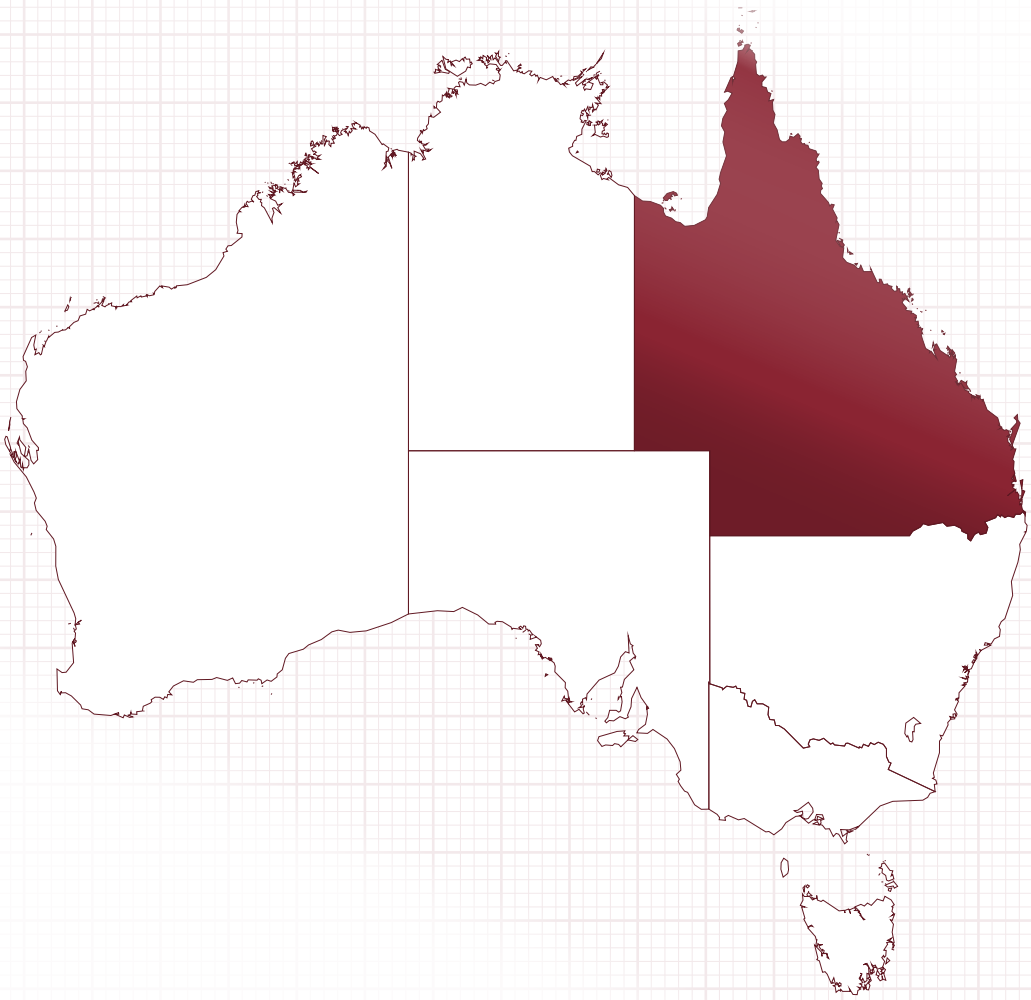
Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry
2018 Annual Report



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Queensland Government

Queensland Cardiac Outcomes Registry
2018 Annual Report

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An electronic version of this document is available at:
clinicalexcellence.qld.gov.au/priority-areas/clinician-engagement/statewide-clinical-networks/cardiac

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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.

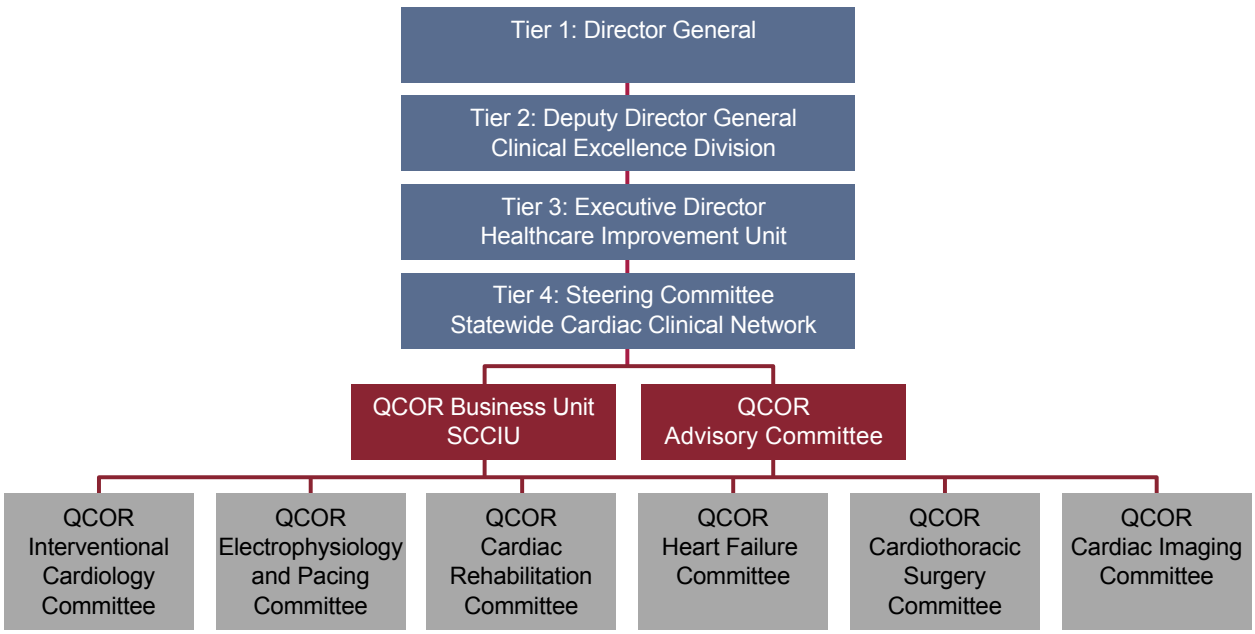
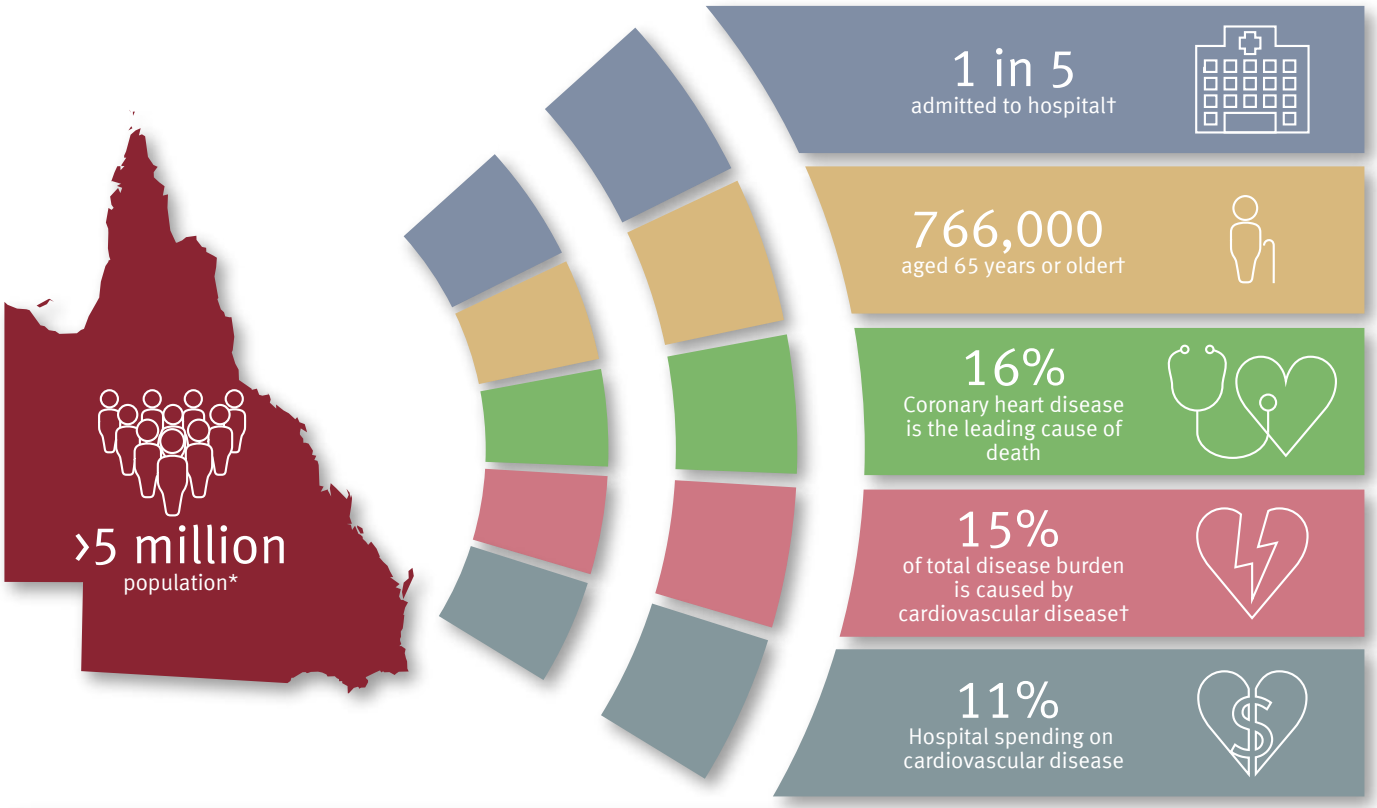


Figure A: Operational structure

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

4,867
percutaneous coronary interventions

401
structural heart disease interventions

148
transcatheter aortic valve replacement procedures

2,384
adult cardiac surgeries

850
adult thoracic surgeries

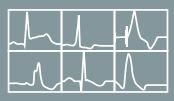
4,474
electrophysiology and pacing procedures

3,136
cardiac implantable electronic device procedures

4,878
new heart failure support services referrals

11,723
cardiac rehabilitation referrals

Clinical indicator progress



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

0.9%
mortality rate for coronary artery bypass surgery at 30 days

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

95%
of cardiac rehabilitation referrals within 3 days of discharge

0.3%
procedural tamponade rate for cardiac device and electrophysiology procedures

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:

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- The Prince Charles Hospital

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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

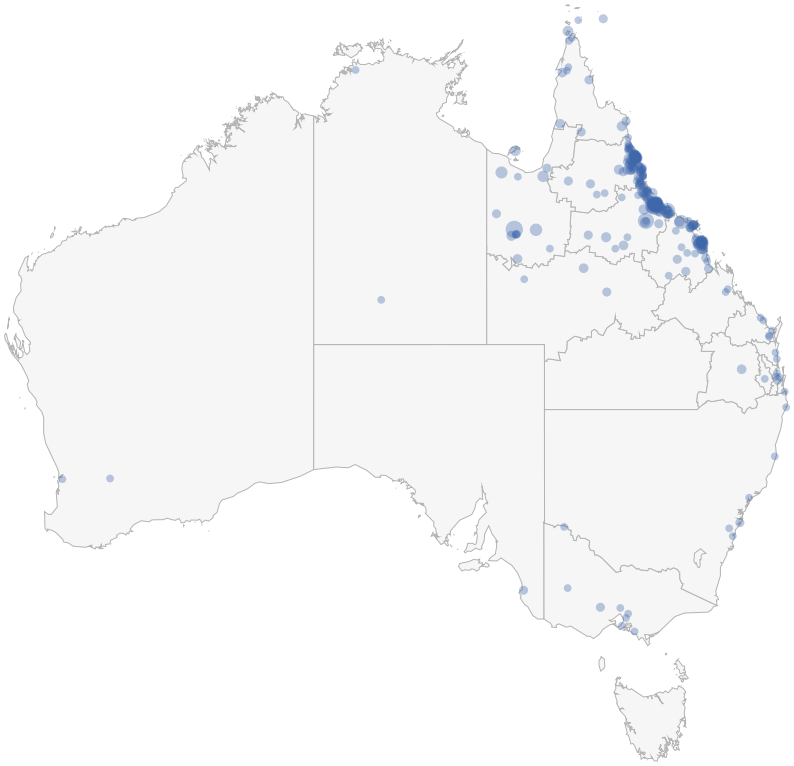
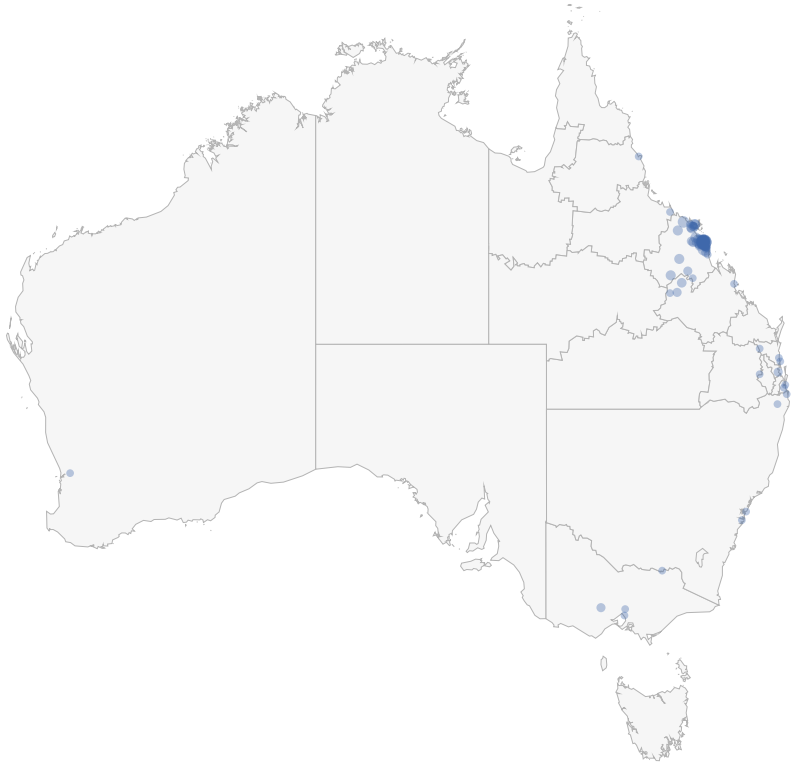


Figure 2: The Townsville Hospital

- 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



- 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

Figure 3: Mackay Base Hospital

7.4 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

Figure 4: Sunshine Coast University Hospital

7.5 The Prince Charles Hospital

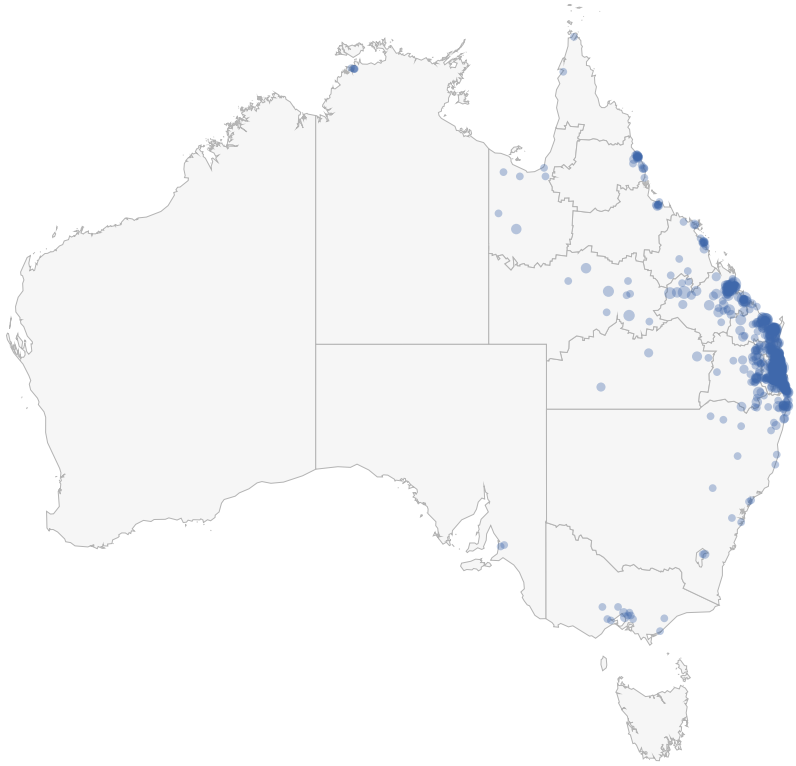


Figure 5: The Prince Charles Hospital

- 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

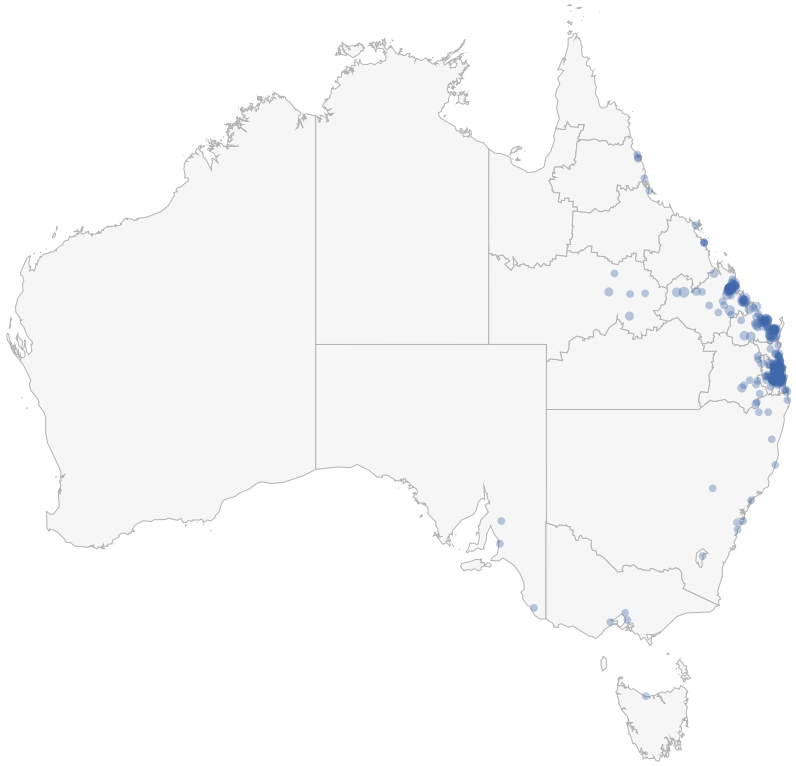


Figure 6: Royal Brisbane and Women's Hospital

- 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

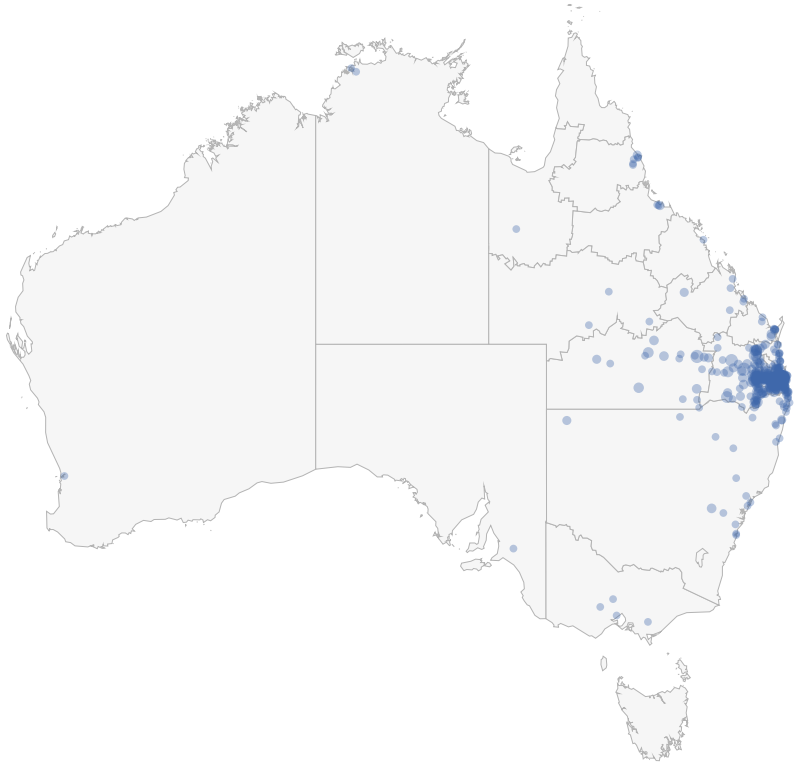


Figure 7: Princess Alexandra Hospital

- 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

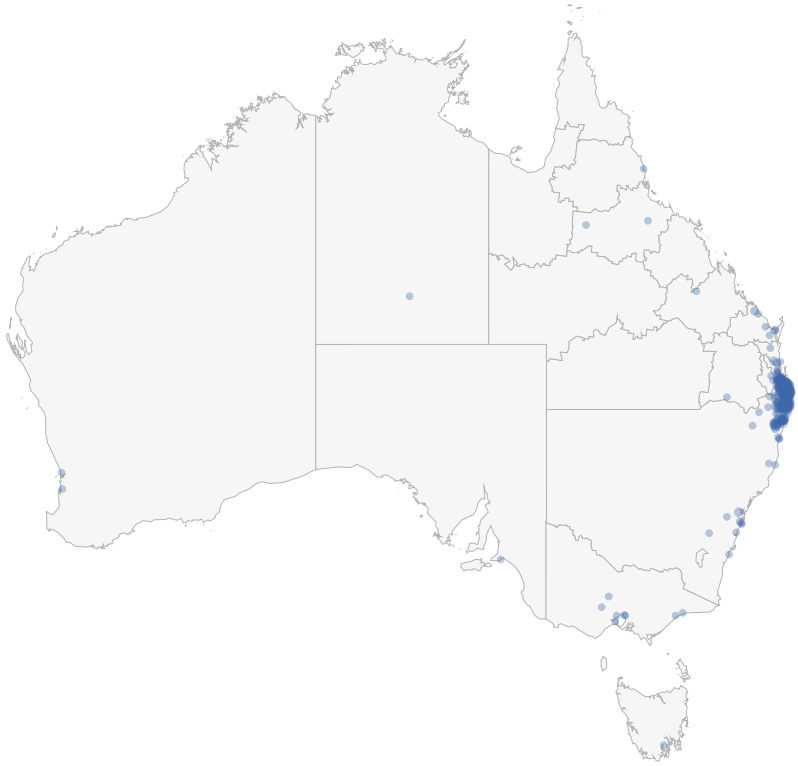


Figure 8: Gold Coast University Hospital

- 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.

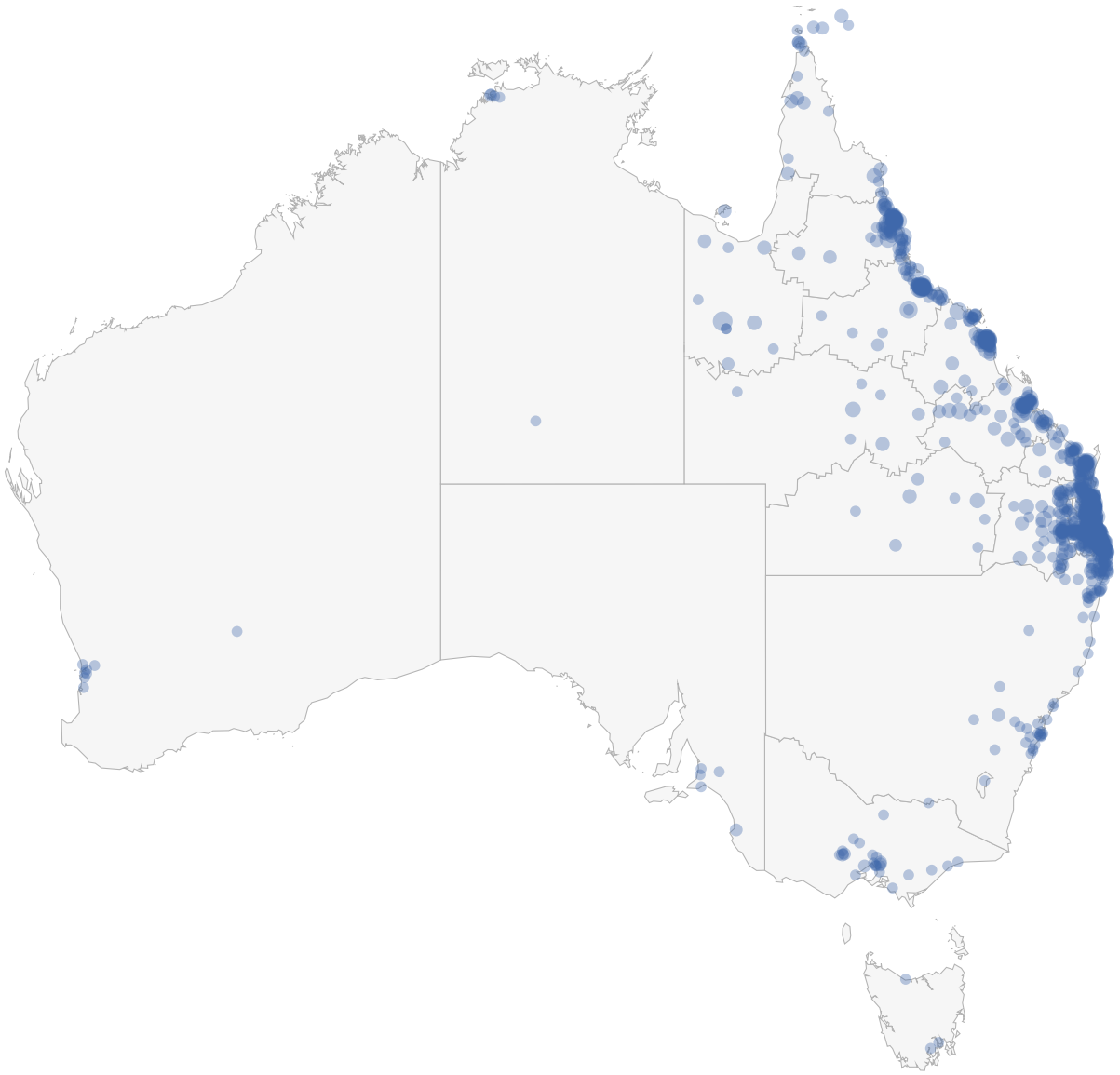


Figure 1: Statewide PCI cases by patient place of usual residence (by residential postcode)

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

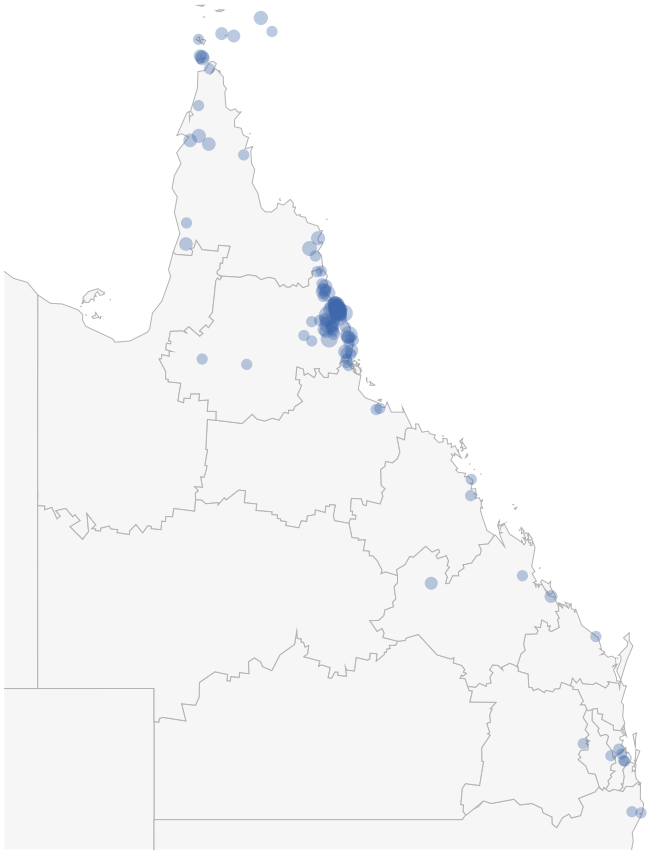


Figure 2: Cairns Hospital

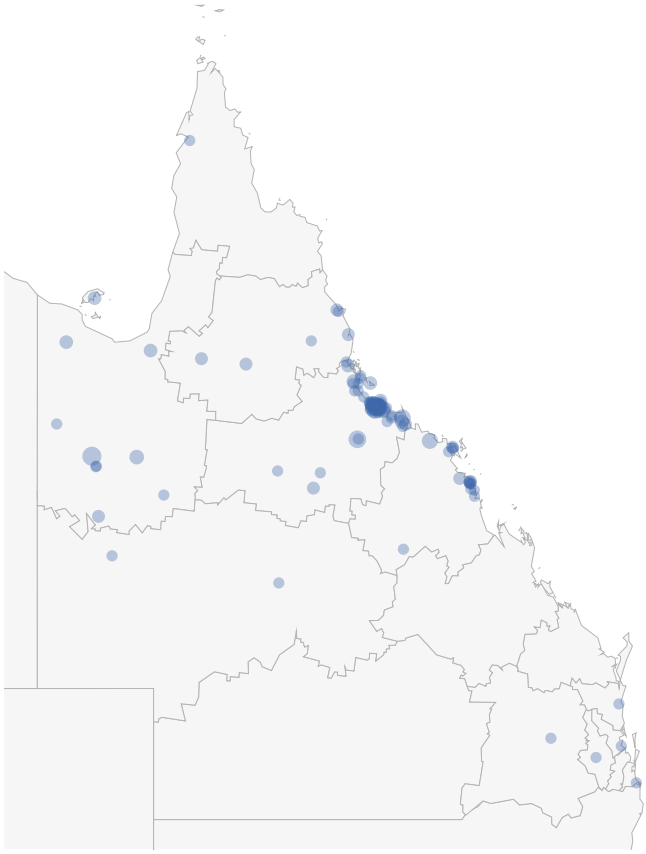


Figure 3: The Townsville Hospital

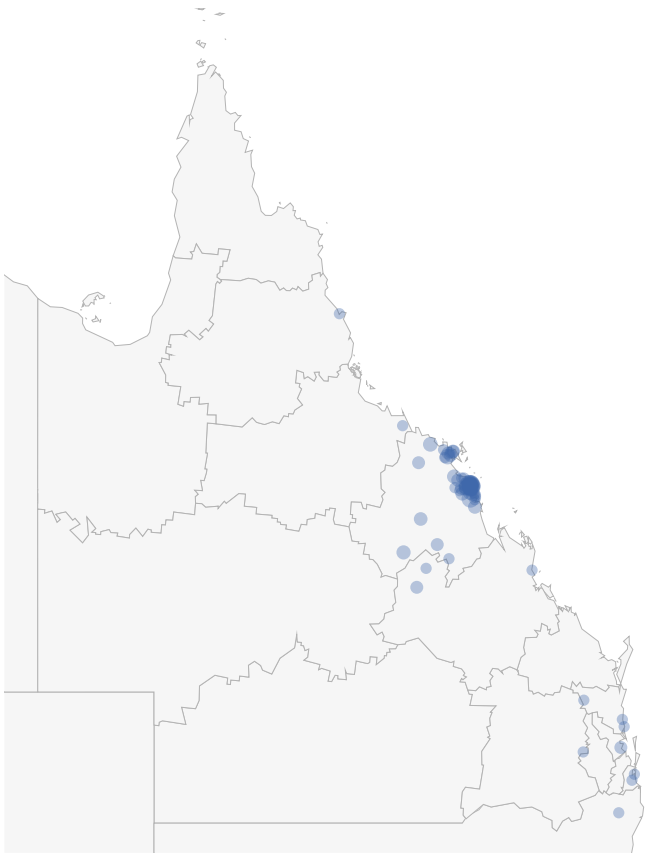


Figure 4: Mackay Base Hospital

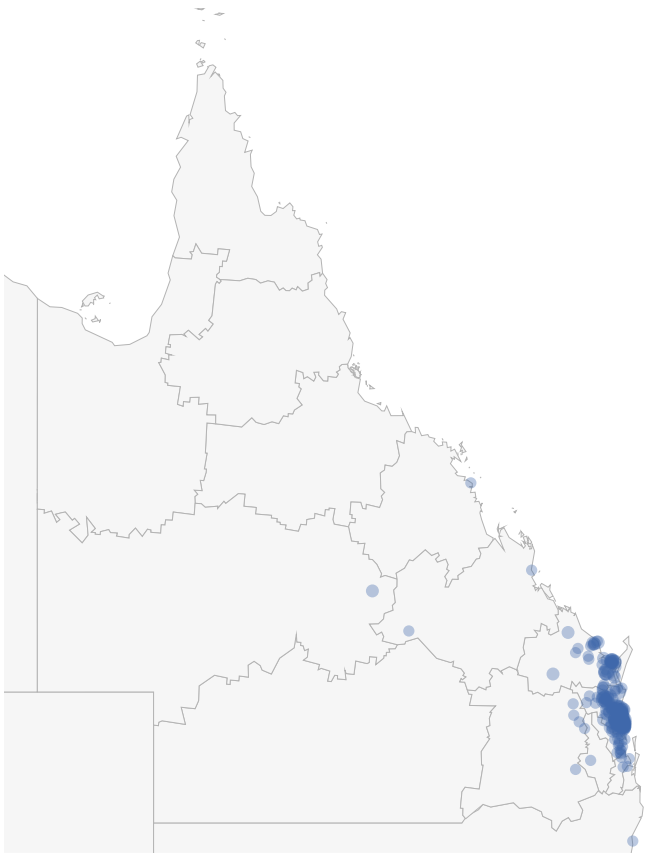


Figure 5: Sunshine Coast University Hospital

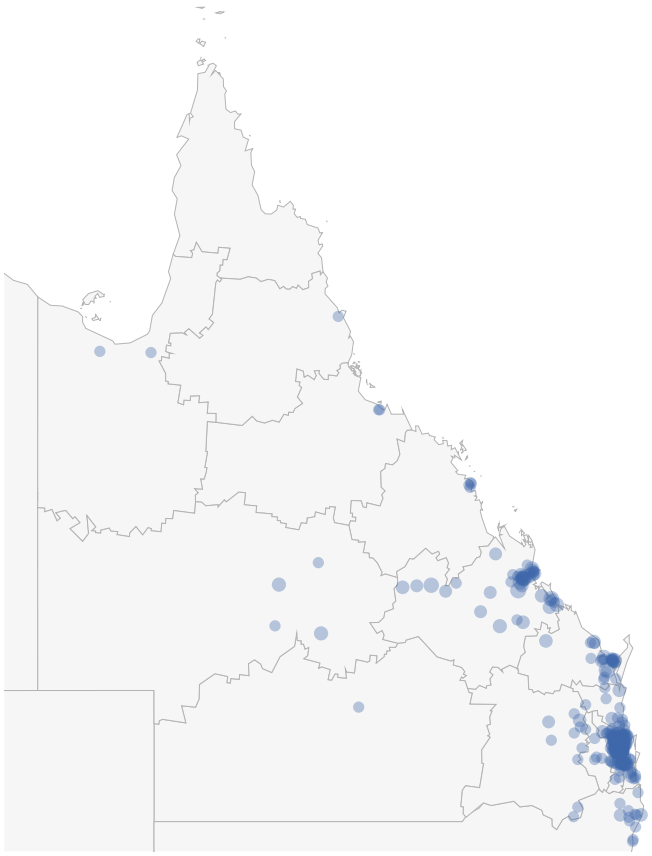


Figure 6: The Prince Charles Hospital

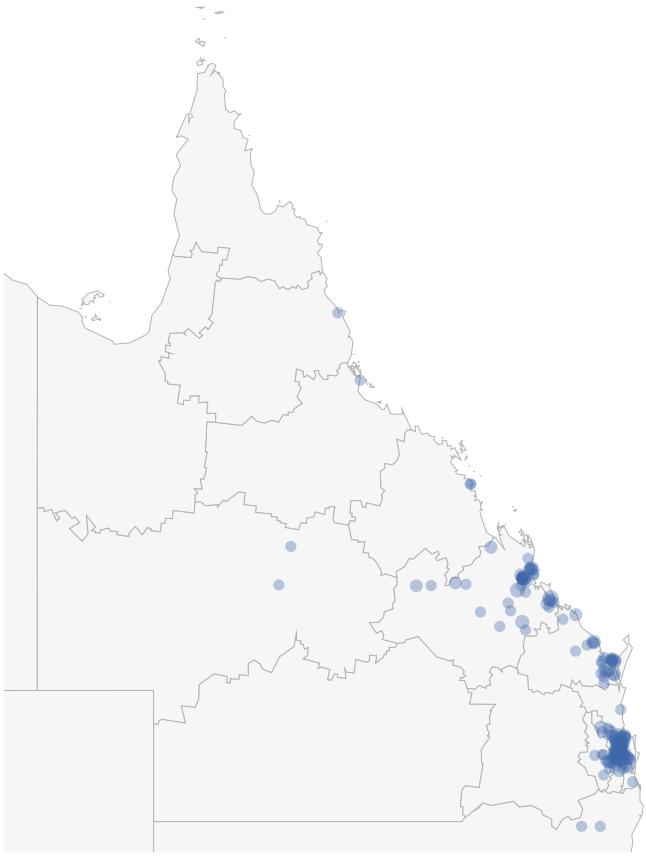


Figure 7: Royal Brisbane and Women's Hospital

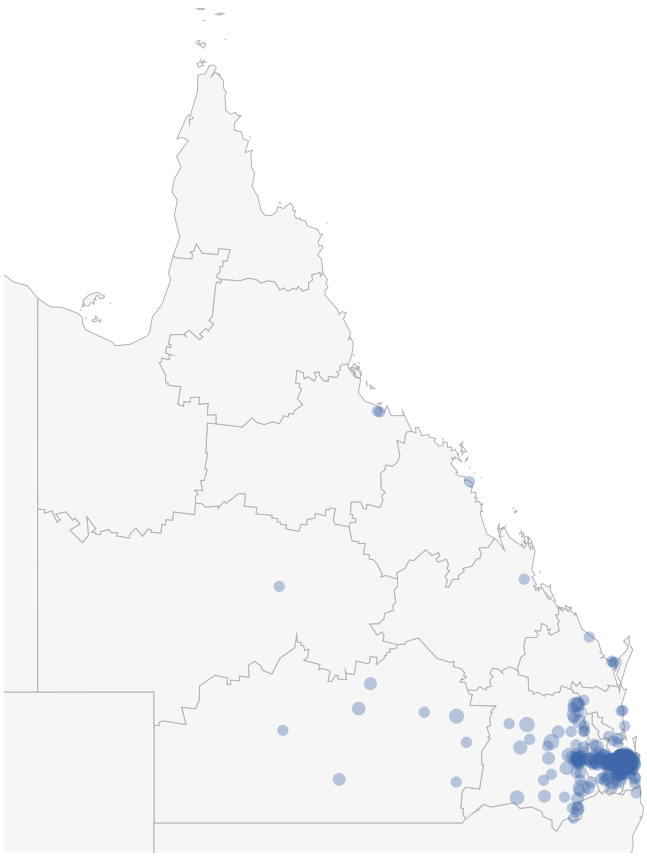


Figure 8: Princess Alexandra Hospital

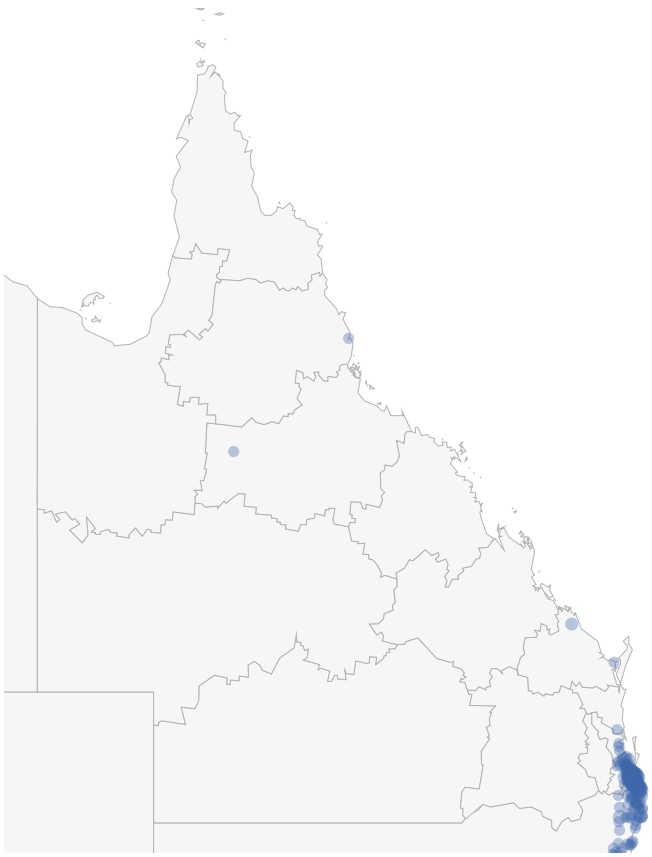


Figure 9: Gold Coast University Hospital

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.

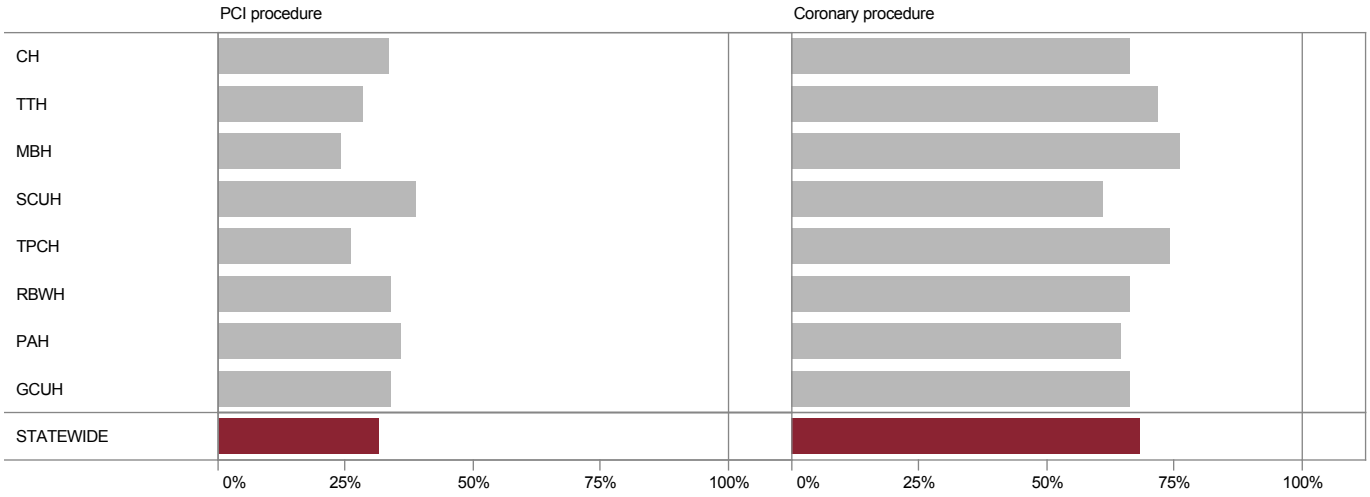


Figure 10: Proportion of cases by procedure category

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**

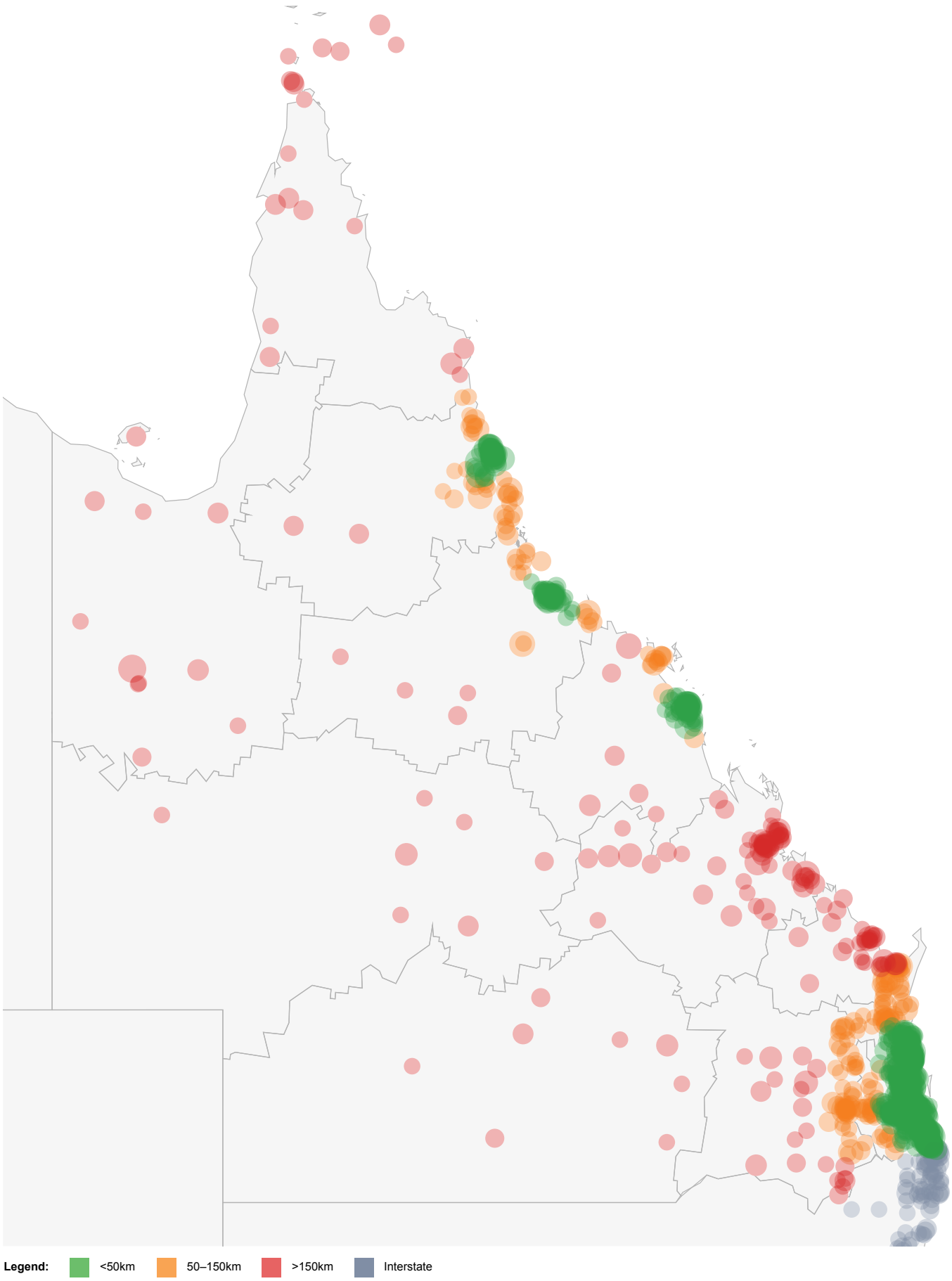


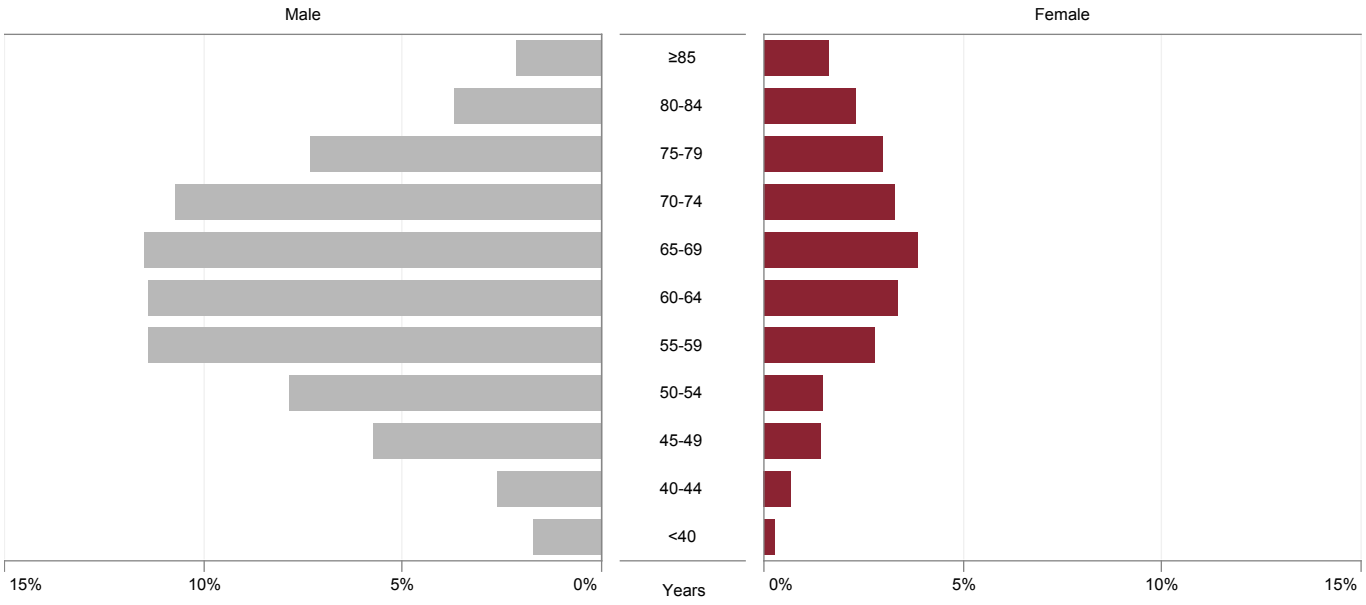
Figure 11: Queensland PCI cases by distance to nearest public PCI facility

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].

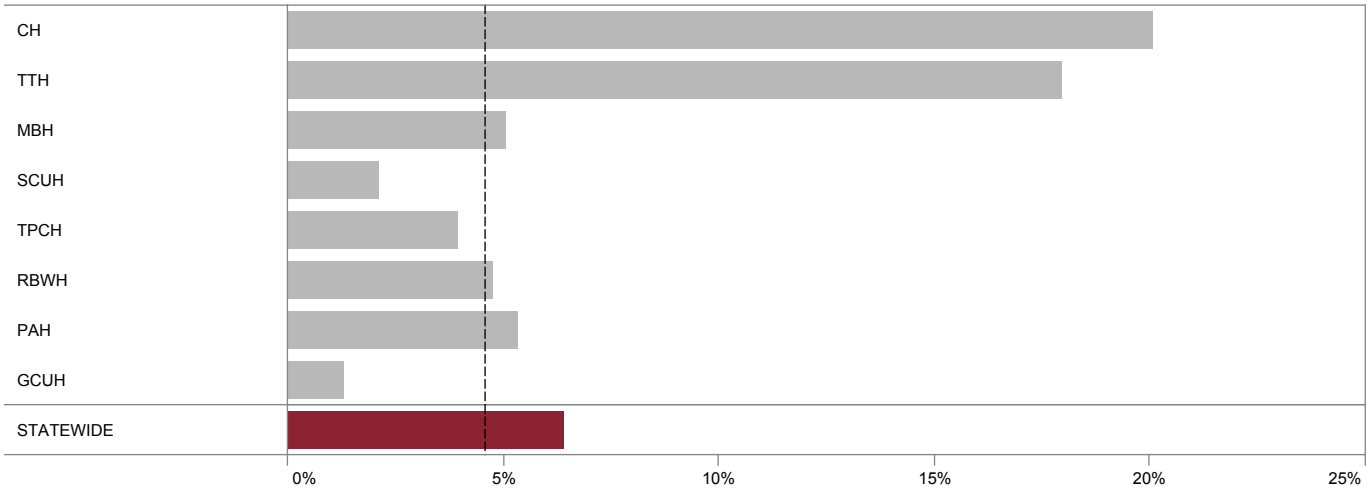
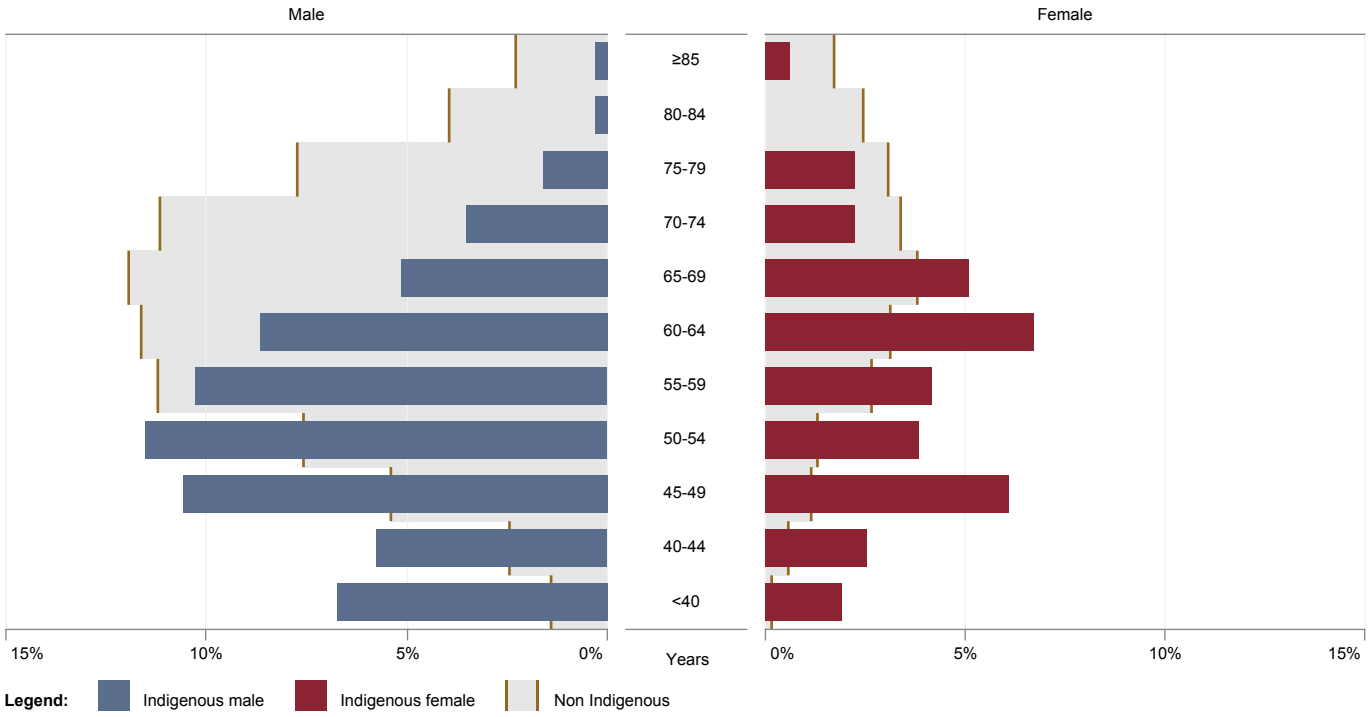


Figure 14: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

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).

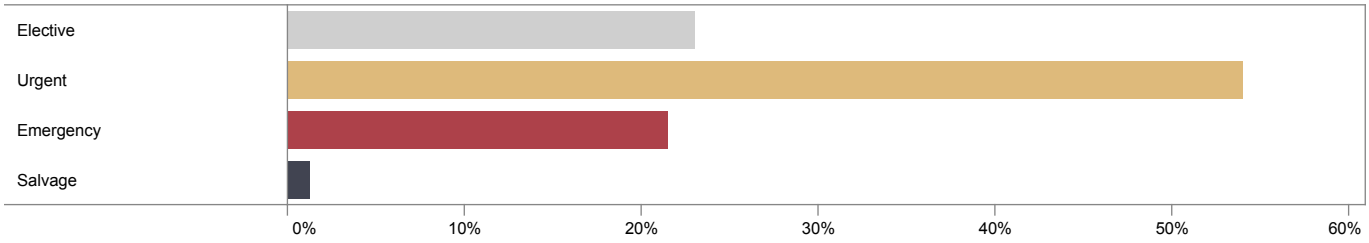


Figure 16: Proportion of all PCI cases by admission status

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**

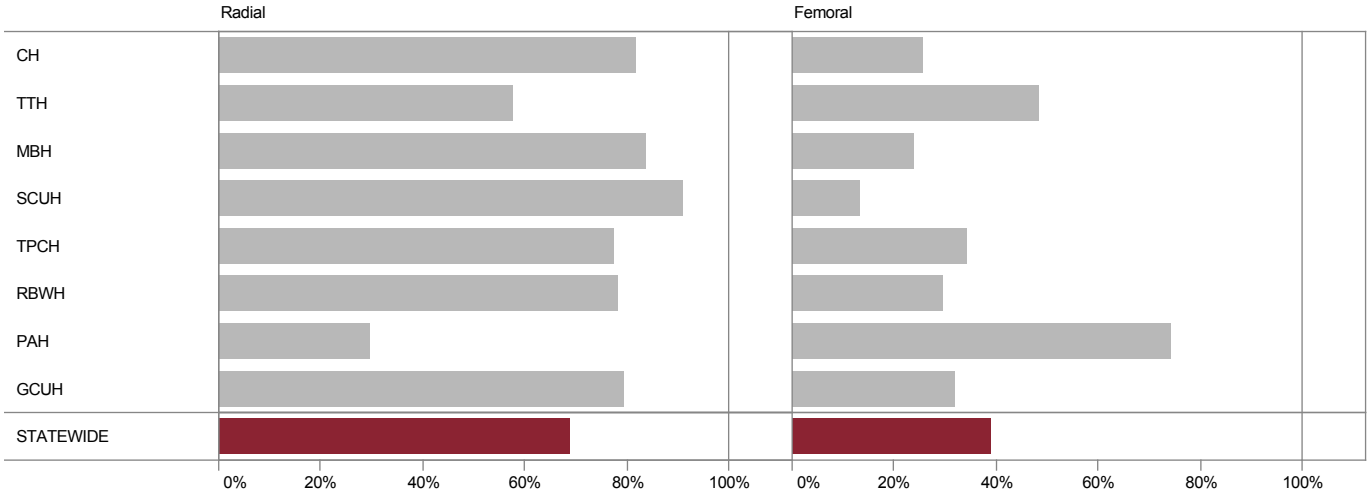


Figure 17: Proportion of PCI cases using radial and femoral access routes by site

6.2.2 STEMI presenting within 6 hours of symptom onset

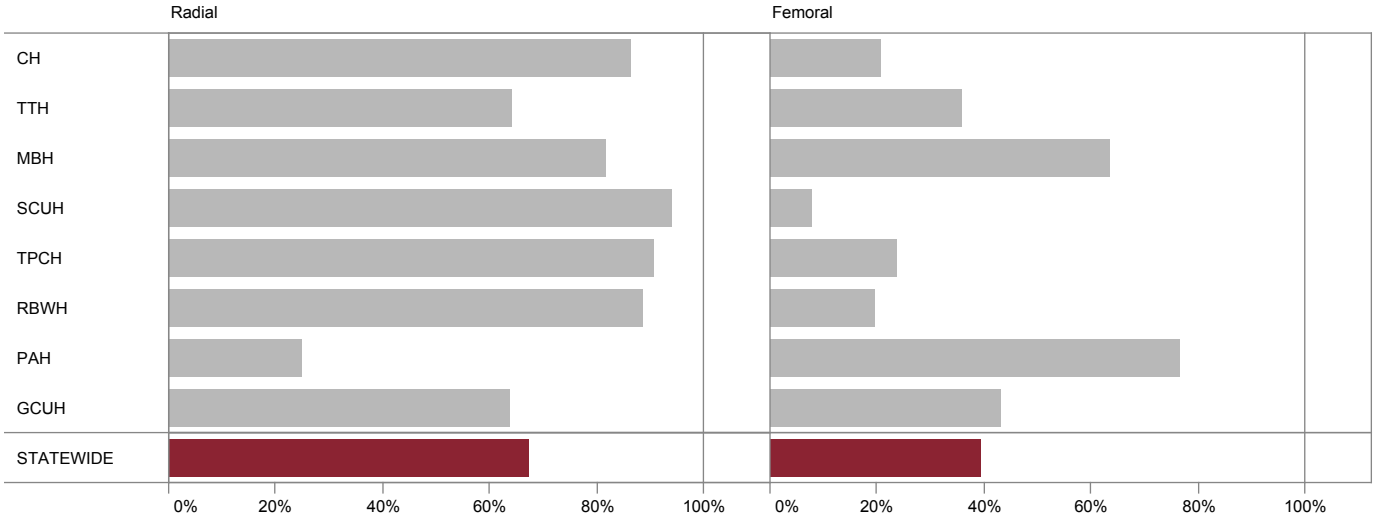


Figure 18: Proportion of STEMI presenting within 6 hours PCI cases using radial and femoral access routes by site

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.

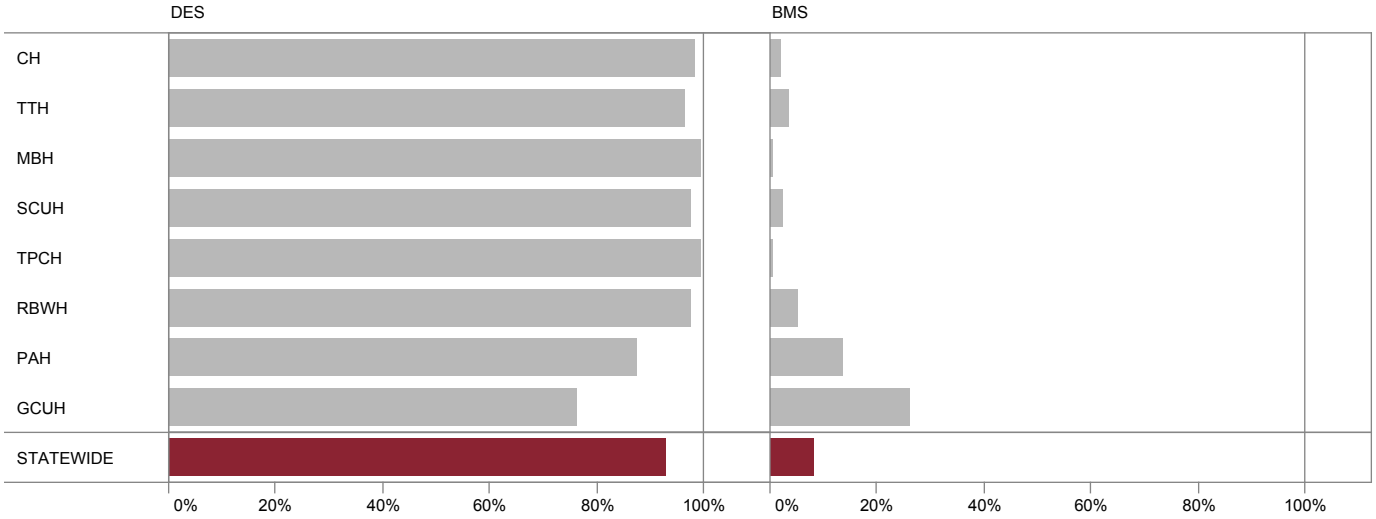


Figure 19: Proportion of stenting cases using DES and BMS

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.

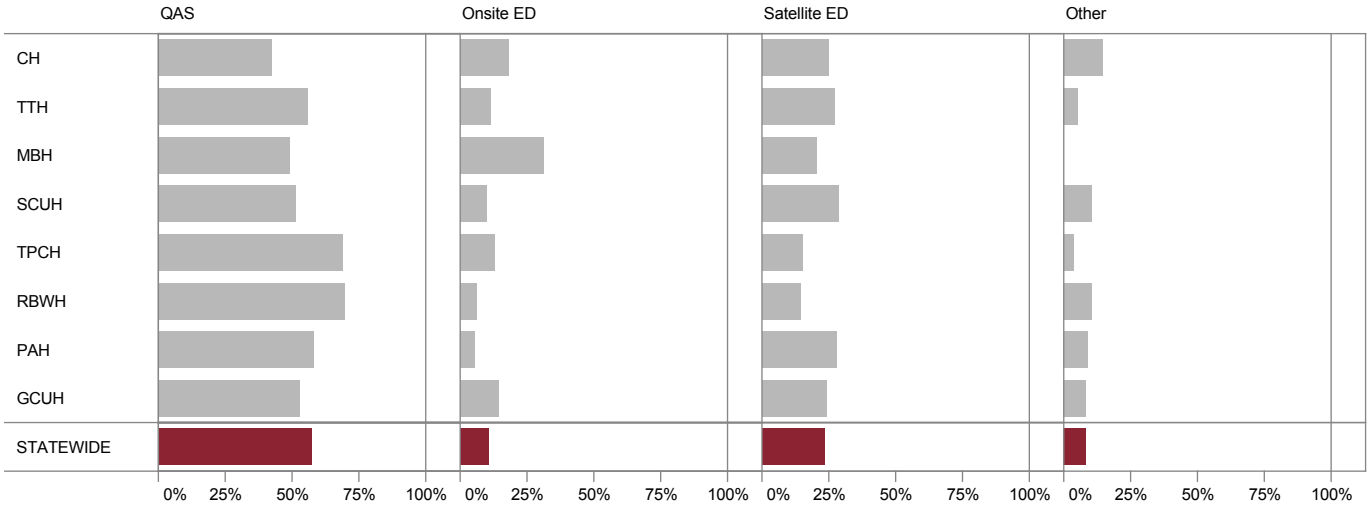


Figure 20: Proportion of STEMI cases by first medical contact

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.

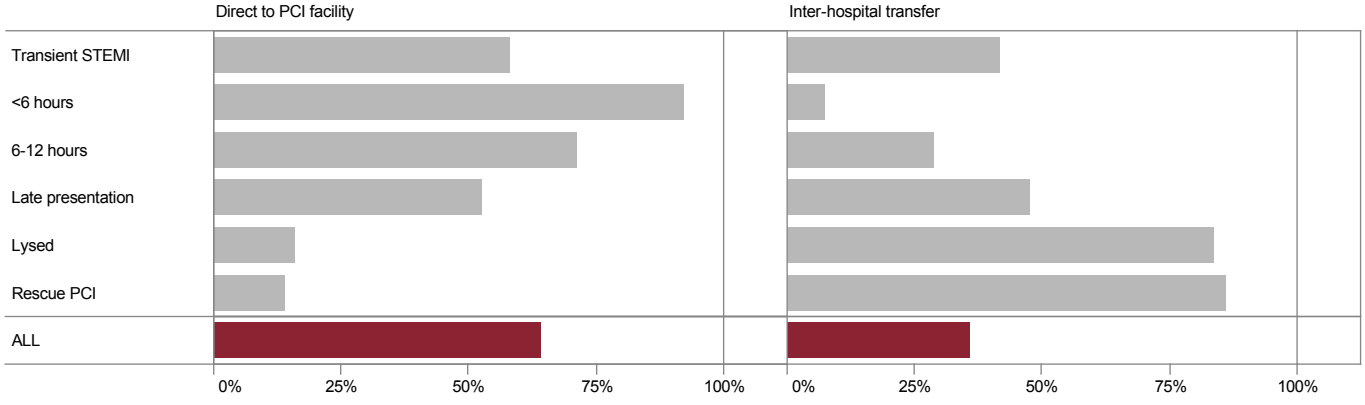


Figure 21: Proportion of STEMI cases by admission pathway and clinical presentation

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**

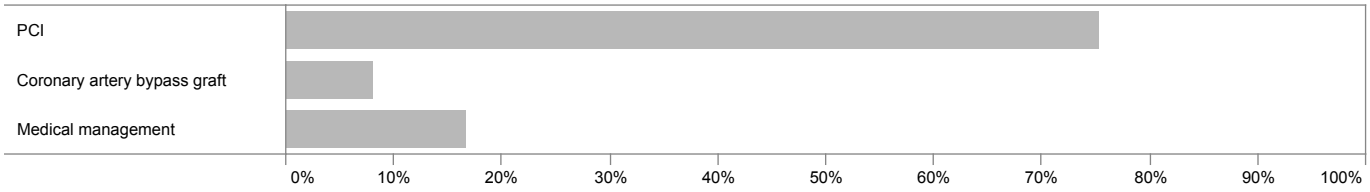


Figure 22: Proportion of lysed patients by clinical management

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

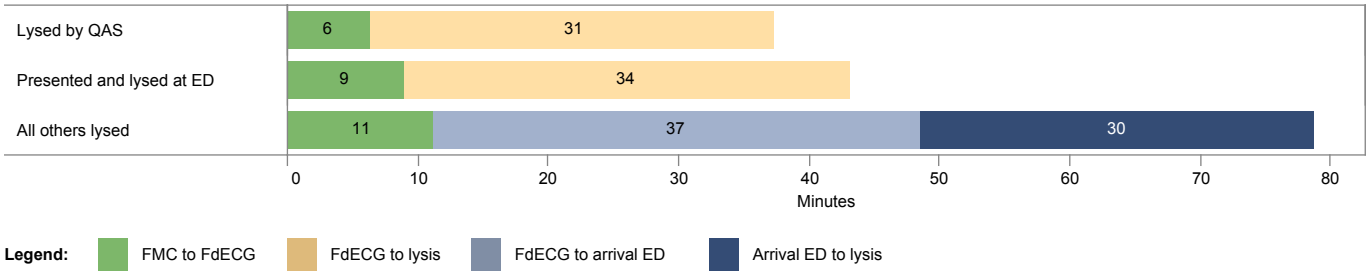


Figure 23: Time to thrombolysis therapy by administration pathway

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).

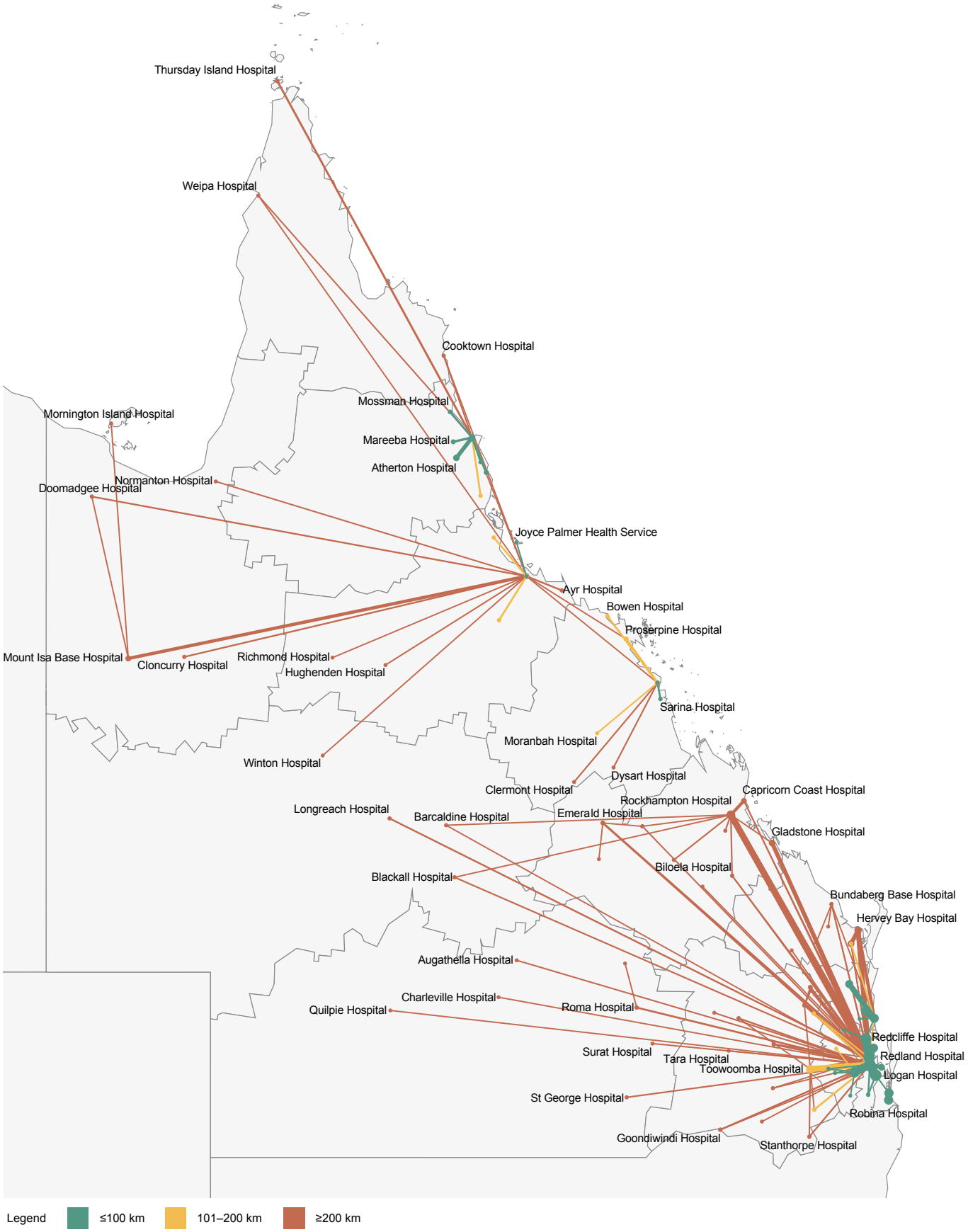
Considerable variation was observed between sites with the proportion of inter-hospital transfers for NSTEMI ranging from 35% to 70%, largely explained by catchment area. Table 27 and Figure 24 provide some perspective based on the cases where geographical data were available.

