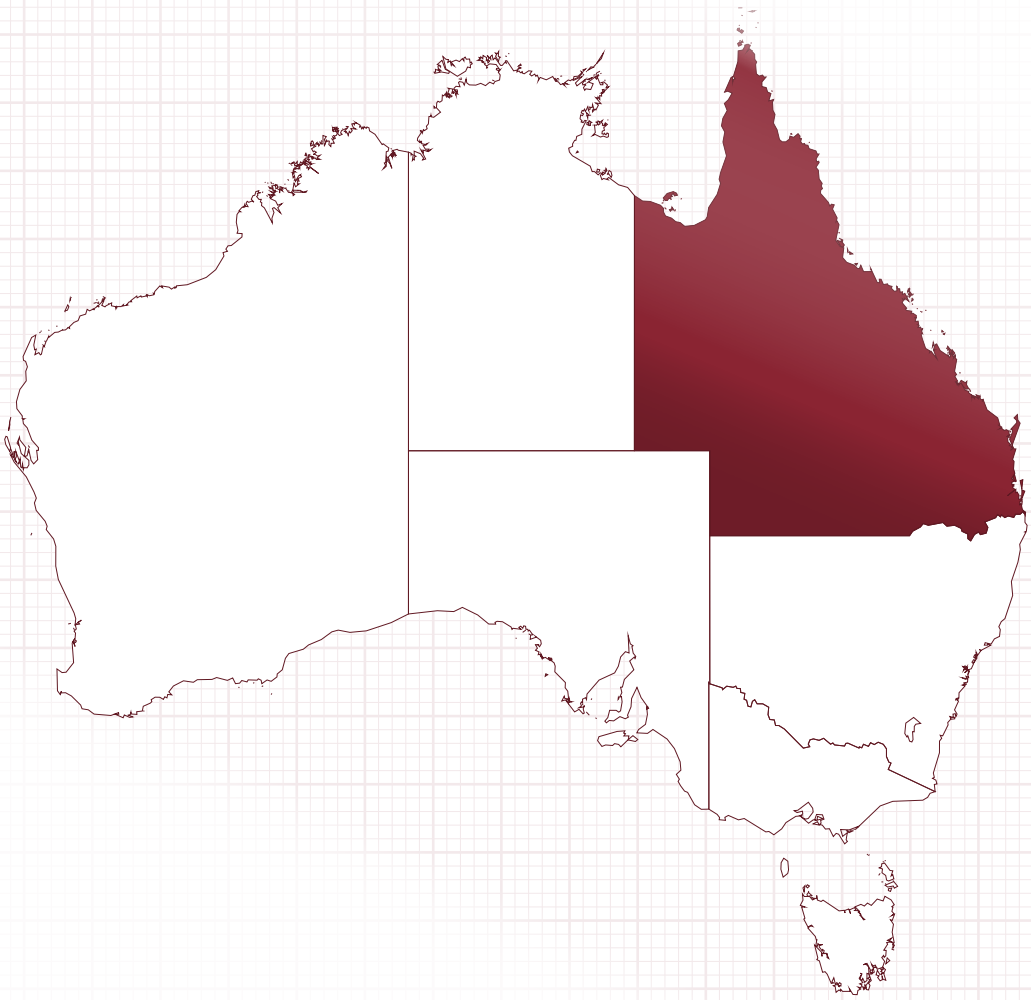
Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry
2018 Annual Report
Interventional Cardiology Audit



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Queensland Government

Queensland Cardiac Outcomes Registry
2018 Annual Report

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For more information contact:
Statewide Cardiac Clinical Network,
Queensland Health, GPO Box 48, Brisbane Qld 4001,
email **scciu@health.qld.gov.au**,
15 Butterfield St, Herston Qld 4006, phone **3328 9771**
for **Statewide Cardiac Clinical Network**.

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1 Foreword

Dr John Wakefield PSM
Director-General
Queensland Health

As Director General of Queensland Health, I am pleased to present the ***Queensland Cardiac Outcomes Registry (QCOR) 2018 Annual Report***. The Annual Report provides detailed information on the performance of our clinical care for, and outcomes of, people with cardiac disorders.

The Annual Report examines a range of clinical areas including cardiac and thoracic surgery, cardiac rehabilitation, cardiac catheter interventions, electrophysiology and pacing, and heart failure support services. This year's Annual Report includes additional analysis of specific areas of interest to enable examination of clinical issues faced by practitioners at the face of patient care.

The Annual Report exemplifies how Queensland Health is meeting its objective to *enable safe, high quality services*. The results show that Queenslanders are receiving some of the best cardiac care in the country, and often the world. 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.

The high level of clinical engagement extends beyond clinical practice to working collaboratively with Queensland Health administrators to improve the efficiency of our organisation. Recently, cardiac clinicians and administrators collaborated and used QCOR data to improve the purchasing process of clinical products resulting in savings of $5 million. These funds will now be available in the relevant Hospital and Health Services to reinvest into patient care.

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

I would like to acknowledge the ongoing effort of the Statewide Cardiac Clinical Network and its many clinicians and colleagues, who have collaborated to produce this Annual Report.

2 Message from the SCCN Chair

It is my pleasure to introduce the 4th Queensland Cardiac Outcome Registry (QCOR) Annual Report. The activities of QCOR continue to mature, and this report gives us yet another opportunity to re-examine the reasons for continuing this work, as well as forming a stimulus to reinvigorate our efforts. The chance to ask, "Why are we doing this?" – a lot of effort, repeated committee meetings, some late nights, and occasional irritation with colleagues, as a counterpoise to the ingrained clinician desire to do the absolute best for every patient we care for and to have data to prove it. The ledger is strongly tilted in the affirmative.

Queensland is now acknowledged as having some of the most comprehensive cardiac data in the country, and the success of this program absolutely rests on the sustained clinician participation on which the programme is built. Every step from patient care, through recording of data, to submission, reverification and analysis is heavily invested by the clinicians. This intensive participation towards a common goal has certainly drawn the cardiac community together and we can be rightly proud of the cohesiveness of the efforts to improve care across the state.

The report this year further extends important elements of patient care – we have a strong collaboration with Queensland Ambulance Service (QAS), and now have access to quite comprehensive prehospital care including QAS administered thrombolysis and outcomes. In a state as large as Queensland it is critical that we track these important aspects of care. The documentation of post hospital cardiac rehabilitation and heart failure management continues to provide a more comprehensive picture extending the window of acute admission and without doubt adding to the safety of our acute interventions.

It is gratifying to see that procedural outcomes across all of the participating institutions remain stable and of high quality.

Finally, one of the important reasons which clinicians originally identified supporting participation in the program has come to fruition – the cardiac data derived from QCOR has now led to specific investment by the state government in the processes of cardiac care. In the coming year, in an initial investment roll out, hospitals in Cairns and Townsville will significantly expand their outreach into rural and remote centres in Torres and Cape and across to the North West Hospital and Health Service. QCOR data has clearly profiled both the need and the shortfall of cardiac services in these areas and has led to a recognition of our responsibilities for delivering safe and efficacious treatment both for patients who live close to major centres, but also especially for those far removed. This programme will extend to the remaining Hospital and Health Services in a multi-year investment.

Again, I give thanks to all of the clinicians who continue to participate in this important work. In the coming year, QCOR will have the capacity to invite private cardiac providers in the state to submit data to QCOR, so that we can obtain a more complete picture both public and private, of cardiac services across the state.

A special thanks is given to the Statewide Cardiac Clinical Informatics Unit technical and administrative staff who continue to supply superb assistance to the program and who are truly integral to the quality of the attached report.

Dr Paul Garrahy
Chair
Statewide Cardiac Clinical Network

3 Introduction

The Queensland Cardiac Outcomes Registry (QCOR) is an ever-evolving clinical information collection which enables clinicians and other key stakeholders access to quality, contextualised clinical and procedural data. On the background of significant investment and direction from the Statewide Cardiac Clinical Network (SCCN) and under the auspices of Clinical Excellence Queensland, QCOR provides analytics and overview for several clinical information systems and databases. By utilising extensive ancillary complementary administrative datasets, a sophisticated level of multi-purpose reporting and insight has been gained.

QCOR data collections are governed by bespoke clinical committees which provide oversight and direction to reporting content and analysis as well as informing decision-making for future endeavours. These committees are supported by Statewide Cardiac Clinical Informatics Unit (SCCIU) who form the business unit of QCOR. All processes and groups report to the SCCN, which is facilitated by Clinical Excellence Queensland.

The strength of the Registry would not be possible without significant clinician input. Assisting to maintain quality, relevance and context through QCOR committees, clinicians are continually developing and evolving the analysis and focus of each specific group. The SCCIU performs the role of coordinating these individual QCOR committees which each have their individual direction and unique requirements.

The SCCIU provide the reporting, analysis, and development of the many clinical cardiology and cardiothoracic surgical applications and systems in use across Queensland Health. The SCCIU also provides data quality and audit functions as well as expert technical and informatics resources for development, maintenance and continual improvement of specialised clinical applications and relevant secondary uses.

The SCCIU team consists of:

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

This 2018 QCOR report now includes a total of 6 clinical audits. The addition of the thoracic surgery audit report complements the existing cardiac surgery report to enable a clearer picture of the work undertaken by cardiac and thoracic surgeons in Queensland. This work reflects efforts in this space and the highlights the vast patient cohort that are encountered by clinicians working in this specialty. It is with this continual development and evolution of clinical reporting maturity that QCOR hopes to further support cardiothoracic clinical informatics into the future.

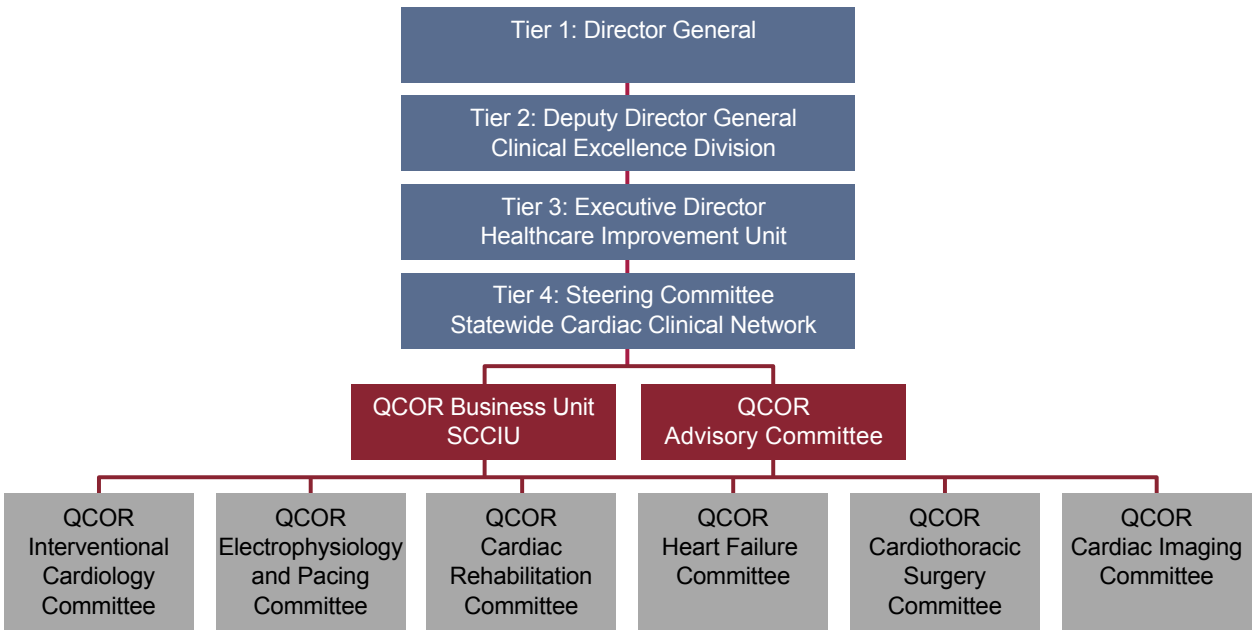
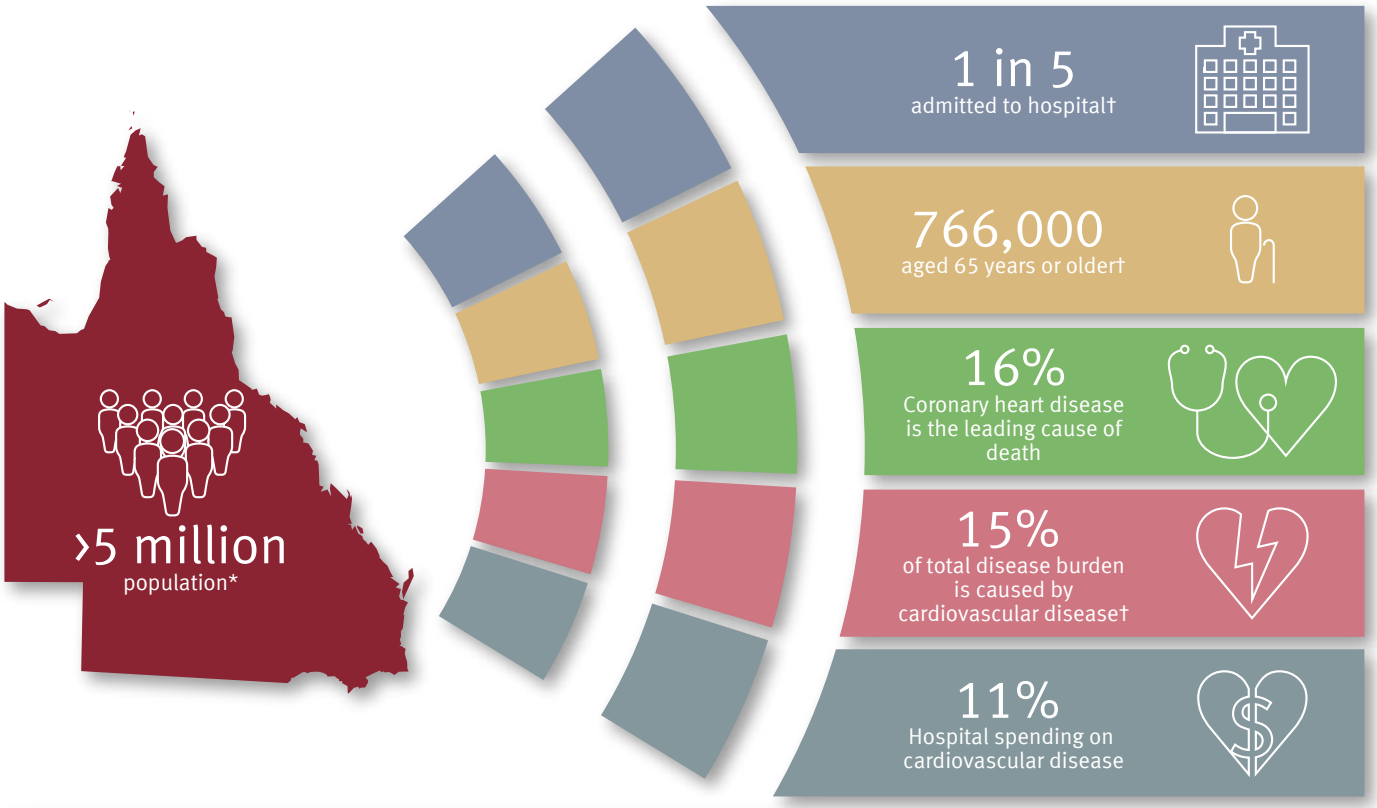


Figure A: Operational structure

Queensland Cardiac Outcomes Registry

The health of Queenslanders



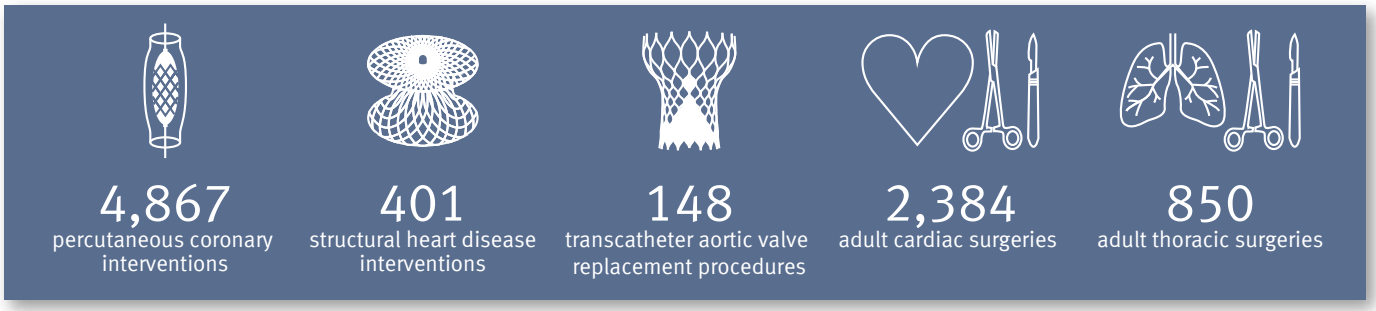
What's new?

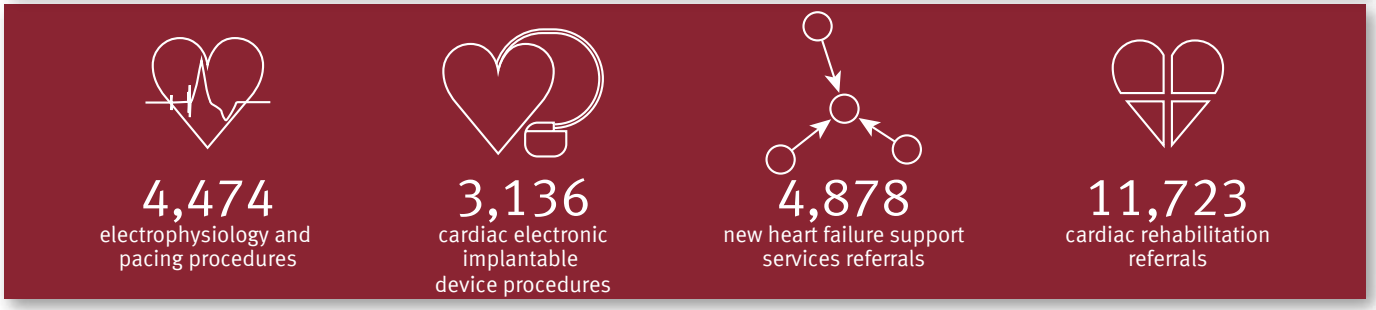
- Thoracic Surgery Audit
- Interhospital transfer for coronary intervention review
- Electrophysiology and pacing clinical indicators
- Cardiac rehabilitation patient outcome measures
- Thrombolysis for STEMI analysis
- Body mass index in cardiac surgery investigation

Figure B: QCOR 2018 infographic

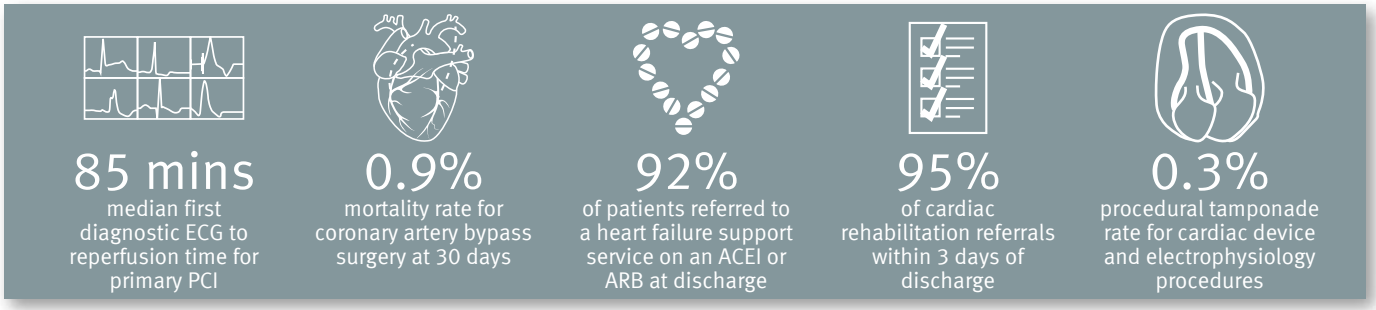
2018 Activity at a Glance

Case and patient volumes





Clinical indicator progress



Continuing our work

- Data linkage opportunities
- National registry alignment
- Clinical indicator review
- Structural heart disease application
- Cardiac outreach application
- ECG Flash project

* Australian Bureau of Statistics. Regional population growth, Australia, 2017-2018. Cat. no. 3218.0. ABS:Canberra; 2019

† Queensland Health (2018).The health of Queenslanders 2018. Report of the Chief Health Officer Queensland. Brisbane. Queensland Government

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

§ Diabetes Australia. State statistical snapshot: Queensland. As at 30 June 2018; 2018

4 Executive summary

This report encompasses procedures and cases for 8 cardiac catheterisation laboratories (CCL) and electrophysiology and pacing (EP) facilities and 5 cardiothoracic surgery units operating across Queensland public hospitals. It also includes referrals to clinical support and rehabilitation services for the management of heart disease including 22 heart failure support services and 55 cardiac rehabilitation outpatient facilities.

- 15,436 diagnostic or interventional cases were performed across the 8 public cardiac catheterisation laboratory facilities in Queensland hospitals. Of these, 4,867 involved percutaneous coronary intervention (PCI).
- Patient outcomes following PCI remain encouraging. The 30 day mortality rate following PCI was 1.9%, and of the 94 deaths observed, 74% were classed as either salvage or emergency PCI.
- In analysis for patients with STEMI, the median time from FdECG to reperfusion and arrival at PCI facility to reperfusion was observed at 85 minutes and 42 minutes. This compares favourably to results for previous years and internationally.
- Across the four sites with a cardiac surgery unit, a total of 2,384 cases were performed including 1,414 CABG and 1,005 valve procedures.
- As in previous years, 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. Once again the exception was the rate of deep sternal wound infection.
- The Cardiac Surgery Audit includes a focused supplement on obesity in cardiac surgery. This report highlights the increased rate of post-operative morbidity and mortality for patients with a higher BMI (>30 kg/m^2).
- The five public hospitals providing thoracic surgery services in 2018 performed a total of 850 cases. Almost one-third (30%) of surgeries followed a preoperative diagnosis of primary lung cancer or pleural disease (33%). This is the first QCOR Annual Report to examine thoracic surgery, and this will be expanded in future years.
- At the 8 public EP sites, a total of 4,474 cases were performed, which included 3,136 cardiac device procedures and 1,061 electrophysiology procedures. This audit includes expanded reporting around clinical indicators for EP cases.
- This Electrophysiology and Pacing Audit identified a median wait time of 81 days for complex ablation procedures, and 33 days for elective ICD implants.
- There were a total of 11,723 referrals to one of the 55 public cardiac rehabilitation services in 2018. Most referrals (77%) followed an admission at a public hospital in Queensland.
- The vast majority of referrals to CR were created within three days of the patient being discharged from hospital (95%), while over half of patients went on to complete an initial assessment by CR within 28 days of discharge (59%).
- There were 4,878 new referrals to a heart failure support service in 2018. Clinical indicator benchmarks were achieved for timely follow-up of referrals, and prescription of angiotensin-converting-enzyme inhibitor (ACEI) or angiotensin II receptor blockers (ARB) and appropriate beta blockers as per clinical guidelines.

