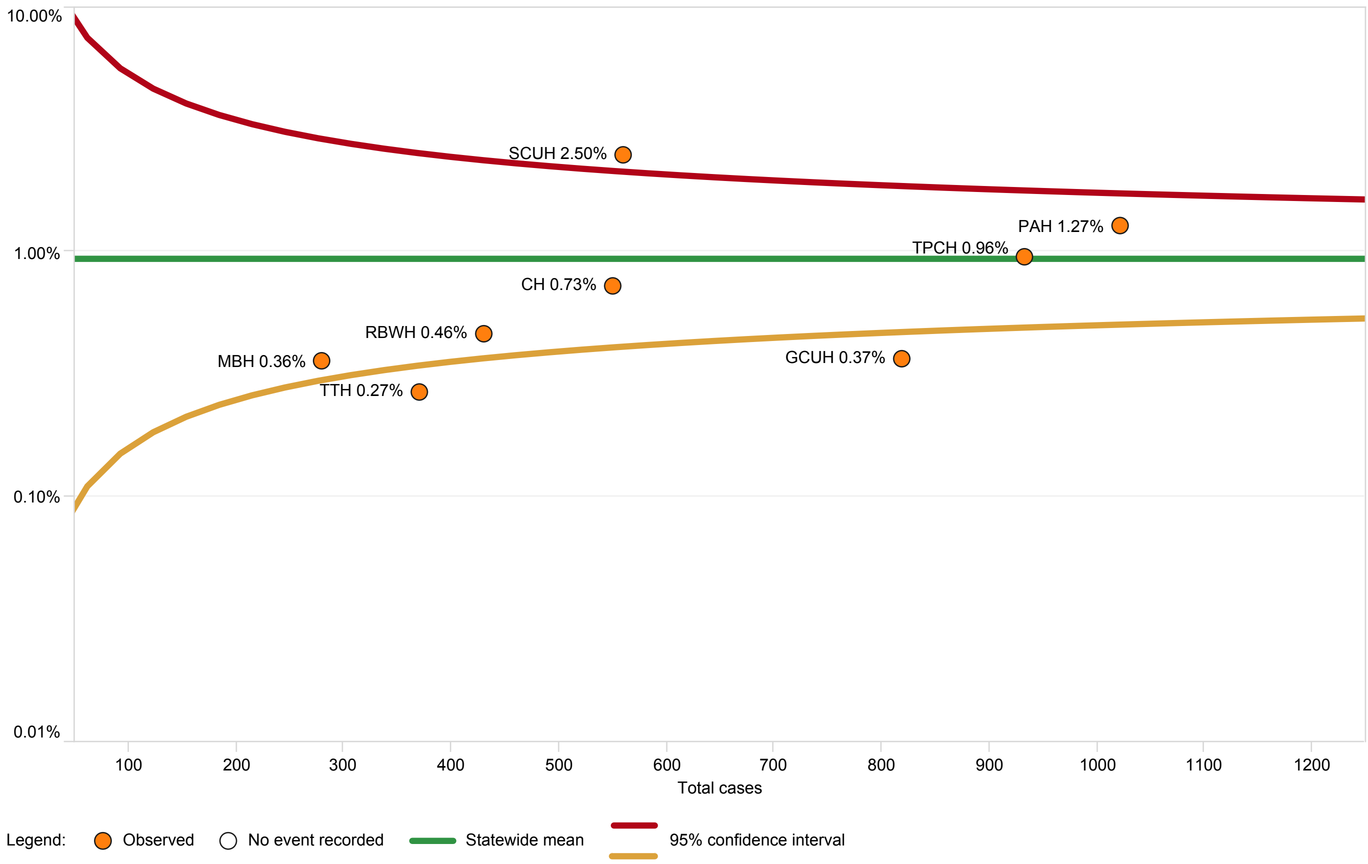


Figure 39: Proportion of PCI cases with immediate major procedure complication by site

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

Complication type	Case n	%
Major intra-procedural complication	**47**	**0.95**
Coronary artery perforation	30	0.61
In-lab death*	8	0.16
Emergency CABG	4	0.08
Tamponade	3	0.06
CVA	2	0.04
No immediate major procedural complication	4,919	99.05
ALL	**4,966**	