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

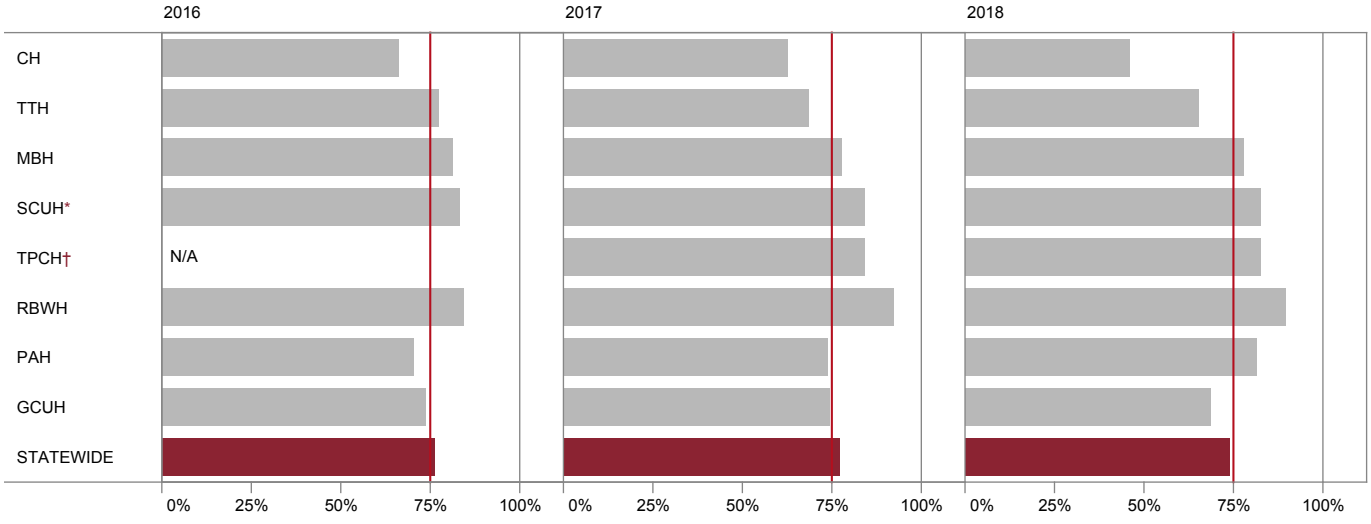
Patients presenting directly to a PCI capable facility had a median wait to coronary angiography of 40 hours and were more likely to have angiography performed within the target timeframe of 72 hours compared with inter-hospital transfers (74% vs 50%).

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

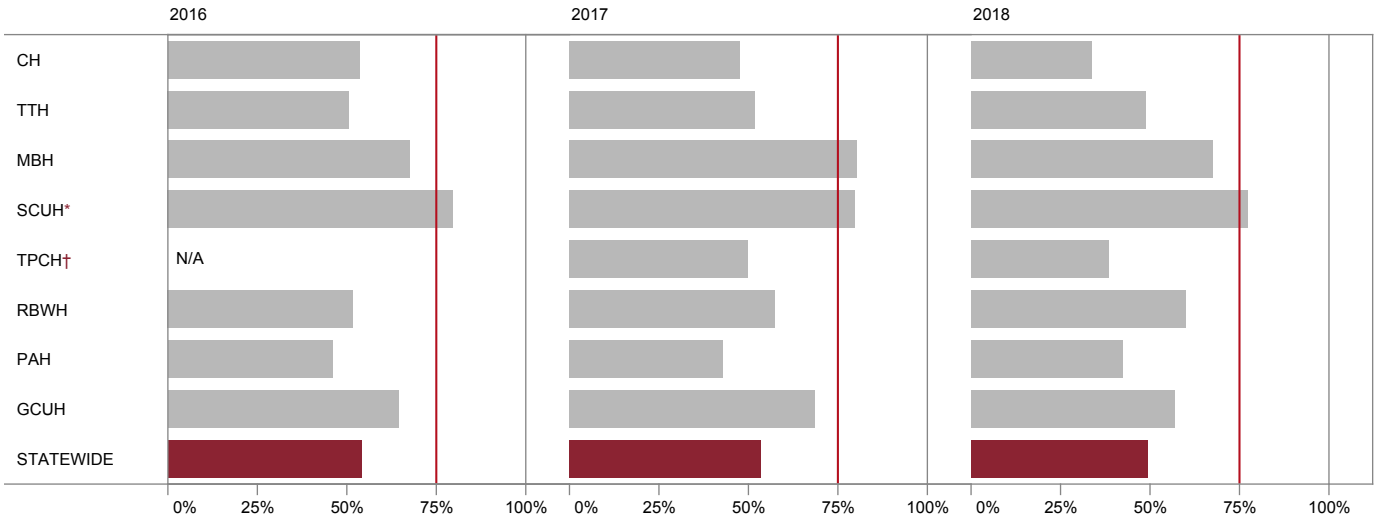
† TPCH interventional cardiology data available from 2017

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.

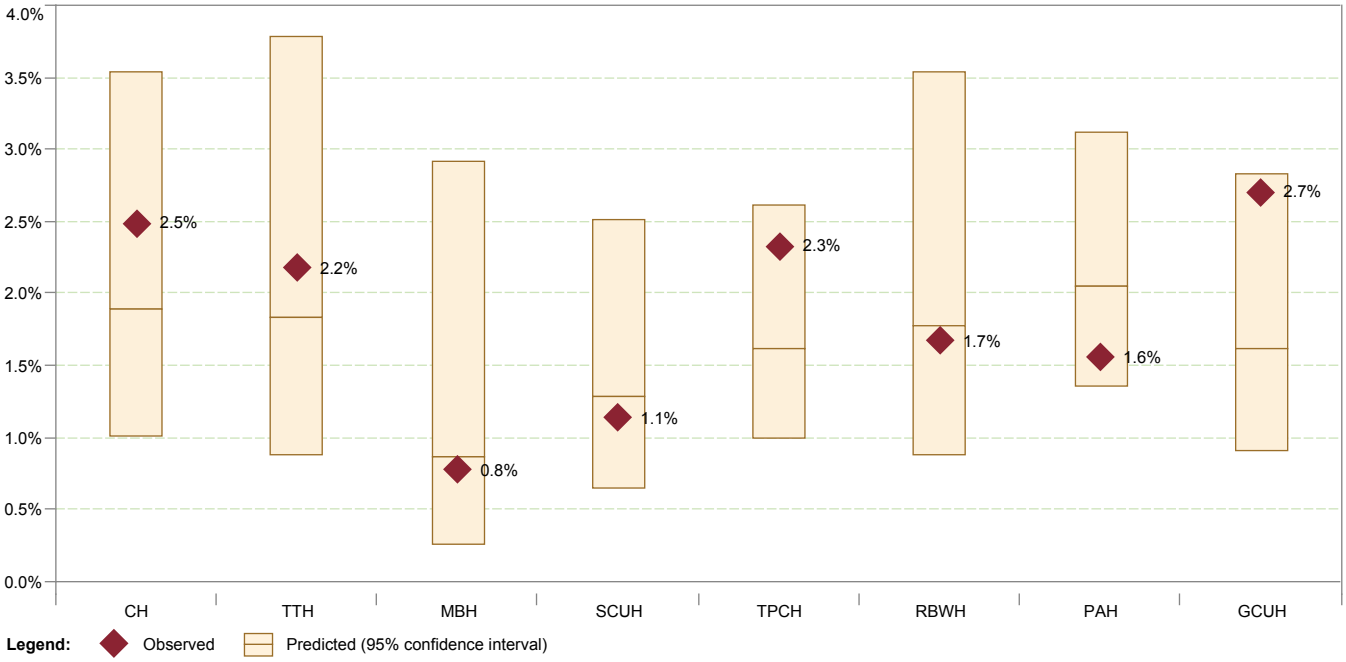
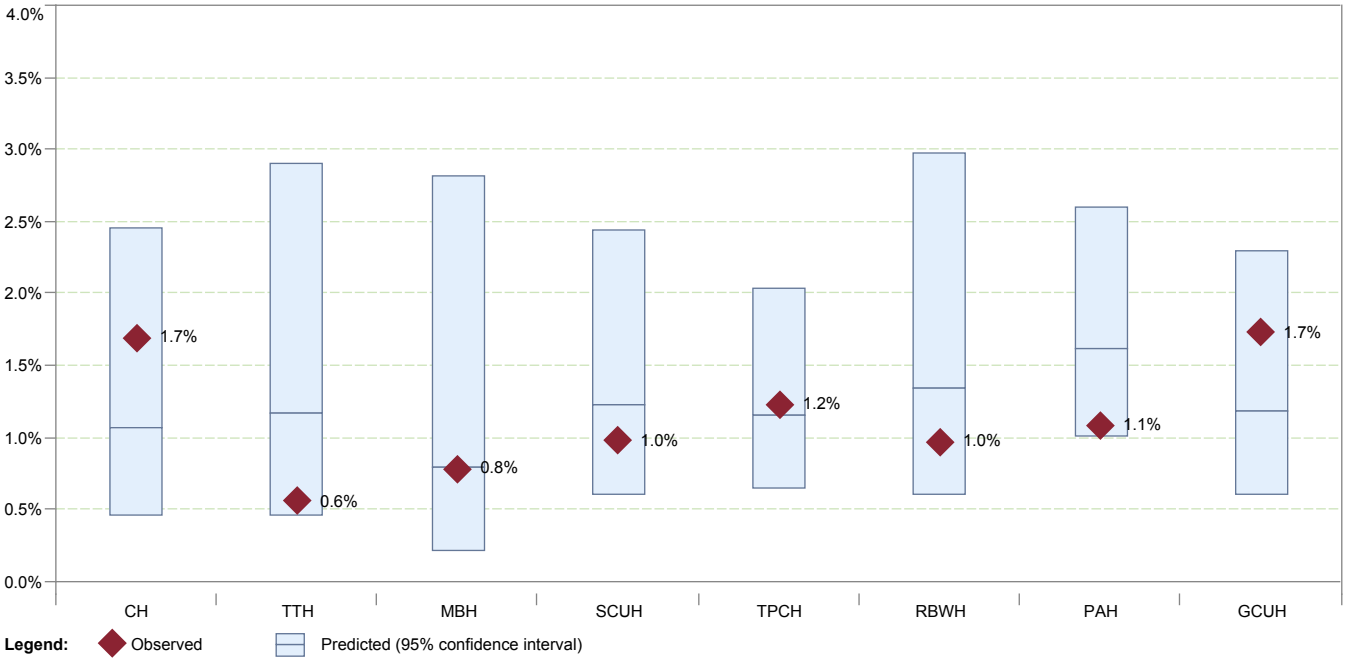


Figure 27: Comparison of observed and predicted mortality rates by site

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.

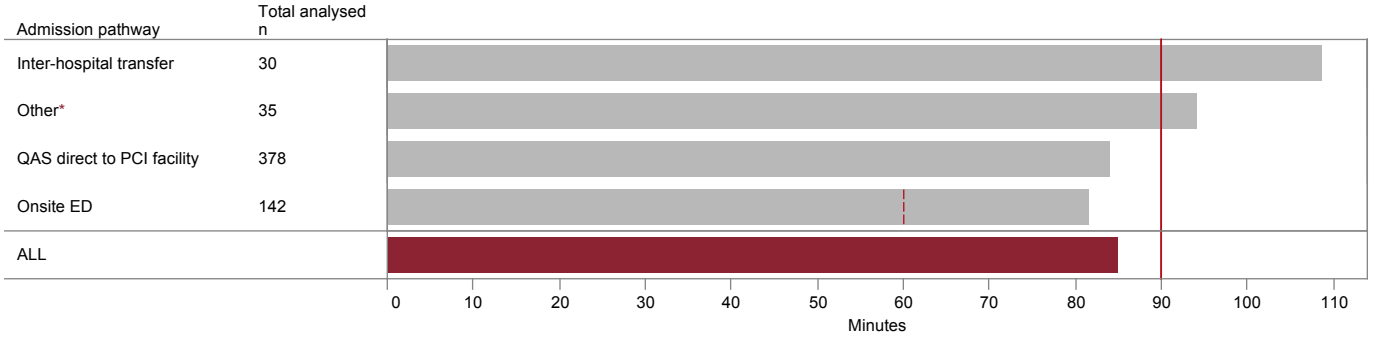
Table 34: Definitions for STEMI time to reperfusion

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

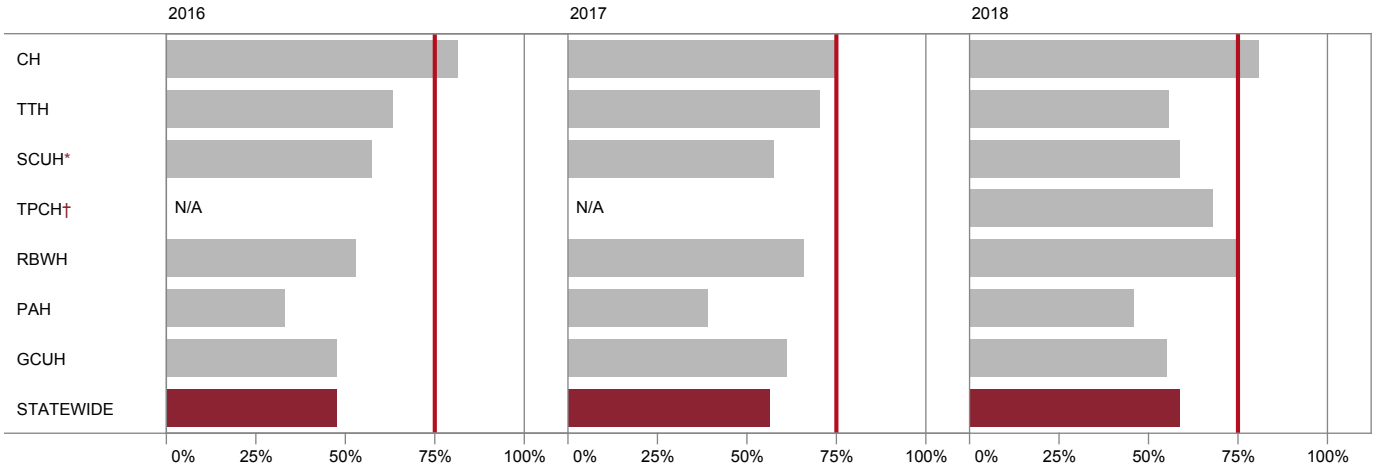
The all-site median time from FdECG to reperfusion was 85 minutes, with median individual site times ranging from 66 minutes to 94 minutes. These results indicate that overall Queensland public facilities are approaching the ambitious benchmark of 90 minutes from time of FdECG to first device. However, 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

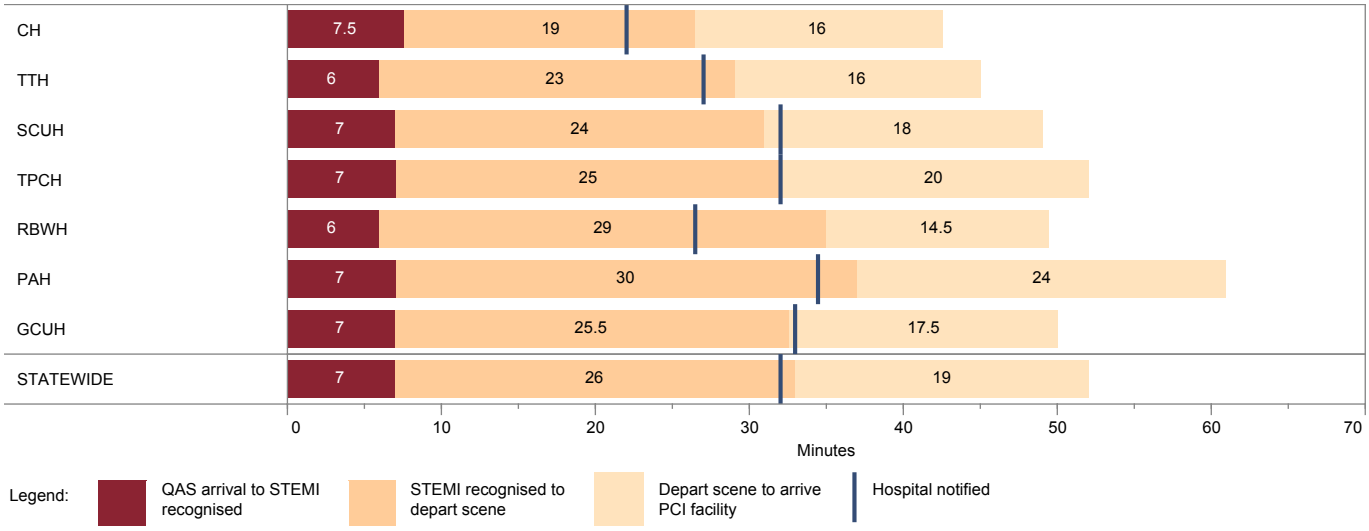
† TPCH data collection extended to include FdECG timestamps in 2018

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

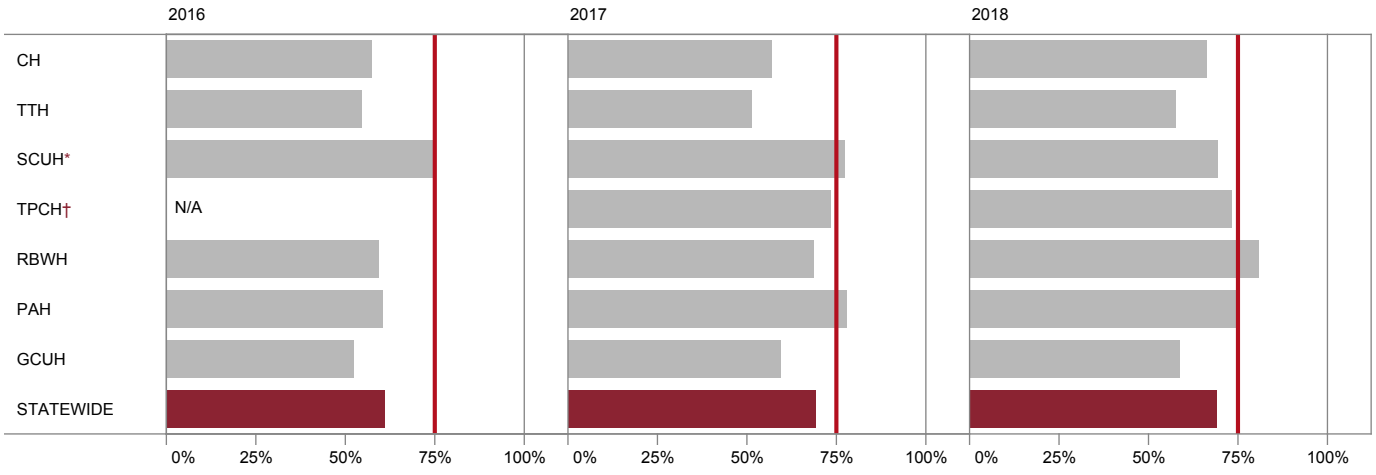
The time between PCI facility arrival and reperfusion ('door-to-device' time) is currently the accepted measure of PCI facility system performance in STEMI. Historically, hospitals have worked to a goal of less than 90 minutes, although more recent guidelines have shortened this target time to less than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

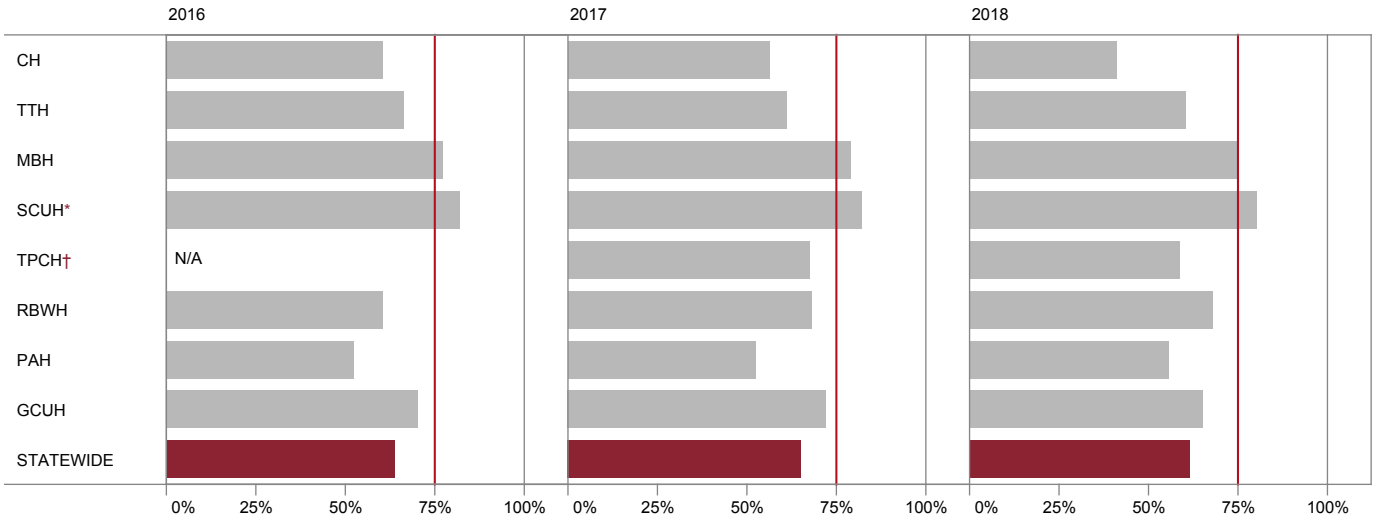
Across the state, the baseline for each PCI centre likely reflects the demographics, logistics and pathways that pertain to that centre. Overall performance from year to year appears to be static (Figure 33), with only about 62% of all cases (direct presenters and inter-hospital transfers) meeting target.

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.

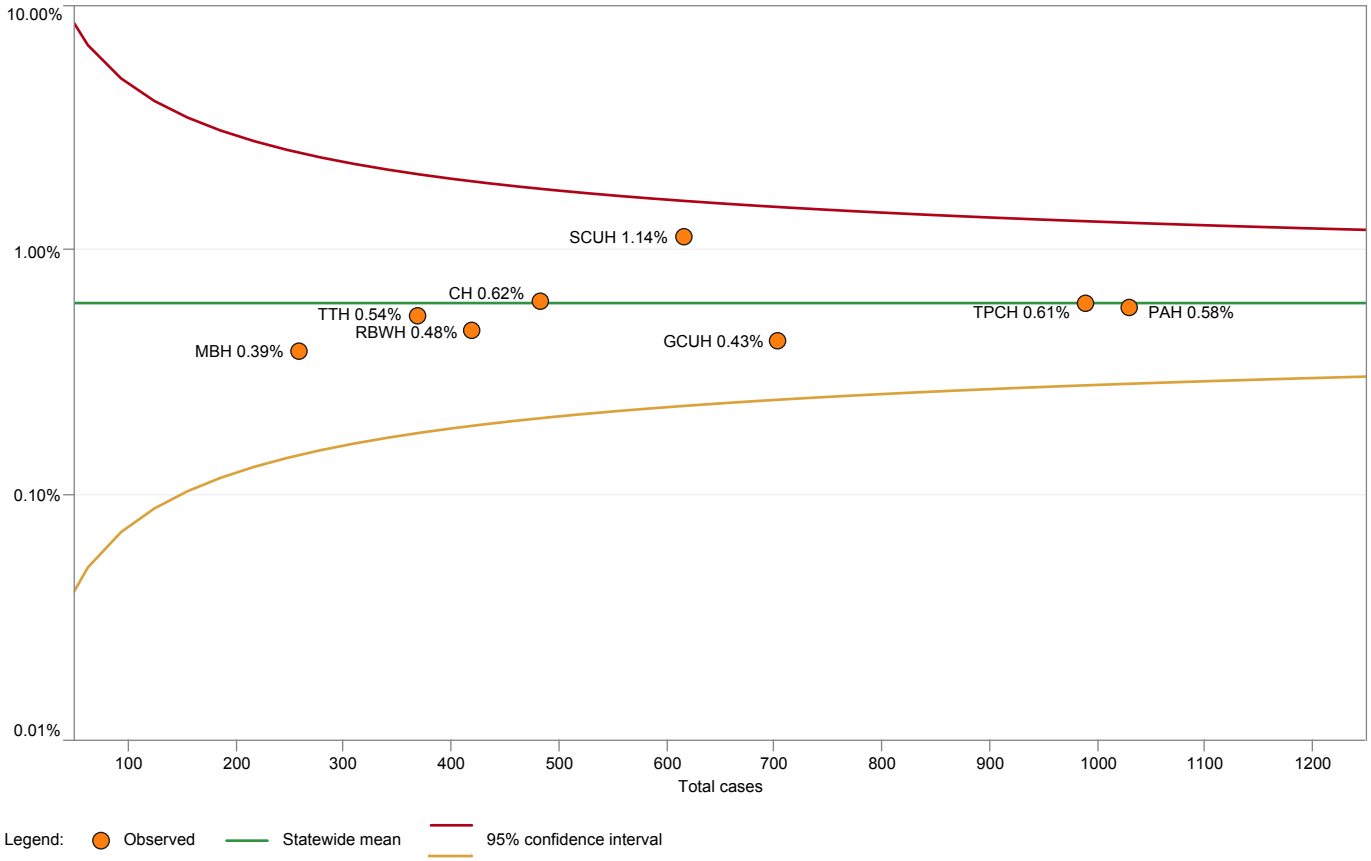


Figure 34: Proportion of PCI cases with immediate major procedure complication by site

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

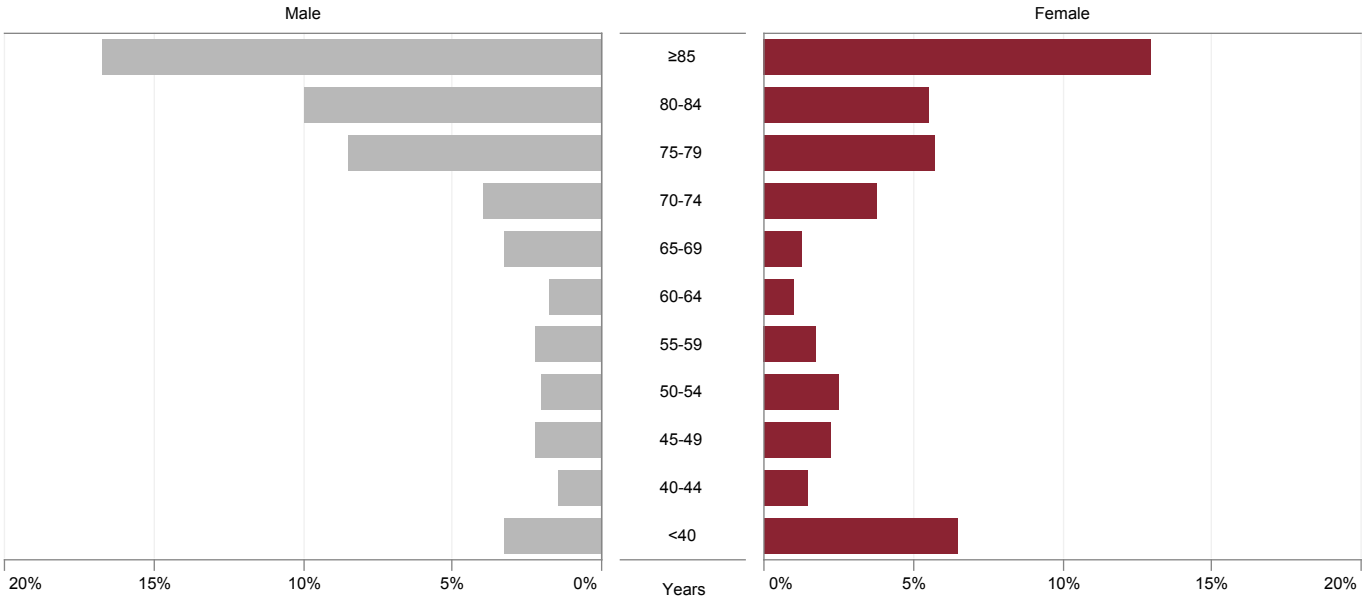
‡ Myocardial septal ablation and renal denervation

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.

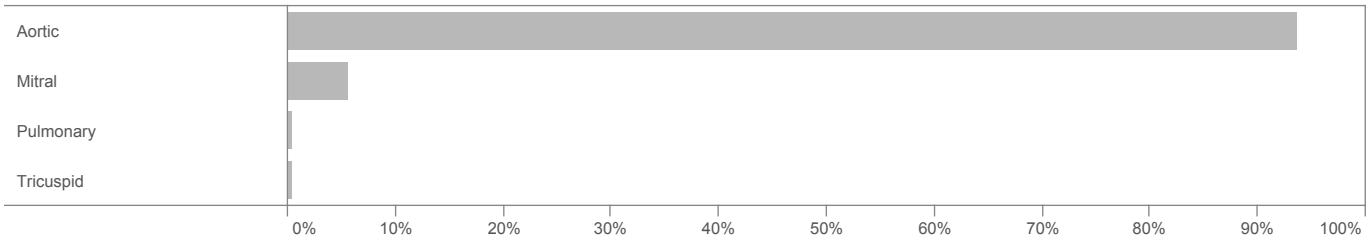


Figure 2: Proportion of all transcatheter valvular interventions by valve type

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)**

Cardiothoracic Surgery Audit

1 Message from the QCOR Cardiothoracic Committee Chair

Presented here is the 2018 QCOR Audit covering Cardiac Surgery.

We continue the project of reporting the numbers of Queenslanders who have had to face cardiac surgery, and ensuring that public hospital cardiac surgery systems are functioning safely. We continue our focus on the statewide and unit-based provision of services. We again take the approach that safety in surgery is a reflection of the structures and systems in place to take people from the place they encounter their disease to the point at which they can engage with life beyond their disease treatment. It is not the work of one individual surgeon standing at the side of a patient, but instead the work of the many hands that pass the patient from one carer to the next – each moment of their journey through their treatment. The contribution of each caring hand to the treatment of the patient can be a brief moment, or it can be the hands that hold a high stakes decision at a critical juncture. Each hand carries Queenslanders through their first moments of their heart disease, to their surgery, and then through their recovery and into their ongoing life.

We report as a group, the characteristics of the patients we have treated, the diseases they have faced and the operations they have experienced. Knowing our patients and what challenges they present, we present how they have fared with their surgery. For the vast majority, the expectations of a recovery that goes to plan are met. For some, they have additional challenges to their surgery that they must deal with, challenges that slow their recovery, or become challenges with which they live.

Along that line, the supplemental report takes a deeper look at the effect of body composition on the journey of a cardiac surgical patient. Body composition reflects multiple influences over the path of our lives and is not easily or quickly changed. Knowing how it changes the experience of surgery is reported in the supplement in this report.

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

2 Key findings

This Queensland Cardiac Surgery Audit describes baseline demographics, risk factors, surgeries performed and surgery outcomes for 2018.

Key findings include:

- In 2018, 2,384 surgeries were performed across the four public adult cardiac surgery units in Queensland.
- The majority of patients were aged between 61 years and 80 years of age (49%) with a median age of 66 years old.
- Approximately three-quarters of patients were male (73%).
- The majority of all patients were overweight or obese (77%).
- The proportion of Indigenous patients overall was 5.8%, however there was wide variation with 20% of patients in Townsville identifying as Aboriginal and Torres Strait Islander.
- Hypertension in combination with statin therapy risk factors were present in over 60% of all patients undergoing coronary artery bypass grafting (CABG) procedures.
- Greater than one-quarter of all patients (28%) were reported to be diabetic at the time of their operation.
- Approximately one-third of patients (31%) had an element of left ventricular dysfunction.
- Over half (58%) of all cases were elective admissions with 15% of elective patients being admitted on the day of surgery.
- In 2018, 1,414 patients had a CABG procedure, the majority (95%) of patients had multi-vessel disease.
- There were 181 patients who underwent aortic surgery, with 62% undergoing ascending aorta replacement.
- Mitral valve repair (70%) was the most common form of valve repair surgery and aortic valve replacement (78%) the most frequently performed replacement surgery.
- Degenerative valve disease (59%) was the primary pathology for aortic and mitral valve intervention.
- Rheumatic heart disease accounted for 16% of all mitral valve pathology leading to mitral valve surgery.
- Major morbidities were evaluated using Society of Thoracic Surgeons (STS) models with most results demonstrating that the observed rate of adverse events is within expectations.
- The mortality rate after surgery is either within the expected range or significantly less than expected, depending on the risk model used to evaluate this outcome.

3 Participating sites

In 2018, there were four public cardiac surgery units spread across metropolitan and regional Queensland, all of which participated in QCOR.

Patients came from a wide geographical area, with most patients residing on the eastern seaboard.

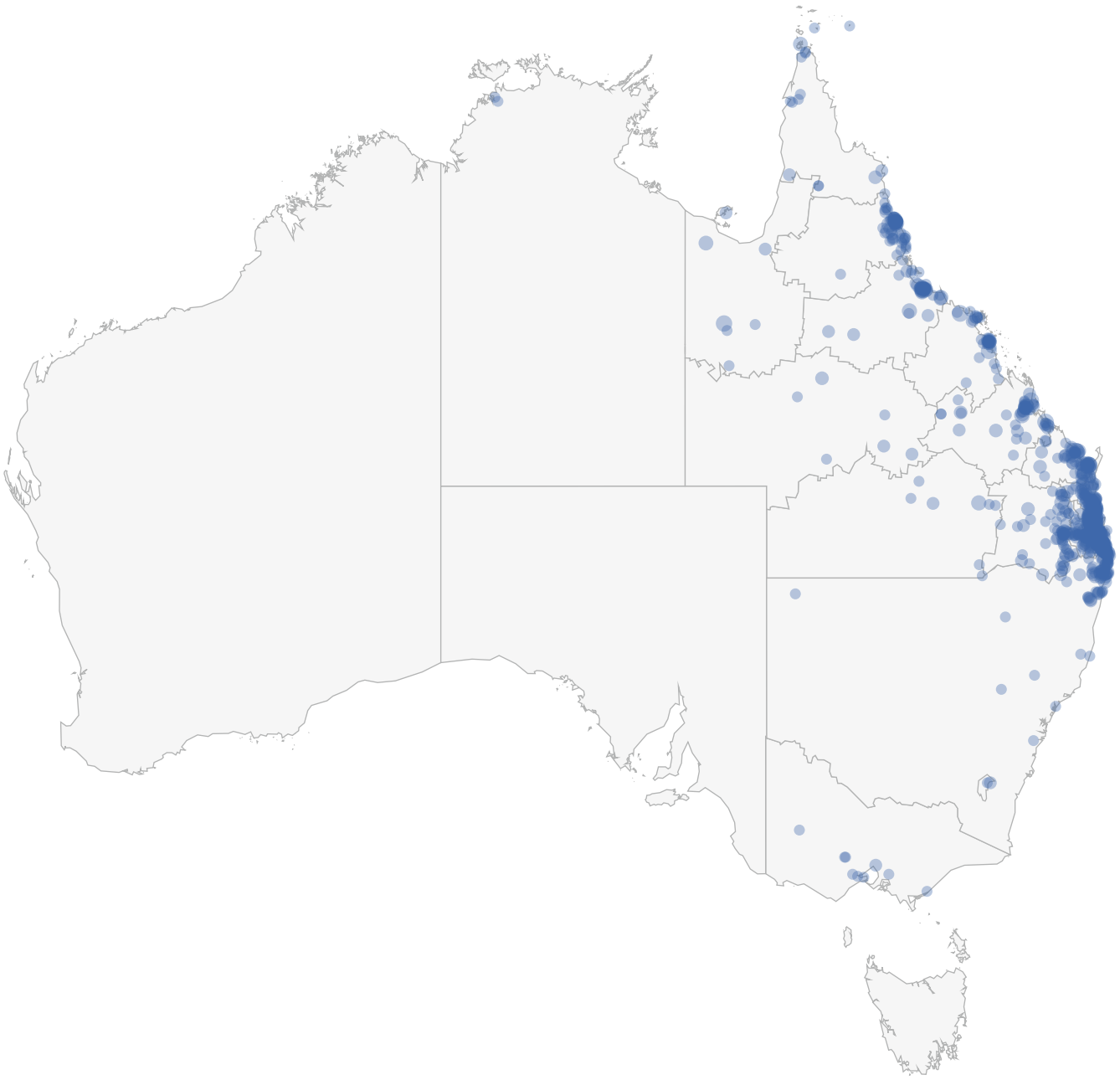


Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

Acronym	Name
TTH	The Townsville Hospital
TPCH	The Prince Charles Hospital
PAH	Princess Alexandra Hospital
GCUH	Gold Coast University Hospital

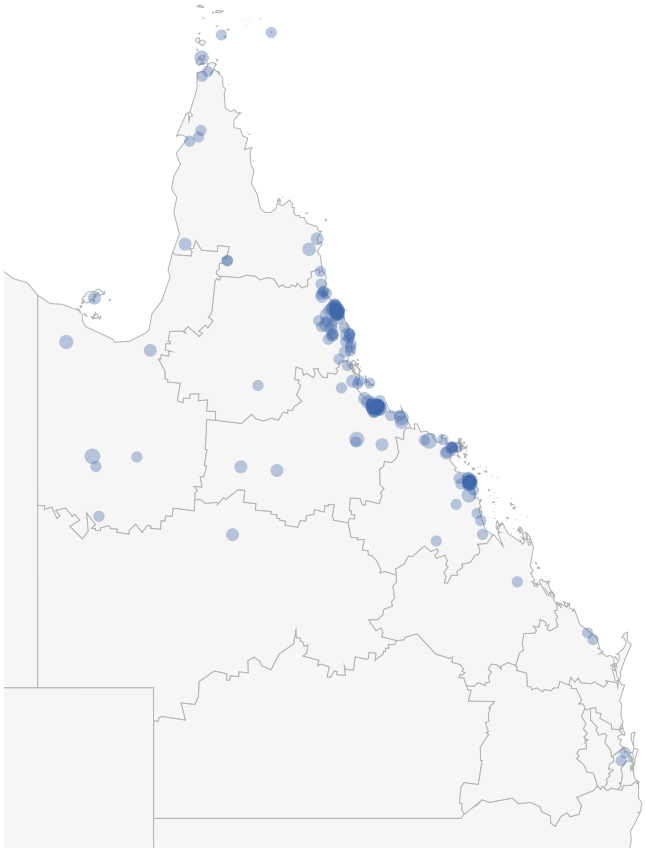


Figure 2: The Townsville Hospital

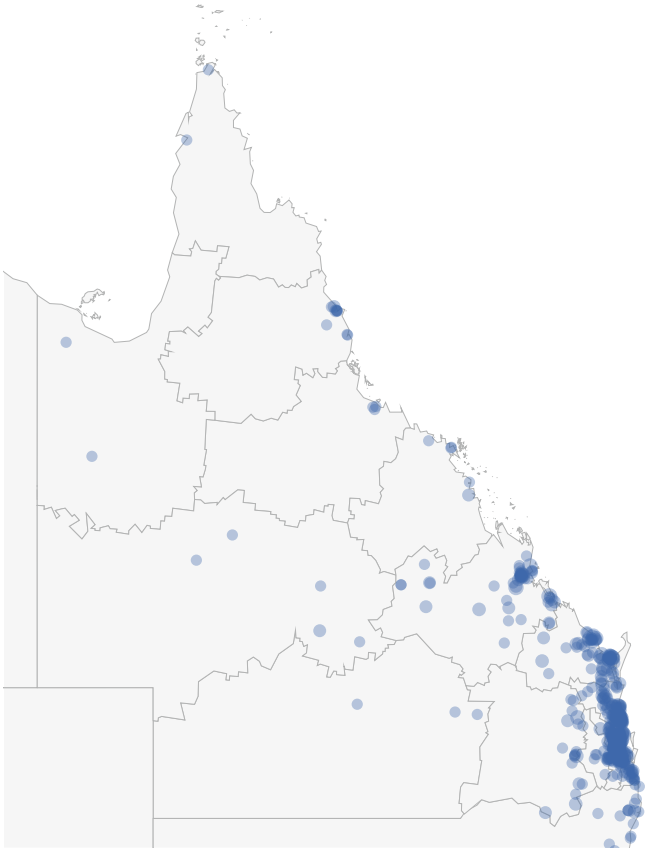


Figure 3: The Prince Charles Hospital

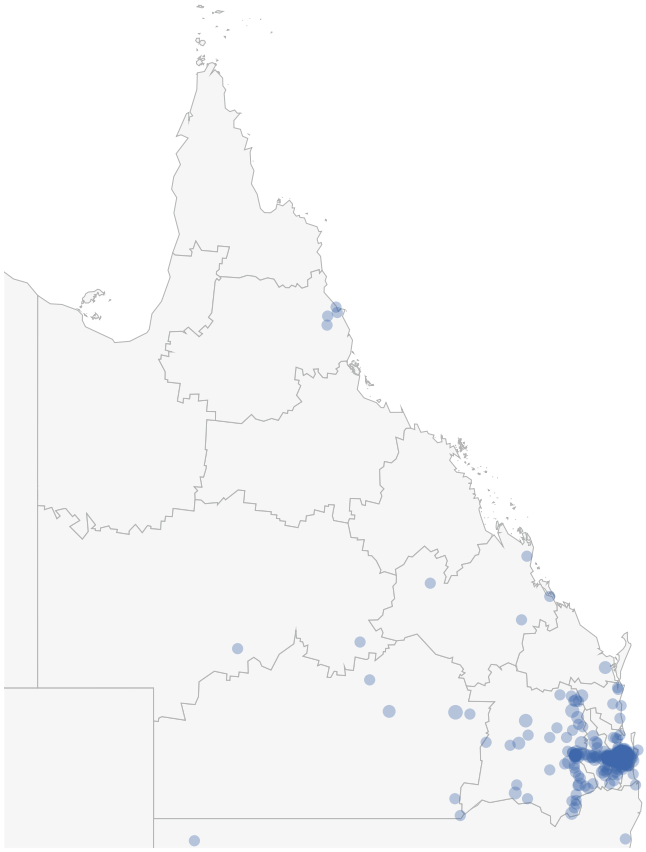


Figure 4: Princess Alexandra Hospital

Figure 5: Gold Coast University Hospital

4 Case totals

4.1 Total surgeries

In 2018, 2,384 cardiac surgical procedures were performed at the participating sites. For the purpose of this Audit, each of the procedure combinations included in those cases have been allocated to a cardiac surgery procedure category as detailed below.

Table 2: Procedure counts and surgery category

Procedure combination	Total cases n	Category*
CABG	1,130	ANY CABG
CABG + other cardiac procedure	35	
CABG + other non-cardiac procedure	6	
CABG + aortic procedure	6	
CABG + other cardiac procedure + other non-cardiac procedure	1	
CABG + valve	204	CABG + VALVE
CABG + valve + other cardiac procedure	16	
CABG + valve + aortic procedure	11	
CABG + valve + aortic procedure + other cardiac procedure	3	
CABG + valve + other non-cardiac procedure	2	
Valve procedure†	555	VALVE
Valve + aortic procedure	111	
Valve + other cardiac procedure	89	
Valve + aortic procedure + other cardiac procedure	7	
Valve + other non-cardiac procedure	5	
Valve + aortic procedure + other non-cardiac procedure	1	
Valve + other cardiac procedure + other non-cardiac procedure	1	
Other cardiac procedure	152	OTHER
Aortic procedure	37	
Other cardiac procedure + other non-cardiac procedure	7	
Aortic procedure + other non-cardiac procedure	3	
Aortic procedure + other cardiac procedure	2	
ALL	**2,384**	

* Category procedure combination allocated

† Includes TAVR procedures (n=76)

4.2 Cases by category

The majority of cases (92%) included some combination of a coronary artery bypass graft (CABG) or a valve procedure.

More than half (59%) of all cardiac surgery procedures involved CABG. Of these, 10% involved a simultaneous CABG and valve procedure.

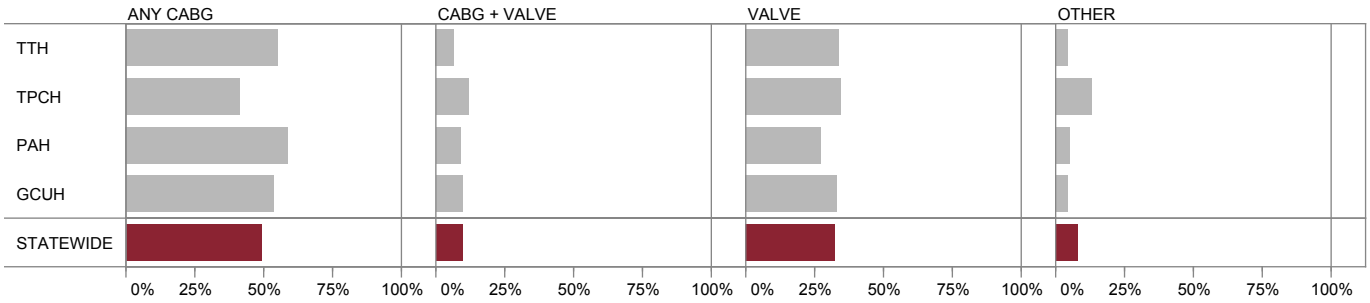


Figure 6: Proportion of cases by site and surgery category

Table 3: Cases by site and surgery category

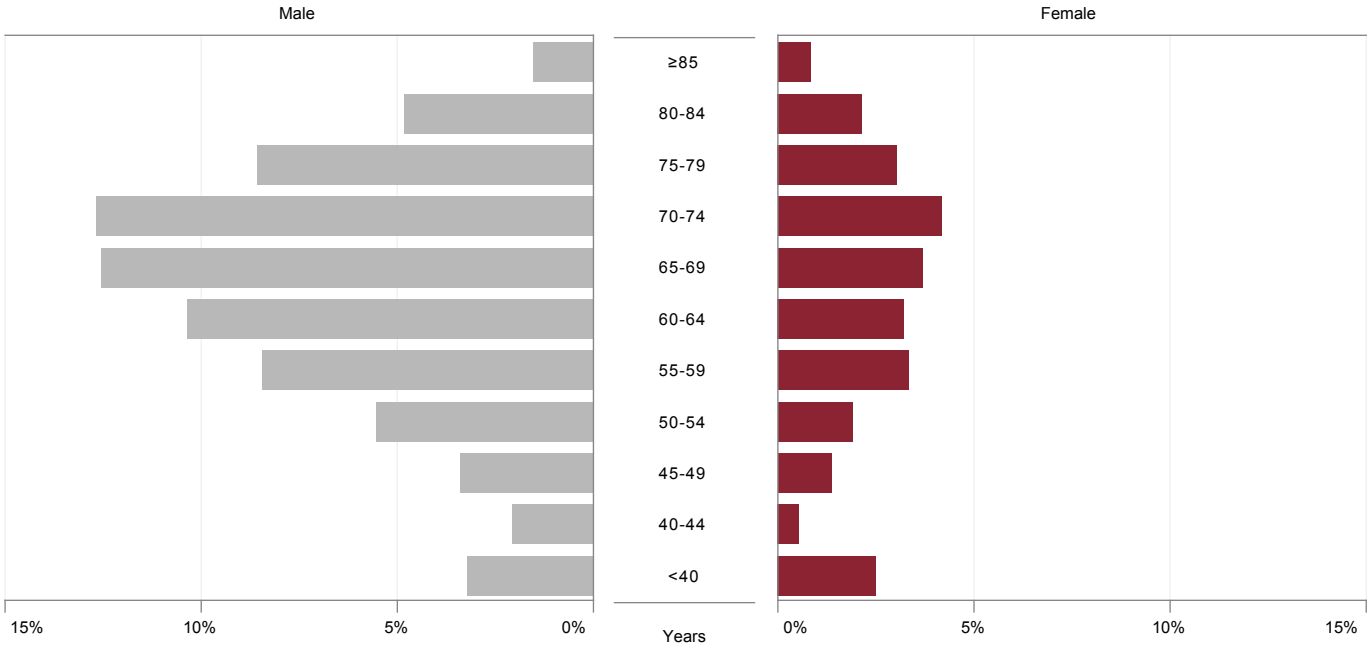
SITE	Total cases n	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)
TTH	359	197 (54.9)	24 (6.7)	122 (34.0)	16 (4.2)
TPCH	1,087	447 (41.1)	126 (11.6)	374 (34.4)	140 (12.9)
PAH	605	356 (58.8)	55 (9.1)	164 (27.1)	30 (5.0)
GCUH	333	178 (53.5)	31 (9.3)	109 (32.7)	15 (4.5)
STATEWIDE	**2,384**	**1,178 (49.5)**	**236 (9.9)**	**769 (32.3)**	**201 (8.3)**

5 Patient characteristics

5.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. Almost half of all patients were aged between 61 years and 80 years (49%). Males aged between 70 years and 74 years accounted for the largest proportion of cases (13%).

The median age of all patients undergoing cardiac surgery was 66 years of age. The median age of both males and females undergoing cardiac surgery was similar, at 66 years and 65 years respectively.



% of total (n=2,384)

Figure 7: Proportion of all cases by age group and gender

Table 4: Median age by gender and surgery category

	Total cases n	Male years	Female years	Total years
ANY CABG	1,178	66	66	66
CABG + VALVE	236	72	69	72
VALVE	769	66	68	66
OTHER	201	56	54	55
ALL	**2,384**	**66**	**65**	**66**

Overall, around three-quarters of patients were male (73%) which reflects the increased risk of coronary artery disease in men.

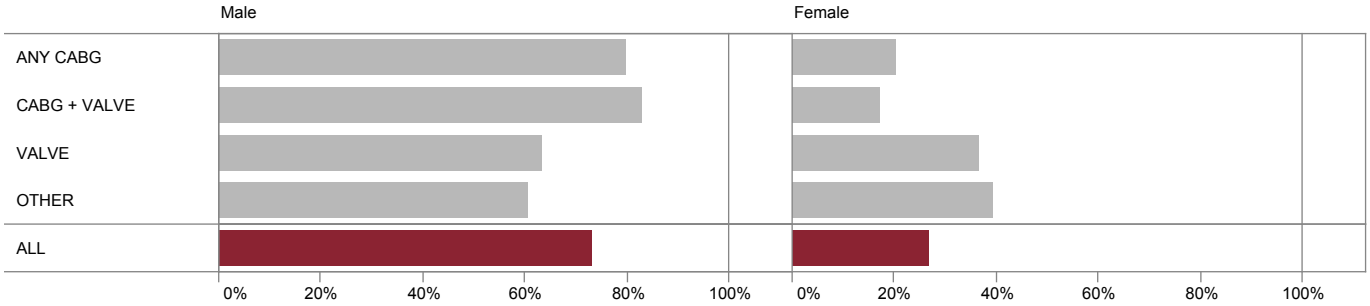
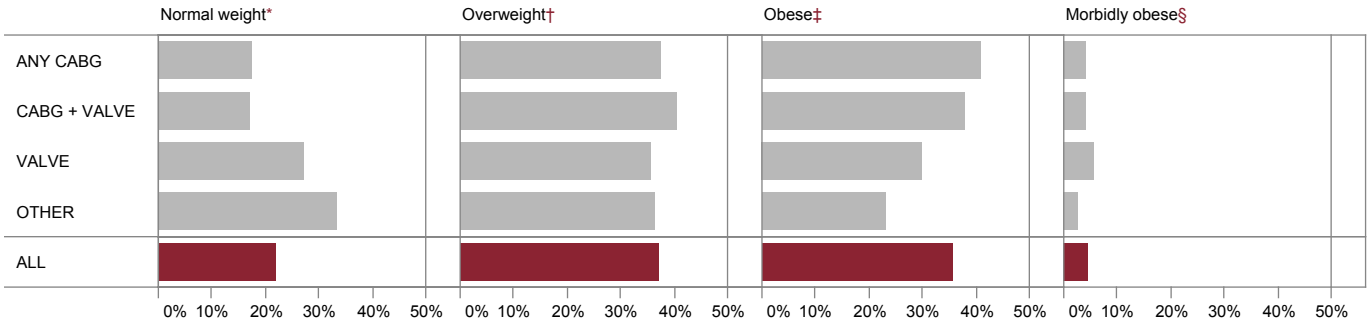


Figure 8: Proportion of cases by gender and surgery category

5.2 Body mass index

Less than one-quarter (22%) of cardiac surgery patients had a healthy body mass index (BMI), while patients having a BMI category of overweight, obese or morbidly obese represented over three-quarters of cardiac surgery patients (77%).

There were less obese patients in the valve-only surgery category (27%) than other categories that include CABG surgery (40% and 38%). Patients classed as underweight (BMI ‹18.5 kg/m²) represented approximately 1% of all cases.



* BMI 18.5–24.9 kg/m²

† BMI 25–29.9 kg/m²

‡ BMI 30–39.9 kg/m²

§ BMI ≥40 kg/m²

Figure 9: Proportion of cases by BMI and surgery category

Table 5: Cases by BMI and surgery category

	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
ANY CABG	5 (0.4)	203 (17.2)	439 (37.3)	481 (40.8)	50 (4.2)
CABG + VALVE	2 (0.8)	40 (16.9)	95 (40.3)	89 (37.7)	10 (4.2)
VALVE	15 (2.0)	210 (27.3)	272 (35.4)	228 (29.7)	43 (5.6)
OTHER	7 (3.5)	67 (33.2)	73 (36.1)	47 (23.3)	5 (2.5)
ALL	**29 (1.2)**	**520 (21.8)**	**879 (36.9)**	**845 (35.4)**	**108 (4.5)**

Missing data not displayed (0.1%)

5.3 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of health with a known impact on the development of an elevated cardiovascular disease. It is recognised that the Aboriginal and Torres Strait Islander population have incidence and prevalence of coronary artery disease.[1]

Approximately 20% of patients undergoing cardiac surgery at TTH identified as Aboriginal and Torres Strait Islander, whereas the overall proportion of identified Aboriginal and Torres Strait Islander patients undergoing cardiac surgery was 5.8%. This proportion is larger than the estimated 4.6% of the overall Queensland population that Aboriginal and Torres Strait Islander people account for.[2]

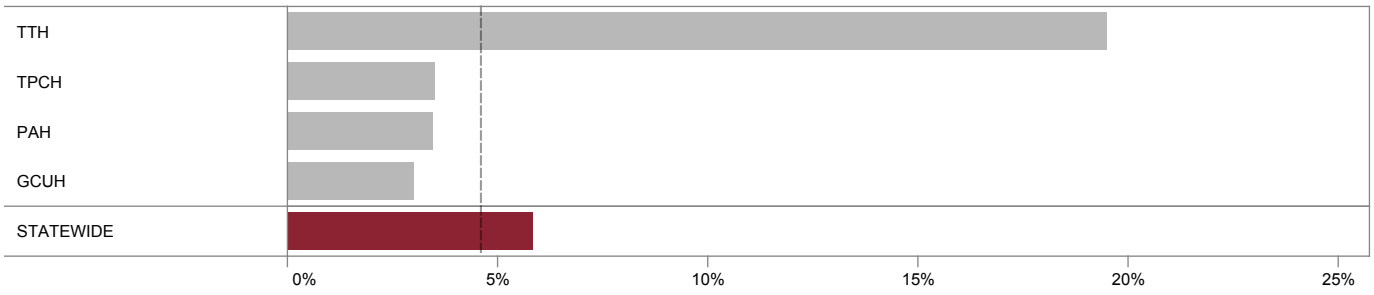


Figure 10: Proportion of all cardiac surgical cases by identified Aboriginal and Torres Strait Islander status and site

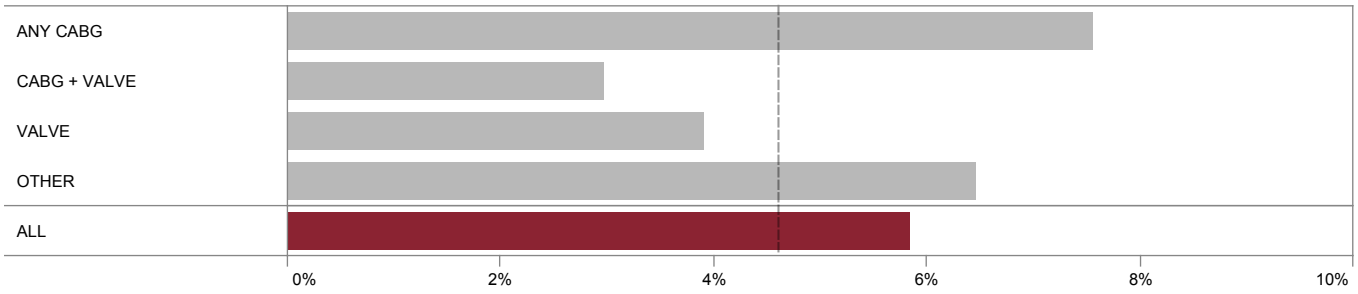
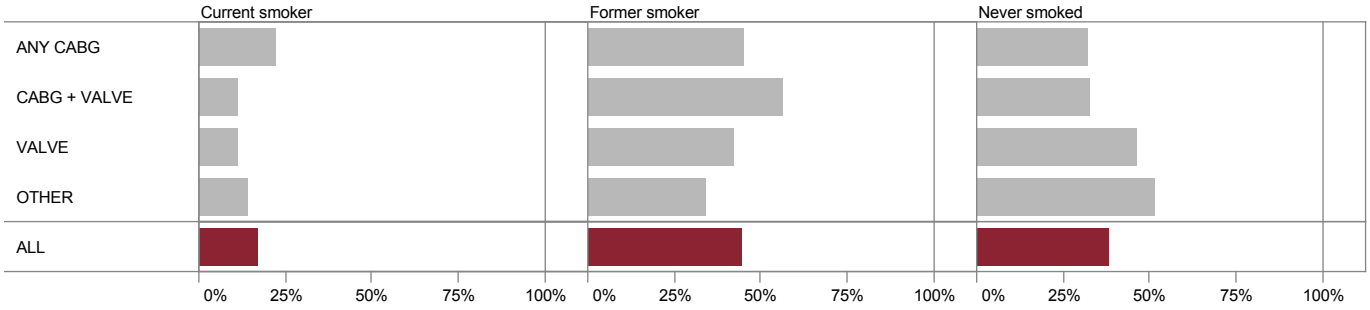


Figure 11: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

6 Risk factor profile

6.1 Smoking history

Overall, 59% of patients had a history of smoking including 16% current smokers (defined as smoking within 30 days of the procedure) and 43% former smokers. Of the remaining patients, 37% reported never having smoked and 5% had an unknown smoking history.



Unknown smoking status not displayed (4.6%)

Figure 12: Proportion of cases by smoking status and surgery category

6.2 Diabetes

Overall, 28% of all cardiac surgical patients were reported as diabetic. The prevalence of diabetes was highest in the CABG patient group (38%).

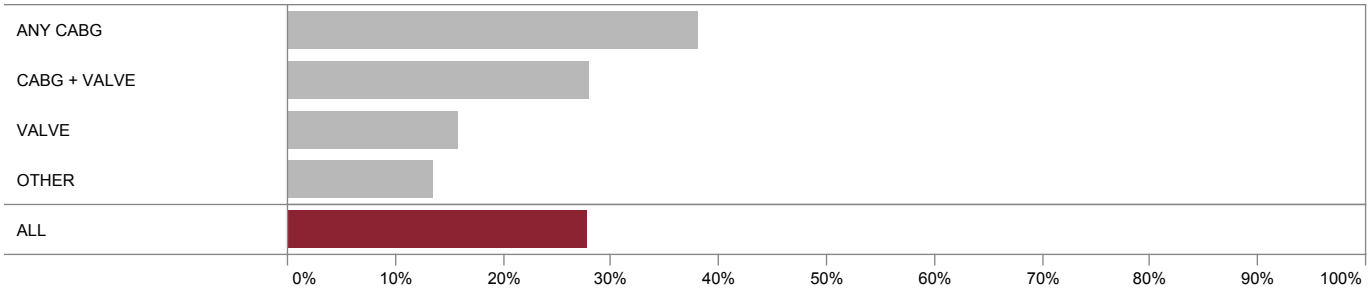


Figure 13: Proportion of cases by diabetes status and surgery category

6.3 Hypertension

Hypertension, defined as receiving antihypertensive medications at the time of surgery, was present in 66% of patients with considerable variation by surgery type (range 38% to 78%).

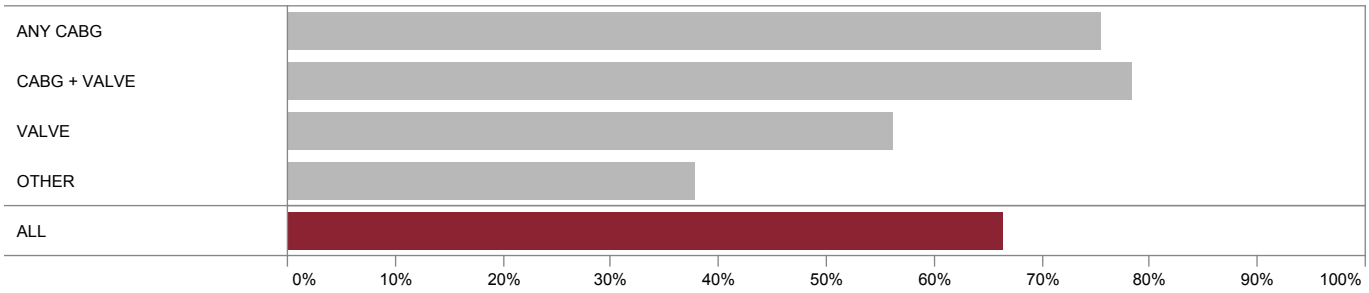


Figure 14: Proportion of cases by hypertension status and surgery category

6.4 Hypercholesterolaemia

Overall, 63% of patients were treated with statins for hypercholesterolaemia at the time of surgery, ranging from 81% in the CABG category to 31% in the other surgery category. This does not account for statin treatment rates prior to admission or investigation for coronary artery disease (CAD).

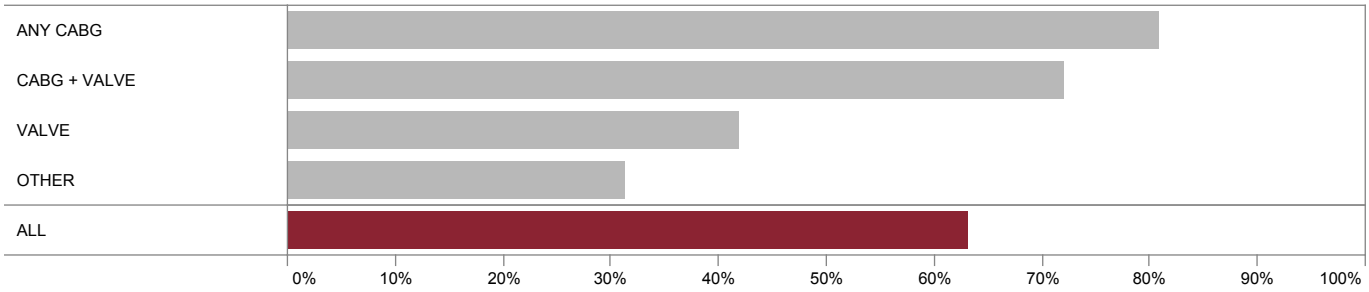
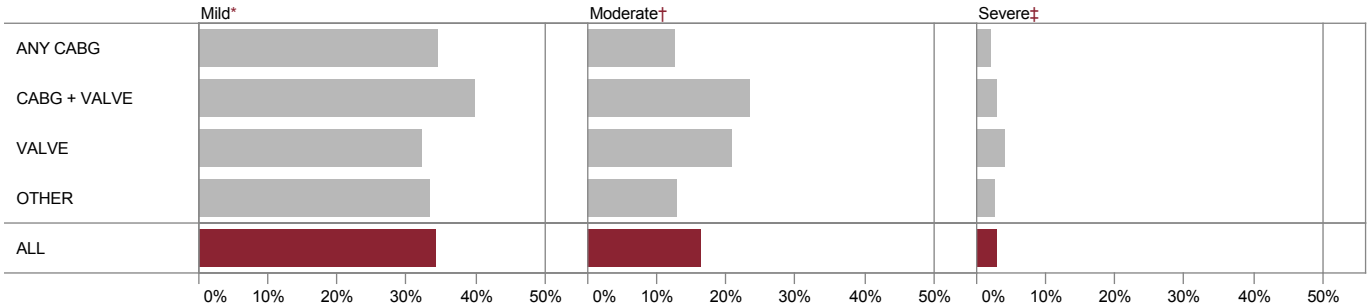


Figure 15: Proportion of cases by statin therapy status and surgery category

6.5 Renal impairment

Approximately half (53%) of all patients were identified as having impaired renal function (eGFR ≤89 mL/min/1.73 m²) at the time of their surgery. Patients undergoing CABG and valve surgery had the highest incidence of renal impairment (66%).



* eGFR 60–89 mL/min/1.73 m²

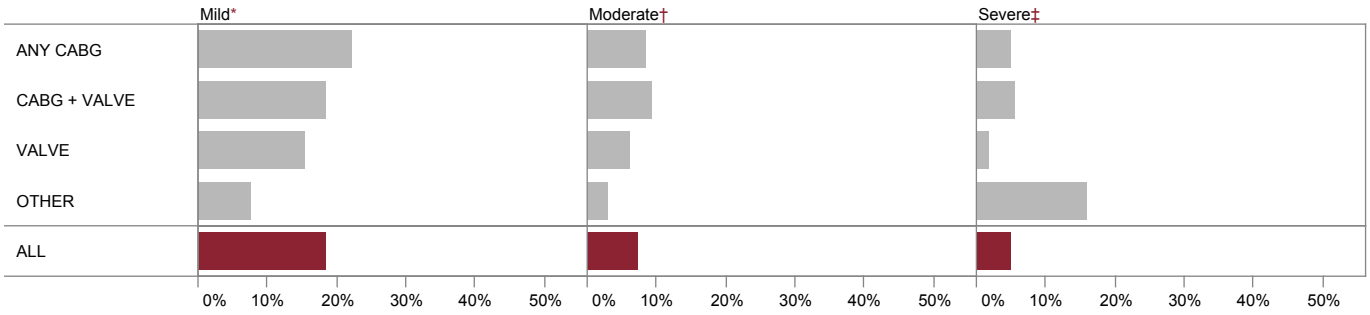
† eGFR 30–59 mL/min/1.73 m²

‡ eGFR <30 mL/min/1.73 m²

Figure 16: Proportion of cases by renal impairment status and surgery category

6.6 Left ventricular dysfunction

Almost one-third (31%) of patients were classed as having an impaired left ventricular ejection fraction (LVEF). This included 18% with mild LV dysfunction (LVEF between 40% to 50%), 7% with moderate LV dysfunction (LVEF between 30% to 39%) and 5% with severe LV dysfunction (LVEF less than 30%).



* LVEF 40–49%

† LVEF 30–39%

‡ LVEF ‹30%

Figure 17: Proportion of cases by LV dysfunction category and surgery category

6.7 Summary of risk factors

The development of CAD is dependent on several background variables and risk factors. Analysis of risk factors and surgical categories found a number of combinations of risk factors that have a greater representation in some categories, thus reflecting the complex medical history of many patients.

Table 6: Summary of risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
Current smoker	255 (21.6)	25 (10.6)	78 (10.2)	26 (12.9)	384 (16.1)
Former smoker	524 (44.5)	126 (53.4)	303 (39.4)	60 (29.9)	1,013 (42.5)
Diabetes	447 (37.9)	66 (28.0)	122 (15.9)	27 (13.4)	662 (27.8)
Hypertension	890 (75.6)	185 (78.4)	431 (56.1)	77 (38.1)	1,583 (66.4)
Hypercholesterolaemia	952 (80.8	170 (72.0)	322 (41.9)	63 (31.2)	1,507 (63.2)
eGFR 60–89 mL/min/1.73 m^2	407 (34.6)	94 (39.8)	247 (32.1)	67 (33.3)	815 (34.2)
eGFR 30–59 mL/min/1.73 m^2	147 (12.5)	55 (23.3)	160 (20.8)	26 (12.9)	388 (16.3)
eGFR <30 mL/min/1.73 m^2	24 (2.0)	7 (3.0)	31 (4.0)	5 (2.5)	67 (2.8)
LVEF 40%–50%	260 (22.1)	43 (18.2)	119 (15.5)	15 (7.9)	437 (18.3)
LVEF 30%–39%	100 (8.5)	22 (9.3)	48 (6.2)	6 (3.0)	176 (7.4)
LVEF <30%	57 (4.8)	13 (5.5)	13 (1.7)	32 (15.9)	115 (4.8)
BMI ≥30 kg/m^2	531 (45.1)	99 (41.9)	272 (35.4)	51 (25.4)	953 (40.0)

Table 7: Summary of combined risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
Hypertension + hypercholesterolaemia	775 (65.8)	143 (60.6)	248 (32.2)	42 (20.9)	1,208 (50.7)
Current/former smoker + hypertension	602 (51.1)	114 (48.3)	223 (29.0)	38 (18.9)	977 (41.0)
Current/former smoker + hypertension + hypercholesterolaemia	527 (44.7)	95 (40.3)	135 (17.6)	22 (10.9)	779 (32.7)
BMI ≥30 kg/m^2 + hypercholesterolaemia	436 (37.0)	76 (32.2)	145 (18.9)	23 (11.4)	680 (28.5)
Diabetes + hypertension + hypercholesterolaemia	352 (29.9)	52 (22.0)	70 (9.1)	12 (6.0)	486 (20.4)
Diabetes + eGFR ≤89mL min/1.73 m^2	203 (17.2)	34 (14.4)	69 (9.0)	15 (7.5)	321 (13.5)
Current/former smoker + BMI ≥30 kg/m^2 + diabetes	183 (15.5)	30 (12.7)	42 (5.5)	3 (1.5)	258 (10.8)
BMI ≥30 kg/m^2 + diabetes	248 (21.1)	41 (17.4)	72 (9.4)	6 (3.0)	367 (15.4)

7 Care and treatment of patients

7.1 Admission status

Elective, urgent or emergent status varied widely between categories of surgeries. Most CABG cases were performed as urgent cases, whilst emergencies were predominately CABG followed by aortic surgery, in particular, correction of aortic dissection.

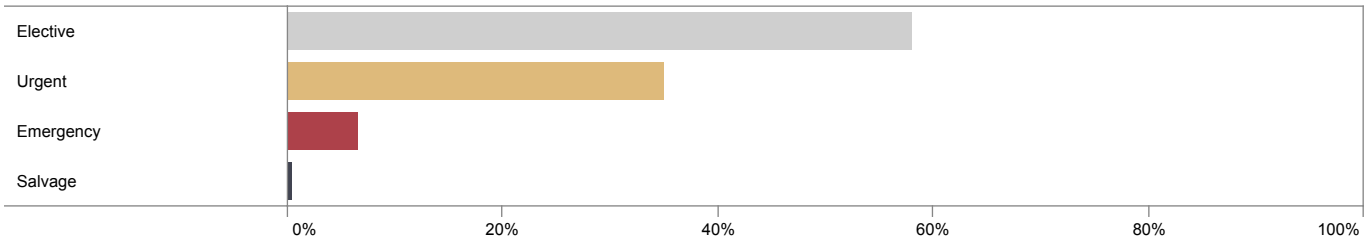


Figure 18: Proportion of cases by admission status

Table 8: Cases by admission status and surgery category

	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)
ANY CABG	520 (44.1)	620 (52.6)	35 (3.0)	3 (0.3)
CABG + VALVE	158 (66.9)	73 (30.9)	5 (2.1)	–
VALVE	627 (81.5)	115 (15.0)	25 (3.3)	2 (0.3)
OTHER	77(38.3)	27 (13.4)	92 (45.5)	5 (2.5)
ALL	**1,382 (58.0)**	**835 (35.0)**	**157 (6.6)**	**10 (0.4)**

7.2 Day of surgery admission

Day of surgery admission (DOSA) rates accounted for 15% of all elective cases, with minor variations observed across most surgery categories.

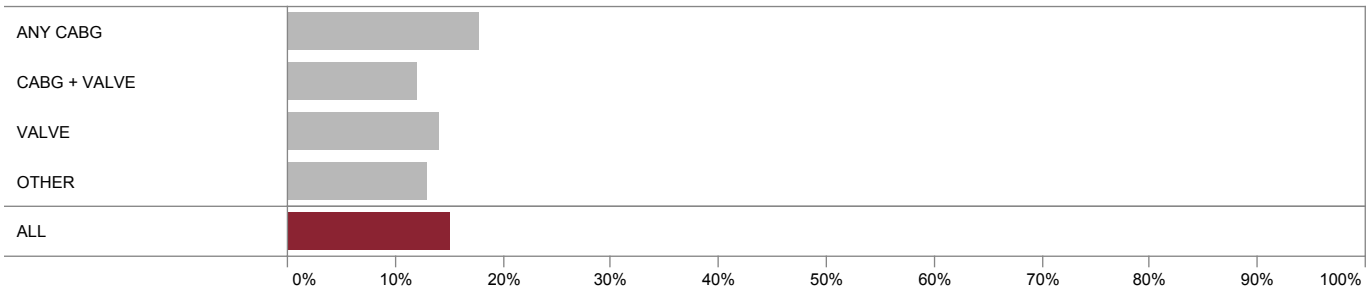


Figure 19: Proportion of elective cases for DOSA cases by surgery category

Table 9: DOSA cases by surgery category

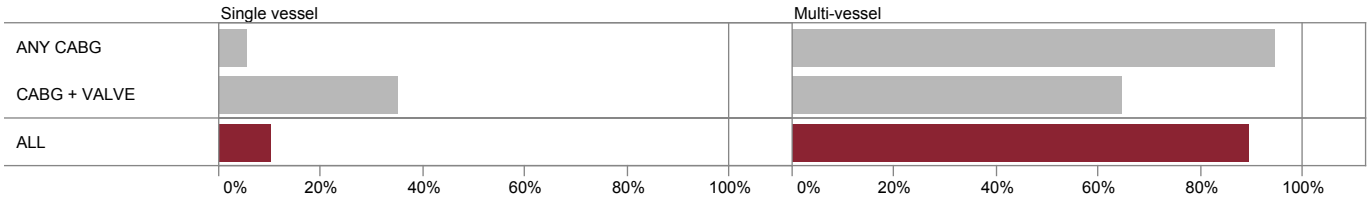
	Total elective cases n	DOSA cases n (%)
ANY CABG	520	92 (17.7)
CABG + VALVE	158	19 (12.0)
VALVE	627	88 (14.1)
OTHER	77	10 (13.0)
ALL	**1,382**	**209 (15.1)**

7.3 Coronary artery bypass grafting

7.3.1 Number of diseased vessels

In total, 1,414 patients had a CABG procedure. The majority (95%) had multi-vessel disease.

When CABG was performed in conjunction with a valve procedure, 65% of patients had multi-vessel disease compared to 95% when CABG surgery was performed without a valve intervention.



Excludes missing data/not applicable (n=6)

Figure 20: Number of diseased vessels

Table 10: Number of diseased vessels

	Single vessel n (%)	Multi-vessel n (%)	Total n (%)
ANY CABG	64 (5.4)	1,114 (94.6)	1,178 (100.0)
CABG + VALVE	81 (35.2)	149 (64.8)	230 (100.0)
ALL	**145 (10.3)**	**1,263 (89.7)**	**1,408 (100.0)**

Excludes missing data/not applicable (n=6)

7.3.2 Number of grafts

The mean number of grafts performed was 2.7. In multi vessel CABG, the mean number of grafts was 2.9.