5 Acknowledgements and authors

This collaborative report was produced by the SCCIU, audit lead for QCOR for and on behalf of the Statewide Cardiac Clinical Network.

The work of QCOR would not be possible without the continued support and funding from Clinical Excellence Queensland. This publication draws on the expertise of many teams and individuals. In particular, the assistance of the Statistical Services Branch, Healthcare Improvement Unit and Queensland Ambulance Service each make significant contributions to ensure the success of the program. Metro North Hospital and Health Service are also recognised through their stake in supporting and hosting the SCCIU operational team.

Furthermore, the tireless work of clinicians who contribute and collate quality data, as part of providing quality patient care, ensures credible analysis and monitoring of the standard of cardiac services in Queensland. The following provided writing assistance with this year's report:

Interventional Cardiology

Dr Sugeet Baveja
- The Townsville Hospital

Dr Niranjan Gaikwad
- The Prince Charles Hospital

Dr Christopher Hammett
- Royal Brisbane and Women's Hospital

A/Prof Richard Lim
- Princess Alexandra Hospital

Dr Rohan Poulter
- Sunshine Coast University Hospital

A/Prof Atifur Rahman
- Gold Coast University Hospital

Dr Shantisagar Vaidya
- Mackay Base Hospital

Dr Gregory Starmer (Chair)
- Cairns Hospital

Queensland Ambulance Service

Dr Tan Doan, PhD

Mr Brett Rogers

Cardiothoracic Surgery

Dr Anil Prabhu
- The Prince Charles Hospital

Dr Andrie Stroebel
- Gold Coast University Hospital

Dr Morgan Windsor
- Royal Brisbane and Women's Hospital
- The Prince Charles Hospital

Dr Sumit Yadav
- The Townsville Hospital

Dr Christopher Cole (Chair)
- Princess Alexandra Hospital

Electrophysiology and Pacing

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
- The Townsville Hospital

Ms Kellie Foder
- Royal Brisbane and Women's Hospital

Dr Bobby John
- The Townsville Hospital

Dr Paul Martin
- Royal Brisbane and Women's Hospital

Ms Sonya Naumann
- Royal Brisbane and Women's Hospital

Dr Kevin Ng
- Cairns Hospital

Dr Robert Park
- Gold Coast University Hospital

A/Prof John Hill (Chair)
- Princess Alexandra Hospital

Cardiac Rehabilitation

Ms Michelle Aust
- Sunshine Coast University Hospital

Ms Maura Barnden
- Metro North Hospital and Health Service

Mr Gary Bennett
- Health Contact Centre

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 Deborah Snow
- Gold Coast Hospital and Health Service

Ms Natalie Thomas
- South West Hospital and Health Service

Mr Stephen Woodruffe (Chair)
- West Moreton Hospital and Health Service

Heart Failure Support Services

Ms Kimberley Bardsley
- Queen Elizabeth II 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

Ms Alicia McClurg
- West Moreton Hospital and Health Service

Dr Kevin Ng
- Cairns Hospital

Ms Robyn Peters
- Princess Alexandra Hospital

Ms Serena Rofail
- Royal Brisbane and Women's Hospital

Dr Yee Weng Wong
- The Prince Charles Hospital

A/Prof John Atherton (Chair)
- Royal Brisbane and Women's Hospital

Statewide Cardiac Clinical Informatics Unit

Mr Michael Mallouhi

Mr Marcus Prior

Dr Ian Smith, PhD

Mr William Vollbon

6 Future plans

Continual progress with expanded analyses and uses of clinical data has been a focus for QCOR in 2018. This is evident through new report elements encompassing thoracic surgery and extended examination of patients undergoing thrombolysis for myocardial infarction. Similarly, obesity and cardiac surgery have been examined and have unveiled key findings that are highly relevant given the increasing incidence of obesity within the general population. Intending to provide clinically relevant analysis, the future work of QCOR is exciting.

The utilisation of linkage data provided by administrative datasets continues to enable and assist QCOR data collections. These data enable information from different sources to be brought together to create a new, richer dataset. Examples of future opportunities for the use of supplementary datasets are medication detail from discharge summaries and pathology investigations undertaken within public Queensland facilities. With access to these expanded data collections, there are opportunities to be seized across many fronts including enhanced risk adjustment options, expanded clinical indicator programs and streamlined participation in national registry activities. Furthermore, this will enable efficiencies in data collections where elements are either not available or practical for collection at the point-of-care, and thereby reduce duplication of entry across clinical systems.

Opportunities exist to better integrate QCOR clinical applications with enterprise systems such as the acclaimed Queensland Health application, The Viewer. It is envisaged that cardiac rehabilitation referrals and assessment forms will be incorporated within the patient record, along with procedure reports generated by the upcoming QCOR structural heart disease application. These developments are set to complement the existing report sharing functionality present within the QCOR electrophysiology system. Further opportunities have been flagged across the heart failure support services and cardiothoracic surgery space to enhance these applications to meet the bespoke requirements of the clinical specialty areas. By embracing opportunities to share valuable clinical data kept in various QCOR systems, investment in QCOR applications will be further realised and valued.

Continual development, revision, and optimisation of clinical indicator programs is essential to the ongoing relevance of the Registry. QCOR will continue to collaborate with experts in all clinical domains to expand the scope of our existing analyses. This will be undertaken with a view to maintain and enhance the quality of reporting and improve the timeliness and relevance of the information provided for clinical leads. Such areas where reporting will be enhanced for next year's Annual Report include:

- Time to angiography for patients receiving thrombolysis
- Expanded radiation safety analyses for diagnostic and interventional cardiology
- Review of risk adjustment models for interventional cardiology
- EuroSCORE II risk adjustment for cardiac surgery patients
- MRA prescription rates for HFrEF patients
- CR referrals rates following cardiac intervention

QCOR is actively investigating opportunities within several areas including the implementation of new patient-reported outcomes and quality-of-life measures and realising further efficiencies concerning statewide procurement of medical devices. New areas of research and research partners and opportunities to contribute to works underway across Queensland Health, and at a national level, are continually being pursued and engaged.

7 Facility profiles

7.1 Cairns Hospital

Figure 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

7.2 The Townsville Hospital

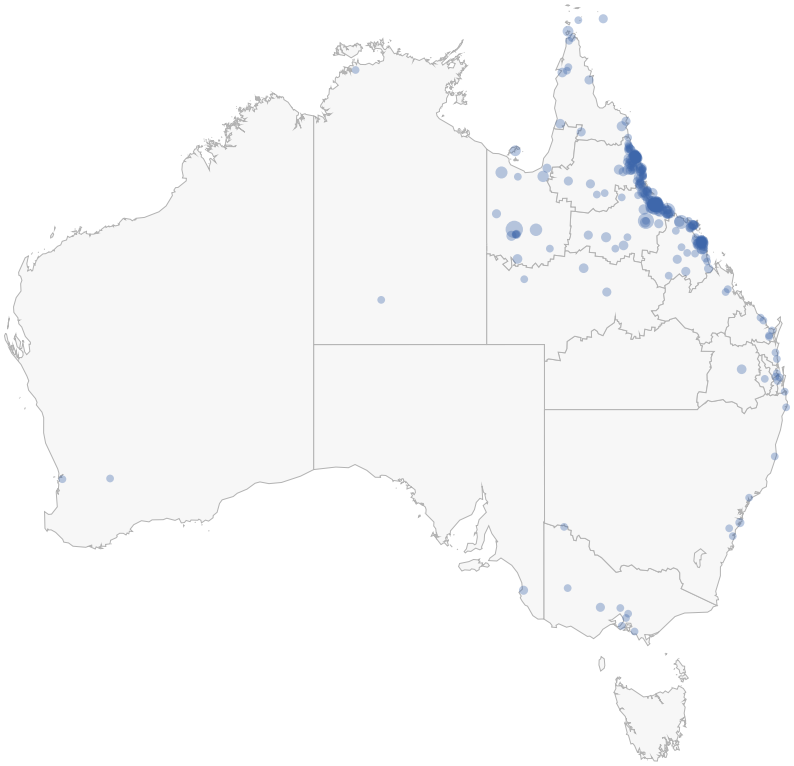


Figure 2: The Townsville Hospital

- 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 The Townsville Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiothoracic surgery

7.3 Mackay Base Hospital

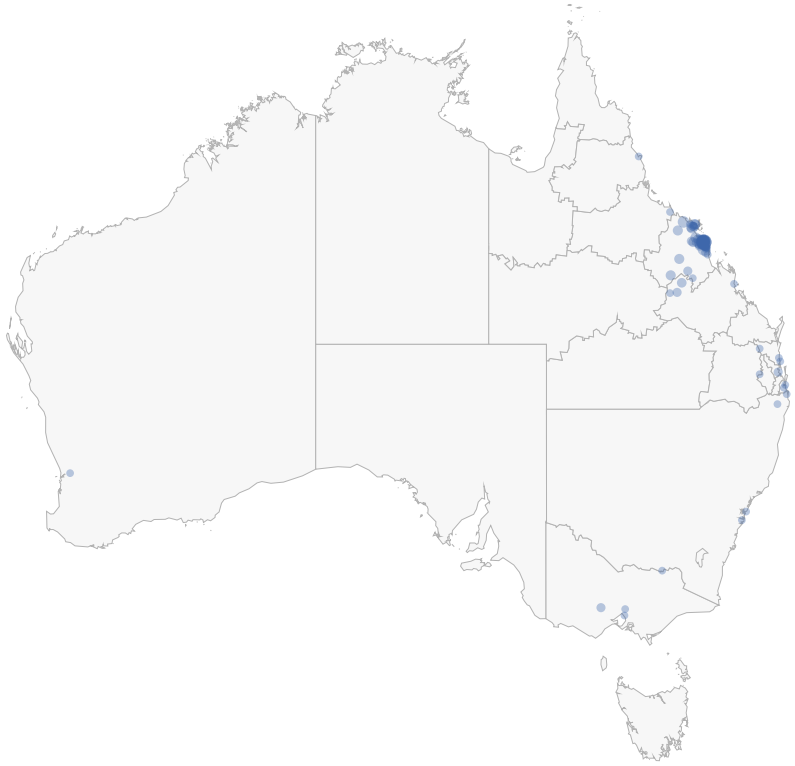


Figure 3: Mackay Base Hospital

- 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
  - Pacemaker and defibrillator implants

7.4 Sunshine Coast University Hospital

Figure 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

7.5 The Prince Charles Hospital

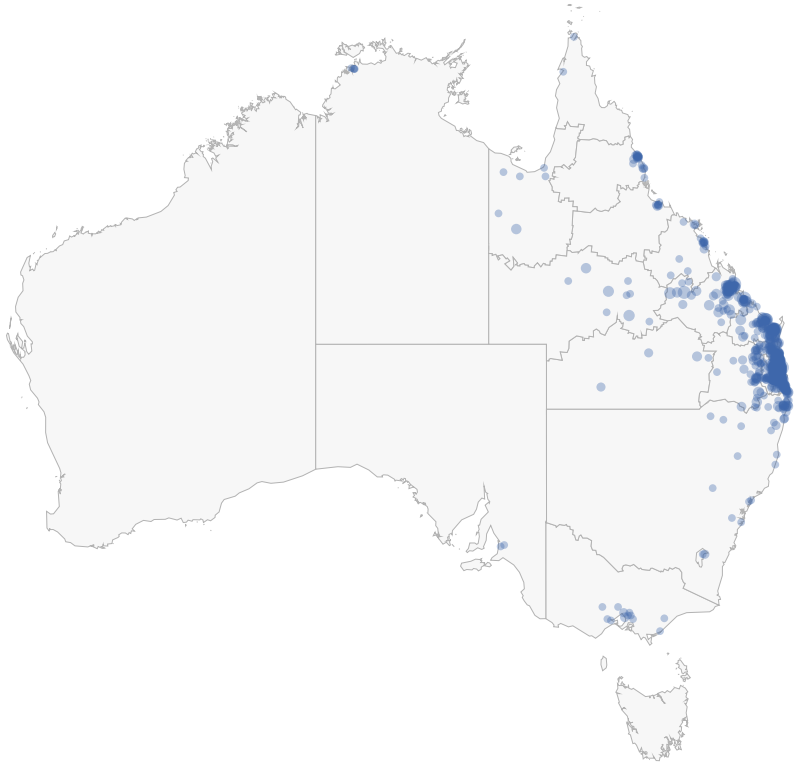


Figure 5: The Prince Charles Hospital

- 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

7.6 Royal Brisbane and Women's Hospital

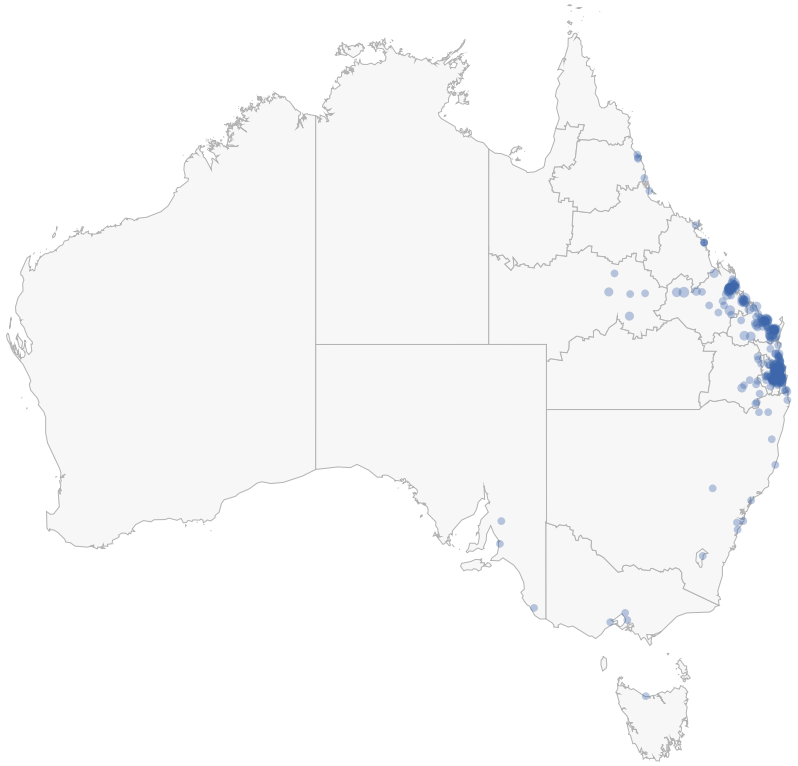


Figure 6: Royal Brisbane and Women's Hospital

- 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

7.7 Princess Alexandra Hospital

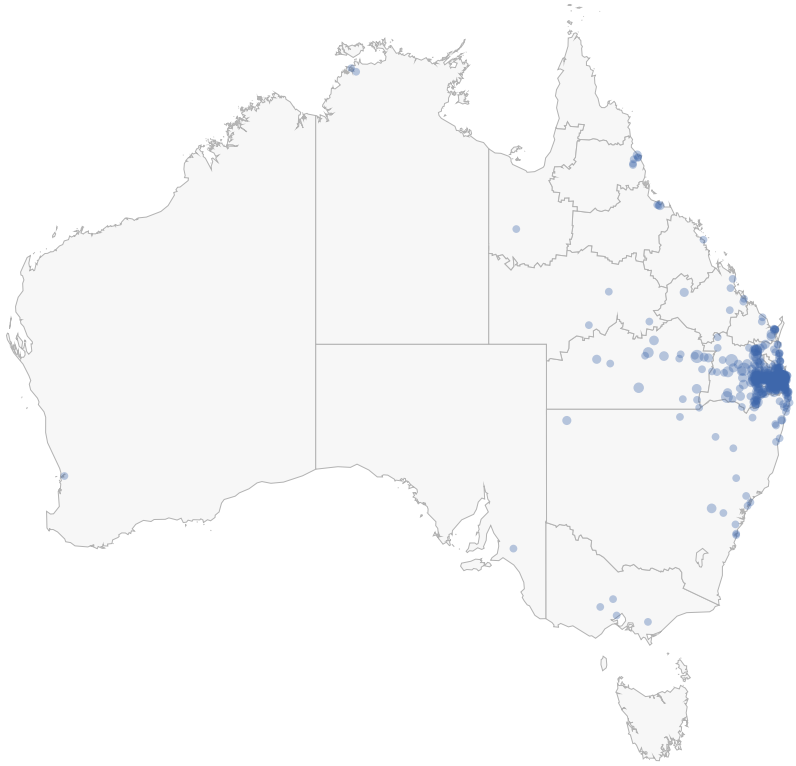


Figure 7: Princess Alexandra Hospital

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

7.8 Gold Coast University Hospital

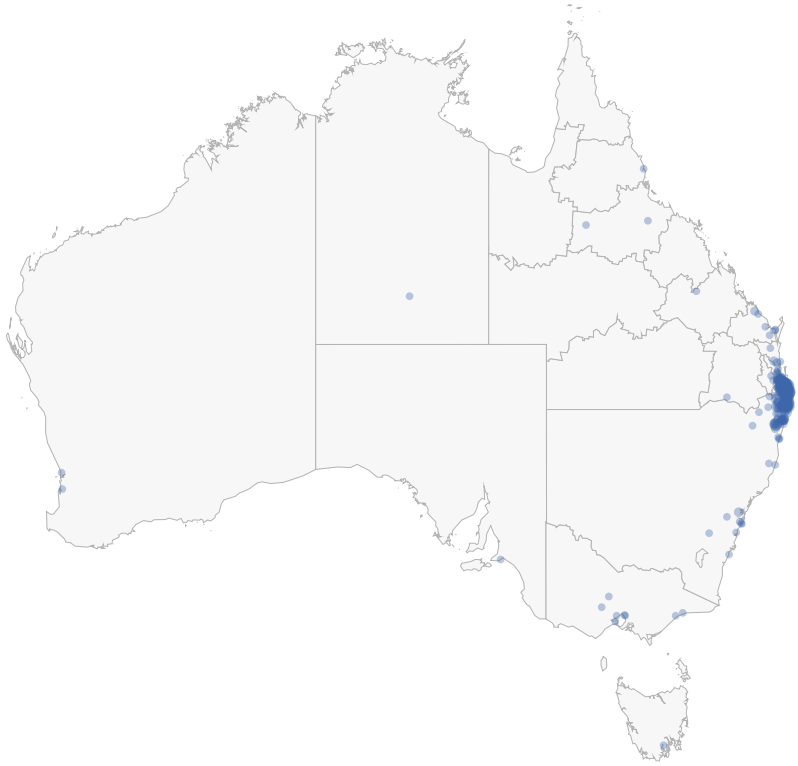


Figure 8: Gold Coast University Hospital

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

Interventional Cardiology Audit

1 Message from the QCOR Interventional Cardiology Committee Chair

This year's Annual Report again provides key and detailed insight into the interventional cardiology activity across all 8 public cardiac catheter laboratory (CCL) hospitals in Queensland. As expected, the report details further growth with over 15,000 coronary procedures performed, including just under 5,000 coronary intervention (stent) procedures – 77% of which were performed in patients presenting with an acute coronary syndrome. Similar to 2017, about one in four patients had to travel more than 50 kilometres for their procedure, reflecting both the geographical challenges associated with delivering tertiary level cardiac care in Queensland, and also highlighting regions that may benefit from expanded cardiac infrastructure. Analysis also once again confirms the important finding that Aboriginal and Torres Strait Islander patients present to the CCL on average about 10 years earlier than non-Indigenous patients.

This report also represents an important incursion into "disease-specific" reporting, with data analysis in a broader group of patients presenting with acute myocardial infarction (AMI), rather than only those that eventually receive an intervention. A better understanding of the overall magnitude of the disease burden is then possible, and inferences drawn. Expanded analyses have been performed in structural heart intervention as well as this sub-specialty area of interventional cardiology continues to develop, evolve and mature.

It remains encouraging to see the ongoing collaboration and participation of all sites involved in this registry, and it is also important to acknowledge the contribution and engagement from the Queensland Ambulance Service who provide important linkage data, particularly for patients requiring emergency management for AMI. Delivering quality data requires quality input, and ensuring the ever expanding volume of data within QCOR is carefully synthesised and audited for quality is a significant undertaking that would not be possible without the data quality improvement coordinators at each site, as well as the QCOR operational and business team, and I would also certainly like to acknowledge and thank these dedicated people.

QCOR has become an important data source which aligns its intended purpose of quality assurance with regional infrastructure planning, consumable utilisation and management, and system improvement. With the early objectives of QCOR already achieved, it is exciting to consider the possible future directions and capabilities of this registry. Remaining paramount, the primary focus and unwavering aspiration of QCOR is to deliver Queenslanders the highest quality 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 2018.

Key findings include:

- A total of 15,436 diagnostic coronary or interventional cases were performed across the 8 cardiac catheterisation laboratory facilities in Queensland public hospitals, including 4,867 PCI cases.
- Over three-quarters (76%) of all PCI patients residing in Queensland had a place of residence within 50 km of the nearest PCI capable facility, while 11% of patients resided more than 150 km from the nearest facility.
- A large proportion of PCI patients (77%) were classed as having an unhealthy body mass index over 25 kg/m^2.
- The proportion of patients identified as Aboriginal and Torres Strait Islander 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 almost 10 years younger than non-Aboriginal and Torres Strait Islander patients.
- The majority of PCI cases (77%) were classed as urgent, emergent or salvage, highlighting the acute and often unstable patient cohort.
- Drug eluting stents were used in 93% of cases, ranging from 76.5% and 99.7% across sites.
- There were 1,473 PCI cases following presentation with ST-elevation myocardial infarction (STEMI) in 2018, of which 53% were managed by primary PCI.
- Median time to reperfusion from first diagnostic ECG for STEMI patients presenting within 6 hours of symptom onset was 85 minutes (range 66 minutes to 94 minutes across sites).
- Median hospital door-to-device time for STEMI patients presenting within six hours of symptom onset was 42 minutes (range 35 minutes to 49 minutes across sites).
- There were a total of 490 thrombolysed STEMIs, for whom the median time from first medical contact to the administration of thrombolysis was 43 minutes.
- PCI for non-ST-elevation myocardial infarction (NSTEMI) represented 29% of all cases, with the median time to angiography of 58 hours. Patients presenting to a non-PCI capable facility have a median wait to coronary angiography 32 hours longer than those who present directly to a PCI capable facility (72 hours vs 40 hours).
- Mortality within 30 days following PCI was 1.9%. Of these 94 deaths, 74% were classed as either salvage or emergency PCI.
- Of all cases, 0.62% recorded a major intra-procedural complication. Coronary artery perforation accounted for the majority (0.47%) of these events.
- Radiation doses were under the high dose threshold in 99.1% of PCI cases across all sites and 99.9% of other coronary procedures.