* Excluding salvage deaths

7.5 High radiation doses

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

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

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

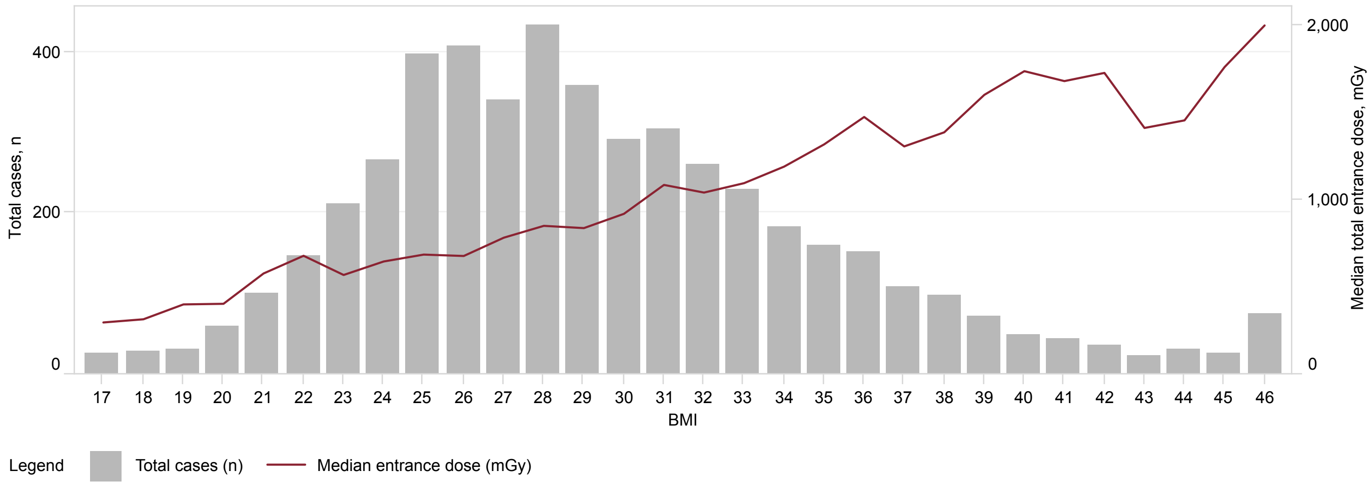


Figure 40: All coronary and PCI procedures median total entrance dose by body mass index

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

Site	**PCI procedures** %	**Other coronary procedures** %
CH	100.0	99.8
TUH	99.2	99.9
MBH	100.0	100.0
SCUH	99.6	100.0
TPCH	99.3	100.0
RBWH	99.8	100.0
PAH	97.2	99.9
GCUH	100.0	99.9
STATEWIDE	**99.2**	**99.9**

8 Supplement: Structural heart disease

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

The ability to collect quality SHD intervention data and participate in national registries relating to this specialty area has been a longstanding focus for Queensland cardiac clinicians. Procedures such as transcatheter aortic valve replacement (TAVR) offer an alternative to surgical interventions, often for patients with many comorbidities and complex chronic diseases. Thus the collection of data to monitor clinically appropriate outcomes is of great importance to ensure rigorous analysis and comparison of outcomes to international and national benchmarks.

Queensland clinicians have collaborated with QCOR to develop and implement a bespoke application for SHD interventions, allowing data to be recorded across the patient journey – from the pre-procedural phase and up to one year post discharge. As of November 2021, the QCOR SHD application has been deployed in five of the seven public hospitals offering SHD interventions. The new system has enabled enhanced data collection, as well as allowing clinicians to produce clinically relevant and encompassing documentation to form part of the patient medical record.

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

Table 1: QCOR SHD application go live dates

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

8.1 Participating sites

A total of 468 SHD interventions were performed across the seven Queensland public cardiac catheterisation laboratories. Two thirds (67%) of cases were valvular interventions including percutaneous valve replacement and valvuloplasty procedures.