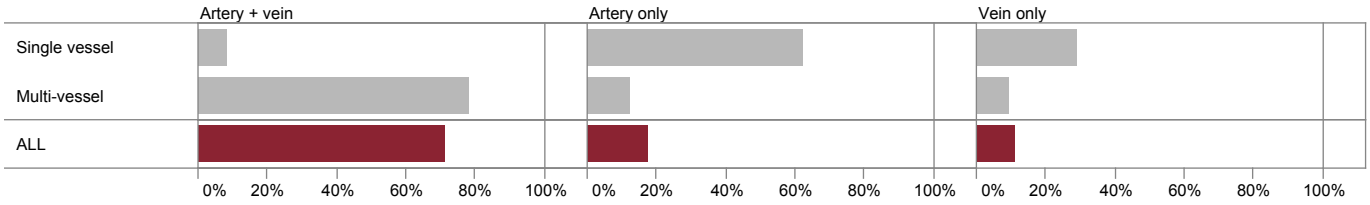
Table 11: Number of grafts by number of diseased vessels

	Single vessel mean	Multi vessel mean	Multi vessel median	Total mean
ANY CABG	1.3	3.0	3	2.9
CABG + VALVE	1.1	2.2	2	1.8
ALL	**1.2**	**2.9**	**3**	**2.7**

Excludes missing data/not applicable (n=6)

7.3.3 Conduits used

In CABG, including surgeries involving valvular intervention, the most common form of revascularisation required the use of a combination of an arterial and vein graft (71%). Total arterial revascularisation occurred in 18% of cases.



Excludes missing data/not applicable (n=6)

Figure 21: Proportion of diseased vessels by conduits used

Table 12: Conduits used by number of diseased vessels

	Artery + vein n (%)	Artery only n (%)	Vein only n (%)
Single vessel	12 (8.3)	90 (62.5)	42 (29.2)
Multi-vessel	986 (78.3)	157 (12.5)	117 (9.3)
ALL	**998 (71.1)**	**247 (17.6)**	**159 (11.3)**

Excludes missing data/not applicable (n=6)

7.3.4 Off-pump CABG

Approximately 2% of isolated CABG operations were performed off-pump.

Table 13: Off-pump CABG

	Total cases n	Off-pump n (%)
Isolated CABG	1,130	20 (1.8)

7.3.5 Y or T grafts

Overall, 5% of all CABG surgeries included a Y or T graft.

Table 14: Y or T graft used by procedure category

	Total cases n	Y or T graft n (%)
ANY CABG	1,178	63 (5.3)
CABG + VALVE	236	6 (2.5)
ALL	**1,414**	**69 (4.9)**

7.4 Aortic surgery

There were a total of 181 cases that included a procedure involving the aorta (not including procedures conducted on the aortic valve).

Most aortic surgery procedures included replacement of the ascending aorta in isolation (62%), while surgery to replace the ascending aorta that includes any part of the aortic arch accounted for 17% of cases.

Aortic aneurysm was the most common reason for aortic surgery (45%).

Table 15: Aortic surgery by procedure type

Aortic surgery type	n (%)
Replacement	153 (84.5)
Ascending	112 (61.9)
Ascending + arch	31 (17.1)
Arch	4 (2.2)
Arch + descending	2 (1.1)
Ascending + arch + descending + thoracoabdominal	2 (1.1)
Ascending + arch + thoracoabdominal	1 (0.6)
Thoracoabdominal	1 (0.6)
Aortoplasty	20 (11.0)
Direct aortoplasty	10 (5.5)
Patch repair	9 (5.0)
Aortoplasty + patch repair	3 (1.7)
Aortoplasty + endarterectomy	1 (0.6)
Aortoplasty and replacement	8 (4.4)
Patch repair + ascending	3 (1.7)
Patch repair + ascending + arch	2 (1.1)
Patch repair + ascending + arch	1 (0.6)
Patch repair + ascending + thoracoabdominal	1 (0.6)
Patch repair + descending	1 (0.6)
ALL	**181 (100.0)**

7.4.1 Aortic pathology

Table 16: Aortic surgery cases by pathology type

Aortic pathology type	n (%)
Aortic aneurysm	81 (44.8)
Aortic dissection (≤2 weeks)	30 (16.6)
Calcification	8 (4.4)
Aortic dissection (>2 weeks)	6 (3.3)
Aortic abscess	3 (1.7)
Traumatic transection	1 (0.6)
Other	52 (28.7)
ALL	**181 (100.0)**

7.5 Valve surgery

In participating sites, valve surgery was performed in 1,005 cases during 2018. The aortic valve was the most commonly operated on valve either with or without other valves (68%). Isolated mitral valve surgery was the next most common valvular surgery (24%).

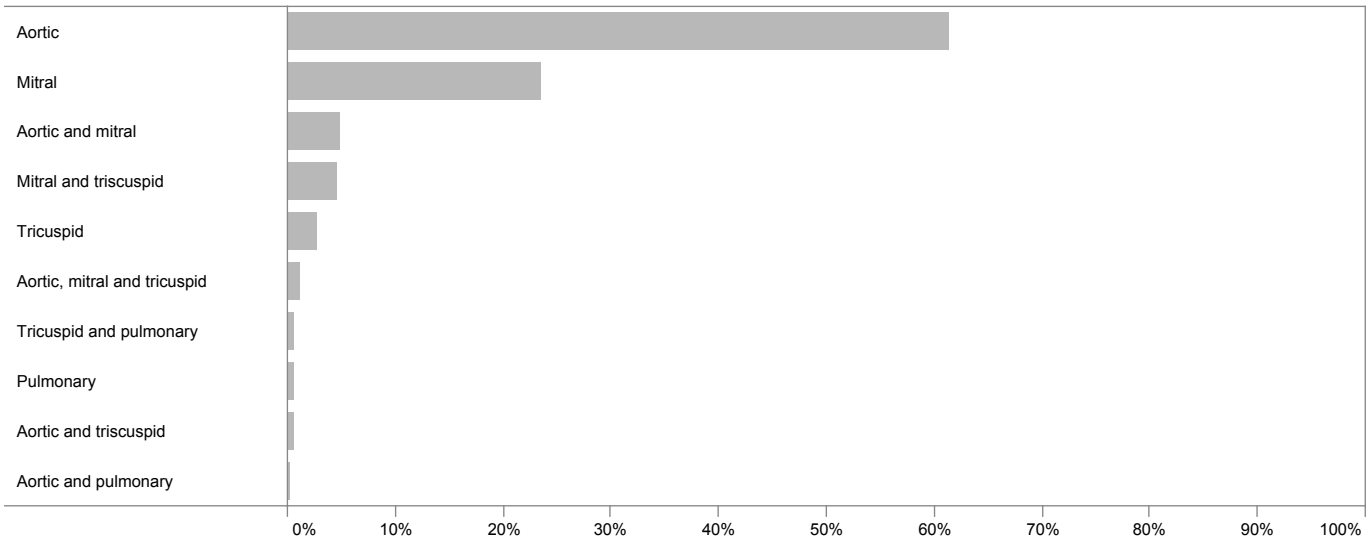


Figure 22: Proportion of valve surgery cases by valve

Table 17: Valve surgery cases by valve

Type of valve surgery	n (%)
Aortic	616 (61.3)
Mitral	236 (23.5)
Aortic and mitral	48 (4.8)
Mitral and tricuspid	47 (4.7)
Tricuspid	28 (2.8)
Aortic, mitral and tricuspid	11 (1.1)
Pulmonary	6 (0.6)
Aortic and tricuspid	6 (0.6)
Tricuspid and pulmonary	6 (0.6)
Aortic and pulmonary	1 (0.1)
ALL	**1,005 (100.0)**

7.5.1 Valve pathology

The most common valve pathology across all valve types was degenerative (54%) and accounted for more than half (59%) of all aortic valve procedures.

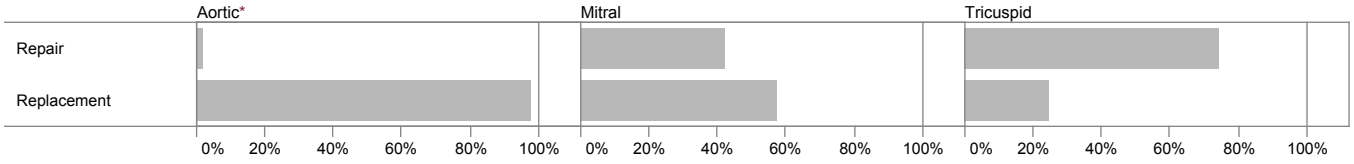
Table 18: Valve pathology by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Degenerative	402 (59.0)	173 (50.5)	34 (34.6)	–	609 (53.7)
Congenital	126 (18.5)	3 (0.9)	10 (10.2)	8 (61.5)	147 (13.0)
Infection	45 (6.6)	36 (10.5)	9 (9.2)	2 (15.4)	92 (8.1)
Rheumatic	23 (3.4)	54 (15.8)	14 (14.3)	–	91 (8.0)
Prosthesis failure	24 (3.5)	20 (5.9)	–	2 (15.4)	46 (4.1)
Ischaemic	–	18 (5.3)	–	–	18 (1.6)
Dissection	14 (2.1)	–	–	–	14 (1.2)
Annuloaortic ectasia	10 (1.5)	–	–	–	10 (0.9)
Functional	–	–	8 (8.2)	–	8 (0.7)
Iatrogenic	1 (0.1)	–	–	–	1 (0.1)
Other	37 (5.4)	38 (11.1)	23 (23.5)	1 (7.7)	99 (8.7)
ALL	**682 (100.0)**	**342 (100.0)**	**98 (100.0)**	**13 (100.0)**	**1,135 (100.0)**

7.5.2 Types of valve surgery

The majority of valve surgery cases involved aortic valve intervention (60%).

The most common aortic valve procedure was replacement surgery (98%) with the remainder involving valve repair. Similarly, for the mitral valve, replacement was more frequent than repair (58% vs 42%).



* Aortic replacement category includes transcatheter aortic valve replacement (TAVR) cases involving CTS

Figure 23: Valve surgery category by valve

Table 19: Valve surgery category by valve

Surgery category	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Repair	13 (1.9)	145 (42.4)	73 (74.5)	–	231 (20.3)
Replacement*	669 (98.1)	197 (57.6)	24 (24.5)	13 (100.0)	903 (79.6)
Inspection only	–	–	1 (1.0)	–	1 (0.1)
ALL	**682 (100.0)**	**342 (100.0)**	**98 (100.0)**	**13 (100.0)**	**1,135 (100.0)**

* Includes TAVR procedure (n=76) involving CTS

Transcatheter aortic valve replacement

A TAVR procedure is often a combined effort of a multidisciplinary heart team which involves both interventional cardiologists and cardiac surgeons, among other specialties. Despite the varied role of the surgeon in the heart team, over half (51%) of all TAVR were performed with a cardiac surgeon involved in the procedure.

It should be noted that the reported number of TAVR cases within this Audit reflects those in which a cardiothoracic surgeon was present during the procedure and does not represent the total number of these surgeries performed in Queensland public hospitals in 2018.

Further detail regarding all TAVR procedures performed in a Queensland public hospital have been included in the structural heart disease supplement of the interventional cardiology chapter of this annual report.

Table 20: TAVR cases by site and CS involvement

Site	All TAVR n	Combined CS and cardiologist TAVR n (%)
TTH	3	3 (100.0)
TPCH	93	21 (22.6)
PAH	33	33 (100.0)
GCUH	19	19 (100.0)
STATEWIDE	**148**	**76 (51.4)**

7.5.3 Valve repair surgery

The most common form of valve repair surgery was repair/reconstruction with annuloplasty (75%) followed by annuloplasty only (13%). Mitral valve repair/reconstruction with annuloplasty was the most common individual valve repair surgery (57%).

Table 21: Valve repair surgery by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Total n (%)
Repair/reconstruction with annuloplasty	–	131 (90.3)	43 (58.9)	174 (75.3)
Annuloplasty only	–	4 (2.8)	27 (37.0)	31 (13.4)
Repair/reconstruction without annuloplasty	–	5 (3.4)	3 (4.1)	8 (3.5)
Root reconstruction with valve sparing	6 (46.2)	–	–	6 (2.6)
Resuspension of aortic valve	6 (46.2)	–	–	6 (2.6)
Tumour tissue removal	1 (7.7)	–	–	1 (0.4)
Decalcification of valve only	–	1 (0.7)	–	1 (0.4)
Alfieri suture	–	2 (1.4)	–	2 (0.9)
Repair paravalvular leak	–	1 (0.7)	–	1 (0.4)
Thrombus removal	–	1 (0.7)	–	1 (0.4)
ALL	**13 (100.0)**	**145 (100.0)**	**73 (100.0)**	**231 (100.0)**

7.5.4 Valve replacement surgery

Aortic valve replacement accounted for the majority of valve replacement surgeries (69%) which included 76 TAVR procedures and 62 aortic root reconstruction surgeries utilising a valved conduit.

Table 22: Valve replacement surgery by valve type

Surgery type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Replacement	531 (79.4)	197 (100.0)	24 (100.0)	13 (100.0)	765 (84.7)
TAVR	76 (11.4)	–	–	–	76 (8.4)
Root reconstruction with valved conduit	62 (9.3)	–	–	–	62 (6.9)
ALL	**669 (100.0)**	**197 (100.0)**	**24 (100.0)**	**13 (100.0)**	**903 (100.0)**

Prosthesis type

The most common form of valve prostheses used across all valve types were biological (84%). Mechanical prostheses were used in 16% of cases with a greater proportion represented in mitral valve replacement surgeries.

Bovine pericardial aortic valve prostheses accounted for the largest proportion of all valves used, representing 50% of all aortic valve prostheses and 37% of the total valvular prostheses used.

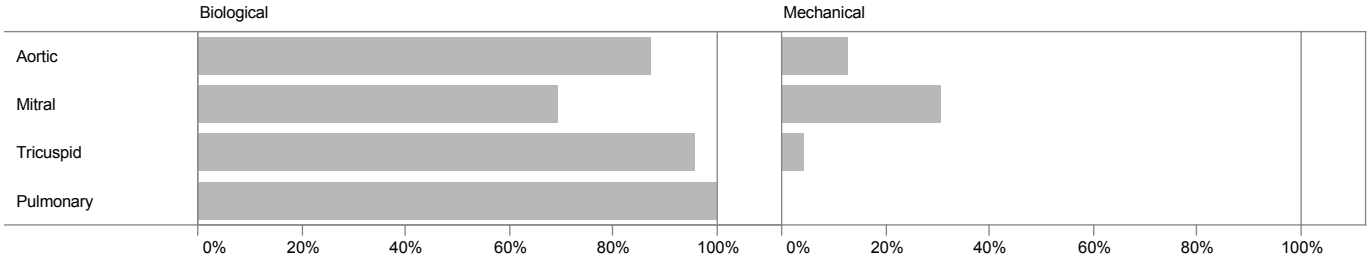


Figure 24: Proportion of valve replacements by valve prosthesis category and valve type

Table 23: Types of valve prosthesis by valve type

Prosthesis type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Biological – bovine	332 (49.6)	29 (14.7)	5 (20.8)	13 (100.0)	378 (41.9)
Biological – porcine	251 (37.5)	108 (54.8)	18 (75.0)	0 (0.0)	377 (41.8)
Mechanical	85 (12.7)	60 (30.5)	1 (4.2)	0 (0.0)	146 (16.2)
Homograft/allograft	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
ALL	**669 (100.0)**	**197 (100.0)**	**24 (100.0)**	**13 (100.0)**	**903 (100.0)**

7.6 Other cardiac surgery

The most common forms of other cardiac surgery were left atrial appendage closure (18%), followed by atrial septal defect repair (13%). Various other cardiac surgeries accounted for 13%.

Table 24: Other cardiac procedures

Procedure	n (%)
Left atrial appendage closure	67 (18.4)
Atrial septal defect repair	46 (12.6)
BSSLTx*	33 (9.0)
Atrial arrhythmia surgery	23 (6.3)
LVOT† myectomy for HOCM‡	22 (6.0)
Cardiac transplant	20 (5.5)
Cardiac tumour	18 (4.9)
Other congenital	16 (4.4)
VAD§ procedure	15 (4.1)
ECMO‖ procedure	10 (2.7)
Pericardiectomy	8 (2.2)
Ventricular septal defect repair	7 (1.9)
PAPVD# repair	5 (1.4)
Trauma	5 (1.4)
Coronary artery endarterectomy	4 (1.1)
Permanent LV epicardial lead	4 (1.1)
Pulmonary thrombo-endarterectomy	4 (1.1)
Patent foramen ovale repair	3 (0.8)
Single lobe lung transplant	3 (0.8)
Cardiopulmonary transplant	3 (0.8)
LV rupture repair	1 (0.3)
Other cardiac	48 (13.2)
ALL	**365 (100.0)**

* Bilateral sequential single lung transplant

† Left ventricular outflow tract

‡ Hypertrophic obstructive cardiomyopathy

§ Ventricular assist device

‖ Extracorporeal membrane oxygenation

\# Partial anomalous pulmonary venous drainage

7.7 Blood product usage

The majority of surgeries did not require blood product transfusion (65%). However, as the urgency of operations increased, so too did the requirement for red blood cells (RBC) and non-red blood cells (NRBC).

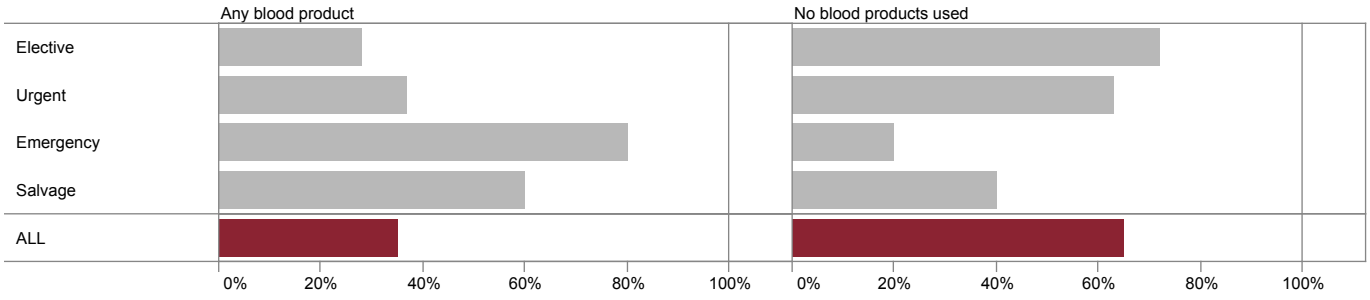


Figure 25: Blood products used by admission status

Table 25: Blood product type used by admission status

Admission status	Both RBC and NRBC n (%)	RBC only n (%)	NRBC only n (%)	No blood products n (%)
Elective	153 (11.1)	115 (8.3)	121 (8.8)	993 (71.9)
Urgent	116 (13.9)	137 (16.4)	57 (6.8)	525 (62.9)
Emergency	86 (54.8)	21 (13.4)	19 (12.1)	31 (19.7)
Salvage	4 (40.0)	1 (10.0)	1 (10.0)	4 (40.0)
ALL	**359 (15.1)**	**274 (11.5)**	**198 (8.3)**	**1,553 (65.1)**

8 Clinical outcomes

There are two aspects of outcomes analysis for procedural related specialties: the risk of complications from procedures, and key targets for optimal procedural performance. This section of the report focuses on the risk of complications from procedures and compares the aggregated outcomes of the four participating sites against calculated risk scores.

Risk adjustment models are a means of estimating patient outcomes based on patient specific and clinical factors known at the time of surgery. Risk scores in cardiac surgery are established from large patient cohorts and are usually relevant for a particular period in time and in a particular geographic area.

A statistical analysis of specific patient factors and procedural factors allows the adjustment of risk for patients with certain characteristics, who are undergoing particular types of surgery.

The most common outcome evaluated using these risk adjustment algorithms is death after an operation, however, the Society of Thoracic Surgeons (STS) has also developed a range of algorithms predictive of the post-operative risk of complications (morbidity). The risk prediction models used in evaluating the 2018 clinical outcomes for cardiac surgical cases are:

- EuroSCORE
- ANZSCTS General Score
- AusSCORE
- STS Score (mortality and morbidity)

The EuroSCORE[10] and the ANZSCTS General Score[11] can be applied to evaluate deaths for all types of cardiac surgical cases, whereas the AusSCORE model[12] has been developed to predict mortality in CABG cases only.

The STS scores provide an estimate of the risk for mortality as well as a range of morbidities. These are specific to subgroups of cardiac surgery procedures (CABG model: isolated CABG only.[13] Valve model: isolated aortic valve replacement, isolated mitral valve replacement or isolated mitral valve repair.[14] Valve + CABG model: CABG plus one of aortic valve replacement, mitral valve replacement or isolated repair.)[15]

EuroSCORE, despite its age, retains a reasonable ability to discriminate risk, however, it has tended to become less calibrated with current cardiac surgical practice. Assessment with the EuroSCORE model has been retained in this report to track historical performance over time. The EuroSCORE II risk prediction model of in-hospital mortality after cardiac surgery was developed to address calibration issues with the initial model. EuroSCORE II will be utilised in the 2019 QCOR Cardiac Surgery Audit.

When interpreting the below analysis, it is important to understand that there is more to performance in surgery than simply the decisions made by the surgeon in, before, during and after the patient enters the operating theatre.

There are several aspects of the patient's entire journey to disease and through treatment and recovery that may combine to influence the outcome of surgery.

8.1 Mortality

The risk adjustment analysis of 30 day mortality has been evaluated using a range of well described risk models.

The STS models are constrained to clearly defined sub-groups of procedures. Patients who met the inclusion criteria were assessed and the remainder of patients excluded from the comparison analysis. In the STS model all included case results were pooled for the CABG only, Valve only and CABG + valve models. Similarly, the AusSCORE model has been presented side-by-side with other risk prediction models for CABG only cases.

All risk adjustment evaluations show that the observed mortality rate is either within or significantly lower than the predicted rate.

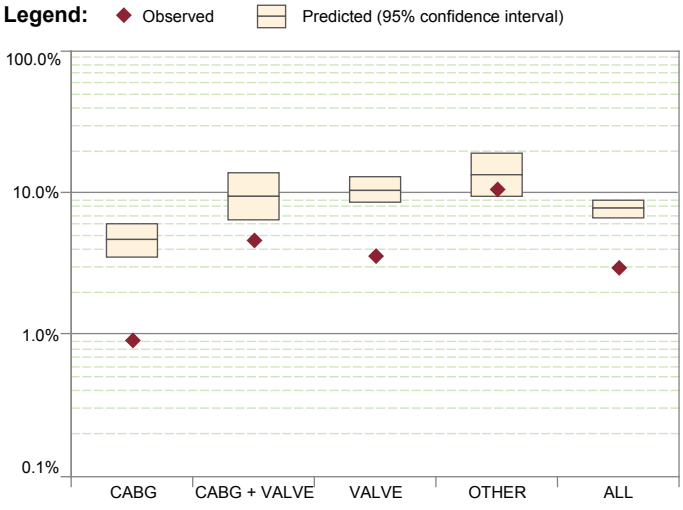


Figure 26: EuroSCORE

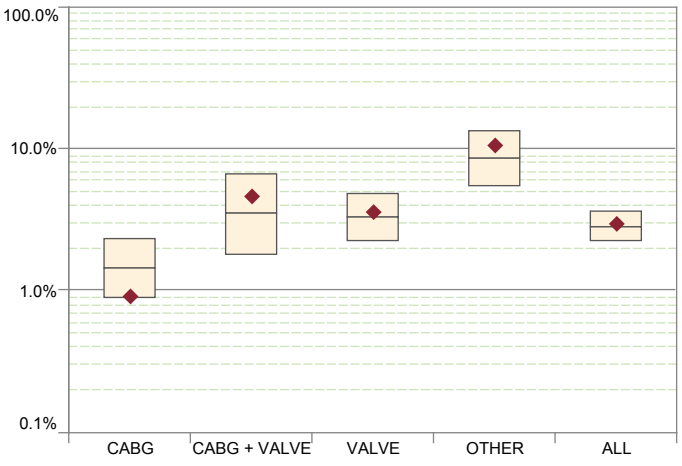


Figure 27: ANZSCTS General Score

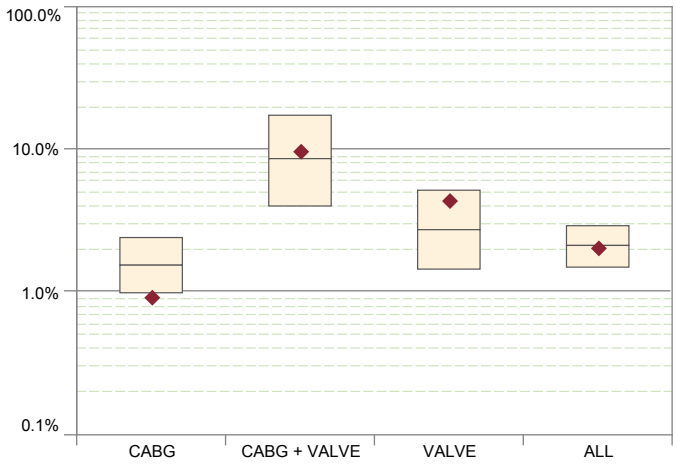


Figure 28: STS (Death)

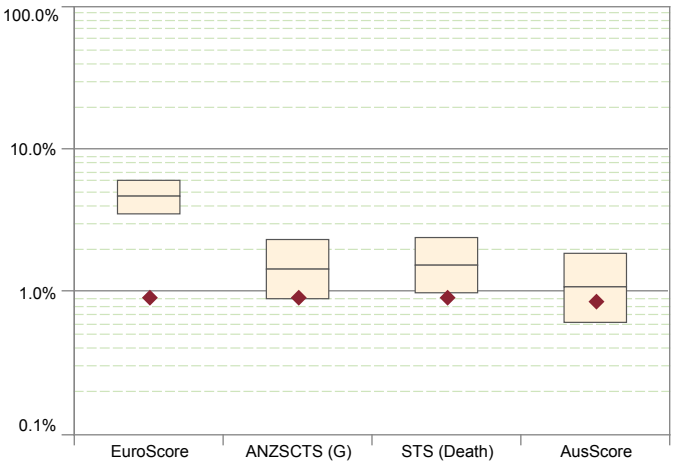


Figure 29: CABG

8.2 Morbidity

Apart from death, patients are at risk of experiencing a range of significant morbidities in the post-operative period. The STS risk models provide an estimate of the level risk for a patient experiencing these morbidities. These models have been applied to the defined surgical subgroups using the distinct inclusion criteria.

The aggregated morbidities chart (Figure 35) represents the observed rate of cases involving at least one of the five morbidities.

For 2018, most comparisons between the observed event rate and the rate predicted using the respective risk scores demonstrate that outcomes are within expectation. The exception is deep sternal wound infection (DSWI) in CABG cases where the rate appears to be higher than predicted.

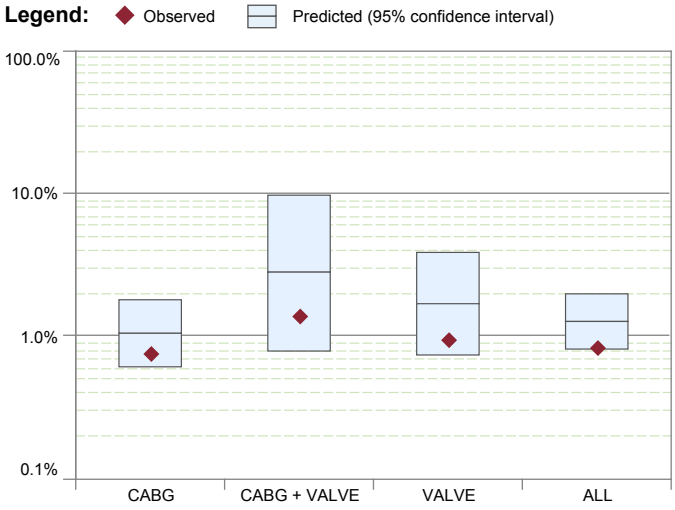


Figure 30: CVA

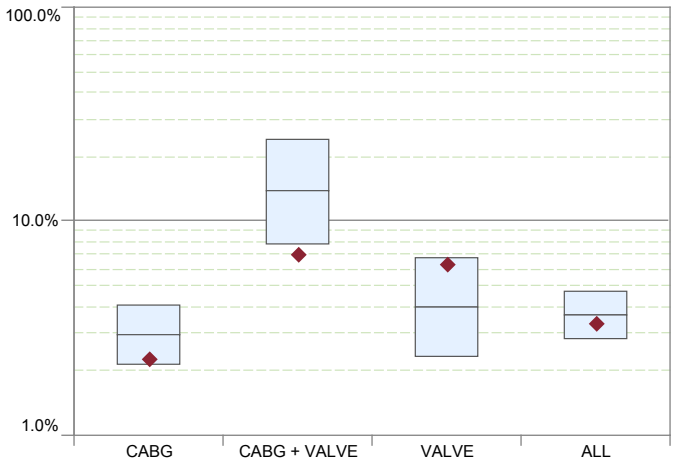


Figure 31: Renal failure

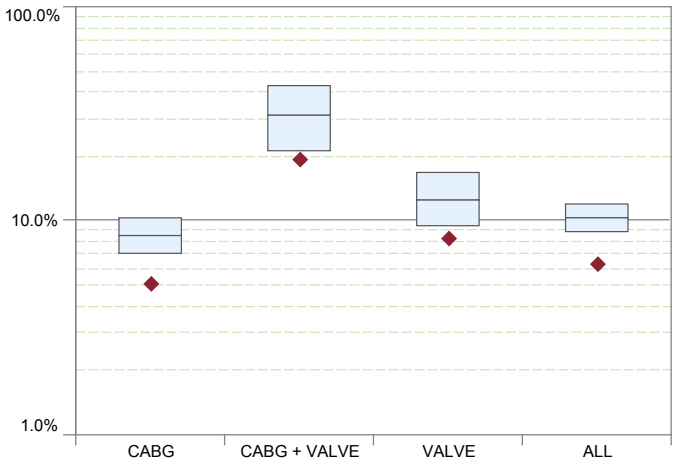


Figure 32: Ventilation >24 hours

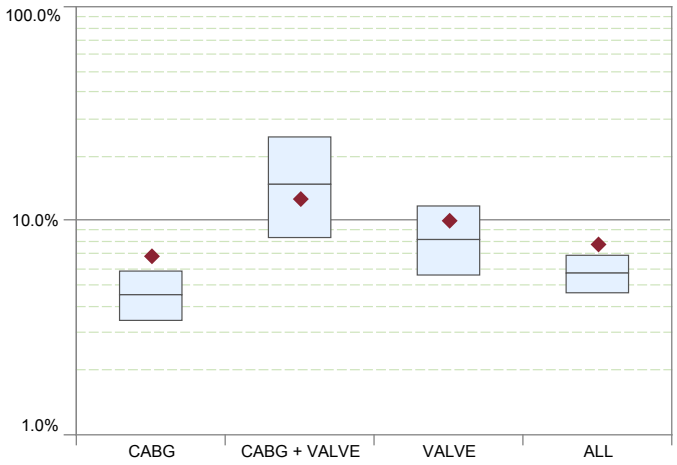


Figure 33: Reoperation

The higher than expected DSWI rate for CABG is similar across 2017 and 2018 patient cohorts. Sites will continue to participate in a process-focused review facilitated by the Australian and New Zealand Society of Cardiac and Thoracic Surgeons (ANZSCTS) that includes analysis of DSWI across an Australian cohort.

When reviewing outcomes, it is important to remember that there are 5 important drivers that may lead to observed differences between the predicted and observed results:

1. Data: Were there any issues with the quality of data? Were events documented accurately using uniformly applied definitions?
2. Case mix: Were there factors inherent in the patient that were not adequately dealt with in the risk adjustment?
3. Environment and resources: Did a lack of resources or environmental issues contribute to the variation?
4. Process of care: Was there a breakdown in the care process?
5. Carer: Were there individual surgeon decisions or technical issues that contributed to the outcome?

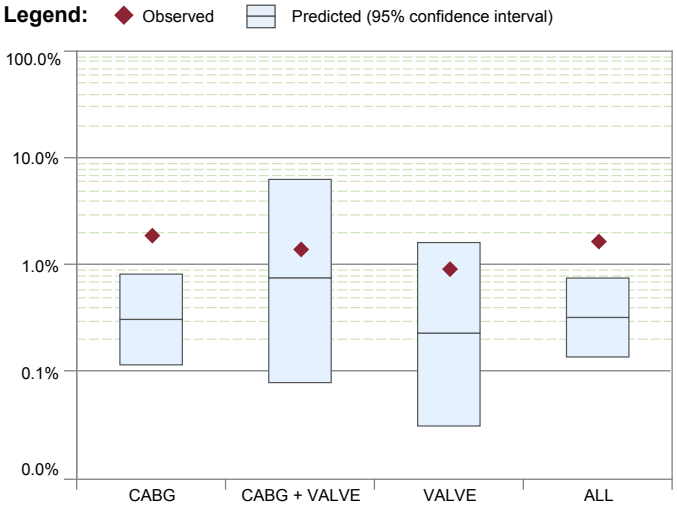


Figure 34: Deep sternal infection

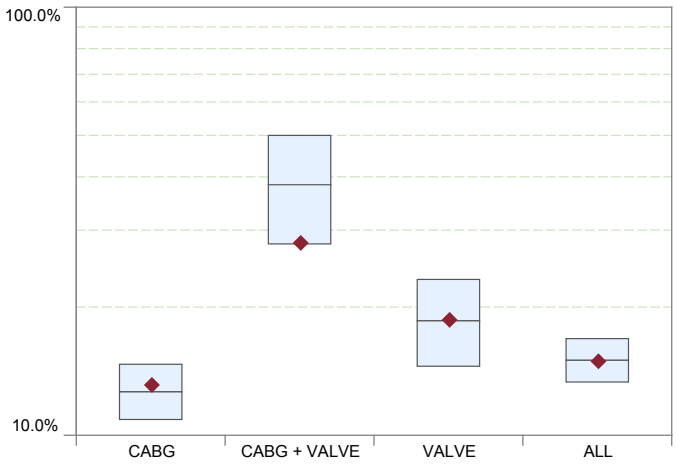


Figure 35: Major morbidity

8.3 Measures of process

The following graphs assesses the length of stay (LOS) of patients compared with that predicted by the STS score. LOS less than 6 days is a measure of process that allows for elective weekly booking procedures.

LOS greater than 14 days excludes the patients who may stay several days after the 6 day cut-off for minor reasons, but instead are on a prolonged recovery pathway.

The LOS comparison indicates that the proportion of cases staying less than 6 days is greater than expected regardless of surgical category.

Similarly, the proportion of patients who stay longer than 14 days is larger than expected. Further investigation is needed to delineate whether this measure is prolonged due to institutional process or factors relating to patient care.

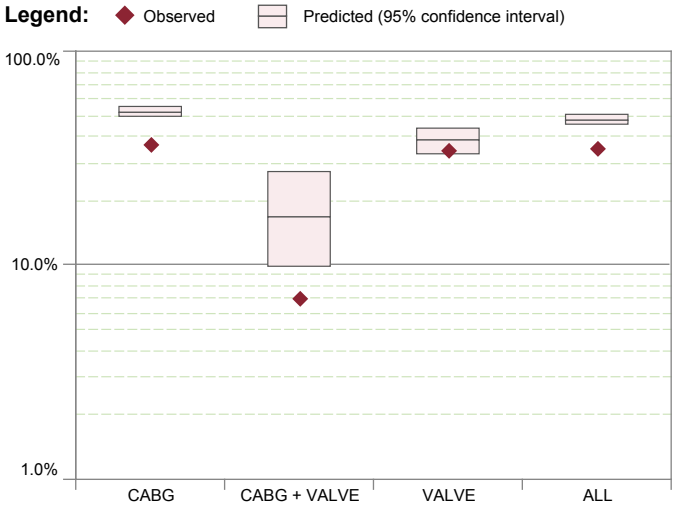


Figure 36: LOS ‹6 days

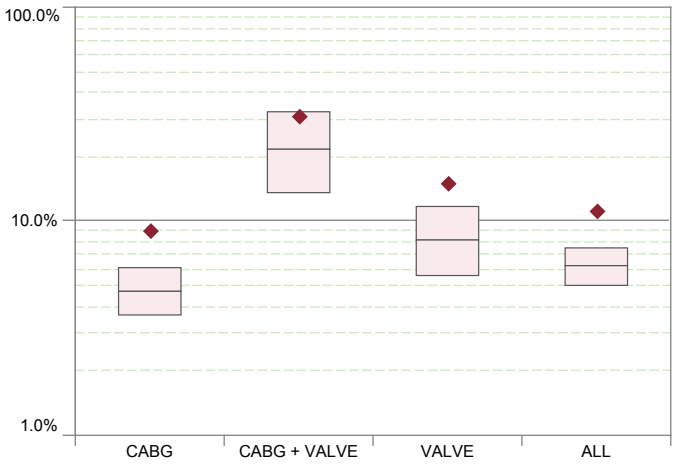


Figure 37: LOS ›14 days

8.4 Failure to rescue

Failure to rescue (FTR) is an important indicator of quality in surgery that focuses primarily on the system of care rather than the surgical procedure and is used to describe the prognosis of the patient cohort that has experienced a post-operative complication.

FTR is calculated from the risk of adverse events and the risk of death in combination, based on the assumption that an adverse event can result in death if not appropriately intervened on by the hospital processes. These adverse events include a combination of stroke, renal failure, reoperation, deep sternal infection and prolonged ventilation (>24 hours) as described by the STS risk models.

From this analysis, the FTR observed rate for CABG cases is statistically better than predicted and the rate for valve, and combined CABG and valve cases is within the expected range.

In summary, processes set up to deal with adverse events appear to be functioning at the expected level.

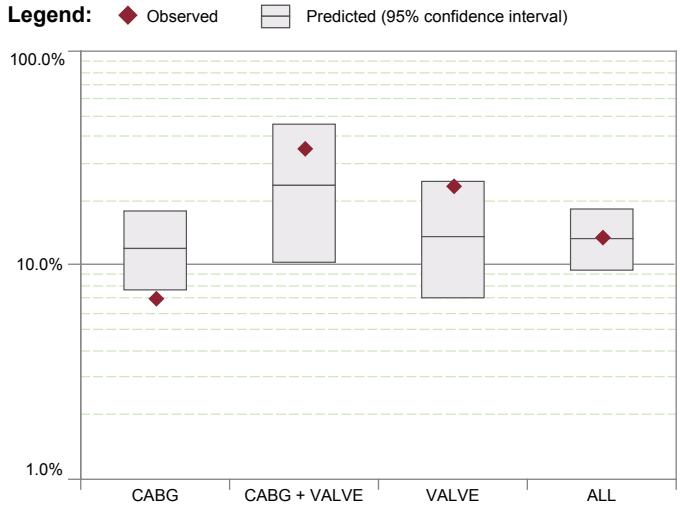


Figure 38: Failure to rescue

9 Conclusions

There are several points to draw from this report.

Less than one-quarter of those who face cardiac surgery have a healthy BMI. Put another way, over three-quarters of people, have an unhealthy BMI. Understanding how unhealthy body weight affects treatment and resource use is important, given that the odds are most patients will not have a healthy body mass.

The modifiable risk factors for coronary artery disease are listed as individual rates, but also in combination. One can see that patients often have multiple modifiable risk factors, demonstrating the additive effect of each risk factor. Reducing the chance that a Queenslander has to undergo surgery for coronary artery disease is about improving their modifiable risk factors, of which many patients have several.

Variations in practice allow for review and natural evolution in processes and clinical workflow. One of these is the marked variation between surgeon involvement in TAVR between units. This presents an opportunity to see if there is an appreciable difference in TAVR outcomes depending on the involvement of surgical teams.

When our patients face cardiac surgery and we explain to them the risks of the surgery ahead of them, we can reassure them that their risks match what is expected, or are better than expected, a reflection of the systems and processes that we all work hard to improve constantly.

Deep sternal wound infection is again higher than expected based on risk scores, but as discussed in previous reports, appears to be a consistent finding, as identified in other non-US jurisdictions. Individual units are monitored by the ANZSCTS processes that include DSWI in their analysis, and compare them to the national cohort, rather than an American derived risk score.

10 Supplement: Body mass index in cardiac surgery

Obesity affects the majority of Australians, with approximately two-thirds (67%) of the population classed as overweight or obese in 2018, increasing from 63% in 2015[16]. For cardiac surgeons, obesity presents an increasing challenge for several reasons. The first of which is the impact on the health of our patients. It is a well-described risk factor for hypertension, diabetes and dyslipidaemia, all of which increase the risk of coronary artery disease and heart failure[17]. Obesity itself adds additional technical challenge for the surgical team, and in a specialty heavily reliant on technique, additional challenge one intuits to result in worse outcomes.

This supplement assesses the impacts of obesity for patients undergoing cardiac surgery at the four public cardiothoracic surgery units in Queensland between 2017 and 2018. It includes an examination of baseline characteristics, surgical treatments, procedural complications, and survival outcomes. For this analysis, all cases entered for the past two years of reporting have been collated into a single cohort, comprising 4,745 individual surgeries involving either CABG, surgical valve intervention or other cardiac surgical procedures.

Body mass index (BMI) is a useful tool for classifying obesity within a population. BMI correlates well with body surface area[19], which is included in STS risk prediction models[13–15]. BMI is assigned a category as defined by the World Health Organisation (WHO)[18]. These classifications have been used within this supplement and are outlined in Table 1. There is discussion from the WHO about variations between ethnic groups and BMI risk categories, but for the purpose of this analysis, the entire cohort is analysed using the widest applicable risk categorisation groupings based on our ethnic mix.

Table 1: BMI category definitions

Category	Measurement*
Underweight	<18.5 kg/m^2
Normal range	18.5–24.9 kg/m^2
Overweight	25.0–29.9 kg/m^2
Obese	30.0–39.9 kg/m^2
Morbidly obese	≥40.0 kg/m^2

* Weight in kilograms divided by the square of height in metres

10.1 Patient characteristics

Of the 4,745 surgeries performed in 2017 and 2018, three-quarters of patients (75%) had a BMI classed as either overweight, obese or morbidly obese (37%, 34% and 4% respectively). Conversely, only 23% had a BMI within the normal range and a smaller proportion (1.3%) were considered underweight.

Over half (57%) of all patients analysed were males with a BMI greater than 30 kg/m^2, whereas the same female cohort accounted for only 18% of all surgeries. The overall median age of patients was 66 years old which was similar across gender and most BMI categories (Table 4). The exception was the smaller group of patients that classed as underweight, where the median age was considerably younger at 53 years.

Table 2: Total cases by body mass index category

BMI category	n	%
Underweight	61	1.3
Normal range	1,098	23.1
Overweight	1,750	36.9
Obese	1,630	34.4
Morbidly obese	206	4.3
ALL	**4,745**	**100.0**

Table 3: Patient age and gender by body mass index category

	Underweight n (%)	Normal range n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)	ALL n (%)
Gender						
Male	28 (45.9)	756 (68.9)	1,361 (77.8)	1,237 (75.9)	116 (56.3)	3,498 (73.7)
Female	33 (54.1)	342 (31.1)	389 (22.2)	393 (24.1)	90 (43.7)	1,247 (26.3)
Age group (years)						
<40	20 (32.8)	110 (10.0)	70 (4.0)	56 (3.4)	10 (4.9)	266 (5.6)
40–49	6 (9.8)	71 (6.5)	118 (6.7)	128 (7.9)	27 (13.1)	350 (7.4)
50–59	10 (16.4)	186 (16.9)	310 (17.7)	311 (19.1)	61 (29.6)	878 (18.5)
60–69	9 (14.8)	304 (27.7)	536 (30.6)	518 (31.8)	60 (29.1)	1,427 (30.1)
70–79	10 (16.4)	293 (26.7)	543 (31.0)	505 (31.0)	42 (20.4)	1,393 (29.4)
≥80	6 (9.8)	134 (12.2)	173 (9.9)	112 (6.9)	6 (2.9)	431 (9.1)
Total	**61 (100.0)**	**1,098 (100.0)**	**1,750 (100.0)**	**1,630 (100.0)**	**206 (100.0)**	**4,745 (100.0)**

Table 4: Median age by gender and body mass index category

BMI category	Male years	Female years	ALL years
Underweight	52	55	53
Normal range	66	66	66
Overweight	67	67	67
Obese	66	67	66
Morbidly obese	60	61	60
Total	**66**	**66**	**66**

10.2 Care and treatment of patients

More than half (60%) of surgical procedures included CABG either with (10%) or without (50%) valvular intervention. Of all surgeries, 42% involved some form of valvular intervention, while 8% of analysed cardiac surgeries did not involve either CABG or valve procedures.

Table 5: Treatment characteristics by body mass index category

	Underweight n (%)	Normal range n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)	ALL n (%)
Surgery category						
ANY CABG	13 (21.3)	458 (41.7)	880 (50.3)	918 (56.3)	100 (48.5)	2,369 (49.9)
CABG + VALVE	3 (4.9)	92 (8.4)	194 (11.1)	182 (11.2)	20 (9.7)	491 (10.3)
VALVE	28 (45.9)	419 (38.2)	552 (31.5)	445 (27.3)	76 (36.9)	1,520 (32.0)
OTHER	17 (27.9)	129 (11.7)	124 (7.1)	85 (5.2)	10 (4.9)	365 (7.7)
Admission status						
Elective	27 (44.3)	574 (52.3)	974 (55.7)	921 (56.5)	116 (56.3)	2,612 (55.0)
Urgent	20 (32.8)	395 (36.0)	645 (36.9)	642 (39.4)	85 (41.3)	1,787 (37.7)
Emergency	14 (23.0)	121 (11.0)	127 (7.3)	66 (4.0)	5 (2.4)	333 (7.0)
Salvage	–	8 (0.7)	4 (0.2)	1 (0.1)	–	13 (0.3)
Elective day of surgery admission						
	4 (14.8)	75 (13.1)	121 (12.4)	162 (17.6)	15 (12.9)	377 (14.4)
Total	**61 (100.0)**	**1,098 (100.0)**	**1,750 (100.0)**	**1,630 (100.0)**	**206 (100.0)**	**4,745 (100.0)**

10.3 Risk factors and comorbidities

The presence of patient risk factors and comorbidities have been summarised by BMI category (Table 6). The most common risk factors affecting the cohort were hypertension and hypercholesterolaemia, which were present in 68% and 63% of patients respectively.

As BMI increased, there was an increasing proportion of patients affected by diabetes, hypertension and hypercholesterolaemia.

Table 6: Risk factors and comorbidities by body mass index category

	Underweight n (%)	Normal range n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)	ALL n (%)
Current smoker	11 (18.0)	236 (21.5)	292 (16.7)	237 (14.5)	31 (15.0)	807 (17.0)
Former smoker	14 (23.0)	370 (33.7)	737 (42.1)	785 (48.2)	99 (48.1)	2,005 (42.3)
Diabetes	9 (14.8)	166 (15.1)	407 (23.3)	616 (37.8)	98 (47.6)	1,296 (27.3)
Hypertension	20 (32.8)	607 (55.3)	1,161 (66.3)	1,255 (77.0)	169 (82.0)	3,212 (67.7)
Hypercholesterolaemia	13 (21.3)	579 (52.7)	1,109 (63.4)	1,160 (71.2)	149 (72.3)	3,010 (63.4)
Mild renal dysfunction*	16 (26.2)	433 (39.4)	691 (39.5)	444 (27.2)	16 (7.8)	1,600 (33.7)
Moderate renal dysfunction†	23 (37.7)	328 (29.9)	313 (17.9)	153 (9.4)	9 (4.4)	826 (17.4)
Severe renal dysfunction‡	5 (8.2)	43 (3.9)	37 (2.1)	36 (2.2)	8 (3.9)	129 (2.7)
LVEF 40–50%	13 (21.3)	187 (17.0)	317 (18.1)	326 (20.0)	41 (19.9)	884 (18.6)
LVEF 30–39%	1 (1.6)	74 (6.7)	117 (6.7)	129 (7.9)	17 (8.3)	338 (7.1)
LVEF <30%	2 (3.3)	62 (5.6)	87 (5.0)	56 (3.4)	10 (4.9)	217 (4.6)

* eGFR 60–89 mL/min/1.73m^2

† eGFR 30–59 mL/min/1.73m^2

‡ eGFR <30 mL/min/1.73m^2

10.4 Patient outcomes

This section examines the effect of patient BMI category on the risk of procedural complications and key targets for surgical performance. For the purpose of this analysis, relative odds ratios (OR) have been derived to compare outcomes against the normal range BMI category while controlling for known clinical risk factors as described by the STS models.

Statistical significance (p-values) is presented in the included tables for analysis of variations across all BMI categories. Multivariate logistic regression adjusted with patient demographic and clinical risk factors was used to investigate the impact of BMI on short-term outcomes (including death within 90 days of surgery). In building the respective models for each outcome BMI category, surgery type, age, gender and admission status were always included while other factors were included via backwards selection. For presentation in the figures, variation between individual BMI categories was normalised against the normal range BMI category.

10.4.1 Mortality

For patients classed as morbidly obese, there was an approximately three-fold increase in the relative odds of death within 90 days of surgery when compared to patients with a BMI within the normal range. This variation in outcomes was evident at 30 days (OR 3.19, p=0.004) and 90 days (OR 3.21, p=0.001) after surgery.

For patients classed as underweight, overweight and obese, variations in these short term mortality outcomes compared to patients in the normal weight range (Figure 1 and Figure 2) were not statistically significant.

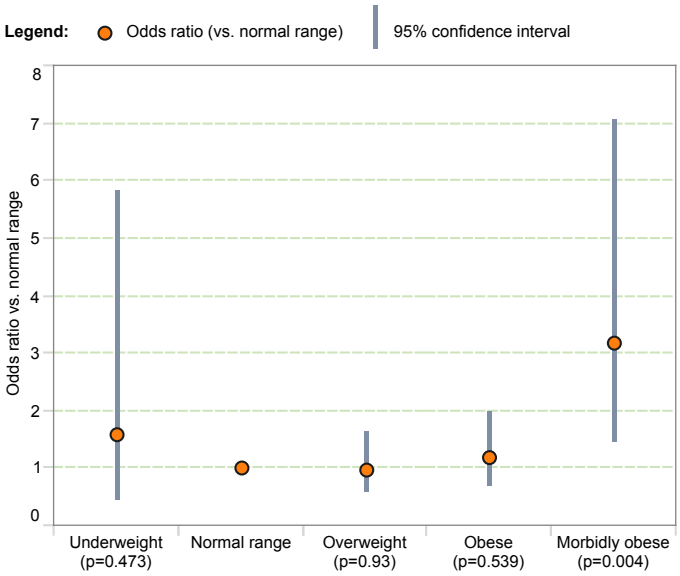


Figure 1: Standardised incidence of death within 30 days of procedure by BMI category

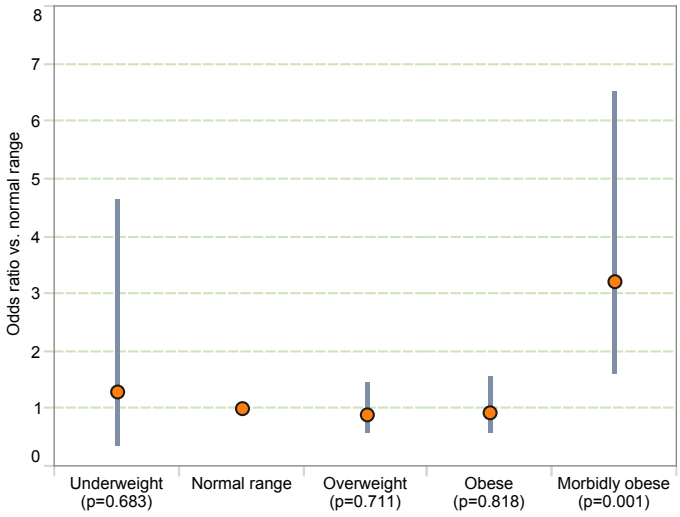


Figure 2: Standardised incidence of death within 90 days of procedure by BMI category

Table 7: Standardised incidence of mortality at 30 days and 90 days post procedure by BMI category

	Underweight	Normal range*	Overweight	Obese	Morbidly obese	Significance p-value
Death in 30 days	1.602	1.0	0.978	1.181	3.194	p=0.043
Death in 90 days	1.302	1.0	0.917	0.944	3.211	p=0.007

* Used as reference/baseline for comparison across categories

10.4.2 Morbidity

After adjusting for the clinical risk factors used by the STS model, evaluation of observed rates of major morbidity (excluding death) showed few statistically significant variations in event rates across BMI categories (Table 8).

The exception was the risk of renal failure following surgery, where higher rates of renal failure were associated with increased BMI category (Figure 3). Patients classed as morbidly obese were almost three times as likely to develop renal failure after surgery (OR 2.92, p=0.001).

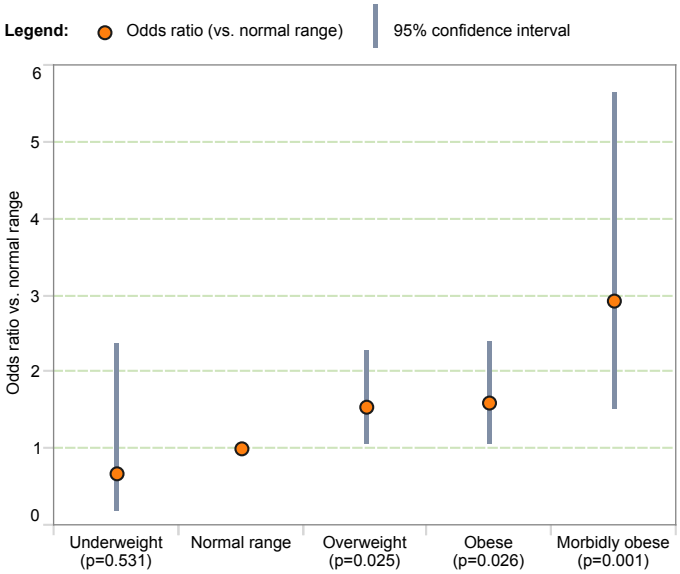


Figure 3: Standardised incidence of renal failure by BMI category

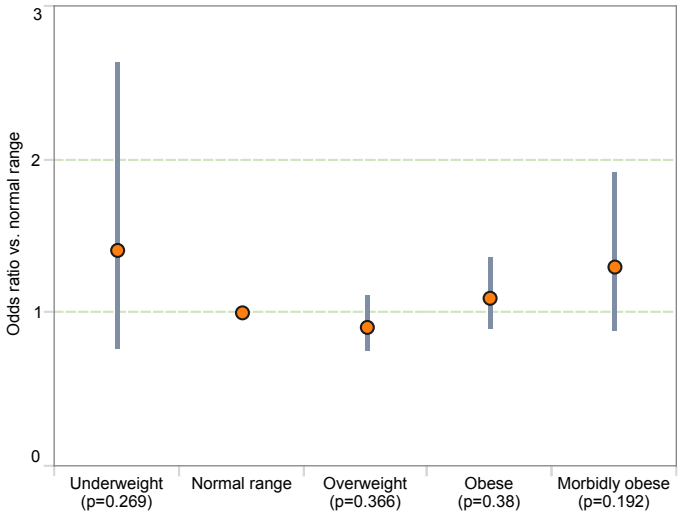


Figure 4: Standardised incidence of major morbidity by BMI category

Table 8: Standardised incidence of major morbidity by body mass index category

	Underweight	Normal range*	Overweight	Obese	Morbidly obese	Significance p-value
CVA	0.91	1.0	1.51	1.66	0.99	p=0.622
Renal failure	0.67	1.0	1.55	1.59	2.92	p=0.011
Prolonged ventilation†	1.83	1.0	0.88	0.92	1.41	p=0.117
Deep sternal infection	0.0	1.0	0.63	1.297	0.87	p=0.163
Reoperation	1.29	1.0	0.94	0.92	1.33	p=0.534
Major morbidity‡	1.42	1.0	0.91	1.10	1.30	p=0.137

* Used as reference/baseline for comparison across categories

† Ventilation >24 hours

‡ Composite of all morbidities above

10.4.3 Measures of process

Evaluation of LOS identified a statistically significant variation across BMI categories for patients with a LOS greater than 14 days (p=0.003).

Compared to patients in the normal range, the data suggested that poorer outcomes resulting in prolonged LOS were associated with patient BMI classed as underweight, obese and morbidly obese (Figure 6).

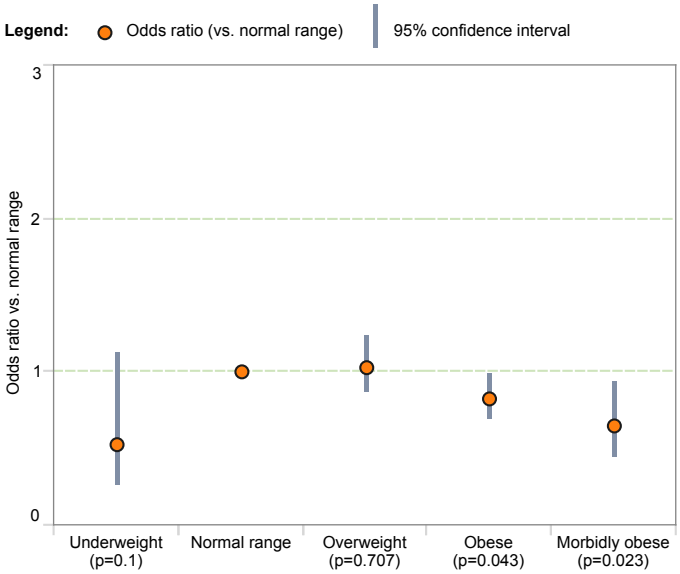


Figure 5: Standardised incidence of length of stay ‹6 days by BMI category

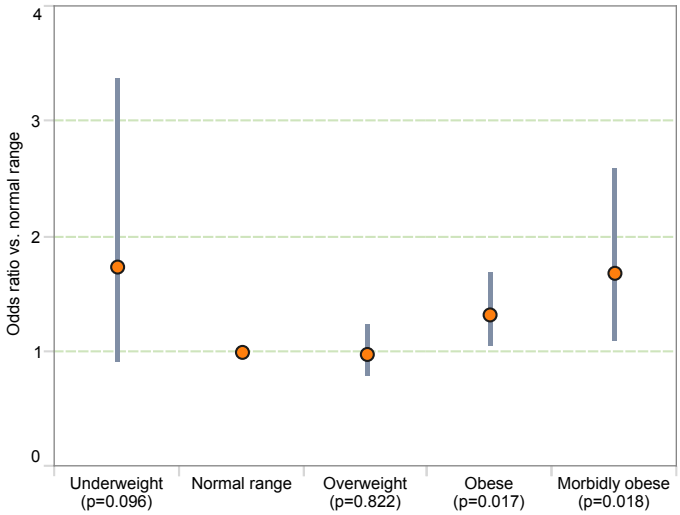


Figure 6: Standardised incidence of length of stay ›14 days by BMI category

Table 9: Standardised incidence of length of stay by BMI category, 2017–2018

	Underweight	Normal range*	Overweight	Obese	Morbidly obese	Significance
LOS ‹6 days	0.53	1.0	1.04	0.83	0.65	p=0.004
LOS ›14 days	1.75	1.0	0.97	1.33	1.68	p=0.003

* Used as reference/baseline for comparison across categories

10.4.4 Rehospitalisation

For all patients classed as having a BMI ›30 kg/m², this analysis found significantly increased likelihood of rehospitalisation within 30 days of surgery compared to patients within the normal range BMI category.

Patients having a BMI classed as obese or morbidly obese were 36% to 49% more likely to be rehospitalised within 30 days of surgery than patients in the normal BMI category (Figure 7).

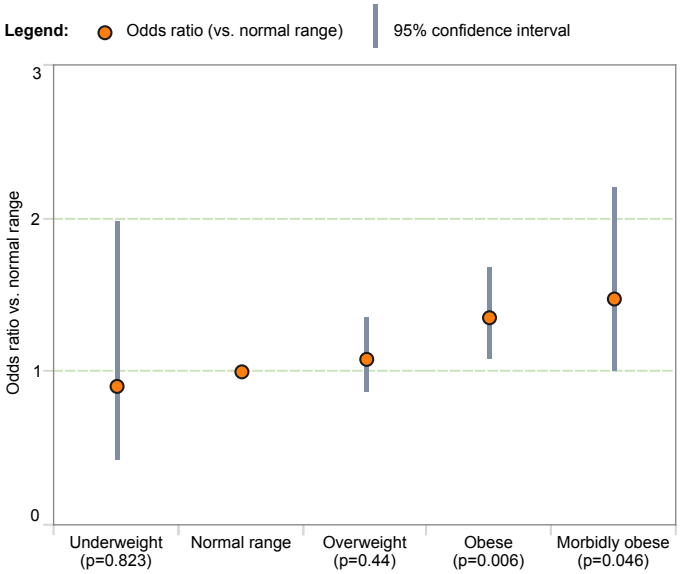


Figure 7: Standardised incidence of rehospitalisation within 30 days of surgery by BMI category

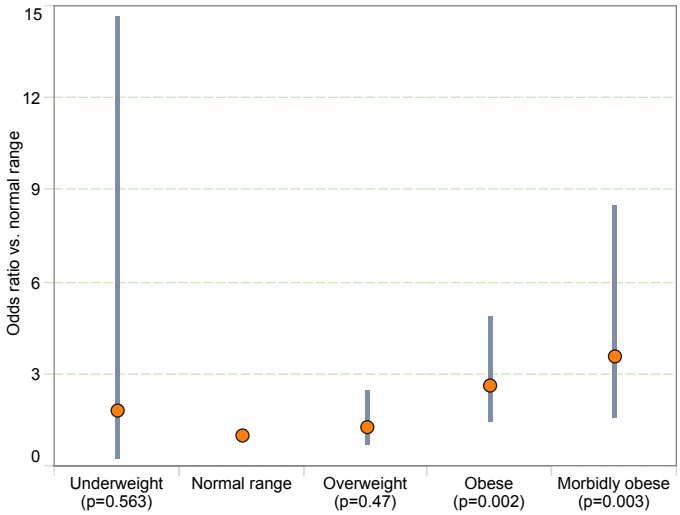


Figure 8: Standardised incidence of rehospitalisation for incisional complications within 30 days of surgery by BMI category

Table 10: Standardised incidence rates of rehospitalisation by BMI category, 2017–2018

	Underweight	Normal range*	Overweight	Obese	Morbidly obese	Significance
Rehospitalisation (any)	0.916	1.0	1.091	1.357	1.486	p=0.023
Rehospitalisation (incisional complications)	1.844	1.0	1.277	2.669	3.603	p=0.001

* Used as reference/baseline for comparison across categories

10.5 Discussion

The timeframe from the diagnosis of heart disease to the event of surgery is often shorter than the time required for a patient to change their BMI to a lower risk grouping. Thus for most patients, the BMI that they bring to their disease treatment is not modifiable prior to their surgery. Hence, it is important to know how this affects their pathway from surgery to recovery.

The most important finding from this report is that the morbidly obese patients have three times higher risk of mortality, not just within their hospital stay, but out to three months from their surgery date. This is a dramatic increase in risk, and cannot be understated. These patients typify the problem of a modifiable risk factor that cannot be changed prior to surgery. The degree of weight loss and the time this would require to move from morbidly obese to obese, then to overweight, and then to normal weight is a timeframe beyond which their heart disease can wait for treatment. And then, even when treated, they have an increased risk of death even when out of hospital recovering for the following three months beyond their surgery. The risk may continue beyond this point and further analysis over a longer period is warranted.

Analysis of measures other than the most dramatic, death, also shows several findings. Increasing BMI is associated with longer stays in hospital, renal failure and the chance of readmission to hospital. Hospital management needs to be aware of the increased resource consumption of this group of patients. This is becoming a fixed increase in the cost of cardiac surgery, as the majority of patients now fit in this group of increased resource consumption compared to normal weight.

This report demonstrates the magnitude and urgency of the problem of high BMI in cardiac surgery. The solution for this is changing the risk of obesity for the community as a whole prior to the diagnosis of heart disease.

Part B: Thoracic Surgery

11 Message from the QCOR Cardiothoracic Committee Chair

Welcome to the first Thoracic Surgery Audit from QCOR.

In the same way that the lungs are between the right and the left sides of the heart, thoracic surgery is intrinsically linked to cardiac surgery. For the reader who is not familiar with the etymology, in Australia and New Zealand, the surgical specialty group is titled, "cardiothoracic surgery", a specialty grouping in common with the UK and North America. Surgeons with this specialty train in both cardiac and thoracic surgery, and once qualified, can practice either cardiac surgery or thoracic surgery or both. In other countries, the pathway to thoracic surgery is through general surgery, or oncological surgery and the pathway to cardiac surgery may overlap with vascular surgery. Thus in other jurisdictions, cardiac surgery is practiced by cardiovascular surgeons, and thoracic surgery is practiced by general surgeons with specialty thoracic surgery interests. This regional definition of the specialty grouping is laid out here to answer the question that some readers may have of, "*Why in a QCOR Annual Report is there a Thoracic Surgery Audit?*". The answer is that the cardiothoracic surgical services of Queensland provide both cardiac surgical and thoracic surgical services, and, in some circumstances, thoracic surgery is provided without cardiac surgical support available. It is therefore important to not look at the activity and results of cardiac surgery in isolation but to also examine the activity and outcomes of thoracic surgery, being that the service provision is largely to provide both specialty services using the same staffing and facilities. A complete report that presents how cardiothoracic surgical services are provided in Queensland must include both cardiac and thoracic surgery.

The next question that arises is why not simply audit and measure cardiothoracic surgery as a single report? The first answer to this is that the primary pathology and hence the focus of each specialty is different. The primary challenges for cardiac surgery are coronary artery disease and valvular heart disease, whereas for thoracic surgery the challenge is lung cancer. The referral pathway for these different pathologies involve different specialty groups, and thus the "denominator" of all the patients who face a disease is managed by different specialty groups. Cardiology manages all those who face coronary artery disease and valvular heart disease. Respiratory medicine, radiation oncology, medical oncology, and palliative care are the specialties involved in the treatment of lung cancer. With different primary pathologies and multidisciplinary team members, cardiac surgery and thoracic surgery are best approached separately for analysis of quality and outcomes. Some thoracic surgery is performed by surgeons who also do cardiac surgery, some thoracic surgery is performed by dedicated thoracic surgeons who do not practice cardiac surgery, and so separate presentations of each specialty is warranted.

A second issue is that the larger project of audit and performance measurement in thoracic surgery is in its early stages, whereas cardiac surgery is more mature in its performance analysis. Cardiac surgical data from Queensland, via QCOR is submitted to the ANZSCTS database and is part of the nationwide quality and performance project run by ANZSCTS. In contrast, there is no national thoracic surgery database, and the analysis of how Australian surgeons and their units perform thoracic surgery is a future reality only. There is work being done on a binational level through ANZSCTS to establish a database for thoracic surgery, and so maturing our processes and analysis on a statewide basis will lay the groundwork for participation in an imminent binational thoracic surgical database.

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

12 Key findings

The first edition of the Queensland Cardiac Outcomes Registry (QCOR) Thoracic Surgery Audit comprises patient demographics, risk factors, surgery types and patient outcomes for surgeries performed in 2018.

Key findings include:

- In 2018, there were 850 thoracic surgical cases performed across 5 public thoracic surgery units in Queensland.
- The median age of patients undergoing thoracic surgery was 60 years of age, with 19% of patients aged under 40 years. Over half of patients were male (58%).
- Patients classed as overweight or obese made up more than half of the patient cohort (61%), including 5% classed as morbidly obese.
- The proportion of Aboriginal and Torres Strait Islander patients undergoing thoracic surgery was 4.3% of the total cohort.
- Preoperative diagnoses of primary lung cancer and pleural disease accounted for 30% and 33% of cases respectively, while other cancer was recorded in 17% of cases. The remaining 21% of cases recorded an other diagnosis.
- Approximately two-thirds (67%) of all patients had a recorded smoking history, including 22% that were current smokers at the time of surgery. This increased to 92% in the primary lung cancer category
- Over one-third (35%) of all patients had some form of respiratory disease.
- There were approximately 13% of patients who had undergone previous thoracic surgery.
- Approximately three-quarters of all cases (76%) were classed as elective, while 5% of cases were emergency operations.
- Out of the 76% of elective cases, 47% were performed on a day of surgery admission pathway.
- Overall, 61% of all thoracic surgery procedures were video-assisted, increasing to 81% for patients with a preoperative diagnosis of pleural disease.
- Lobectomy (40%) and lymph node sampling (40%) were the most common procedures performed on patients with a preoperative diagnosis of primary lung cancer.
- Approximately 5% of all cases required a blood product transfusion.
- The median length of stay (LOS) for thoracic surgery patients was 6 days. Patients with a preoperative diagnosis of pleural disease tended to stay longer with a median LOS of 11 days.
- There were 107 cases having one or more new major morbidities recorded post procedure. Prolonged air leak (46%) and reoperation (13%) were the most common reasons for major morbidity.
- Unadjusted all-cause mortality at 30 days was 0.6%, increasing to 2.6% at 90 days.

13 Participating sites

In 2018, there were 5 public thoracic surgery sites in Queensland. All sites that offered cardiac surgery also performed thoracic surgery, with the addition of the Royal Brisbane and Women's Hospital (RBWH) which offered thoracic surgery only.