3 Participating sites

During 2018, there were 8 public hospitals offering CCL services across both metropolitan and regional Queensland.

Logan Hospital CCL was utilised for diagnostic coronary angiography for a short period of time in support of the PAH while laboratory works were undertaken. For the sake of this report, the activity is incorporated with the PAH.

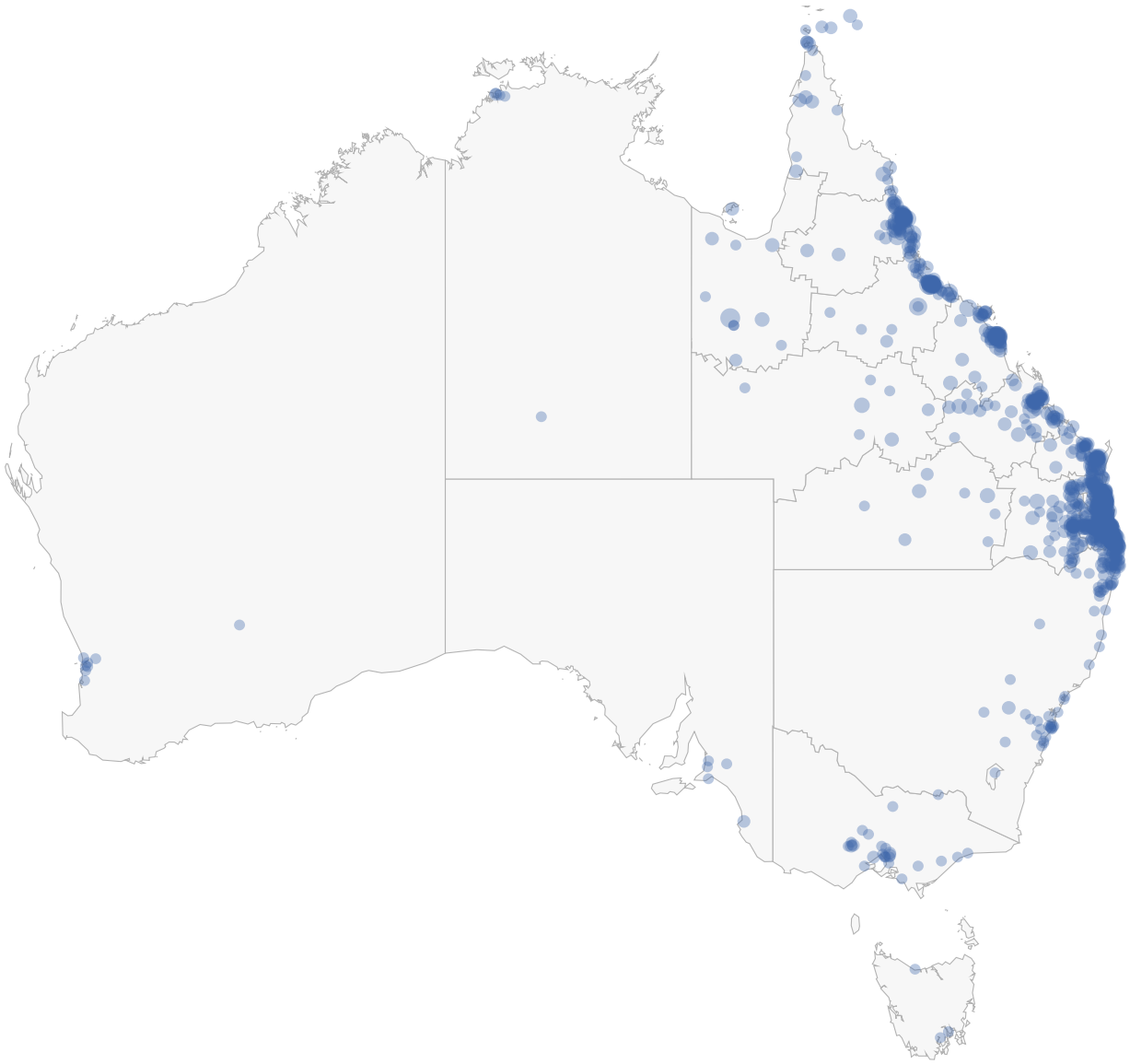


Figure 1: Statewide PCI cases by patient place of usual residence (by residential postcode)

Table 1: Participating sites

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

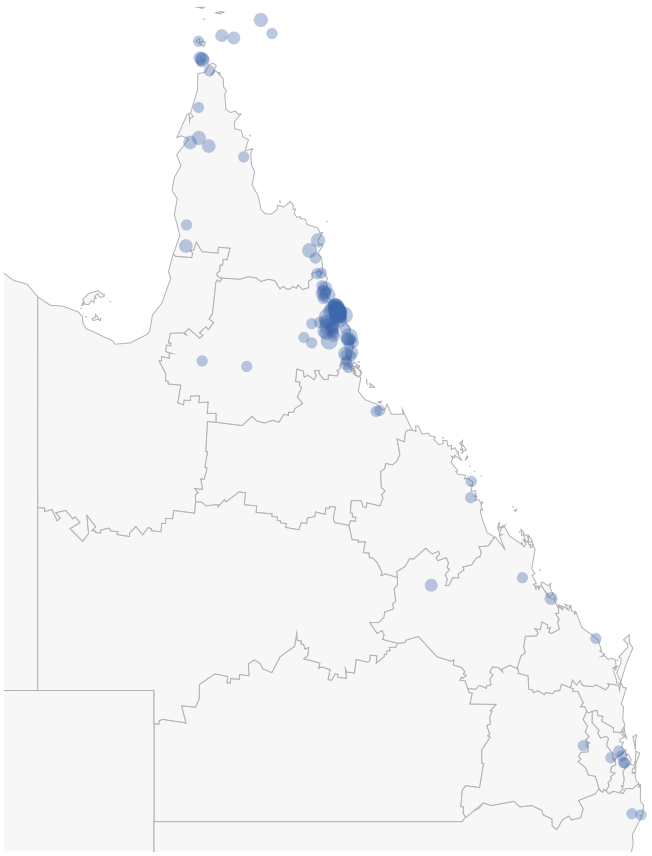


Figure 2: Cairns Hospital

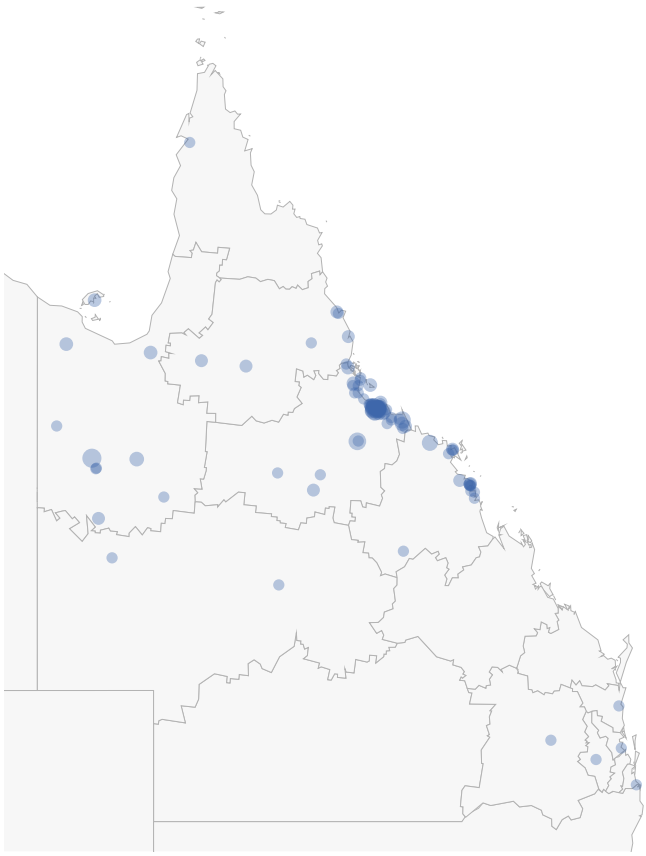


Figure 3: The Townsville Hospital

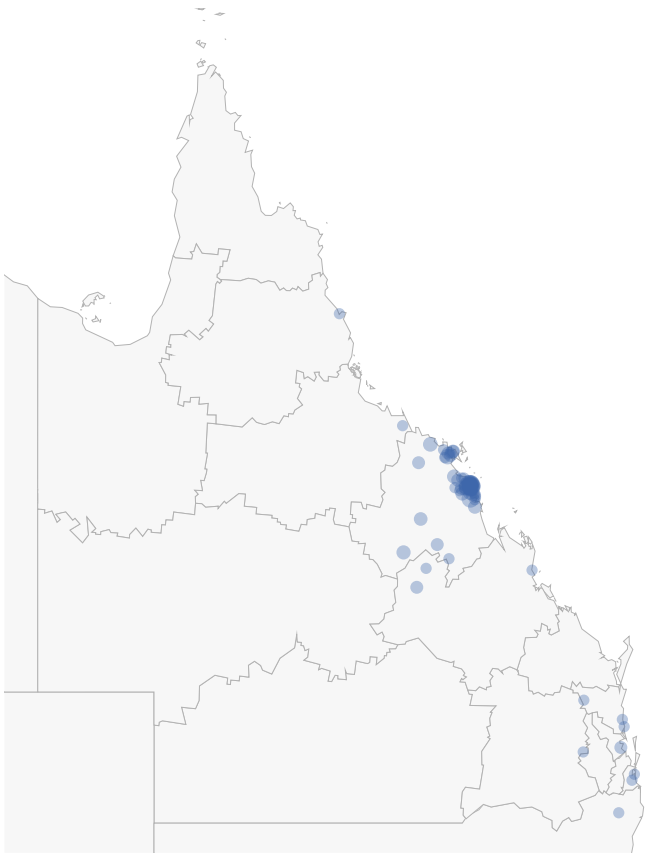


Figure 4: Mackay Base Hospital

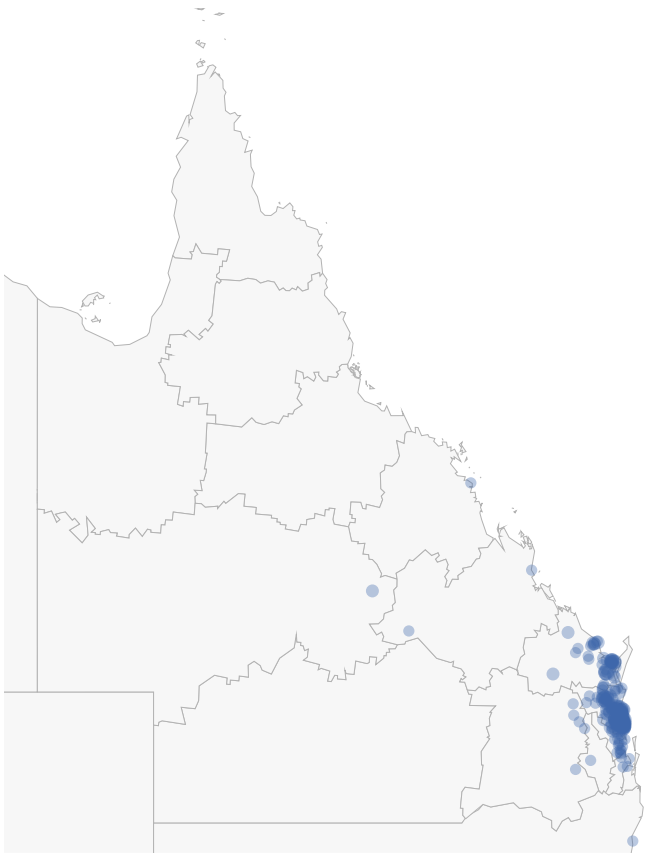


Figure 5: Sunshine Coast University Hospital

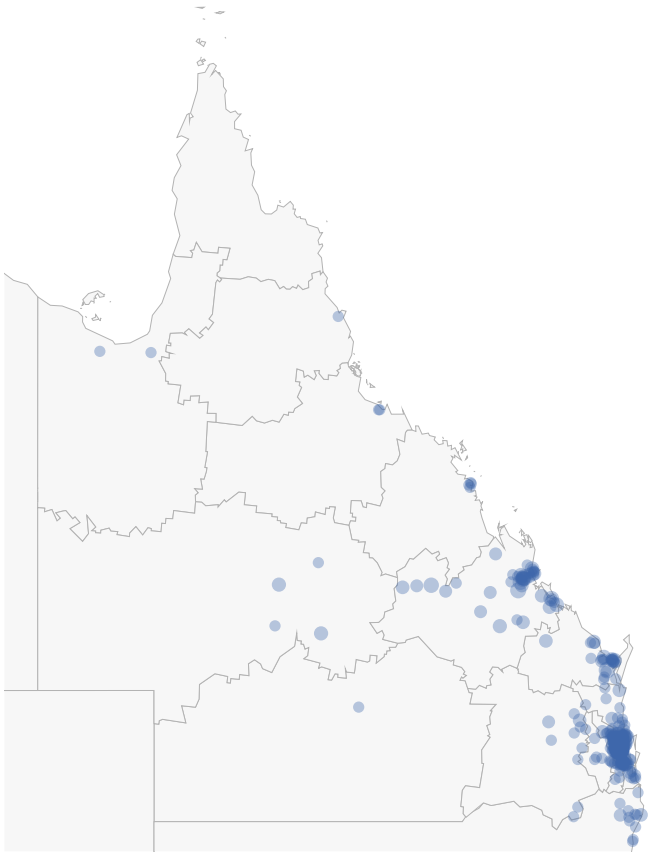


Figure 6: The Prince Charles Hospital

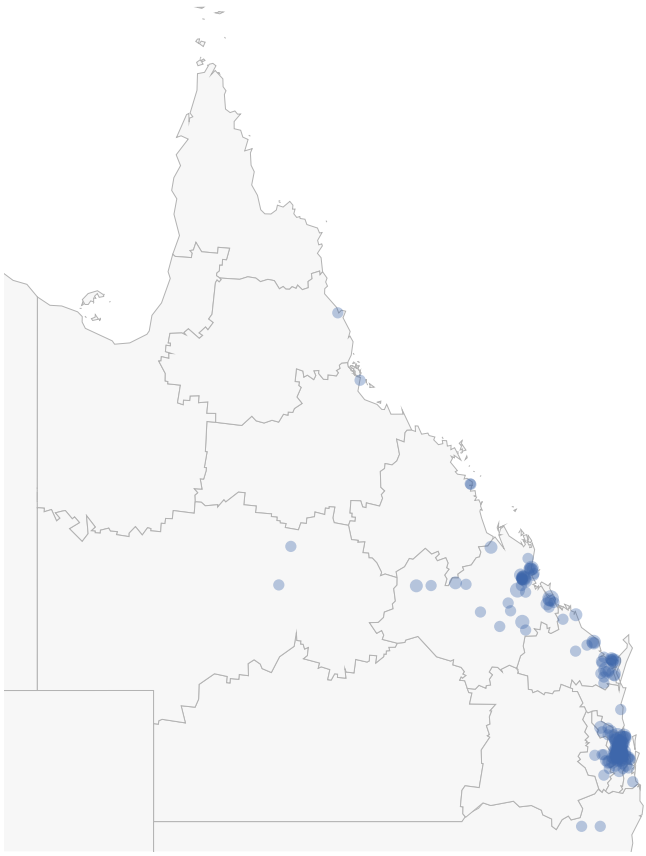


Figure 7: Royal Brisbane and Women's Hospital

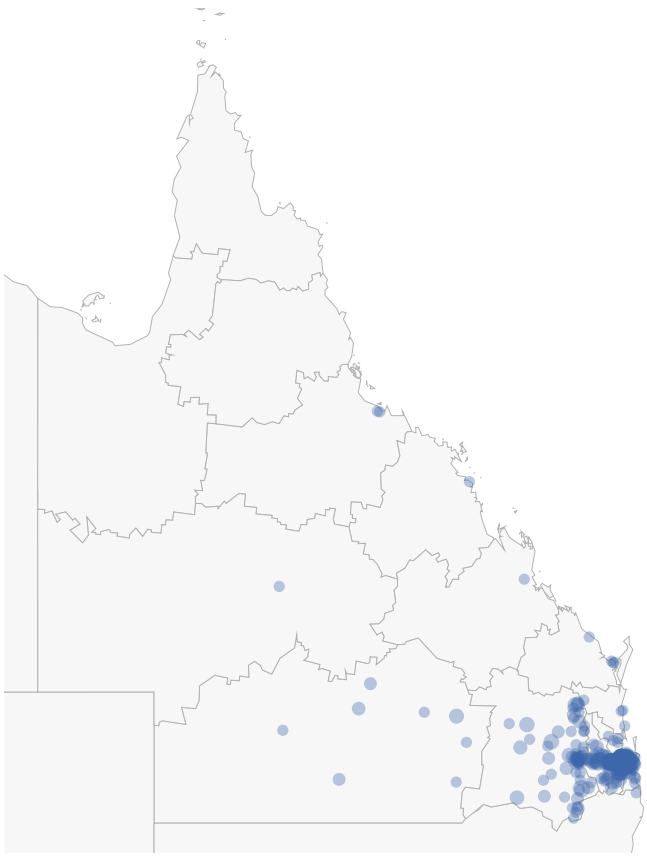


Figure 8: Princess Alexandra Hospital

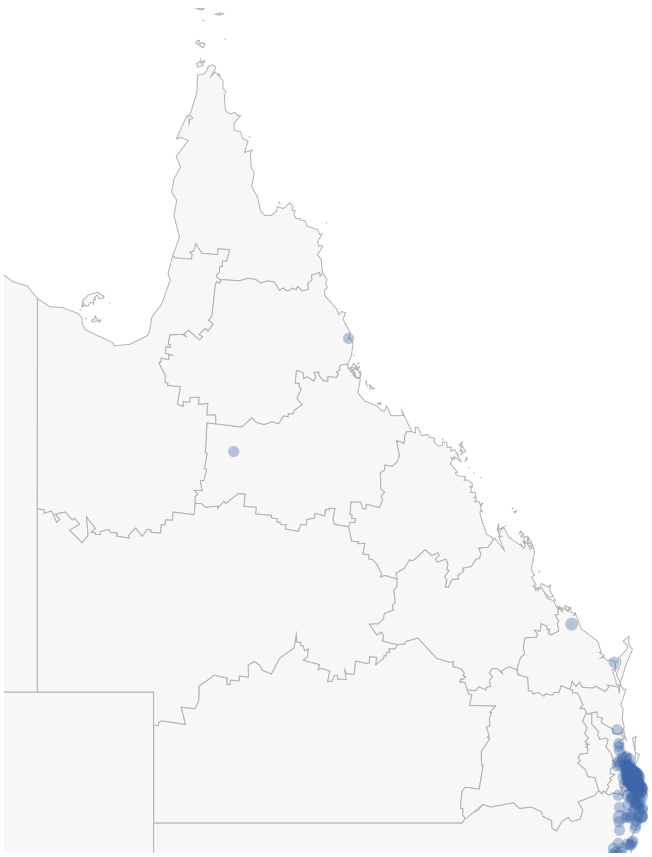


Figure 9: Gold Coast University Hospital

4 Total coronary cases

4.1 Procedure type

In 2018, the 8 public CCL facilities performed a total of 15,436 coronary cases, with 4,867 (32%) involving a percutaneous coronary intervention (PCI) which are the main subject of this report.

The focus of this report is a specialised subset of invasive cardiology cases performed in the CCL environment across Queensland public hospitals. This does not include non-coronary procedures, such as right heart catheterisation, right ventricular cardiac biopsy and peripheral intervention.

In addition, detail for 401 structural heart disease interventions including percutaneous valve replacement, valvuloplasty and device closure procedures is included as a supplement to this report. Activities relating to electrophysiology and pacing procedures are included in a separate audit within this Annual Report.

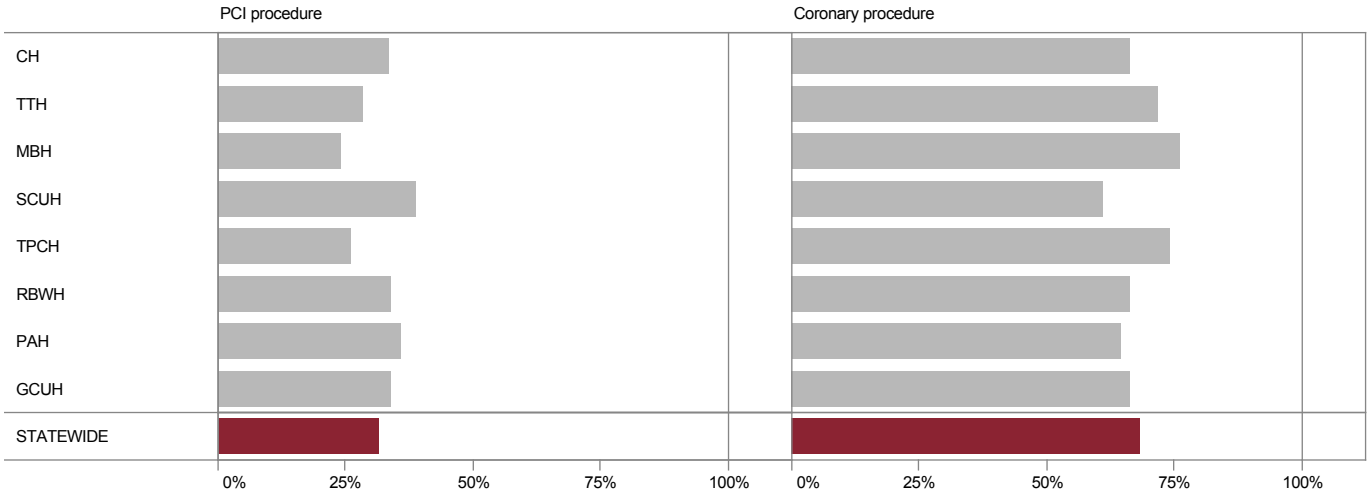


Figure 10: Proportion of cases by procedure category

Table 2: Total cases by procedure category

Site	PCI procedure* n (%)	Other coronary procedure† n (%)	All coronary cases n
CH	483 (33.5)	959 (66.5)	1,442
TTH	368 (28.3)	933 (71.7)	1,301
MBH	258 (24.1)	813 (75.9)	1,071
SCUH	616 (39.0)	965 (61.0)	1,581
TPCH	989 (26.0)	2,821 (74.0)	3,810
RBWH	420 (33.6)	830 (66.4)	1,250
PAH	1,029 (35.5)	1,869 (64.5)	2,898
GCUH	704 (33.8)	1,379 (66.2)	2,083
STATEWIDE	**4,867 (31.5)**	**10,569 (68.5)**	**15,436**

* 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

4.2 Total cases by clinical presentation

The most common presentation category was of non-ST-elevation acute coronary syndrome (ACS) which includes both NSTEMI and unstable angina, while ST-elevation ACS (STEMI) cases represented 12% of all cases, and 30% of all PCI cases.