Table 2: Total SHD cases by participating site

Site	Total cases n	Device closure* n (%)	Valvular intervention† n (%)	Other‡ n (%)
CH	26	20 (76.9)	5 (19.2)	1 (3.8)
TUH	32	6 (18.8)	26 (81.3)	–
SCUH	19	17 (89.5)	2 (10.5)	–
TPCH	222	21 (9.5)	190 (85.6)	11 (5.0)
RBWH	29	25 (86.2)	4 (13.8)	–
PAH	101	40 (39.6)	57 (56.4)	4 (4.0)
GCUH	39	9 (23.1)	29 (74.4)	1 (2.6)
STATEWIDE	**468**	**138 (29.5)**	**313 (66.9)**	**17 (3.6)**

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

† Percutaneous valve replacement and valvuloplasty

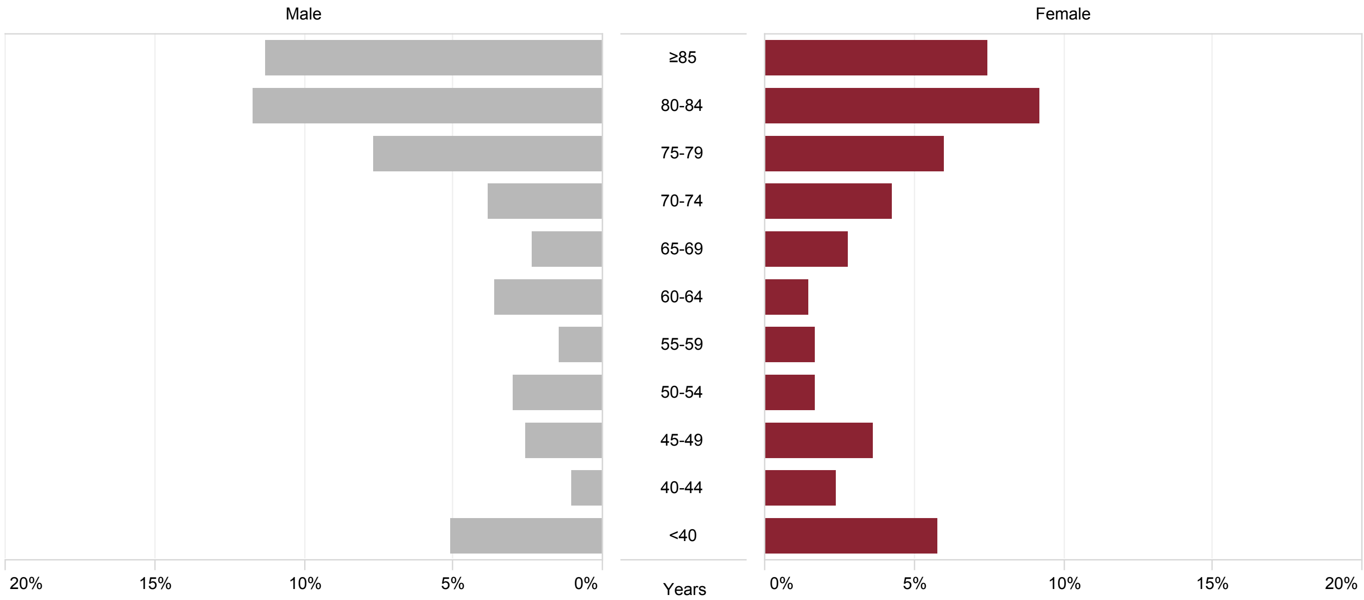
‡ Myocardial septal ablation and renal denervation

8.2 Patient characteristics

8.2.1 Age and gender

Gender of patients undergoing an SHD intervention were closely distributed with 54% male and 46% female. Almost one fifth (19%) 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 81 years compared to 46 years for device closure procedures.



% of total (n=468)

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

Table 3: Median age by gender and procedure category

	Male years	Female years	All years
Device closures	49	45	46
Valvular intervention	82	81	81
Other	68	69	68
Total	**78**	**75**	**76**

8.3 Care and treatment of SHD patients

8.3.1 Device closures

There were 138 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 81% and 15% of case volumes respectively.

Table 4: Device closure procedures by participating site

Site	Total cases n	PFO* n (%)	ASD† n (%)	PDA‡ n (%)	LAA§ n (%)
CH	20	18 (90.0)	2 (10.0)	–	–
TUH	6	5 (83.3)	1 (16.7)	–	–
SCUH	17	14 (82.4)	3 (17.6)	–	–
TPCH	21	12 (57.1)	4 (19.0)	3 (14.3)	2 (9.5)
RBWH	25	22 (88.0)	3 (12.0)	–	–
PAH	40	32 (80.0)	8 (20.0)	–	–
GCUH	9	9 (100.0)	–	–	–
STATEWIDE	**138**	**112 (81.2)**	**21 (15.2)**	**3 (2.2)**	**2 (1.4)**

* Patent foramen ovale

† Atrial septal defect

‡ Patent ductus arteriosus

§ Left atrial appendage

8.3.2 Valvular interventions

The total number of valvular interventions performed across the seven participating sites was 313, comprising of transcatheter valvuloplasty (18%) and transcatheter valve replacement (82%) procedures.