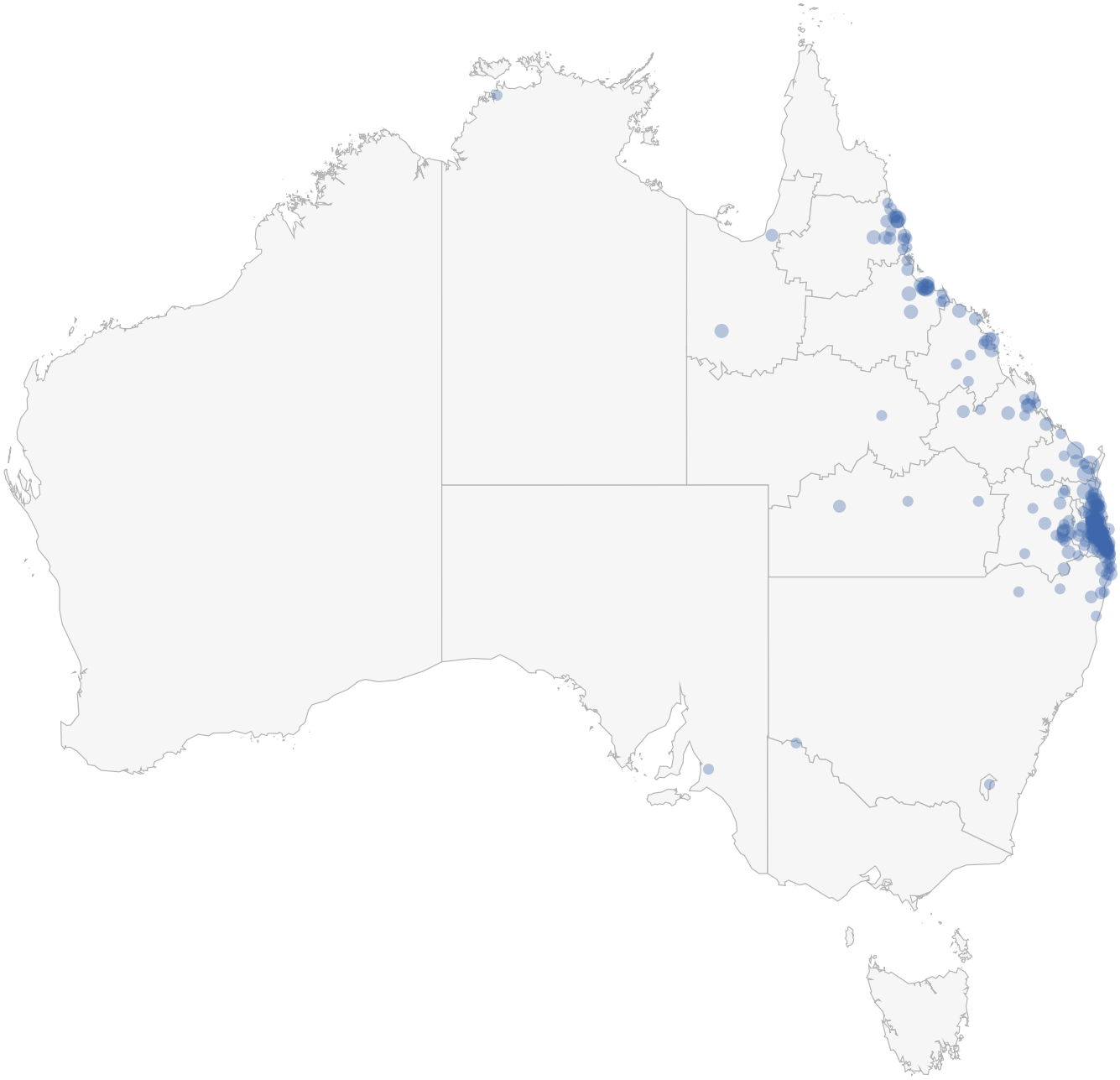


Figure 1: Thoracic surgery cases by residential postcode

Table 1: Participating sites

Acronym	Name
TTH	The Townsville Hospital
TPCH	The Prince Charles Hospital
RBWH	Royal Brisbane and Women's Hospital
PAH	Princess Alexandra Hospital
GCUH	Gold Coast University Hospital

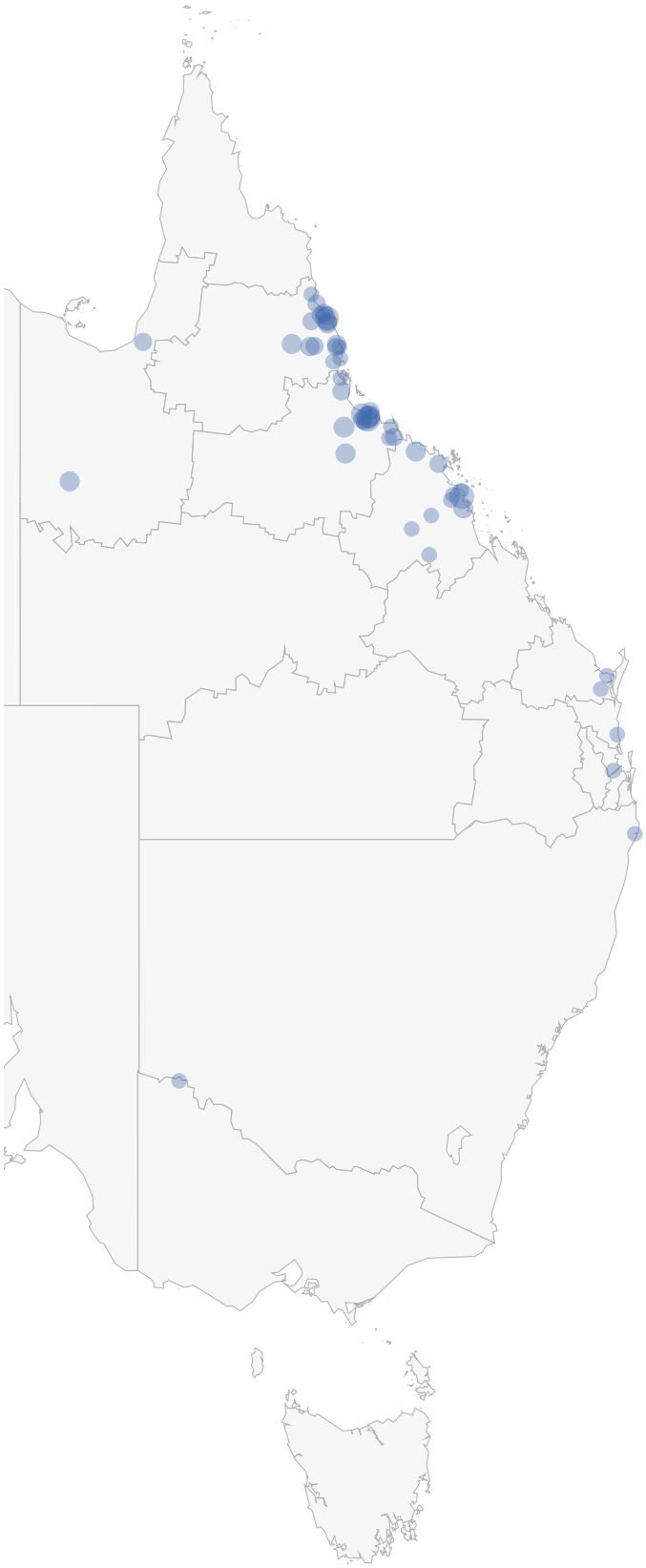


Figure 2: The Townsville Hospital

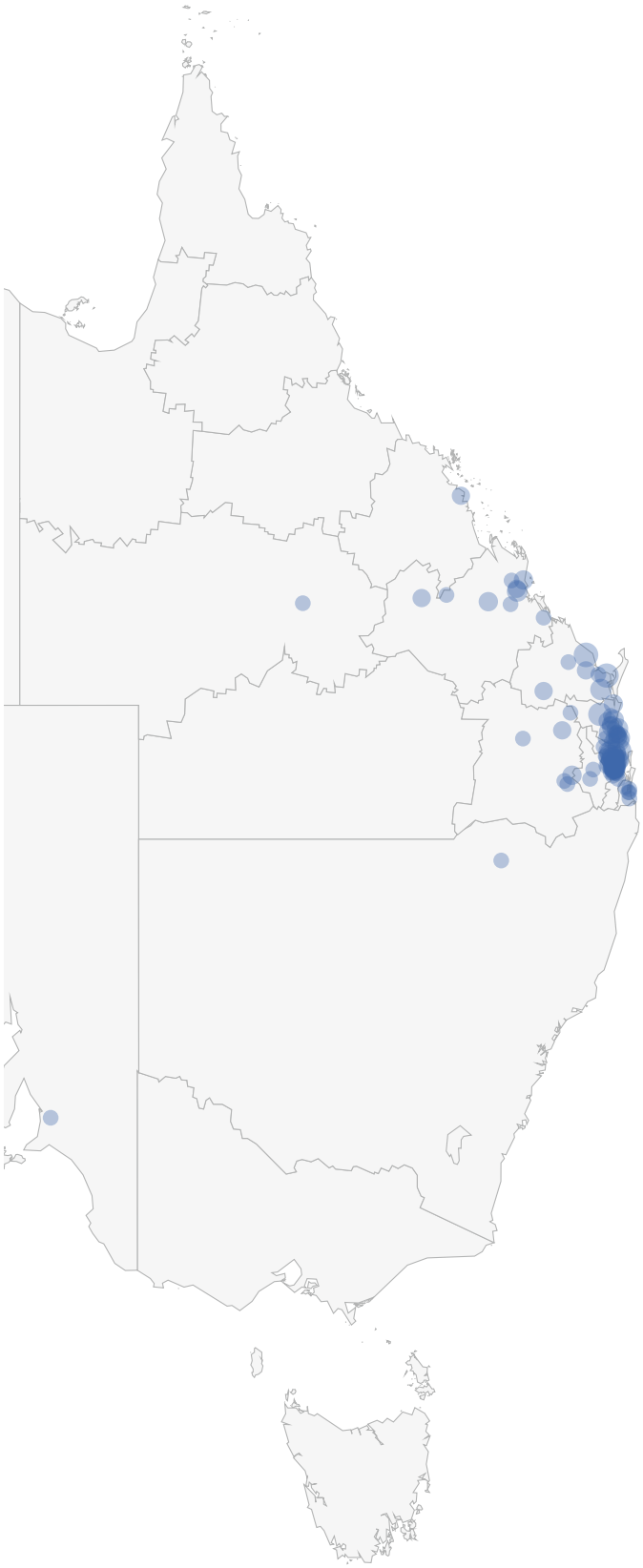


Figure 3: The Prince Charles Hospital

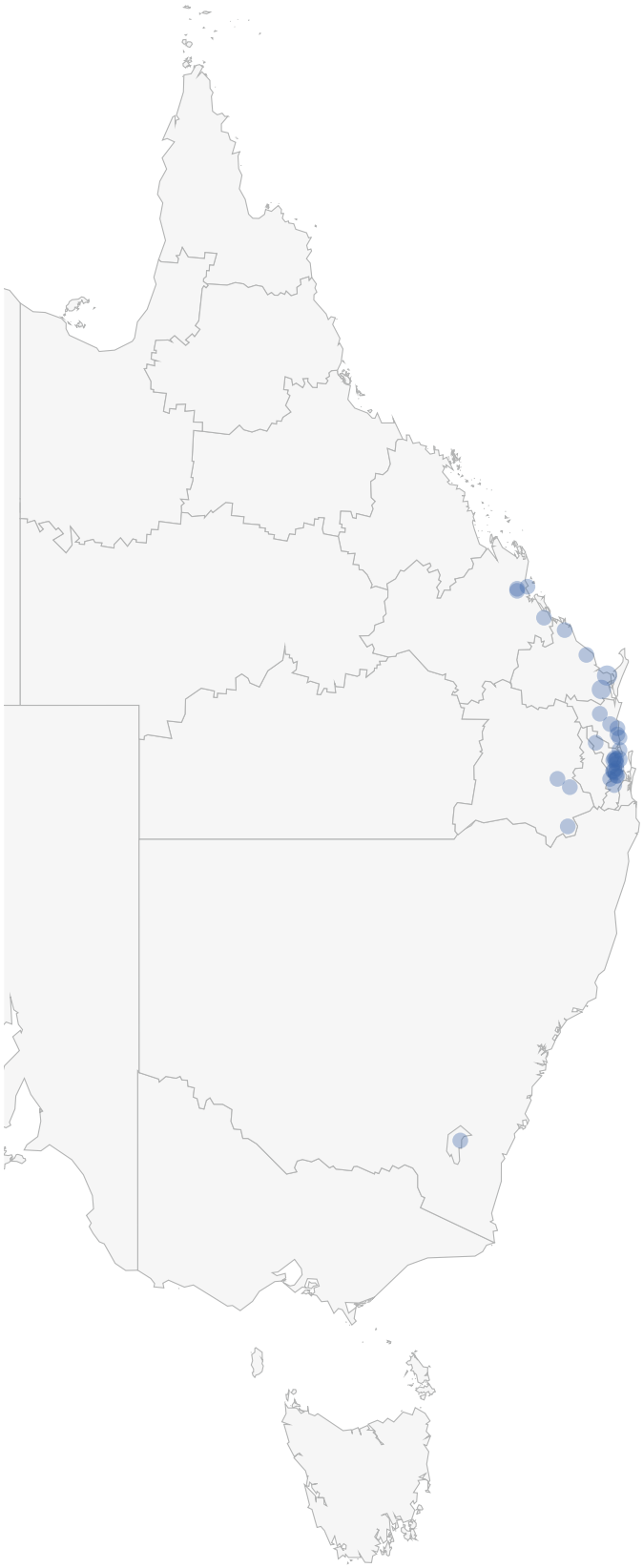


Figure 4: Royal Brisbane and Women's Hospital

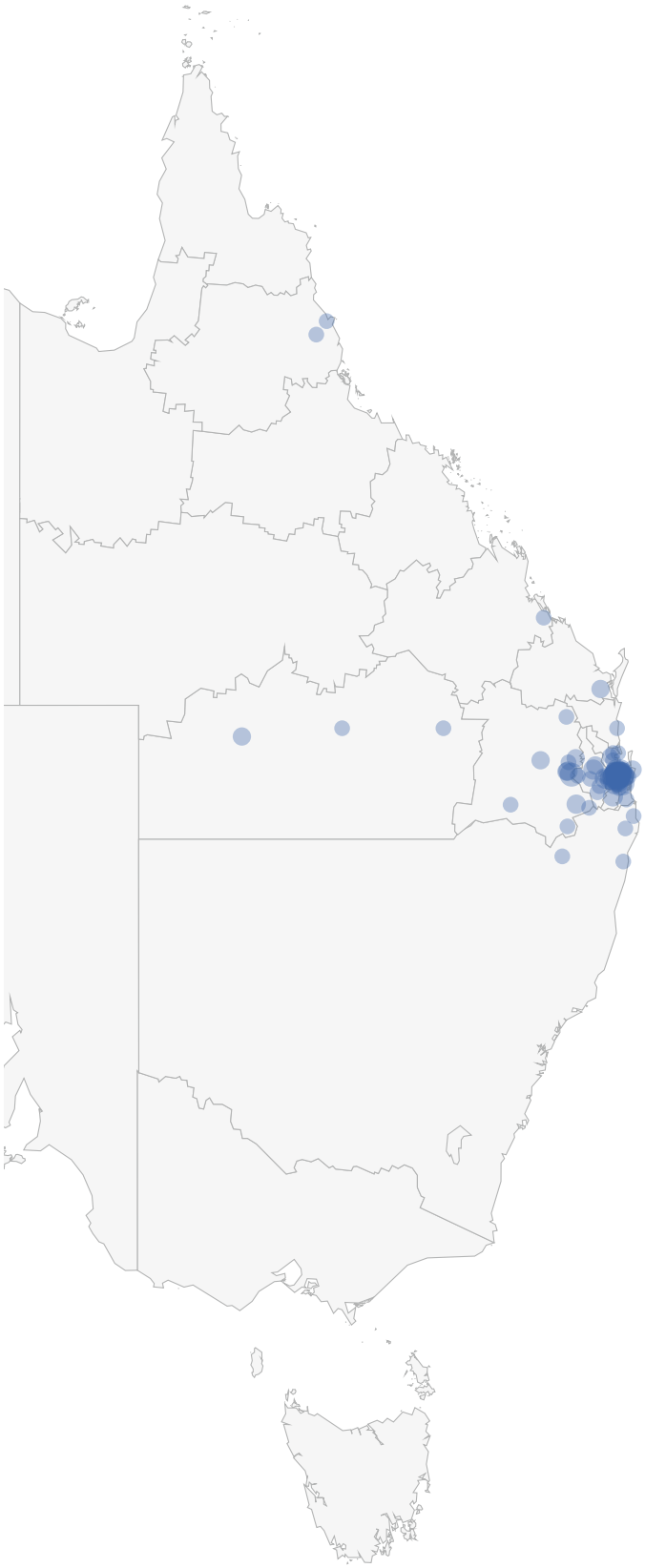


Figure 5: Princess Alexandra Hospital

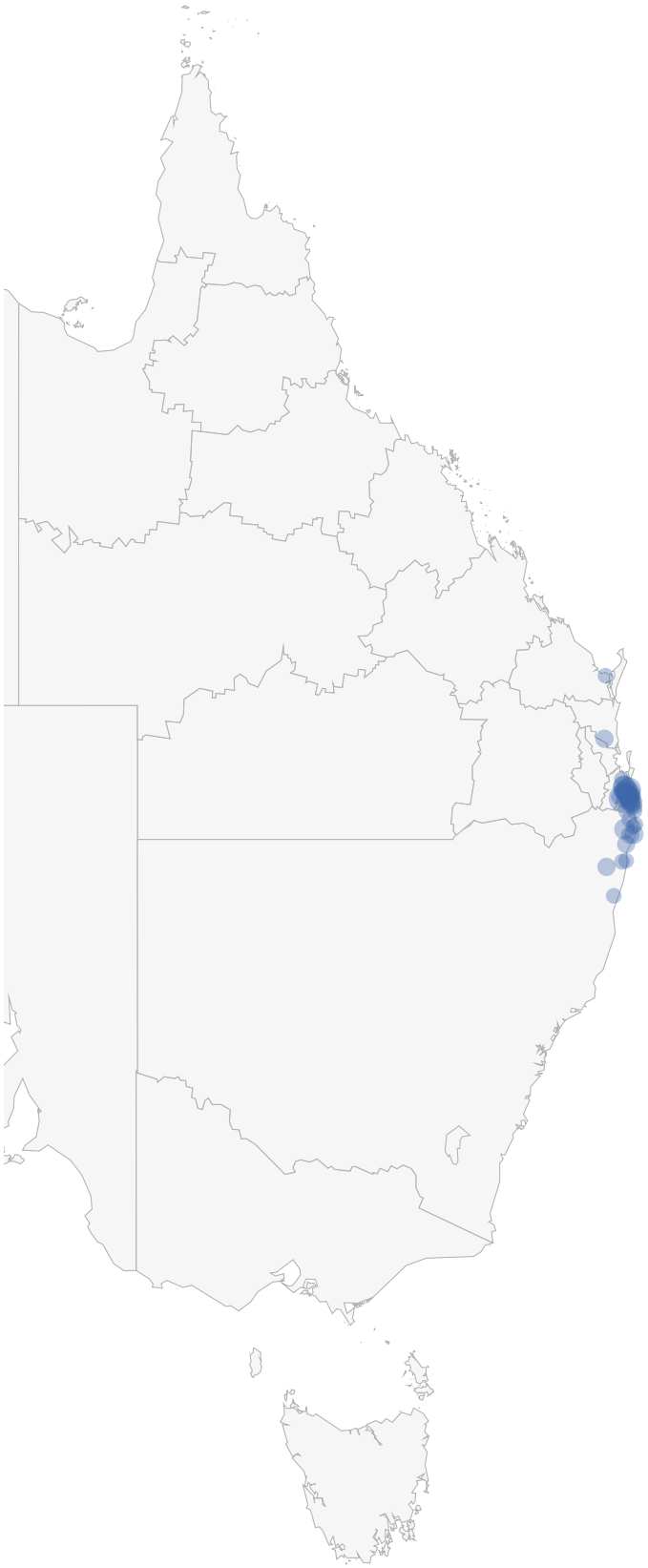


Figure 6: Gold Coast University Hospital

14 Case totals

14.1 Total surgeries

In 2018, 850 cases were performed across 5 public thoracic surgery units within Queensland. Patients undergoing thoracic surgery have been assigned a preoperative diagnosis category of either primary lung cancer, other cancer, pleural disease or other indication for surgery.

The most common preoperative diagnosis category for surgery was cancer (46%), with 30% of cases diagnosed as primary lung cancer.

Table 2: Cases by site and preoperative diagnosis category

SITE	Total cases n	Primary lung cancer n (%)	Other cancer* n (%)	Pleural disease† n (%)	Other‡ n (%)
TTH	148	34 (23.0)	36 (24.3)	45 (30.4)	33 (22.3)
TPCH	306	97 (31.7)	40 (13.1)	106 (34.6)	63 (20.6)
RBWH	39	20 (51.3)	7 (17.9)	6 (15.4)	6 (15.4)
PAH	209	62 (29.7)	31 (14.8)	70 (33.5)	46 (22.0)
GCUH	148	40 (27.0)	26 (17.6)	51 (34.5)	31 (20.9)
STATEWIDE	850	253 (29.8)	140 (16.5)	278 (32.7)	179 (21.1)

* Lung metastases, solitary lung lesion of uncertain aetiology or pleural malignancy/malignant effusion

† Pneumothorax, haemothorax, empyema or pleural thickening/nodules

‡ Chest wall disease, mediastinal disease, tracheal disease, oesophageal disease, infective focus or other diagnosis

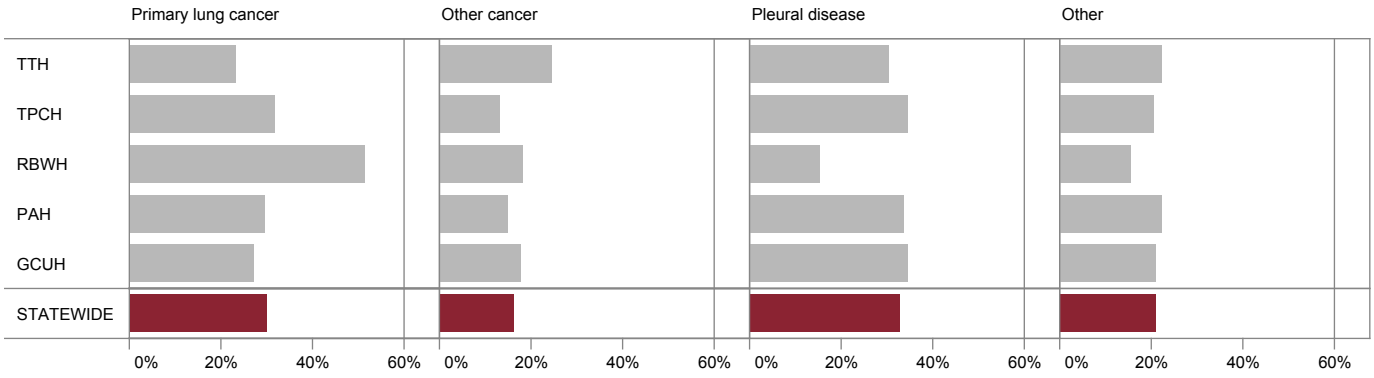


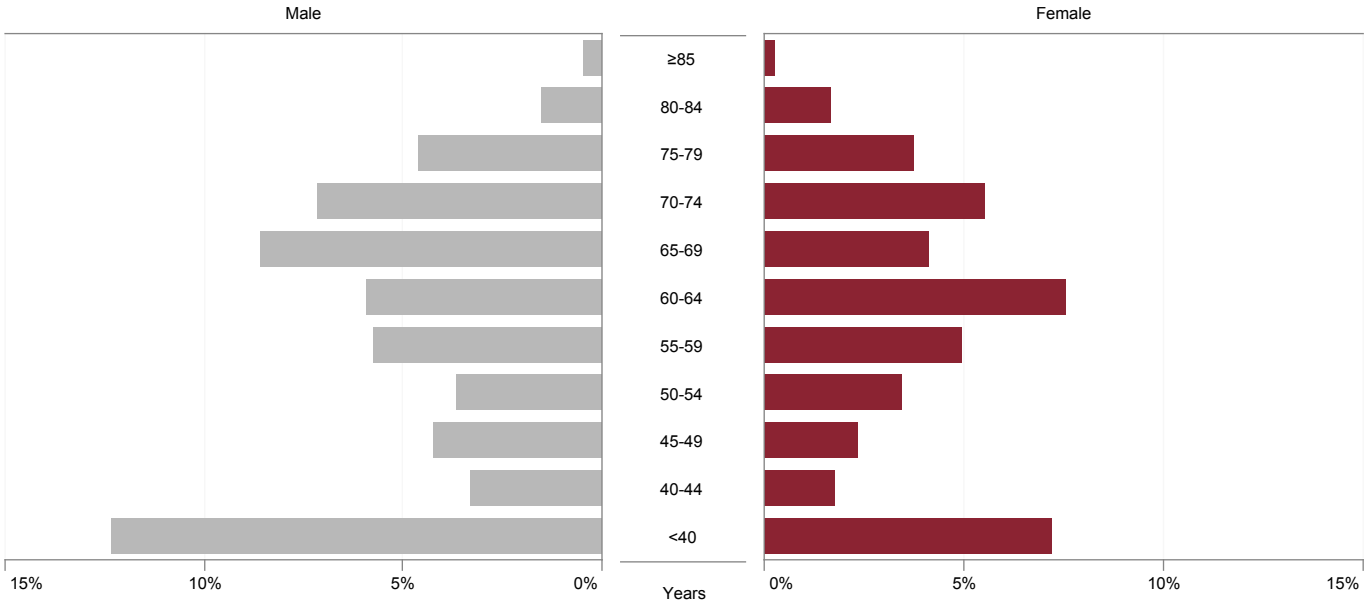
Figure 7: Proportion of cases by site and preoperative diagnosis category

15 Patient characteristics

15.1 Age and gender

The median age for thoracic surgical patients was 60 years, while almost one in five (19%) of patients were less than 40 years of age.

The majority of patients were male (58%). Distribution of cases between genders were evenly divided among patients with a preoperative cancer diagnosis (47% and 54% for primary lung cancer and other cancer respectively), while patients with pleural disease were more commonly male (71%).



% of total (n=850)

Figure 8: Proportion of all cases by age group and gender

Table 3: Median age by gender and preoperative diagnosis category

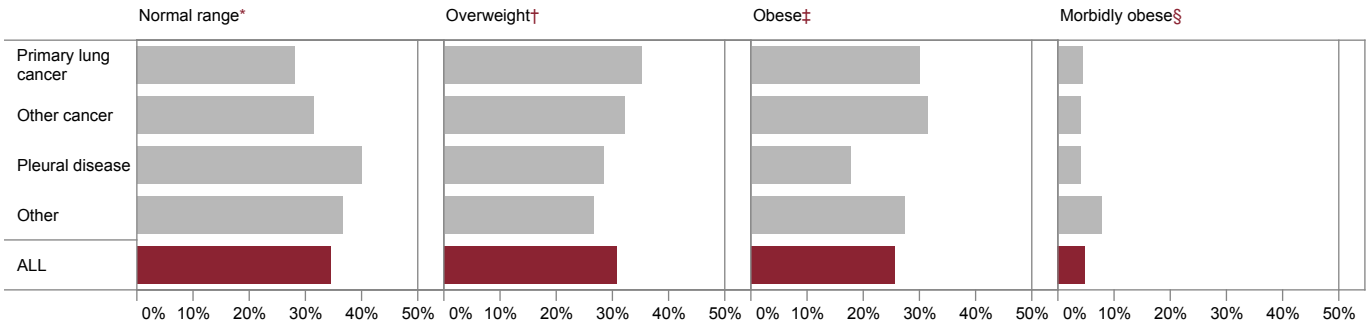
Preoperative diagnosis	Male years	Female years	ALL years
Primary lung cancer	65	65	65
Other cancer	68	61	64
Pleural disease	47	54	49
Other	54	49	53
ALL	**59**	**61**	**60**

Table 4: Proportion of cases by gender and preoperative diagnosis category

Preoperative diagnosis	Male n (%)	Female n (%)
Primary lung cancer	118 (46.6)	135 (53.4)
Other cancer	76 (54.3)	64 (45.7)
Pleural disease	197 (70.9)	81 (29.1)
Other	98 (54.7)	81 (45.3)
ALL	**489 (57.5)**	**361 (42.5)**

15.2 Body mass index

The majority (56%) of thoracic surgery patients were classed as overweight or obese, while 34% of patients had a body mass index (BMI) within the normal range. Almost 5% of patients were classed as underweight.



Underweight category (BMI <18.5 kg/m^2) is not displayed (4.7%)

Excludes missing data (7.6%)

* BMI 18.5–24.9 kg/m^2

† BMI 25–29.9 kg/m^2

‡ BMI 30–39.9 kg/m^2

§ BMI ≥40 kg/m^2

Figure 9: Proportion of cases by BMI and preoperative diagnosis categories

Table 5: BMI category by preoperative diagnosis category

Preoperative diagnosis	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
Primary lung cancer	6 (2.6)	66 (28.2)	82 (35.0)	70 (29.9)	10 (4.3)
Other cancer	2 (1.6)	40 (31.3)	41 (32.0)	40 (31.3)	5 (3.9)
Pleural disease	26 (10.1)	103 (39.9)	73 (28.3)	46 (17.8)	10 (3.9)
Other	3 (1.8)	60 (36.4)	44 (26.7)	45 (27.3)	13 (7.9)
ALL	37 (4.7)	269 (34.3)	240 (30.6)	201 (25.6)	38 (4.8)

Excludes missing data (7.6%)

15.3 Aboriginal and Torres Strait Islander status

The overall proportion of identified Aboriginal and Torres Strait Islander patients undergoing thoracic surgery was 4.3%.

Table 6: Aboriginal and Torres Strait Islander status by preoperative diagnosis category

Preoperative diagnosis	Indigenous n (%)	Non-Indigenous n (%)
Primary lung cancer	5 (2.0)	243 (98.0)
Other cancer	5 (3.7)	131 (96.3)
Pleural disease	16 (5.9)	253 (94.1)
Other	10 (5.7)	166 (94.3)
ALL	36 (4.3)	793 (95.7)

Excludes missing data (2.5%)

16 Risk factors and comorbidities

16.1 Smoking history

Approximately 22% of patients were current smokers (defined as smoking within 30 days prior to surgery), while 45% of patients had some smoking history and only 22% were identified as having never smoked. There were 11% of cases where this data was recorded as unknown.

There was considerable variation for patients in the primary lung cancer category, where the vast majority of patients (92%) were recorded as either current or former smokers.

Table 7: Smoking history by preoperative diagnosis category

Preoperative diagnosis	Current smoker n (%)	Former smoker n (%)	Never smoked n (%)	Unknown n (%)
Primary lung cancer	56 (22.8)	169 (68.7)	17 (6.9)	4 (1.6)
Other cancer	20 (14.7)	67 (49.3)	38 (27.9)	11 (8.1)
Pleural disease	79 (28.8)	80 (29.2)	64 (23.4)	51 (18.6)
Other	30 (17.1)	56 (32.0)	64 (36.6)	25 (14.3)
ALL	**185 (22.3)**	**372 (44.8)**	**183 (22.0)**	**91 (11.0)**

Excludes missing data (2.2%)

16.2 Respiratory disease

The majority of patients (65%) did not have respiratory disease, while almost one-third (31%) were recorded as having mild or moderate respiratory disease.

Table 8: Respiratory disease according to preoperative diagnosis category

Preoperative diagnosis	Mild* n (%)	Moderate† n (%)	Severe‡ n (%)
Primary lung cancer	42 (18.2)	57 (24.7)	5 (2.2)
Other cancer	20 (15.2)	16 (12.1)	7 (5.3)
Pleural disease	29 (10.8)	41 (15.2)	13 (4.8)
Other	18 (10.6)	26 (15.3)	7 (4.1)
ALL	**109 (13.6)**	**140 (17.5)**	**32 (4.0)**

Excludes missing data (5.6%)

* Patient is on chronic inhaled or oral bronchodilator therapy

† Patient is on chronic oral steroid therapy directed at lung disease

‡ Mechanical ventilation for chronic lung disease, or pO_2 on room air <60 mmHg or pCO_2 on room air >50 mmHg

16.3 Diabetes

There were 13% of thoracic surgery patients recorded as having diabetes, with the largest proportion identified amongst patients undergoing surgery for primary lung cancer (16%).

Table 9: Diabetes status by preoperative diagnosis category

Preoperative diagnosis	Diabetes n (%)	No diabetes n (%)
Primary lung cancer	40 (16.3)	206 (83.7)
Other cancer	15 (11.0)	121 (89.0)
Pleural disease	37 (13.5)	237 (86.5)
Other	17 (9.7)	158 (90.3)
ALL	**109 (13.1)**	**722 (86.9)**

Excludes missing data (2.2%)

16.4 Coronary artery disease

Overall, 11% of patients were identified as having a prior diagnosis of coronary artery disease (CAD), while 12% of the cohort had an unknown CAD history.

Table 10: Coronary artery disease status by preoperative diagnosis category

Preoperative diagnosis	CAD n (%)	No CAD n (%)	Unknown n (%)
Primary lung cancer	32 (13.2)	169 (69.8)	41 (16.9)
Other cancer	9 (6.6)	112 (82.4)	15 (11.0)
Pleural disease	22 (8.1)	221 (81.0)	30 (11.0)
Other	24 (13.8)	136 (78.2)	14 (8.0)
ALL	**87 (10.5)**	**638 (77.3)**	**100 (12.1)**

Excludes missing data (2.9%)

16.5 Renal function

Over one-quarter (27%) of patients had mild renal impairment at the time of surgery. Renal function has been determined using estimated glomerular filtration rate (eGFR), calculated from the creatinine measurement recorded preoperatively.

Table 11: Renal function by preoperative diagnosis category

Preoperative diagnosis	Normal* n (%)	Mild† n (%)	Moderate‡ n (%)	Severe§ n (%)
Primary lung cancer	116 (49.6)	81 (34.6)	37 (15.8)	–
Other cancer	70 (54.7)	38 (29.7)	19 (14.8)	1 (0.8)
Pleural disease	177 (68.1)	56 (21.5)	23 (8.8)	4 (1.5)
Other	109 (64.5)	41 (24.3)	16 (9.5)	3 (1.8)
ALL	**472 (59.7)**	**216 (27.3)**	**95 (12.0)**	**8 (1.0)**

Excludes missing data (6.9%)

* eGFR ≥90 mL/min/1.73 m^2

† eGFR 60–89 mL/min/1.73 m^2

‡ eGFR 30–59 mL/min/1.73 m^2

§ eGFR <30 mL/min/1.73 m^2

16.6 Cerebrovascular disease

Approximately 3% of patients were described as having cerebrovascular disease. Of these patients, 2% were characterised by a reversible neurological deficit with a complete return of function within 72 hours. Less than 1% exhibited residual symptoms greater than 72 hours post onset.

Table 12: Cerebrovascular disease type by preoperative diagnosis category

Preoperative diagnosis	Reversible* n (%)	Irreversible† n (%)	No n (%)
Primary lung cancer	7 (2.8)	1 (0.4)	238 (96.8)
Other cancer	4 (3.6)	–	132 (97.1)
Pleural disease	3 (1.1)	4 (1.4)	267 (97.4)
Other	3 (1.6)	2 (1.0)	170 (97.1)
ALL	**17 (2.1)**	**7 (0.8)**	**806 (97.1)**

Excludes missing data (2.2%)

* Typically includes transient ischaemic attack

† Typically includes cerebrovascular accident

16.7 Peripheral vascular disease

The prevalence of peripheral vascular disease was 4% in patients undergoing thoracic surgery, ranging from 1% to 8% across diagnosis categories.

Table 13: Peripheral vascular disease status by preoperative diagnosis category

Preoperative diagnosis	Yes n (%)	No n (%)
Primary lung cancer	19 (7.7)	227 (92.3)
Other cancer	5 (3.7)	131 (96.3)
Pleural disease	6 (2.2)	268 (97.8)
Other	2 (1.1)	173 (98.9)
ALL	**32 (3.9)**	**799 (96.1)**

Excludes missing data (2.2%)

16.8 Previous interventions

16.8.1 Previous thoracic surgery

There were 13% of patients who underwent prior thoracic surgery, ranging from 9% in the primary lung cancer group to 18% in the pleural disease category.

Table 14: Previous thoracic surgery by preoperative diagnosis category

Preoperative diagnosis	Yes n (%)	No n (%)
Primary lung cancer	21 (9.0)	213 (91.0)
Other cancer	16 (12.5)	112 (87.5)
Pleural disease	49 (18.1)	221 (81.9)
Other	20 (11.6)	153 (88.4)
ALL	**106 (13.2)**	**699 (86.8)**

Excludes missing data (5.3%)

16.8.2 Previous pulmonary resection

Overall, 8% of patients had undergone a previous pulmonary resection operation.

Table 15: Previous pulmonary resection surgery by preoperative diagnosis category

Preoperative diagnosis	Yes n (%)	No n (%)
Primary lung cancer	17 (7.1)	223 (92.9)
Other cancer	15 (11.1)	120 (88.9)
Pleural disease	28 (10.2)	246 (89.8)
Other	8 (4.6)	166 (95.4)
ALL	**68 (8.3)**	**755 (91.7)**

Excludes missing data (3.2%)

17 Care and treatment of patients

17.1 Admission status

Approximately three-quarters of all cases (76%) were classed as elective, while emergency admissions accounted for only 5% of cases.

The highest proportion of non-elective cases was within the pleural disease category, where over half (53%) were classed as either urgent (42%) or emergency (11%).

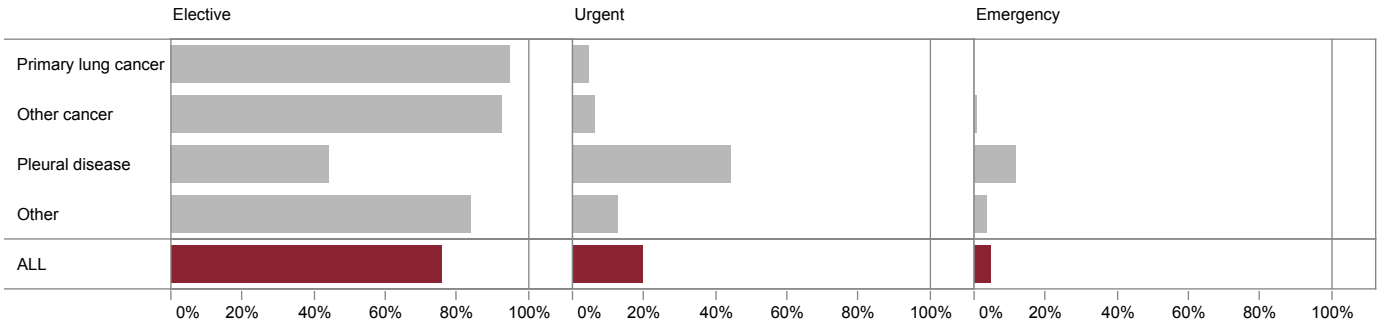


Figure 10: Admission status by preoperative diagnosis category

17.1.1 Elective day of surgery admissions

Of all elective cases, 47% were recorded as day of surgery admissions (DOSA).

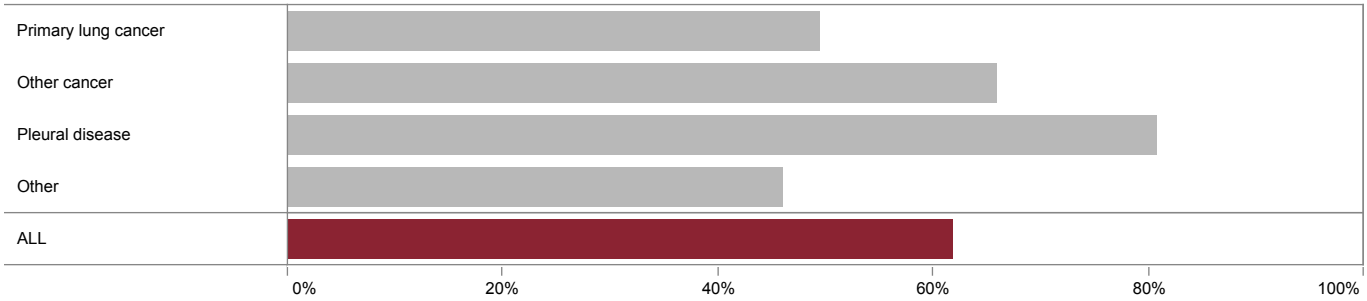
Table 16: Day of surgery admissions by preoperative diagnosis category

Preoperative diagnosis	DOSA n (%)
Primary lung cancer	101 (41.9)
Other cancer	79 (60.8)
Pleural disease	43 (35.0)
Other	77 (51.3)
ALL	**300 (46.6)**

17.2 Surgical technique

17.2.1 Video-assisted thoracic surgery

The majority of cases (62%) utilised video-assisted thoracic surgery (VATS), including 81% of cases in the pleural disease category.



Excludes missing data (1.3%)

Figure 11: Proportion of cases utilising VATS by preoperative diagnosis category

Number of ports

Of procedures undertaken through VATS, 42% utilised 3 ports for the operation.

Table 17: VATS cases by number of ports used and preoperative diagnosis category

Preoperative diagnosis	1 port n (%)	2 ports n (%)	3 ports n (%)	≥4 ports n (%)
Primary lung cancer	28 (22.8)	48 (39.0)	45 (36.6)	1 (0.8)
Other cancer	24 (26.4)	29 (31.9)	37 (40.7)	–
Pleural disease	56 (25.0)	68 (30.4)	97 (43.3)	1 (0.4)
Other	14 (17.3)	21 (25.9)	40 (49.4)	2 (2.5)
ALL	**122 (23.5)**	**166 (32.0)**	**219 (42.2)**	**4 (0.8)**

Excludes missing data (1.5%)

17.2.2 Incision type

Almost half (52%) of surgeries were solely video-assisted, while 27% of surgeries were performed by thoracotomy. Other incision types accounted for 5% of all cases.

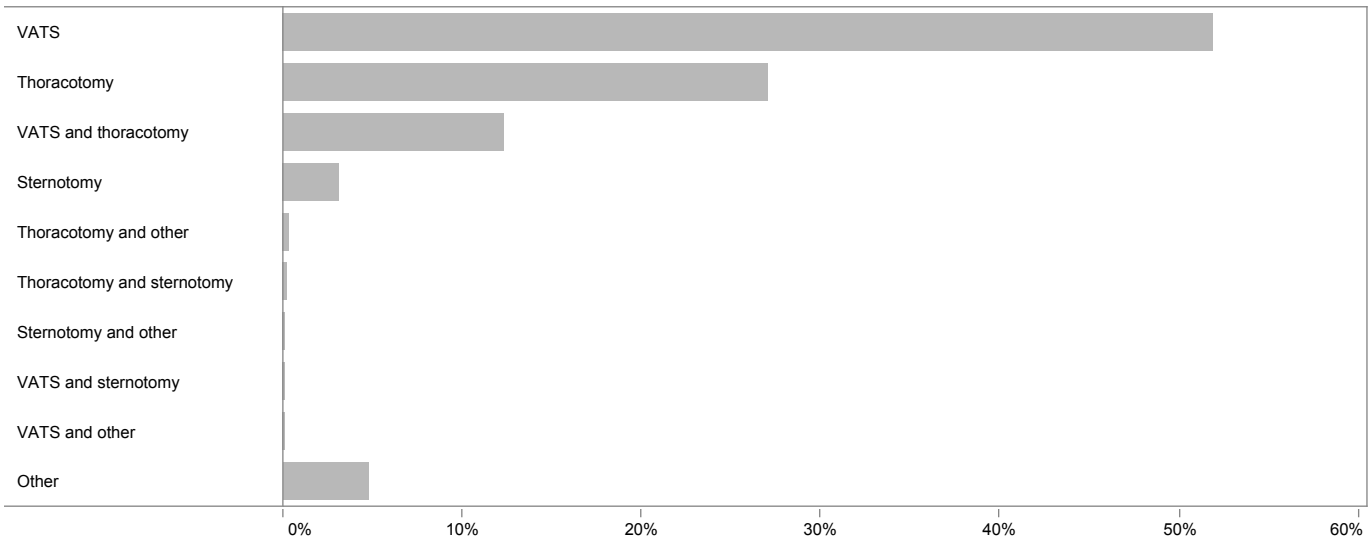


Figure 12: Proportion of all cases by incision type

Table 18: Incision type by preoperative diagnosis category

Incision type	Primary lung cancer n (%)	Other cancer n (%)	Pleural disease n (%)	Other n (%)	All n (%)
VATS	72 (29.3)	74 (54.8)	197 (71.9)	75 (49.7)	418 (51.9)
Thoracotomy	119 (48.4)	42 (31.1)	37 (13.5)	20 (13.2)	218 (27.0)
VATS and thoracotomy	51 (20.7)	17 (12.6)	25 (9.1)	6 (4.0)	99 (12.3)
Other	2 (0.8)	1 (0.7)	8 (2.9)	27 (17.9)	38 (4.7)
Sternotomy	1 (0.4)	–	3 (1.1)	21 (13.9)	25 (3.1)
Thoracotomy and other	–	1 (0.7)	2 (0.7)	–	3 (0.4)
Thoracotomy and sternotomy	1 (0.4)	–	–	1 (0.7)	2 (0.2)
Sternotomy and other	–	–	–	1 (0.7)	1 (0.1)
VATS and other	–	–	1 (0.4)	–	1 (0.1)
VATS and sternotomy	–	–	1 (0.4)	–	1 (0.1)
Other	2 (0.8)	1 (0.7)	8 (2.9)	27 (17.9)	38 (4.7)
Total	**246 (100.0)**	**135 (100.0)**	**274 (100.0)**	**151 (100.0)**	**806 (100.0)**

Excludes missing data (5.2%)

17.3 Surgery types

Lobectomy (29%) and lymph node sampling (29%) were the most common procedures performed on patients with a preoperative diagnosis of primary lung cancer.

Lobectomy (20%) and wedge resection (20%) were the most common procedures in the other cancer cohort, while pleural disease was most commonly treated with pleurodesis (24%).

It is important to note that the procedures outlined in this section are frequently undertaken in combination.

Table 19: Surgical procedures for primary lung cancer

	n (%)
Lobectomy	169 (29.3)
Lymph node sampling	165 (28.6)
Bronchoscopy	89 (15.5)
Wedge resection	34 (5.9)
Lymph node dissection	20 (3.5)
Bilobectomy	16 (2.8)
Pneumonectomy	14 (2.4)
Pleural biopsy	12 (2.1)
Pleurodesis	10 (1.7)
Pleural drainage	7 (1.2)
Decortication	4 (0.7)
Segmentectomy	4 (0.7)
Air leak control	3 (0.5)
Sleeve resection	2 (0.3)
Muscle flap	2 (0.3)
Pericardial window	2 (0.3)
Insertion of permanent pacemaker	1 (0.2)
Other	22 (3.8)
Total	**576 (100.0)**

Table 20: Surgical procedures for other cancer

	n (%)
Lobectomy	54 (20.1)
Wedge resection	53 (19.7)
Lymph node sampling	47 (17.5)
Bronchoscopy	28 (10.4)
Pleural biopsy	22 (8.2)
Pleurodesis	21 (7.8)
Pleural drainage	13 (4.8)
Lymph node dissection	9 (3.3)
Decortication	3 (1.1)
Clot evacuation	2 (0.7)
Pericardial window	2 (0.7)
Thymectomy	2 (0.7)
Resection mediastinal mass	2 (0.7)
Other	11 (4.1)
Total	**269 (100.0)**

Table 21: Surgical procedures for pleural disease

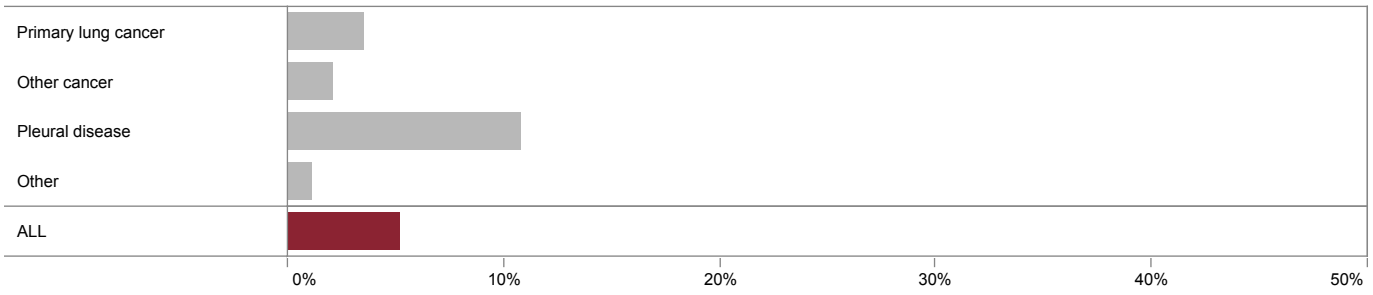
	n (%)
Pleurodesis	141 (23.7)
Pleural drainage	93 (15.7)
Decortication	81 (13.6)
Wedge resection	78 (13.1)
Bronchoscopy	55 (9.3)
Pleural biopsy	49 (8.2)
Clot evacuation	21 (3.5)
Bullectomy	10 (1.7)
Pericardial window	7 (1.2)
Open reduction internal fixation of ribs	5 (0.8)
Air leak control	3 (0.5)
Rib resection	2 (0.3)
Other	49 (8.2)
Total	**594 (100.0)**

Table 22: Surgical procedures for all other surgeries

	n (%)
Bronchoscopy	32 (11.9)
Wedge resection	27 (10.0)
Thymectomy	14 (5.2)
Sympathectomy	14 (5.2)
Resection mediastinal mass	13 (4.8)
Mediastinoscopy	13 (4.8)
Lobectomy	11 (4.1)
Lymph node sampling	11 (4.1)
Nuss bar	9 (3.3)
Pericardial window	6 (2.2)
Rib resection	5 (1.9)
Chest wall resection	5 (1.9)
Decortication	5 (1.9)
Open biopsy	5 (1.9)
Chest wall reconstruction	5 (1.9)
Sternectomy – partial	4 (1.5)
Lung biopsy	3 (1.1)
Bilobectomy	3 (1.1)
Lymph node dissection	2 (0.7)
Bullectomy	2 (0.7)
Pleurodesis	2 (0.7)
Plication	2 (0.7)
Pleural biopsy	2 (0.7)
Removal of foreign body	2 (0.7)
Pectus repair	2 (0.7)
Other	70 (26.0)
Total	**269 (100.0)**

17.4 Blood product usage

Approximately 5% of all thoracic surgical cases required blood product usage. Just over 2% of patients were transfused with both red blood cell (RBC) and non-red blood cell products (NRBC). Over 10% of patients diagnosed with pleural disease required some blood product transfusion.



Excludes missing data (2.7%)

Figure 13: Proportion of cases requiring blood product transfusion

Table 23: Blood product types used by preoperative diagnosis category

Preoperative diagnosis	RBC and NRBC n (%)	RBC only n (%)	NRBC only n (%)	No blood products used n (%)
Primary lung cancer	5 (2.0)	4 (1.6)	–	236 (96.3)
Other cancer	–	3 (2.2)	–	131 (97.8)
Pleural disease	11 (4.0)	18 (6.5)	1 (0.4)	245 (89.1)
Other	1 (0.6)	1 (0.6)	–	171 (98.8)
ALL	**17 (2.1)**	**26 (3.1)**	**1 (0.1)**	**783 (94.7)**

Excludes missing data (2.7%)

18 Clinical outcomes

18.1 Length of stay

The median length of stay for thoracic surgery patients was 6 days, ranging from 4 days to 11 days across preoperative diagnosis categories.

Table 24: Length of stay by preoperative diagnosis category

Preoperative diagnosis	Median days	Interquartile range days
Primary lung cancer	6.1	4.8–9.0
Other cancer	4.3	3.1–6.4
Pleural disease	10.8	5.6–19.7
Other	4.1	2.1–7.9
ALL	**6.2**	**4.0–11.2**

18.2 Major morbidity

There were 107 cases (13%) having one or more new major morbidities recorded post procedure. The incidence rate of major morbidity ranged from 19% in the primary lung cancer group to 8% in the other cancer category.

Prolonged air leak greater than 7 days accounted for 26% of the total major morbidities experienced by patients undergoing thoracic surgery.

Table 25: New major morbidity by diagnosis category

Preoperative diagnosis	Yes n (%)	No n (%)
Primary lung cancer	48 (19.0)	205 (81.0)
Other cancer	11 (7.9)	129 (92.1)
Pleural disease	33 (11.9)	245 (88.1)
Other	15 (8.4)	164 (91.6)
ALL	**107 (12.6)**	**743 (87.4)**

Excludes missing data (2.4%)

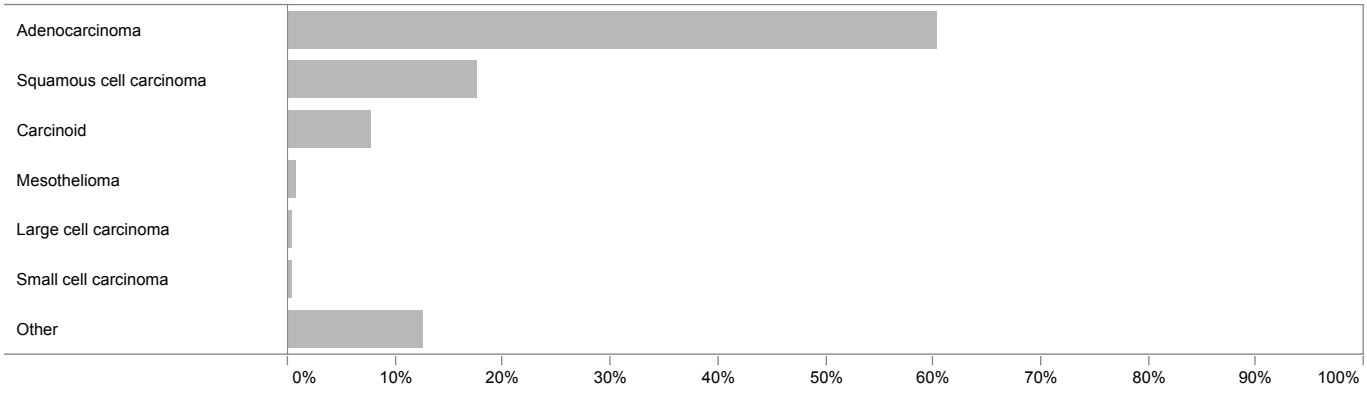
Table 26: Type of major morbidity

Major morbidity type	n (%)
Prolonged air leak (>7 days)	28 (26.2)
Air leak (72 hours-7 days)	21 (19.6)
Reoperation	14 (13.1)
Atrial fibrillation	9 (8.4)
Pneumonia	7 (6.5)
Wound infection	6 (5.6)
Cerebrovascular accident	1 (0.9)
Lung herniation	1 (0.9)
Lung torsion	1 (0.9)
Other major morbidity	19 (17.8)
ALL	**107 (100.0)**

18.3 Primary lung cancer outcomes

18.3.1 Final histopathology

In patients with a preoperative suspicion of primary lung malignancy, adenocarcinoma (60%) was the most common lung cancer according to final histopathology, followed by squamous cell carcinoma (18%).



Excludes missing data (3.2%)

Figure 14: Proportion of primary lung cancer cases by final histopathology

Table 27: Final histopathology results for primary lung malignancy

Histopathology	n (%)
Adenocarcinoma	148 (60.4)
Squamous cell carcinoma	43 (17.6)
Carcinoid	19 (7.8)
Mesothelioma	2 (0.8)
Large cell carcinoma	1 (0.4)
Small cell carcinoma	1 (0.4)
Other	31 (12.7)
ALL	**245 (100.0)**

18.3.2 Stage classification

According to postoperative TNM (tumour, lymph node, metastases) staging classification[20], the most common primary lung malignancy was a grade Ia2 tumour (24%) followed by a grade Ib malignancy (18%).

Table 28: Primary lung malignancy by final postoperative stage classification.

Postoperative stage classification	n (%)
Ia1	11 (5.2)
Ia2	52 (24.4)
Ia3	32 (15.0)
Ib	38 (17.8)
IIa	9 (4.2)
IIb	35 (16.3)
IIIa	21 (9.8)
IIIb	1 (0.5)
IVa	7 (3.3)
IVb	2 (0.9)
Staging indeterminate	5 (2.3)
Total	**213 (100.0)**

Excludes missing data/not applicable (15.8%)

18.4 Unadjusted all-cause mortality

The unadjusted all-cause mortality rate within 30 days of thoracic surgery was 0.6%, increasing to 2.6% at 90 days.

This has been identified as an area of focus for future Thoracic Surgery Audits. Specifically, reporting of longer-term survival for primary lung cancer patients.

Table 29: All-cause unadjusted mortality up to 90 days post surgery

Category	Total cases n	Death in 30 days n (%)	Death in 90 days n (%)
Primary lung cancer	253	1 (0.4)	7 (2.8)
Other cancer	140	1 (0.7)	7 (5.0)
Pleural disease	278	2 (0.7)	5 (1.8)
Other	179	1 (0.6)	3 (1.7)
ALL	**850**	**5 (0.6)**	**22 (2.6)**

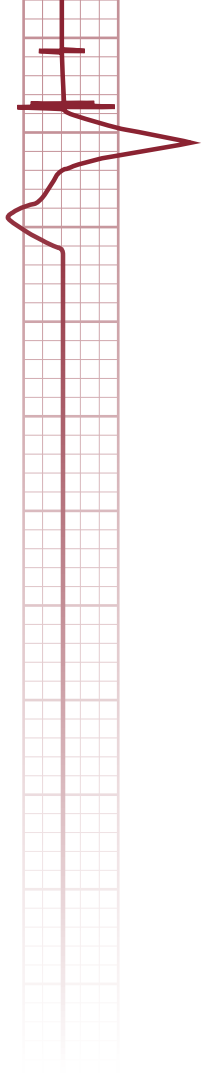
19 Conclusions

This is the first comprehensive report on the workload faced by the Thoracic Surgeons of Queensland from the QCOR data set. It demonstrates the challenges faced in performing thoracic surgery, in particular the challenge of timely management of pleural disease, and the incidence and management of airleaks after lung surgery.

The initial assessment of the mortality associated with thoracic surgery shows excellent results, with exceptionally low rates of mortality in what is often considered high risk surgery. The second element of the brief mortality analysis is that including a longer timeframe identifies some patients who survive the first month, but not the second or third. This is not a common analysis in surgery, as the focus is usually on the first month after surgery. This demonstrates that the patients who require lung resection to control a cancer have their surgery done with exceptional safety and are then discharged home in a timely manner, but perhaps have significant challenges to their health that mean ongoing recovery and survival in the months to follow can be ultimately an unwinnable challenge for some patients.

The challenge to the clinical units is to improve the data quality in the database. Missing data rates are small, but need to be improved. Data assurance with activity reports from individual units needs to be performed regularly to ensure the database and the report does indeed capture all activity in the thoracic surgical units of Queensland. A further recommendation is to extend involvement to public-private partnerships that provide thoracic surgery to public hospital patients in order to comprehensively report on all thoracic surgery funded by Queensland Health.

Electrophysiology and Pacing Audit



1 Message from the QCOR Electrophysiology and Pacing Committee Chair

The 2018 QCOR report includes a more complete dataset than its predecessor, allowing some year-to-year comparisons of data for the first time, as well as data describing procedural success over time and other clinical indicators. Importantly in this report, unmet need is now reflected by waiting times for cardiac electrophysiology and pacing procedures. Profiling continues regarding demographics, activity and quality for these procedures which prolong life (implantable cardioverter defibrillator, ICD), compensate pathology of slow heart rhythm (pacemakers) and heart failure (cardiac resynchronisation therapy), cure most fast heart rhythms or palliate and reduce hospitalisations the remainder (ablation for atrial fibrillation and ventricular tachycardia). Recently the introduction of an additional Medicare Benefits Schedule item number for implantable ECG loop recorders (ILRs) in the investigation of cryptogenic stroke has resulted in a very large increase in demand for these devices, mandating formulation of rational, evidence-based, multi-disciplinary strategy to address that demand.

All of these procedures can enhance quality of life and reduce burden of disease for the community. However, they require adequate infrastructure and adequate specialised workforce. Deficiencies here are longstanding and increasing, as we continue to face the increasing, mutually-exacerbating epidemics of atrial fibrillation and heart failure. There is nil scope for 'increased efficiency' when staff are too few and overworked. Again the 2018 report contains authoritative activity and quality mapping, now with documentation of waiting times to reflect unmet need which must guide planning to address these deficiencies urgently.

In the background, the increasing, aging population shows improved survival of other cardiovascular procedures, continues to exhibit adverse lifestyle trends and demands technological advances. In the larger centres, capacity to perform ablation procedures continues to be choked by ever-increasing demand for pacemaker and ICD device procedures. While these device procedures should always have priority, in Queensland Health they are usually performed by operators with expertise in cardiac electrophysiology and ablation, on patients who benefit from that expertise. If ablation is imperilled to wither on a vine of indifference and inaction, loss of that expertise will compromise:

- outcomes across the service,
- patient access to ablation which is already tenuous and embarrassingly meagre when compared to access to ablation in the private health system, and
- specialised training in cardiac electrophysiology.

Analysis of this and future reports will yield very important learnings about the journeys of public patients who undergo procedures for heart rhythm disorders. I wish to acknowledge the hard work of QCOR administrative staff, and all contributors to the dataset including cardiac scientists and clinical colleagues who apply integrity, co-operation and passion to their work in heart rhythm management.

Associate Professor John Hill
Chair
QCOR Electrophysiology and Pacing Committee

2 Key findings

This Electrophysiology and Pacing Audit describes baseline demographics, risk factors, procedures performed and outcomes for 2018.

Key findings include:

- Across Queensland, 8 public sites contributed to the registry with 7 sites contributing a complete year of data. Gold Coast University Hospital began direct data entry on 29 January 2018.
- 4,474 electrophysiology and pacing cases were including 3,136 device procedures and 1,061 electrophysiology procedures.
- The majority of all patients were aged over 60 years (70%) with a median age of 69 years.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 3.7%.
- The vast majority of patients (72%) were classed as having an unhealthy body mass index (BMI) of greater than 30 kg/m^2.
- The majority of procedures (61%) were classified as high-urgency procedures that are clinically indicated within 30 days.
- Outpatient procedures accounted for 54% of all cases.
- There were 520 standard electrophysiology procedures performed with a further 568 complex procedures undertaken, which utilise three-dimensional mapping technology, involve pulmonary vein isolation or ventricular arrhythmias.
- Radiofrequency ablation was the energy source utilised in the vast majority of ablation cases (85%).
- Atrial flutter, pulmonary vein isolation (atrial fibrillation) and atrioventricular node re-entry tachycardia ablations accounted for 81% of all ablation cases.
- The reported complication rate for all device procedures was 2.9%, while electrophysiology procedures had a 3.2% complication rate.
- There was a 0.3% procedural tamponade rate reported for all cases.
- The statewide median wait time for complex ablation was 81 days with 73% of cases meeting the 180 day benchmark.
- The 12 month device system loss rate due to infection was 1.4%.

3 Participating sites

In 2018, there were 8 public electrophysiology and pacing units spread across metropolitan and regional Queensland. All 8 of these entered data directly into the Queensland Cardiac Outcomes Registry (QCOR) electrophysiology and pacing application. The eighth site, Gold Coast University Hospital began direct entry in early 2018.

Patients came from a wide geographical area, with the majority of patients residing on the eastern seaboard.

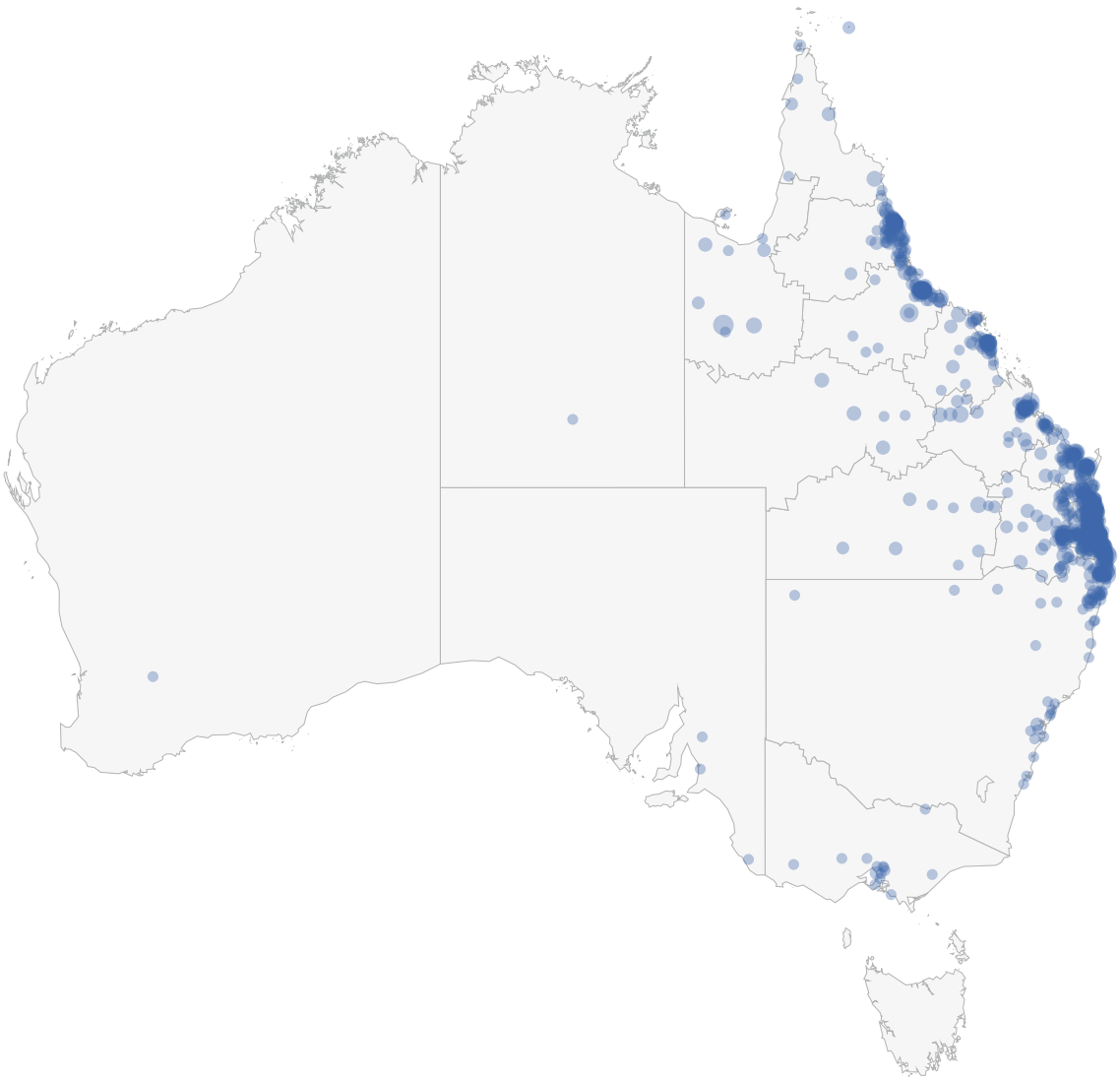


Figure 1: Electrophysiology and pacing cases by residential postcode

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

Gold Coast University Hospital commenced direct data entry 29 January 2018

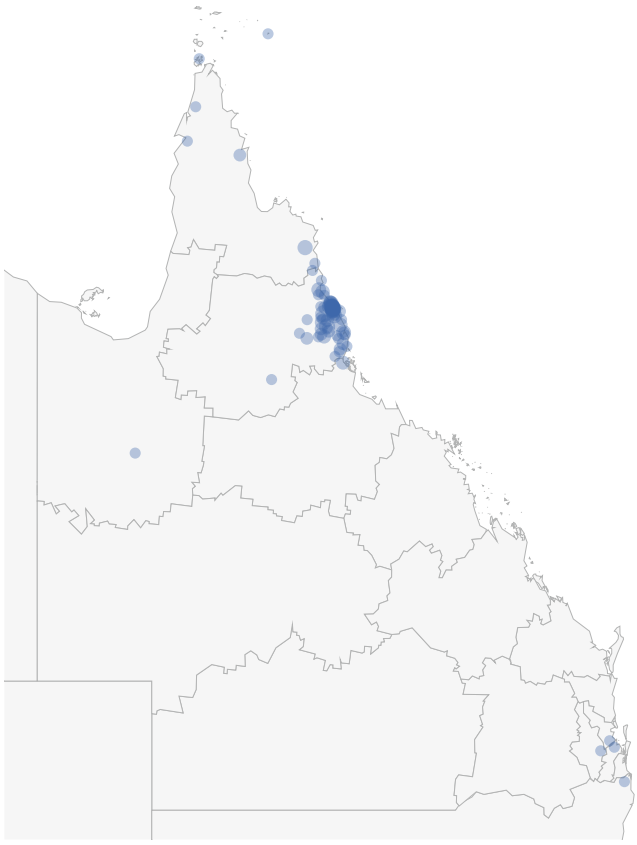


Figure 2: Cairns Hospital

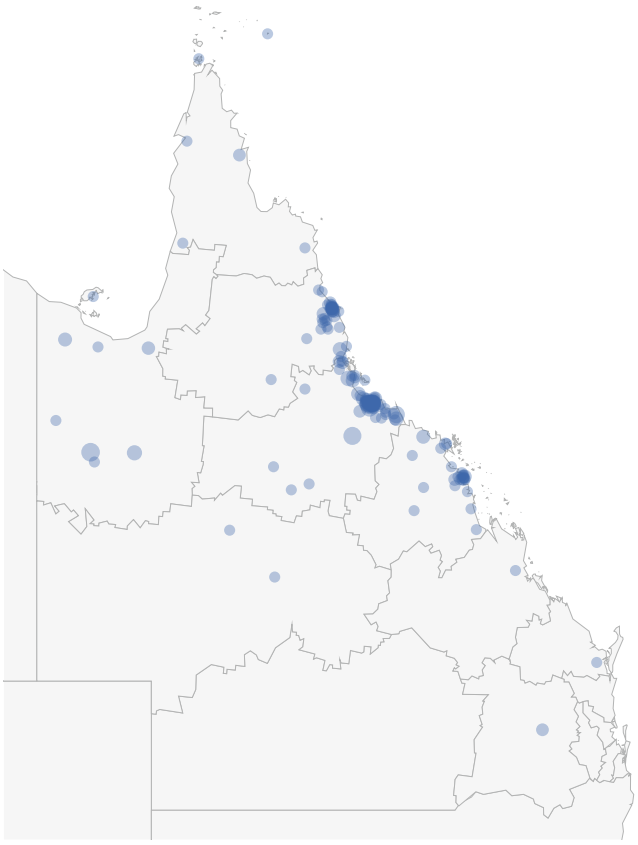


Figure 3: The Townsville Hospital

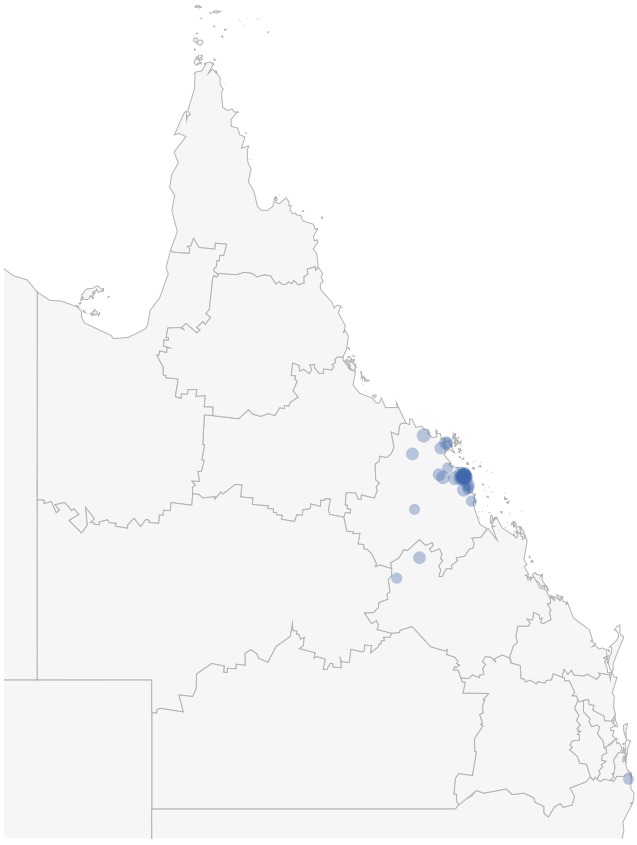


Figure 4: Mackay Base Hospital

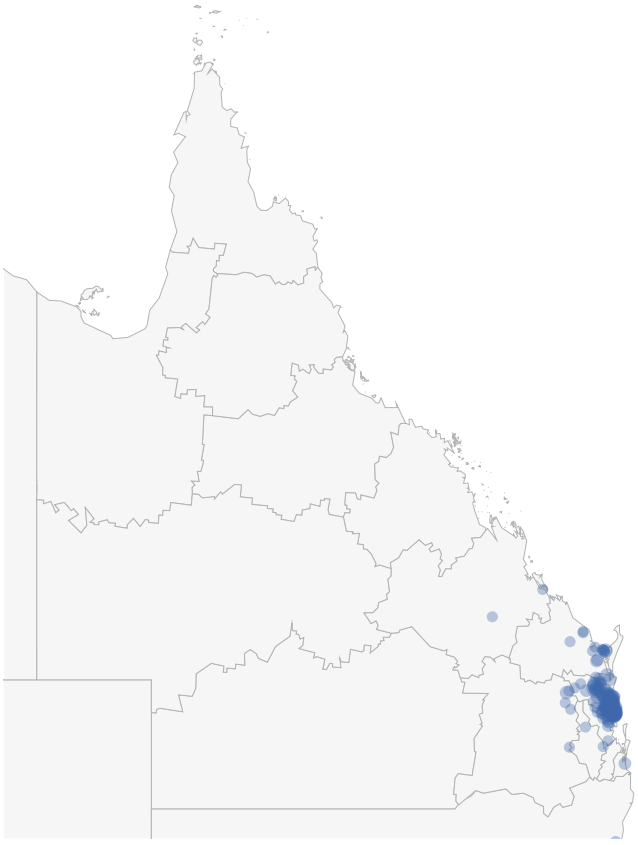


Figure 5: Sunshine Coast University Hospital

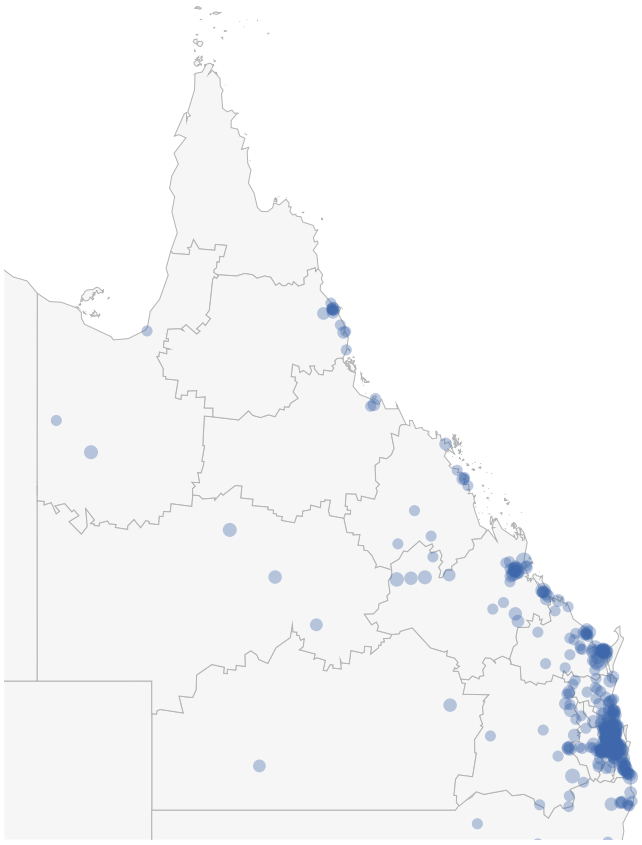


Figure 6: The Prince Charles Hospital

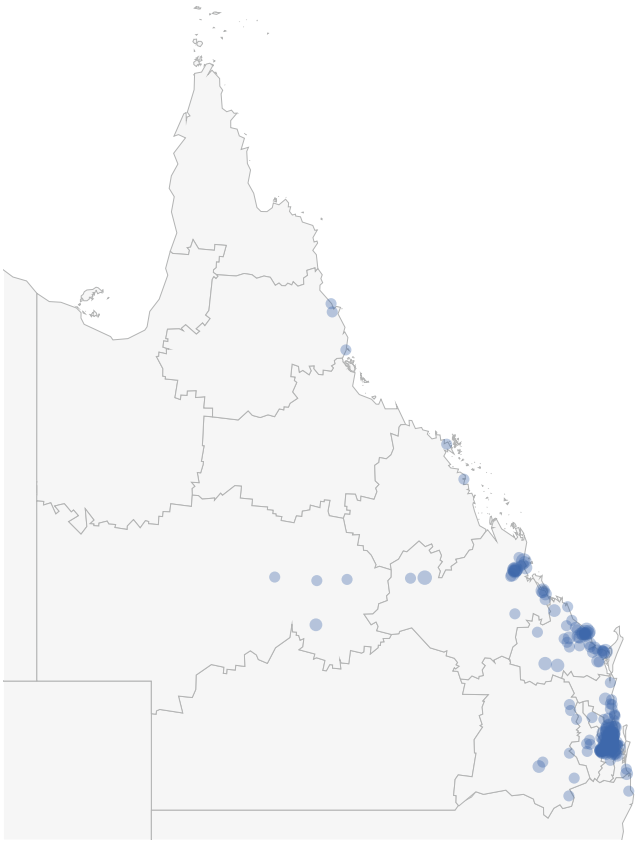


Figure 7: Royal Brisbane and Women's Hospital

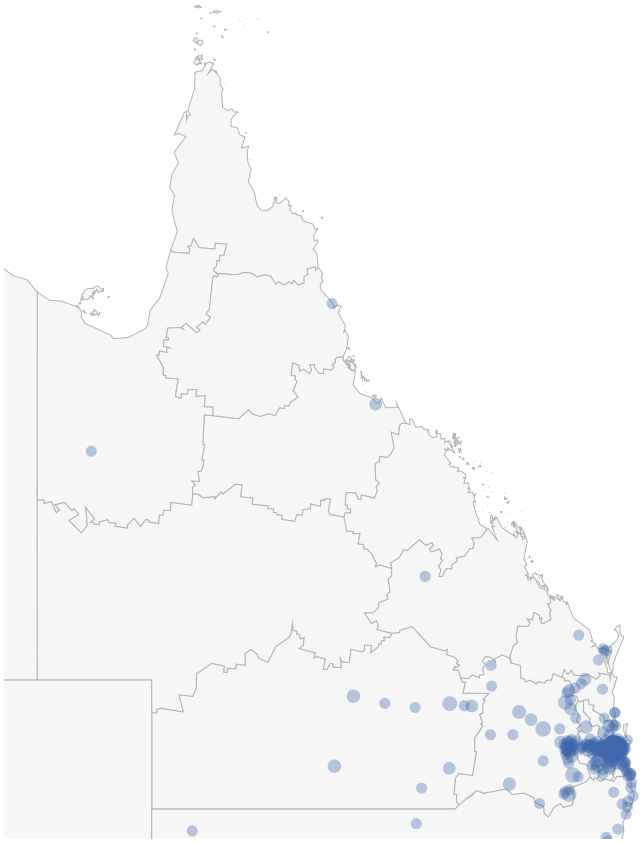


Figure 8: Princess Alexandra Hospital

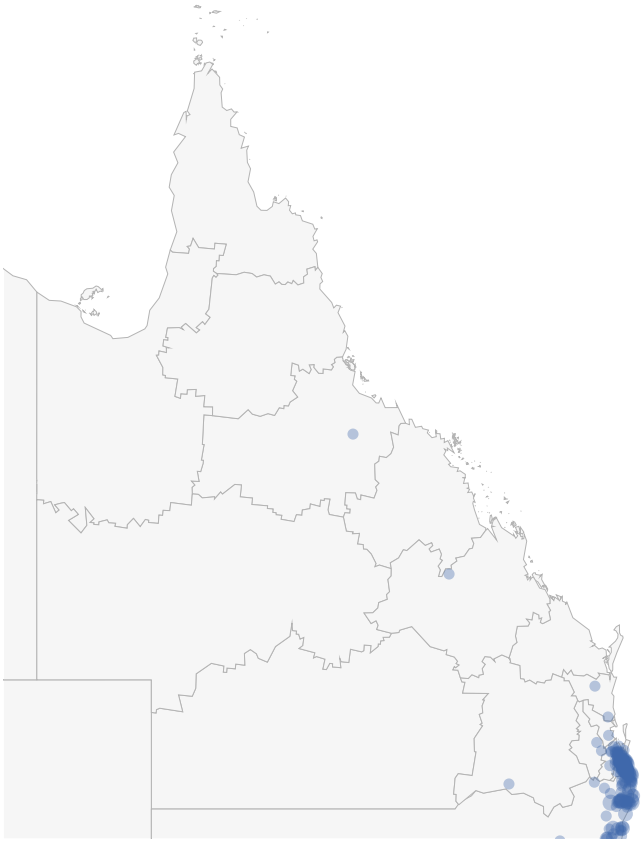


Figure 9: Gold Coast University Hospital

4 Case totals

4.1 Case volume

In 2018, 4,474 electrophysiology and pacing procedures were documented using the QCOR electrophysiology and pacing application. This number does not reflect the overall case totals as statewide uptake concluded in early 2018.