The most common clinical presentation across all cases was of an ACS, which accounted for approximately one-third of all cases (31%). Almost two-thirds of PCI procedures undertaken were categorised as either STEMI or NSTEMI (59%).

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	138 (9.6)	295 (20.5)	1,009 (70.0)
TTH	115 (8.8)	241 (18.5)	945 (72.6)
MBH	48 (4.5)	160 (14.9)	863 (80.6)
SCUH	273 (17.3)	330 (20.9)	978 (61.9)
TPCH	312 (8.2)	620 (16.3)	2,878 (75.5)
RBWH	134 (10.7)	349 (27.9)	767 (61.4)
PAH	543 (18.7)	708 (24.4)	1,647 (56.8)
GCUH	247 (11.9)	299 (14.4)	1,537 (73.8)
STATEWIDE	**1,810 (11.7)**	**3,002 (19.4)**	**10,624 (68.8)**

Table 4: PCI cases by clinical presentation category

Site	STEMI n (%)	NSTEMI n (%)	Other n (%)
CH	120 (24.8)	166 (34.4)	197 (40.8)
TTH	89 (24.2)	79 (21.5)	200 (54.3)
MBH	39 (15.1)	64 (24.8)	155 (60.1)
SCUH	235 (38.1)	155 (25.2)	226 (36.7)
TPCH	253 (25.6)	257 (26.0)	479 (48.4)
RBWH	104 (24.8)	168 (40.0)	148 (35.2)
PAH	412 (40.0)	354 (34.4)	263 (25.6)
GCUH	221 (31.4)	163 (23.2)	320 (45.5)
STATEWIDE	**1,473 (30.3)**	**1,406 (28.9)**	**1,988 (40.8)**

4.3 Place of residence

The vast majority of PCI patients (94%) had a usual place of residence within Queensland, with a smaller proportion originating from interstate (5%) and overseas (1%). For GCUH, almost one-quarter of PCI patients (22%) originated from outside of Queensland.

Patients came from a wide geographical area with the majority of patients residing on the eastern seaboard. More than half of all patients were seen at their local Hospital and Health Service (HHS). Of those patients residing in Queensland, the majority (76%) had a place of usual residence within 50 kilometres of the nearest public PCI facility.

Table 5: PCI cases by place of usual residence category

Site	Queensland %	Within HHS %	Interstate %	Overseas %
CH	93.8	79.9	3.3	2.9
TTH	95.9	72.0	3.8	0.3
MBH	96.1	90.7	3.5	0.4
SCUH	97.6	75.4	1.5	1.0
TPCH	97.2	66.9	2.1	0.7
RBWH	95.9	50.5	2.4	1.7
PAH	97.6	58.6	1.4	1.1
GCUH	77.8	73.5	21.2	1.0
STATEWIDE	**93.9**	**68.7**	**5.0**	**1.1**

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

Site	‹50 km %	50–150 km %	›150 km %
CH	67.3	20.5	12.1
TTH	64.3	17.6	18.1
MBH	79.8	11.7	8.5
SCUH	71.6	22.2	6.2
TPCH	76.8	5.6	17.6
RBWH	65.6	9.2	25.2
PAH	77.2	16.3	6.6
GCUH	99.1	0.4	0.5
STATEWIDE	**76.1**	**12.6**	**11.3**

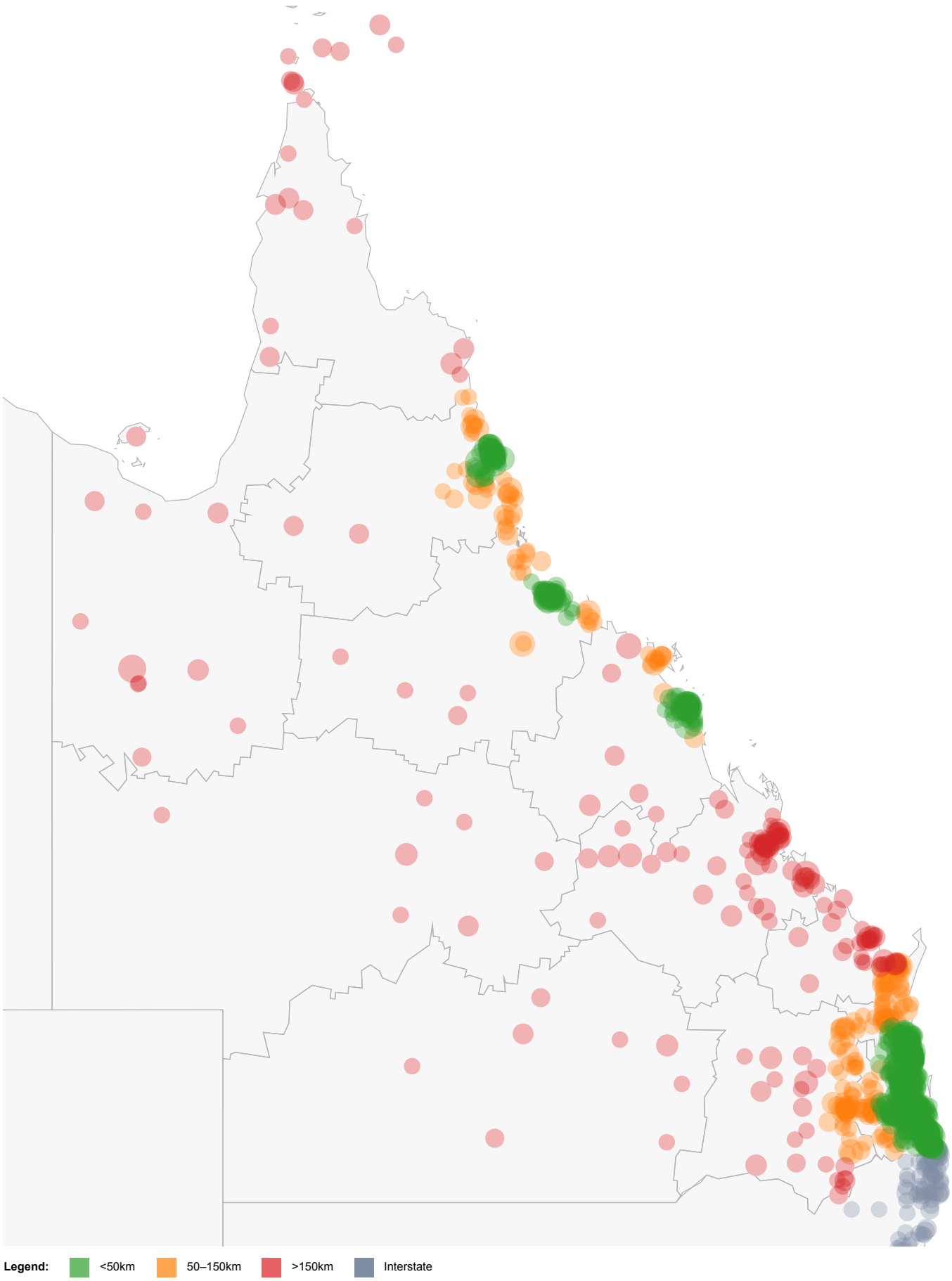


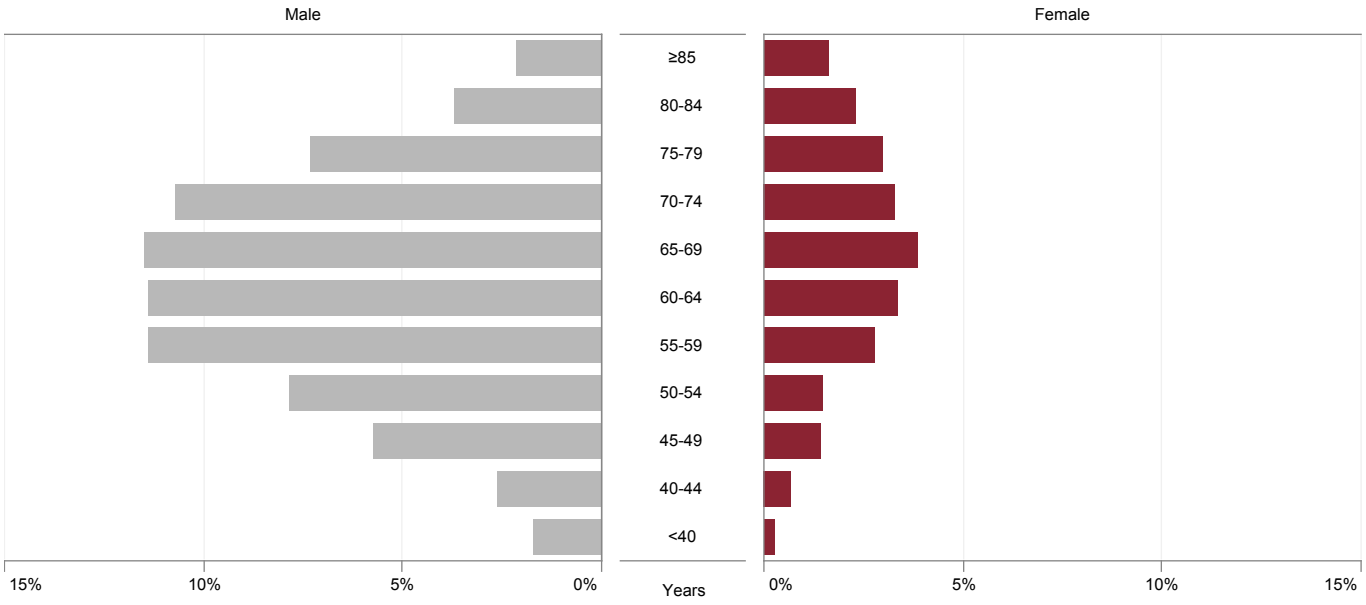
Figure 11: Queensland PCI cases by distance to nearest public PCI facility

5 Patient characteristics

5.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. The median age of patients undergoing PCI was 65 years of age and ranged from 62 years to 67 years across sites.

The median age for females was higher than for males (68 years vs 64 years).



% of total PCI (n=4,867)

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	64.3	65.7	64.7
TTH	60.8	65.1	61.5
MBH	60.7	69.3	62.5
SCUH	65.1	68.5	66.1
TPCH	66.2	69.6	67.0
RBWH	62.9	68.0	64.7
PAH	61.9	64.3	62.4
GCUH	65.8	68.7	66.5
STATEWIDE	**63.8**	**67.8**	**64.8**

5.2 Body mass index

Patients across all sites displayed similar results for body mass index (BMI), with less than one-quarter of patients (22%) in the normal BMI range and 37%, 35% and 5% classified as overweight, obese and morbidly obese respectively. There were less than 1% of cases classified as underweight (BMI ‹18.5 kg/m²).

Excludes missing/invalid data (0.6%)

* BMI 18.5–24.9 kg/m²

† BMI 25–29.9 kg/m²

‡ BMI 30–39.9 kg/m²

§ BMI ≥40 kg/m²

Figure 13: Proportion of all PCI cases by body mass index category

Table 8: All PCI cases by body mass index category

Site	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
CH	6 (1.2)	98 (20.3)	172 (35.6)	180 (37.3)	27 (5.6)
TTH	7 (1.9)	72 (19.7)	135 (36.9)	139 (38.0)	13 (3.6)
MBH	1 (0.4)	41 (16.0)	90 (35.0)	111 (43.2)	14 (5.4)
SCUH	5 (0.8)	144 (23.5)	261 (42.5)	172 (28.0)	32 (5.2)
TPCH	11 (1.1)	198 (20.0)	345 (34.9)	377 (38.1)	58 (5.9)
RBWH	4 (1.0)	106 (25.2)	135 (32.1)	137 (32.6)	38 (9.0)
PAH	9 (0.9)	217 (21.1)	382 (37.2)	376 (36.6)	44 (4.3)
GCUH	7 (1.0)	170 (24.1)	285 (40.5)	224 (31.8)	18 (2.6)
STATEWIDE	**50 (1.0)**	**1,046 (21.5)**	**1,805 (37.1)**	**1,716 (35.3)**	**244 (5.0)**

Excludes missing/invalid data (0.6%)

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 population have a higher incidence and prevalence of coronary artery disease[1].

The increased proportion of identified Aboriginal and Torres Strait Islander patients in the northern HHSs (CH, 20% and TTH, 18%) reflects the resident population within these areas and can be noted for service provision and planning.

The proportion of identified Aboriginal and Torres Strait Islander patients requiring a PCI procedure across all sites (6.4%) exceeds the estimated proportion of Aboriginal and Torres Strait Islander persons within Queensland (4.6%)[2].

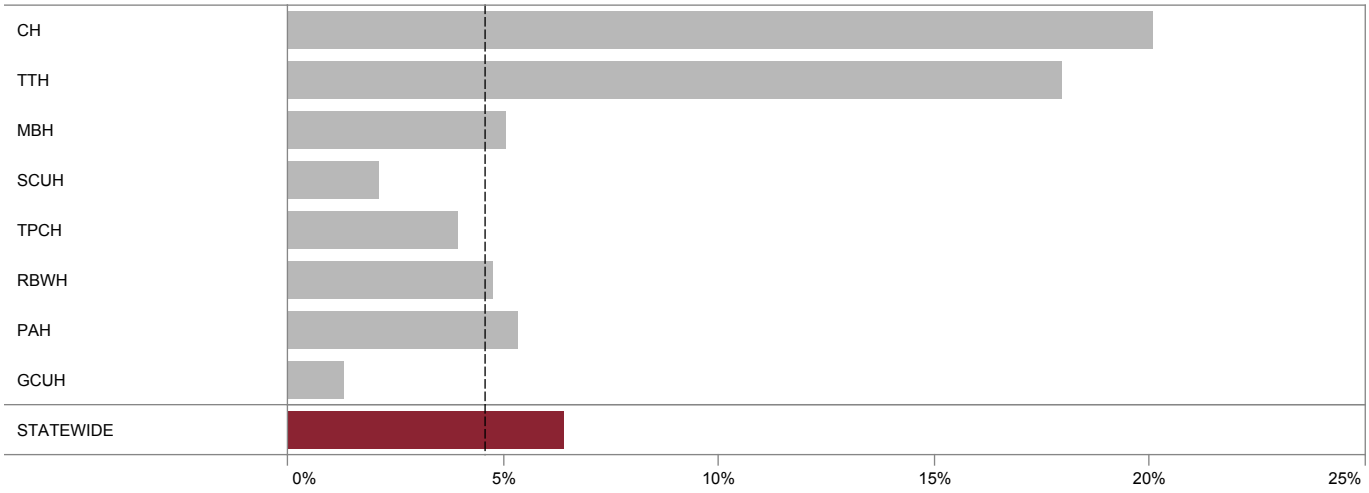
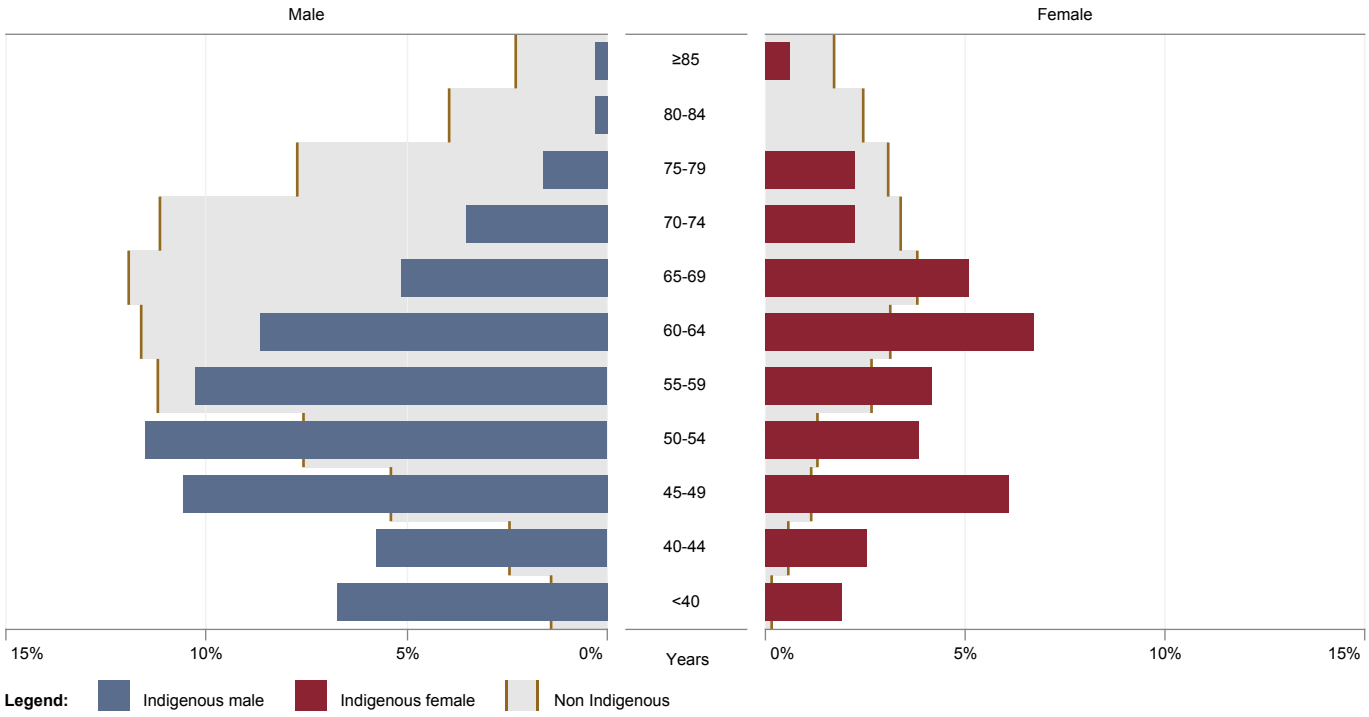


Figure 14: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

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 65 years).



% of total with complete data (n=4,858)

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	53.7	59.8	55.5
Non Aboriginal and Torres Strait Islander	64.4	68.7	65.4
ALL	**63.8**	**67.8**	**64.8**

Excludes missing data (0.2%)

6 Care and treatment of PCI patients

6.1 Admission status

There were 4,867 PCI procedures performed in 2018 by the 8 public sites across Queensland. Patients were classified into admission status defined by the National Cardiovascular Data Registry as follows:[3]

Despite published definitions, the percentage distribution varied considerably between institutions as classification of cases is sometimes operator-dependent and confounded by complex clinical presentation.

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 a last resort. The patient is in cardiogenic shock at the start of the procedure. Within the last ten minutes prior to the start of the procedure the patient has also received chest compressions for a total of at least sixty seconds or has been on unanticipated extracorporeal circulatory support (e.g. extracorporeal membrane oxygenation, cardiopulmonary support).

Urgent and emergent cases accounted for the majority (76%) of PCI cases, reflecting the acute and often complex case mix draining to Queensland public hospitals.

Salvage cases varied between institutions, with CH, TTH and RBWH performing approximately 2% of PCI cases in these exceptional and highly complex clinical scenarios (1.9%, 2.4% and 1.7% respectively).

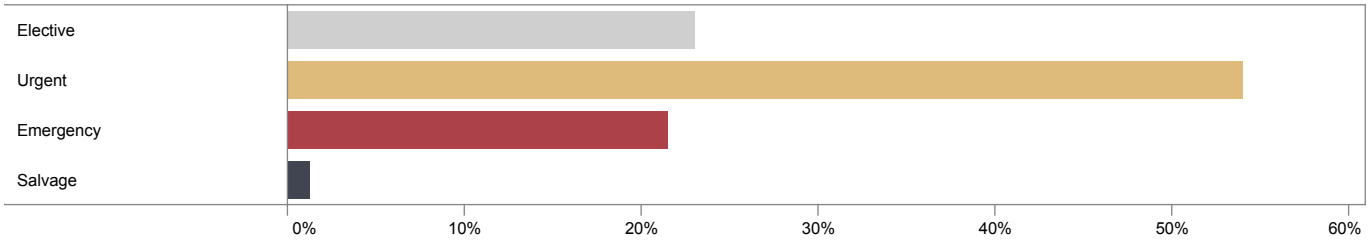


Figure 16: Proportion of all PCI cases by admission status

Table 11: PCI cases by site and admission status

	Elective n (%)	Urgent n (%)	Emergent n (%)	Salvage n (%)
CH	132 (27.3)	262 (54.2)	80 (16.6)	9 (1.9)
TTH	84 (22.8)	217 (59.0)	58 (15.8)	9 (2.4)
MBH	125 (48.4)	112 (43.4)	20 (7.8)	1 (0.4)
SCUH	100 (16.2)	346 (56.2)	168 (27.3)	2 (0.3)
TPCH	276 (27.9)	498 (50.4)	201 (20.3)	14 (1.4)
RBWH	50 (11.9)	281 (66.9)	82 (19.5)	7 (1.7)
PAH	178 (17.3)	595 (57.8)	243 (23.6)	13 (1.3)
GCUH	177 (25.1)	321 (45.6)	197 (28.0)	9 (1.3)
STATEWIDE	**1,122 (23.1)**	**2,632 (54.1)**	**1,049 (21.6)**	**64 (1.3)**

6.2 Access route

6.2.1 All PCI cases

Across all sites, the majority of PCI cases (92%) used a single access route, with 67% being via the radial approach and 34% femoral. Another access route including brachial or ulnar was utilised in less than one per cent of cases. The use of the radial approach varied between different PCI centres (29% to 91%).