The aortic valve was the most common valve requiring intervention, accounting for 92% of cases.

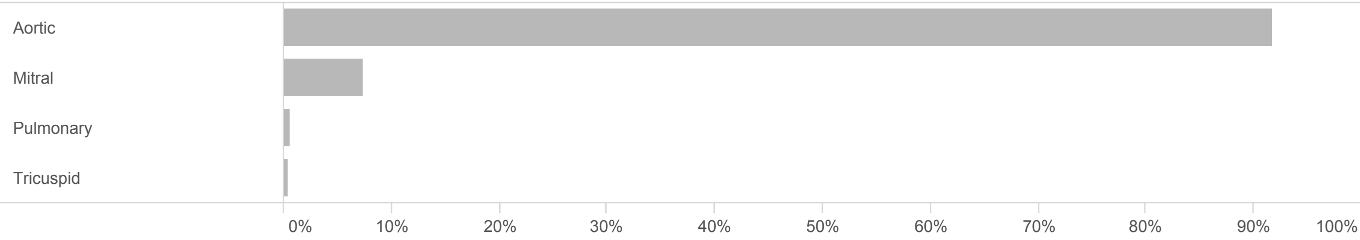


Figure 2: Proportion of all transcatheter valvular interventions by valve type

Table 5: Transcatheter valvular interventions by cardiac valve

Site	Total cases n	Aortic n (%)	Mitral n (%)	Pulmonary n (%)	Tricuspid n (%)
CH	5	5 (100.0)	–	–	–
TUH	26	22 (84.6)	4 (15.4)	–	–
SCUH	2	2 (100.0)	–	–	–
TPCH	190	168 (88.4)	19 (10.0)	2 (1.1)	1 (0.5)
RBWH	4	4 (100.0)	–	–	–
PAH	57	57 (100.0)	–	–	–
GCUH	29	29 (100.0)	–	–	–
STATEWIDE	**313**	**287 (91.7)**	**23 (7.3)**	**2 (0.6)**	**1 (0.3)**

Table 6: Transcatheter valvular interventions by type

Site	Total cases n	Transcatheter valvuloplasty n (%)	Transcatheter valve replacement n (%)
CH	5	5 (100.0)	–
TUH	26	5 (19.2)	21 (80.8)
SCUH	2	2 (100.0)	–
TPCH	190	33 (17.4)	157 (82.6)
RBWH	4	4 (100.0)	–
PAH	57	2 (3.5)	55 (96.5)
GCUH	29	6 (20.7)	23 (79.3)
STATEWIDE	**313**	**57 (18.2)**	**256 (81.8)**

The rapid evolution of transcatheter based technology has meant that transcatheter valve replacement procedures have become an increasing common approach for treating patients with conditions often otherwise reliant on conventional cardiac surgery. There were four sites which offered transcatheter valve replacement procedures where the vast majority were transcatheter aortic valve replacement (97%).

Table 7: Transcatheter valvuloplasty procedures

Site	Balloon aortic valvuloplasty n (%)	Balloon mitral valvuloplasty n (%)	Mitral leaflet clip n (%)	Balloon tricuspid valvuloplasty n (%)
CH	5 (100.0)	–	–	–
TUH	1 (20.0)	4 (80.0)	–	–
SCUH	2 (100.0)	–	–	–
TPCH	18 (54.5)	1 (3.0)	13 (39.4)	1 (3.0)
RBWH	4 (100.0)	–	–	–
PAH	2 (100.0)	–	–	–
GCUH	6 (100.0)	–	–	–
STATEWIDE	**38 (66.7)**	**5 (8.8)**	**13 (22.8)**	**1 (1.8)**

Table 8: Transcatheter valve replacement procedures

Site	TAVR* n (%)	TMVR† n (%)	TTVR‡ n (%)	TPVR§ n (%)
TUH	21 (100.0)	–	–	–
TPCH	150 (95.5)	5 (3.2)	–	2 (1.3)
PAH	55 (100.0)	–	–	–
GCUH	23 (100.0)	–	–	–
STATEWIDE	**249 (97.3)**	**5 (2.0)**	**0 (0.0)**	**2 (0.8)**