Table 2: Total cases by category

Procedure combination	Total cases n (%)	Category
Cardiac device procedure	3,098 (69.2)	Device
Cardiac device procedure + EP study	22 (0.5)	
Cardiac device procedure + other procedure	10 (0.2)	
Cardiac device procedure + EP study + ablation	4 (0.1)	
Cardiac device procedure + EP study + cardioversion	1 (<0.1)	
Cardiac device procedure + cardioversion	1 (<0.1)	
EP study + ablation	772 (17.2)	EP
EP study	184 (4.1)	
Ablation	50 (1.1)	
EP study + ablation + cardioversion	38 (0.8)	
EP study + cardioversion	11 (0.2)	
EP study + drug challenge	4 (0.1)	
EP study + ablation + other procedure	1 (<0.1)	
EP study + other procedure	1 (<0.1)	
Cardioversion	198 (4.4)	Other
Other procedure	46 (1.0)	
Drug challenge	32 (0.7)	
Cardioversion + other procedure	1 (<0.1)	
ALL	**4,474 (100.0)**	

Case totals do not reflect all activity due to incomplete year of data acquisition

4.2 Cases by category

The majority of cases performed were cardiac device procedures accounting for over two-thirds (70%) of documented procedures. The remainder of cases were electrophysiology and ablation procedures (24%) with the remainder categorised as other procedures (6%).

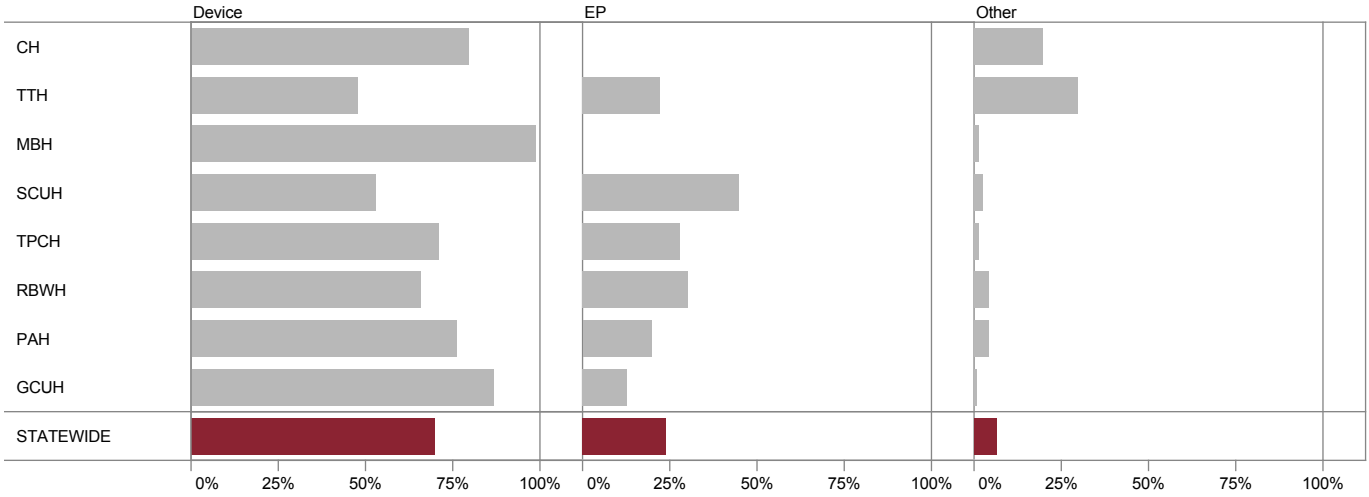


Figure 10: Proportion of cases by site and category

Table 3: Cases by case category

Site	Device n (%)	EP n (%)	Other n (%)	Total n (%)
CH	213 (6.8)	–	53 (19.1)	266 (5.9)
TTH	223 (7.1)	103 (9.7)	138 (49.8)	464 (10.4)
MBH	95 (3.0)	–	1 (0.4)	96 (2.1)
SCUH	275 (8.8)	231 (21.8)	12 (4.3)	518 (11.6)
TPCH	821 (26.2)	322 (30.3)	12 (4.3)	1,155 (25.8)
RBWH	352 (11.2)	161 (15.2)	22 (7.9)	535 (11.9)
PAH	680 (21.7)	174 (16.4)	37 (13.4)	891 (19.9)
GCUH	478 (15.2)	69 (6.5)	2 (0.7)	549 (12.3)
STATEWIDE	**3,136 (70.1)**	**1,061 (23.7)**	**277 (6.2)**	**4,474 (100.0)**

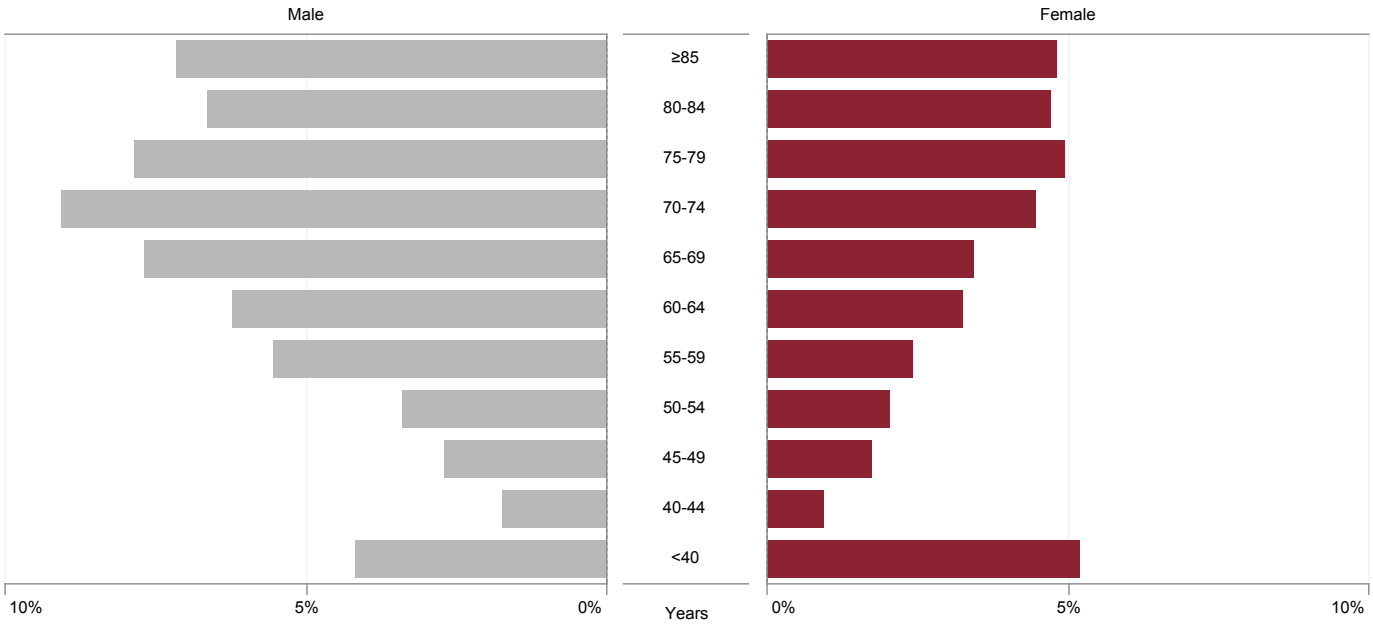
Case totals do not reflect all 2018 activity for GCUH

5 Patient characteristics

5.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. The majority of patients were aged 60 years and above (70%). The median age of the overall electrophysiology and pacing patient cohort was 69 years of age.

The median age of male and female patients was 69 years. Patient age differed greatly by procedure category with the median age of patients undergoing electrophysiology procedures being 58 years compared to 73 years for cardiac device procedures.



% of total (n=4,474)

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

Table 4: Median age by gender and case category

	Total cases n	Male years	Female years	ALL years
Device	3,136	72	74	73
EP	1,061	60	55	58
Other	277	62	66	63
Total	**4,474**	**69**	**69**	**69**

Case totals do not reflect all activity due to incomplete year of data acquisition

Overall, 62% of patients were male with a similar distribution across all procedure categories. The largest proportion of females was represented in the electrophysiology category (41%).

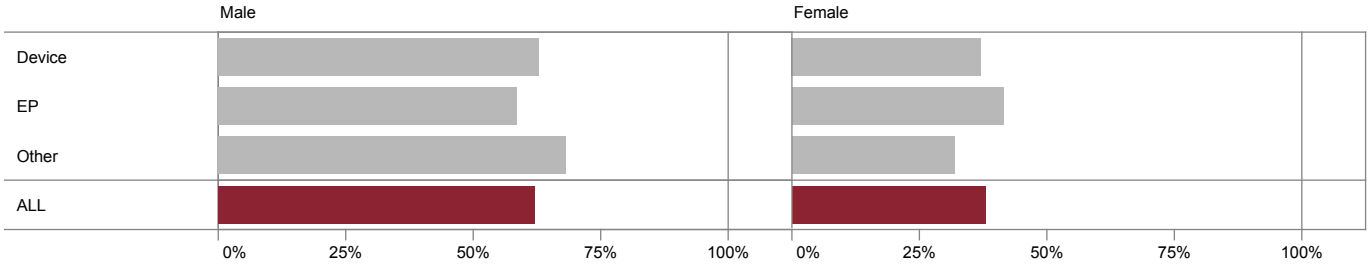


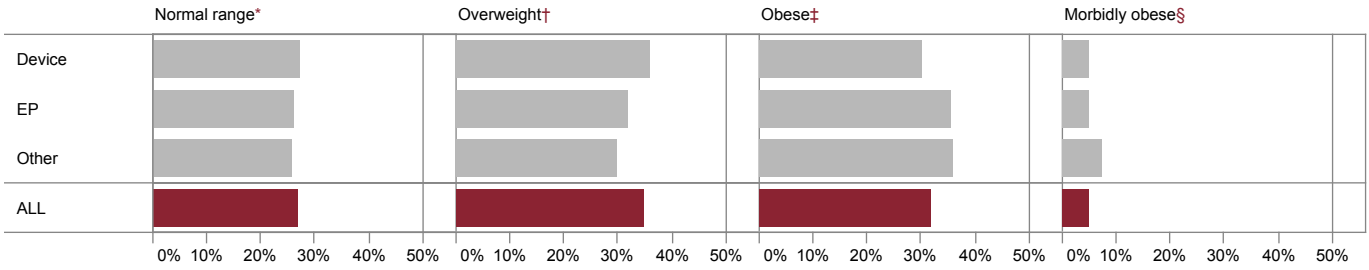
Figure 12: Proportion of cases by gender and category

Table 5: Proportion of cases by gender and category

	Total cases n	Male n (%)	Female n (%)
Device	3,136	1,968 (62.8)	1,168 (37.2)
EP	1,061	622 (58.6)	439 (41.4)
Other	277	189 (68.2)	88 (31.8)
ALL	**4,474**	**2,779 (62.1)**	**1,695 (37.9)**

5.2 Body mass index

Patients classed as having a body mass index (BMI) category of overweight (35%), obese (32%) or morbidly obese (5%) represented almost three-quarters of all electrophysiology and pacing patients. Patients classed as underweight represented 2% of all cases.



Underweight category (2%) not displayed

* BMI 18.5–24.9 kg/m^2

† BMI 25–29.9 kg/m^2

‡ BMI 30–39.9 kg/m^2

§ BMI ≥40 kg/m^2

Figure 13: Proportion of cases by BMI and case category

5.3 Aboriginal and Torres Strait Islander status

Overall, the proportion of identified Aboriginal and Torres Strait Islander patients undergoing electrophysiology and pacing procedures was 3.7%. This correlates closely to the estimated proportion of Aboriginal and Torres Strait Islander persons within Queensland (4.6%).[2] There was large variation between units, with the North Queensland sites seeing a larger proportion of Aboriginal and Torres Strait Islander patients (Figure 14).

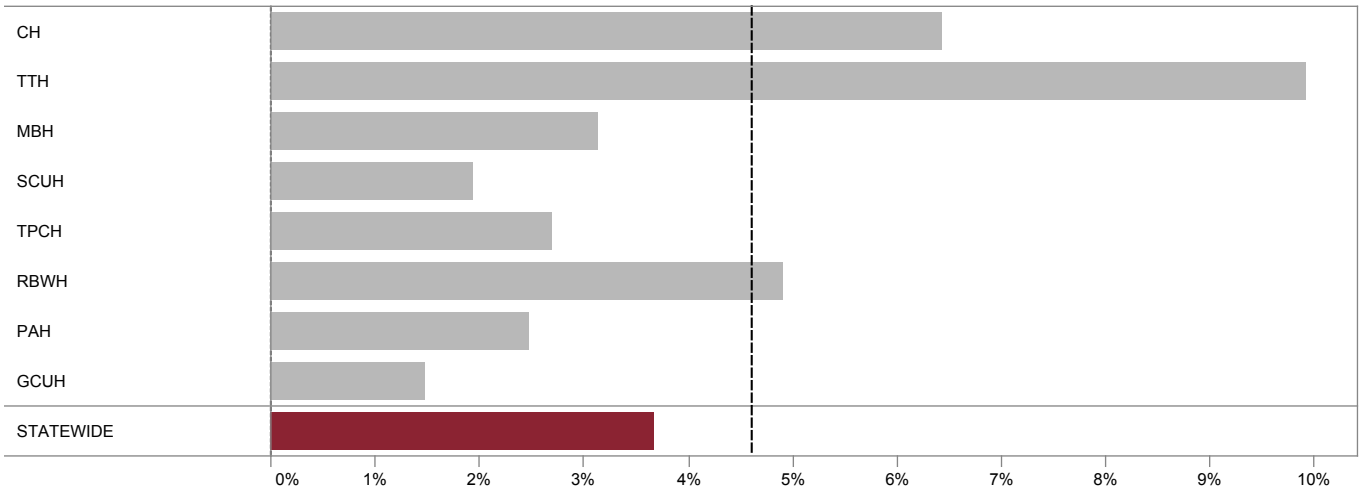
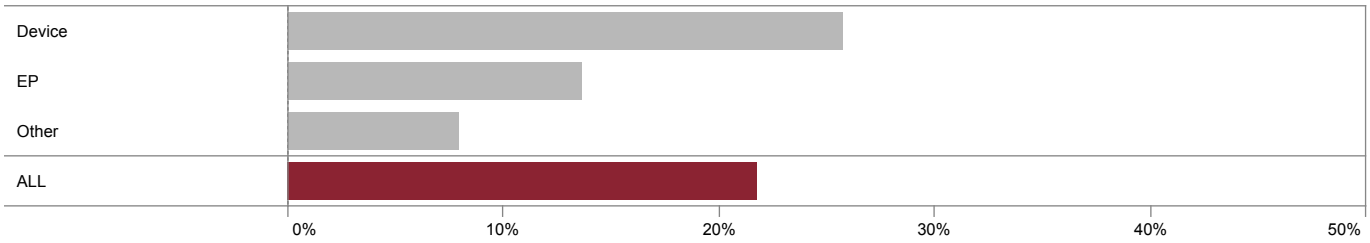


Figure 14: Proportion of cases by identified Aboriginal and Torres Strait Islander status and site

6 Risk factors and comorbidities

6.1 Coronary artery disease

Across the state, 26% of device procedure patients were reported to have a history of coronary artery disease. This figure was far lower among the electrophysiology cohort (14%).

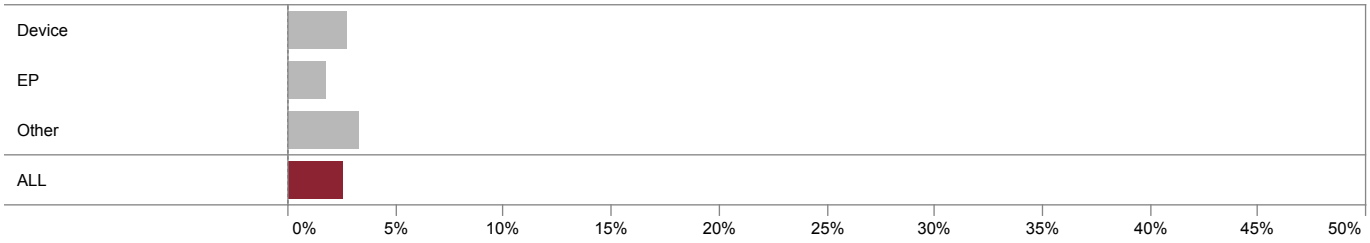


Excludes missing data (27%)

Figure 15: Proportion of cases by coronary artery disease history and case category

6.2 Family history of sudden cardiac death

During the surveyed period, 3% of patients who underwent other procedures such as cardioversion and drug challenges had a documented family history of sudden cardiac death. Similarly, 3% of device patients also had this risk factor.

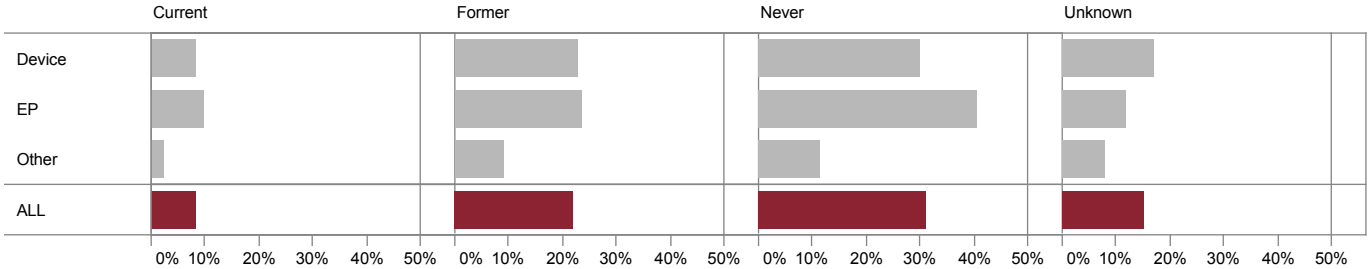


Excludes missing data (31%)

Figure 16: Proportion of cases by sudden cardiac death history and case category

6.3 Smoking history

Overall, 30% of patients had a history of smoking, including 8% who were documented as being current smokers and 22% former smokers. There were 31% of patients who reported never having smoked and 15% with an unknown smoking history.

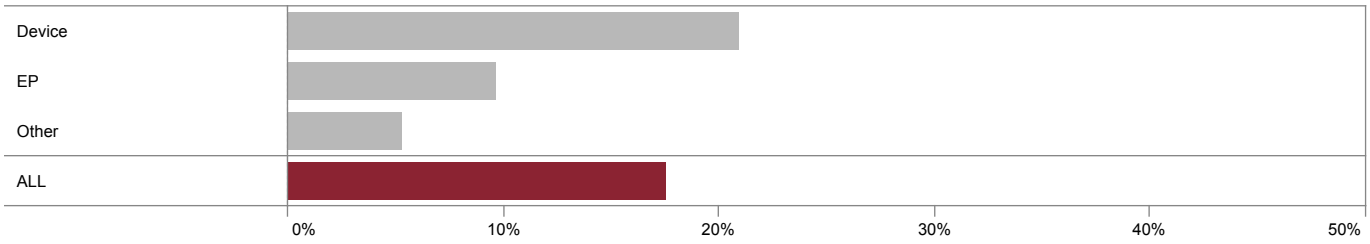


Excludes missing data (24%)

Figure 17: Proportion of cases by smoking status and case category

6.4 Diabetes

The prevalence of diabetes was highest in the cardiac device procedure group, with 21% of patients known to be diabetic. Overall, 18% of the cohort had some form of diabetes under treatment.

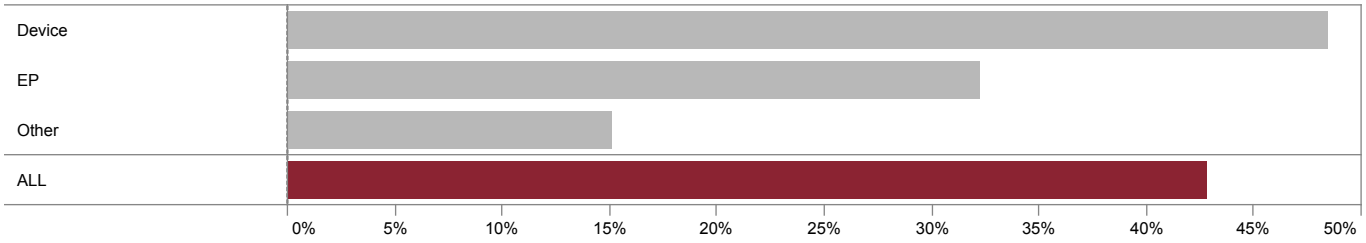


Excludes missing data (23%)

Figure 18: Proportion of cases by diabetes status and case category

6.5 Hypertension

Hypertension, defined as receiving antihypertensive medications at the time of case, was present in over 43% of patients irrespective of case type. Patients in the cardiac device procedure category had a greater incidence of hypertension (49%).

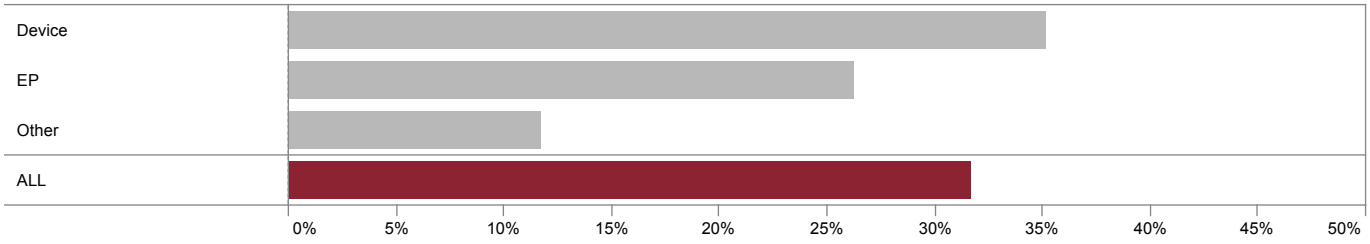


Excludes missing data (21%)

Figure 19: Proportion of cases by hypertension status and case category

6.6 Dyslipidaemia

Within this cohort, 32% of patients were treated with statins for dyslipidaemia at the time of case. This ranged from 35% for device procedures to 26% in the electrophysiology category.

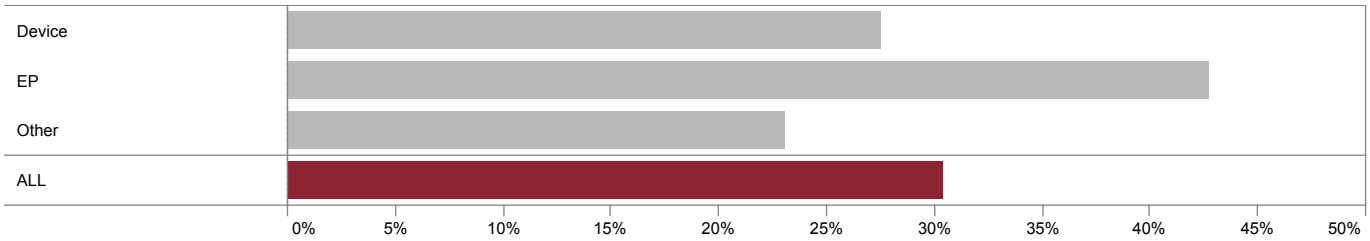


Excludes missing data (24%)

Figure 20: Proportion of cases by dyslipidaemia status and case category

6.7 Atrial arrhythmia history

Almost one-third of patients (30%) had a history of atrial arrhythmia (atrial fibrillation, flutter or other atrial arrhythmia). The prevalence of atrial arrhythmia ranged from 23% to 43% across procedure categories.

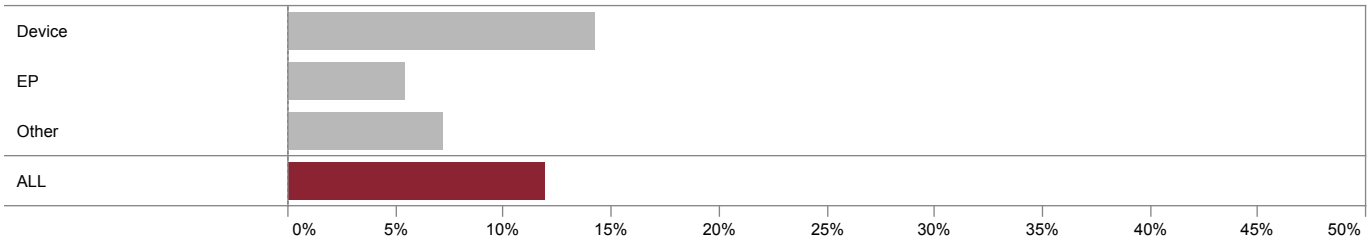


Excludes missing data (29%)

Figure 21: Proportion of cases by atrial arrhythmia status and case category

6.8 Heart failure

Overall, 12% of patients had a classification of heart failure at the time of case, ranging from 14% for device procedures to 5% in the electrophysiology category.

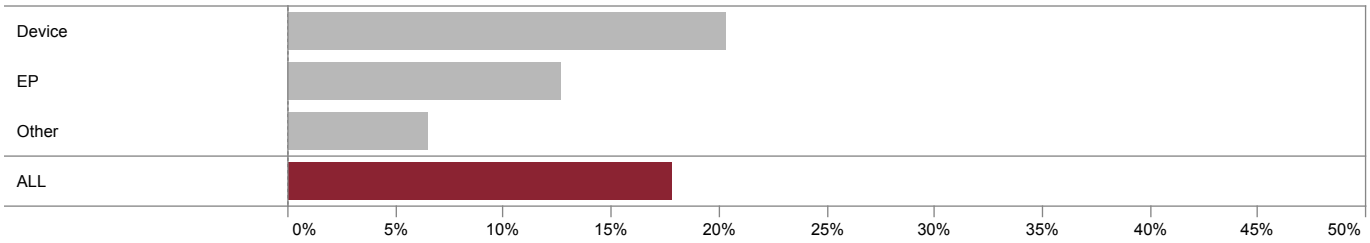


Excludes missing data (33%)

Figure 22: Proportion of cases by heart failure status and case category

6.9 Valvular heart disease

Valvular heart disease was documented for 18% of patients, ranging from 20% for device procedures to 13% in the electrophysiology category.

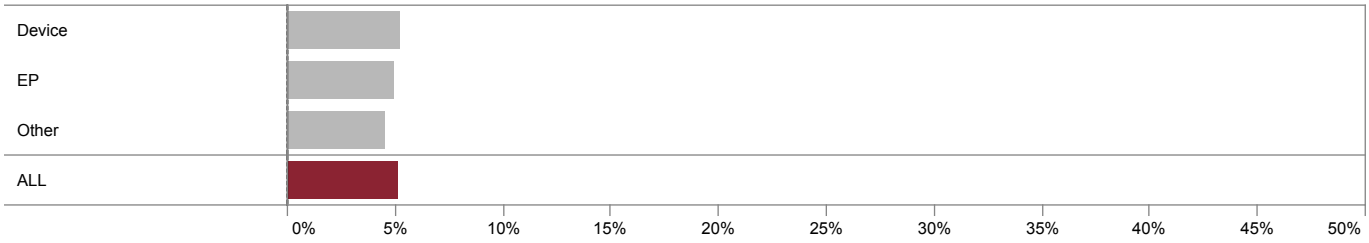


Excludes missing data (33%)

Figure 23: Proportion of cases by valvular heart disease and case category

6.10 Other cardiovascular disease and co-morbidities

Overall, 5% of patients had a form of other cardiovascular disease or co-morbidity at the time of case, with an even distribution across case categories.

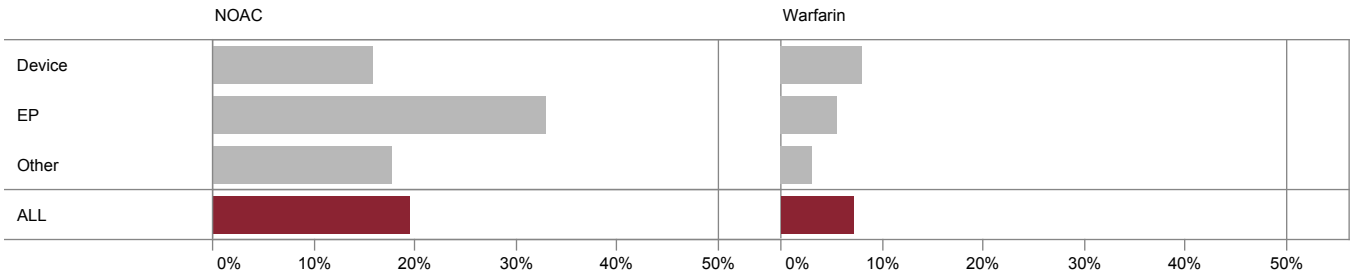


Excludes missing data (37%)

Figure 24: Proportion of cases by CV disease history and co-morbidity and case category

6.11 Anticoagulation

Patients were identified as being on anticoagulant therapy including either Warfarin or non-vitamin K antagonist oral anticoagulants (NOAC) at the time of case. Anticoagulated patients comprised 27% of the total cohort with patients in the electrophysiology category having the highest use of anticoagulants (39%).



Excludes missing data (39%)

Figure 25: Proportion of cases by anticoagulation status and case category

7 Care and treatment of patients

7.1 Urgency category

Urgency categories are based on the timeframe which the procedure is clinically indicated. Categorisation is judged by the individual treating clinician.

Across the state, category one cases formed the majority of procedures undertaken. Urgency category ranged widely between sites with category one cases varying from 28% to 90%. Further disparity was noted within category three, with these cases accounting for 1% to 37% of case volumes by site.

Table 6: Proportion of all cases by urgency category and site

	Total cases n	Category 1* n (%)	Category 2† n (%)	Category 3‡ n (%)
CH	266	217 (81.6)	37 (13.9)	7 (2.6)
TTH	464	246 (53.0)	51 (11.0)	13 (2.8)
MBH	96	59 (61.5)	34 (35.4)	2 (2.1)
SCUH	518	143 (27.6)	195 (37.6)	136 (26.3)
TPCH	1,155	791 (68.5)	254 (22.0)	110 (9.5)
RBWH	535	229 (42.8)	107 (20.0)	199 (37.2)
PAH	891	443 (49.7)	263 (29.5)	184 (20.7)
GCUH	549	496 (90.3)	45 (8.2)	5 (0.9)
STATEWIDE	**4,474**	**2,624 (58.6)**	**986 (22.0)**	**656 (14.7)**

Includes missing data 4.7%

Case totals do not reflect all 2018 activity for GCUH

* Procedures that are clinically indicated within 30 days

† Procedures that are clinically indicated within 90 days

‡ Procedures that are clinically indicated within 365 days

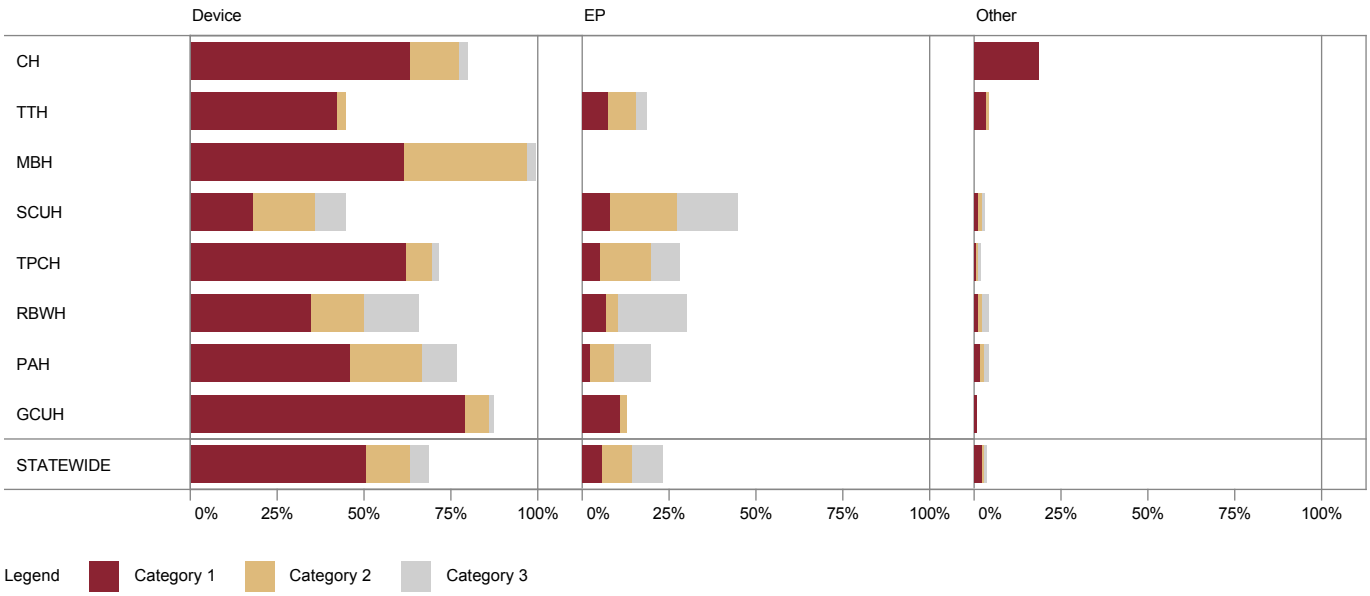


Figure 26: Proportion of all cases by urgency category, procedure category and site

7.2 Admission source

The majority of all cases were performed on patients classed as outpatients (54%). Non-admitted inter-hospital transfers accounted for less than 1% of all case volume

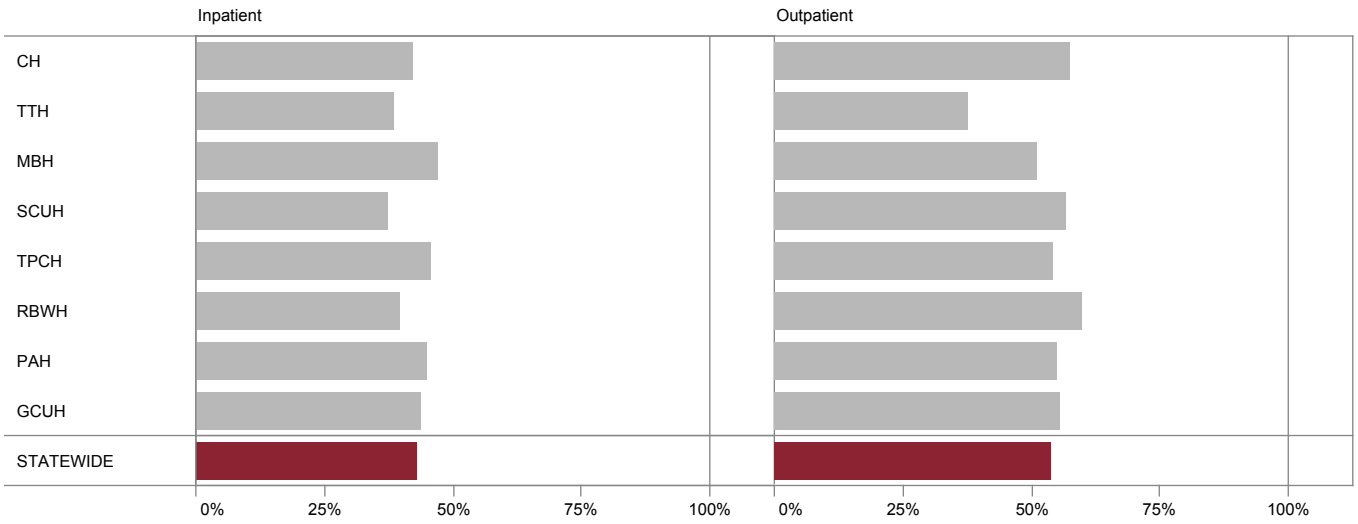


Figure 27: Admission source by site

Table 7: Admission source by site

	Total cases n*	Inpatient n (%)	Outpatient n (%)	Non-admitted inter-hospital transfer n (%)
CH	266	112 (42.1)	153 (57.5)	–
TTH	464	179 (38.6)	175 (37.7)	–
MBH	96	45 (46.9)	49 (51.0)	2 (2.1)
SCUH	518	192 (37.1)	293 (56.6)	–
TPCH	1,155	530 (45.9)	624 (54.0)	1 (0.1)
RBWH	535	213 (39.8)	321 (60.0)	1 (0.2)
PAH	891	402 (45.1)	489 (54.9)	–
GCUH	549	239 (43.5)	305 (55.6)	5 (0.9)
STATEWIDE	**4,474**	**1,912 (42.7)**	**2,409 (53.8)**	**9 (0.2)**

* Includes missing data 3.2%

Case totals do not reflect all 2018 activity for GCUH

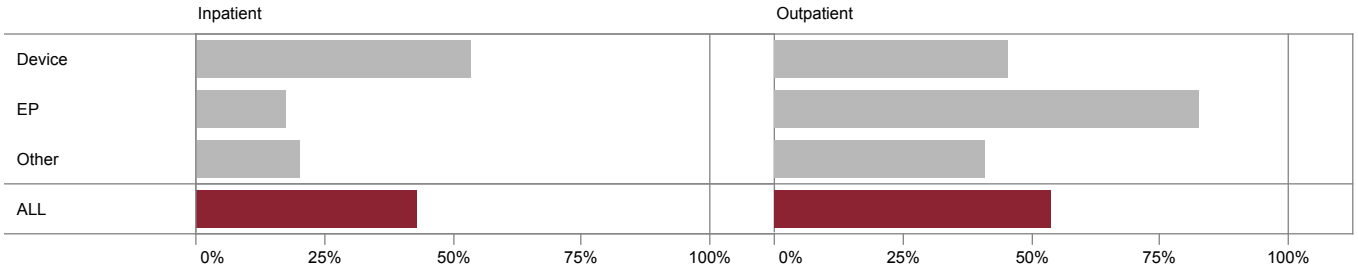


Figure 28: Admission source by case category

7.3 Admission source and urgency category

Category one procedures accounted for the highest proportion of inpatient and outpatient cases. There was a marked increase in proportions for inpatient procedures with category one cases accounting for over three-quarters of cases (86%). Outpatient procedures demonstrated more even distribution across the three categories.

Table 8: Outpatient cases by urgency category

Outpatient site	Total cases n*	Category 1 n (%)	Category 2 n (%)	Category 3 n (%)
CH	153	109 (71.2)	32 (20.9)	7 (4.6)
TTH	175	103 (58.9)	40 (22.9)	13 (7.4)
MBH	49	15 (30.6)	32 (65.3)	2 (4.1)
SCUH	293	42 (14.3)	113 (38.6)	128 (43.7)
TPCH	624	290 (46.5)	229 (36.7)	105 (16.8)
RBWH	321	32 (10.0)	96 (29.9)	193 (60.1)
PAH	489	114 (23.3)	225 (46.0)	150 (30.7)
GCUH	305	263 (86.2)	36 (11.8)	4 (1.3)
STATEWIDE	**2,409**	**968 (40.2)**	**803 (33.3)**	**602 (25.0)**

* Includes 1.5% missing data

Case totals do not reflect all 2018 activity for GCUH

Table 9: Inpatient cases by urgency category

Inpatient site	Total cases n*	Category 1 n (%)	Category 2 n (%)	Category 3 n (%)
CH	112	108 (96.4)	4 (3.6)	–
TTH	179	143 (79.9)	10 (5.6)	–
MBH	45	42 (93.3)	2 (4.4)	–
SCUH	192	100 (52.1)	66 (34.4)	8 (4.2)
TPCH	530	501 (94.5)	25 (4.7)	4 (0.8)
RBWH	213	196 (92.0)	11 (5.2)	6 (2.8)
PAH	402	329 (81.8)	38 (9.5)	34 (8.5)
GCUH	239	228 (95.4)	9 (3.8)	1 (0.4)
STATEWIDE	**1,912**	**1,647 (86.1)**	**165 (8.6)**	**53 (2.8)**

Case totals do not reflect all 2018 activity for GCUH

7.4 Device procedures

Case types and procedure combinations varied across the state and is driven primarily by services offered at individual sites. Single and dual chamber pacemaker implants/generator changes accounted for the majority of cases across the state. There were 7 sites across the state offering biventricular pacemaker (BiV)/ implantable cardioverter defibrillator insertion with three sites providing leadless pacemaker implants.

Table 10: Cardiac device case types by site

Site	Procedure type	Case n (%)
CH	Pacemaker implant/generator change	121 (56.8)
	Loop recorder implant/explant	59 (27.7)
	ICD implant/generator change/upgrade	18 (8.5)
	Lead revision/replacement/pocket revision	5 (2.3)
	BiV ICD implant/generator change/upgrade	4 (1.9)
	BiV pacemaker implant/generator change/upgrade	4 (1.9)
	Device explant	1 (0.5)
	Insertion of epicardial lead	1 (0.5)
TTH	Pacemaker implant/generator change	99 (44.4)
	ICD implant/generator change/upgrade	49 (22.0)
	BiV ICD implant/generator change/upgrade	38 (17.0)
	Loop recorder implant/explant	16 (7.2)
	Lead revision/replacement/pocket revision	10 (4.5)
	BiV pacemaker implant/generator change/upgrade	6 (2.7)
	Device explant	4 (1.8)
	Temporary pacing system	1 (0.4)
MBH	Pacemaker implant/generator change	51 (53.7)
	Loop recorder implant/explant	30 (31.6)
	Temporary pacing system	12 (12.6)
	ICD implant/generator change/upgrade	2 (2.1)
SCUH	Pacemaker implant/generator change	183 (66.8)
	ICD implant/generator change/upgrade	38 (13.9)
	Loop recorder implant/explant	22(8.0)
	BiV pacemaker implant/generator change/upgrade	13 (4.7)
	BiV ICD implant/generator change/upgrade	10 (3.6)
	Lead revision/replacement/pocket revision	5 (1.8)
	Device explant	2 (0.7)
	Temporary pacing system	1 (0.4)
TPCH	Pacemaker implant/generator change	374 (45.6)
	ICD implant/generator change/upgrade	160 (19.5)
	Device explant	76 (9.3)
	BiV ICD implant/generator change/upgrade	72 (8.8)
	Loop recorder implant/explant	60 (7.3)
	BiV pacemaker implant/generator change/upgrade	29 (3.5)
	Lead revision/replacement/pocket revision	25 (3.0)
	Leadless pacemaker implant	12 (1.5)
	Temporary pacing system	10 (1.2)
	Defibrillation threshold testing	2 (0.2)
	Insertion of epicardial lead	1 (0.1)
RBWH	Pacemaker implant/generator change	135 (38.4)
	Loop recorder implant/explant	93 (26.4)
	ICD implant/generator change/upgrade	62 (17.6)
	BiV ICD implant/generator change/upgrade	24 (6.8)
	BiV pacemaker implant/generator change/upgrade	23 (6.5)
	Lead revision/replacement/pocket revision	11 (3.1)
	Temporary pacing system	2 (0.6)
	Device explant	1 (0.3)
	Insertion of epicardial lead	1 (0.3)

PAH	Pacemaker implant/generator change	445 (65.4)
	ICD implant/generator change/upgrade	113 (16.6)
	Loop recorder implant/explant	44 (6.5)
	BiV ICD implant/generator change/upgrade	31 (4.6)
	Lead revision/replacement/pocket revision	14 (2.1)
	BiV pacemaker implant/generator change/upgrade	10 (1.5)
	Temporary pacing system	8 (1.2)
	Leadless pacemaker implant	6 (0.9)
	Device explant	5 (0.7)
	Defibrillation threshold testing	4 (0.6)
GCUH	Pacemaker implant/generator change	287 (60.0)
	ICD implant/generator change/upgrade	94 (19.7)
	Loop recorder implant/explant	38 (7.9)
	Lead revision/replacement/pocket revision	29 (6.1)
	BiV ICD implant/generator change/upgrade	13 (2.7)
	Device explant	6 (1.3)
	BiV pacemaker implant/generator change/upgrade	4 (0.8)
	Leadless pacemaker implant	3 (0.6)
	Defibrillation threshold testing	2 (0.4)
	Insertion of epicardial lead	1 (0.2)
	Temporary pacing system	1 (0.2)
STATEWIDE		**3,136**

Case totals do not reflect all 2018 activity for GCUH

7.5 Electrophysiology studies/ablations

Electrophysiology studies including radiofrequency ablation were the most common individual procedure performed across all sites, ranging from 60% of case volume at TTH to 83% at PAH.

Table 11: Electrophysiology study/ablation types by site

Site	Procedure type	Case n (%)
TTH	Radiofrequency ablation	62 (59.6)
	Cryotherapy ablation	22 (21.2)
	Electrophysiology study	19 (18.3)
	Radiofrequency and cryotherapy ablation	1 (‹1.0)
SCUH	Radiofrequency ablation	141 (60.5)
	Cryotherapy ablation	48 (20.6)
	Electrophysiology study	42 (18.0)
	Electrophysiology study with drug challenge	2 (0.9)
TPCH	Radiofrequency ablation	228 (67.9)
	Electrophysiology study	66 (19.6)
	Cryotherapy ablation	35 (10.4)
	Electrophysiology study with drug challenge	4 (1.2)
	Radiofrequency and cryotherapy ablation	3 (0.9)
RBWH	Radiofrequency ablation	103 (61.7)
	Electrophysiology study	47 (28.1)
	Cryotherapy ablation	8 (4.8)
	Radiofrequency and cryotherapy ablation	8 (4.8)
	Electrophysiology study with drug challenge	1 (0.6)
PAH	Radiofrequency ablation	147 (83.1)
	Electrophysiology study	24 (13.6)
	Cryotherapy ablation	6 (3.4)
GCUH	Radiofrequency ablation	54 (76.1)
	Electrophysiology study	17 (23.9)
STATEWIDE		**1,088**

Case totals do not reflect all 2018 activity for GCUH

7.5.1 Standard vs complex electrophysiology

Complex electrophysiology cases involving three-dimensional mapping technology, ventricular arrhythmias or pulmonary vein isolation accounted for 52% of all electrophysiology cases.

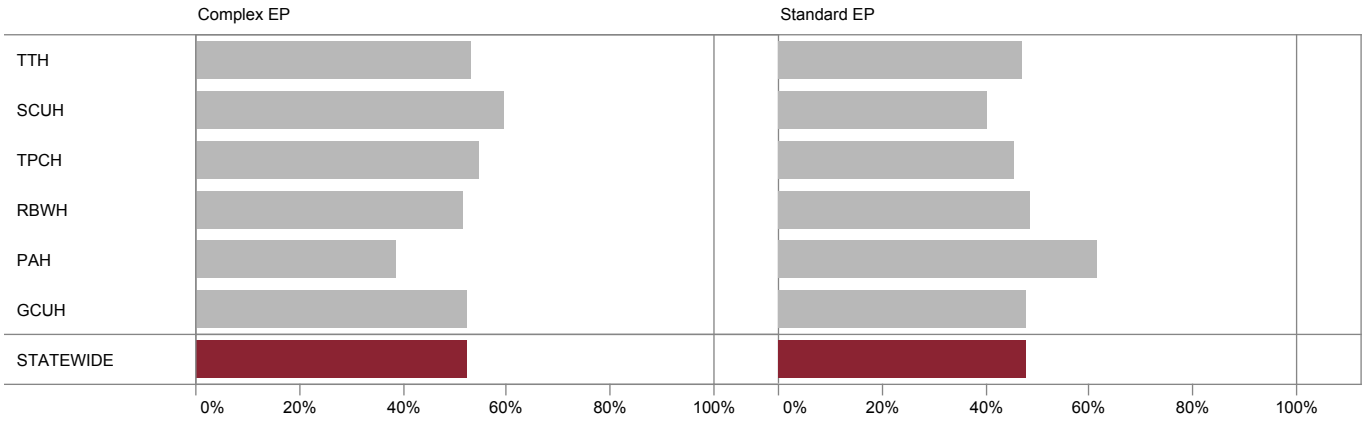


Figure 29: Complexity of electrophysiology procedures by site

Table 12: Proportion of standard and complex electrophysiology procedures by site

Site	Procedure type	Total n	Complex EP n	Standard EP n
TTH	Radiofrequency ablation	62	28	34
	Cryotherapy ablation	22	22	–
	Electrophysiology study	19	4	15
	Radiofrequency and cryotherapy ablation	1	1	–
SCUH	Radiofrequency ablation	141	74	67
	Cryotherapy ablation	48	45	3
	Electrophysiology study	42	19	23
	Electrophysiology study with drug challenge	2	1	1
TPCH	Radiofrequency ablation	228	117	111
	Electrophysiology study	66	27	39
	Cryotherapy ablation	35	35	–
	Electrophysiology study with drug challenge	4	1	3
	Radiofrequency and cryotherapy ablation	3	3	–
RBWH	Radiofrequency ablation	103	63	40
	Electrophysiology study	47	14	33
	Cryotherapy ablation	8	6	2
	Radiofrequency and cryotherapy ablation	8	3	5
	Electrophysiology study with drug challenge	1	–	1
PAH	Radiofrequency ablation	147	64	83
	Electrophysiology study	24	4	20
	Cryotherapy ablation	6	–	6
GCUH	Radiofrequency ablation	54	33	21
	Electrophysiology study	17	4	13
STATEWIDE		**1,088**	**568**	**520**

Case totals do not reflect all 2018 activity for GCUH

7.5.2 Three-dimensional mapping system

The total proportion of electrophysiology cases utilising three-dimensional mapping systems across sites, and distribution across vendors is shown in Table 13. Two vendors accounted for 85% of all three-dimensional mapping systems used.

Table 13: Three dimensional mapping system type by site

	Total cases n	CARTO n (%)	ESI n (%)	Rhythmia n (%)	ESI + Rhythmia n (%)	Other n (%)
TTH	29	7 (24.1)	22 (75.9)	–	–	–
SCUH	81	–	35 (43.2)	44 (54.3)	–	2 (2.5)
TPCH	131	41 (31.3)	78 (59.5)	11 (8.4)	1 (0.8)	–
RBWH	77	7 (9.1)	65 (84.4)	–	–	5 (6.5)
PAH	57	32 (56.1)	25 (43.9)	–	–	–
GCUH	32	21 (65.6)	11 (34.4)	–	–	–
STATEWIDE	**407**	**108 (26.5)**	**236 (58.0)**	**55 (13.5)**	**1 (0.2)**	**7 (1.7)**

Case totals do not reflect all 2018 activity for GCUH

7.6 Ablation type

Radiofrequency ablation is the principal method across all sites with 85% of all cases utilising this energy. There was variation in the proportionate use between sites with some more likely to use multiple types which is possibly a function of equipment availability. A small proportion of cases (1%) utilised two energy types.

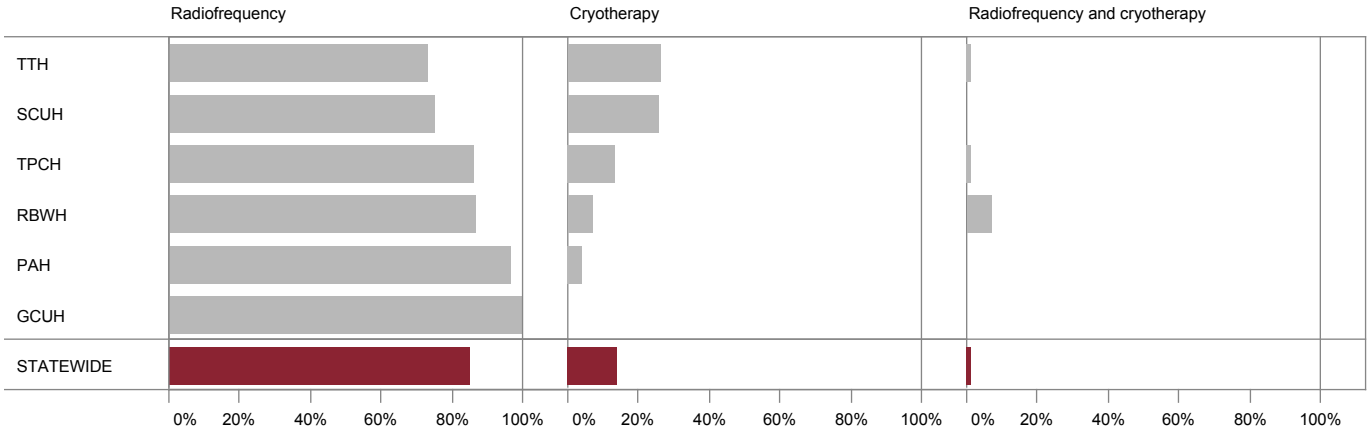


Figure 30: Ablation type by site

Table 14: Ablation type by site

	Total cases n	Radiofrequency n (%)	Cryotherapy n (%)	Radiofrequency + Cryotherapy n (%)
TTH	85	62 (72.9)	22 (25.9)	1 (1.2)
SCUH	189	141(74.6)	48 (25.4)	–
TPCH	265	227 (85.7)	35 (13.2)	3 (1.1)
RBWH	119	103 (86.6)	8 (6.7)	8 (6.7)
PAH	153	147 (96.1)	6 (3.9)	–
GCUH	54	54 (100.0)	–	–
STATEWIDE	**865**	**734 (84.9)**	**119 (13.8)**	**12 (1.3)**

Case totals do not reflect all 2018 activity for GCUH

7.6.1 Ablation type/arrhythmia

The most frequently ablated clinical arrhythmia was atrial fibrillation (pulmonary vein isolation), which accounted for 34% of ablations across all sites. This was followed by atrial flutter (21%) and atrioventricular nodal re-entry tachycardias (AVNRT) (20%).

Age and gender varied depending on the arrythmia ablated. Patients undergoing accessory pathway ablation had a lower median age than those who underwent pulmonary vein isolation or AV node ablation. These details are further expanded in Table 15.

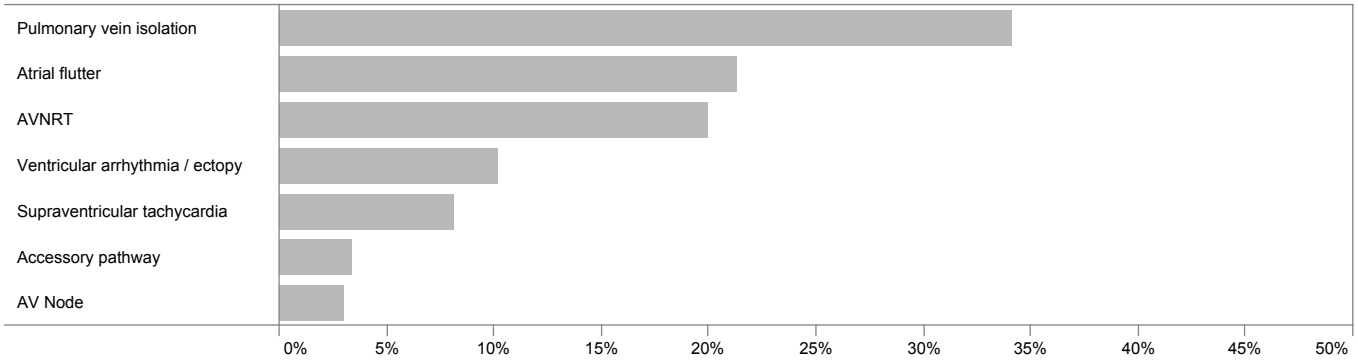


Figure 31: Proportion of arrhythmias ablated

Table 15: Median age and gender by ablation type

Ablation type	Gender	Total cases n (%)	Median age years
Pulmonary vein isolation	Male	189 (64.1)	58
	Female	106 (35.9)	62
Atrial flutter	Male	138 (75.0)	65
	Female	46 (25.0)	62
AVNRT	Male	66 (38.2)	59
	Female	107 (61.8)	46
Ventricular arrhythmia/ectopy	Male	58 (65.9)	66
	Female	30 (34.1)	49
Supraventricular tachycardia	Male	28 (40.0)	44
	Female	42 (60.0)	44
Accessory pathway	Male	17 (58.6)	30
	Female	12 (41.4)	26
AV node	Male	13 (50.0)	78
	Female	13 (50.0)	76
ALL		**865 (100.0)**	**59**

Table 16: Arrhythmia type by site

Site	Ablation type	Count n (%)
TTH	Pulmonary vein isolation	25 (29.4)
	AVNRT	20 (23.5)
	Atrial flutter	18 (21.2)
	Ventricular arrhythmia/ectopy	9 (10.6)
	Accessory pathway	6 (7.1)
	Supraventricular tachycardia	5 (5.9)
	AV node	2 (2.4)
SCUH	Pulmonary vein isolation	93 (49.2)
	Atrial flutter	57 (30.2)
	AVNRT	16 (8.5)
	AV node	9 (4.8)
	Ventricular arrhythmia/ectopy	6 (3.2)
	Supraventricular tachycardia	6 (3.2)
	Accessory pathway	2 (1.1)
TPCH	Pulmonary vein isolation	79 (29.8)
	AVNRT	53 (20.0)
	Atrial flutter	45 (17.0)
	Ventricular arrhythmia/ectopy	45 (17.0)
	Supraventricular tachycardia	29 (10.9)
	Accessory pathway	8 (3.0)
	AV node	6 (2.3)
RBWH	Pulmonary vein isolation	33 (27.7)
	AVNRT	33 (27.7)
	Atrial flutter	26 (21.8)
	Supraventricular tachycardia	11 (9.2)
	Ventricular arrhythmia/ectopy	10 (8.4)
	Accessory pathway	5 (4.2)
	AV node	1 (0.8)
PAH	Pulmonary vein isolation	48 (31.4)
	AVNRT	47 (30.7)
	Atrial flutter	25 (16.3)
	Supraventricular tachycardia	12 (7.8)
	Ventricular arrhythmia/ectopy	9 (16.7)
	Accessory pathway	7 (4.6)
	AV node	5 (3.3)
GCUH	Pulmonary vein isolation	17 (31.5)
	Atrial flutter	13 (24.1)
	Ventricular arrhythmia/ectopy	9 (16.7)
	Supraventricular tachycardia	7 (13.0)
	AVNRT	4 (7.4)
	AV node	3 (5.6)
	Accessory pathway	1 (1.9)
STATEWIDE		**865**

Case totals do not reflect all 2018 activity for GCUH

7.7 Other procedures

The most common forms of other procedure were cardioversions (72%). Variations in clinical practice across sites can be observed here, with not all cardioversions performed being carried out in the electrophysiology laboratory environment or documented using the QCOR application.

Table 17: Other procedures

	Total n	Cardioversion n (%)	Drug challenge n (%)	Other n (%)
CH	53	45 (84.9)	2 (3.8)	6 (11.3)
TTH	138	118 (85.5)	5 (2.9)	15 (10.9)
MBH	1	–	–	1 (100.0)
SCUH	12	–	10 (83.3)	2 (16.7)
TPCH	12	2 (16.7)	–	10 (83.3)
RBWH	22	1 (4.5)	13 (59.1)	8 (36.4)
PAH	37	33 (89.2)	1 (2.7)	3 (8.1)
GCUH	2	1 (50.0)	–	1 (50.0)
STATEWIDE	**277**	**200 (72.2)**	**31 (11.2)**	**46 (16.6)**

Case totals do not reflect all activity due to incomplete year of data acquisition

8 Procedural complications

Lead complications were the most frequently encountered complication for device procedures and pericardial effusions were the most commonly observed complication across electrophysiology procedures. The summary of complications below denotes events observed during the procedure as well as post. The QCOR electrophysiology application is predominantly utilised for procedural detail reporting, and as such documentation of procedural complications is the responsibility of site practitioners.

The complication rates for procedures in Tables 18 and 19 are reflected as the proportion of the total number of device and electrophysiology procedures respectively. On some rare occasions, the development of an intraprocedural complication such as coronary sinus dissection necessitated a change of procedure type from BiV implant/upgrade to a non-BiV device procedure. In these instances, complications are reported against the final procedure type.

The overall device procedure complication rate was 2.9%, while electrophysiology procedures had a 3.2% complication rate.

Table 18: Cardiac device procedure complications

Procedure type	Complication	Total n (%)
Pacemaker implant/generator change	Lead complication	14 (0.5)
	Other	11 (0.4)
	Pneumothorax	7 (0.2)
	Pericardial effusion with or without tamponade	5 (0.2)
	Haematoma	4 (0.1)
	Infection	4 (0.1)
	Cardiac arrest	2 (<0.1)
Loop recorder implant/explant	Device migration/erosion	2 (<0.1)
	Drug reaction	2 (<0.1)
	Other	1 (<0.1)
ICD implant/generator change/upgrade	Lead complication	3 (0.1)
	Other	3 (0.1)
	Bleeding	2 (<0.1)
	Haematoma	2 (<0.1)
	Infection	2 (<0.1)
	Cardiac arrest	1 (<0.1)
	Drug reaction	1 (<0.1)
	Pneumothorax	1 (<0.1)
BiV ICD implant/generator change/upgrade	Lead dislodgement	3 (0.1)
	Conduction block	2 (<0.1)
	Coronary sinus dissection	2 (<0.1)
	Pericardial effusion without tamponade	2 (<0.1)
	Bleeding	1 (<0.1)
BiV pacemaker implant/generator change/upgrade	Coronary sinus dissection	3 (0.1)
	Coronary sinus perforation	1 (<0.1)
	Lead complication	1 (<0.1)
	Pericardial effusion without tamponade	1 (<0.1)
Device explant	Lead complication	1 (<0.1)
Lead revision/replacement/pocket revision	Lead complication	5 (0.2)
	Pericardial effusion with tamponade	1 (<0.1)
	Pneumothorax	1 (<0.1)
	Vascular injury	1 (<0.1)
ALL		**90 (2.9)**

Table 19: Electrophysiology procedure complications by study type and complexity

Procedure type	Complexity	Complication	Total n (%)
Electrophysiology study	Complex EP	Conduction block	1 (<0.1)
		Pericardial effusion with tamponade	1 (<0.1)
Cryotherapy ablation	Standard EP	Arrhythmia returned	2 (0.2)
		Conduction block	1 (<0.1)
	Complex EP	Pericardial effusion with tamponade	1 (<0.1)
		Phrenic nerve injury	1 (<0.1)
Radiofrequency ablation	Standard EP	Conduction block	2 (0.2)
		Atrial arrhythmia requiring DCCV	1 (<0.1)
		Ventricular arrhythmia	1 (<0.1)
	Complex EP	Pericardial effusion with tamponade	8 (0.8)
		Arrhythmia returned	7 (0.7)
		Pericardial effusion	3 (0.3)
		Infection	2 (0.2)
		Other	2 (0.2)
		Bleeding	1 (<0.1)
ALL			**34 (3.2)**

9 Clinical indicators

Clinical indicators are important measures of the clinical management and outcomes of patient care. An indicator that is clinically relevant and useful should highlight specific issues that may require attention or signal areas for improvement. Usually rate-based, indicators identify the rate of occurrence of an event. There is emerging recognition that a capacity to evaluate and report on quality is a critical building block for system-wide improvement of healthcare delivery and patient outcomes.

The quality and safety indicators which have been nominated by the statewide electrophysiology working group are outlined in Table 20.

Table 20: Electrophysiology and pacing clinical indicators

Clinical indicator	Description
1	Waiting time from booking date to procedure by case category
2	Procedural tamponade rates
3	Reintervention within one year of procedure date due to cardiac device lead dislodgement
4	Rehospitalisation within one year of procedure due to infection resulting in loss of the device
5	12 month all-cause mortality for cardiac device procedures

9.1 Waiting time from referral date to procedure by case category

Waiting times for clinical interventions and investigations are an important metric for monitoring service provision and identifying potential unmet need. This clinical indicator examines the waiting time for various cardiac device procedure types. Specifically, the median wait time from the date the procedure was referred to the case date. For the purpose of this indicator, procedures performed on patients classed as elective (procedures not performed as part of an acute admission) are examined.

The adverse consequences of treatment delay are well known and include deterioration in the condition for which treatment is awaited, the loss of utility from delay (especially if treatment can relieve significant disability), a rise in the costs of total treatment, accumulation of any loss of income from work and as an extreme outcome, death.

An important distinction exists between the waiting time of the patients booked for their procedure and those who are referred for specialist opinion and subsequent treatment. As this indicator examines the wait time from booking date to case date, it is reflective of system performance that is specifically focused on electrophysiology and pacing demand and need.

9.1.1 Elective pacemaker

Examination of the waiting time for elective pacemaker procedures is below. Of the 227 cases with complete data, the median wait time was 17 days.

Table 21: Elective pacemaker wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days
Statewide	349	227	17	1–34

9.1.2 Elective ICD wait time and proportion within 28 days

This analysis examines the waiting time for elective ICD procedures and the proportion adhering to the benchmark of 28 days or less.

Table 22: Elective ICD wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days	Met target %
Statewide	217	120	33	7–53	44

9.1.3 Standard ablation

Waiting times for standard ablation procedures are presented below. Of the 208 cases eligible for analysis, the median wait time was 91 days. One-quarter of patients had a wait time of 159 days or more.

Table 23: Elective standard ablation wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days
Statewide	297	208	91	47–159

9.1.4 Complex ablation (with proportion within 180 days or less)

Complex ablations are defined as cases using three-dimensional mapping technology or involving ventricular arrhythmia or pulmonary vein isolation. This indicator examines the waiting time for these procedures and the proportion adhering to the benchmark of 180 days or less. This indicator is reported at a site level and investigates those sites with >20 cases with data for analysis.

A median wait time of 81 days was observed with a large interquartile range demonstrating that there are a number of patients with considerably long waits.

Table 24: Elective complex ablation wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days	Met target %
TTH	27	0	N/A	N/A	N/A
SCUH	102	7	N/A	N/A	N/A
TPCH	144	140	127	55–233	64
RBWH	67	67	28	18–43	99
PAH	43	42	121	50–354	60
GCUH	28	1	N/A	N/A	N/A
STATEWIDE	**411**	**225**	**81**	**35–193**	**73**

N/A: Not displayed due to <20 cases available for analysis

9.2 Procedural tamponade rates

Cardiac tamponade is a known complication of cardiac device and electrophysiology procedures. This indicator examines the rate of procedural pericardial tamponade. As pericardial tamponade is a clinical diagnosis, this indicator explicitly reports those patients with this specific diagnosis and does not include those patients with the diagnosis or finding of pericardial effusion.

Table 25: Procedural tamponade analysis

Procedure category	Total cases analysed n	Procedural tamponade observed n	Procedural tamponade rate %
Device	3,136	4	0.1
EP	1,061	10	0.9
ALL	**4,197**	**14**	**0.3**

9.3 Reintervention within one year of procedure date due to cardiac device lead dislodgement

This indicator identifies the number of cases where lead dislodgement was observed within one year of lead insertion. The cases included in this indicator were all new device implants or upgrades where a new lead/s had been implanted and a lead revision or replacement was subsequently required due to dislodgement. Index implant procedures were cases performed within Queensland Health implanting facilities in the 2017 calendar year.

The analysis showed 26 cases (1.8%) where reintervention was required within 12 months of the index procedure. Higher rates of reintervention were noted in the biventricular device category which may reflect the greater complexity of these systems.

Of these 26 cases, 9 atrial and 17 ventricular lead dislodgements were noted. Septal and apically positioned ventricular leads were the most commonly observed lead dislodgement sites (7 each) followed by right ventricular outflow tract (n=2) and His bundle sites (n=1).

These results compare favourably with international cohorts where observed dislodgement rates for pacemaker system implants vary from 1.0 to 2.7%[21].

Table 26: Reintervention due to lead dislodgement analysis

	Cases analysed n	Atrial lead n	Ventricular lead n	12 month lead dislodgement n	12 month lead dislodgement rate %
Pacemaker implant	968	8	11	19	2.0
ICD implant	301	1	2	3	1.0
Any BiV implant	155	0	4	4	2.6
All 2017 device cases	**1,424**	**9**	**17**	**26**	**1.8**

9.4 Rehospitalisation within one year of procedure due to infection resulting in loss of the device system

One of the most serious long-term complications related to mortality and morbidity for patients with cardiac implantable electronic devices is infection. Complete removal of all hardware is the recommended treatment for patients with established device infection because infection relapse rates due to retained hardware are high.

A 1.4% system loss rate was observed at 12 months which is reassuring when compared to international literature which suggests infection rates necessitating explant of approximately 2.4%[22].

Table 27: Rehospitalisation with device loss analysis

	Cases analysed n	12 month system loss due to infection n	12 month system loss rate %
2017 device cases	1,765	25	1.4

9.5 12 month all-cause mortality for cardiac device procedures

12 month all-cause mortality is examined for patients with cardiac devices procedures in 2017. It is important to note that patients undergoing these procedures are often of an advanced age, have advanced symptomatology (advanced heart failure in patients with biventricular pacing) and often have multiple comorbidities and risk factors.

Table 28: 12 month all-cause unadjusted mortality for cardiac device procedures

	Cases analysed n	12 month mortality observed n	12 month mortality rate %	Median age at procedure years	Interquartile range years
Any BiV procedure	189	12	6.3	71	63–77
ICD procedure	422	15	3.6	62	53–71
Pacemaker procedures	1,154	85	7.4	77	69–84
All 2017 device cases	**1,765**	**112**	**6.3**	**74**	**64–81**

10 Conclusions

The 2018 QCOR Annual Report has demonstrated significant advances in analysis of activity and outcomes in cardiac electrophysiology. Reference to QCOR data has improved the cost-effectiveness of procurement of cardiac electronic implantable devices. The savings realised thereby have permitted funding to be redirected to other areas of need. With continued clinical input and focus, QCOR data and reporting will be able to inform clinicians not only of performance and quality but also to provide unprecedented insight into service capacity and throughput. It is unusual for such insight to be available to clinicians beyond Queensland Health, nationally or internationally. Indeed, the detail and rigour of QCOR data exemplifies what is possible with an engaged clinical group.

It is mandatory that QCOR data, which is accurate and contextualised, should inform planning for sustained and appropriate growth of infrastructure and specialised workforce across the state. Enhancement of reporting of clinical quality indicators has highlighted further the unmet demand for cardiac ablation procedures, expressed most particularly as unacceptable wait times at TPCH and PAH. While the median statewide wait time in 2018 for complex ablation procedures was 81 days, the corresponding mean wait time for ablation for atrial fibrillation at PAH was 336 days, and 171 days for complex ablation at TPCH. This disparity speaks to issues of prioritisation for laboratory building and workforce recruitment now, but also underlines the need to mitigate, with vision guided by QCOR data, future increase of unmet need at newer sites. The nature of wait time data available from some sites beyond Brisbane remains heterogeneous, still requiring collation and interpretation to ensure consistency in measurement and presentation. It should be recognised that wait times recorded do not include outpatient waiting times for a patient to be assessed by (the too few) heart rhythm specialists. No measure of unmet need can account for the reluctance to refer patients for complex ablation by general practitioners and even colleague cardiologists who are aware of long, unsatisfactory wait times.

Trends in QCOR data support the premise that when plans are considered for building of an additional laboratory for coronary angiography/PCI, provision should be made for a cardiac electrophysiology laboratory to be built in tandem – this makes sense in terms of economy of scale for building and in view of ever-rising demand for EP-pacing services, itself partly consequent on the additional, invasive coronary activities. It is axiomatic that planning for infrastructure should proceed in parallel with planning for expansion of specialised workforce. These concepts are being examined by the Systems Planning Branch.