Table 12: PCI access route by site

Site	Total PCI cases n	Radial approach %	Femoral approach %	Other approach %
CH	483	81.8	25.7	–
TTH	368	57.6	48.1	0.5
MBH	258	83.7	23.6	0.4
SCUH	616	91.2	13.1	0.3
TPCH	989	77.7	34.3	1.1
RBWH	420	78.1	29.8	0.7
PAH	1,029	29.4	74.5	0.4
GCUH	704	79.5	31.8	–
STATEWIDE	**4,867**	**68.7**	**39.0**	**0.5**

Totals ›100% due to multiple access sites

Table 13: PCI access route by site

Site	Single approach %	Multiple approaches %
CH	92.5	7.5
TTH	94.0	6.0
MBH	92.2	7.8
SCUH	95.3	4.7
TPCH	87.5	12.5
RBWH	91.7	8.3
PAH	95.7	4.3
GCUH	88.6	11.4
STATEWIDE	**92.0**	**8.0**

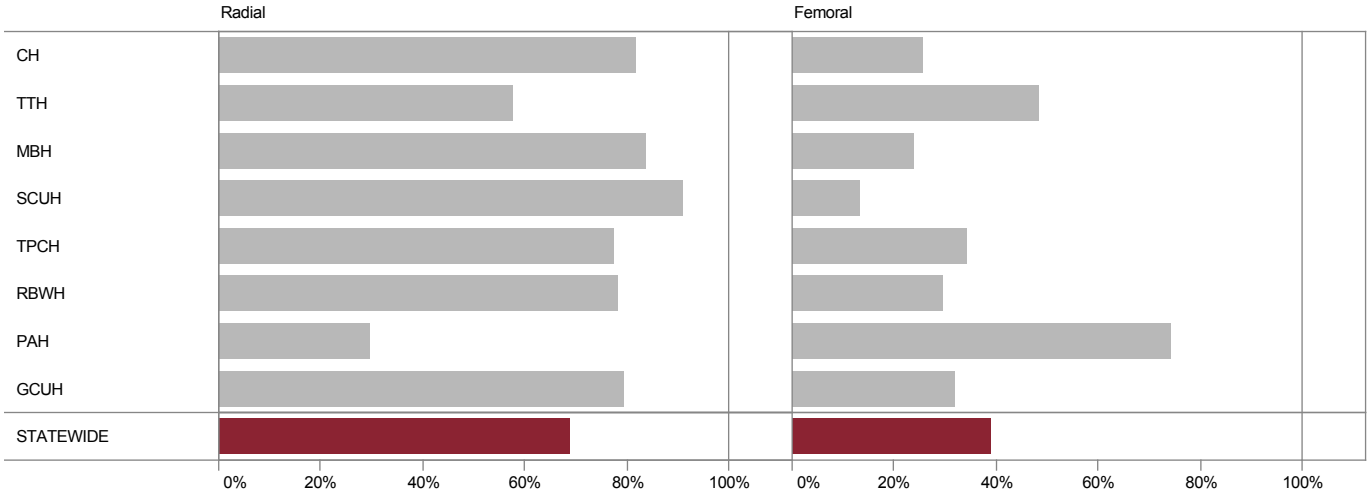


Figure 17: Proportion of PCI cases using radial and femoral access routes by site

6.2.2 STEMI presenting within 6 hours of symptom onset

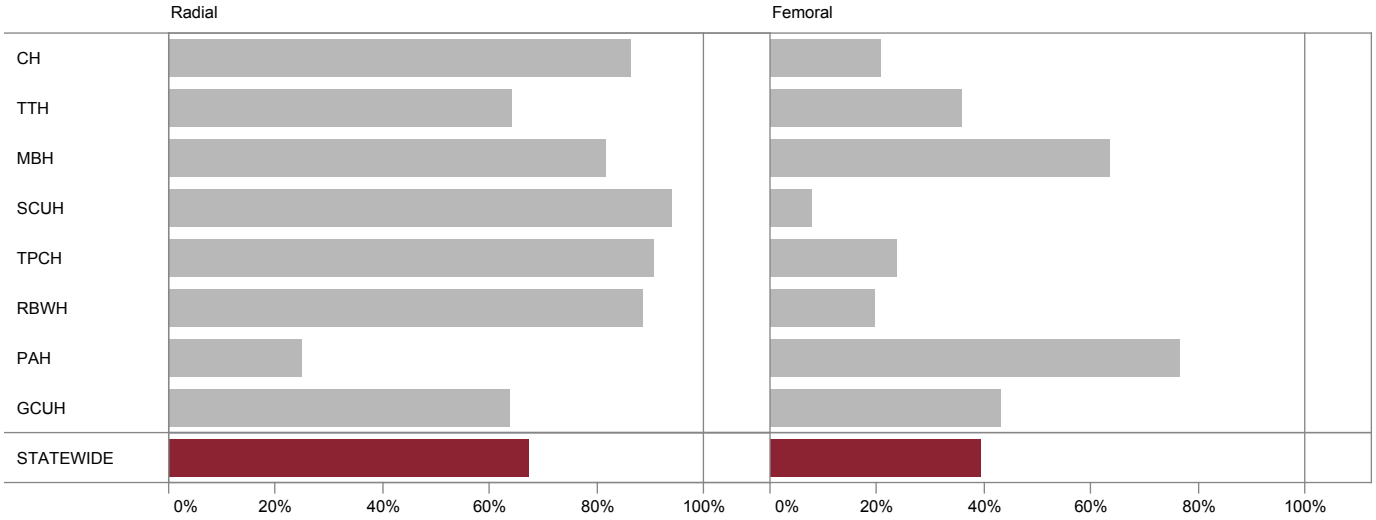


Figure 18: Proportion of STEMI presenting within 6 hours PCI cases using radial and femoral access routes by site

6.3 Vessels treated

Of all vessels or grafts treated by PCI, the vast majority were native vessels with coronary artery graft PCI accounting for only 3% of interventions.

Of the vessels treated, 46% of cases involved the left anterior descending coronary artery (LAD), followed by right coronary artery (RCA) at 38%, circumflex coronary artery (LCx) at 26% and left main coronary artery (LMCA) at 3%.

Table 14: Grafts and vessels treated by site

Site	LMCA %	LAD %	LCx %	RCA %	Graft %
CH	1.7	44.7	24.8	36.2	4.1
TTH	2.7	44.3	22.0	41.8	5.2
MBH	1.9	47.7	28.3	32.6	1.9
SCUH	3.2	48.2	29.7	34.9	2.6
TPCH	5.6	47.4	23.4	40.1	4.1
RBWH	2.1	46.7	30.0	37.9	3.3
PAH	3.6	47.3	27.1	36.5	1.9
GCUH	1.7	42.9	24.6	39.6	2.1
STATEWIDE	**3.2**	**46.3**	**26.0**	**37.8**	**3.1**

Table 15: Total native vessels treated by site

Site	Single vessel n (%)	Two vessel n (%)	Three vessel n (%)
CH	411 (88.8)	49 (10.6)	3 (0.6)
TTH	296 (84.8)	51 (14.6)	2 (0.6)
MBH	223 (88.1)	29 (11.5)	1 (0.4)
SCUH	506 (84.3)	83 (13.8)	11 (1.8)
TPCH	783 (82.6)	138 (14.6)	27 (2.8)
RBWH	335 (82.5)	62 (15.3)	9 (2.2)
PAH	868 (86.0)	118 (11.7)	23 (2.3)
GCUH	615 (89.3)	71 (10.3)	3 (0.4)
STATEWIDE	**4,037 (85.6)**	**601 (12.7)**	**79 (1.7)**

Excludes any graft PCI (n=150)

Table 16: Grafts treated by site

Site	Graft only n (%)	Graft and one native vessel n (%)	Graft and two native vessels n (%)
CH	19 (95.0)	1 (5.0)	–
TTH	18 (94.7)	1 (5.3)	–
MBH	4 (80.0)	1 (20.0)	–
SCUH	11 (68.8)	4 (25.0)	1 (6.3)
TPCH	33 (80.5)	6 (14.6)	2 (4.9)
RBWH	11 (78.6)	3 (21.4)	–
PAH	18 (90.0)	2 (10.0)	–
GCUH	15 (100.0)	–	–
STATEWIDE	**129 (86.0)**	**18 (12.0)**	**3 (2.0)**

6.4 Stent type

Stents are grouped into one of four different types – drug-eluting stents (DES), bare metal stents (BMS), bioresorbable vascular scaffolds (BVS) and covered stents.

Across all centres, there were an average of 1.5 stents used for each of the 4,549 PCI cases involving stent deployment. DES were used in 93% of cases, ranging from 77% to almost 100% across centres, while BMS were used in 8% of cases. A BVS or covered stent was used in less than 1% of cases.

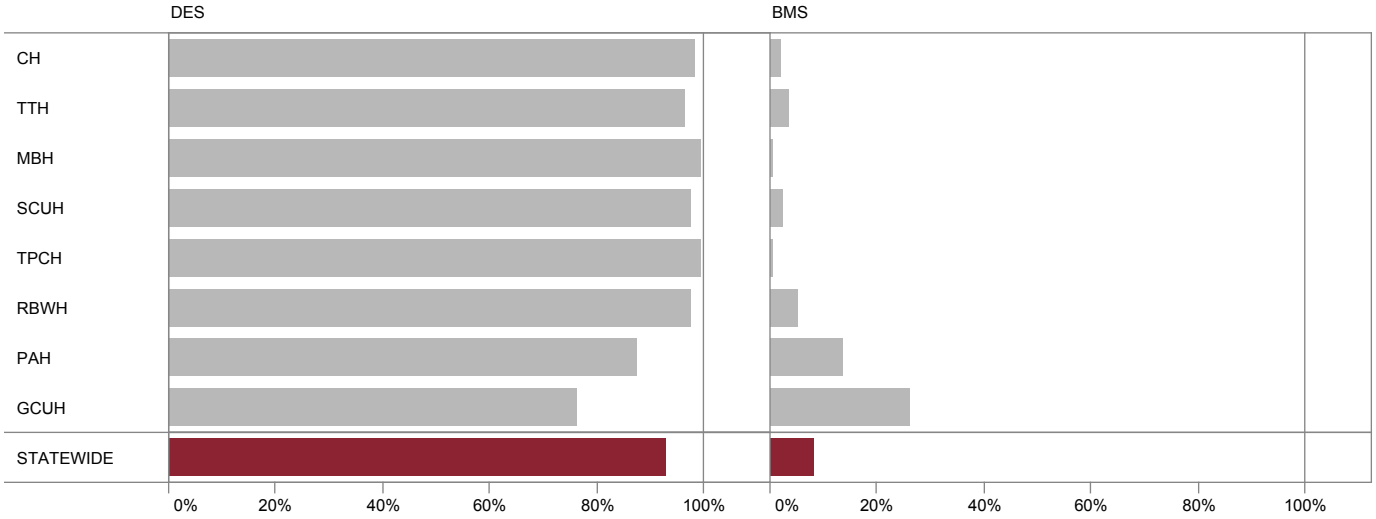


Figure 19: Proportion of stenting cases using DES and BMS

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

	Total n	DES %	BMS %	BVS %	Covered stent %	Stents per case mean
CH	438	94.3	2.1	4.1	0.5	1.5
TTH	347	96.5	3.5	–	–	1.4
MBH	229	99.6	0.4	–	–	1.4
SCUH	587	97.6	2.4	–	0.2	1.5
TPCH	922	99.7	0.2	–	0.5	1.5
RBWH	386	97.7	5.2	–	–	1.5
PAH	986	87.4	13.8	–	–	1.6
GCUH	654	76.5	26.0	–	–	1.4
STATEWIDE	**4,549**	**92.5**	**8.0**	**0.4**	**0.2**	**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 outcomes. PCI capable hospitals have therefore developed rapid triage and transfer systems to fast-track STEMI patients into the CCL for rapid reperfusion (primary PCI).

Decision-making for the method of reperfusion depends on many factors. Timeliness of treatment and patient characteristics indicate which treatment method is appropriate and applicable.

Given the time-critical nature of this presentation type, ongoing refinement 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 large proportion of STEMI patients who do not present to hospital and are not treated with any form of reperfusion therapy, however this element of care is outside the scope of this registry.

6.5.1 Clinical presentation

In 2018, there were 1,473 documented STEMI PCI cases with over half (53%) presenting as primary PCI cases and 12% presenting after 12 hours (late presenters).

There were 23% of reperfusion-eligible patients who had received thrombolysis (lysis), including 5% requiring rescue PCI because lysis 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	20 (16.7)	44 (36.7)	4 (3.3)	13 (10.8)	25 (20.8)	14 (11.7)
TTH	3 (3.4)	42 (47.2)	4 (4.5)	7 (7.9)	27 (30.3)	6 (6.7)
MBH	1 (2.6)	11 (28.2)	–	15 (38.5)	11 (28.2)	1 (2.6)
SCUH	27 (11.5)	104 (44.3)	11 (4.7)	20 (8.5)	54 (23.0)	19 (8.1)
TPCH	17 (6.7)	130 (51.4)	17 (6.7)	41 (16.2)	38 (15.0)	10 (4.0)
RBWH	5 (4.8)	62 (59.6)	9 (8.7)	12 (11.5)	12 (11.5)	4 (3.8)
PAH	66 (16.0)	180 (43.7)	20 (4.9)	30 (7.3)	93 (22.6)	23 (5.6)
GCUH	20 (9.0)	127 (57.5)	18 (8.1)	35 (15.8)	19 (8.6)	2 (0.9)
STATEWIDE	**159 (10.8)**	**700 (47.5)**	**83 (5.6)**	**173 (11.7)**	**279 (18.9)**	**79 (5.4)**

6.5.2 First medical contact

Across all sites, 57% of patients with a STEMI presented via the Queensland Ambulance Service (QAS). A smaller proportion of patients presented to the emergency department (ED) of either a PCI (onsite ED) or non-PCI capable (satellite ED) facility (11% and 24% respectively). The remaining 8% presented to other health facilities such as general practitioner (GP) clinics, community health centres or other outpatient clinic.

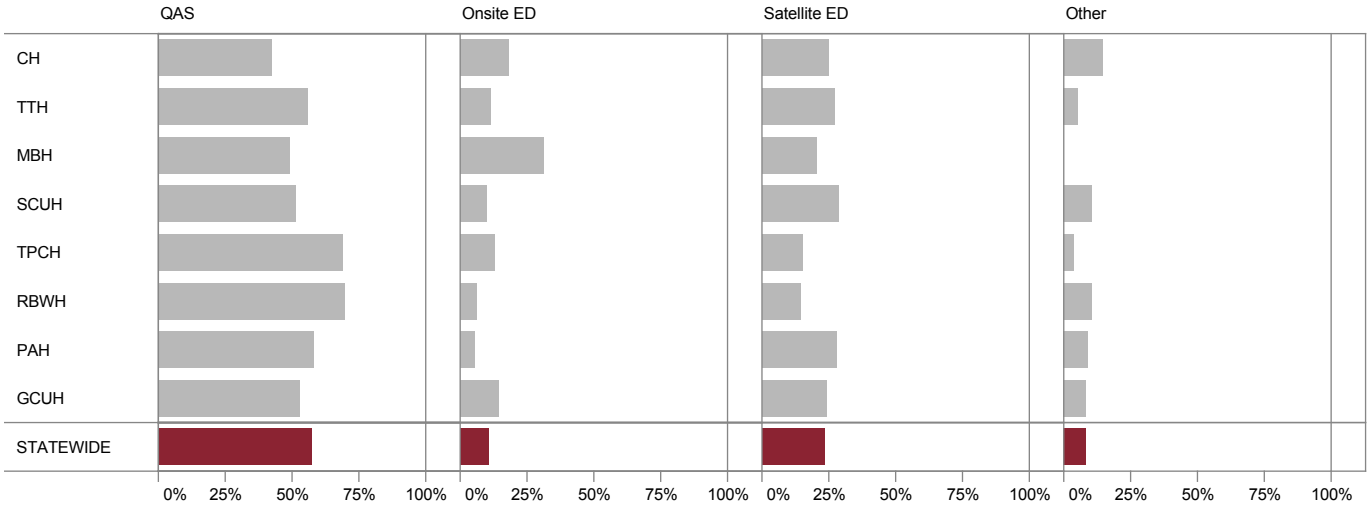


Figure 20: Proportion of STEMI cases by first medical contact

6.5.3 Admission pathway

After first medical contact, almost two-thirds (64%) of STEMI PCI patients were admitted directly to the treating centre.

Admission pathway varied considerably by STEMI presentation. For lysed and rescue PCI, there were 85% and 86% admitted via inter-hospital transfer respectively.

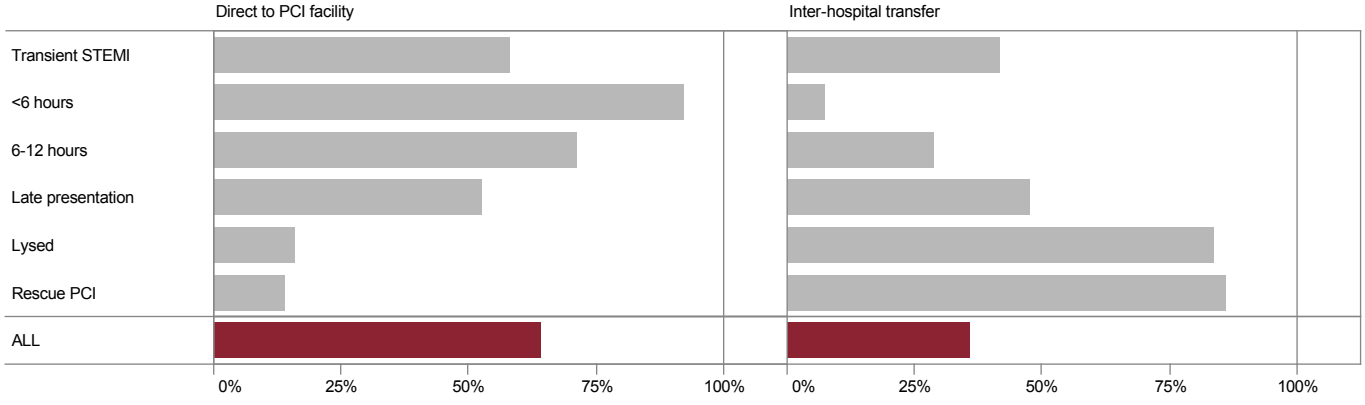


Figure 21: Proportion of STEMI cases by admission pathway and clinical presentation

6.5.4 Thrombolysed patients

The method of reperfusion depends on many factors together determining the treatment method most appropriate and applicable 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.

In 2018, there were a total of 490 thrombolysed STEMI presentations with the majority (73%) receiving a PCI, which increased to 75% when accounting for subsequent staged interventions (Table 20). A smaller proportion (8%) went on to receive coronary artery bypass graft surgery (CABG).

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	48	39 (81.3)	8.1
TTH	45	33 (73.3)	9.0
MBH	19	12 (63.2)	4.7
SCUH	98	73 (74.5)	11.9
TPCH	65	48 (73.8)	4.9
RBWH	31	16 (51.6)	3.8
PAH	158	116 (73.4)	11.3
GCUH	26	21 (80.8)	3.0
STATEWIDE	**490**	**358 (73.0)**	**7.4**

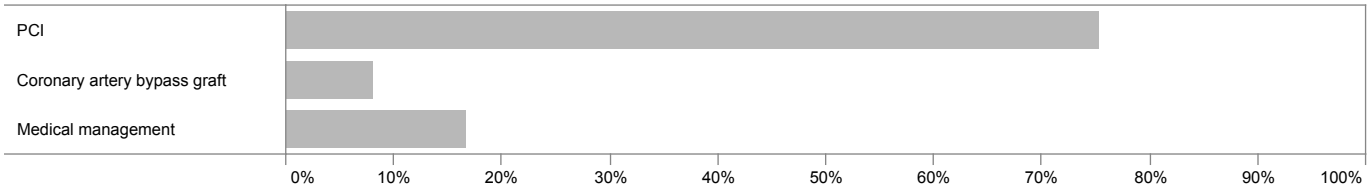


Figure 22: Proportion of lysed patients by clinical management

Table 20: Total lysed patients by clinical management

	%
PCI	75.3
Coronary artery bypass graft surgery	8.0
Medical management	16.7
ALL	**100.0**

For patients receiving pre-hospital thrombolysis, the median time from first medical contact (FMC) to thombolysis administration was 6 minutes less than patients who presented to ED and were lysed in hospital (37 minutes vs 43 minutes).

For ED presenters, these figures should be interpreted with caution due to the volume of missing data and smaller proportion of cases available for analysis compared to QAS presenters (64% vs 21% missing data respectively). This will form a focus for future audits in terms of increasing the availability of data that can be analysed.

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. FMC may occur in the hospital or pre-hospital setting.
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

Site	Total lysed STEMIs n	Total analysed n	Median FMC to lysis minutes	Interquartile range minutes
QAS prehospital thrombolysis	117	115	37	30–50
Presented and lysed at ED	281	102	43	34–65
All others*	92	43	79	60–112
ALL	**490**	**266**	**43**	**33–65**

* Includes initial presentation to QAS or GP and subsequent lysis in hospital

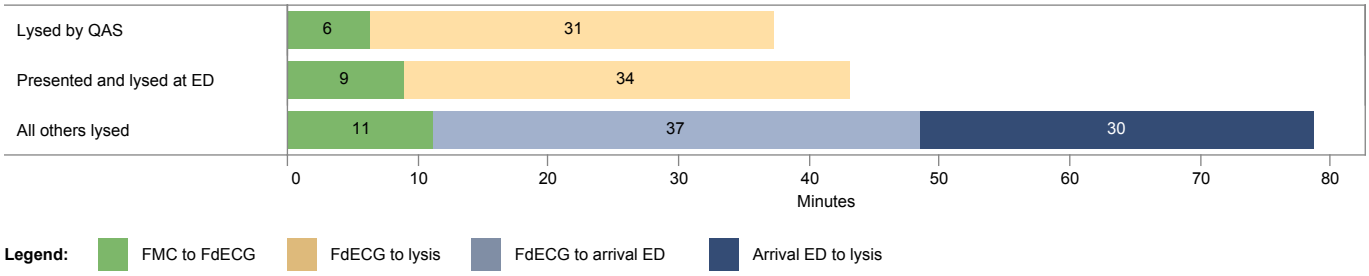


Figure 23: Time to thrombolysis therapy by administration pathway

Approximately one-fifth (19%) of lysed STEMI patients were not indicated for pre-hospital thrombolysis, which resulted in a median 37 minute transport time between FdECG and arrival at the treating facility.

The majority (75%) of these patients had been located within close proximity to hospital. A smaller proportion were not indicated for pre-hospital thrombolysis due to advanced age (15%), significant other comorbidity or complex clinical presentation (Table 23).

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

	n (%)
Close proximity to hospital	69 (75.0)
>75 years of age	14 (15.2)
Cancer	4 (4.3)
Systolic BP >180 mmHg	2 (2.2)
Bleeding or clotting disorder	1 (1.1)
CPR >10 minutes	1 (1.1)
Prolonged pain duration >6 hours	1 (1.1)
ALL	92 (100.0)

6.6 NSTEMI presentations

6.6.1 Case load

Of all PCI and coronary cases performed in CCL facilities during 2018, there were 3,002 coded with a procedural indication of NSTEMI. NSTEMI cases accounted for 29% of PCI cases across all centres, with site variation ranging from 22% to 40%. These figures were almost identical in 2017.

Time to coronary angiography for patients presenting to hospital with a NSTEMI remains a key clinical quality indicator for QCOR. National and international guidelines remain unchanged since the initial 2015 report recommending coronary angiography should be performed within 72 hours of diagnosis[4].

A major barrier to achieving this target is the time taken to transfer patients from non-PCI capable facilities to the accepting PCI centre. Multiple reasons for delays include capacity constraints and transfer logistics, factors which are more complicated to improve than changes in practice. Overall, the figures for 2017 and 2018 (when highly sensitive troponin assays were increasingly used) are broadly similar, suggesting only a minor impact on clinicians' approach to truly high-risk cases.

There were a total of 2,825 patients presenting with NSTEMI, of which over half (52%) were revascularised via PCI, while a further 14% underwent CABG and the remainder were medically managed or referred outside of Queensland Health.