* Transcatheter aortic valve replacement/implantation

† Transcatheter mitral valve replacement

‡ Transcatheter tricuspid valve replacement

§ Transcatheter pulmonary valve replacement

Table 9: Other structural heart disease interventions

Site	Myocardial septal ablation n (%)	Percutaneous insertion of pulmonary arterial pressure monitoring device n (%)	Renal denervation n (%)
CH	–	–	1 (100.0)
TPCH	–	1 (9.1)	10 (90.9)
PAH	4 (100.0)	–	–
GCUH	–	–	1 (100.0)
STATEWIDE	**4 (23.5)**	**1 (5.9)**	**12 (70.6)**

8.4 Patient outcomes

8.4.1 All-cause 30 day mortality

Thirty day mortality rates typically reflect the success of the procedural or technical component of any intervention. Across the seven public cardiac catheterisation laboratories in Queensland that offer SHD interventions, the all-cause, unadjusted 30 day mortality rate was 1.1%. Incidence of 30 day mortality was exclusively encountered in the valvular intervention group. Further descriptions of longer term outcomes for TAVR cohorts from previous years are discussed further in the subsequent analysis.

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

Site	Total cases n	Device closure n (%)	Valvular intervention n (%)	Other n (%)	Total mortality n (%)
CH	26	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
TUH	32	0 (0.0)	0 (0.0)	–	0 (0.0)
SCUH	19	0 (0.0)	0 (0.0)	–	0 (0.0)
TPCH	222	0 (0.0)	4 (2.1)	0 (0.0)	4 (1.8)
RBWH	29	0 (0.0)	0 (0.0)	–	0 (0.0)
PAH	101	0 (0.0)	1 (1.8)	0 (0.0)	1 (1.0)
GCUH	39	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
STATEWIDE	**468**	**0 (0.0)**	**5 (1.6)**	**0 (0.0)**	**5 (1.1)**

8.4.2 All TAVR cases

Patients who undergo TAVR are typically of advanced age and usually present with multiple comorbidities and risk factors that may preclude them from surgical valve replacement. The most common indication for TAVR procedures is aortic valve stenosis, which is a well known disease that predominantly affects elderly patients and is associated with a poor prognosis and debilitating symptoms. Patients who are at prohibitive risk for surgical aortic valve replacement may be offered TAVR, with a valve prosthesis which is delivered percutaneously. Although survival rates at one year are similar for patients undergoing TAVR compared to those who have surgical valve replacement, neurologic events such as stroke are reported to be higher in the TAVR cohort.[15] This is balanced against the prospect of improved functional status and quality of life for patients who otherwise would not have been offered an intervention.

As such, risk scores often applied to patients who would otherwise undergo surgical intervention are high, reflective of these comorbidities.

International research and other registries report outcome and mortality data which is often stratified by procedural complexity and is risk adjusted. The PARTNER 2 trial examined intermediate risk patients with aortic valve stenosis and described a 30 day all-cause mortality rate of 3.9%, a one year all-cause mortality rate of 12.3% and two year all-cause mortality rate of 16.7%.[16] Large international registry findings support these outcomes with one year all-cause mortality rates of 20.7% to 28.0% reported.[17]

Furthermore, international registries also report decreases in technical complications related to TAVR procedures over time owing to the contemporary nature of these procedures and the challenges associated with establishing new TAVR services and care teams.[17]

We present all-cause unadjusted mortality at 30 days and one year without risk stratification or delineation of other confounding items such as device type, vascular approach or clinical status. As such, patients in our cohort are likely to fall into a higher risk category than those encountered in the PARTNER 2 trial, demonstrating the high degree of case complexity encountered with this local patient group.[16] This is further illustrated by the median age of the 2018 and 2019 cohorts which was 84 years and 83 years respectively.

2020 cases

Of the four sites performing TAVR in 2020, the overall all-cause unadjusted mortality rate within 30 days of the procedure was 1.2%.

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

Site	Total cases n	30 day mortality n (%)
TUH	21	0 (0.0)
TPCH	150	2 (1.3)
PAH	55	1 (1.8)
GCUH	23	0 (0.0)
STATEWIDE	**249**	**3 (1.2)**

2019 and 2018 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%, and 12.0% at one year. For the TAVR procedures performed in 2018, the overall all-cause unadjusted mortality rate at two years post procedure was 13.5%.