Clinical indicators highlight that only 44% of elective ICD procedures were undertaken within 30 days. This represents unsatisfactory delay which must be addressed. Issues of inadequate workforce and deficient laboratory infrastructure will have contributed. Procedural tamponade rates are satisfactory at 0.2%, while device lead dislodgments are likely under-reported. Device loss at 1 year due to infection is probably satisfactory at 1.2%, but there is no room for complacency here.

Where 12 month all-cause mortality after device procedure exceeded age-matched population background rates in 2018, it was noted that small number of deaths in younger patients were statistically insignificant, while data captured for elderly patients likely represented death in spite of, not because of, their procedures.

The QCOR initiatives have underscored the importance of quality data capture and the indispensable nature of clinical input to guide useful and relevant reporting. With further focus on data completeness and integrity, the power of the QCOR cardiac electrophysiology registry will continue to inform improvement of service provision and delivery of quality, timely clinical care for Queensland Health patients who have cardiac rhythm disorders. Such improvement necessitates immediate repair of infrastructure and workforce deficiencies to create a sustainable, adequate foundation from which to launch the exciting future of cardiac electrophysiology.

Cardiac Rehabilitation Audit

1 Message from the QCOR Cardiac Rehabilitation Committee Chair

It is my sincere pleasure to introduce the second QCOR Cardiac Rehabilitation Audit. This is the first annual report to document a full year of data collection for our statewide cardiac rehabilitation services. The previous audit reported just a 6 month period of data collection from July to December 2017, whereas this report documents a full calendar year of data collection through 2018. This will also be our first opportunity to compare data collection year to year. Also, while the 2017 report documented solely admission (preassessment) data, this 2018 report will present some limited post program data. This will be our first insight into the effectiveness of cardiac rehabilitation, at a local level and on a statewide scale.

Data collection has centred around the inclusion of service performance measures (timely referral, timely assessment) and patient clinical indicators (e.g. medications, risk factors, exercise tolerance, mental health) on both admission and completion of cardiac rehabilitation programs.

This report presents that a total of 11,723 patients were referred to one of the 53 cardiac rehabilitation sites accessible through Queensland Health in 2018. Of these, 95% of patients were referred to cardiac rehabilitation in a timely manner (within 3 days) and 62% were assessed within 28 days of referral. Analysis has highlighted the higher incidence of cardiovascular disease in the Aboriginal and Torres Strait Islander population through the increased rate of referral to cardiac rehabilitation. The median age of these patients is 10 years younger than that of non-Indigenous Queenslanders, further reflecting the impacts on this population group.

I would sincerely like to thank the hardworking nurses and allied health professionals responsible for the hours of data entry involved in collecting this information. This tool is the envy of many of our sister state departments of health. The QCOR Cardiac Rehabilitation tool is unique in that it is a point-of-care assessment tool and data collection device in one, with education capabilities built-in. I am very proud of the efforts of our cardiac rehabilitation clinicians, the committee responsible for overseeing the collection of this data and very thankful for the ongoing support of the SCCIU team.

Stephen Woodruffe
Chair
QCOR Cardiac Rehabilitation Committee

2 Key findings

This second QCOR Cardiac Rehabilitation (CR) Audit examines referrals to one of 55 participating public outpatient CR sites for 2018. Key findings include:

- A total of 11,723 referrals were made to public CR sites across Queensland.
- Approximately 77% of all referrals originated from an inpatient setting, while 14% of referrals originated from outside of Queensland Health.
- Male patients accounted for 70% of all referrals to CR.
- Approximately 15% of all referrals were for patients aged 65 years to 69 years of age.
- The median age of all patients was 66 years. There was considerable variation between Aboriginal and Torres Strait Islander patients (56 years) and non-Indigenous patients (66 years).
- The total proportion of Aboriginal and Torres Strait Islander patients was 6.3%. Large geographical variance was noted with North Queensland sites having a significantly higher proportion of Aboriginal and Torres Strait Islander patients.
- Overall, 65% of referrals had a pre assessment diagnosis of ischaemic heart disease.
- At pre assessment, 79% of patients were classed as being an unhealthy weight with 38% classed as overweight, 36% obese and 5% morbidly obese.
- Only 36% of patients were recorded as being sufficiently active at pre assessment.
- Completion of a timely referral (within 3 days of discharge from hospital) was achieved in 95% of cases.
- A timely overall journey occurred in 59% of cases (referred within 3 days of discharge and assessed by CR program within 28 days of discharge).
- In total, 40% of patients who completed a pre assessment continued CR to the completion of a post assessment.

3 Participating sites

In 2018, there were 60 public CR sites operated across 14 Hospital and Health Services (HHS) and one Queensland Health division (Health Support Queensland) located in rural and metropolitan Queensland. Of these, 55 participated in QCOR.

Table 1: Participating CR sites

Legend: ◉ Engaged and contributing ◍ Partially contributing (‹50% of referrals) ○ Not contributing

HHS/Organisation	CR program	Locations	2017	2018
Cairns and Hinterland	Cairns Outpatient CR Program	Cairns	◉	◉
	Cassowary Area CR	Innisfail, Tully	◉	◉
	Tablelands CR	Atherton, Mareeba	◉	◉
	Mossman CR and Prevention Program	Mossman	◉	◉
Central Queensland	Community Health CR	Gladstone	◉	◉
	Biloela CR Program	Biloela	◉	◉
	CR Outpatient Program	Rockhampton, Capricorn Coast	◉	◉
Central West	Longreach and Central West CR Program	Longreach	◉	◉
		Blackall*	-	◉
Darling Downs	Toowoomba Hospital Heart Care	Toowoomba	◉	◉
	Warwick CR Service	Warwick	◉	◉
	Chinchilla-Miles CR Service	Chinchilla, Miles	◉	◉
	Dalby-Tara CR Service	Dalby, Tara	◉	◉
	Kingaroy Hospital South Burnett CR	Kingaroy	◉	◉
	Goondiwindi CR	Goondiwindi	○	○
	Stanthorpe Health CR Program	Stanthorpe	○	○
Gold Coast	Gold Coast Heart Health Service	Robina	◉	◉
HSQ†	COACH Program	Health Contact Centre	◉	◉
Mackay	Mackay Heart Health Service	Mackay	◉	◉
	Mackay Rural District CR	Proserpine	◉	◍
		Bowen	○	○
Metro North	Complex Chronic Disease	Caboolture, Chermside, North Lakes, Redcliffe	◉	◉
Metro South	Bayside CR Program	Redland	◉	◉
	Brisbane South Heart Smart	Eight Mile Plains, Inala	◉	◉
	Logan-Beaudesert CR Service	Browns Plains	◉	◉
	PAH Heart Recovery Program	Princess Alexandra Hospital	◉	◉
North West	Mount Isa CR Program	Mount Isa	◉	◉
South West	South West CR Services	Charleville, Roma	◉	◉
		St George*	-	◉
Sunshine Coast	Cardiac Rehab	Caloundra, Gympie, Maroochydore, Nambour, Noosa	◉	◉
Townsville	Townsville CR Outpatient Program	Townsville	◉	◉
	Ingham CR Outpatient Program	Ingham	◉	◍
	Charters Towers Community Health CR	Charters Towers	○	◍
	Ayr Health Service	Ayr	○	○
	Hughenden CR Program	Hughenden	○	○
West Moreton	Ipswich and West Moreton CR	Ipswich, Boonah, Esk, Gatton, Laidley	◉	◉
Wide Bay	Fraser Coast CR	Hervey Bay, Maryborough	◉	◉
	Wide Bay Rural and Allied Health*	Biggenden, Eidsvold, Gayndah, Mundubbera	-	◉

* New CR service commencing in 2018

† Health Support Queensland

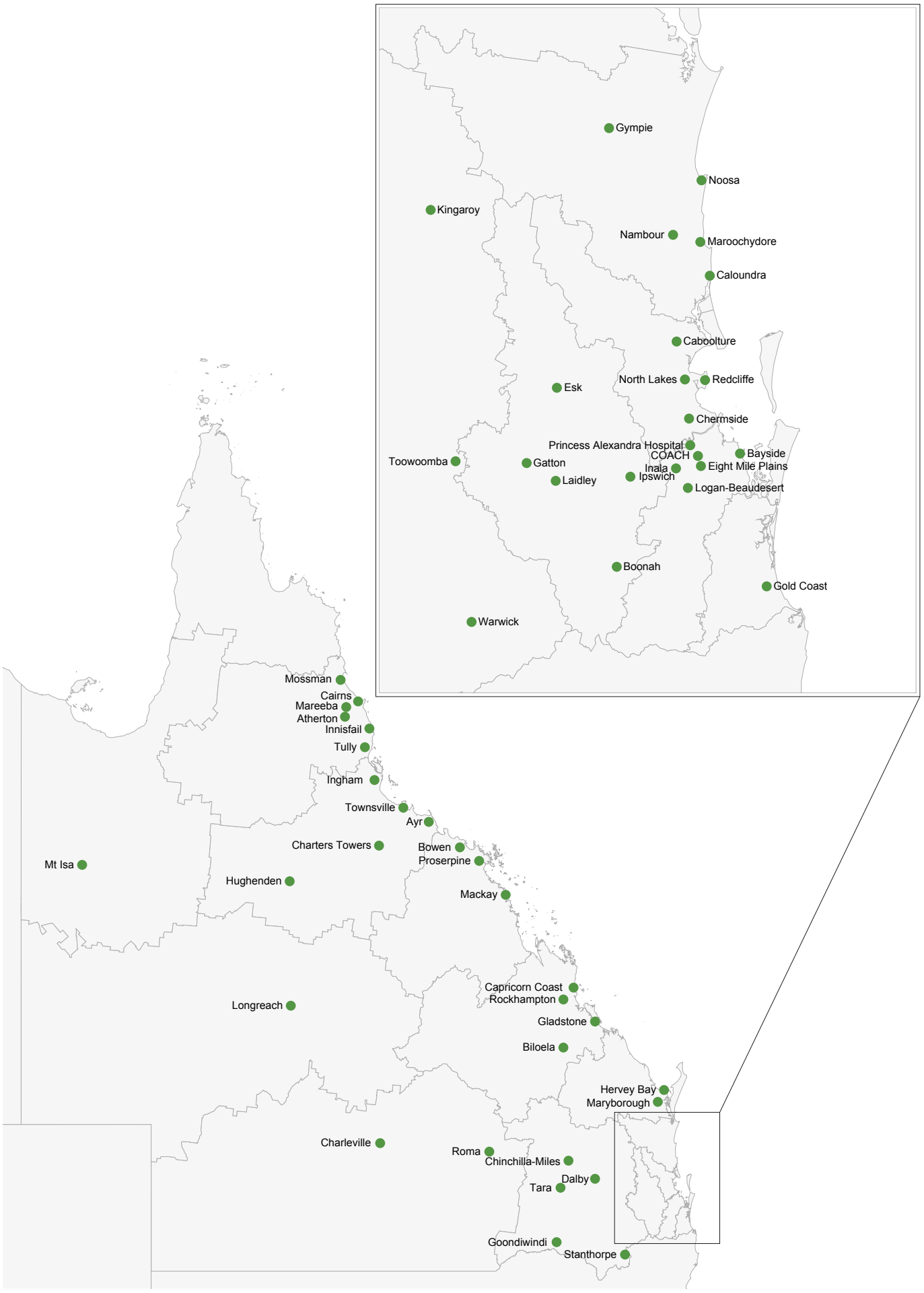


Figure 1: Map of Queensland public CR sites

4 Total referrals

4.1 Statewide

The volume of CR referrals entered into QCOR expanded through 2018 to include 11,723 new referrals for the year, bringing the overall total to over 18,000 referrals since the system was launched and CR data collection commenced in July 2017 (Figure 2).

The initial implementation of the QCOR CR module had a specific focus towards patients discharged from a public hospital. Referral patterns have continued to be consistent throughout the calendar year of 2018, with the majority of referrals (77%) originating from an inpatient setting.

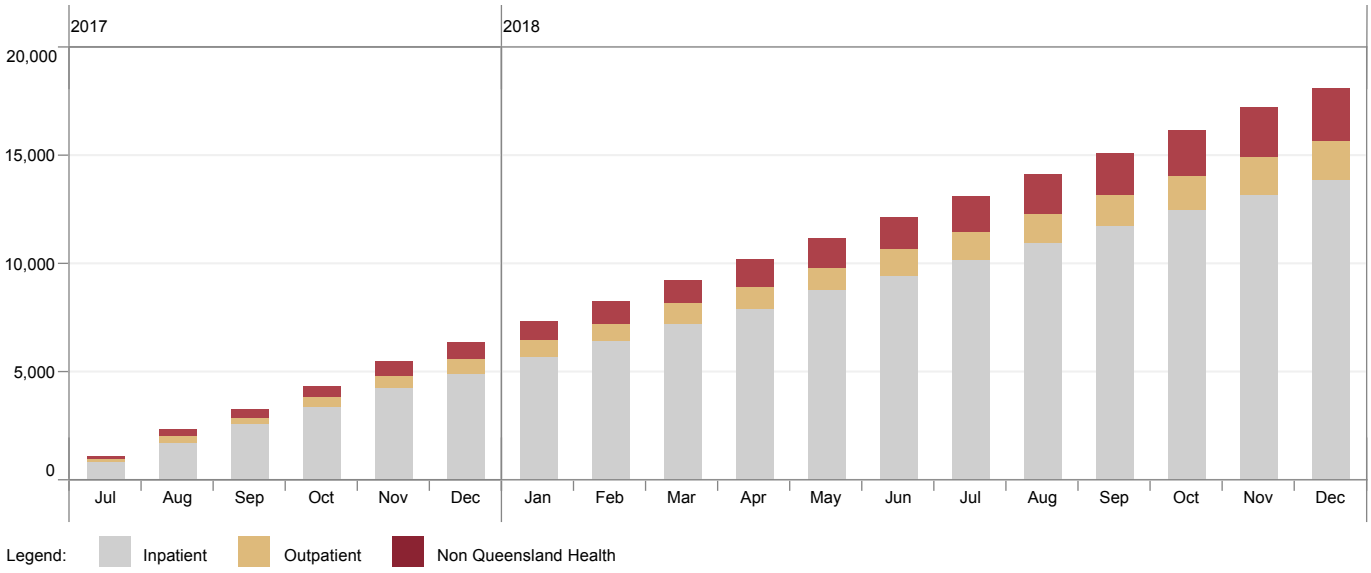


Figure 2: Cumulative total CR referrals by month, 2017–2018

Table 2: Total referrals by admission source, 2017–2018

Referral origin	2017 %	2018 %
Inpatient	78.0	76.5
Outpatient	9.6	10.0
Non Queensland Health	12.5	13.5

Patients were located across a wide geographical area with the majority residing in population centres along the eastern seaboard. Just under half (49%) of all patients were residing in major cities, and the remainder in regional and remote areas of Queensland. This reflects the decentralised distribution of the population within the state.

It is important to note that referrals for patients residing interstate or overseas are not generally accepted. The inclusion of these referrals is reflective of local site processes and may also vary based on available resources. While some sites leverage QCOR to maintain a record of overall referral volumes, others utilise different processes and as such may not represent all inpatient activity which does not lead to a referral to a Queensland public CR program.

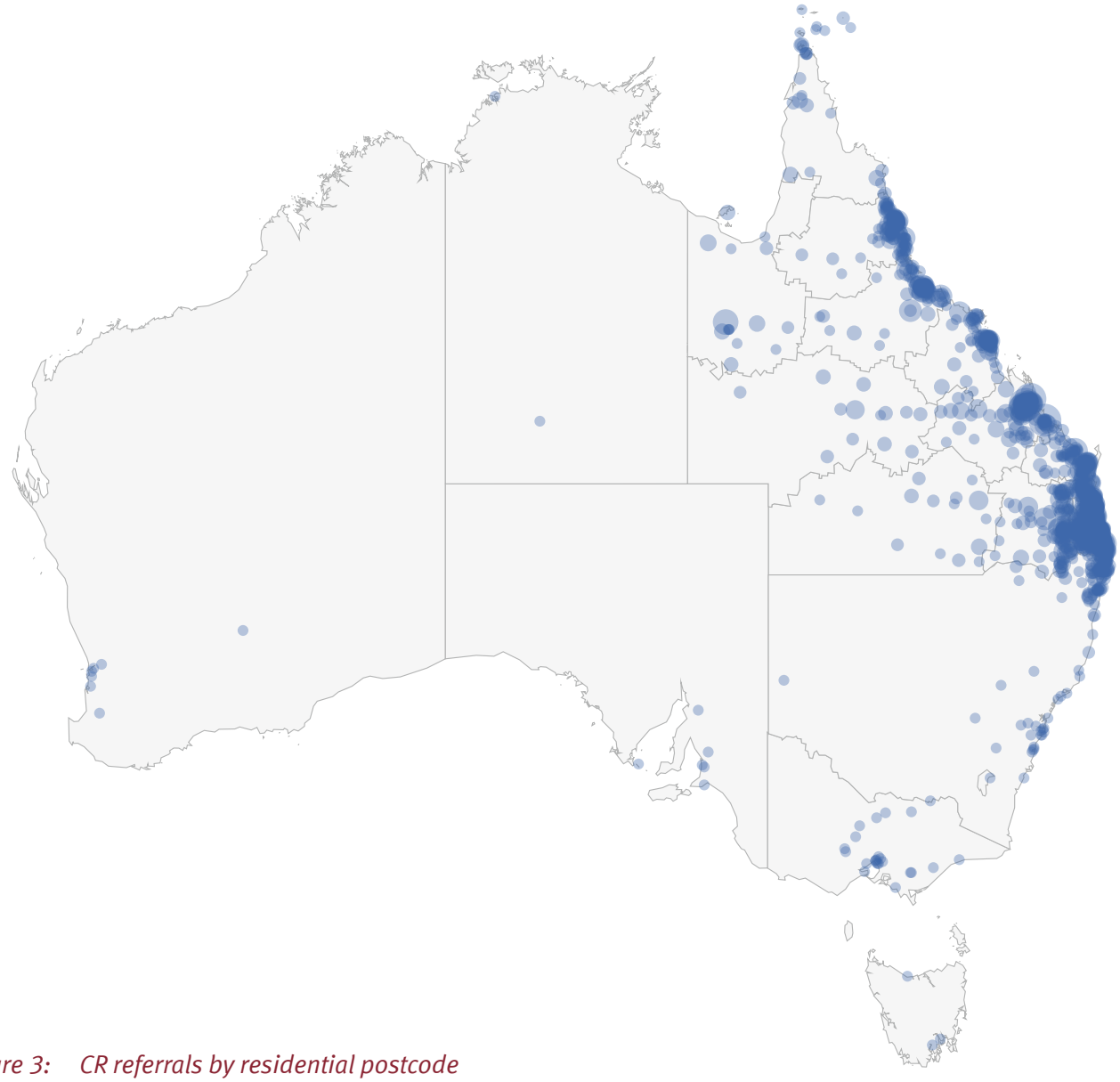


Figure 3: CR referrals by residential postcode

Table 3: CR referrals by remoteness classification

Remoteness classification*	%
Major Cities of Australia	49.3
Inner Regional Australia	30.4
Outer Regional Australia	16.8
Remote Australia	1.3
Very Remote Australia	2.2
ALL	**100.0**

* Classified by Accessibility and Remoteness Index of Australia

4.2 Origin of referrals

The majority of referrals (77%) originated from an inpatient setting, with smaller proportions of referrals flowing to CR from an outpatient setting (10%) and outside of Queensland Health (14%).

There were considerable variations across participating HHS in the proportion of referrals from external sources, which ranged from 1% to 31%. This indicates not all sites are entering details for patients referred from general practitioners, private hospitals or external specialists.

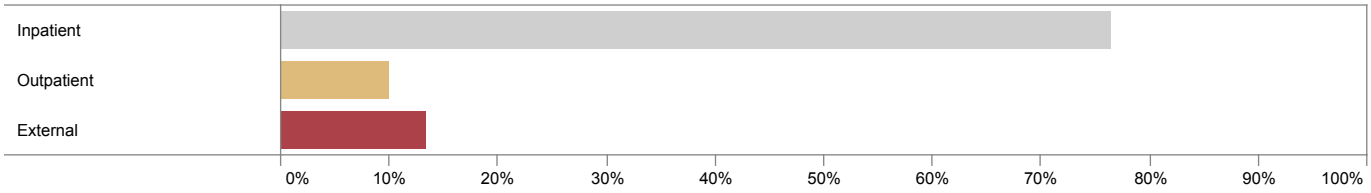


Figure 4: Proportion of referrals by referral source

Table 4: Referral sources by outpatient program HHS

HHS/division	Total referrals n	Inpatient* n (%)	Outpatient* n (%)	External n (%)
Cairns and Hinterland	725	598 (82.5)	53 (7.3)	74 (10.2)
Central Queensland	1,368	909 (66.4)	233 (17.0)	226 (16.5)
Central West	39	19 (48.7)	20 (51.3)	–
Darling Downs	474	333 (70.3)	41 (8.6)	100 (21.1)
Gold Coast	1,598	1,247 (78.0)	189 (11.8)	162 (10.1)
Health Support Queensland	1,567	1,389 (88.6)	144 (9.2)	34 (2.2)
Mackay	298	247 (82.9)	47 (15.8)	4 (1.3)
Metro North	1,175	825 (70.2)	82 (7.0)	268 (22.8)
Metro South	1,647	1,194 (72.5)	98 (6.0)	355 (21.6)
North West	79	56 (70.9)	20 (25.3)	3 (3.8)
South West	45	26 (57.8)	10 (22.2)	9 (20.0)
Sunshine Coast	969	867 (89.5)	37 (3.8)	65 (6.7)
Townsville	624	507 (81.3)	98 (15.7)	19 (3.0)
West Moreton	828	510 (61.6)	65 (7.9)	253 (30.6)
Wide Bay	287	237 (82.6)	40 (13.9)	10 (3.5)
Statewide	**11,723**	**8,964 (76.5)**	**1,177 (10.0)**	**1,582 (13.5)**

* Includes referrals from a Queensland Health public facility

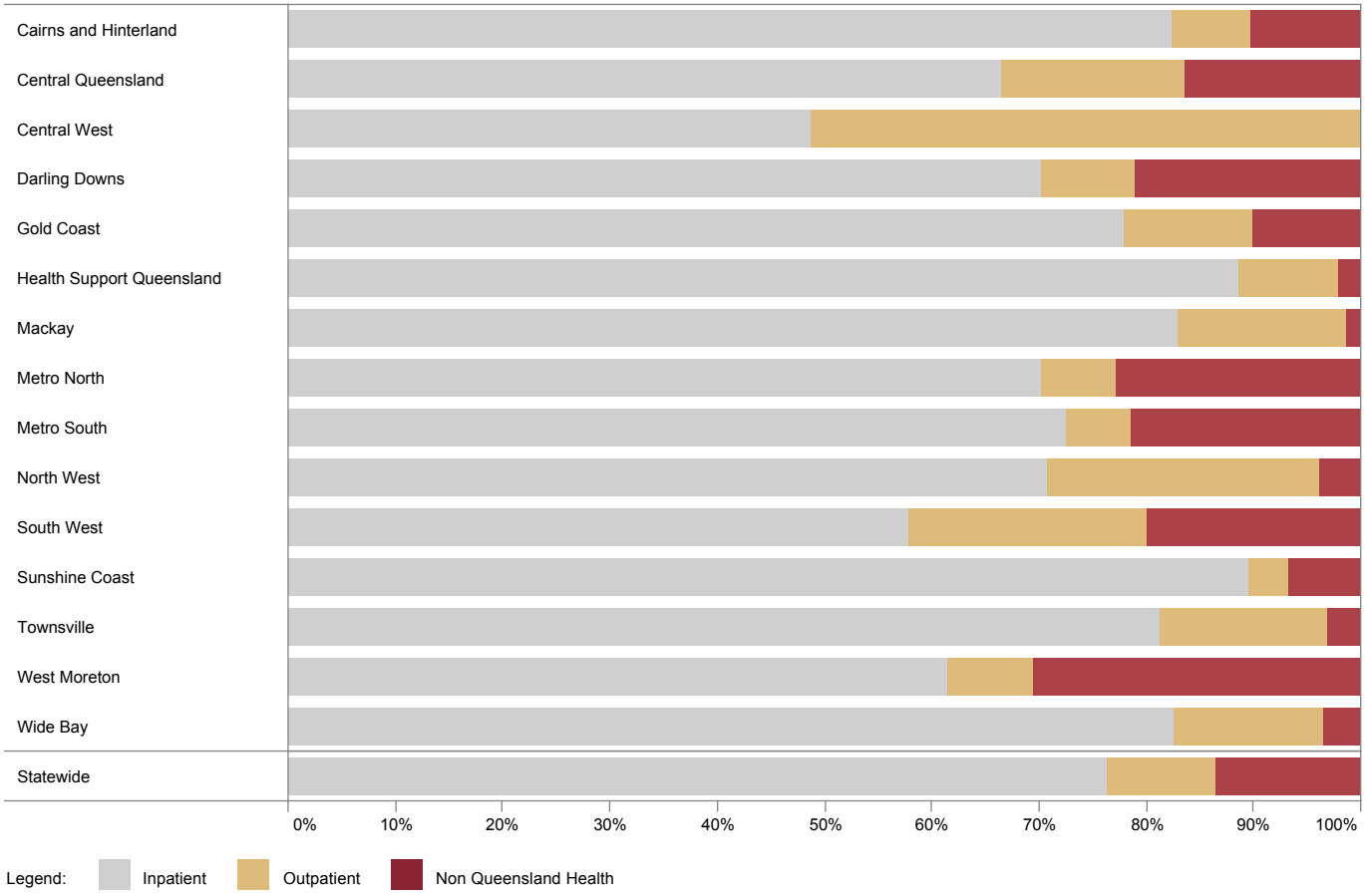


Figure 5: Proportion of referrals by referral source and outpatient program HHS

4.3 Inpatient referrals

For referrals originating from an inpatient setting, the largest referrer was Metro North Hospital and Health Service which accounted for almost one-quarter (24%) of referrals. The largest CR program was the COACH Program (Health Support Queensland) which received 16% of all inpatient referrals.

Table 5: CR inpatient referrals by source and destination HHS

HHS/organisation	Outgoing inpatient referrals n (%)	Incoming inpatient referrals n (%)
Cairns and Hinterland	500 (5.6)	598 (6.7)
Central Queensland	724 (8.1)	909 (10.1)
Central West	3 (<0.1)	19 (0.2)
Darling Downs	108 (1.2)	333 (3.7)
Gold Coast	1,251 (14.0)	1,247 (13.9)
Health Support Queensland	–	1,389 (15.5)
Mackay	240 (2.7)	247 (2.8)
Mater Health Services	113 (1.3)	–
Metro North	2,178 (24.3)	825 (9.2)
Metro South	1,748 (19.5)	1,194 (13.3)
North West	2 (<0.1)	56 (0.6)
South West	–	26 (0.3)
Sunshine Coast	826 (9.2)	867 (9.7)
Townsville	957 (10.7)	507 (5.7)
West Moreton	208 (2.3)	510 (5.7)
Wide Bay	106 (1.2)	237 (2.6)
Statewide	**8,964 (100.0)**	**8,964 (100.0)**

The flow of inpatient referrals from the originating HHS or organisation (acute site) to the CR outpatient program HHS is illustrated in Figure 6. The majority of inpatient referrals remained within the originating HHS, though there was some variation noted.

It should be highlighted that there are no outpatient programs for Mater Health Services, and conversely Health Support Queensland provides an outpatient service only.

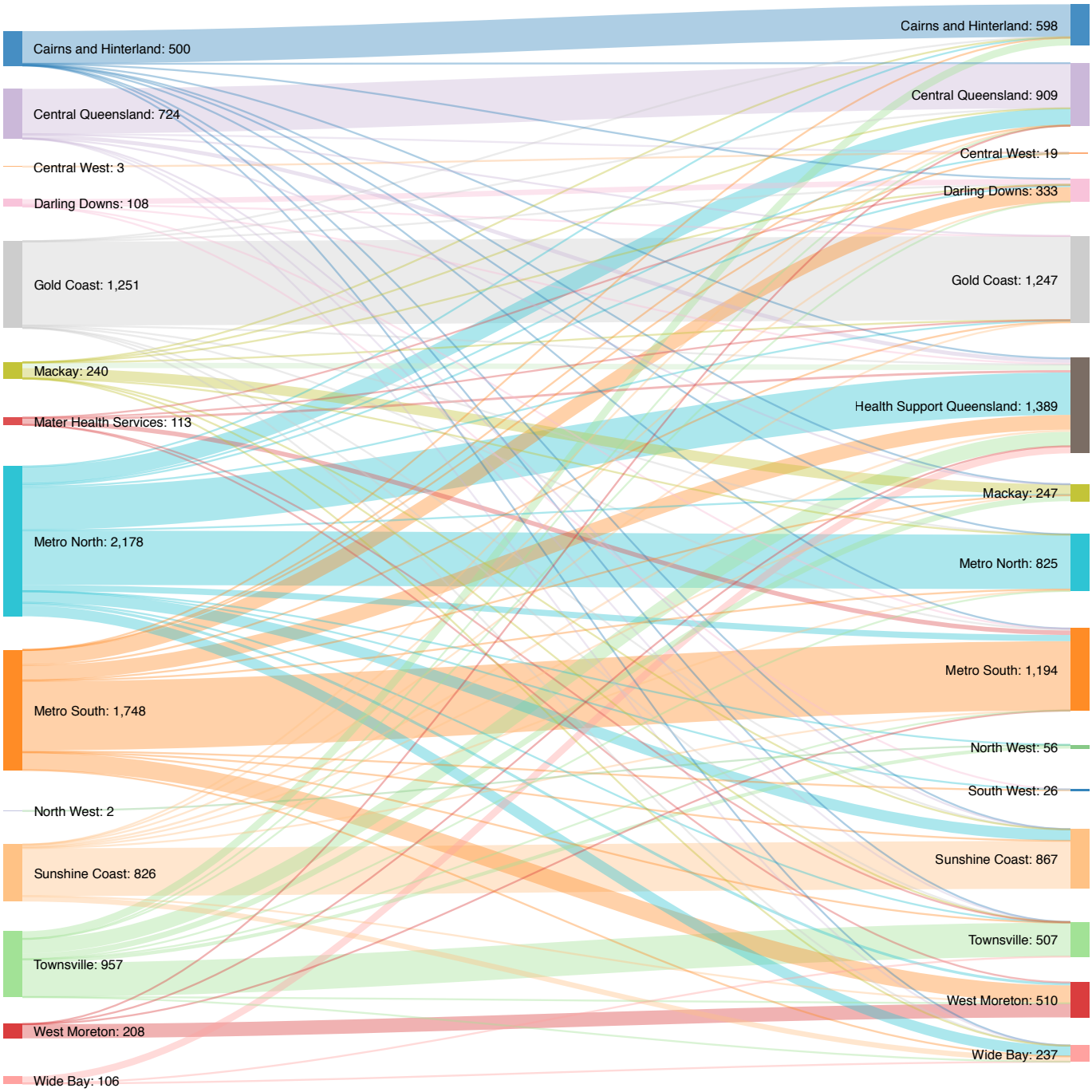


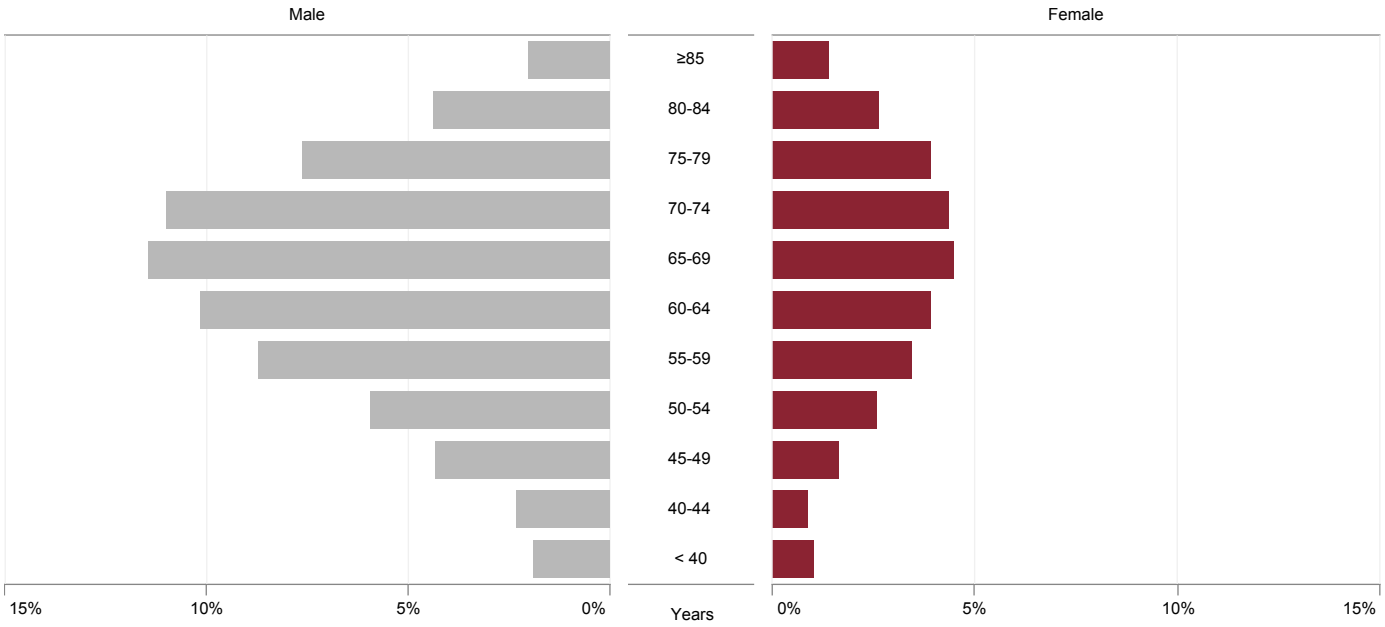
Figure 6: Number of CR inpatient referrals by source and destination HHS/organisation

5 Patient characteristics

5.1 Age and gender

Development of cardiovascular disease is related to age. Overall, 70% of patients were male and 30% female, while the age distribution of referrals was similar for genders.

The highest proportion of referrals for both males and females was in the 65 years to 69 years age group which accounted for 16% of all referrals.



% of total referrals (n=11,723)

Figure 7: Referrals by patient gender and age group

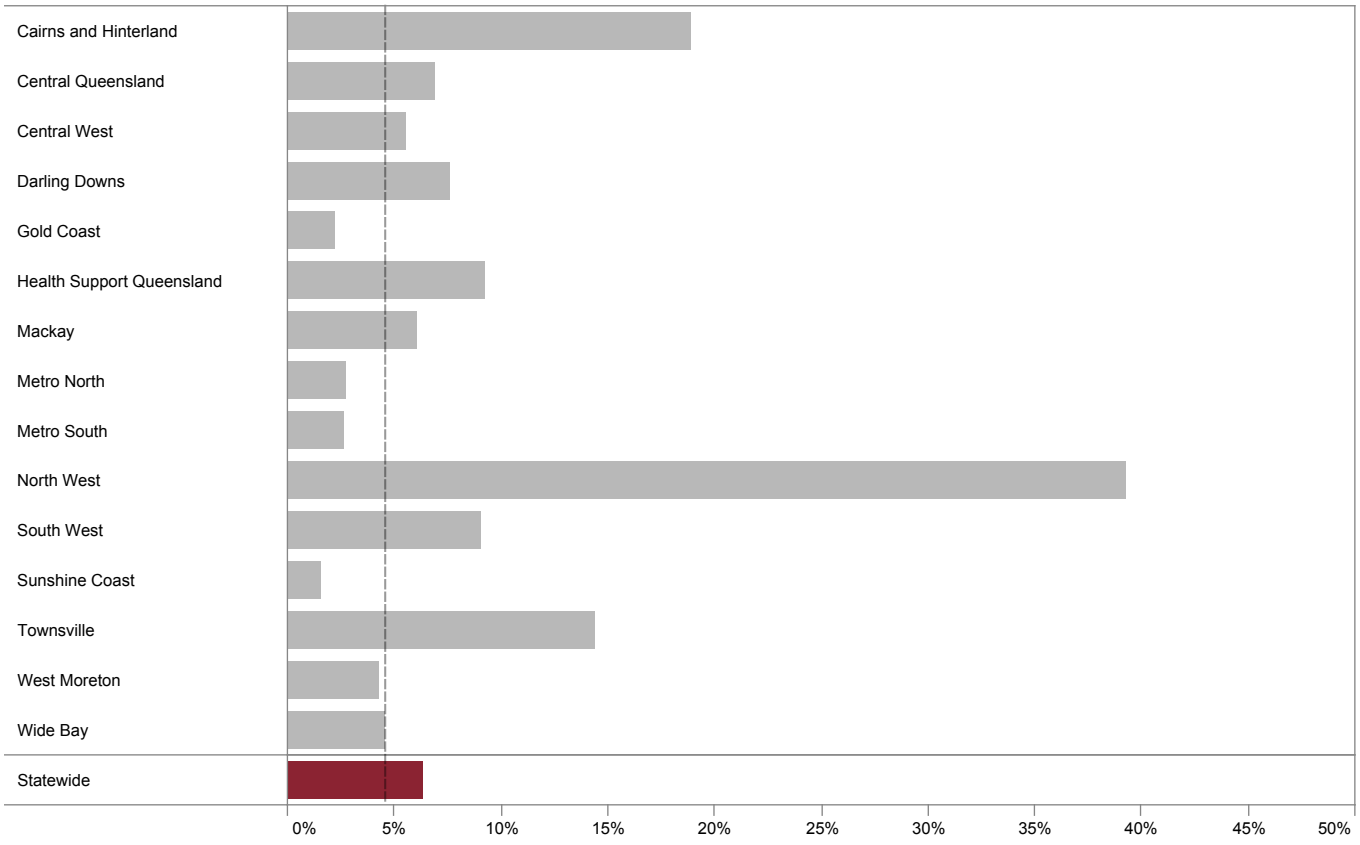
Table 6: Median patient age by gender and HHS

Outpatient HHS/division	Male years	Female years	ALL years
Cairns and Hinterland	64	63	64
Central Queensland	68	68	68
Central West	66	62	64
Darling Downs	67	66	66
Gold Coast	68	70	68
Health Support Queensland	64	67	65
Mackay	61	66	63
Metro North	66	67	67
Metro South	64	66	64
North West	60	57	60
South West	67	58	61
Sunshine Coast	67	70	68
Townsville	65	65	65
West Moreton	66	64	66
Wide Bay	69	67	68
Statewide	**66**	**67**	**66**

5.2 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant in the development of cardiovascular disease. It is recognised that the Aboriginal and Torres Strait Islander population has a higher incidence and prevalence of coronary artery disease. In this patient set, Aboriginal and Torres Strait Islander patients represented 6.3% of all statewide referrals with considerable variation observed across all HHS.

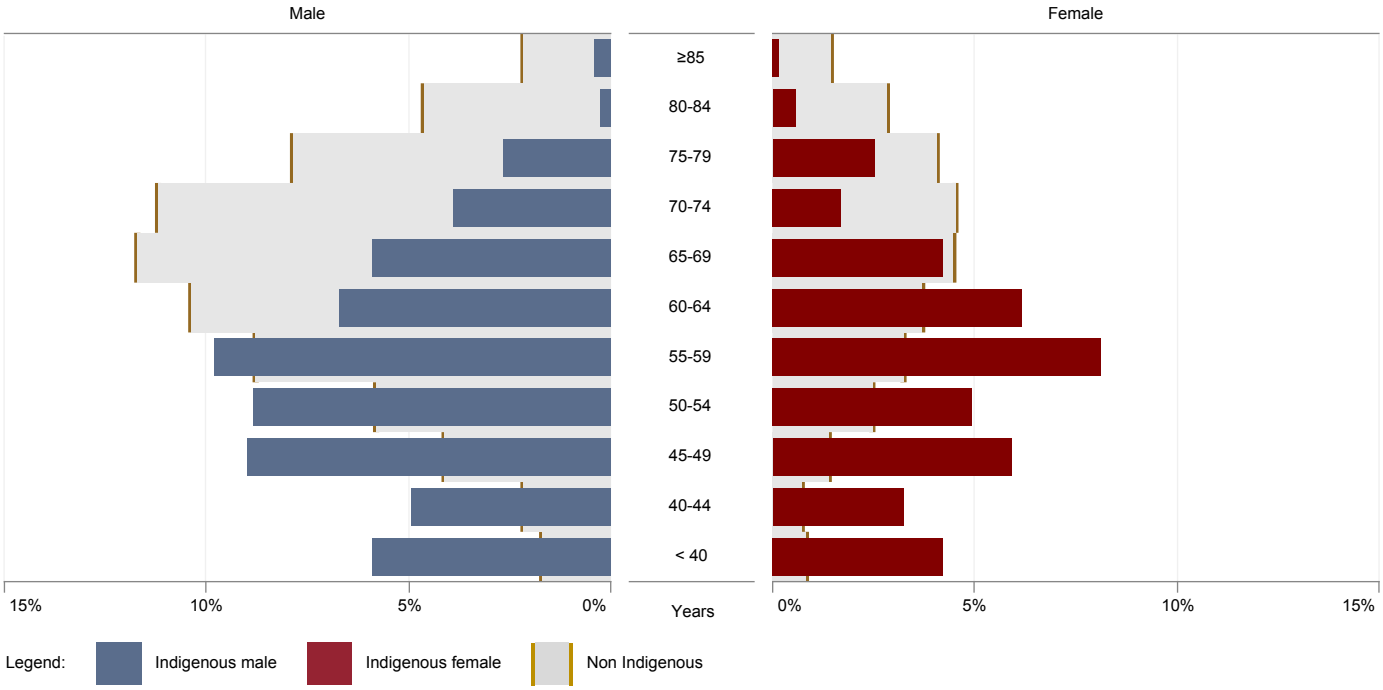
Larger proportions of Aboriginal and Torres Strait Islander patients were referred to CR programs in northern and western HHS with Cairns and Hinterland, North West, Townsville and South West HHS all reporting greater than 10% of patients identifying as Aboriginal and Torres Strait Islander.



Excludes missing data (3.9%)

Figure 8: Proportion of identified Aboriginal and Torres Strait Islander patients by outpatient HHS

The proportion of Aboriginal and Torres Strait Islander patients referred to CR had a median age considerably lower than other patients (56 years vs 66 years respectively). This finding is consistent with other QCOR Audits, which suggests the presence of a cardiovascular disease health gap for Aboriginal and Torres Strait Islander patients.



Excludes missing data (3.9%)

Figure 9: Proportion of all CR referrals by age group and Indigenous status

Table 7: Patient age by gender and Indigenous status

	Male years	Female years	All years
Aboriginal and Torres Strait Islander	55	57	56
Non Aboriginal and Torres Strait Islander	66	68	66
ALL	**66**	**67**	**66**

6 Program participation

6.1 Pre assessment stage

The assessment of a patient by CR comprises a comprehensive cardiovascular disease risk factor review. This extends beyond a patient's presenting medical and social history to encompass overall health, physical well-being, psychological factors, availability of social support and patient-reported quality of life.

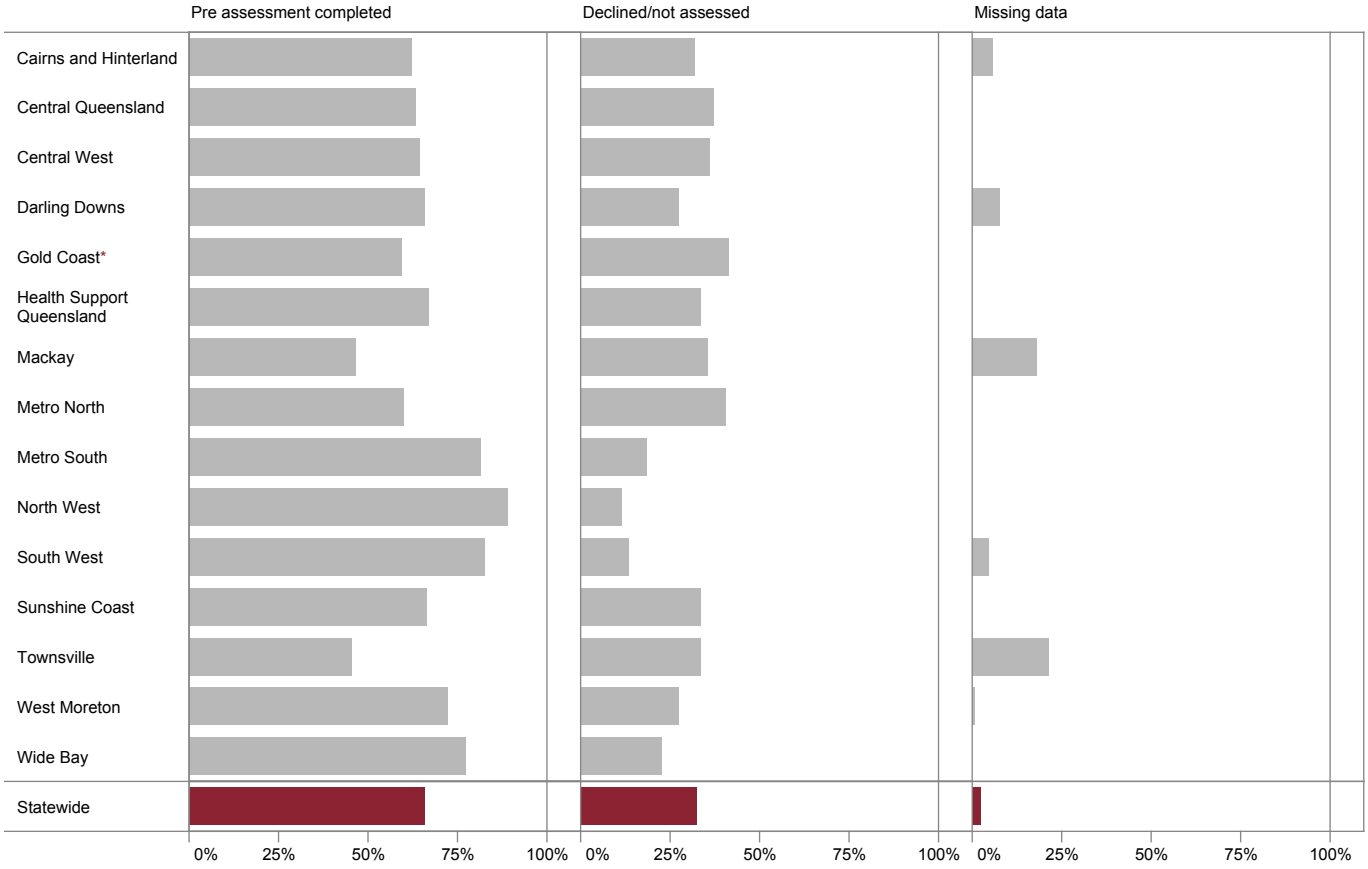
An assessment by outpatient CR is generally conducted in two stages which occur before and after a patient attends the specialist CR program. These stages are referred to as the pre assessment and post assessment. The pre assessment signifies the successful uptake and recruitment of a patient onto the CR program. Assessments may be undertaken over the phone or face-to-face.

The proportion of total referrals which proceeded to a pre assessment within any timeframe was 65%. It should be noted that this is a very limited metric which should be interpreted with caution. This is due to varying processes across the state for patients refusing or not interested in attending CR, as well as patients residing overseas and interstate. These issues are discussed later in the report.

Table 8: Total pre assessments completed by HHS

Outpatient HHS/division	Pre assessment completed n (%)	Declined/not assessed n (%)	Missing data n (%)
Cairns and Hinterland	451 (62.2)	231 (31.9)	43 (5.9)
Central Queensland	862 (63.0)	506 (37.0)	–
Central West	25 (64.1)	14 (35.9)	–
Darling Downs	310 (65.4)	129 (27.2)	35 (7.4)
Gold Coast	944 (59.1)	654 (40.9)*	–
Health Support Queensland	1,042 (66.5)	525 (33.5)	–
Mackay	139 (46.6)	105 (35.2)	54 (18.1)
Metro North	701 (59.7)	474 (40.3)	–
Metro South	1,337 (81.2)	310 (18.8)	–
North West	70 (88.6)	9 (11.4)	–
South West	37 (82.2)	6 (13.3)	2 (4.4)
Sunshine Coast	642 (66.3)	327 (33.7)	–
Townsville	282 (45.2)	209 (33.5)	133 (21.3)
West Moreton	597 (72.1)	228 (27.5)	3 (0.4)
Wide Bay	222 (77.4)	65 (22.6)	–
Statewide	**7,661 (65.4)**	**3,792 (32.3)**	**270 (2.3)**

* Total for Gold Coast HHS includes 23% of referrals for patients residing interstate, who are typically referred for CR outside of Queensland Health



* Total for Gold Coast HHS includes 23% of referrals for patients residing interstate, who are typically referred for CR outside of Queensland Health

Figure 10: Proportion of CR referrals proceeding to pre assessment by HHS

6.2 Post assessment stage

The post assessment is representative of completion and graduation from the specialist CR outpatient program. This provides an opportunity for the patient and clinician to reflect upon the targets defined at the pre assessment. Of 7,661 completed pre assessments, there were an overall 40% of patients who proceeded to a completed post assessment.

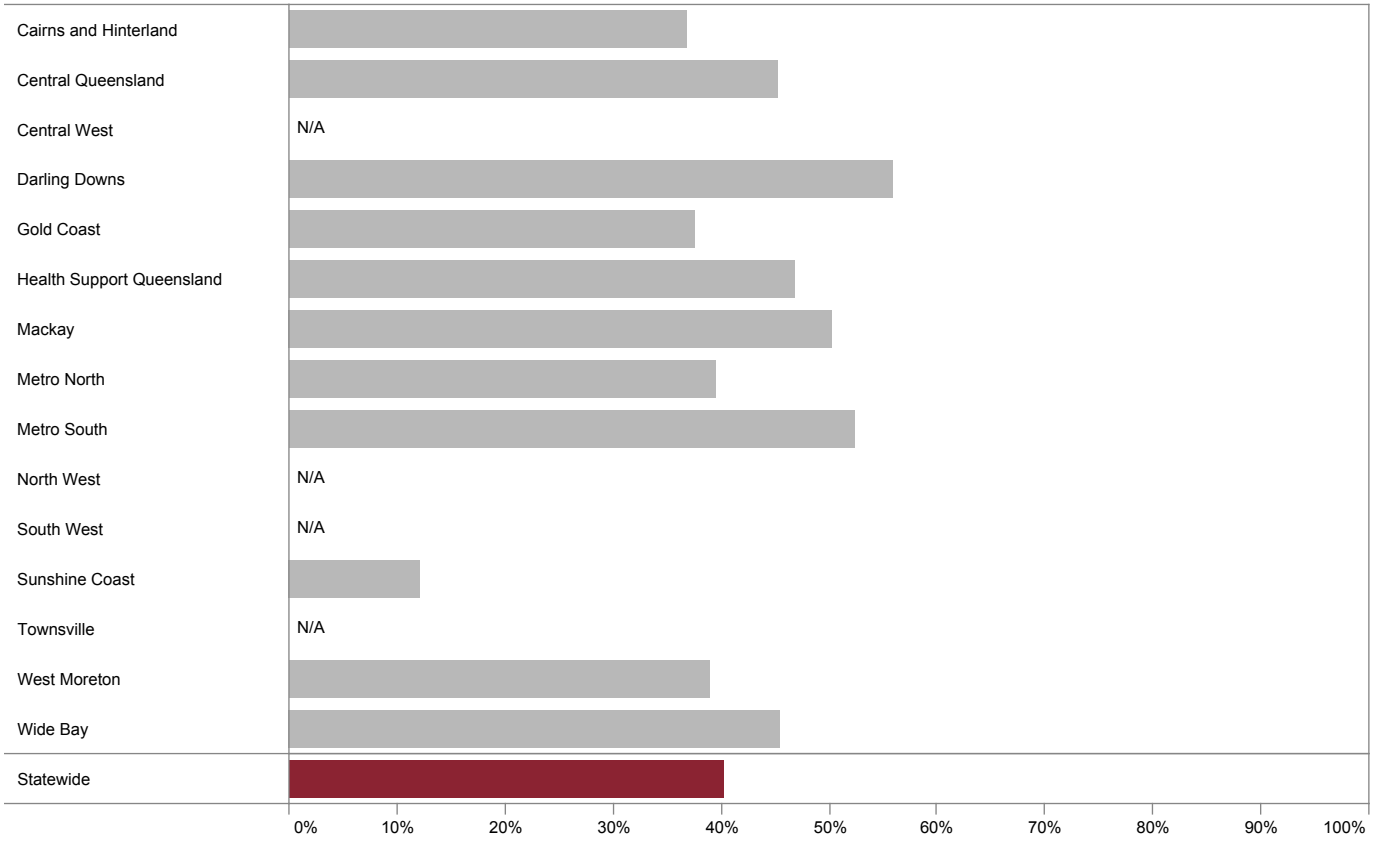
Completion rates and median time delays from post assessment to pre assessment varied considerably by HHS. The median time from pre assessment to post assessment was 82 days, ranging from 55 days to 167 days across outpatient HHS. There was also a considerable variation in the proportion of cases where a post assessment had been completed, indicating that local practices towards post assessment completion and data entry vary considerably at a local level. Furthermore, a range of issues may contribute to completion of the post assessment, which may include timing, patient availability or other factors outside the control of the program.

This has been identified as an area for future focus and expanding of reporting, as it would allow more comprehensive analysis around outcomes and patient benefits for CR. The data reported in this section uses a minimum 90 day window for post assessment completion, which may skew results for sites using longer program timeframes.

Table 9: Total post assessments completed by HHS

Outpatient HHS/division	Post assessment completed n (%)	Median time to post assessment days
Cairns and Hinterland	166 (36.8)	76
Central Queensland	391 (45.4)	74
Central West	14 (56.0)	N/A
Darling Downs	173 (55.8)	65
Gold Coast	354 (37.5)	76
Health Support Queensland	488 (46.8)	167
Mackay	70 (50.4)	68
Metro North	277 (39.5)	106
Metro South	701 (52.4)	71
North West	13 (18.6)	N/A
South West	15 (40.5)	N/A
Sunshine Coast	78 (12.1)	97
Townsville	10 (3.5)	N/A
West Moreton	232 (38.9)	73
Wide Bay	101 (45.5)	55
Statewide	**3,083 (40.2)**	**82**

N/A: Not displayed due to <20 post assessments for analysis



N/A: Not displayed due to <20 post assessments for analysis

Figure 11: Proportion of CR pre assessments proceeding to post assessment

6.3 Program outcomes

The following sections use paired observations from the pre assessment and post assessment stages to identify changes in health status for patients participating in CR. Measures included in this analysis include patient reported outcome measures (PROMs) and other functional or pathological investigations.

A limiting factor for this analysis is availability of data for the post assessment stage. Specifically, the availability of updated pathology and other investigations, and specific model of care employed by the CR program may result in limited data from which conclusions can be drawn.

Table 10: Outline of CR program outcome measures

Program outcome	Measure	Category
1	Lipid profile	Pathology
2	Six minute walk test	Functional
3	Patient Health Questionnaire	PROMs
4	Assessment of Quality of Life	PROMs

6.3.1 Lipid profile

Data for lipid values such as total cholesterol was available for a smaller proportion of patients completing CR. A barrier to reporting this outcome is that updated pathology results are not always available for the post assessment stage.

In this analysis, HDL-C values remained consistent while total cholesterol, LDL-C, and triglycerides showed a favorable trend. This is consistent with improvement in lipid profile post CR.

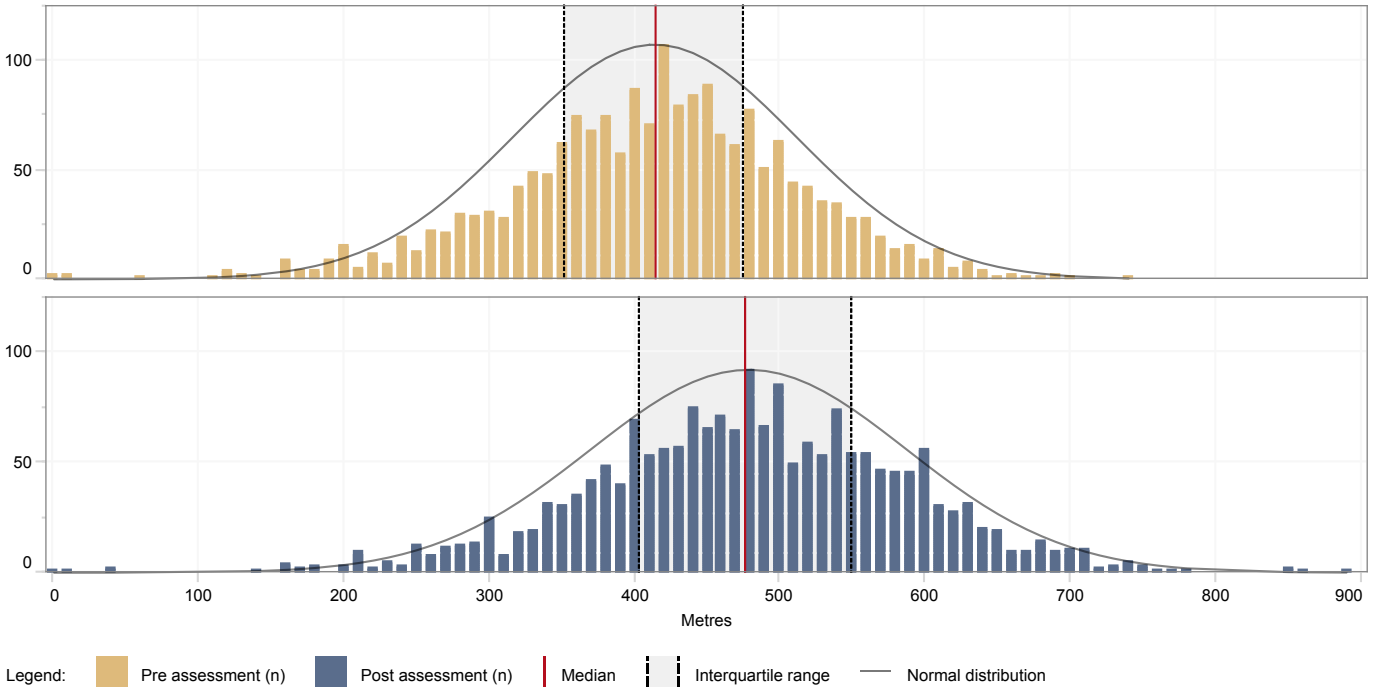
Table 11: Summary of lipid values

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Total cholesterol (mmol/L)	398	4.7 ± 1.4	3.8 ± 1.0	-0.9 ± 1.3
Triglycerides (mmol/L)	364	1.7 ± 1.0	1.4 ± 0.8	-0.3 ± 0.9
HDL-C (mmol/L)	338	1.1 ± 0.3	1.1 ± 0.4	0.0 ± 0.3
LDL-C (mmol/L)	329	2.7 ± 1.2	1.8 ± 0.9	-0.9 ± 1.2

6.3.2 Six minute walk test

A functional measure is indicated prior to implementing an exercise program in order to determine exercise prescription and measure improvement. The six minute walk test (6MWT) is a standardised investigation of submaximal exercise capacity that is often used in patients with cardiopulmonary disease. Changes in walk distance are useful in assessing functional capacity and the efficacy of therapeutic interventions such as pharmacotherapy and CR.[23]

For the 3,083 post assessments completed, there were 1,884 cases where the patient had completed a 6MWT at both the pre assessment and post assessment stages. The 6MWT is not always feasible for data collection due to the different models of care that exist, with some programs not offering an exercise component. In the majority of these instances (75%) patients demonstrated an improvement in 6MWT, with 57% showing an increase of greater than 50 metres (Table 13).



Results rounded to 10 metres

Figure 12: Comparison of pre assessment and post assessment 6MWT results

Table 12: Summary of 6MWT results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change Mean ± SD
Distance travelled (metres)	1,884	410 ± 98	475 ± 109	65 ± 64

Table 13: Change in 6MWT results

	n (%)
Improved ≥50 metres	1,076 (57.1)
Improved 25–49 metres	347 (18.4)
No change (±25 metres)	377 (20.0)
Worsened ≥25 metres	84 (4.5)
ALL	**1,884 (100.0)**

6.3.3 Patient Health Questionairre

The CR assessment often includes a brief screening for anxiety and depressive disorders, both of which are significant risk factors for patients suffering coronary artery disease associated with adverse cardiovascular outcomes independent of other risk factors.

The Patient Health Questionnaire-4 (PHQ-4) is a validated tool for screening anxiety and depressive disorders.[24] This instrument is a four-item composite measure derived from the Generalized Anxiety Disorder-7 scale (GAD–7) and the Patient Health Questionnaire-9 (PHQ-9). Each of the four items on the PHQ-4 is scored using a four point scale with categories of high psychological distress being scored 9–12 points and mild psychological distress scoring between 3–5 points. A score of 0–2 points suggests minimal depression and anxiety.

A total of 2,546 paired data were available for analysis. Almost one-third of patients (32%) demonstrated an improved PHQ-4 score at post assessment.

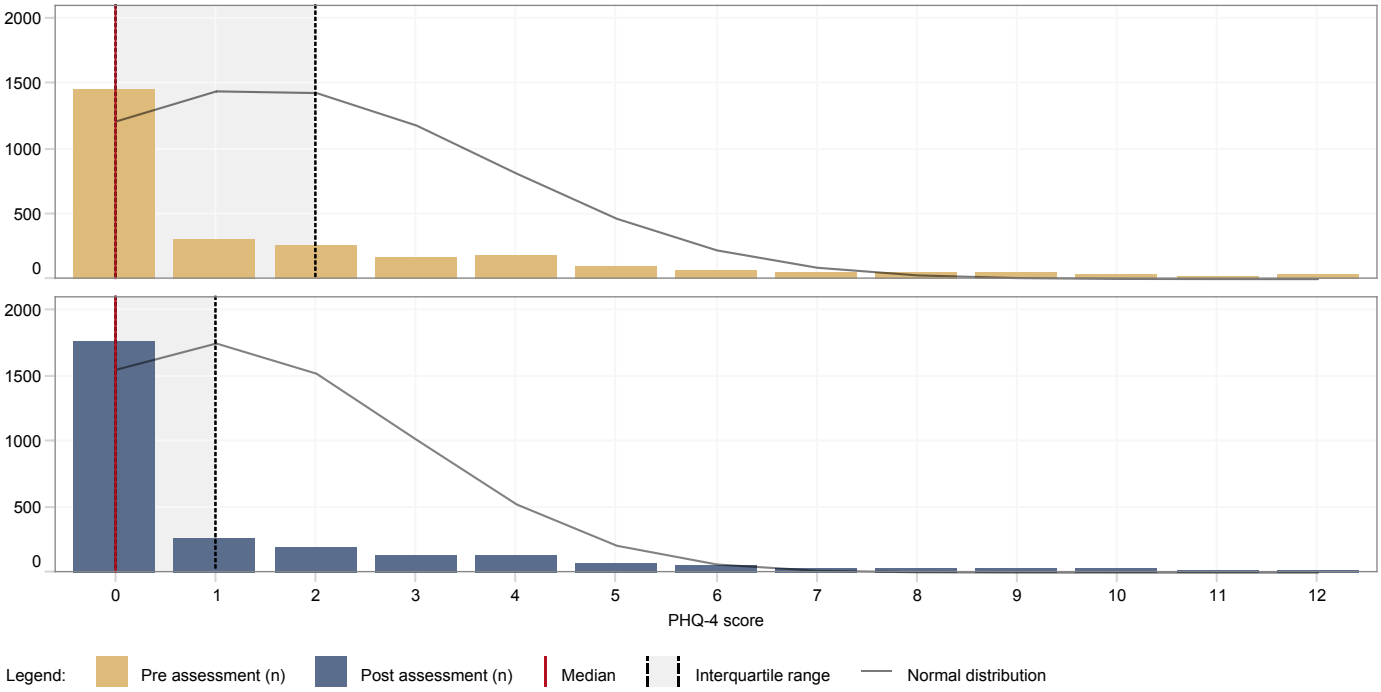


Figure 13: Comparison of pre assessment and post assessment PHQ-4 results

Table 14: Summary of PHQ-4 results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in score Mean ± SD
Depression score (PHQ-2)	2,546	0.7 ± 1.2	0.5 ± 1.1	-0.2 ± 1.2
Anxiety score (GAD-2)	2,546	0.8 ± 1.4	0.6 ± 1.2	-0.3 ± 1.3
Overall score	**2,546**	**1.5 ± 2.3**	**1.0 ± 2.0**	**-0.5 ± 2.1**

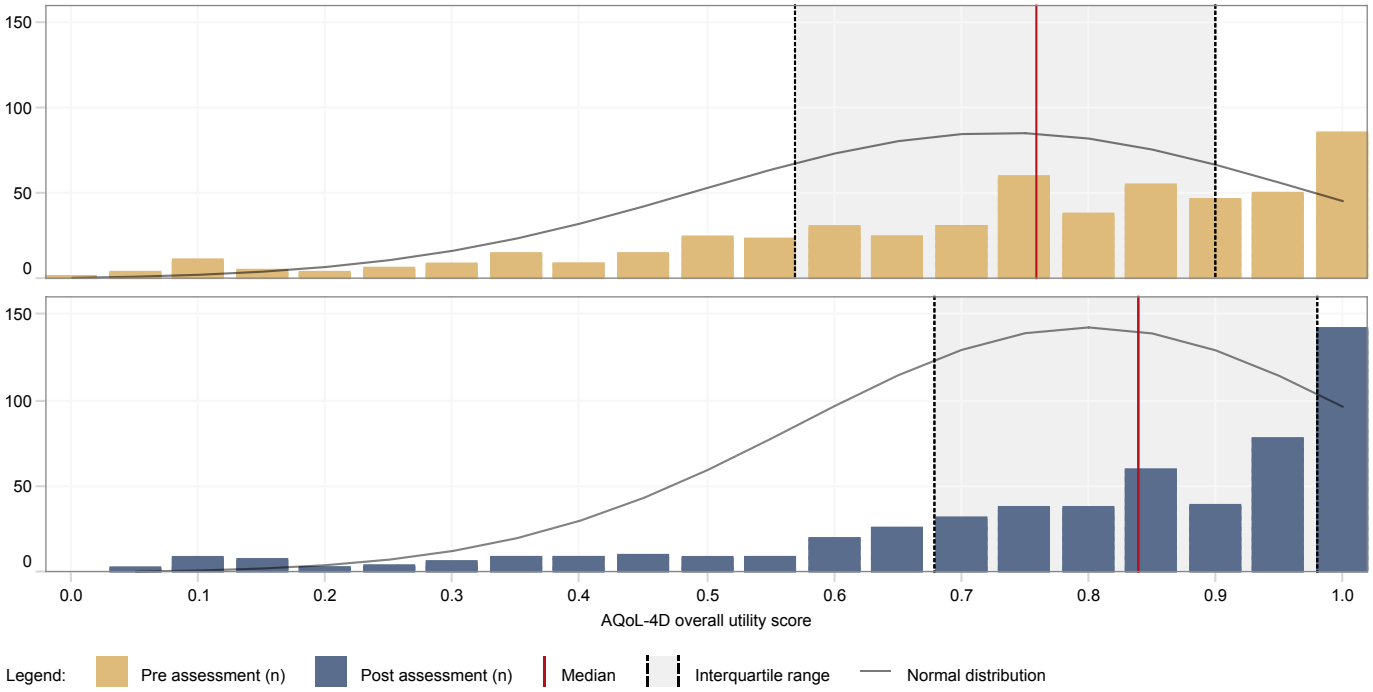
Table 15: Change in PHQ-4 results

	n (%)
Any improvement	819 (32.2)
No change	1,336 (52.5)
Any worse result	391 (15.4)
ALL	**2,546 (100.0)**

6.3.4 Assessment of Quality of Life

The Assessment of Quality of Life (AQoL-4D) is a multi-attribute utility instrument developed to assess health-related quality of life. It measures PROMs across four domains of health, scored individually, as well as providing an overall score. AQoL-4D utility scores range from 0.00–1.00, with scores closer to 1.00 indicating higher satisfaction of patients reporting the status of their own health.

For the 545 records available at the pre and post CR timeframes, the mean overall pre assessment AQoL-4D utility score was 0.71 which compares similarly to expected results for patients with a cardiovascular diagnosis.[25] This utility score improved to 0.78 at the post assessment stage, where 59% of patients demonstrated an improved overall utility score after CR intervention (Table 16 and Table 17).



Results rounded to 0.05 utility score

Figure 14: Comparison of pre assessment and post assessment AQoL-4D results

Table 16: Summary of AQoL-4D results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in score Mean ± SD
Independent living	545	0.89 ± 0.19	0.95 ± 0.13	0.06 ± 0.16
Relationships	545	0.91 ± 0.15	0.93 ± 0.15	0.02 ± 0.16
Senses	545	0.94 ± 0.10	0.94 ± 0.09	0.01 ± 0.09
Mental health	545	0.90 ± 0.12	0.92 ± 0.12	0.02 ± 0.13
Overall score	**545**	**0.71 ± 0.24**	**0.78 ± 0.23**	**0.07 ± 0.22**

Table 17: Change in AQoL-4D results

	n (%)
Any improvement	321 (58.9)
No change	74 (13.6)
Any worse result	150 (27.5)
ALL	**545 (100.0)**

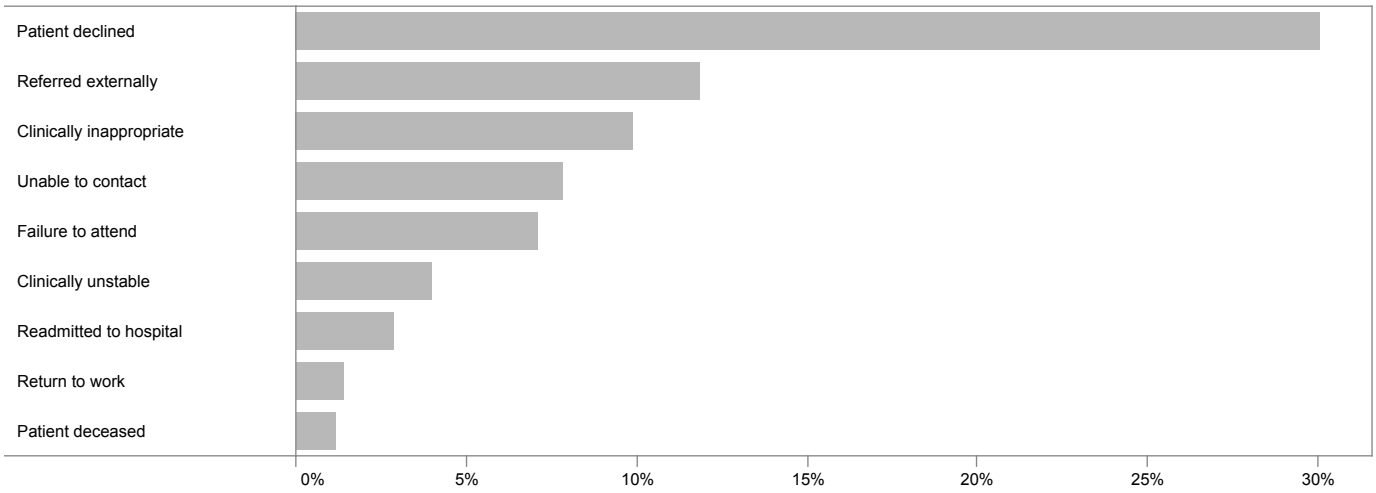
6.4 Failure to participate

It is well known that there are several reasons patients may not participate in a CR program. This was identified as a point for future focus through last year's Audit. Subsequently, QCOR has been enhanced to provide increased granularity which will allow future reports to include more specific detail around reasons this may occur. In this cohort the most common reason for not participating was that the patient would decline or opt not to participate (30%).

Aside from patients that declined the service, there are a number of specific reasons a referral may not proceed to pre assessment. These include patients who are uncontactable, failed to attend their appointments or are medically unsuitable. Interstate referrals also accounted for a large number of referrals which did not proceed through to an assessment. This is particularly relevant for the Gold Coast HHS where a high proportion (23%) of patients referred to this CR program are residents of northern New South Wales and followed up outside of Queensland Health.

It is important to recognise that in some instances, the clinician may still provide opportunistic education and advice to a patient who declined to participate, though this is difficult to incorporate into outcome measure reporting. Furthermore, there is an unmeasured subset of patients who refuse the initial referral to CR and are currently outside the scope of this registry.

Further information relating to the patients who had declined to participate in CR is included in section 8 of this report.



Other reasons not displayed (24%)

Figure 15: Reasons for no pre assessment being conducted

7 Clinical presentation

7.1 Diagnosis

Patients attending a CR pre assessment have been grouped into a diagnosis category for the following analysis based on information provided on the referral to CR. The majority of assessments (65%) followed a previous diagnosis of ischaemic heart disease (IHD).

Table 18: Pre assessments by diagnosis category

Diagnosis category	n	%
Ischaemic heart disease*	4,982	65.0
Valvular disease	637	8.3
Other†	2,042	26.7
ALL	**7,661**	**100.0**

* STEMI, NSTEMI and angina

† Typically includes arrhythmia, congestive heart failure and any other diagnosis

7.2 Most recent procedure

The most common procedure preceding referral to CR was percutaneous coronary intervention (PCI), which had been documented for 39% of all referrals and approximately half (52%) of referrals for patients with IHD.

There were 14% of cases where the most recent procedure had not been identified. This could be attributable to missing data or patients presenting and subsequently being conservatively managed thus having no procedure applicable. This ambiguity has been identified as a point for future improvements to QCOR.