Table 24: NSTEMI cases by site

Site	Total NSTEMI cases n	NSTEMI receiving PCI n (%)	Proportion of all PCI cases %
CH	295	166 (56.3)	34.4
TTH	241	79 (32.8)	21.5
MBH	160	64 (40.0)	24.8
SCUH	330	155 (47.0)	25.2
TPCH	620	257 (41.5)	26.0
RBWH	349	168 (48.1)	40.0
PAH	708	354 (50.0)	34.4
GCUH	299	163 (54.5)	23.2
STATEWIDE	**3,002**	**1,406 (46.8)**	**28.9**

Table 25: NSTEMI cases by site and revascularisation method within 90 days

Site	Total NSTEMI patients n	PCI revascularisation n (%)	CABG revascularisation n (%)	Other management* n (%)
CH	270	161 (59.6)	30 (11.1)	79 (29.3)
TTH	228	93 (40.8)	30 (13.2)	105 (46.1)
MBH	153	72 (47.1)	14 (9.2)	67 (43.8)
SCUH	321	171 (53.3)	26 (8.1)	124 (38.6)
TPCH	592	268 (45.3)	75 (12.7)	249 (42.1)
RBWH	325	170 (52.3)	53 (16.3)	102 (31.4)
PAH	645	354 (54.9)	125 (19.4)	166 (25.7)
GCUH	291	167 (57.4)	30 (10.3)	94 (32.3)
STATEWIDE	**2,825**	**1,456 (51.5)**	**383 (13.6)**	**986 (34.9)**

* Medical management or referred outside of Queensland Health

6.6.2 Admission source

Similar to 2017, there were more NSTEMI cases where the patient was transferred from another hospital than those presenting directly to the PCI facility (53% and 47% respectively).

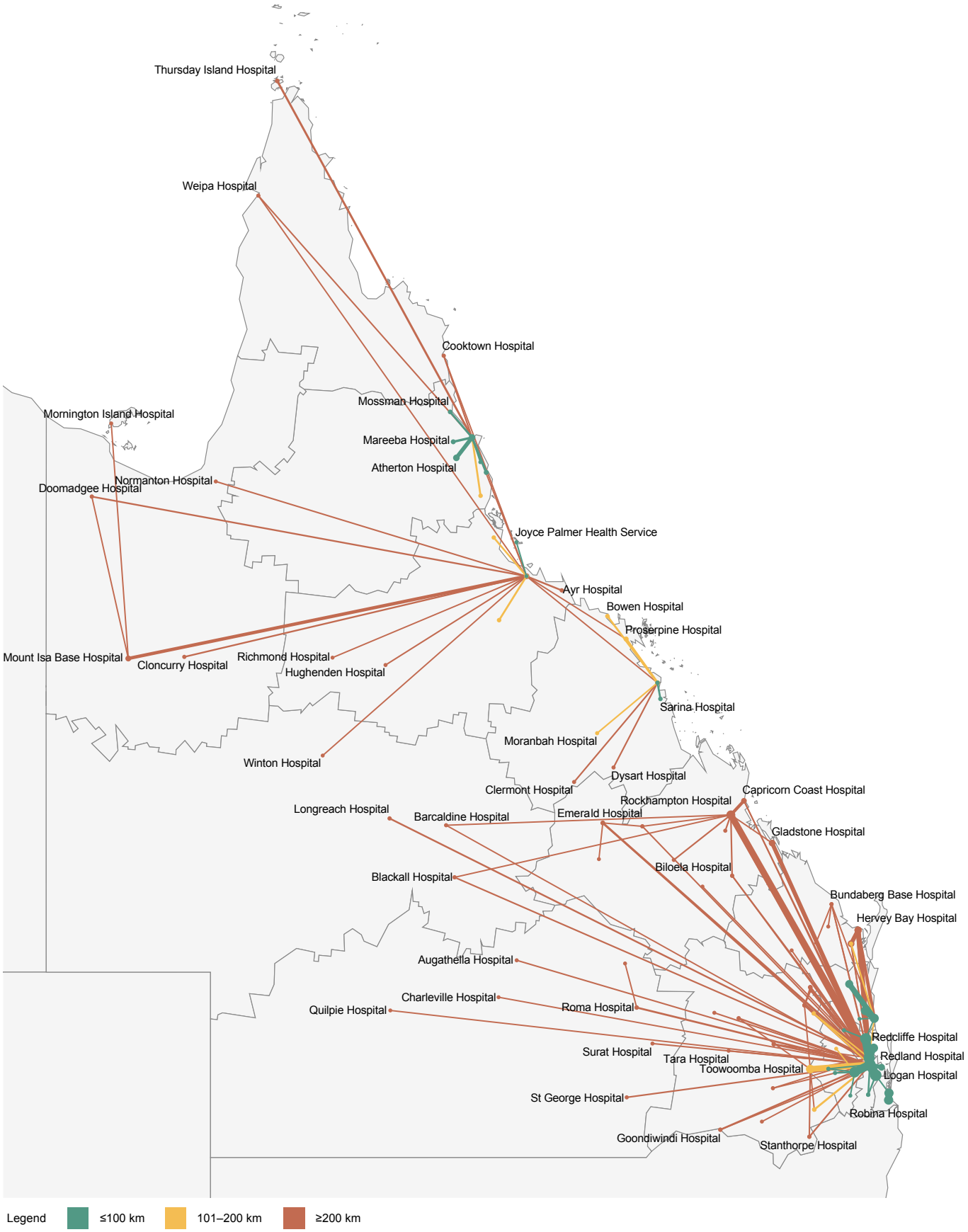
Considerable variation was observed between sites with the proportion of inter-hospital transfers for NSTEMI ranging from 35% to 70%, largely explained by catchment area. Table 27 and Figure 24 provide some perspective based on the cases where geographical data were available.

Table 26: NSTEMI admission source to treating facility

Site	Direct to PCI facility n (%)	Inter-hospital transfer n (%)
CH	189 (64.1)	106 (35.9)
TTH	156 (64.7)	85 (35.3)
MBH	105 (65.6)	55 (34.4)
SCUH	164 (49.7)	166 (50.3)
TPCH	276 (44.5)	344 (55.5)
RBWH	105 (30.1)	244 (69.9)
PAH	242 (34.2)	466 (65.8)
GCUH	169 (56.5)	130 (43.5)
STATEWIDE	**1,406 (46.8)**	**1,596 (53.2)**

Table 27: NSTEMI inter-hospital transfers by estimated distance to transfer

Site	Total analysed n	Median kilometres	Interquartile range kilometres
CH	86	93	78–93
TTH	61	779	263–901
MBH	37	125	125–191
SCH	133	93	30–93
TPCH	295	246	39–605
RBWH	210	281	45–611
PAH	368	40	24–122
GCUH	61	17	17–17
STATEWIDE	**1,251**	**90**	**30–281**



Excludes interstate transfers due to incomplete referring facility data

Figure 24: NSTEMI inter-hospital transfers by estimated distance to transfer

6.6.3 Time to angiography

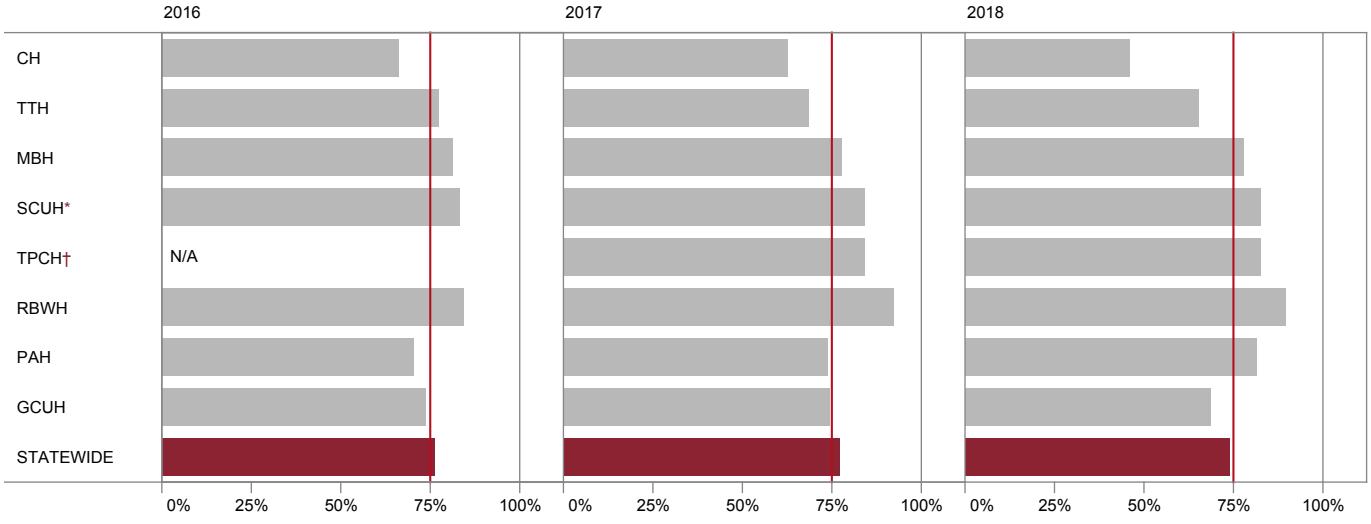
Patients presenting directly to a PCI capable facility had a median wait to coronary angiography of 40 hours and were more likely to have angiography performed within the target timeframe of 72 hours compared with inter-hospital transfers (74% vs 50%).

For direct presenters, the wide range of 19 hours–75 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 2017, there was for direct presenters (Table 28) only a minor increase in NSTEMI cases available for analysis (1,227 vs 1,208) but a slight reduction in the proportion meeting target (74% vs 78%). In contrast, for inter-hospital transfers (Table 29), there was a reduction in both cases available for analysis (1,251 vs 1,371) and proportion meeting target (54% vs 50%).

Table 28: Time to angiography for direct presenters

Site	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	189	153	83	43–131	45.8
TTH	156	136	58	31–87	65.4
MBH	105	100	39	19–70	78.0
SCUH	164	155	35	20–56	82.6
TPCH	276	253	24	14–53	82.6
RBWH	105	80	22	13–38	90.0
PAH	242	191	38	21–64	81.7
GCUH	169	159	47	22–83	68.6
STATEWIDE	**1,406**	**1,227**	**40**	**19–75**	**74.2**



* PCI service for Nambour General Hospital transferred and counted under SCUH from 2017 onwards

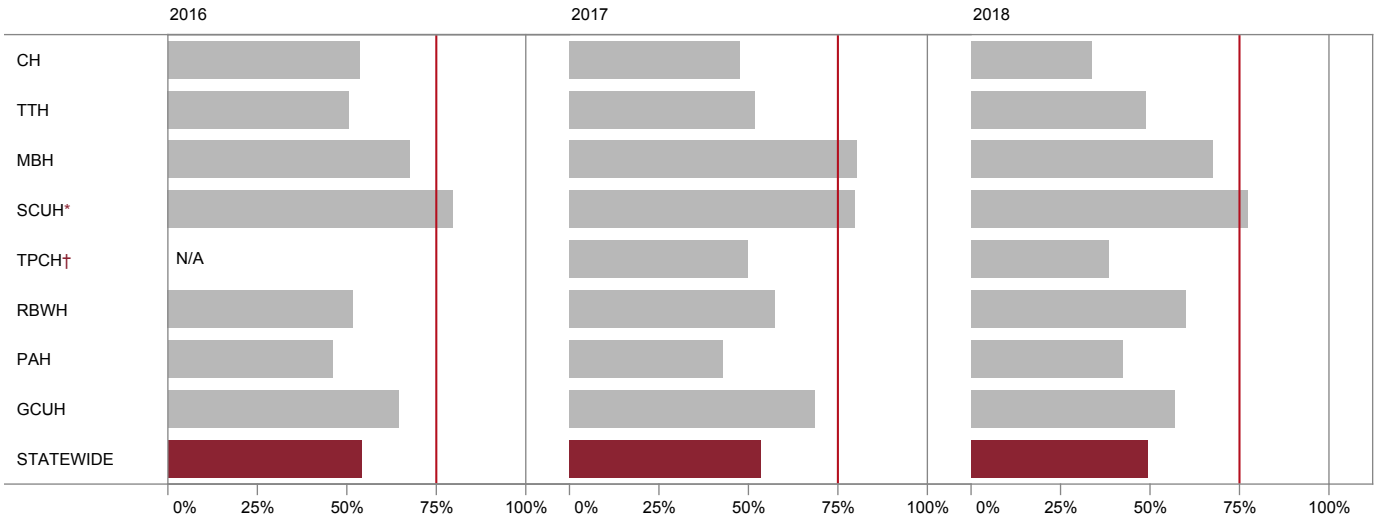
† TPCH interventional cardiology data available from 2017

Figure 25: Proportion of NSTEMI direct presenters receiving angiography within 72 hours, 2016 to 2018

These data highlight the ongoing potential for overall system improvement and the opportunity to review statewide and local strategies to deal with two distinct cohorts: direct presenters and inter-hospital transfers.

Table 29: Time to angiography for inter-hospital transfers

SITE	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	106	86	97	53–145	33.7
TTH	86	61	73	55–97	49.2
MBH	55	37	37	22–84	67.6
SCUH	166	133	46	25–68	77.4
TPCH	343	295	92	48–138	38.6
RBWH	244	210	64	43–93	60.0
PAH	466	368	84	56–115	42.7
GCUH	130	61	69	49–100	57.4
STATEWIDE	**1,596**	**1,251**	**72**	**46–114**	**49.5**



* PCI service for Nambour General Hospital transferred and counted under SCUH from 2017 onwards

† TPCH has contributed data to QCOR from 2017 onwards

Figure 26: Proportion of NSTEMI inter-hospital transfers receiving angiography within 72 hours, 2016 to 2018

7 Clinical indicators

The interventional cardiology clinical indicator program is a valuable focus of QCOR. Many key guidelines within Australia and internationally advise the use of defined and validated quality indicators as a means to measure and improve patient care.

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 and international best practice recommendations.

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 FdECG
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 despite successful PCI being performed, from the underlying condition for which PCI is being done.

The overall 30 day unadjusted mortality rate for patients undergoing PCI procedures at Queensland public hospitals for 2018 was 1.9%. This result compares favourably with the 30 day mortality rate of 2.8% presented by the British Cardiovascular Interventional Society (BCIS) in their review of PCI outcomes for the 2014 calendar year (chosen as the comparator as BCIS reports in subsequent years have given in-hospital rather than 30 day mortality).[5]

Table 31 presents unadjusted mortality according to admission status. As should be expected, the risk of death increases according to the severity of the patient's condition (admission status). Mortality was 58% 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	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)	Case count n	Total deaths n (%)
CH	1 (0.8)	3 (1.1)	4 (5.0)	4 (44.4)	483	12 (2.5)
TTH	1 (1.2)	–	1 (1.7)	6 (66.7)	368	8 (2.2)
MBH	–	1 (0.9)	1 (5.0)	–	258	2 (0.8)
SCUH	1 (1.0)	2 (0.6)	3 (1.8)	1 (50.0)	616	7 (1.1)
TPCH	–	5 (1.0)	7 (3.5)	11 (78.6)	989	23 (2.3)
RBWH	–	3 (1.1)	1 (1.2)	3 (42.9)	420	7 (1.7)
PAH	–	3 (0.5)	8 (3.3)	5 (38.5)	1,029	16 (1.6)
GCUH	–	3 (0.9)	9 (4.6)	7 (77.8)	704	19 (2.7)
STATEWIDE	**3 (0.3)**	**20 (0.8)**	**34 (3.2)**	**37 (57.8)**	**4,867**	**94 (1.9)**

% of total cases by presentation and site

Figure 27 presents the observed mortality rates by site, superimposed on the predicted mortality rates (with 95% confidence interval) calculated using the Victorian Cardiac Outcomes Registry (VCOR) risk adjustment model[6]. This analysis used an imputed dataset to account 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 6 factors – ACS, age, LAD coronary artery involvement, renal function, left ventricular function, and cardiogenic shock. Other critical presentations with very high mortality risk, such as out-of-hospital ventricular fibrillation (VF) arrest with uncertain neurological recovery, are not adjusted for and therefore the model is likely to underestimate true mortality risk. This is relevant in our dataset where there were marked differences between hospitals in the proportion of high-risk salvage patients taken for PCI (ranging from 0.3%–2.4% 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 28 presents the observed and expected mortality rates excluding salvage.

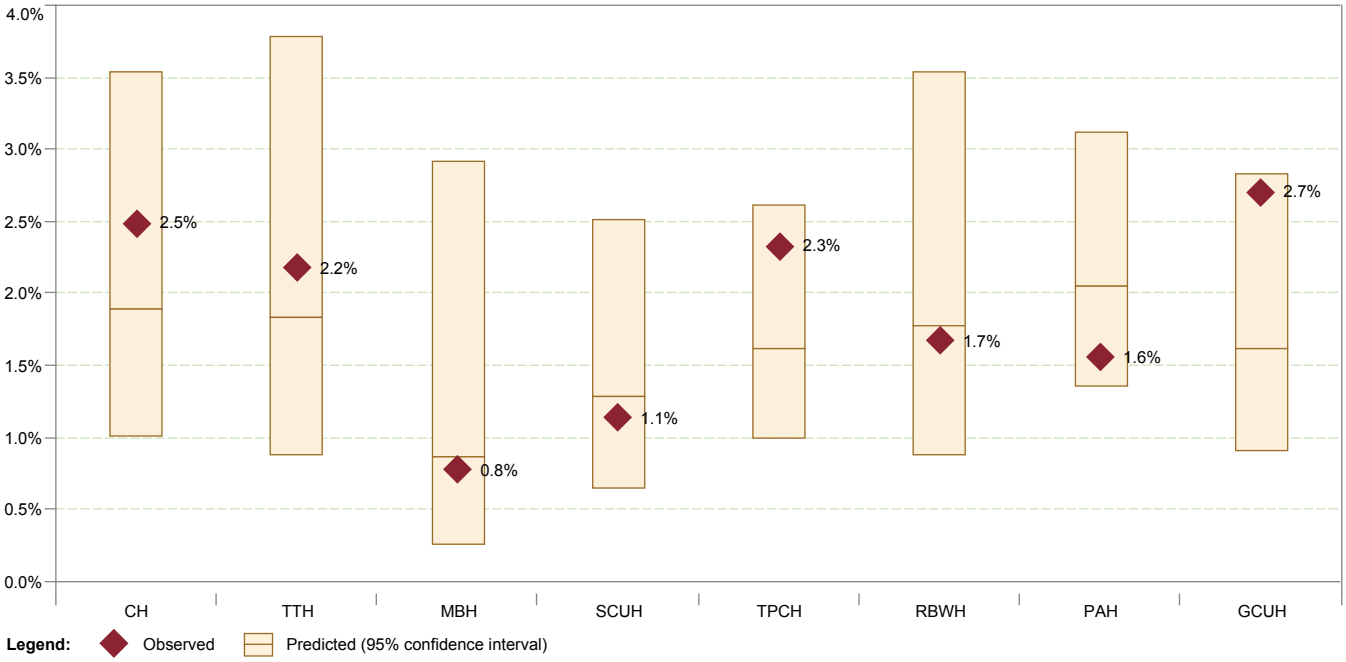
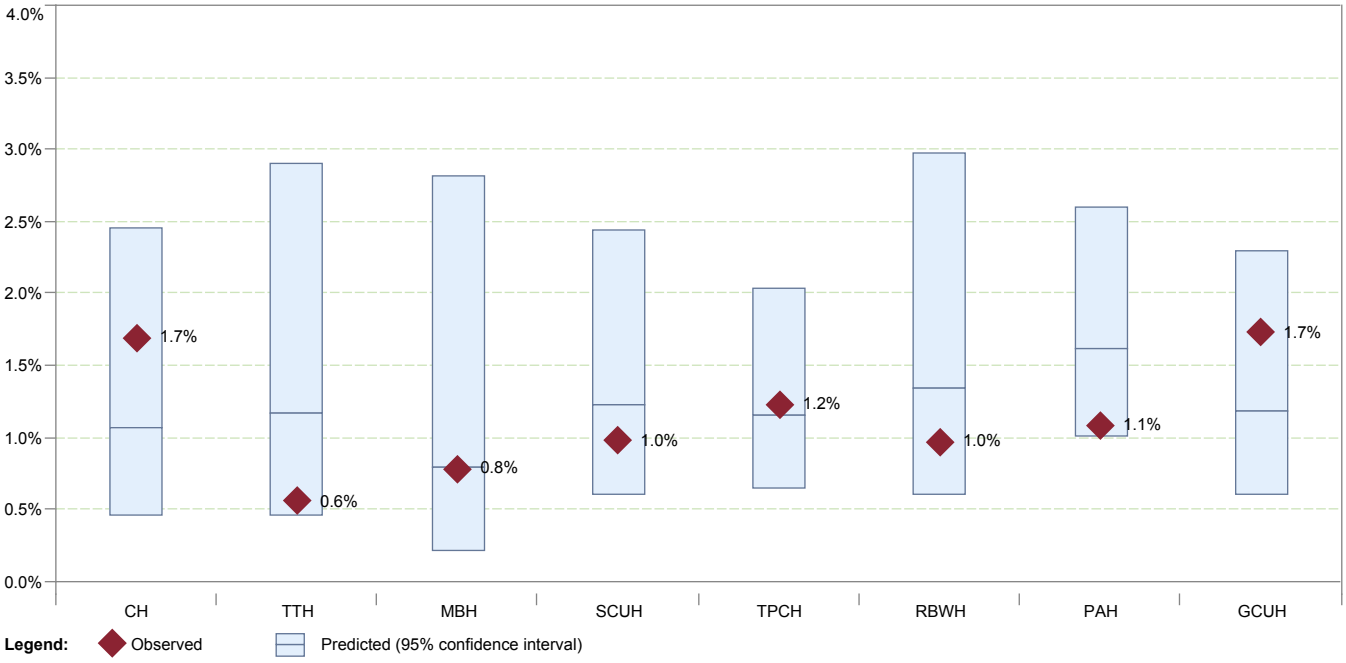


Figure 27: Comparison of observed and predicted mortality rates by site

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[5], and the American College of Cardiology (ACC) CathPCI registry[7]. 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 us to recalibrate and adapt one of these models to the specific characteristics of our 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=64)

Figure 28: 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 1,810 documented STEMI cases in 2018, 1,473 cases (81%) included a PCI intervention and are the subject of the following outcomes analyses. For this analysis, patients presenting as salvage are excluded, allowing focus to be retained on the measurement of PCI outcomes.