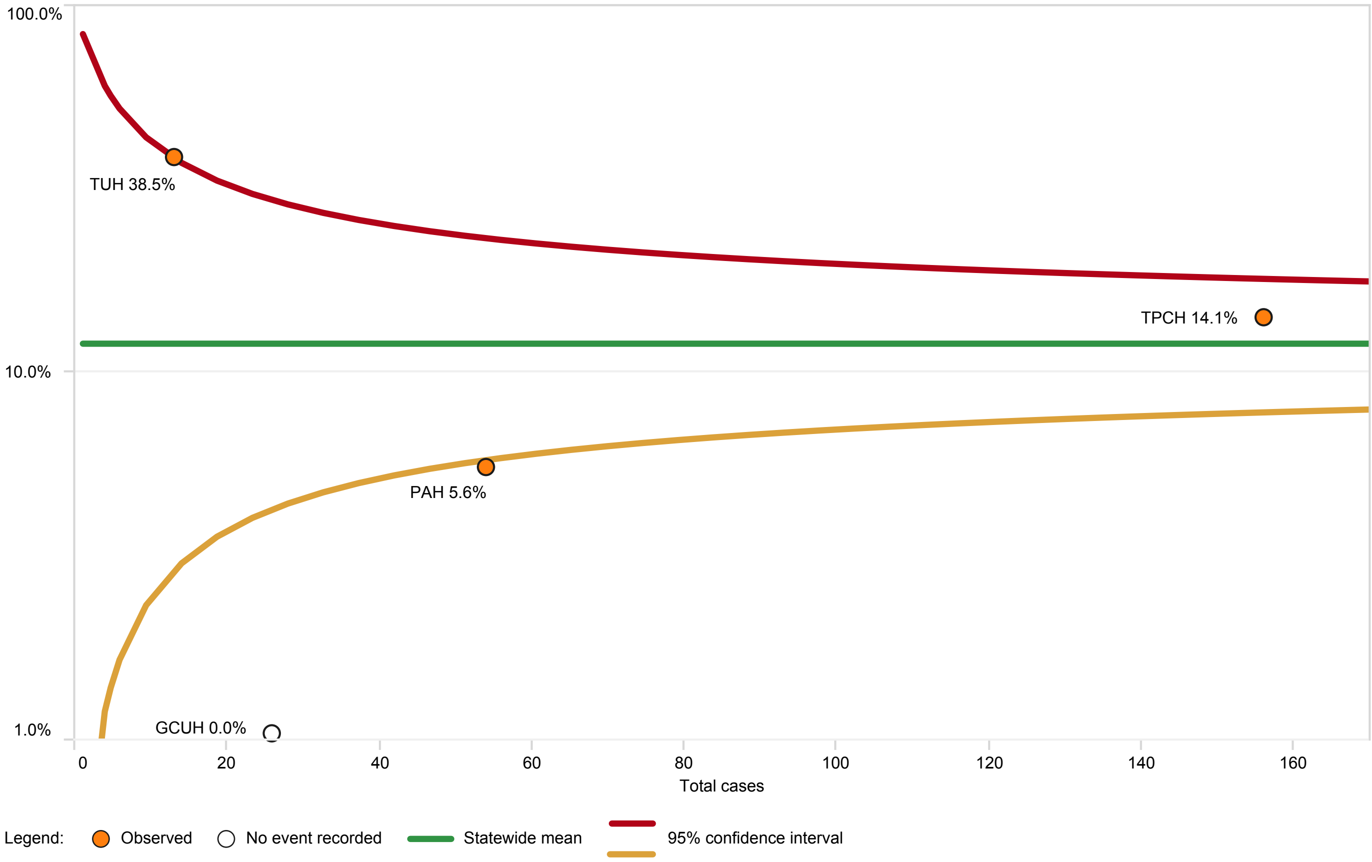


Figure 3: One year mortality post TAVR by site (2019 cohort)

Table 12: One year mortality post TAVR by site (2019 cohort)

Site	Total cases n	30 day mortality n (%)	1 year mortality n (%)	Median age at procedure years	Interquartile range years
TUH	13	0 (0.0)	5 (38.5)	82	76–87
TPCH	156	5 (3.2)	22 (14.1)	82	78–86
PAH	54	0 (0.0)	3 (5.6)	81	78–84
GCUH	26	0 (0.0)	0 (0.0)	84	79–86
STATEWIDE	**249**	**5 (2.0)**	**30 (12.0)**	**83**	**77–85**