Table 19: Most recent procedure by diagnosis category

Most recent procedure	Ischaemic heart disease n (%)	Valvular disease n (%)	Other n (%)	ALL n (%)
PCI	2,593 (52.0)	5 (0.8)	400 (19.6)	2,998 (39.1)
Coronary angiogram	921 (18.5)	25 (3.9)	429 (21.0)	1,375 (17.9)
CABG	798 (16.0)	47 (7.4)	270 (13.2)	1,115 (14.6)
Valve procedure	11 (0.2)	452 (71.0)	76 (3.7)	539 (7.0)
Device procedure	16 (0.3)	2 (0.3)	156 (7.6)	174 (2.3)
CABG + valve procedure	66 (1.3)	62 (9.7)	25 (1.2)	153 (2.0)
Other	61 (1.2)	12 (1.9)	173 (8.5)	246 (3.2)
Not specified	516 (10.4)	32 (5.0)	513 (25.1)	1,061 (13.8)

7.3 Risk factors and comorbidities

The following risk factors and comorbidities are discussed with the patient through the assessment phase and generally self-reported by the patient. With all self-reporting instances, it is important to note that sometimes responses are not accurately conveyed while the patient and clinician are in the establishment phase of their relationship. As a result, some of the risk factor metrics may be understated.

7.3.1 Smoking

At the time of the pre-assessment, 9% of patients were identified as current smokers (defined as smoking within 30 days), while 51% were classed as former smokers and 40% reported never having smoked.

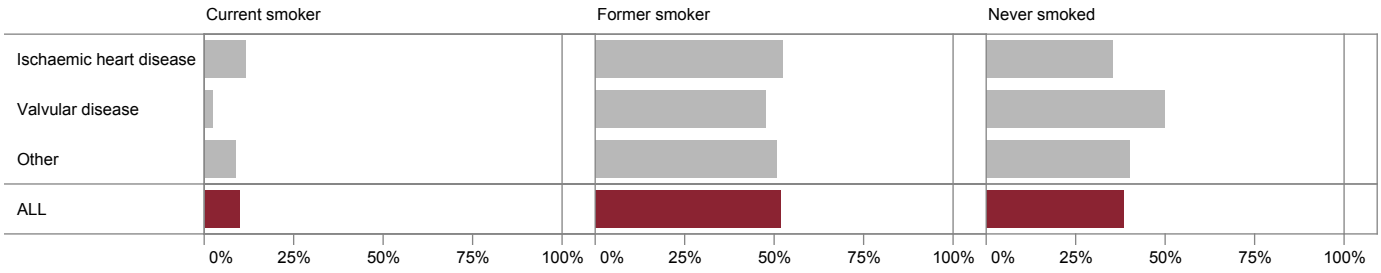
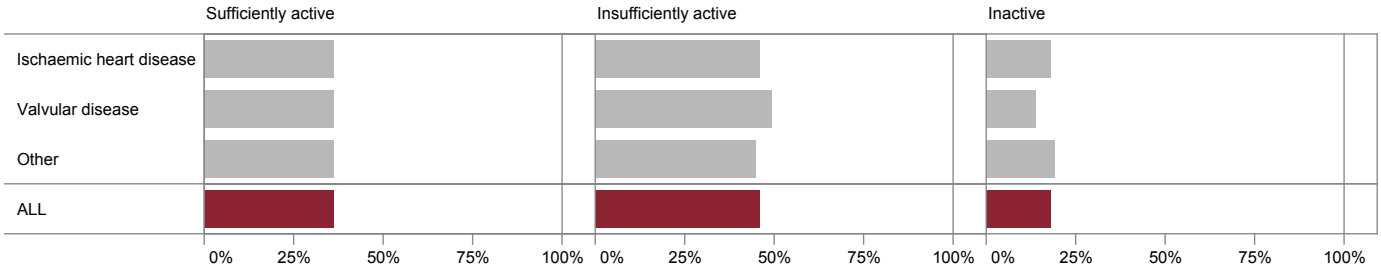


Figure 16: Smoking status by diagnosis category

7.3.2 Activity level

There were only 36% of patients who met the physical activity guidelines for their age and were sufficiently active. Conversely, 18% of patients were classed as inactive, which had been defined as only undertaking activities associated with daily living. The remaining 46% of patients were classed as insufficiently active according to current guidelines.

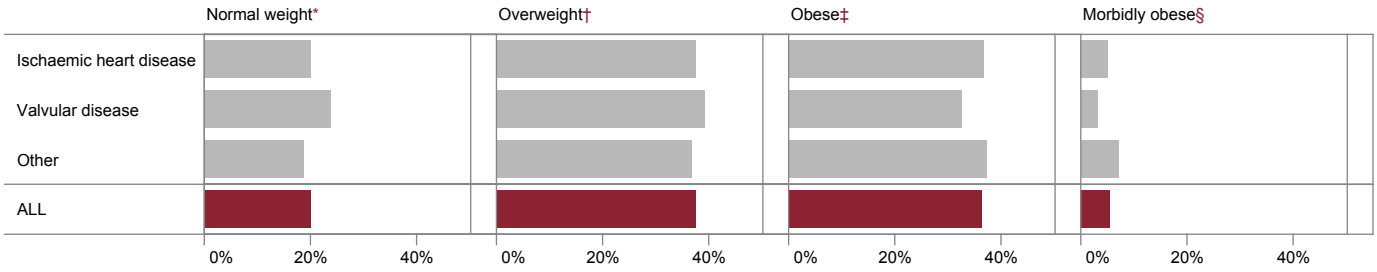


Excludes COACH assessments (n=1,042)

Figure 17: Activity level by diagnosis category

7.3.3 Body mass index

Less than one-quarter (20%) of patients were identified as having a body mass index (BMI) within the normal range, while the majority (80%) of patients attending outpatient CR were classified as overweight, obese or morbidly obese. Less than one percent of patients were classified as underweight (BMI ‹18.5 kg/m^2).



Underweight category (‹1%) not displayed

* BMI 18.5–24.9 kg/m^2

† BMI 25–29.9 kg/m^2

‡ BMI 30–39.9 kg/m^2

§ BMI ≥40 kg/m^2

Figure 18: BMI category by diagnosis category

7.3.4 Diabetes

Overall, 27% of patients had diabetes as a comorbidity with considerable variation observed between diagnosis categories, ranging from 16% for valvular disease to 28% in the IHD and other diagnosis categories.

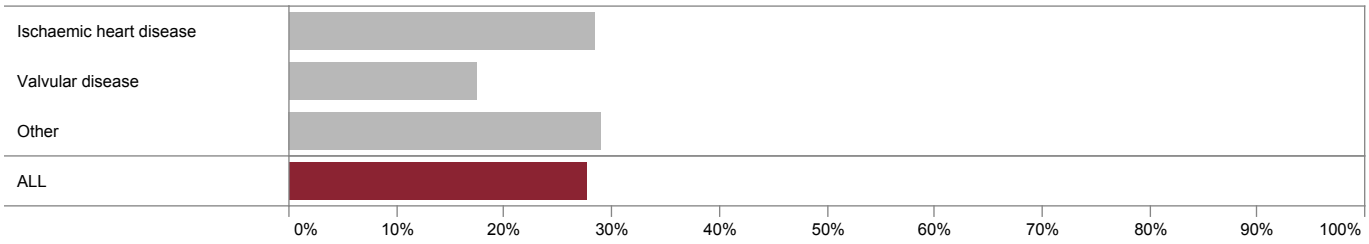
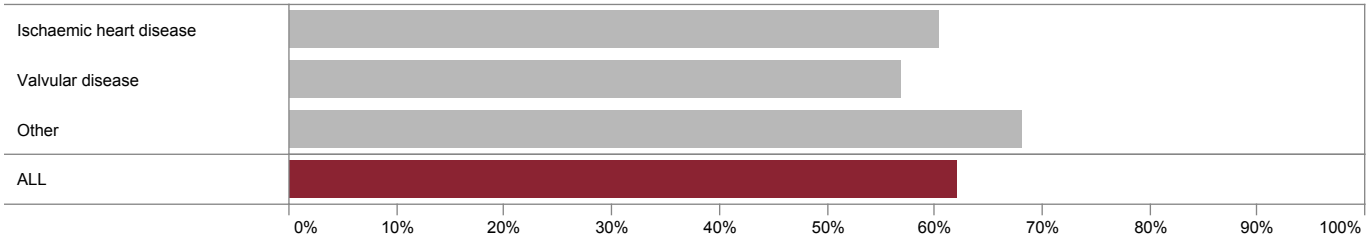


Figure 19: Diabetes status by diagnosis category

7.3.5 High blood pressure

More than half of patients assessed (62%) were identified as having hypertension, ranging from 57% to 68% across diagnosis categories.



Excludes COACH assessments (n=1,042)

Figure 20: High blood pressure by diagnosis category

7.3.6 Abnormal cholesterol

The majority of patients (89%) had a history of abnormal cholesterol levels or had been prescribed lipid lowering therapy by the time of assessment. This ranged from 64% to 95% across diagnosis categories.

Abnormal cholesterol levels for patients with known cardiovascular disease include measures of:

- Total cholesterol ›4.0 mmol/L
- HDL ‹1.0 mmol/L
- LDL ›2.0 mmol/L
- Triglycerides ›2.0 mmol/L.[26]

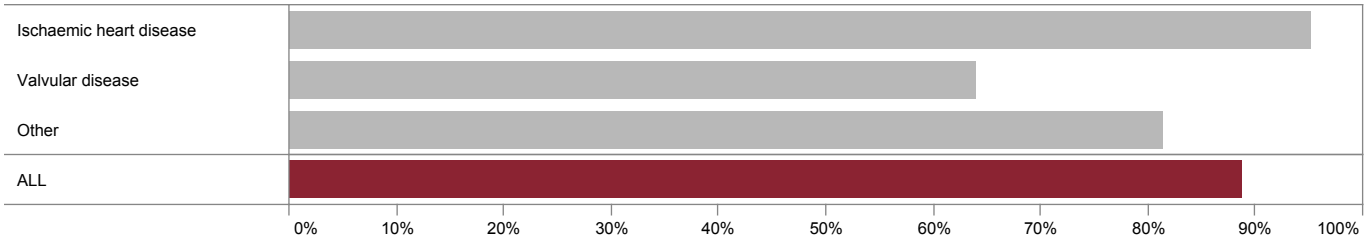


Figure 21: Abnormal cholesterol by diagnosis category

7.3.7 Family history of cardiovascular disease

Less than half (44%) of patients had a family history of cardiovascular disease. This had been defined as having a first degree relative diagnosed with cardiovascular disease by the age of 60 years.

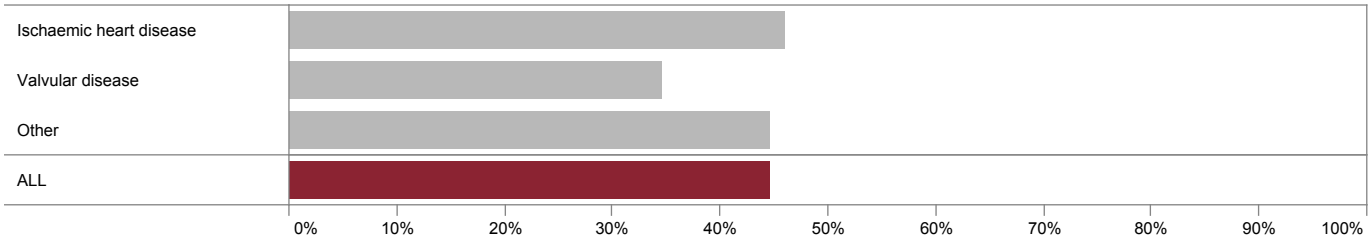
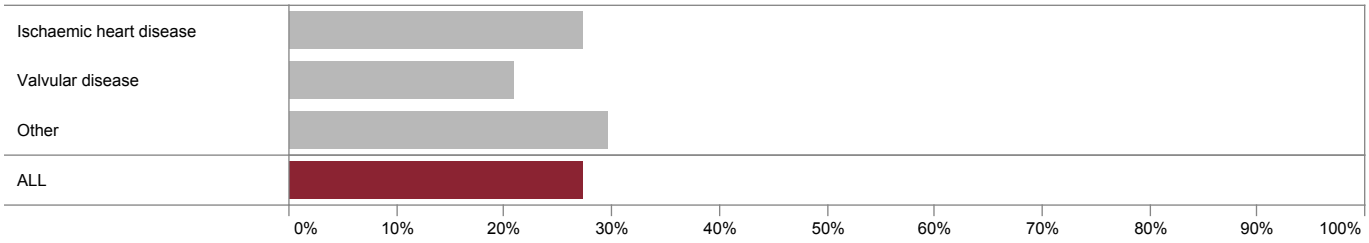


Figure 22: Family history of cardiovascular disease by diagnosis category

7.3.8 History of depression

Over one-quarter of patients (27%) had a history of depression prior to the referral to CR.



Excludes COACH assessments (n=1,042)

Figure 23: History of depression by diagnosis category

7.3.9 Heart failure

Overall there were 12% of patients assessed by outpatient CR who were documented as having heart failure. This was higher in the other diagnosis category, which includes the proportion of patients having heart failure as a principal diagnosis.

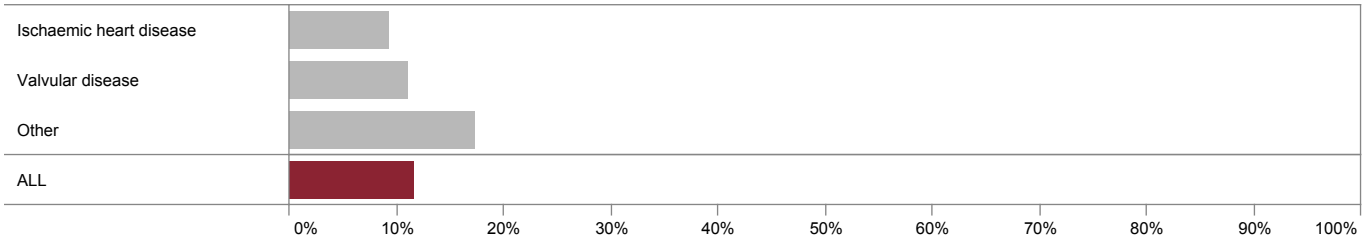
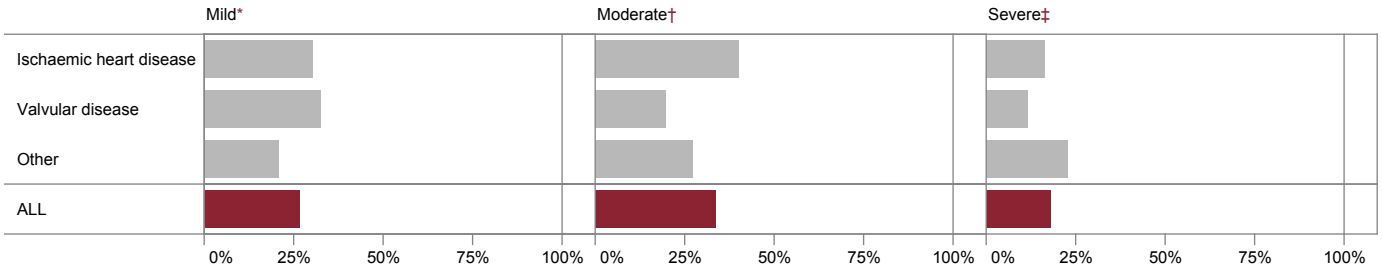


Figure 24: Heart failure by diagnosis category

Heart failure and left ventricular (LV) dysfunction

Of the patients documented to have heart failure (Figure 24), 79% were classed as having HF with a reduced left ventricular ejection fraction (LVEF ‹50%). Of these, 27% had mild LV dysfunction, 33% with moderate LV dysfunction and 18% with severe LV dysfunction.

The remainder (21%) were documented as having heart failure associated with a preserved ejection fraction (LVEF ≥50%).



* LVEF 40–49%

† LVEF 30–39%

‡ LVEF ‹30%

Figure 25: Proportion of HF patients with reduced ejection fraction by LV dysfunction and diagnosis category

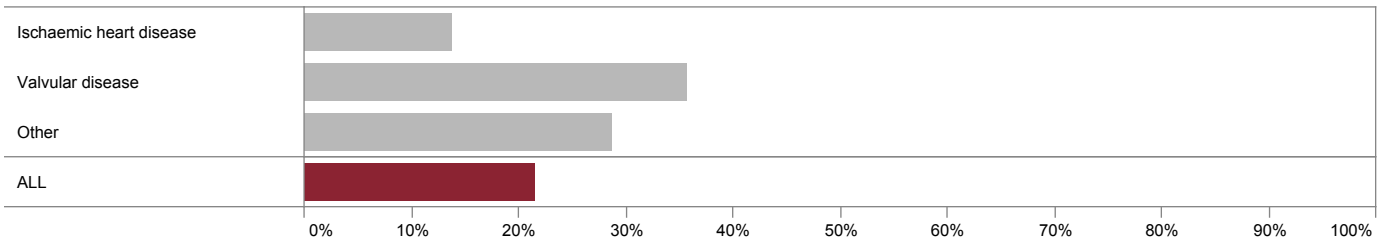


Figure 26: Proportion of HF patients with preserved ejection fraction by diagnosis category

7.4 Current medications

Over three-quarters of patients were being treated with aspirin (83%) and lipid lowering medications (84%). As expected, there was variation in medication across diagnosis categories. Patients with IHD tended to use antiplatelet and sublingual nitrate medications more than patients with valvular disease which is consistent with the different disease processes.

Table 20: Current medications by diagnosis category

Medications	IHD %	Valvular disease %	Other %	ALL %
Aspirin	90.9	64.3	69.1	82.9
ACEI/ARB	65.7	39.8	57.5	61.4
Antiplatelet	66.0	9.5	34.1	52.9
Anticoagulant	16.8	46.8	25.1	21.5
Beta blocker	65.8	45.6	60.2	62.6
Diabetic medications	22.4	13.8	23.9	22.1
Dual antiplatelet	62.2	7.0	29.1	48.8
Lipid lowering	90.8	57.3	74.1	83.6
Sublingual nitrate	58.1	6.0	27.3	45.6
Other	59.3	77.1	67.3	62.9

8 Clinical indicators

The CR clinical indicator program remains focused towards the timely referral and uptake to CR for admitted patients being discharged from public hospitals. This requires collaboration between the acute and outpatient services, each having their own targets (clinical indicator 1 and 2 respectively).

Overall system performance is measured through clinical indicator 3, which requires the acute and outpatient services to both meet their respective targets. For the purpose of this indicator, any referrals crossing between HHS are counted under both the referring and receiving HHS.

A future focus for the committee will be to expand the scope of the CR clinical indicators. Several areas have been highlighted including referrals from a non-acute setting and improvement at the post assessment stage. Discussion has highlighted a need for consistent CR practice and robust data entry prior to implementation of any new clinical quality indicators.

Table 21: Cardiac rehabilitation clinical indicators

#	Clinical indicator	Description
1	Timely referral	Documented referral to CR within three days of discharge
2	Timely assessment	Initial CR pre assessment completed within 28 days of discharge
3	Timely journey	Composite of timely referral and assessment

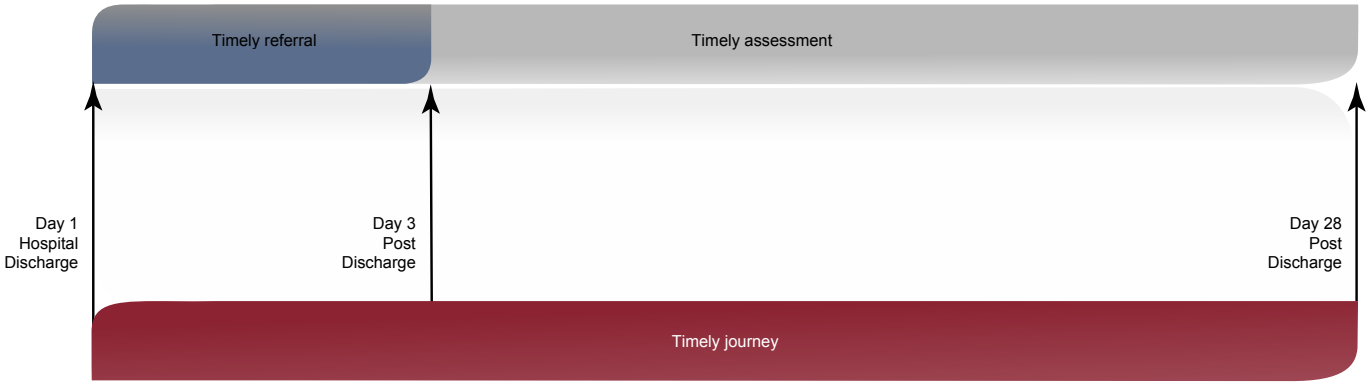


Figure 27: Timely referral, assessment and overall journey

8.1.1 Timely referral

This indicator examines the proportion of inpatient referrals to CR originating from a public hospital which had been provided to the CR program in a timely manner. This requires the referral to be submitted to the outpatient program within three days of the patient being discharged from hospital.

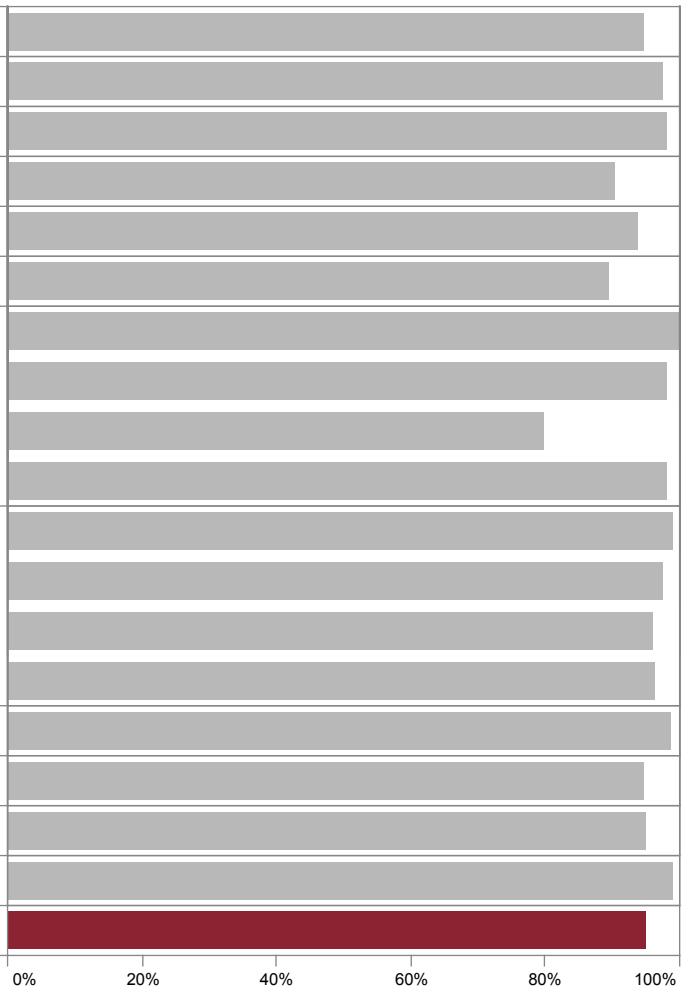
Overall performance is high, with 95% of referrals contributed to QCOR being submitted within three days of discharge.

Table 22: Timely referrals by referring HHS

Referring HHS/organisation	Total inpatient referrals n	Target met n (%)
Cairns and Hinterland	500	473 (94.6)
Central Queensland	724	703 (97.1)
Central West	3	N/A
Darling Downs	108	105 (97.2)
Gold Coast	1,251	1,128 (90.2)
Mackay	240	225 (93.8)
Mater Health Services	113	101 (89.4)
Metro North	2,178	2,058 (94.5)
Metro South	1,748	1,703 (97.4)
North West	2	N/A
Sunshine Coast	826	814 (98.5)
Townsville	957	906 (94.7)
West Moreton	208	198 (95.2)
Wide Bay	106	102 (96.2)
Statewide	**8,964**	**8,519 (95.0)**

N/A = Not displayed due to <20 referrals eligible for analysis

Referring HHS/ organisation	Referring site	Total analysed n
Cairns and Hinterland	Cairns Hospital	500
Central Queensland	Rockhampton Hospital	714
Darling Downs	Toowoomba Hospital	104
Gold Coast	Gold Coast University Hospital	1,245
Mackay	Mackay Base Hospital	240
Mater Health Services	Mater Hospital Brisbane	113
Metro North	Caboolture Hospital	115
	Redcliffe Hospital	58
	Royal Brisbane & Women's Hospital	449
	The Prince Charles Hospital	1,556
Metro South	Logan Hospital	107
	Princess Alexandra Hospital	1,513
	Queen Elizabeth II Jubilee Hospital	48
	Redland Hospital	80
Sunshine Coast	Sunshine Coast University Hospital	822
Townsville	The Townsville Hospital	957
West Moreton	Ipswich Hospital	208
Wide Bay	Bundaberg Base Hospital	103
Statewide		



Sites with <20 referrals eligible for analysis not displayed

Figure 28: Timely referrals by referring hospital

8.1.2 Timely assessment

This indicator examines the proportion of referrals to CR which proceed to an assessment within 28 days of discharge.

In order to retain focus on the performance of the outpatient CR program, referrals which are not provided in a timely manner (less than three days from discharge) have been excluded from the analysis. Further to this, other ineligibility criteria are outlined in Table 20. The exclusions are applied where information is available and has been documented in the application.

Overall, more than half of all patients (62%) are being assessed in a timely manner, however there was some variation across health services.

Table 23: Summary of referrals ineligible for timely assessment clinical indicator

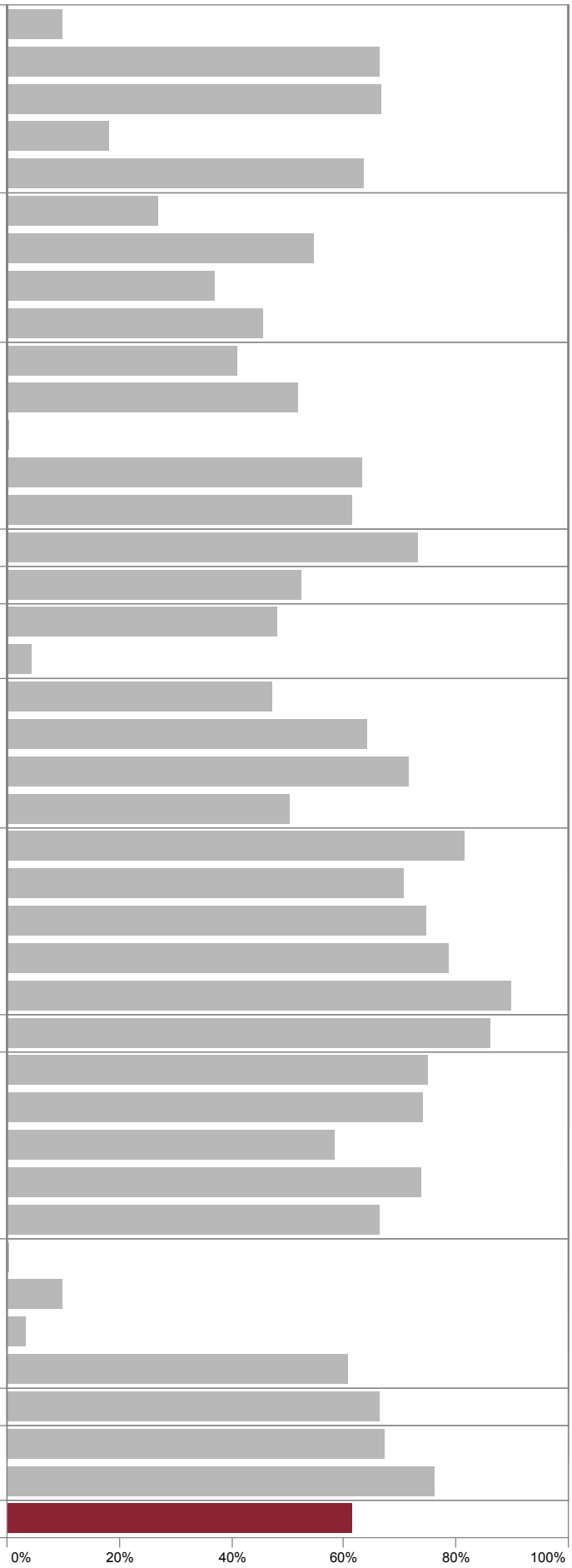
Summary	n
Referred outside of Queensland Health	525
Referral submitted ›3 days after discharge	388
Patient already attending CR program	101
Readmitted to hospital	88
Patient deceased	37
Total ineligible	**1,139**

Table 24: Timely assessment indicator by outpatient HHS

Outpatient HHS/division	Total inpatient referrals n	Total eligible for analysis n	Target met n (%)
Cairns and Hinterland	598	521	309 (59.3)
Central Queensland	909	790	358 (45.3)
Central West	19	13	N/A
Darling Downs	333	309	161 (52.1)
Gold Coast	1,247	803	588 (73.2)
Health Support Queensland	1,389	1,239	652 (52.6)
Mackay	247	218	77 (35.3)
Metro North	825	770	455 (59.1)
Metro South	1,194	1,133	912 (80.5)
North West	56	50	43 (86.0)
South West	26	24	14 (58.3)
Sunshine Coast	867	805	567 (70.4)
Townsville	507	464	214 (46.1)
West Moreton	510	474	315 (66.5)
Wide Bay	237	212	150 (70.8)
Statewide	**8,964**	**7,825**	**4,818 (61.6)**

N/A = Not displayed due to ‹20 referrals eligible for analysis

Outpatient HHS/division	Program	Total analysed n
Cairns and Hinterland	Atherton	51
	Cairns	367
	Innisfail	42
	Mareeba	22
	Mossman	22
Central Queensland	Biloela	26
	Capricorn Coast	97
	Gladstone	78
	Rockhampton	589
Darling Downs	Dalby-Tara	22
	Kingaroy	56
	Stanthorpe	24
	Toowoomba	153
	Warwick	31
Gold Coast	Gold Coast	803
Health Support Queensland	COACH	1,239
Mackay	Mackay	156
	Proserpine	46
Metro North	Caboolture	224
	Chermside	240
	North Lakes	191
	Redcliffe	115
Metro South	Bayside	261
	Eight Mile Plains	130
	Inala	75
	Logan-Beaudesert	430
	Princess Alexandra Hospital	237
North West	Mt Isa	50
Sunshine Coast	Caloundra	219
	Gympie	155
	Maroochydore	130
	Nambour	164
	Noosa	137
Townsville	Ayr	53
	Charters Towers	30
	Ingham	30
	Townsville	346
West Moreton	Ipswich	474
Wide Bay	Hervey Bay	128
	Maryborough	84
Statewide		



Sites with <20 pre assessments eligible for analysis not displayed

Figure 29: Timely assessment by outpatient program

8.1.3 Timely journey

This patient-centric measure of overall system performance requires strong coordination and links between the referring acute and outpatient CR sites. It measures the proportion of eligible inpatient referrals submitted by the acute site within three days of discharge, as well as the ability of the receiving CR program to meet the target of completing a pre assessment within 28 days of discharge.

Referrals are excluded from the analysis for the reasons outlined in Table 25. The exclusions are applied where information is available and has been documented in the application.

It is important to note that for the purpose of this indicator, any referral which crosses between HHS is counted against both participating services.

Table 25: Summary of referrals ineligible for timely journey clinical indicator

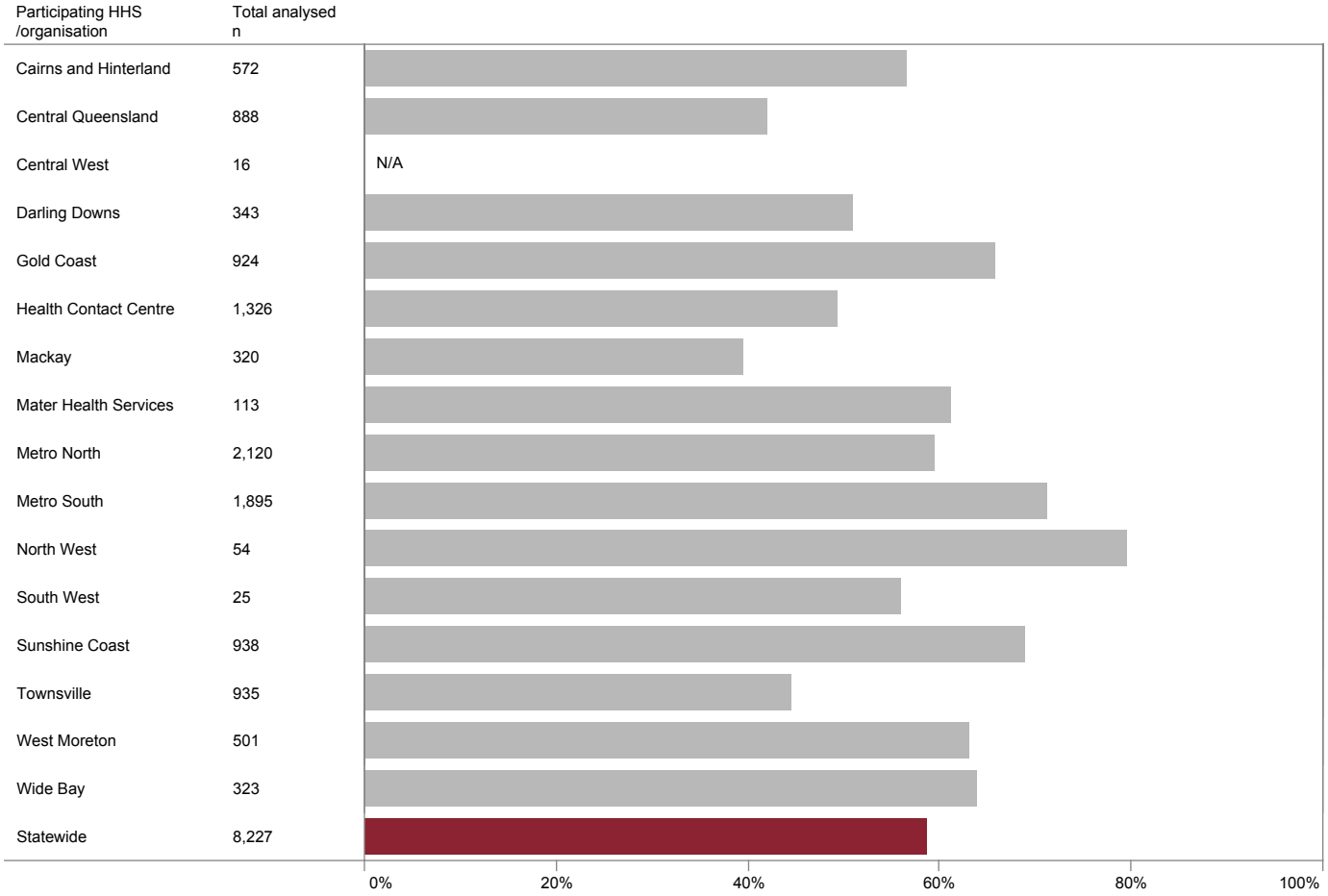
Summary	n
Referred outside of Queensland Health	525
Patient already attending CR program	101
Readmitted to hospital	88
Patient deceased	37
Total ineligible	**751**

Table 26: Timely journey indicator by participating HHS/organisation

Participating HHS/organisation	Total inpatient referrals* n	Total eligible for analysis n	Target met n (%)
Cairns and Hinterland	624	572	324 (56.6)
Central Queensland	979	885	372 (42.0)
Central West	19	16	N/A
Darling Downs	361	343	175 (51.0)
Gold Coast	1,290	920	607 (66.0)
Health Support Queensland	1,389	1,326	652 (49.2)
Mackay	337	319	126 (39.5)
Mater Health Services	113	113	69 (61.1)
Metro North	2,214	2,115	1,259 (59.5)
Metro South	1,939	1,894	1,347 (71.1)
North West	56	54	43 (79.6)
South West	26	25	14 (56.0)
Sunshine Coast	998	936	646 (69.0)
Townsville	970	934	415 (44.4)
West Moreton	514	501	316 (63.1)
Wide Bay	340	320	206 (64.4)
Statewide	**8,964**	**8,213**	**4,818 (58.7)**

N/A = Not displayed due to <20 referrals eligible for analysis

* Includes both incoming and outgoing referrals



N/A: Not displayed due to <20 referrals eligible for analysis

Figure 30: Timely journey indicator by participating HHS/organisation

9 Declined referrals

An initiative of the 2017 CR audit was to further define the subset of patients who did not uptake CR for whatever reason, with the aim to increase the level of detail available to describe the barriers to participation.

The cohort of patients who declined to participate in CR have been examined with an aim to identify common themes and opportunities for clinicians to improve patient participation rates. A limiting factor for this analysis is the amount of data available to describe this cohort, which is limited to the information included on the initial referral only.

9.1 Age and gender

Patients most likely to decline CR participation are males aged 70 years to 74 years (12%). The largest group of females to decline CR were aged in the 80 years to 84 years category (5%).

Conversely, patients aged 65 years to 69 years (17%) were the most likely to complete a CR program.

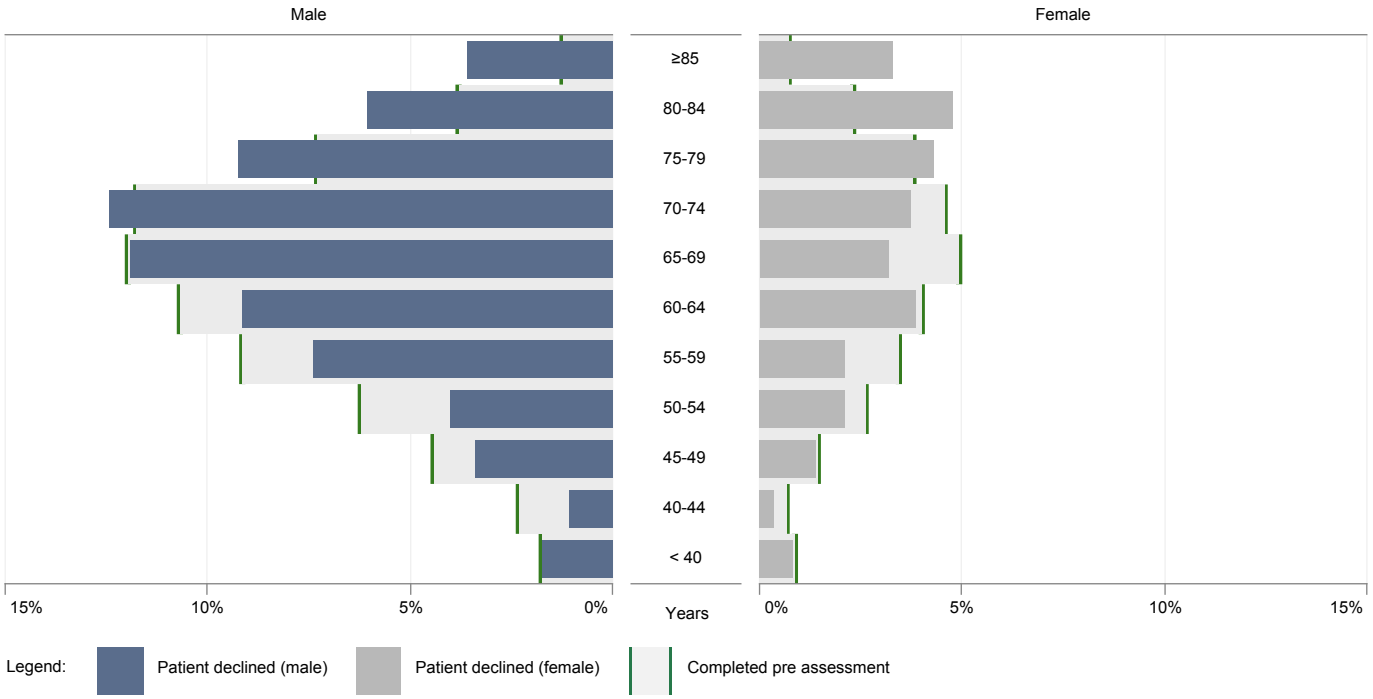


Figure 31: Patient CR program participation status by age group and gender

Table 27: Patient age (years) by program participation status

	Male Median (IQR)	Female Median (IQR)	ALL Median (IQR)
Patient declined	68 (60–75)	71 (61–81)	69 (60–77)
Fully assessed	65 (57–72)	67 (58–74)	66 (57–73)

9.2 Diagnosis category

Of the patients who declined, 42% had a diagnosis of ischaemic heart disease and 5% valvular disease. By comparison, patients who had completed an initial assessment were more commonly associated with ischaemic heart disease and valvular heart disease (65% and 8% respectively). Most patients (53%) who declined CR had an other diagnosis.

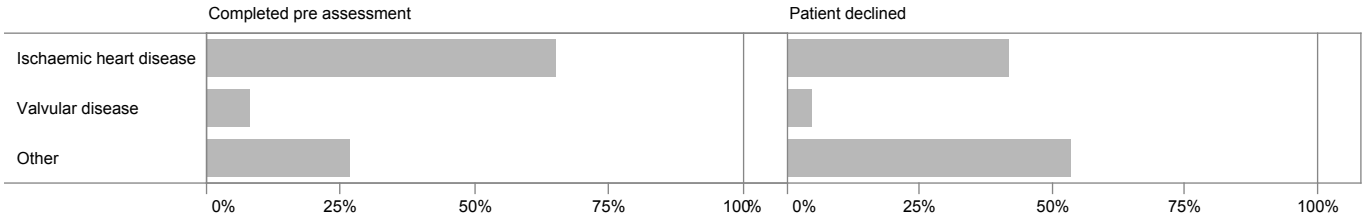


Figure 32: Proportion of cases by diagnosis category and program participation status

Table 28: Diagnosis category by program participation status

Diagnosis category	Completed pre assessment n (%)	Patient declined n (%)
Ischaemic heart disease	4,982 (65.0)	459 (42.0)
Valvular disease	637 (8.3)	50 (4.6)
Other	2,042 (26.7)	583 (53.4)
ALL	**7,661 (100.0)**	**1,092 (100.0)**

9.3 Most recent procedure

Overall, 20% of patients that had declined to participate in CR were recorded as having undergone PCI, while approximately 5% had undergone CABG. Almost half of patients (46%) who declined CR had no recent procedure specified.

For the cohort that proceeded to assessment, their most recent procedure was more closely related to their participation status. This data suggests that patients who went on to uptake onto a CR program may be more likely to have undergone an invasive cardiac procedure prior to referral. However, care should be taken when interpreting these findings as this data element is not always completed at the time of referral. Therefore, it may not fully represent the preceding patient medical history.

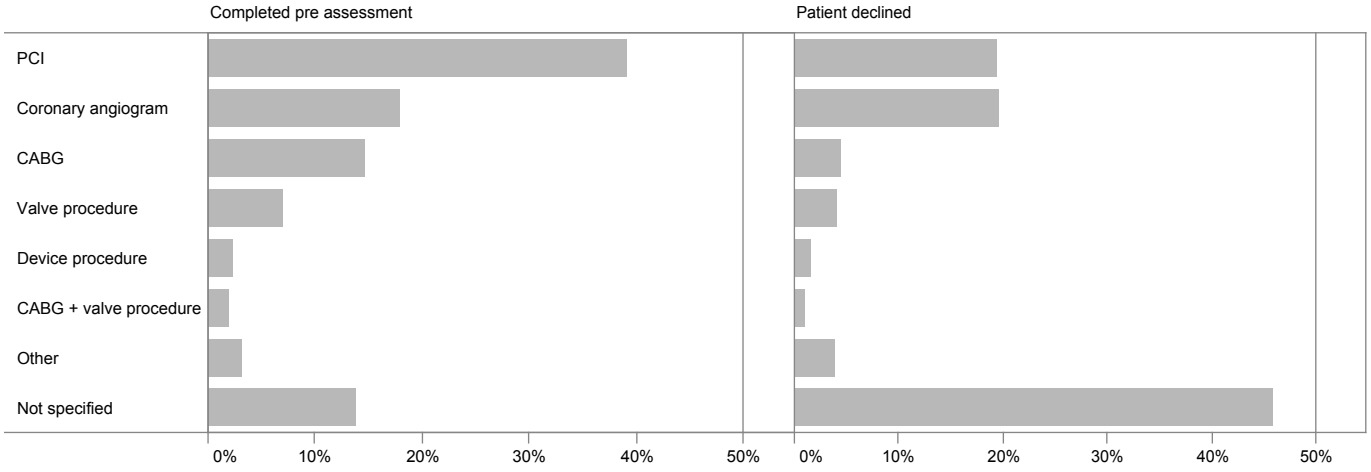


Figure 33: Proportion of cases by most recent procedure and program participation status

Table 29: Most recent procedure by program participation status

Most recent procedure	Completed pre assessment n (%)	Patient declined n (%)
PCI	2,998 (39.1)	213 (19.5)
Coronary angiogram	1,375 (17.9)	215 (19.7)
CABG	1,115 (14.6)	48 (4.4)
Valve procedure	539 (7.0)	45 (4.1)
Device procedure	174 (2.3)	18 (1.6)
CABG + valve procedure	153 (2.0)	10 (0.9)
Other	246 (3.2)	42 (3.8)
Not specified	1,061 (13.8)	501 (45.9)
ALL	**7,661 (100.0)**	**1,092 (100.0)**

9.4 Place of residence

A higher proportion (49%) of patients declining to participate in CR resided in major cities of Australia. Irrespective of geographic location, there were similar proportionate rates for those who had taken up CR and those who had declined.

Table 30: Remoteness classification by program participation status

Remoteness classification*	Completed pre assessment n (%)	Patient declined n (%)
Major Cities of Australia	4,030 (52.6)	536 (49.1)
Inner Regional Australia	2,283 (29.8)	332 (30.4)
Outer Regional Australia	1,073 (14.0)	182 (16.7)
Remote Australia	92 (1.2)	14 (1.3)
Very Remote Australia	176 (2.3)	24 (2.2)
ALL	**7,661 (100.0)**	**1,092 (100.0)**

* Classified by Accessibility and Remoteness Index of Australia

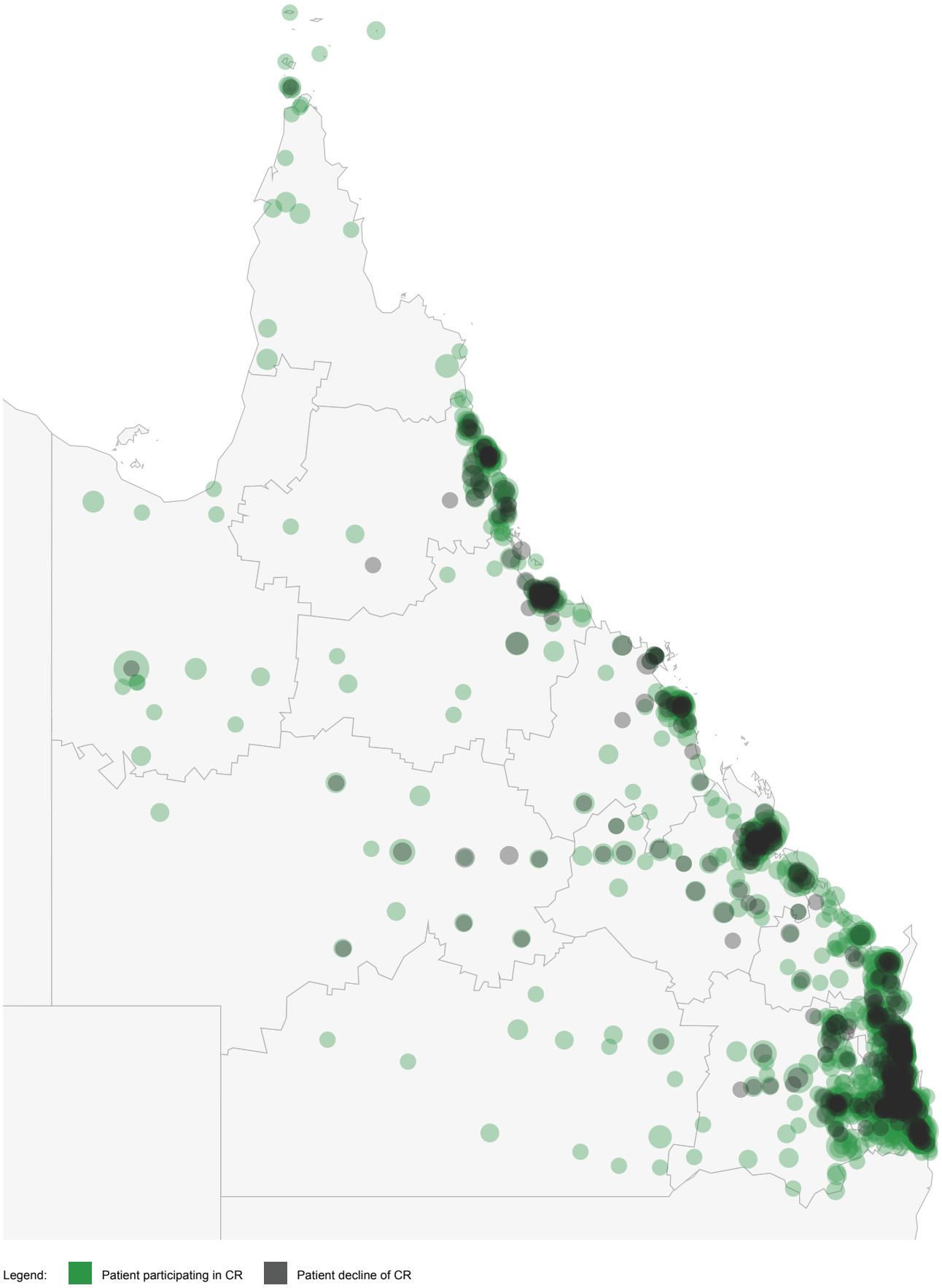


Figure 34: Patient residential postcode by program participation status

10 Conclusions

This report is the first to add a full year of data regarding patients referred to any of the 60 public CR sites in Queensland. In particular, for the 55 sites which had contributed data to QCOR for 2018. This adds to a growing body of information describing the baseline demographics, clinical presentation and risk factors affecting patients referred to a public CR service.

The data offers rich insight into the process of care for 11,723 new referrals in 2018. Across the analysis, the data is reassuring and shows the majority of patients had been referred for and received an initial assessment in a timely manner (95% and 62% meeting respective benchmarks). Where post assessment data were available, it is also gratifying to see over half of patients had been documented with an improved health status across the majority of metrics analysed.

Through the increased scope of the CR Audit, clear variations in practice have been identified across the state. This is highlighted by the deliberate inclusion of several sites (Goondiwindi, Stanthorpe, Bowen, Ayr and Hughenden) which have yet to contribute data through QCOR. It is hoped this inclusion may draw attention to staffing and resource availability for those sites. Across the state the relative lack of descriptive data for staffing and practitioner disciplines, and inability to correlate reported results against the model of care employed by each site hinders the analysis and makes it difficult to draw firm conclusions at this time.

Similarly, the report highlights varying practices towards patients assumed eligible for CR but not receiving a referral for whatever reason. This may occur at the behest of the patient or through other circumstances outside of the patient's control. It must be acknowledged there are clear limitations in reporting for patients who had refused or otherwise had not been referred for CR. This forms a gap in the current analysis and limits the ability to fully describe such barriers to participation. This is despite the spotlight on patients who refused or rejected to attend a CR program as further investigation is clearly warranted.

The initial examination of post assessment outcomes yields promising results suggesting clear benefits for patients who completed both the pre assessment and post assessment stages. However, these findings must be interpreted with caution due to the reduced cases included in these analyses and inconsistent post assessment completion rates. Hence there is potential for a selection bias to be in play. Nevertheless, the initial data speaks volumes for the unique potential for CR data to satisfy questions regarding patient-reported outcomes and experiences in post-discharge care.

As the data collection continues to mature and evolve, it is expected that this will allow more sophisticated analyses in future audits. This would include linkages between the CR report data and other QCOR data collections, which would follow the overall registry's direction towards a more patient-centric and disease-based model of reporting. The continued support of CR clinicians is recognised and vital to ensuring the ongoing success and development of CR services, and achieving quality patient outcomes across Queensland.

Heart Failure Support Services Audit

1 Message from the Heart Failure Steering Committee Chair

It is my pleasure to release the third annual report on patients referred to Heart Failure Support Services (HFSS) in Queensland Health. Since 2015 we have collected information on the care and outcomes of 14,500 unique patients with heart failure who were referred to one of the multidisciplinary support services of nurses and allied health across Queensland Health.

Clinical performance indicators are based on patients referred to a HFSS in the 2018 calendar year and are related to timeliness of follow-up, assessment of left ventricular function, prescription of key medications and beta blocker titration. The select group of clinical indicators is reflective of best practice at a statewide and local level.

Patient outcomes include information about survival, re-hospitalisation and days alive and out-of-hospital at a statewide level. The outcome analysis is based on the cohort from the previous year to allow for tracking outcomes over the 12 months post the hospital discharge associated with the referral.

This rich dataset would not exist without the commitment of heart failure nurses and other healthcare providers to data collection as part of routine practice. Reporting of clinical standards and outcomes is in the context of a larger ongoing statewide quality improvement program where the reasons for variations in practice can be explored and systems of care can be developed to ensure that patients receive the best standard of care.

Patients and their families referred to heart failure support services manage a multitude of social, emotional and physical factors related to this chronic condition. We hope that the monitoring of our clinical practice is one small, but important contribution to ensuring that patients receive the best possible clinical care to ultimately live longer and achieve the best quality of life.

Associate Professor John Atherton
Chair of the QCOR Heart Failure committee

2 Key findings

Characteristics of the 2018 cohort of referrals to a Heart Failure Support Service (HFSS)

- The majority of the 4,878 referrals were: male (68%), non-Indigenous (94.7%), referred to South East Queensland HFSS (85%); from an inpatient setting (70%); and diagnosed with HFrEF (80.2%).
- Median age of referrals was 69 years old with: males younger than females (68 vs 72 years); Aboriginal and Torres Strait Islander younger than non-Indigenous patients (56 vs 70 years); HFrEF patients younger than HFpEF (68 vs 76 years); and over 20% aged 80 years or more.

Clinical indicator performance for 2018

- Most indicators met benchmarks at a statewide level except for the review and titration of beta blockers (Clinical indicator 5a, b, c) (see Table 1).
- There is variation in practice with many of the 21 HFSS below benchmarks for clinical indicators 1a (follow-up of inpatient referrals in two weeks) and 5a, b, c (beta blocker review and titration).
- Prescribing of guideline directed medications met benchmarks for all sites.

Table 1: Summary of statewide clinical indicator performance

#	Clinical indicator	% referrals
1a	Follow-up of acute patients within 2 weeks	78.5
1b	Follow-up of non-acute patients within 4 weeks	82.4*
2	Assessment of left ventricular ejection fraction within 2 years	95.5*
3a	ACEI/ARB† prescription at hospital discharge	92.1*
3b	ACEI/ARB† at first clinical review	91.0*
4a	Beta blocker‡ prescription at hospital discharge	89.6*
4b	Beta blocker‡ prescription at first clinical review	91.3*
5a	Beta blocker‡ titration status review at six months post referral	66.7
5b	Beta blocker‡ achievement of guideline recommended target	32.4
5c	Beta blocker‡ achievement of guideline recommended target dose or maximum tolerated dose	72.2

* Benchmark met (benchmark is 80% achievement except for 5b which is 50%)

† Angiotensin-converting-enzyme inhibitor (ACEI) or angiotensin II receptor blockers (ARB)

‡ Bisoprolol, Carvedilol, Metoprolol sustained release, or Nebivolol

Patient outcomes

Patient outcomes regarding hospital use and death are based on 2017 referrals from an inpatient source to allow for 12 month follow-up from the index hospitalisation. Key findings are summarised in Table 2.

Table 2: Summary of outcomes for patients referred from a hospital setting

#	Measures post index hospitalisation*	30 days	1 year
1	All-cause mortality	1.7%	14.3%
2	a) All-cause rehospitalisation	17.8%	57.0%
	b) Heart failure rehospitalisation	5.6%	24.2%
3	Composite all-cause hospitalisation or all-cause mortality	18.1%	58.1%
4	Days alive and out-of-hospital†	N/A	363 median days‡

* Commences from date of discharge for index admission

† A single measure of mortality, readmissions and length of stay

‡ Approximately 55% of patients had additional time in hospital

Recommendations

- Monitor Mineralocorticoid receptor antagonists (MRA) prescribing and use of Angiotensin Receptor-Neprilysin Inhibitors (ARNI) (underway for 2019 cohort).
- Collect information about HF with associated valvular disease and right heart failure (underway for 2019 cohort).
- Record reasons for not achieving target dose of beta blockers (underway for 2019 cohort).
- Record the use of cardiac implantable electronic devices (CIED) (under development for 2020 cohort).
- Include a clinical indicator related to exercise training.
- Further develop systems of care to improve beta blocker titration.
- Collect additional variables to allow for risk adjustment of patient outcomes.

3 Participating sites

Heart failure support services (HFSS) consist of teams of specialised nurses with medical support. Some services include a range of allied health. Of the 22 HFSS in Queensland, 21 contributed data to this year's annual report. There were 23 services in 2017, but two nursing services at The Prince Charles Hospital amalgamated into one in 2018. The locations and services offered are shown in Figure 1 and Table 3.

Table 3: Queensland Heart Failure Support Services (HFSS) facilities and acronyms

Hospital and Health Service (HHS)	HFSS Facility	Acronym
Cairns and Hinterland	Cairns Hospital	CH
Central Queensland	Gladstone Hospital	GLH
	Rockhampton Hospital	RKH
Darling Downs	Toowoomba Hospital	TWH
Gold Coast	Gold Coast Community Health	GCCH
Mackay	Mackay Base Hospital	MBH
Metro North	Caboolture Hospital	CBH
	Redcliffe Hospital*	RDH
	Royal Brisbane and Women's Hospital	RBWH
	The Prince Charles Hospital	TPCH
Metro South	Logan Hospital	LGH
	Mater Adult Hospital, Brisbane	MTHB
	Princess Alexandra Hospital	PAH
	Queen Elizabeth II Hospital	QEII
	Redland Hospital	RLH
North West	Mt Isa Hospital	MIH
Sunshine Coast	Gympie Hospital	GYH
	Sunshine Coast University Hospital	SCUH
Townsville	Townsville Hospital	TTH
West Moreton	Ipswich Community Health	IPCH
Wide Bay	Bundaberg Hospital†	BNH
	Hervey Bay Hospital (includes Maryborough)	HBH

* Partial participation

† Did not participate

Figure 1: Heart Failure Support Service locations

Table 4: Components of Queensland Heart Failure Support Services

HHS	Facility	HFSS Disciplines				Modes of service (telephone + ...)				
		Nurse	NP*	Pharm†	Physio or AEP‡	In-patient	Nurse or MD clinics	Home visits	Groups	Medical mentor§
Cairns and Hinterland	CH	Y	Y	–	Y	Y	Y	Y	Y	Y
Central Queensland	GLH	Y	–	–	Y	Y	–	–	Y	Video clinic
	RKH	Y	Y	Y	Y	Y	Y	–	Y	Y
Darling Downs	TWH	Y	–	Y	–	–	Y	Y	–	Y
Gold Coast	GCCH	Y	–	Y	Y	Y	Y	Y	Y	Y
Mackay	MBH	Y	–	–	Y	–	Y	–	Y	Y
Metro North	CBH	Y	–	Y	–	–	Y	–	–	Y
	RDH	Y	–	–	–	–	–	Y	–	Y
	RBWH	Y	–	Y	Y	Y	Y	–	Y	Y
	TPCH	Y	Y	Y	Y	Y	Y	–	Y	Y
Metro South	LGH	Y	Y	Y	Y	Y	Y	Y	Y	Y
	MTHB	Y	Y	–	R	Y	Y	Y	–	Y
	PAH	Y	Y	Y	Y	Y	Y	Y	Y	Y
	QEII	Y	Y	Y	R	Y	Y	Y	–	Y
	RLH	Y	Y	–	Y	Y	Y	Y	Y	Y
North West	MIH	Y	Y	–	R	Y	Y	Y	–	Outreach
Sunshine Coast	GYH	Y	–	–	–	Y	Y	Y	Y	Y
	SCUH	Y	Y	–	R	Y	Y	Y	–	Y
Townsville	TTH	Y	Y	Y	R	Y	Y	Y	–	Y
West Moreton	IPCH	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wide Bay	BNH	Y	–	–	R	–	–	–	–	Y
	HBH	Y	Y	–	Y	Y	Y	Y	Y	Video clinic
Statewide		100%	59%	50%	82%	77%	86%	68%	59%	100%

* Nurse practitioner who can prescribe medications

† Pharmacist

§ The HFSS has a cardiologist or general physician mentor

‡ Physiotherapist or Accredited Exercise Physiologist

R Referral for exercise that is routinely accepted by another program such as cardiac or pulmonary rehab

4 New referrals

In 2018, there were 4,878 new referrals reported by 21 participating HFSS.

4.1 Location of referrals

Table 5: Distribution of new referrals by HFSS location

Referrals per HHS	n (%)	Referrals per facility in each HHS	n (%)
Cairns and Hinterland	156 (3.2)	Cairns Hospital	156 (3.9)
Central Queensland	201 (4.2)	Gladstone Hospital	13 (0.3)
		Rockhampton Hospital	188 (3.9)
Darling Downs	100 (2.1)	Toowoomba Hospital	100 (2.1)
Gold Coast	503 (10.3)	Gold Coast Community Health	503 (10.3)
Mackay	85 (1.7)	Mackay Base Hospital	85 (1.7)
Metro North	1,367 (28.0)	Caboolture Hospital	187 (3.8)
		Redcliffe Hospital	33 (0.7)
		Royal Brisbane and Women's Hospital	362 (7.4)
		The Prince Charles Hospital	785 (16.1)
Metro South	1,409 (28.9)	Logan Hospital	362 (7.4)
		Mater Adult Hospital	92 (1.9)
		Princess Alexandra Hospital	639 (13.1)
		Queen Elizabeth II Hospital	133 (2.7)
		Redland Hospital	183 (3.8)
North West	45 (0.9)	Mt Isa Hospital	45 (0.9)
Sunshine Coast	488 (10.0)	Gympie Hospital	113 (2.3)
		Sunshine Coast University Hospital	375 (7.7)
Townsville	184 (3.8)	Townsville Hospital	184 (3.8)
West Moreton	274 (5.6)	Ipswich Community Health	274 (5.6)
Wide Bay	66 (1.4)	Hervey Bay Hospital	66 (1.4)
Statewide			**4,878 (100.0)**

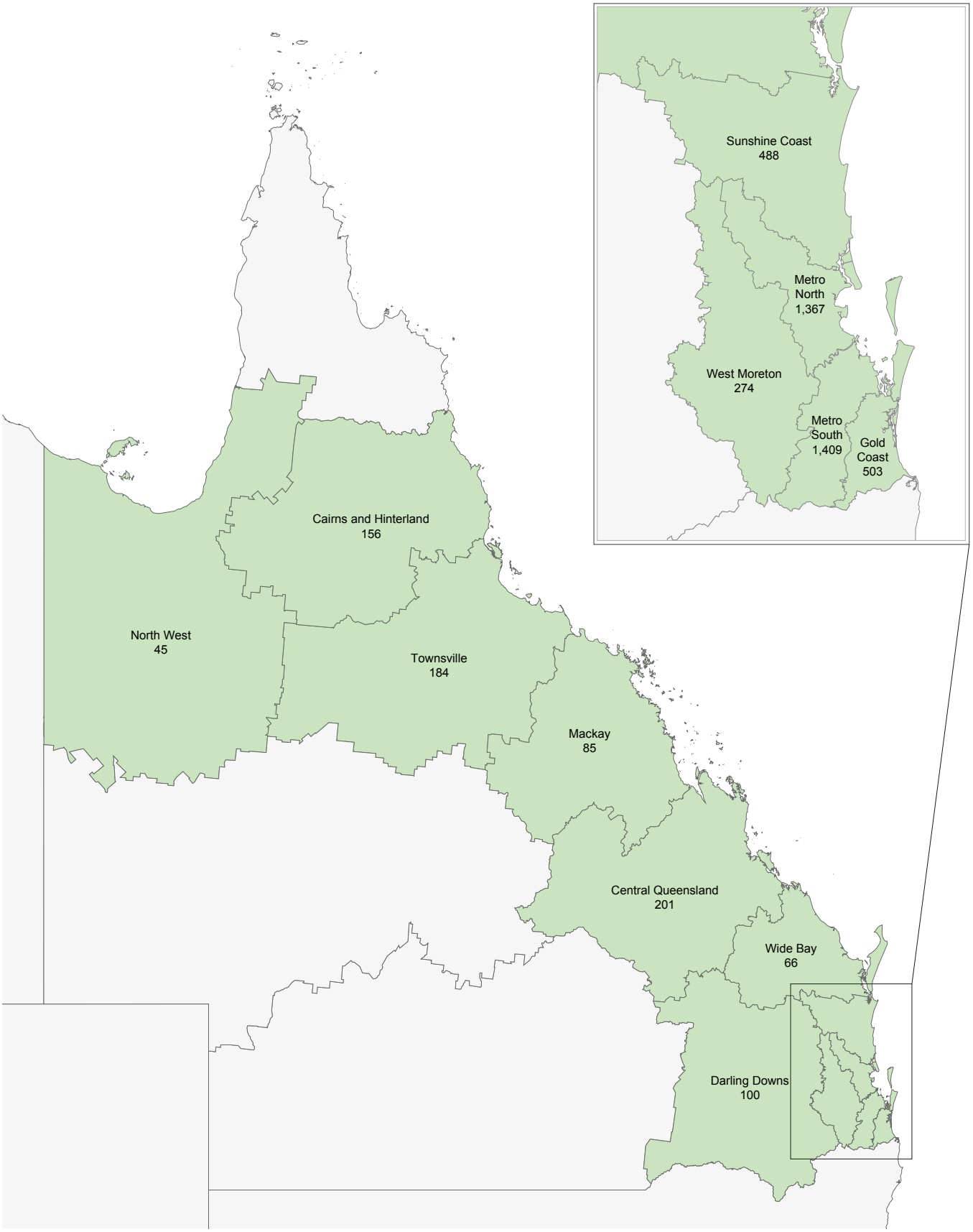


Figure 2: Regional distribution of new referrals

4.2 Referral source

Most referrals originated from an inpatient setting (70%). Few referrals came directly from primary care (3%) as most referrals flow to specialty outpatient clinics for diagnosis and treatment optimisation prior to referral to a HFSS.

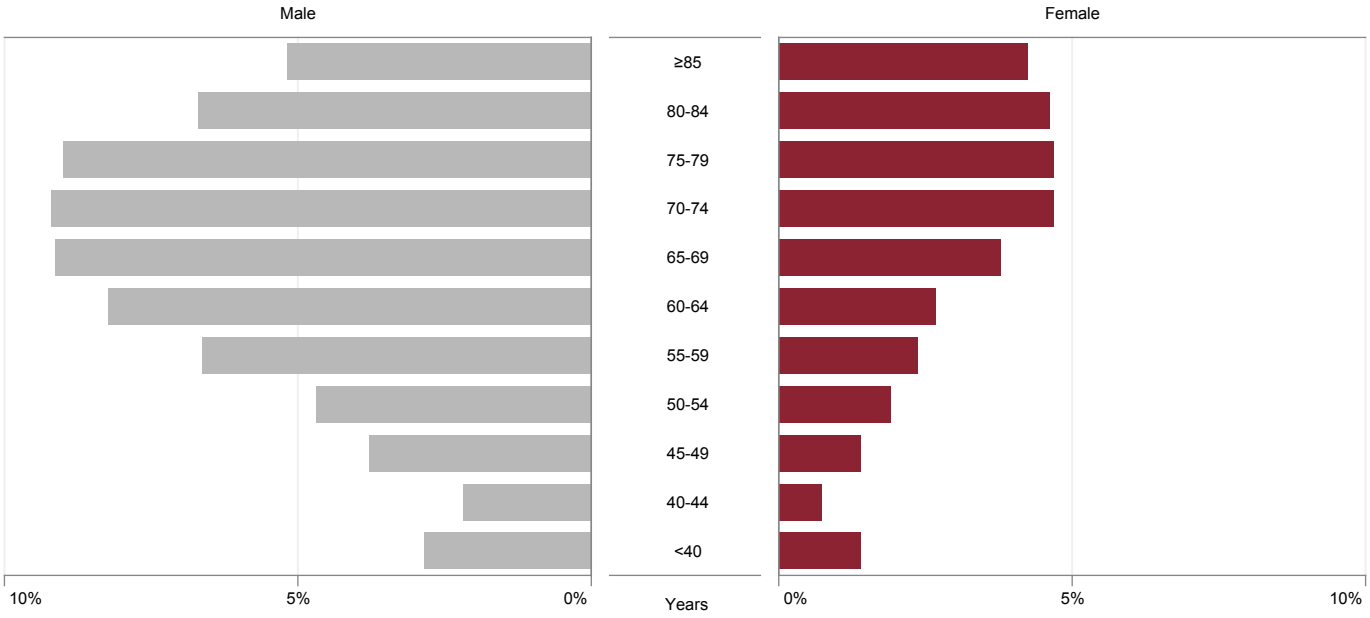
Table 6: Source of HFSS referral

HHS	HFSS	Inpatient n (%)	Outpatient n (%)	Another HFSS n (%)	Primary care n (%)
Cairns and Hinterland	Cairns Hospital	96 (61.5)	60 (38.5)	–	–
Central Queensland	Gladstone Hospital	7 (53.8)	1 (7.7)	5 (38.5)	–
	Rockhampton Hospital	112 (59.6)	59 (31.4)	4 (2.1)	13 (6.9)
Darling Downs	Toowoomba Hospital	16 (16.0)	74 (74.0)	10 (10.0)	–
Gold Coast	Gold Coast Community Health	374 (74.4)	86 (17.1)	21 (4.2)	22 (4.4)
Mackay	Mackay Base Hospital	38 (44.7)	45 (52.9)	2 (2.4)	–
Metro North	Caboolture Hospital	29 (15.5)	56 (29.9)	8 (4.3)	94 (50.3)
	Redcliffe Hospital	16 (48.5)	14 (42.4)	3 (9.1)	–
	Royal Brisbane and Women's Hospital	271 (74.9)	90 (24.9)	1 (0.3)	–
	The Prince Charles Hospital	689 (87.8)	91 (11.6)	4 (0.5)	1 (0.1)
Metro South	Logan Hospital	261 (72.1)	35 (9.7)	59 (16.3)	7 (1.9)
	Mater Adult Hospital	66 (71.7)	26 (28.3)	–	–
	Princess Alexandra Hospital	591 (92.5)	44 (6.9)	4 (0.6)	–
	Queen Elizabeth II Hospital	93 (69.9)	24 (18.0)	15 (11.3)	1 (0.8)
	Redland Hospital	87 (47.5)	27 (14.8)	67 (36.6)	2 (1.1)
North West	Mt Isa Hospital	16 (35.6)	29 (64.4)	–	–
Sunshine Coast	Gympie Hospital	61 (54.0)	14 (12.4)	37 (32.7)	1 (0.9)
	Sunshine Coast University Hospital	307 (81.9)	62 (16.5)	6 (1.6)	–
Townsville	Townsville Hospital	123 (66.8)	60 (32.6)	1 (0.5)	–
West Moreton	Ipswich Community Health	152 (55.5)	86 (31.4)	34 (12.4)	2 (0.7)
Wide Bay	Hervey Bay Hospital	8 (12.1)	14 (21.2)	40 (60.6)	4 (6.1)
Statewide		**3,413 (70.0)**	**997 (20.4)**	**321 (6.6)**	**147 (3.0)**

5 Patient characteristics

5.1 Age

The statewide median age of patients managed by a HFSS was 69 years. The median age of women (72 years) was four years older than for men. Over one-third (34%) of patients were 75 years of age and older.



% of total (n=4,878)

Figure 3: Proportion of referrals to HFSS by gender and age group

Table 7: Median age of referrals by gender

HHS	HFSS	Male years	Female years	ALL years
Cairns and Hinterland	Cairns Hospital	63	65	64
Central Queensland	Gladstone Hospital	59	74	67
	Rockhampton Hospital	69	66	68
Darling Downs	Toowoomba Hospital	65	59	63
Gold Coast	Gold Coast Community Health	70	75	72
Mackay	Mackay Base Hospital	63	68	65
Metro North	Caboolture Hospital	71	70	71
	Redcliffe Hospital	80	78	78
	Royal Brisbane and Women's Hospital	67	72	68
	The Prince Charles Hospital	68	72	70
Metro South	Logan Hospital	67	75	69
	Mater Adult Hospital	66	75	70
	Princess Alexandra Hospital	68	71	69
	Queen Elizabeth II Hospital	67	76	70
	Redland Hospital	68	77	73
North West	Mt Isa Hospital	59	57	58
Sunshine Coast	Gympie Hospital	76	75	76
	Sunshine Coast University Hospital	72	73	72
Townsville	Townsville Hospital	65	66	65
West Moreton	Ipswich Community Health	66	71	67
Wide Bay	Hervey Bay Hospital	71	74	71
Statewide		**68**	**72**	**69**

5.2 Gender

The majority of patients were male (68%), ranging from 42% to 81% across participating sites.