The outcomes for cohort of STEMI patients who underwent primary PCI remain encouraging. All-cause mortality rates at 30 days varied from 0.9% to 4.2% between participating facilities with a statewide rate of 2.3%. Of these 1,424 patients analysed, a total of 33 mortalities were identified with the majority (73%) 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 n (%)
CH	–	3	–	113	3 (2.7)
TTH	–	1	–	81	1 (1.2)
MBH	–	1	–	38	1 (2.6)
SCUH	1	1	–	233	2 (0.9)
TPCH	–	5	3	242	8 (3.3)
RBWH	–	1	–	99	1 (1.0)
PAH	1	7	–	402	8 (2.0)
GCUH	1	5	3	216	9 (4.2)
STATEWIDE	**3**	**24**	**6**	**1,424**	**33 (2.3)**

* Excluding salvage cases (n=49)

7.1.3 STEMI presentation within 6 hours from symptom onset

Further analysis of the STEMI cohort who underwent primary PCI within 6 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 are again 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 n (%)
CH	–	1	–	42	1 (2.4)
TTH	–	1	–	38	1 (2.6)
MBH	–	1	–	10	1 (9.1)
SCUH	–	–	–	103	0 (0.0)
TPCH	–	1	2	123	3 (2.4)
RBWH	–	–	–	60	0 (0.0)
PAH	–	3	–	172	3 (1.7)
GCUH	1	5	2	124	8 (6.5)
STATEWIDE	**1**	**14**	**4**	**673**	**17 (2.5)**

* Excluding salvage cases (n=27)

7.2 STEMI less than 6 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-to-device time as an important modifiable and objective measure of overall STEMI system performance.[8]

Both the European and American STEMI guidelines recommend a target first diagnostic ECG-to-device time less than 90 minutes.[8,9] It is widely recognised that these targets are ambitious and difficult to achieve in real-world practice as primary PCI becomes more available to larger catchment populations.

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

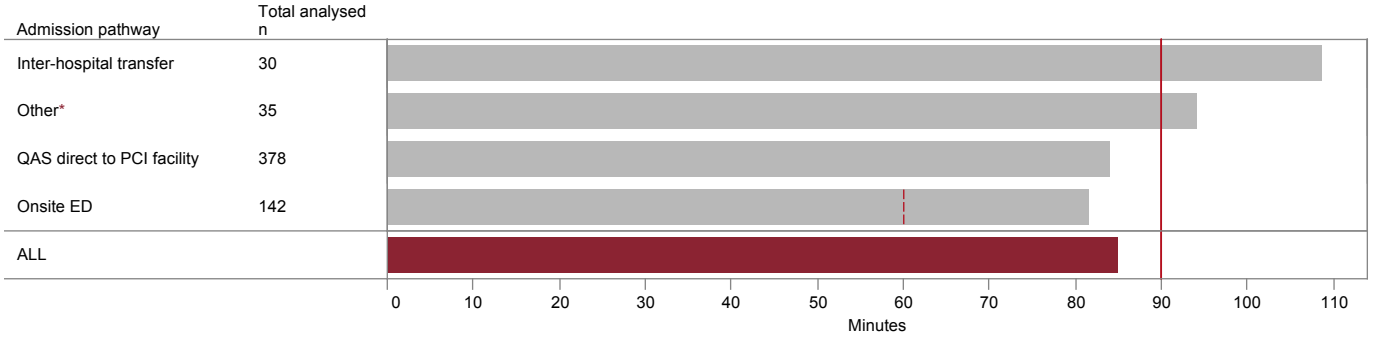
Table 34: Definitions for STEMI time to reperfusion

Time	Definition
First diagnostic ECG	FdECG refers to the timestamp when the ECG shows ST-elevation (or equivalent) and can be regarded as time zero in the therapeutic pathway. The interpretation of FdECG 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 complete perfusion observed on initial angiography, that timestamp is used instead of first device time.

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

In total, there were 700 STEMI primary PCI cases presenting within 6 hours of symptom onset. Of these, there were 115 cases which had been excluded per the criteria in Table 35 leaving 585 cases which are eligible for the following analysis. Further cases are excluded from the arrival at PCI facility to reperfusion analysis, which is presented later, where timestamps for arrival at the PCI facility were missing or not recorded.

As observed in previous QCOR Audits, there was considerable variation in time from FdECG to reperfusion depending on the admission pathway to the treating facility, ranging from 109 minutes to 82 minutes for inter-hospital transfers and PCI facility onsite ED respectively.



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

Figure 29: STEMI presenting within 6 hours of symptom onset – median FdECG to first device time by admission pathway

Table 35: STEMI <6 hours cases ineligible for analysis

Summary	n
Out-of-hospital arrest	33
Salvage	25
Significant comorbidities/frailty	13
Intubation	11
Previous CABG	10
Shock/acute pulmonary oedema	8
Unsuccessful PCI	8
Thrombolysis contraindicated	7
Total ineligible	**115**

7.2.1 Time from first diagnostic ECG to first device

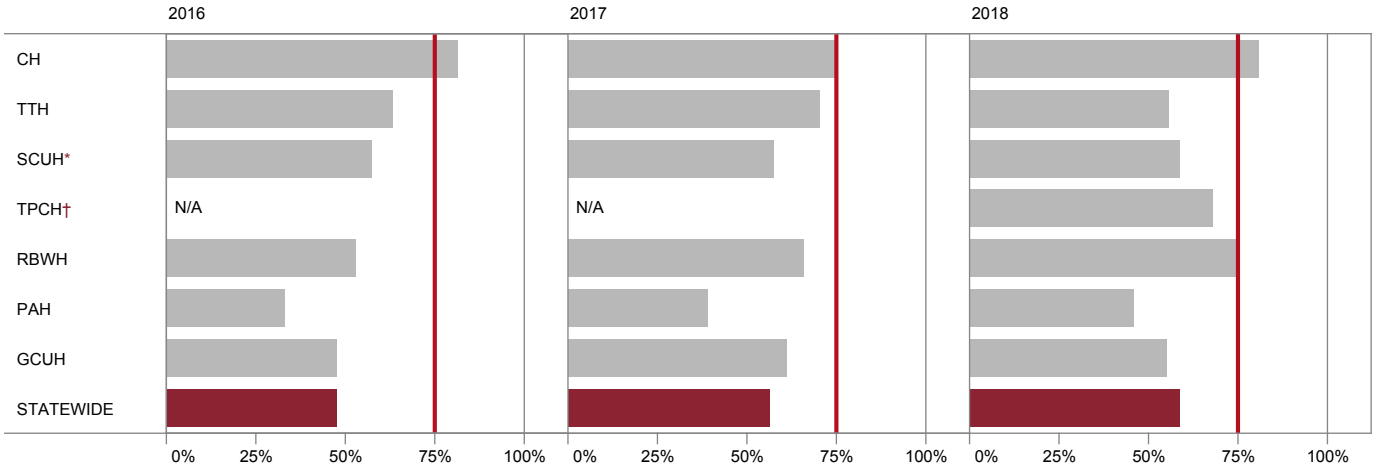
The all-site median time from FdECG to reperfusion was 85 minutes, with median individual site times ranging from 66 minutes to 94 minutes. These results indicate that overall Queensland public facilities are approaching the ambitious benchmark of 90 minutes from time of FdECG to first device. However, only 59% of patients analysed receive timely reperfusion per current guidelines (FdECG to reperfusion)[6], 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 36: FdECG to reperfusion for STEMI presenting within 6 hours of symptom onset

SITE	Total cases n	Total analysed n	Median minutes	Interquartile range minutes	Met 90 min target %
CH	44	37	66	56–81	81.1
TTH	42	34	82	52–100	55.9
MBH*	11	10	–	–	–
SCUH	104	95	85	73–106	58.9
TPCH	130	107	81	70–94	68.2
RBWH	62	54	80	66–89	75.9
PAH	180	149	94	79–115	46.3
GCUH	127	99	86	76–108	56.6
STATEWIDE	**700**	**585**	**85**	**71–106**	**59.1**

* MBH is not displayed as it has ‹20 cases for analysis



MBH is not displayed as it has ‹20 cases for analysis

* PCI service for Nambour General Hospital transferred and counted under SCUH from 2017 onwards

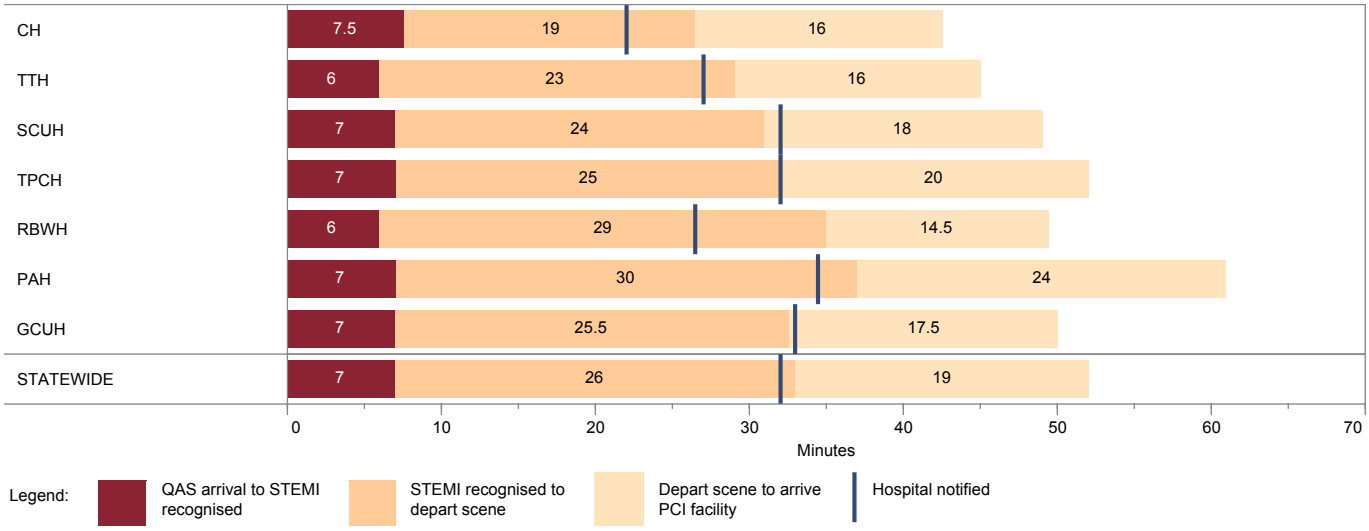
† TPCH data collection extended to include FdECG timestamps in 2018

Figure 30: Proportion of STEMI cases (‹6 hours of symptom onset) where time from FdECG to reperfusion met 90 min target, 2016–2018

Pre-hospital notification processes

The QAS has a well-established process for the management of pre-hospital STEMI. On recognition by a QAS paramedic of STEMI meeting criteria for primary PCI, direct contact is made with the on-call interventional cardiologist of the receiving hospital via a dedicated referral line. A pre-hospital treatment plan is agreed upon and, if primary PCI is appropriate, the CCL is activated.

From 2019, a discrete timestamp for when the PCI cardiologist is consulted will be collected separately for reporting.



MBH not displayed due to <20 cases available for analysis

Figure 31: STEMI presenting within 6 hours of symptom onset pre-hospital component breakdown – QAS direct to PCI facility

Hospital processes

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

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

7.2.2 Time from arrival PCI capable facility to first device

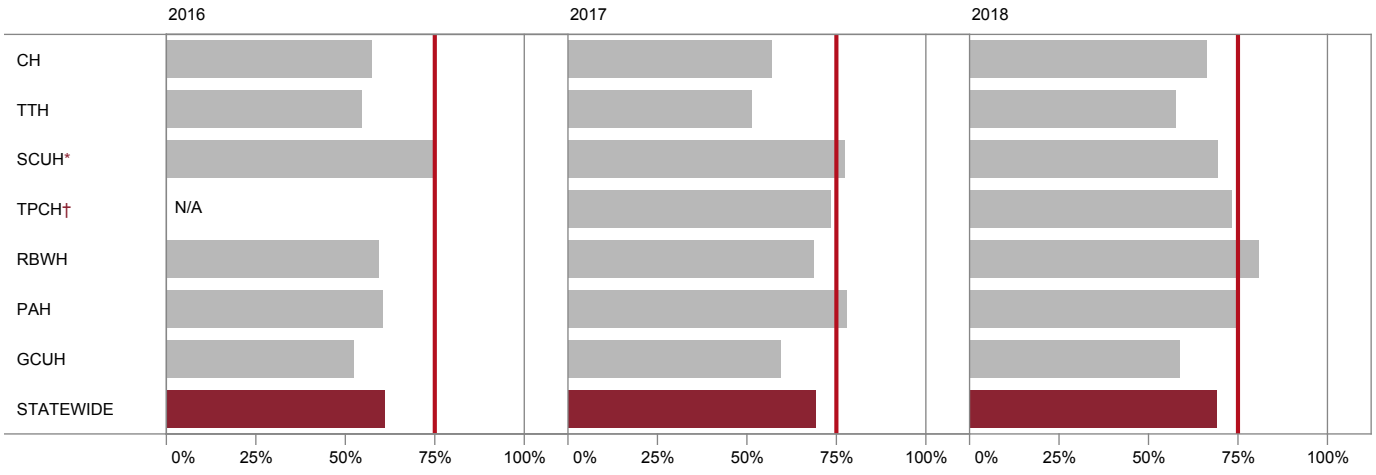
The time between PCI facility arrival and reperfusion ('door-to-device' time) is currently the accepted measure of PCI facility system performance in STEMI. Historically, hospitals have worked to a goal of less than 90 minutes, although more recent guidelines have shortened this target time to less than 60 minutes.[4,9]

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 42 minutes (range 35 minutes to 49 minutes across sites).

Table 37: Arrival at PCI hospital to first device for STEMI presenting within 6 hours of symptom onset

SITE	Total cases n	Total analysed n	Median minutes	Interquartile range minutes	Met 60 min target %
CH	44	33	48	28–64	66.7
TTH	42	33	46	35–72	57.6
MBH*	11	10	–	–	–
SCUH	104	87	38	27–70	69.0
TPCH	130	105	39	28–65	73.3
RBWH	62	52	35	27–45	80.8
PAH	180	145	38	28–57	75.9
GCUH	127	93	49	36–82	59.1
STATEWIDE	**700**	**558**	**42**	**29–67**	**69.5**

* MBH is not displayed as it has ‹20 cases for analysis



* PCI service for Nambour General Hospital transferred and counted under SCUH from 2017 onwards

† TPCH interventional cardiology data available from 2017

Figure 32: Proportion of cases where arrival at PCI hospital to first device ≤60 minutes was met for STEMI presenting within 6 hours of symptom onset, 2016–2018

7.3 NSTEMI – time to angiography

Coronary angiography is necessary to determine the severity of coronary disease with both quality of life and prognostic implications for patients presenting with non-ST-elevation myocardial infarction. National and international guidelines recommend that this should be offered and 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.[4]

For this indicator, the QCOR Interventional Cardiology Committee recommended that the benchmark for treatment should remain at 72 hours in order to capture all-comers with the working diagnosis of NSTEMI. It is acknowledged that the wider use of highly sensitive troponin assays might translate into greater heterogeneity in diagnosis and disease severity without the potential benefit of a universal risk prediction score.

Table 38 lists the cases excluded from analysis and the reasons for exclusion, the first being particularly pertinent in preventing corruption of meaningful interpretation by cases of incidental static elevation in cardiac biomarkers.

Table 38: NSTEMI time to angiography cases ineligible for analysis

	n
Admitted with an unrelated principal diagnosis	137
Planned or staged PCI	125
Transferred from an interstate hospital	65
Coronary angiography not performed at index admission	58
Transferred from a private hospital	41
Stable non-admitted patients transferred directly to lab for planned angiography	23
Incomplete data	75
Total ineligible	**524**

Of a total of 3,002 NSTEMI cases, 53% were inter-hospital transfers and 48% received PCI. The median time to angiography with or without PCI was 58 hours (direct presenters 40 hours vs inter-hospital transfers 72 hours). By comparison, the corresponding figures for 2017 were 53 hours, 37 hours and 68 hours. Figure 33 depicts the proportions of cases meeting target in the last 3 years.

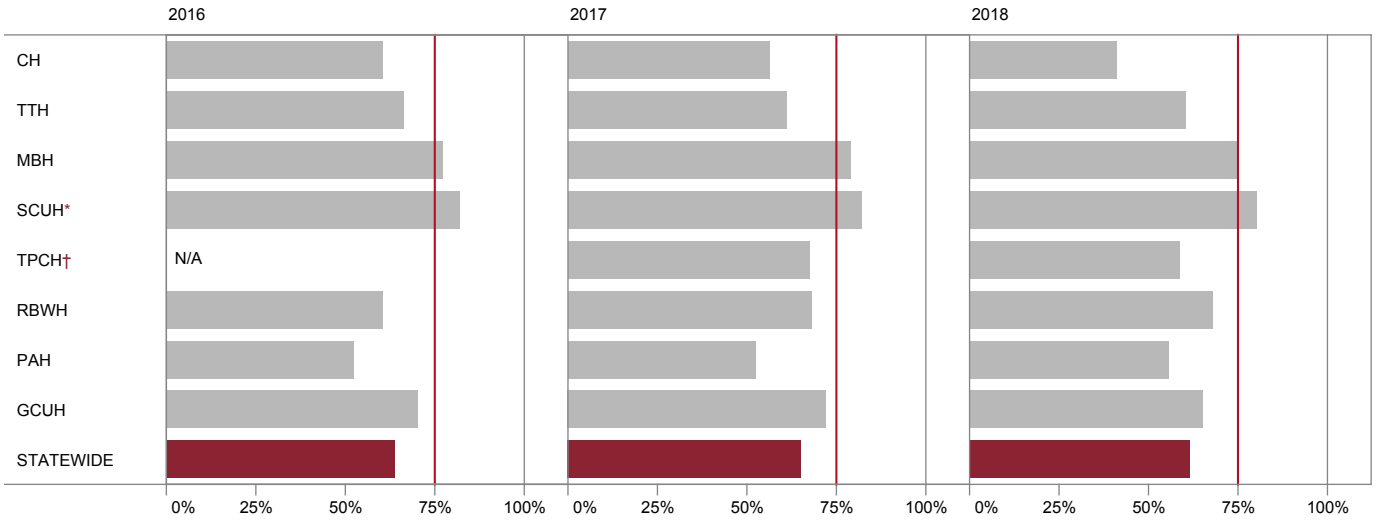
Across the state, the baseline for each PCI centre likely reflects the demographics, logistics and pathways that pertain to that centre. Overall performance from year to year appears to be static (Figure 33), with only about 62% of all cases (direct presenters and inter-hospital transfers) meeting target.

Notwithstanding that the somewhat arbitrary target of 75% for a wait of ‹72 hours to angiography is partly based on historical data, there clearly is room for improvement across the state for both direct presenters and inter-hospital transfers. One future consideration for more sophisticated targeted and meaningful analysis to enhance quality improvement is stratifying the NSTEMI population by whether they actually proceed to revascularisation during the index admission.

With further maturation and robust data entry, the registry will also allow correlation of this time-sensitive quality indicator with the hard end-points of 30 day cardiac mortality and non-fatal STEMI.

Table 39: NSTEMI time to angiography by site

SITE	Total NSTEMI cases n	Total analysed n	Inter-hospital transfers %	Median hours	Interquartile range hours	Met 72 hour target %
CH	295	239	35.9	89	47–136	41.4
TTH	241	197	35.3	64	39–90	60.4
MBH	160	137	34.4	38	19–72	75.2
SCUH	330	288	50.3	37	22–66	80.2
TPCH	620	548	55.5	53	21–110	58.9
RBWH	349	290	69.9	53	30–82	68.3
PAH	708	559	65.8	67	38–98	56.0
GCUH	299	220	43.5	56	27–87	65.5
STATEWIDE	**3,002**	**2,478**	**53.2**	**58**	**28–95**	**61.7**



* PCI service for Nambour General Hospital transferred and counted under SCUH from 2017 onwards

† TPCH interventional cardiology data available from 2017

Figure 33: Proportion of NSTEMI cases meeting time to angiography target of 72 hours, 2016–2018

7.4 Major procedural complications

This quality indicator examines in lab intra-procedural complications. In 2018, 30 cases (0.62%) recorded an immediate major procedural complication.

Events included in this analysis are coronary artery perforation, in lab death, pericardial tamponade and emergency CABG.

Overall, the numbers are far too low for further comment, other than to state that it is reassuring.

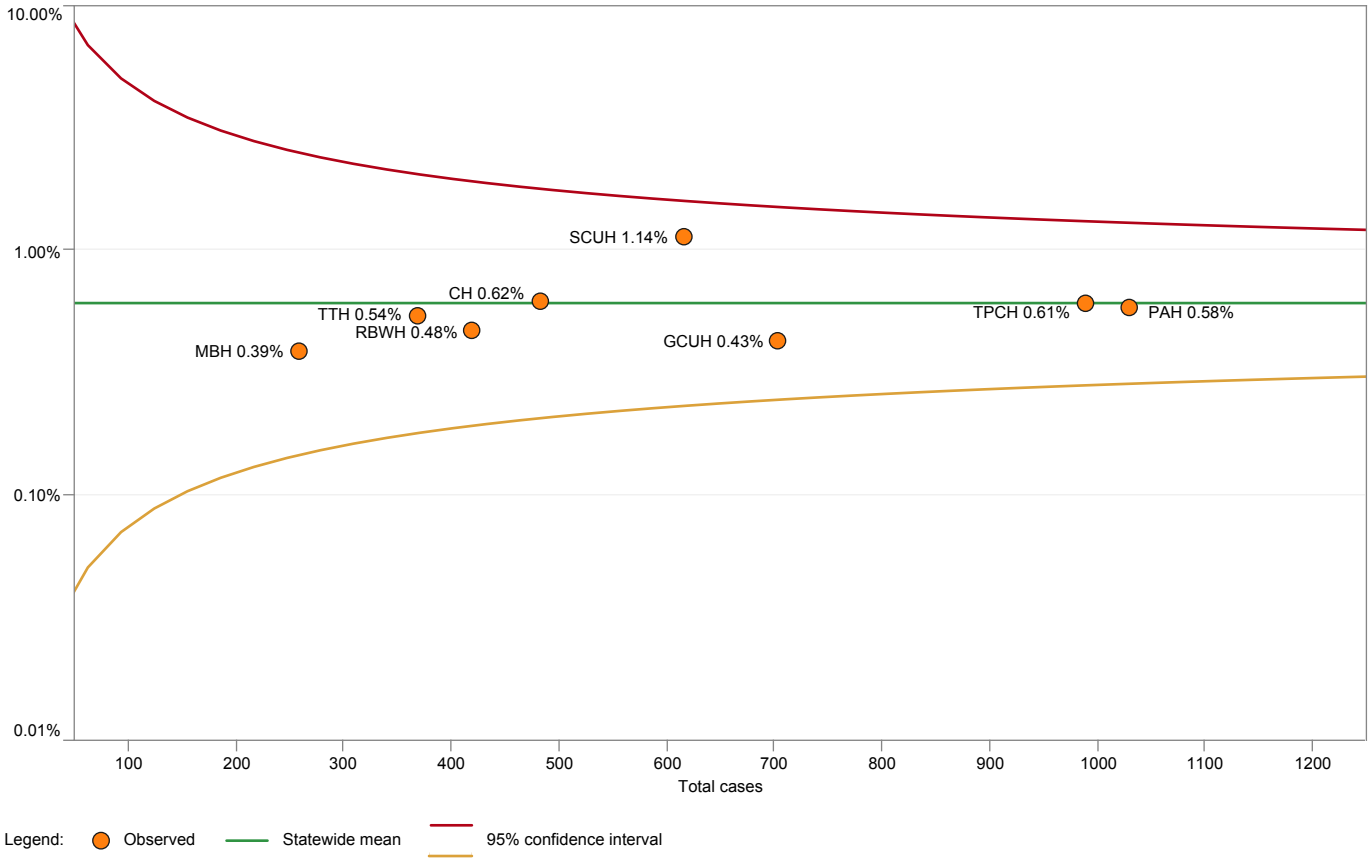


Figure 34: Proportion of PCI cases with immediate major procedure complication by site

Table 40: All PCI cases by immediate major procedural complication type

Complication type	Case n	%
Major intra-procedural complication	**30**	**0.62**
In lab death*	4	0.08
Coronary artery perforation	23	0.47
Emergency CABG	3	0.06
No immediate major procedural complication	4,837	99.38
Total	**4,867**	**100.00**

* Excluding salvage deaths

7.5 Safe radiation doses

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

Fortunately, conservative thresholds are applied and monitored throughout Queensland. However, as the complexity of procedural work undertaken by interventional cardiologists increases, along with an increase in patients with a large body mass, it is increasingly important to remain vigilant about radiation hygiene. This indicator examines the proportion of cases exceeding the high dose threshold of 5Gy.