Table 13: All-cause unadjusted mortality up to 2 years post TAVR by site (2018 cohort)

Site	Total cases n	30 day mortality n (%)	1 year mortality n (%)	2 year mortality n (%)	Median age at procedure years	Interquartile range years
TUH	3	0 (0.0)	0 (0.0)	0 (0.0)	78	76–80
TPCH	93	1 (1.1)	8 (8.6)	13 (14.0)	85	79–88
PAH	33	1 (3.0)	5 (15.2)	5 (15.2)	84	80–87
GCUH	19	0 (0.0)	1 (5.3)	2 (10.5)	84	76–86
STATEWIDE	**148**	**2 (1.4)**	**14 (9.5)**	**20 (13.5)**	**84**	**78–85**

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Glossary

6MWT	Six Minute Walk Test
ACC	Aristotle Comprehensive Complexity
ACEI	Angiotensin Converting Enzyme Inhibitor
ACP	Advanced Care Paramedic
ACS	Acute Coronary Syndromes
AEP	Accredited Exercise Physiologist
ANZCORS	Australia and New Zealand Congenital Outcomes Registry for Surgery
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
AQoL	Assessment of Quality of Life
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
COVID-19	Coronavirus disease 2019
CI	Clinical Indicator
CPB	Cardiopulmonary Bypass
CR	Cardiac Rehabilitation
CRT	Cardiac Resynchronisation Therapy
CS	Cardiac Surgery
CVA	Cerebrovascular Accident
DAOH	Days Alive and Out of Hospital
DES	Drug Eluting Stent
DOSA	Day of Surgery Admission
DSWI	Deep Sternal Wound Infection
ECG	12 lead Electrocardiograph
ECMO	Extracorporeal membrane oxygenation
ED	Emergency Department
eGFR	Estimated Glomerular Filtration Rate
EP	Electrophysiology
FdECG	First Diagnostic Electrocardiograph
FMC	First Medical Contact
FTR	Failure to Rescue
GAD	Generalized Anxiety Disorder
GCCH	Gold Coast Community Health
GCS	Glasgow Coma Scale
GCUH	Gold Coast University Hospital
GLH	Gladstone Hospital
GP	General Practitioner
GYH	Gympie Hospital
HBH	Hervey Bay Hospital (includes Maryborough)
HCC	Health Contact Centre
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HFSS	Heart Failure Support Service
HHS	Hospital and Health Service
HOCM	Hypertrophic Obstructive Cardiomyopathy
HSQ	Health Support Queensland
IC	Interventional Cardiology
ICD	Implantable Cardioverter Defibrillator
IE	Infective Endocarditis
IHT	Interhospital Transfer
IPCH	Ipswich Community Health
IVDU	Intravenous Drug Use
LAA	Left Atrial Appendage
LAD	Left Anterior Descending Artery
LCX	Circumflex Artery
LGH	Logan Hospital
LOS	Length Of Stay
LV	Left Ventricle
LVEF	Left Ventricular Ejection Fraction
LVOT	Left Ventricular Outflow Tract
MBH	Mackay Base Hospital
MI	Myocardial Infarction
MIH	Mt Isa Hospital
MKH	Mackay Base Hospital
MRA	Mineralocorticoid Receptor Antagonists
MSSA	Methicillin Susceptible Staphylococcus Aureus
MTHB	Mater Adult Hospital, Brisbane
NCDR	The National Cardiovascular Data Registry

NCR	National Cardiac Registry
NCS	Networked Cardiac Services
NP	Nurse Practitioner
NRBC	Non-Red Blood Cells
NSTEMI	Non-ST Elevation Myocardial Infarction
OR	Odds Ratio
OOHCA	Out of Hospital Cardiac Arrest
ORIF	Open Reduction Internal Fixation
PAH	Princess Alexandra Hospital
PAPVD	Partial Anomalous Pulmonary Venous Drainage
PCI	Percutaneous Coronary Intervention
PDA	Patent Ductus Arteriosus
PFO	Patent Foramen Ovale
PHQ	Patient Health Questionnaire
PICU	Paediatric intensive care unit
PROMS	Patient Reported Outcome Measures
QAS	Queensland Ambulance Service
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
SMoCC	Self Management of Chronic Conditions
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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