Table 41: Proportion of cases meeting the safe dose threshold by case type

Site	PCI procedures %	Other coronary procedures %
CH	99.8	99.7
TTH	99.5	100.0
MBH	99.6	100.0
SCUH	99.7	99.9
TPCH	99.1	100.0
RBWH	98.1	100.0
PAH	98.1	99.9
GCUH	99.9	99.9
STATEWIDE	**99.1**	**99.9**

8 Conclusions

This year's Interventional Cardiology Audit has built on the valuable foundation work that has been undertaken to further investigate a wide range of clinically relevant focus areas as well as cross-registry investigation to better understand the interplay between PCI and surgical revascularisation. Utilisation of this data will help to inform further efforts in this space.

An area of focus has been the collection of supporting risk adjustment data. These efforts have realised an enormous improvement in completeness and quality. The endeavours of site quality improvement coordinators and data managers are to be commended with the rate of data completion showing continued improvement through the year and this is evident in the completeness of the 2018 report.

Risk adjustment continues to be a focus of both local and international registries to better report quality and safety. Though the limitations of reporting and using mortality as a metric for quality are well-known, it is a focus of the group to investigate the utilisation of better-calibrated risk models to properly understand and monitor patient outcomes.

Further to this, it is anticipated that the currently reported clinical indicators be reviewed to ensure continued clinical relevance and utility. Given the current works in developing a national PCI registry, it is timely and appropriate to reflect on current indicators and if necessary, amend what is currently reported. This will ensure ongoing monitoring reflects contemporary best clinical practice and drive continual improvement.

The valuable input of the QAS in this year's report exemplifies the positive relationship by continuing to collaborate to produce quality, translational results. This collaboration has been the basis of focused examination of patients undergoing pre-hospital thrombolysis which has produced analysis that enables optimisation and monitoring of this critical clinical service. It is anticipated with expanded data capture capacity that this area will be explored further and with greater detail in future reports.

Structural heart disease interventions continue to become a larger part of the work performed in the CCL. Data collection in this area continues to be a focus for future development, with a new clinical application in the advanced stages of delivery. It is hoped that with further insight into these patients, review of local practice can occur and a consolidated means for contributing to national registries can be employed.

The current analyses undertaken as part of the infrastructure in place for QCOR has continued to deliver significant successes through secondary uses of clinical data. QCOR PCI data has informed several planning and procurement activities that continue to deliver benefits for all Queenslanders through cost-saving, avoidance, and redirection of funding to areas of need. Through the tireless work of clinicians and support staff, the return on investment in QCOR data collection and analysis continues to be realised.

9 Supplement: Structural heart disease

This 2018 edition of the QCOR structural heart disease (SHD) supplementary report has progressed to include all SHD procedures performed in Queensland public CCL facilities. The SHD supplement along with the formation of a QCOR SHD sub-committee illustrates the sustained focus of the QCOR Interventional Cardiology Committee to providing insight into this expanding area of cardiac care. The Statewide Cardiac Clinical Network remains committed to extending registry participation to private healthcare facilities in the near future.

The launch of a bespoke procedural reporting and registry module for SHD will provide clinicians a tailored point-of-care reporting tool and enable participation in national quality and patient safety auditing activities.

9.1 Participating sites

In 2018, there were 7 participating CCL facilities performing a total of 401 SHD interventions.

Table 1: Total SHD cases by participating site

Site	Total cases n	Device closure* n (%)	Valvular intervention† n (%)	Other‡ n (%)
CH	16	10 (62.5)	6 (37.5)	–
TTH	24	14 (58.3)	10 (41.7)	–
SCUH	17	8 (47.1)	9 (52.9)	–
TPCH	207	35 (16.9)	169 (81.6)	3 (1.4)
RBWH	18	8 (44.4)	10 (55.6)	–
PAH	70	33 (47.1)	36 (51.4)	1 (1.4)
GCUH	49	16 (32.7)	27 (55.1)	6 (12.2)
STATEWIDE	**401**	**124 (30.9)**	**267 (66.6)**	**10 (2.5)**

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

† Percutaneous valve replacement and valvuloplasty

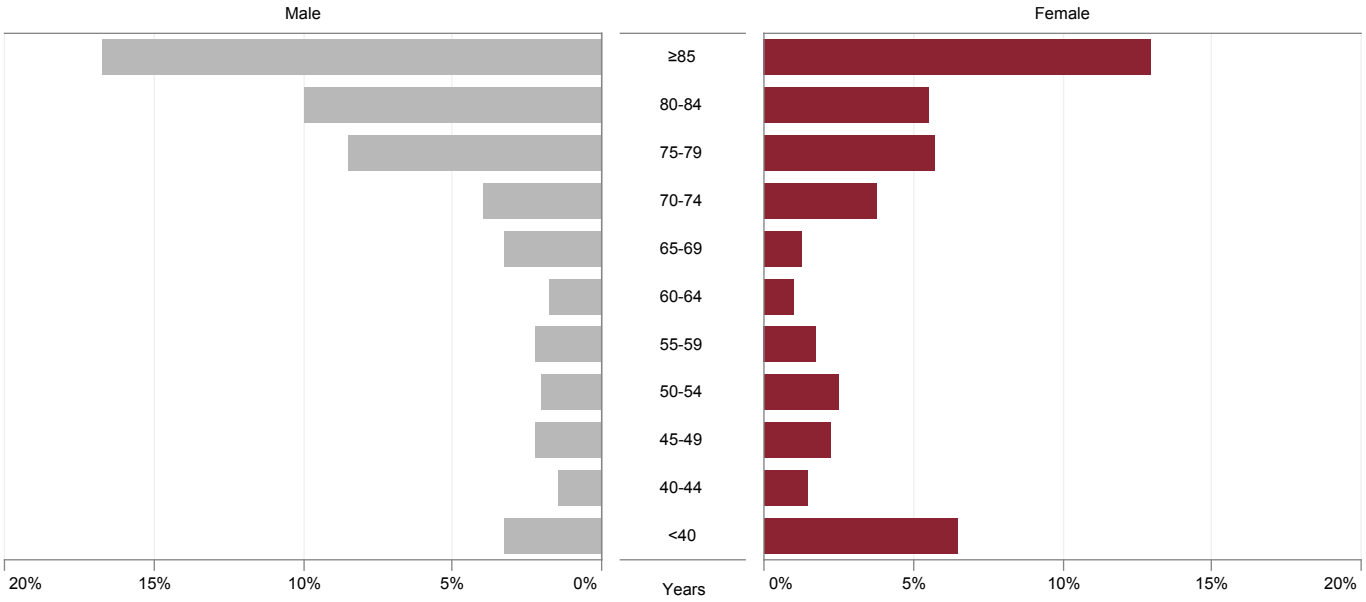
‡ Myocardial septal ablation and renal denervation

9.2 Patient characteristics

9.2.1 Age and gender

Patients undergoing an SHD intervention were distributed between genders at 55% male and 45% female.

Age varied considerably by procedure category, with patients undergoing a valvular intervention having an overall median age of 84 years compared to 50 years for device closure procedures.



% of total (n=401)

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

Table 2: Median age by gender and procedure category

	Male years	Female years	All cases years
Device closures	53	48	50
Valvular intervention	84	85	84
Other	55	54	55
ALL	**80**	**78**	**79**

9.3 Care and treatment of SHD patients

9.3.1 Device closures

In 2018, there were a total of 124 device closures performed across participating centres. The most common procedures were for the correction of a patent foramen ovale (PFO), followed by atrial septal defect (ASD) at 55% and 34% of overall case volumes respectively.

Table 3: Device closure procedures by participating site

Site	Total cases n	PFO* n (%)	ASD† n (%)	PDA‡ n (%)	LAA§ n (%)	Para-valvular leak n (%)
CH	10	6 (60.0)	4 (40.0)	–	–	–
TTH	14	8 (57.1)	6 (42.9)	–	–	–
SCUH	8	8 (100.0)	–	–	–	–
TPCH	35	12 (34.3)	10 (28.6)	3 (8.6)	9 (25.7)	1 (2.9)
RBWH	8	8 (100.0)	–	–	–	–
PAH	33	11 (33.3)	21 (63.6)	–	–	1 (3.0)
GCUH	16	15 (93.8)	1 (6.3)	–	–	–
STATEWIDE	**124**	**68 (54.8)**	**42 (33.9)**	**3 (2.4)**	**9 (7.3)**	**2 (1.6)**

* Patent foramen ovale

† Atrial septal defect

‡ Patent ductus arteriosus

§ Left atrial appendage

9.3.2 Valvular interventions

In 2018, there were 267 valvular interventions performed across 7 participating sites. These comprised of transcatheter valvuloplasty (Table 6) and transcatheter valve replacement (Table 7) procedures.

The aortic valve was the most common valve requiring intervention and accounted for 94% of overall cases and majority of cases across all participating sites.

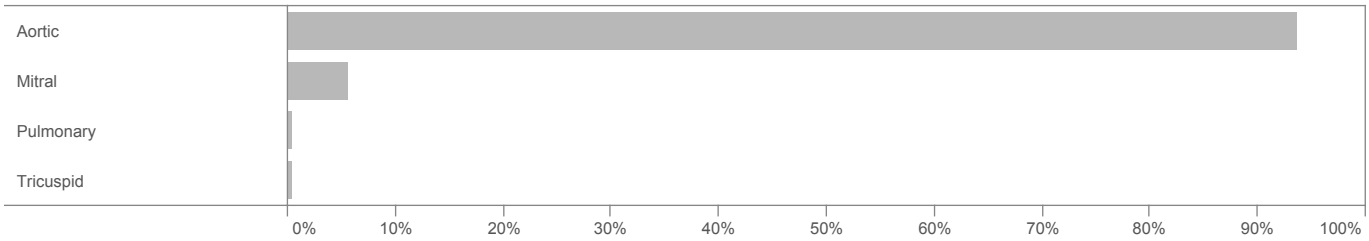


Figure 2: Proportion of all transcatheter valvular interventions by valve type

Table 4: Proportion of transcatheter valvular interventions by cardiac valve

Site	Total cases n	Aortic n (%)	Mitral n (%)	Pulmonary n (%)	Tricuspid n (%)
CH	6	6 (100.0)	–	–	–
TTH	10	8 (80.0)	2 (20.0)	–	–
SCUH	9	9 (100.0)	–	–	–
TPCH	169	155 (91.7)	12 (7.1)	1 (0.6)	1 (0.6)
RBWH	10	10 (100.0)	–	–	–
PAH	36	35 (97.2)	1 (2.8)	–	–
GCUH	27	27 (100.0)	–	–	–
STATEWIDE	**267**	**250 (93.6)**	**15 (5.6)**	**1 (0.4)**	**1 (0.4)**

Table 5: Transcatheter valvular interventions by type

Site	Total cases n	Transcatheter valvuloplasty n (%)	Transcatheter valve replacement n (%)
CH	6	6 (100.0)	–
TTH	10	7 (70.0)	3 (30.0)
SCUH	9	9 (100.0)	–
TPCH	169	73 (43.2)	96 (56.8)
RBWH	10	10 (100.0)	–
PAH	36	3 (8.3)	33 (91.7)
GCUH	27	8 (29.6)	19 (70.4)
STATEWIDE	**267**	**116 (43.4)**	**151 (56.6)**

Transcatheter valve replacement procedures constitute a new and highly sophisticated approach to treating patients with conditions otherwise reliant on conventional cardiac surgery. Only four sites offered transcatheter valve replacement procedures in 2018.

Table 6: Transcatheter valvuloplasty procedures

Site	Balloon aortic valvuloplasty n (%)	Balloon mitral valvuloplasty n (%)	MitraClip n (%)
CH	6 (100.0)	–	–
TTH	5 (71.4)	2 (28.6)	–
SCUH	9 (100.0)	–	–
TPCH	62 (84.9)	1 (1.4)	10 (13.7)
RBWH	10 (100.0)	–	–
PAH	2 (66.7)	1 (33.3)	–
GCUH	8 (100.0)	–	–
STATEWIDE	**102 (87.9)**	**4 (3.5)**	**10 (8.6)**

Table 7: Transcatheter valve replacement procedures

Site	TAVR* n (%)	TMVR† n (%)	TTVR‡ n (%)	TPVR§ n (%)
TTH	3 (100.0)	–	–	–
TPCH	93 (96.9)	1 (1.0)	1 (1.0)	1 (1.0)
PAH	33 (100.0)	–	–	–
GCUH	19 (100.0)	–	–	–
STATEWIDE	**148 (98.0)**	**1 (0.7)**	**1 (0.7)**	**1 (0.7)**

* Transcatheter aortic valve replacement

† Transcatheter mitral valve replacement

‡ Transcatheter tricuspid valve replacement

§ Transcatheter pulmonary valve replacement

Table 8: Other structural heart disease interventions

Site	Myocardial septal ablation n (%)	Renal denervation n (%)
TPCH	2 (66.7)	1 (33.3)
PAH	–	1 (100.0)
GCUH	–	6 (100.0)
STATEWIDE	**2 (20.0)**	**8 (80.0)**

9.4 Patient outcomes

9.4.1 All-cause 30 day mortality

For the participating sites performing structural heart disease interventions within 2018, there was an overall all-cause unadjusted mortality rate within 30 days of 1.5%.

Table 9: All-cause unadjusted 30 day mortality post SHD intervention by procedure category and site

Site	Total cases n	Device closure n (%)	Valvular intervention n (%)	Other n (%)	Total deaths n (%)
CH	16	0 (0.0)	1 (16.7)	0 (0.0)	1 (6.3)
TTH	24	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
SCUH	17	0 (0.0)	1 (11.1)	0 (0.0)	1 (5.9)
TPCH	207	0 (0.0)	2 (1.2)	0 (0.0)	2 (1.0)
RBWH	18	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
PAH	70	0 (0.0)	1 (2.8)	0 (0.0)	1 (1.4)
GCUH	49	0 (0.0)	1 (3.7)	0 (0.0)	1 (2.0)
STATEWIDE	**401**	**0 (0.0)**	**6 (2.2)**	**0 (0.0)**	**6 (1.5)**

9.4.2 All TAVR cases

2018 cases

Of the four sites performing TAVR in 2018, the overall all-cause unadjusted mortality rate within 30 days of the procedure was 1.4%.

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

Site	Total cases n	30 day mortality n (%)
TTH	3	0 (0.0)
TPCH	93	1 (1.1)
PAH	33	1 (3.0)
GCUH	19	0 (0.0)
STATEWIDE	**148**	**2 (1.4)**

2016 and 2017 cases

Of the three sites performing TAVR within 2017, the overall all-cause unadjusted mortality rate within 30 days of the procedure was 3.1%, and 13.3% at 365 days. For the two sites performing TAVR the previous year, the overall all-cause unadjusted mortality rate at 2 years post procedure was 16.7%.

Table 11: All-cause unadjusted 30 day and 1 year mortality post TAVR by site (2017 cohort)

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

Table 12: All-cause unadjusted mortality up to 2 years post TAVR by site (2016 cohort)

Site	Total cases n	1 year mortality n (%)	2 year mortality n (%)
TPCH	87	9 (10.3)	14 (16.1)
PAH	15	1 (6.7)	3 (20.0)
STATEWIDE	**102**	**10 (9.8)**	**17 (16.7)**

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Interventional Cardiology Audit

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Glossary

6MWT	Six Minute Walk Test
ACC	American College of Cardiology
ACEI	Angiotensin Converting Enzyme Inhibitor
ACOR	Australasian Cardiac Outcomes Registry
ACS	Acute Coronary Syndromes
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
AQoL	Assessment of Quality of Life
ARB	Angiotensin II Receptor Blocker
ARNI	Angiotensin Receptor-Neprilysin Inhibitors
ASD	Atrial Septal Defect
ATSI	Aboriginal and Torres Strait
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
CH	Cairns Hospital
CHF	Congestive Heart Failure
CI	Clinical Indicator
CR	Cardiac Rehabilitation
CRT	Cardiac Resynchronisation Therapy
CS	Cardiac Surgery
CV	Cardiovascular
CVA	Cerebrovascular Accident
DAOH	Days Alive and Out of Hospital
DES	Drug Eluting Stent
DOSA	Day Of Surgery Admission
DSWI	Deep Sternal Wound Infection
ECG	12 lead Electrocardiograph
ECMO	Extracorporeal Membrane Oxygenation
ED	Emergency Department
eGFR	Estimated Glomerular Filtration Rate
EP	Electrophysiology
FdECG	First Diagnostic Electrocardiograph
FTR	Failure To Rescue
GAD	Generalized Anxiety Disorder
GCCH	Gold Coast Community Health
GCUH	Gold Coast University Hospital
GLH	Gladstone Hospital
GP	General Practitioner
GYH	Gympie Hospital
HBH	Hervey Bay Hospital (includes Maryborough)
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HFSS	Heart Failure Support Service
HHS	Hospital and Health Service
HOCM	Hypertrophic Obstructive Cardiomyopathy
HSQ	Health Support Queensland
IC	Interventional Cardiology
ICD	Implantable Cardioverter Defibrillator
IHT	Inter-hospital Transfer
IPCH	Ipswich Community Health
LAA	Left Atrial Appendage
LAD	Left Anterior Descending Artery
LCX	Circumflex Artery
LGH	Logan Hospital
LOS	Length Of Stay
LV	Left Ventricle
LVEF	Left Ventricular Ejection Fraction
LVOT	Left Ventricular Outflow Tract
MBH	Mackay Base Hospital
MI	Myocardial Infarction
MIH	Mt Isa Hospital
MRA	Mineralocorticoid Receptor Antagonists
MTHB	Mater Adult Hospital, Brisbane
NCDR	The National Cardiovascular Data Registry
NOAC	Non-Vitamin K Antagonist Oral Anticoagulants
NP	Nurse Practitioner
NRBC	Non-Red Blood Cells
NSTEMI	Non ST-Elevation Myocardial Infarction
OR	Odds Ratio
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 Questionairre
QAS	Queensland Ambulance Service
QCOR	Queensland Cardiac Outcomes Registry
QEII	Queen Elizabeth II Hospital
QH	Queensland Health
QHAPDC	Queensland Hospital Admitted Patient Data Collection
RBC	Red Blood Cells
RBWH	Royal Brisbane and Women's Hospital
RCA	Right Coronary Artery
RDH	Redcliffe Hospital
RHD	Rheumatic Heart Disease
RKH	Rockhampton Hospital
RLH	Redland Hospital
SCCIU	Statewide Cardiac Clinical Informatics Unit
SCCN	Statewide Cardiac Clinical Network
SCUH	Sunshine Coast University Hospital
SHD	Structural Heart Disease
STEMI	ST-Elevation Myocardial Infarction
STS	Society of Thoracic Surgery
TAVR	Transcatheter Aortic Valve Replacement
TMVR	Transcatheter Mitral Valve Replacement
TNM	Tumour, Lymph Node, Metastases
TPCH	The Prince Charles Hospital
TPVR	Transcatheter Pulmonary Valve Replacement
TTH	The Townsville 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

Ongoing initiatives

Whilst continually refining and improving data collection and reporting practices for the benefit of public facilities, QCOR is also beginning the investigation of a method to collect and analyse clinical data for private healthcare facilities. Following interest from various private providers, QCOR is looking to extend its quality and safety focus to accommodate the requirements of these facilities. It is anticipated that QCOR will provide a role in the delivery of reports and benchmarking activities whilst also acting as a conduit to the various national registries in existence and development.

Cardiac outreach continues to expand in Queensland with formalised and newly funded services having commenced between Cairns and Hinterland and Torres and Cape Hospital and Health Service intending to provide cardiac care in many of these communities for the first time. Services will commence in January 2020 between Townsville and North West. The forward plan for the rollout of this model across the state has been developed in partnership with consumers and clinicians. A new system, the QCOR Outreach application has been developed to track activity, service provision and patient outcomes. This ground-up development specifically for cardiac outreach finished testing and goes live for use in late 2019.

The QCOR Structural Heart Disease module is currently in advanced stages of development with wider deployment expected in 2020. This QCOR module has been developed to provide superior procedure reporting capabilities for structural heart disease interventions, device closure, and percutaneous valve replacement and repair procedures. It will enable participation in national quality and safety activities for transcatheter aortic valve replacement as well as allow clinicians to utilise the application for collecting pre and post-procedural data in unprecedented detail. The application has been through rigorous testing with user training and further enhancements planned for the near future.

The ECG Flash initiative of the SCCN has continued to be implemented at several sites throughout 2018 and 2019. Deployment of hardware to spoke sites has been via a staged approach with uptake being varied based on local site workload and workforce. Integration of ECG Flash with workflow within hub sites continues to evolve with sites now taking the initiative to embrace and feedback to sites regarding the appropriate use of the system. Analysis of the utility of the system is beginning to take place with a focus on clinical efficacy and benefit. It is anticipated that QCOR will be able to support this new initiative through procedural linkage and outcome monitoring for the subset of patients whose clinical path utilised ECG Flash and went on to subsequent investigation or management.

Opportunities for participation in the formative stages of national registries and initiatives have been embraced by Queensland clinicians. These important initiatives which are in various stage of development will be critical to the future of clinical registries in Australia. It is anticipated that with further involvement from local stakeholders that these entities will evolve into relevant and useful tools for patient-centred reporting and outcomes.

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