Table 8: Number and proportion of referrals to HFSS by gender

HHS	HFSS	Male n (%)	Female n (%)	ALL n (%)
Cairns and Hinterland	Cairns Hospital	116 (74.4)	40 (25.6)	156 (100.0)
Central Queensland	Gladstone Hospital	10 (76.9)	3 (23.1)	13 (100.0)
	Rockhampton Hospital	133 (70.7)	55 (29.3)	188 (100.0)
Darling Downs	Toowoomba Hospital	81 (81.0)	19 (19.0)	100 (100.0)
Gold Coast	Gold Coast Community Health	347 (69.0)	156 (31.0)	503 (100.0)
Mackay	Mackay Base Hospital	56 (65.9)	29 (34.1)	85 (100.0)
Metro North	Caboolture Hospital	129 (69.0)	58 (31.0)	187 (100.0)
	Redcliffe Hospital	14 (42.4)	19 (57.6)	33 (100.0)
	Royal Brisbane and Women's Hospital	251 (69.3)	111 (30.7)	362 (100.0)
	The Prince Charles Hospital	507 (64.6)	278 (35.4)	785 (100.0)
Metro South	Logan Hospital	247 (68.2)	115 (31.8)	362 (100.0)
	Mater Adult Hospital	57 (62.0)	35 (38.0)	92 (100.0)
	Princess Alexandra Hospital	450 (70.4)	189 (29.6)	639 (100.0)
	Queen Elizabeth II Hospital	81 (60.9)	52 (39.1)	133 (100.0)
	Redland Hospital	109 (59.6)	74 (40.4)	183 (100.0)
North West	Mt Isa Hospital	30 (66.7)	15 (33.3)	45 (100.0)
Sunshine Coast	Gympie Hospital	68 (60.2)	45 (39.8)	113 (100.0)
	Sunshine Coast University Hospital	263 (70.1)	112 (29.9)	375 (100.0)
Townsville	Townsville Hospital	129 (70.1)	55 (29.9)	184 (100.0)
West Moreton	Ipswich Community Health	171 (62.4)	103 (37.6)	274 (100.0)
Wide Bay	Hervey Bay Hospital	48 (72.7)	18 (27.3)	66 (100.0)
Statewide		**3,297 (67.6)**	**1,581 (32.4)**	**4,878 (100.0)**

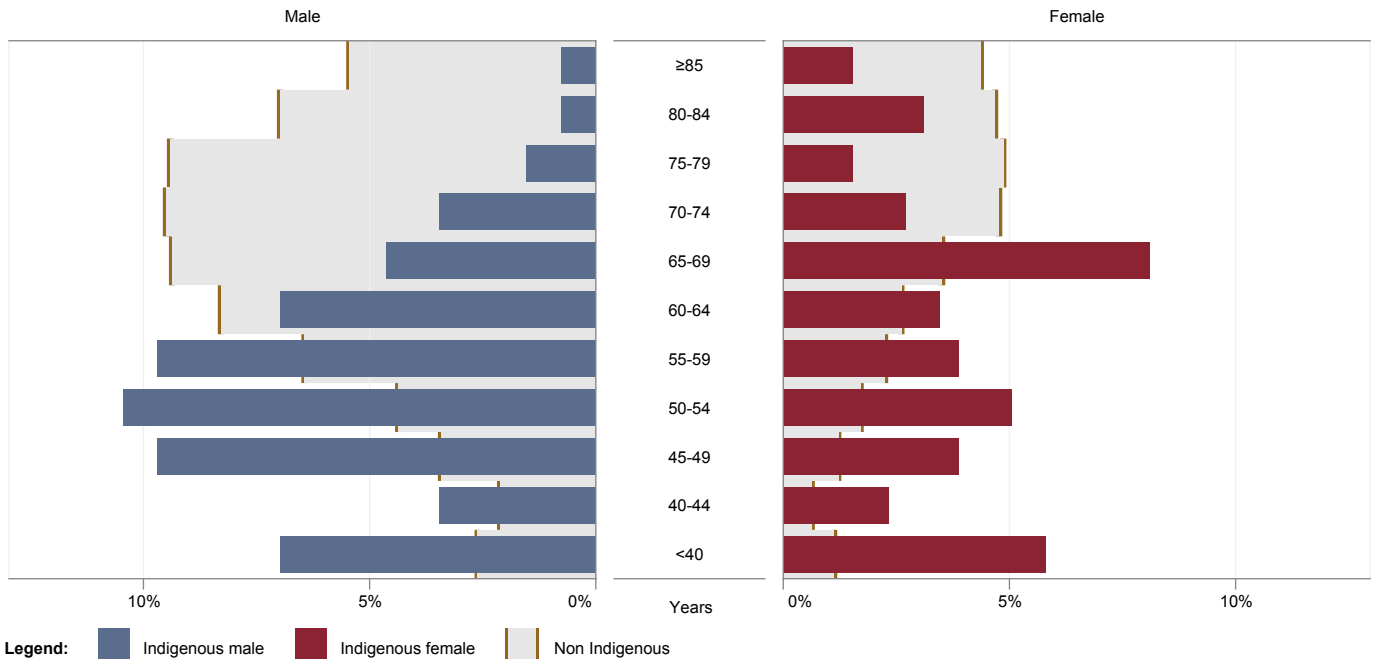
5.3 Aboriginal and Torres Strait Islander status

Patients of identified Aboriginal and Torres Strait Islander status made up 5.5% of all referrals. The number of referrals (n=258) represented a 40% increase in referrals from the previous year (n=185). Aboriginal and Torres Strait Islander patients were significantly younger than other Queenslanders. Table 9 shows that the proportion of Aboriginal and Torres Strait Islander referrals was highest in Mt Isa (47%), followed by Townsville (23%) and Cairns (20%).

Although a smaller proportion of total referrals, almost 40% of all Aboriginal and Torres Strait Islander referrals were to facilities in the greater Brisbane area (Metro North or Metro South Hospital and Health Services).

Table 9: Proportion of site referrals identified Aboriginal and Torres Strait Islander

HHS	Facility	Indigenous n (%)	Non-Indigenous n (%)	Not stated / unknown n (%)
Cairns and Hinterland	Cairns Hospital	31 (19.9)	125 (80.1)	–
Central Queensland	Gladstone Hospital	1 (7.7)	12 (92.3)	–
	Rockhampton Hospital	20 (10.6)	168 (89.4)	–
Darling Downs	Toowoomba Hospital	5 (5.0)	94 (94.0)	1 (1.0)
Gold Coast	Gold Coast Community Health	10 (2.0)	488 (97.0)	5 (1.0)
Mackay	Mackay Base Hospital	5 (5.9)	80 (94.1)	–
Metro North	Caboolture Hospital	7 (3.7)	180 (96.3)	–
	Redcliffe Hospital	–	33 (100.0)	–
	Royal Brisbane and Women's Hospital	12 (3.3)	349 (96.4)	1 (0.3)
	The Prince Charles Hospital	22 (2.8)	763 (97.2)	–
Metro South	Logan Hospital	15 (4.1)	347 (95.9)	–
	Mater Adult Hospital	4 (4.3)	86 (93.5)	2 (2.2)
	Princess Alexandra Hospital	32 (5.0)	605 (94.7)	2 (0.3)
	Queen Elizabeth II Hospital	3 (2.3)	130 (97.7)	–
	Redland Hospital	8 (4.4)	175 (95.6)	–
North West	Mt Isa Hospital	21 (46.7)	24 (53.3)	–
Sunshine Coast	Gympie Hospital	1 (0.9)	112 (99.1)	–
	Sunshine Coast University Hospital	7 (1.9)	366 (97.6)	2 (0.5)
Townsville	Townsville Hospital	42 (22.8)	142 (77.2)	–
West Moreton	Ipswich Community Health	12 (4.4)	262 (95.6)	–
Wide Bay	Hervey Bay Hospital	–	66 (100.0)	–
Statewide		**258 (5.3)**	**4,607 (94.4)**	**13 (0.3)**



% of total Indigenous (n=258) and total Non-Indigenous (n=4,607)

Excludes missing data (0.3%)

Figure 4: Proportion of all referrals by age group and Indigenous status

Table 10: Median patient age by gender and Indigenous status

HHS	Total referrals n	Male years	Female years	ALL years
Indigenous	258	55	60	56
Non-Indigenous	4,607	69	73	70
ALL	**4,865**	**68**	**72**	**69**

5.4 Classification of heart failure by left ventricular ejection fraction

Heart failure with reduced ejection fraction (HFrEF) was defined as patients with an ejection fraction (EF) equal or equivalent to 50% at time of diagnosis. The EF may return to normal for some patients but still require ongoing medications to manage HFrEF.[27]

The data categorised patients as predominately HFrEF or heart failure with preserved ejection fraction (HFpEF). HFrEF was attributed to 80% of patients in the 2018 cohort. The table below shows the rates of HFrEF and HFpEF as well as the rates where the phenotype is uncertain. Six sites had more than 20% of referrals with HFpEF. Five sites had over 95% of referrals with HFrEF and, of these, four were in Far North Queensland (Cairns, Townsville, Mackay and Mt Isa).

There was no significant gender difference between patients with HFpEF (males 49.7% vs females 50.3%). Patients with HFrEF were more likely to be male (71.7%) with a median age was eight years younger than for HFpEF (68 years vs 76 years).

Table 11: Proportion of patients by heart failure type

HHS	HFSS	HFrEF* n (%)	HFpEF† n (%)	Unsure/ Unknown n (%)
Cairns and Hinterland	Cairns Hospital	154 (98.7)	1 (0.6)	1 (0.6)
Central Queensland	Gladstone Hospital	11 (84.6)	1 (7.7)	1 (7.7)
	Rockhampton Hospital	157 (83.5)	26 (13.8)	5 (2.7)
Darling Downs	Toowoomba Hospital	97 (97.0)	–	3 (3.0)
Gold Coast	Gold Coast Community Health	396 (78.7)	96 (19.1)	11 (2.2)
Mackay	Mackay Base Hospital	85 (100.0)	–	–
Metro North	Caboolture Hospital	138 (73.8)	39 (20.9)	10 (5.3)
	Redcliffe Hospital	15 (45.5)	9 (27.3)	9 (27.3)
	Royal Brisbane and Women's Hospital	308 (85.1)	50 (13.8)	4 (1.1)
	The Prince Charles Hospital	559 (71.2)	184 (23.4)	42 (5.4)
Metro South	Logan Hospital	269 (74.3)	85 (23.5)	8 (2.2)
	Mater Adult Hospital	67 (72.8)	14 (15.2)	11 (12.0)
	Princess Alexandra Hospital	550 (86.1)	73 (11.4)	16 (2.5)
	Queen Elizabeth II Hospital	107 (80.5)	18 (13.5)	8 (6.0)
	Redland Hospital	127 (69.4)	41 (22.4)	15 (8.2)
North West	Mt Isa Hospital	43 (95.6)	2 (4.4)	–
Sunshine Coast	Gympie Hospital	56 (49.6)	44 (38.9)	13 (11.5)
	Sunshine Coast University Hospital	320 (85.3)	53 (14.1)	2 (0.5)
Townsville	Townsville Hospital	171 (92.9)	8 (4.3)	5 (2.7)
West Moreton	Ipswich Community Health	222 (81.0)	50 (18.2)	2 (0.7)
Wide Bay	Hervey Bay Hospital	58 (87.9)	8 (12.1)	–
Statewide		**3,910 (80.2)**	**802 (16.4)**	**166 (3.4)**

* Heart failure with reduced ejection fraction (LVEF ‹50%)

† Heart failure with preserved ejection fraction (LVEF ≥50%)

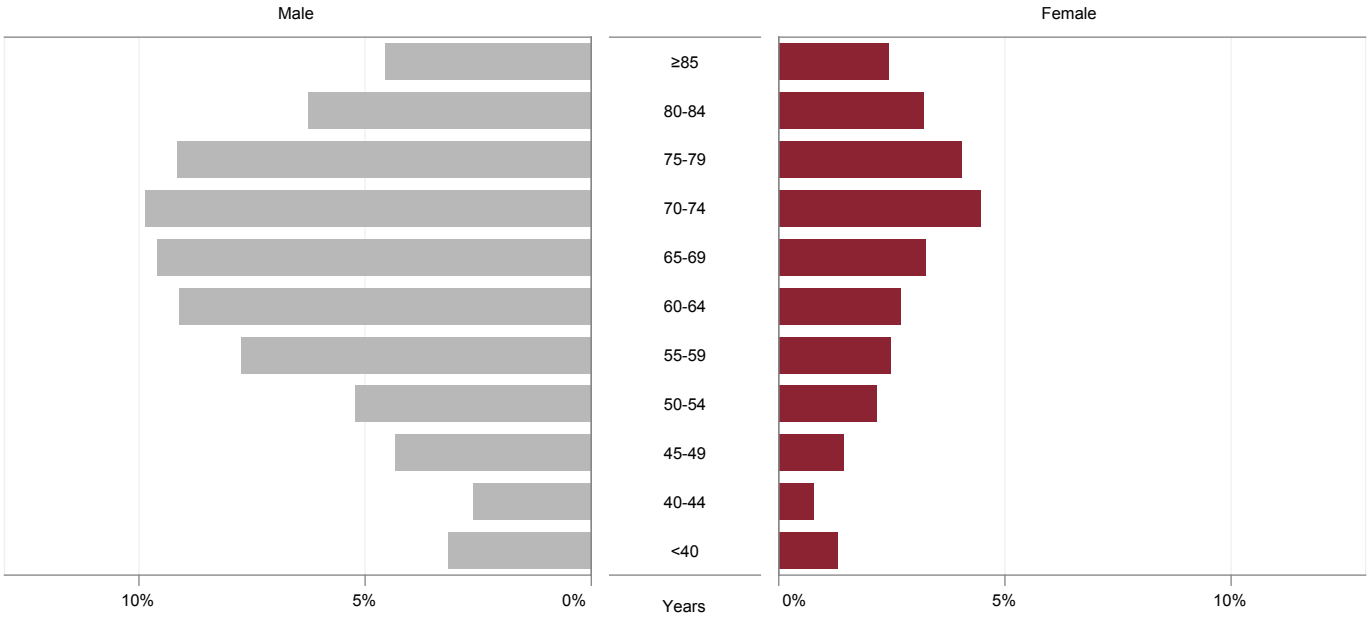
Table 12: Summary of patient age, gender and Indigenous status by type of heart failure

	HFrEF*	HFpEF†	Unsure/ Unknown
Number	3,910	802	166
Age (median years)	68	76	77
% male	71.7	49.7	2.0
% Indigenous	4.6	3.6	0.1

Excludes missing data (3.5%)

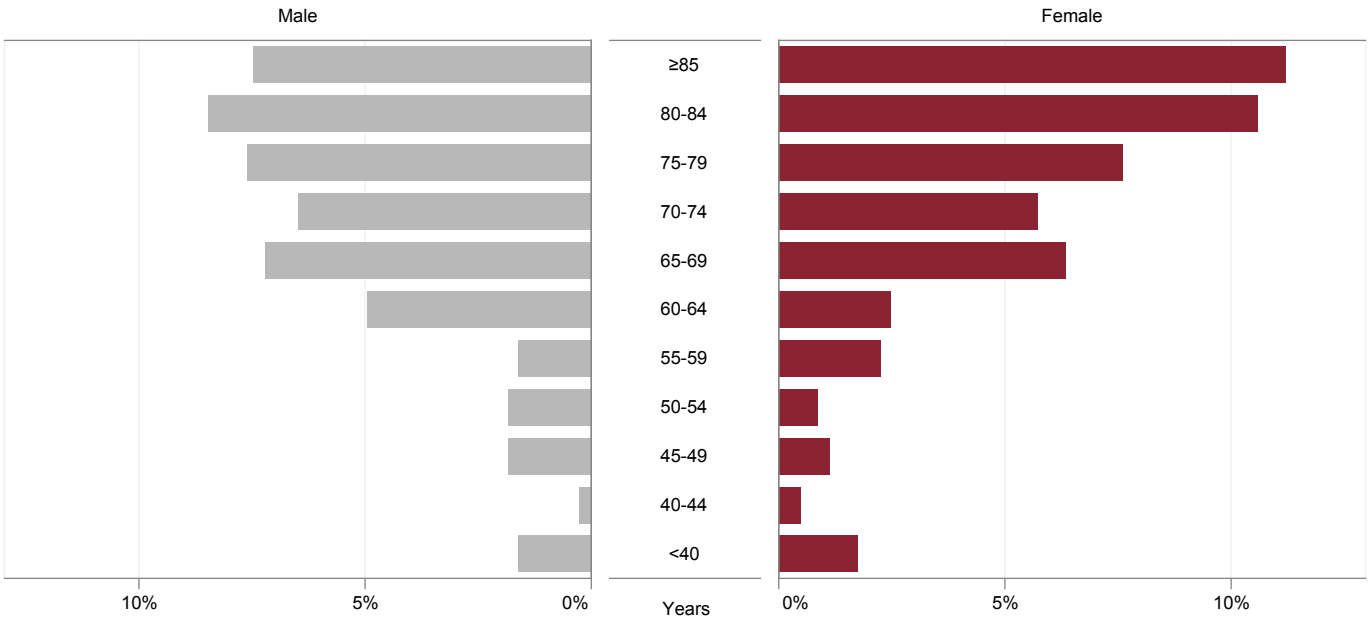
* Heart failure with reduced ejection fraction

† Heart failure with preserved ejection fraction



% of total with HFrEF (n=3,910)

Figure 5: Proportion of HFrEF referrals by gender and age group



% of total with HFpEF (n=802)

Figure 6: Proportion of HFpEF referrals by gender and age group

5.5 Summary of patient characteristics

Patient characteristics from all referrals to a HFSS is shown below.

Table 13: Summary of patient characteristics

Characteristic	Summary
Participating HFSS	21
New referrals	4,878
Referrals from South East Queensland	84.9%
Referral source:	
Inpatient	70.0%
Outpatient	20.4%
Another HFSS	6.6%
Primary care	3.0%
Age (median years):	
All (median, range by service)	69 (58–78) years
Male vs Female	68 vs 72 years
ATSI* vs other	56 vs 70 years
HFrEF† vs HFpEF‡	68 vs 76 years
Age group:	
80 years and over	20.7%
Males	67.6%
ATSI*	5.3%
HFrEF†	80.2% (57.5% male)
HFpEF‡	16.4% (8.1% male)

* Aboriginal and Torres Strait Islander

† Heart failure with reduced ejection fraction

‡ Heart failure with preserved ejection fraction

6 Clinical indicators

The number of clinical indicators collected was intentionally limited to allow pragmatic data entry as part of routine clinical practice. The five clinical indicators selected are shown in Table 14.

The target benchmark for all indicators was set at 80%, except for 5b (beta blocker titration to clinical guideline target dose at six months) where the benchmark was set at 50%. The lower benchmark of 50% acknowledges that target doses derived from clinical trials may be inappropriate in clinical practice where patients are often older with greater disease severity and associated comorbidities compared to patients recruited to large drug trials.[28]

Table 14: Clinical indicators

Indicator #	Process measures
1	First clinical review: Timeliness of follow-up by a HFSS for inpatient and outpatient referrals 1a) First clinical review within 2 weeks for inpatient referrals 1b) First clinical review within 4 weeks for non-acute referrals
2	Left ventricular ejection fraction assessed within 2 years of referral to HFSS
3	Prescription of angiotensin-converting-enzyme inhibitor (ACEI) or angiotensin II receptor blockers (ARB) for patients with HFrEF 3a) ACEI/ARB prescription at hospital discharge 3b) ACEI/ARB prescription at time of first clinical review
4	Prescription of guideline recommended beta blockers for HFrEF (Bisoprolol, Carvedilol, Metoprolol sustained release, or Nebivolol) 4a) Beta blocker prescription at hospital discharge 4b) Beta blocker prescription at time of first clinical review
5	Beta blocker review and titration 5a) Beta blocker titration review within six months of first clinical review 5b) Beta blocker clinical guideline target dose achieved at time of titration review 5c) Beta blocker clinical guideline target or maximum tolerated dose achieved at time of titration review

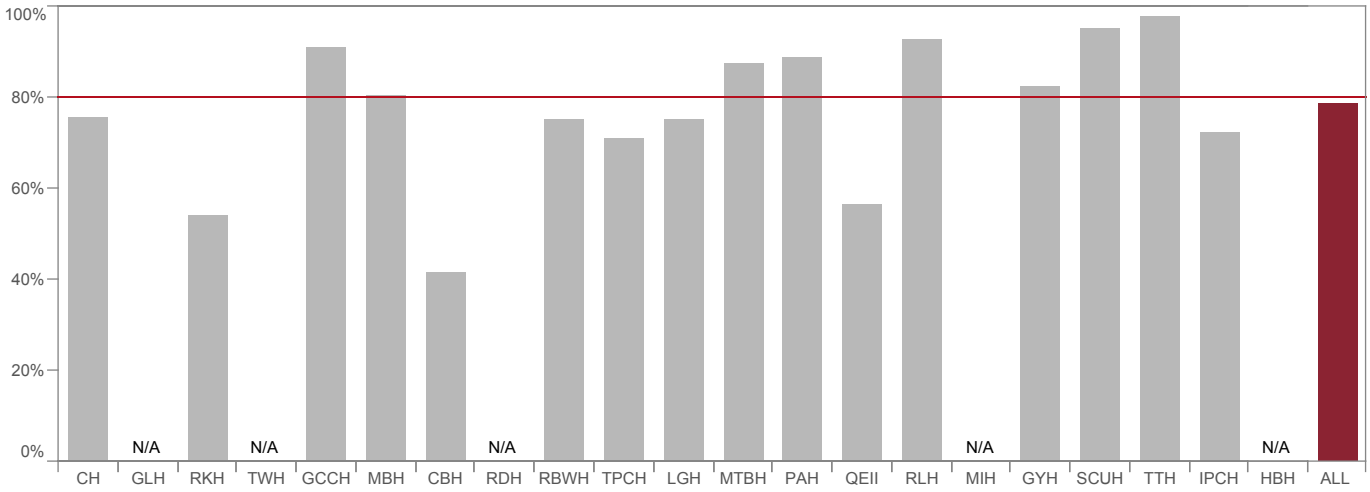
6.1 First clinical review

The HFSS review is defined as a clinical (rather than administrative) intervention and can be conducted by phone, clinic or home visit. Patients were excluded if they died, were referred to another HFSS, declined follow-up or could not be contacted, as well as other reasons outlined in Table 15.

1a First clinical review by Heart Failure Support Service within 2 weeks of hospital discharge or date of referral if after discharge (for inpatient referrals).

Early post discharge follow-up is recommended for patients with HF to monitor symptoms, provide education and support self-management principles. The appropriate timeframe chosen for this intervention was review within two weeks of hospital discharge or date of referral after recent hospitalisation.

Of the 3,413 patients referred from an acute setting, 79% received a clinical review by a HFSS within two weeks of hospital discharge.



N/A = Eligible referrals <20

Figure 7: Inpatients who received first HFSS clinical review within 2 weeks of hospital discharge

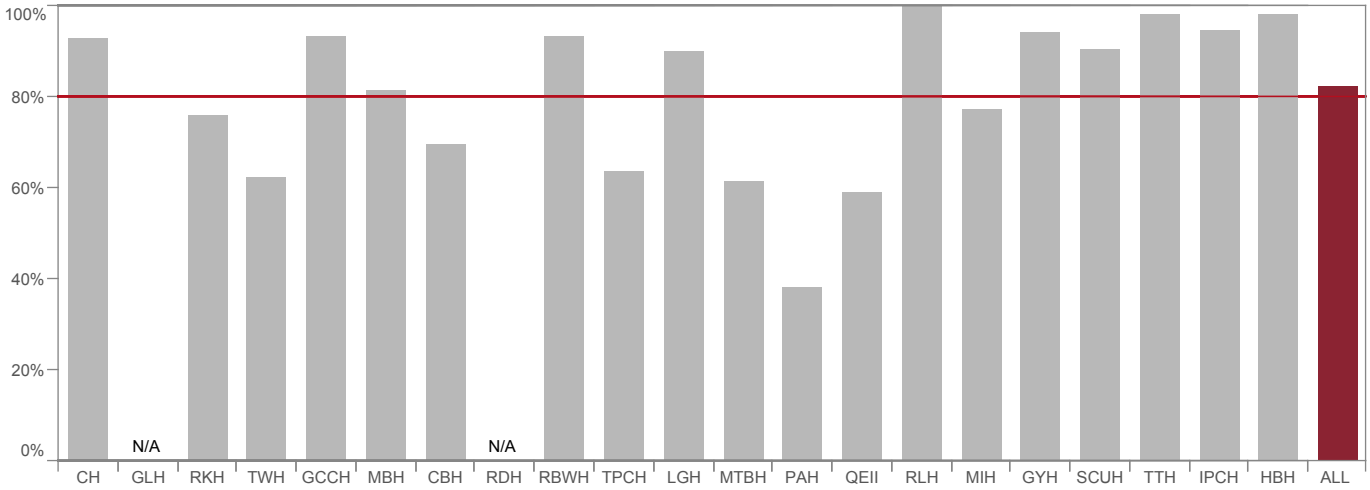
Table 15: Inpatients receiving first HFSS clinical review within 2 weeks of hospital discharge

	n	%
Eligible for analysis	2,378	
Achieved benchmark	1,867	78.5
Benchmark not achieved	511	21.5
Ineligible	988	
Referred to another HFSS	566	
Patient declined service	126	
Patient could not be contacted, lives out of area or repeated failure to attend	125	
Patient deceased	55	
Referred to another service (e.g. cardiac rehabilitation or community nursing)	47	
HF no longer prime issue (palliative care, high care nursing home etc.)	43	
Medical follow-up only (GP, private or public physician)	19	
HFSS at capacity workload	7	
Other reason	47	
Total inpatient referrals	**3,413**	

1b First Heart Failure Support Service clinical review within 4 weeks for non-acute referrals

For non-acute patients, the Statewide HF Steering Committee determined four weeks following referral to be the recommended timeframe for first clinical review.

Referrals for 1,465 patients came from non-acute services, of which 82% received a clinical review within four weeks of referral.



N/A = Eligible referrals <20

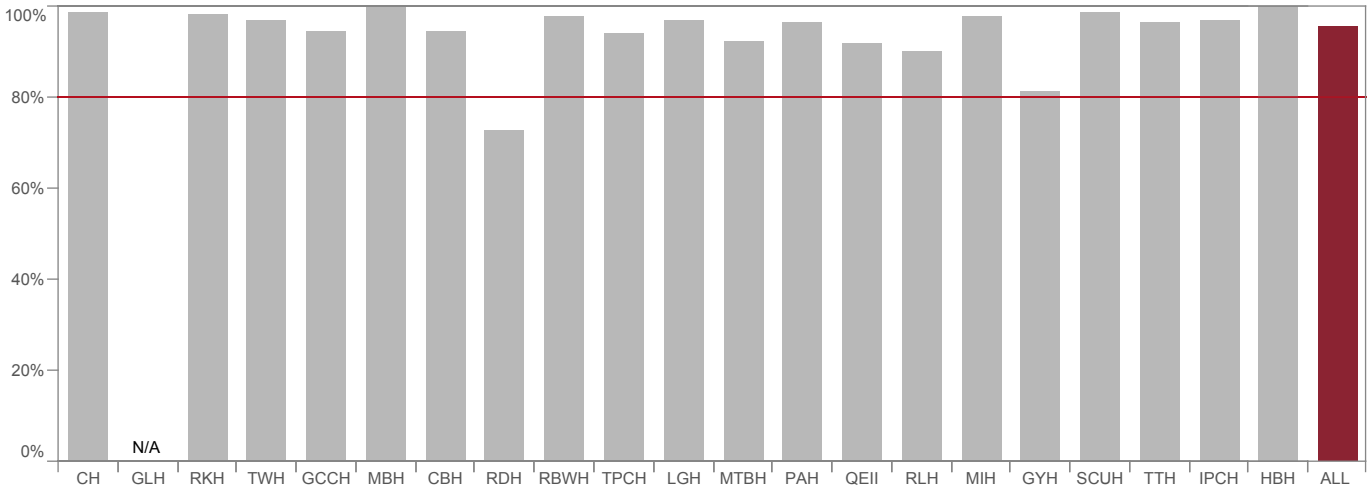
Figure 8: Proportion of non-acute patients who received first HFSS clinical review within 4 weeks of referral

Table 16: Non-acute patients receiving first HFSS clinical review within 4 weeks of referral

	n	%
Eligible for analysis	1,327	
Achieved benchmark	1,094	82.4
Benchmark not achieved	233	17.6
Ineligible	138	
Patient could not be contacted, lives out of area or repeated failure to attend	42	
Patient declined service	38	
Referred to another HFSS	23	
HF no longer prime issue (palliative care, high care nursing home etc.)	10	
Patient deceased	8	
Medical management with no support service (not advised)	4	
Referred to another service (e.g. cardiac rehabilitation or community nursing)	4	
Other reason	9	
Total non-acute patients	1,465	

6.2 Left ventricular ejection fraction (LVEF) assessed within 2 years of referral to HFSS

Australian clinical guidelines recommend that all patients with heart failure should have an assessment of left ventricular function.[27] In 96% of cases, LVEF was assessed within two years of referral to HFSS.



N/A = Eligible referrals <20

Figure 9: Proportion of all patients who had LVEF assessed within two years of referral to HFSS

Table 17: Patients who had LVEF assessed within two years of referral

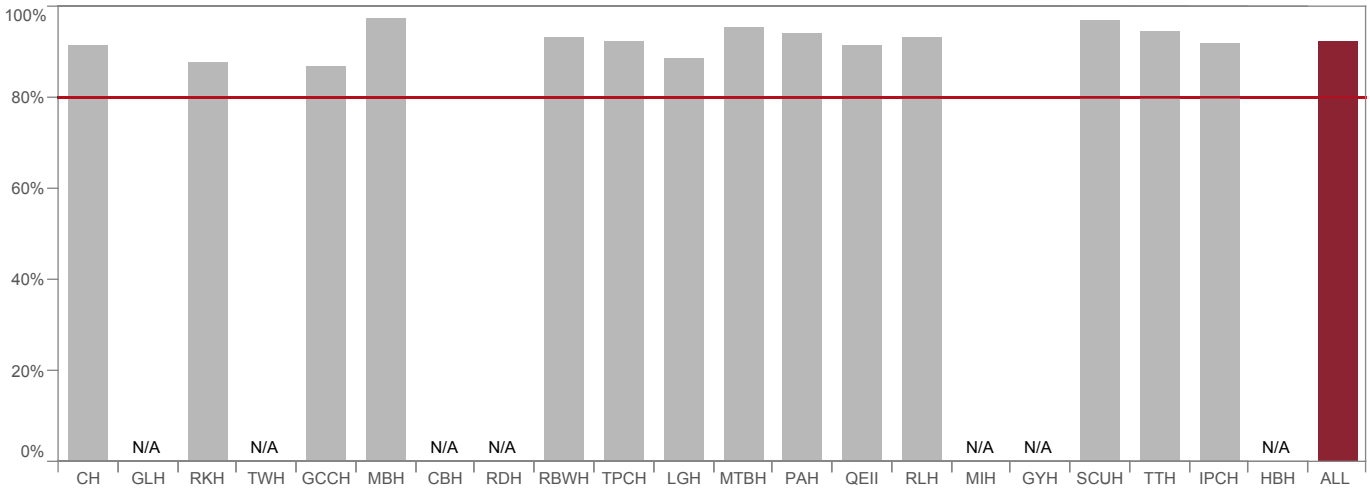
	n	%
Eligible for analysis	4,878	
Achieved benchmark	4,657	95.5
Benchmark not achieved	221	4.5
Ineligible	N/A	
Total referrals	**4,878**	

6.3 Prescription of ACEI or ARB for patients with HFrEF

Angiotensin-converting-enzyme inhibitor (ACEI) or angiotensin II receptor blockers (ARB) have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all symptomatic patients unless contraindicated or not tolerated.

3a ACEI or ARB prescription for HFrEF at hospital discharge

In 2018, 92% of patients referred to a HFSS were prescribed an ACEI or ARB therapy on hospital discharge.



N/A = Eligible referrals <20

Figure 10: Proportion of patients who were on ACEI or ARB therapy at time of hospital discharge

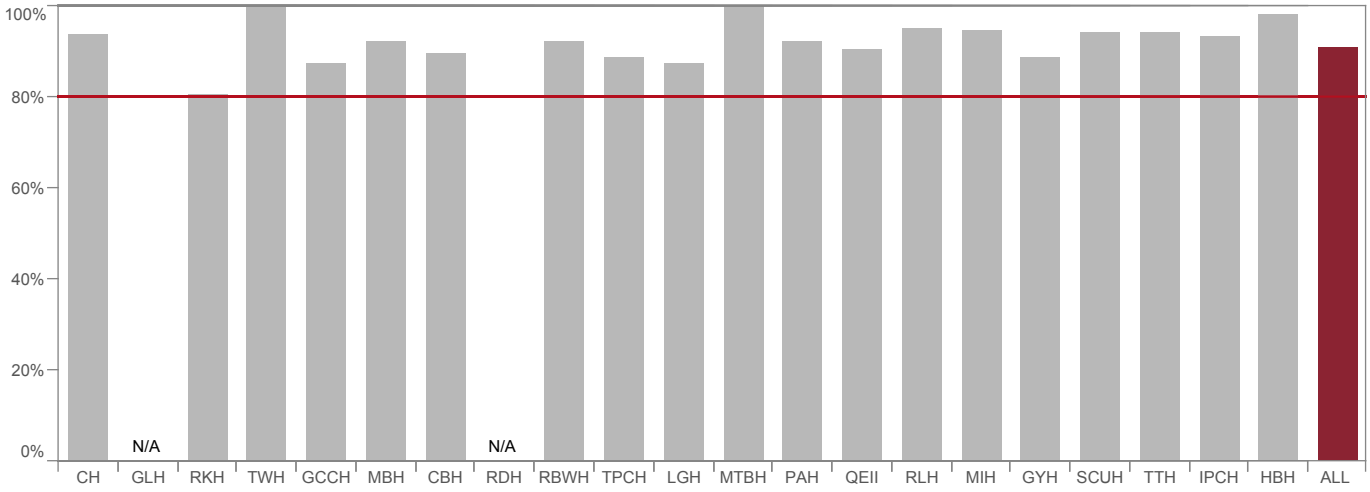
Table 18: Inpatients on ACEI or ARB at time of hospital discharge

	n	%
Eligible for analysis	2,513	
Achieved benchmark	2,315	92.1
Benchmark not achieved	198	7.9
Ineligible	896	
Not HFrEF	655	
Documented contraindication*	156	
LV function assessment not available	85	
Incomplete data	4	
Total inpatient referrals	**3,413**	

* Adverse reaction to ACEI or ARB, palliative intent to treatment, pregnancy, eGFR <30 mL/min, severe aortic stenosis, renal artery stenosis, serum potassium >5.5 mmol/L, symptomatic hypotension

3b ACEI or ARB prescription for HFrEF at time of first HFSS clinical review

At the time of first clinical review, the target for prescription of ACEI or ARB was met for 91% of patients.



N/A = Eligible referrals <20

Figure 11: Proportion of patients on ACEI or ARB therapy at time of first clinical review by site

Table 19: Patients on an ACEI or ARB at first clinical review

	n	%
Eligible for analysis	2,920	
Achieved benchmark	2,656	91.0
Benchmark not achieved	264	9.0
Ineligible	1895	
Not HFrEF	663	
Referred to another HFSS	589	
Patient could not be contacted, lives out of area or repeated failure to attend	167	
Patient declined service	164	
Patient deceased	63	
Documented contraindication*	60	
LV function assessment not available	55	
HF no longer prime issue (palliative care, high care nursing home etc.)	53	
Referred to another service (e.g. cardiac rehabilitation or community nursing)	51	
Medical follow-up only (GP, private or public physician)	23	
HFSS at capacity workload	7	
Other reason	56	
Incomplete data	7	
Total referrals	**4,878**	

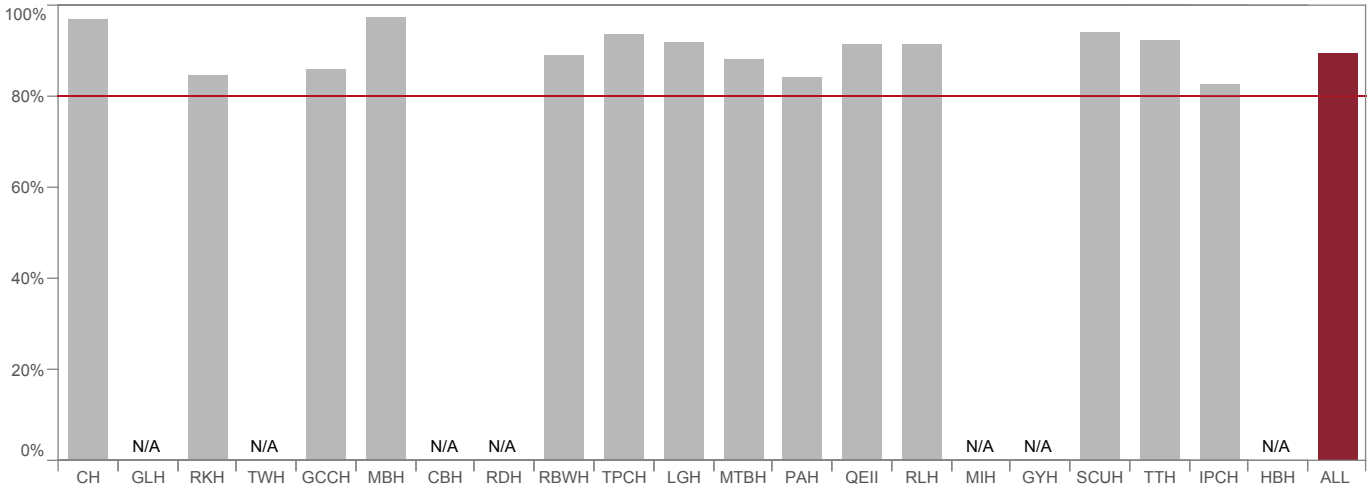
* Adverse reaction to ACEI or ARB, palliative intent to treatment, pregnancy, eGFR <30 mL/min, severe aortic stenosis, renal artery stenosis, serum potassium >5.5 mmol/L, symptomatic hypotension

6.4 Prescription of guideline recommended beta blockers for HFrEF

Guideline recommended beta blockers have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all symptomatic patients unless contraindicated or not tolerated.[27] Guideline recommended beta blockers include: Bisoprolol, Carvedilol, Metoprolol sustained release, or Nebivolol. Results pertain only to these beta blocker medications.

4a Beta blocker prescription for HFrEF at time of hospital discharge

In 2018, 90% of acute referrals were reported to be on a guideline recommended beta blocker at the time of discharge from hospital.



N/A = eligible referrals <20

Figure 12: Proportion of patients on guideline recommended beta blocker at hospital discharge by site

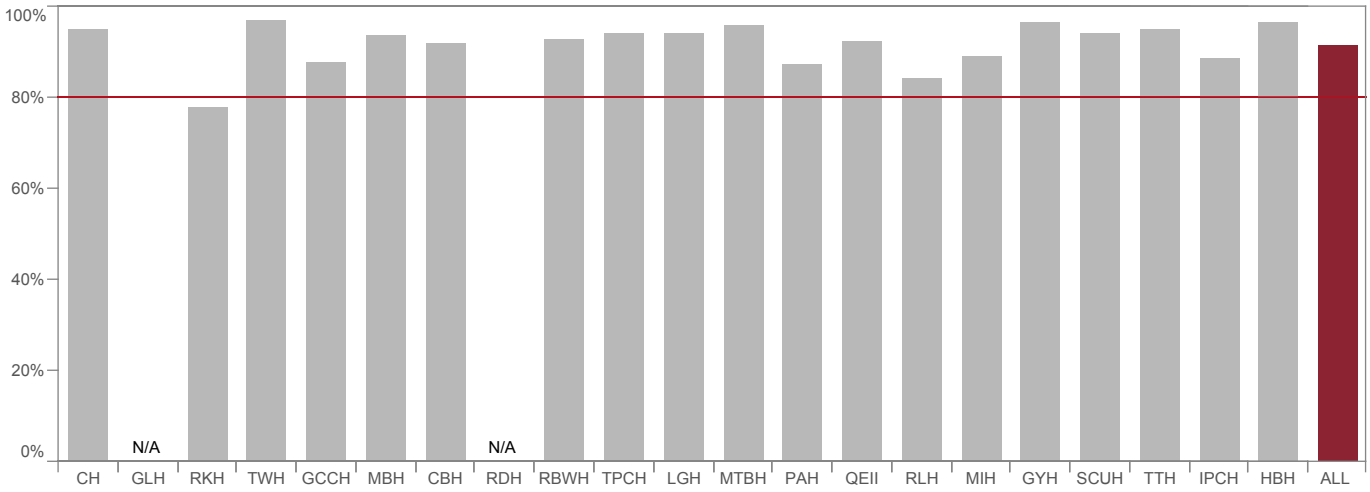
Table 20: Patients on guideline recommended beta blocker at hospital discharge

	n	%
Eligible for analysis	2,598	
Achieved benchmark	2,328	89.6
Benchmark not achieved	270	10.4
Ineligible	811	
Not HFrEF	655	
LV function assessment not available	85	
Documented contraindication*	71	
Incomplete data	4	
Total inpatient referrals	**3,413**	

* Adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR <50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

4b Beta blocker prescription for HFREF at time of first HFSS clinical review

In 2018, 91% of referrals to HFSS were reported to be on a guideline recommended beta blocker at the time of first clinical review.



N/A = Eligible referrals <20

Figure 13: Proportion of patients on guideline recommended beta blocker therapy at first clinical review by site

Table 21: Patients on guideline recommended beta blocker at first clinical review

	n	%
Eligible for analysis	2,910	
Achieved benchmark	2,657	91.3
Benchmark not achieved	253	8.7
Ineligible	1961	
Not HFrEF	663	
Referred to another HFSS	589	
Patient could not be contacted, lives out of area or repeated failure to attend	167	
Patient declined service	164	
Documented contraindication*	70	
Patient deceased	63	
LV function not assessed	55	
HF no longer prime issue (palliative care, high care nursing home etc.)	53	
Referred to another service (e.g. cardiac rehabilitation or community nursing)	51	
Medical follow-up only (GP, private or public physician)	23	
HFSS at capacity workload	7	
Other reason	56	
Incomplete data	7	
Total referrals	**4,878**	

* Adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR <50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

6.5 Beta blocker titration

This indicator looks at the progress of titration of guideline recommended beta blockers at six months following hospital discharge or when deactivated from the HFSS, whichever is sooner. The timeframe is taken from the first clinical review by HFSS (usually at four weeks from referral or hospital discharge).

The indicator measures three components of beta blocker titration at six months, including:

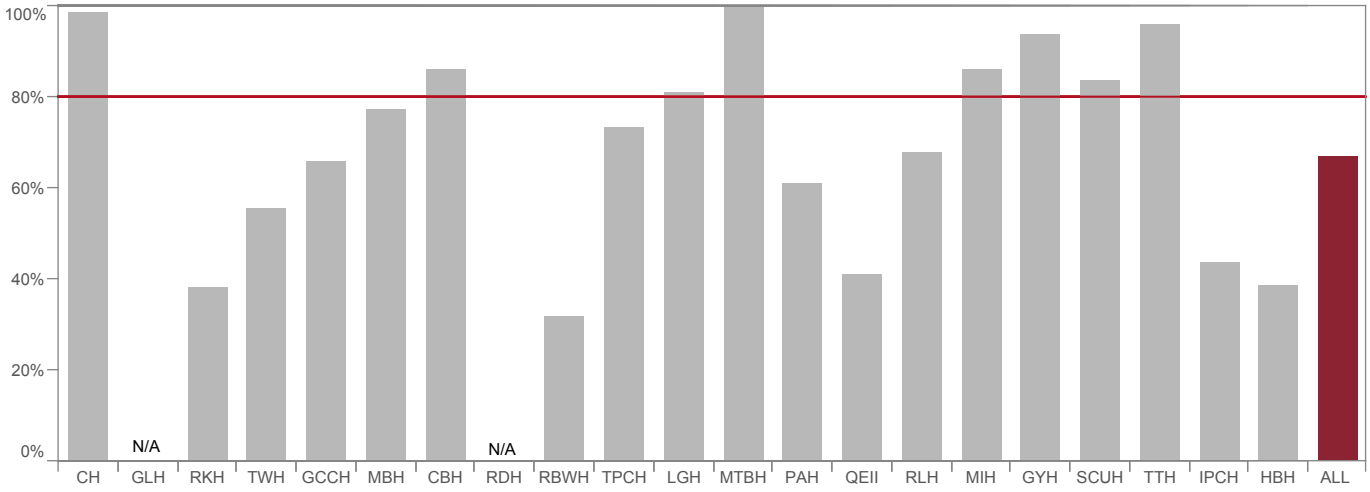
a) Review of titration status undertaken,

b) Achievement of target dose, and

c) Achievement of target or maximum tolerated dose.

5a Beta blocker titration review conducted within six months of first HFSS clinical review

In 2018, 67% of patients received a beta-blocker titration review at six months from referral or at the time of deactivation from the HFSS (whichever is sooner).



N/A = Eligible referrals <20

Figure 14: Proportion of patients who had a beta blocker titration review conducted within six months by site

Table 22: Patients who had a beta blocker titration review within six months

	n	%
Eligible for analysis	1,449	
Achieved benchmark	967	66.7
Benchmark not achieved	482	33.3
Ineligible	1978	
Not HFrEF	636	
Patient on target dose at the time of referral	590	
Patient declined service	111	
Patient could not be contacted, lives out of area or repeated failure to attend	95	
Medical follow-up only (GP, private or public physician)	90	
Referred to another HFSS	89	
Documented contraindication*	84	
Patient deceased	78	
LV function not assessed	74	
HF no longer prime issue (palliative care, high care nursing home etc.)	27	
Patient at max tolerated dose	20	
Referred to another service (e.g. cardiac rehabilitation or community nursing)	5	
Other reason	79	
Incomplete data	48	
Total	**3,475**	

* Adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR ‹50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

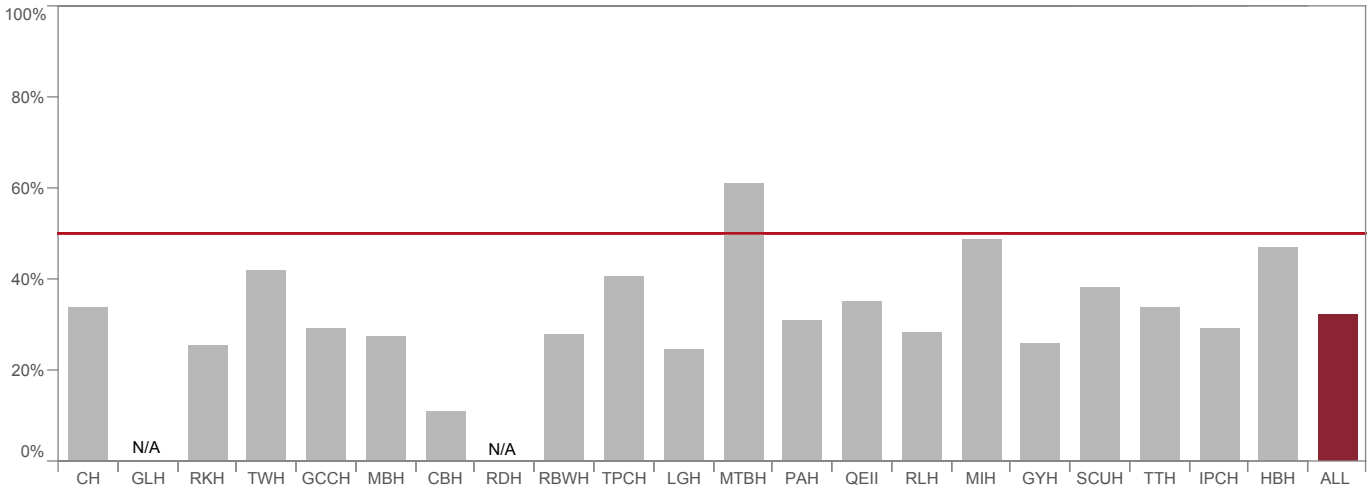
5b Beta blocker clinical guideline target dose achieved at time of titration review

The benchmark for target dose beta blocker titration was set lower than the other indicators at 50%. This lower benchmark is to accommodate differences in patients recruited to clinical trials compared to patients presenting in clinical practice who are older with more comorbidities.

Guideline recommended target dose was achieved for 32% of referrals within 6 months, with only one site exceeding the benchmark (see Figure 15).

Daily target doses are:

- Carvedilol 50–100 mg
- Metoprolol sustained release 190 mg
- Bisoprolol 10 mg
- Nebivolol 10 mg



N/A = Eligible referrals <20

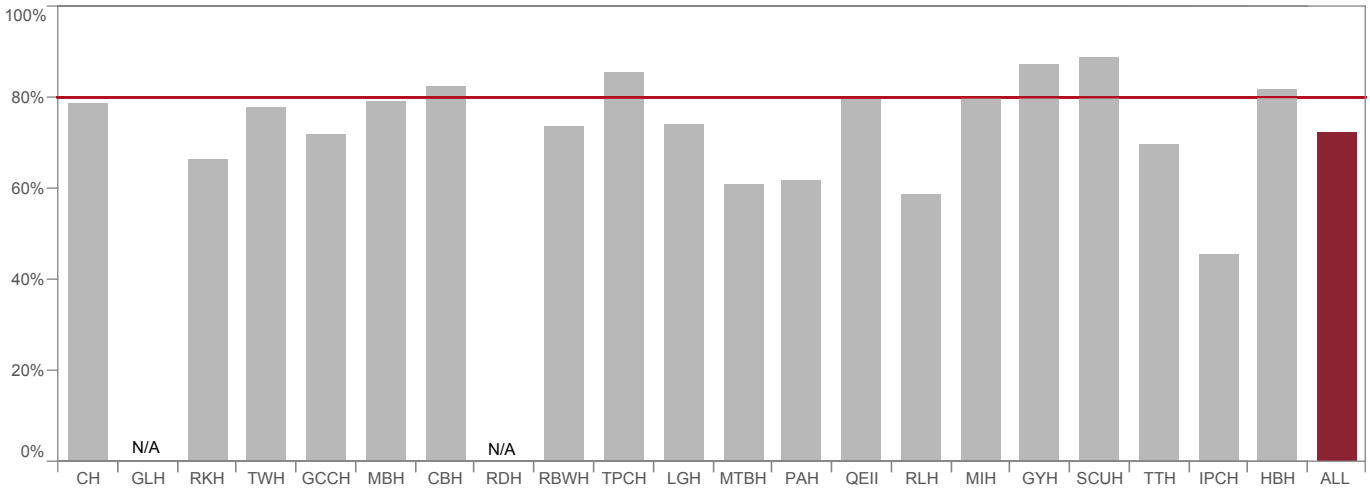
Figure 15: Proportion of patients who achieved target beta blocker dose at time of titration review by site

Table 23: Patients who achieved target beta blocker dose at time of titration review

	n	%
Eligible for analysis	1,449	
Achieved benchmark	1,046	72.2
Benchmark not achieved	403	27.8
Ineligible	N/A	
Total titration reviews conducted	**1,449**	

5c Beta blocker titration clinical guideline target or maximum tolerated dose achieved at time of titration review

Maximum tolerated dose of beta blockers is based on a medical judgement balancing the harm and benefit of up-titration. The number of patients reaching the target dose or maximum tolerated dose of guideline recommended beta blocker medication by the time of the titration review was 72%.



N/A = Eligible referrals <20

Figure 16: Proportion of patients who achieved target beta blocker dose or maximum tolerated dose at time of titration review

Table 24: Patients who achieved target or maximum tolerated beta blocker dose at time of titration review

	n	%
Eligible for analysis	1,449	
Achieved benchmark	470	32.4
Benchmark not achieved	979	67.6
Ineligible	N/A	
Total titration reviews conducted	**1,449**	

6.6 Summary of clinical indicators

Table 25: Summary of clinical process indicator performance by site

		Clinical Indicator achievement %									
HHS	**HFSS**	**1a**	**1b**	**2**	**3a**	**3b**	**4a**	**4b**	**5a**	**5b**	**5c**
Cairns and Hinterland	Cairns Hospital	75	93	99	91	94	97	95	99	34	79
Central Queensland	Gladstone Hospital	–	–	–	–	–	–	–	–	–	–
	Rockhampton Hospital	54	76	98	88	81	85	78	38	26	66
Darling Downs	Toowoomba Hospital	–	63	97	–	100	–	97	56	42	78
Gold Coast	Gold Coast Community Health	91	93	95	87	87	86	88	66	29	72
Mackay	Mackay Base Hospital	81	81	100	97	92	97	94	77	27	79
Metro North	Caboolture Hospital	41	70	95	–	90	–	92	86	11	82
	Redcliffe Hospital	–	–	73	–	–	–	–	–	–	–
	Royal Brisbane and Women's Hospital	75	93	98	93	93	89	93	32	28	74
	The Prince Charles Hospital	71	63	94	92	89	94	94	73	40	85
Metro South	Logan Hospital	75	90	97	89	87	92	94	81	25	74
	Mater Adult Hospital	88	62	92	95	100	88	96	100	61	61
	Princess Alexandra Hospital	89	38	96	94	93	84	88	61	31	62
	Queen Elizabeth II Hospital	57	59	92	91	90	91	92	41	35	80
	Redland Hospital	93	100	90	93	95	92	84	68	28	59
North West	Mt Isa Hospital	–	77	98	–	94	–	89	86	49	80
Sunshine Coast	Gympie Hospital	82	94	81	–	89	–	96	94	26	87
	Sunshine Coast University Hospital	95	91	99	97	94	94	94	84	38	89
Townsville	Townsville Hospital	98	98	96	95	94	92	95	96	34	69
West Moreton	Ipswich Community Health	72	94	97	92	93	83	88	44	29	46
Wide Bay	Hervey Bay Hospital	–	98	100	–	98	–	97	39	47	82
Statewide		**79**	**82**	**96**	**92**	**91**	**90**	**91**	**67**	**32**	**72**

Legend:

1a Follow-up of acute patients within 2 weeks (Benchmark: 80%)

1b Follow-up of non-acute patients within 4 weeks (Benchmark: 80%)

2 Assessment of left ventricular ejection fraction within 2 years (Benchmark: 80%)

3a Angiotensin-converting-enzyme inhibitor or angiotensin II receptor blockers prescription at hospital discharge (Benchmark: 80%)

3b Angiotensin-converting-enzyme inhibitor or angiotensin II receptor blockers prescription at first clinical review (Benchmark: 80%)

4a Guideline recommended beta blocker prescription at hospital discharge (Benchmark: 80%)

4b Guideline recommended beta blocker prescription at first clinical review (Benchmark: 80%)

5a Beta blocker titration status review at six months post referral (Benchmark: 80%)

5b Beta blockers achievement of guideline recommended target dose (Benchmark: 50%)

5c Beta blockers achievement of guideline recommended target dose or maximum tolerated dose (Benchmark: 80%)

7 Patient outcomes

Heart failure hospitalisations are associated with subsequent increased risk of mortality and recurrent hospitalisation. Support from multidisciplinary HF disease management programmes (such as Queensland's HFSS) and adherence to recommended therapies are associated with improved post-discharge outcomes.

7.1 Methods

This analysis used the previously reported 2017 patient cohort from the QCOR HFSS HERO registry to examine the early (30 day) and one year clinical outcomes (rehospitalisation and mortality) among patients referred to HFSS. This was performed using probabilistic data linkage from the Queensland Hospital Admitted Patient Data Collection (QHAPDC) and Queensland Registry of Births, Deaths and Marriages.

For this report, only HFSS referrals initiated during an inpatient encounter for 2017 were included. Where patients had multiple referrals to a HFSS during this period, the earliest admission of the calendar year was considered as the index admission (which may not be the first time that a patient has been hospitalised with heart failure).

Eligibility criteria for the mortality and readmission analysis cohort were applied at the time of the index admission. The eligibility status for days alive and out of hospital (DAOH) analysis was reviewed at all subsequent admissions over 12 months to exclude patients who were transferred to private hospitals or interstate.

The patient outcome indicators of interest are summarised in Table 26. Survival curves were constructed using the Kaplan–Meier method and cumulative incidence function (CIF) was used to estimate the risk of all-cause and HF related re-hospitalisation to account for the competing risk of death.

DAOH was calculated to reflect the burden of recurrent hospitalisation, hospital length of stay and death, and was expressed as both median values with 25th and 75th percentiles and mean values. Categorical variables were summarised as frequencies and percentages.

Table 26: Patient outcome indicators

Indicator #	Measure
1	All-cause mortality within one year after index hospitalisation discharge
2	Rehospitalisation within one year after index hospitalisation discharge a) All-cause rehospitalisation b) Heart failure rehospitalisation*
3	Composite of all-cause hospitalisation or all-cause mortality within one year after index hospitalisation discharge
4	Days alive and out of hospital within one year of index hospital discharge date

* ICD10AM codes: E87.7, I13.0, I13.2, I25.5, I42.0, I42.1, I42.2, I42.5, I42.6, I42.7, I42.8, I42.9, I46.0, I46.1, I46.9, I50, J81, J90, R18, R57.0, R60.1

7.2 Findings

In 2017 there were 3,207 inpatient referrals, and of these 96% were successfully linked via the QHAPDC. There were 460 patients who were ineligible for readmission and mortality analysis for various reasons shown in Table 27. A further 52 patients (1.7%) did not have complete follow up of 365 days to allow DAOH analysis.

Table 27: Eligibility criteria for patient outcome indicators

	n	%
Total 2017 inpatient referrals	**3,207**	**100**
Ineligible at index admission		
Duplicate patient record	218	6.8
Died during index admission	21	0.7
Not a Queensland resident	53	1.7
Index admission is not overnight	26	0.8
Transferred to private hospital	25	0.8
No linkage data available	117	3.7
Included in readmission and mortality analysis	**2,747**	**85.7**
Ineligible at subsequent admission over 1 year		
Transferred to private hospital	47	1.5
Moved outside of Queensland	5	0.2
Included in days alive and out of hospital analysis	**2,695**	**84.0**

7.2.1 All-cause mortality

Among patients referred to HFSS during an inpatient encounter, the 30 day and one year unadjusted all-cause mortality rates were 1.7% and 14.3%. The Kaplan-Meier survival analyses below (Figures 17–19) suggest that older age was associated with increased mortality rates at all time points and particularly at 12 months.

Table 28: Cumulative all-cause unadjusted mortality rate from 30 to 365 days after index discharge date

	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Total deaths identified	46 (1.7)	122 (4.4)	218 (7.9)	393 (14.3)
Died during subsequent admission*	22 (0.8)	48 (1.7)	78 (2.8)	147 (5.4)
All other deaths	24 (0.9)	74 (2.7)	140 (5.1)	246 (9.0)
Total at risk	**2,701 (98.3)**	**2,625 (95.6)**	**2,529 (92.1)**	**2,354 (85.7)**

* Data available for Queensland public hospitals only removed fullstop

Table 29: Cumulative all-cause unadjusted mortality by patient characteristic

	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	1,777	22 (1.2)	66 (3.7)	135 (7.6)	246 (13.8)
Female	970	24 (2.5)	56 (5.8)	83 (8.6)	147 (15.2)
Age group					
<65 years	939	5 (0.5)	18 (1.9)	33 (3.5)	57 (6.1)
65–74 years	710	11 (1.5)	22 (3.1)	48 (6.8)	88 (12.4)
≥75 years	1,098	30 (2.7)	82 (7.5)	137 (12.5)	248 (22.6)
Heart failure phenotype					
HFrEF	2,098	32 (1.5)	84 (4.0)	142 (6.8)	257 (12.2)
HFpEF	519	8 (1.5)	25 (4.8)	57 (11.0)	109 (21.0)
Missing/unsure	130	6 (4.6)	13 (10.0)	19 (14.6)	27 (20.8)

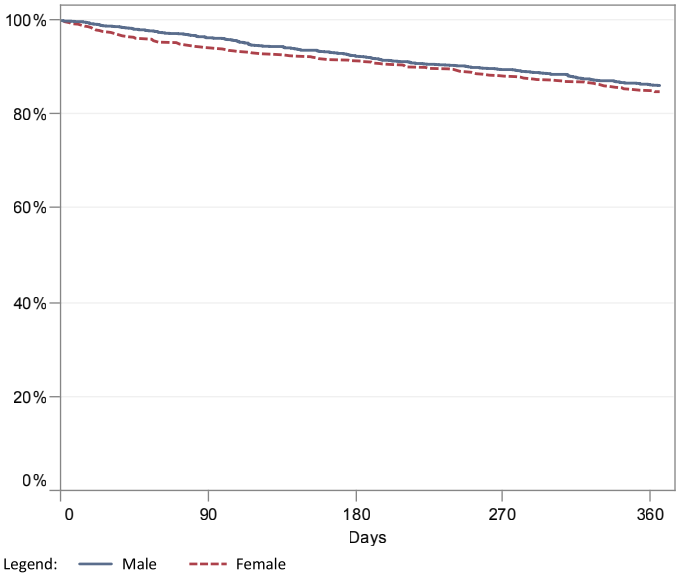


Figure 17: Heart failure survival by gender

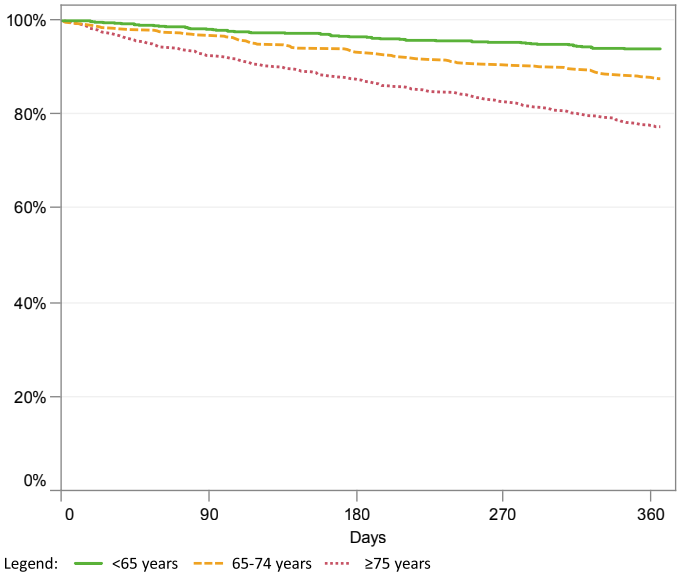


Figure 18: Heart failure survival by age group

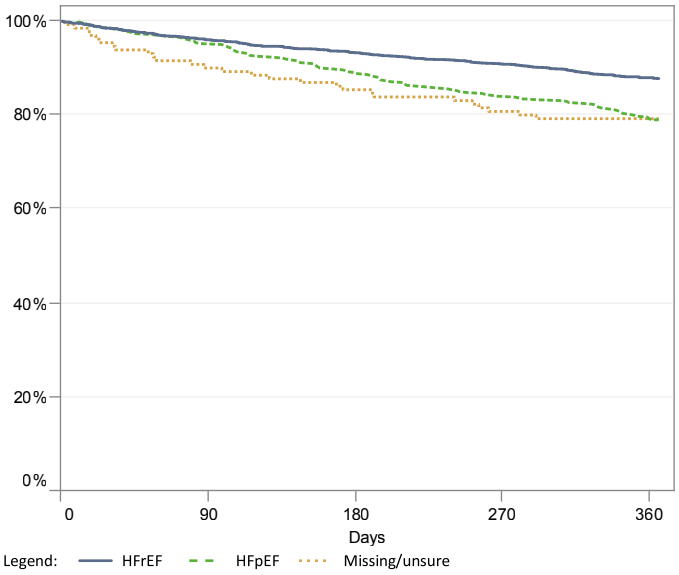


Figure 19: Heart failure survival by phenotype

7.2.2 All-cause and heart failure rehospitalisation

Cumulative incidence curves for all-cause and HF hospitalisation are shown in Figure 20 and 21. Of the 2,747 eligible patients referred to HFSS during 2017, the unadjusted rate of all-cause hospitalisation was 17.8% at 30 days, increasing to 57.0 % at 365 days. Hospitalisations relating to HF (as identified by discharge diagnosis coding) were 5.6% and 24.2% at 30 days and one year respectively.

The overall risk of hospitalisation or death within 12 months post the index admission was 58.1% (Figure 22). Almost one-third of patients referred to a HFSS were rehospitalised at least two times in the subsequent 12 months (Table 30).

Table 30: Number of rehospitalisations per patient over one year since discharge

Total in 1 year	All-cause n (%)	Heart failure n (%)
0	1,222 (44.5)	2,134 (77.7)
1	637 (23.2)	387 (14.1)
2	370 (13.5)	137 (5.0)
3	196 (7.1)	47 (1.7)
4	134 (4.9)	20 (0.7)
≥5	188 (6.8)	22 (0.8)

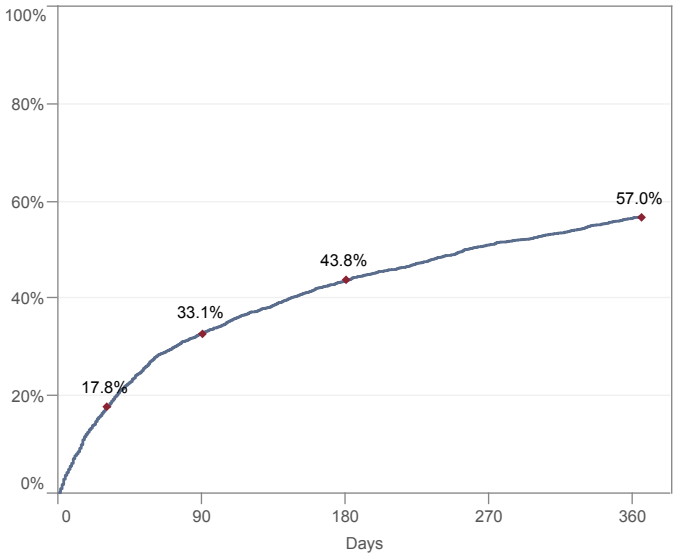


Figure 20: Cumulative incidence of all-cause rehospitalisation

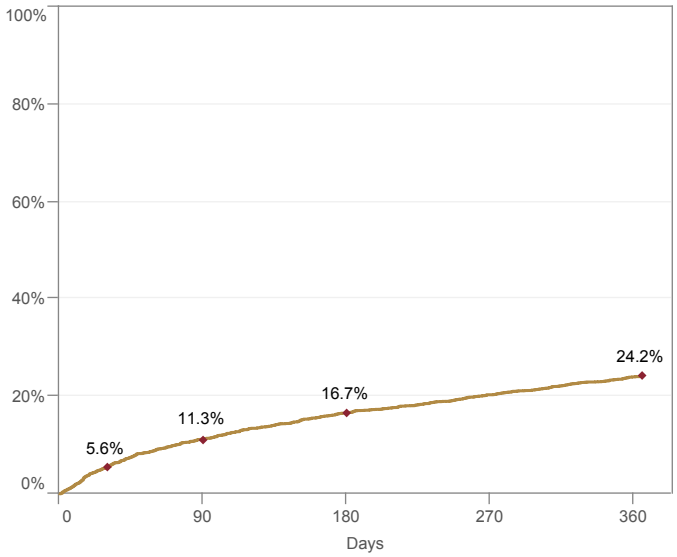


Figure 21: Cumulative incidence of heart failure rehospitalisation

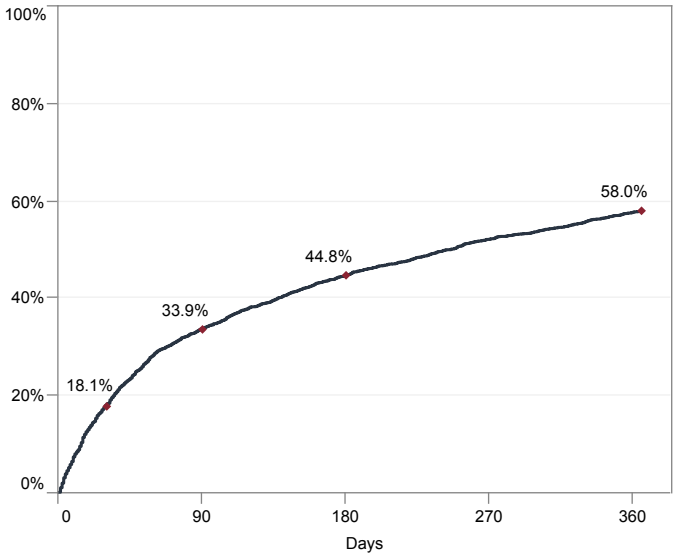


Figure 22: Cumulative incidence of all-cause rehospitalisation or death

7.2.3 Days alive and out of hospital

Days alive and out of hospital (DAOH) incorporates mortality and all hospitalisations (including length of hospital stay) within one year of discharge. This single measure demonstrates the post discharge time alive and not in hospital as a combined measure.

Almost 43% of patients survived more than a year without rehospitalisation with a median of 363 days for the whole group. The mean DAOH was 328.3, which equates to over 98,000 days lost due to death or hospitalisation over 12 months in 2,695 patients.

The box and whisker plots in Figure 24 illustrate the distribution of scores for different characteristics. The median of the data is close to 365 for most categories (the box shows the middle 50% of scores). The whiskers stretching to the right illustrate that many patients spent subsequent time in hospital or died. The DAOH was much lower for patients who were over 75 years old or had an uncertain heart failure phenotype or HFpEF compared to other characteristics.

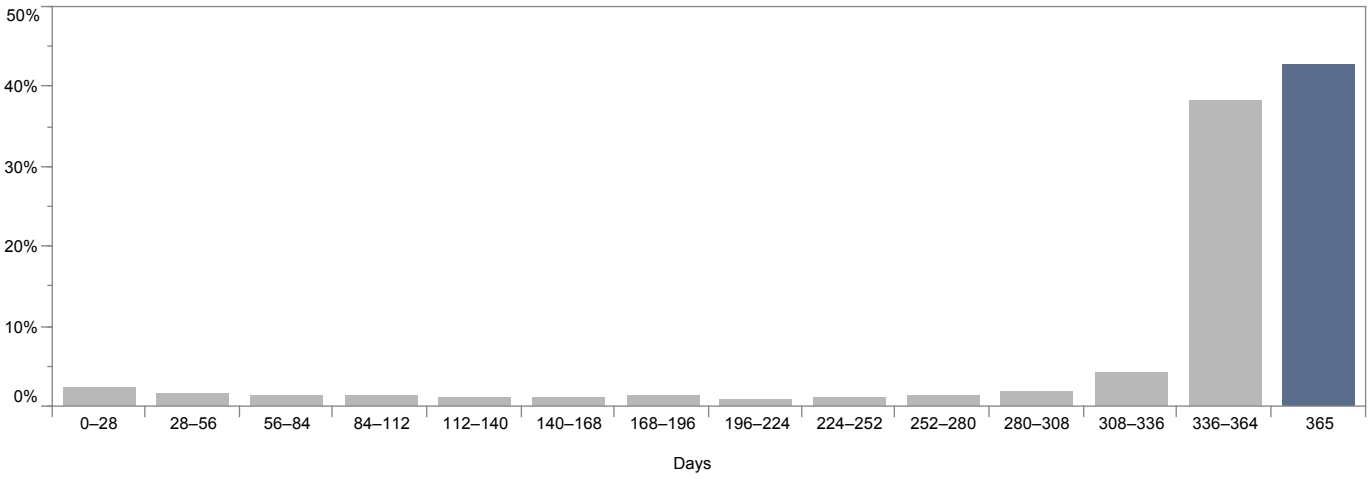
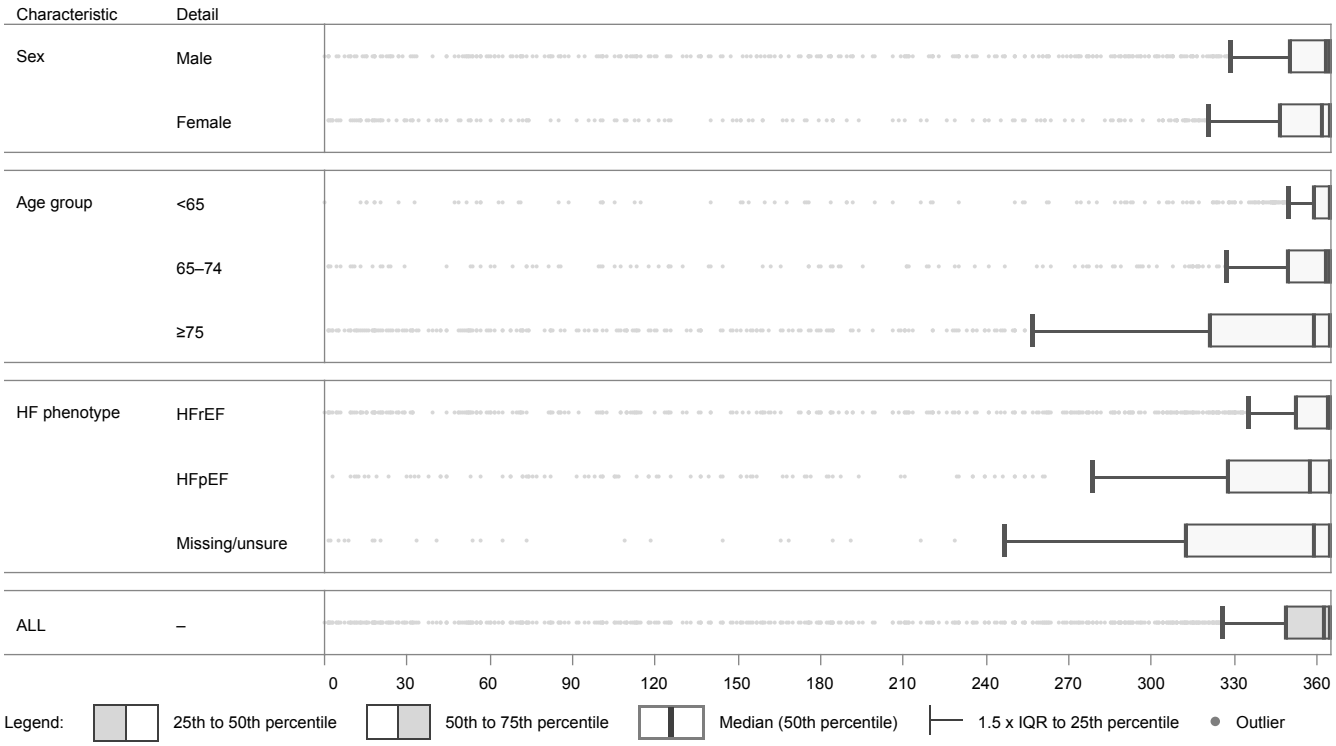


Figure 23: Days alive and out of hospital within one year after hospital discharge

Table 31: Days alive and out of hospital within one year of discharge by patient characteristics

Characteristic	Detail	n	Mean	Median (IQR)
Sex	Male	1,750	330.3	364 (351–365)
	Female	945	324.5	362 (347–365)
Age group	<65	929	346.8	365 (359–365)
	65–74	699	333.1	363 (350–365)
	≥75	1,067	309.0	359 (322–365)
HF phenotype	HFrEF	2,068	333.4	364 (353–365)
	HFpEF	500	313.2	358 (328–365)
	Missing/unsure	127	303.3	359 (312–365)
Statewide		**2,695**	**328.3**	**363 (349–365)**



Mean, median and interquartile range (IQR) are given in days

Figure 24: Days alive and out of hospital within one year of discharge by patient characteristics

8 Conclusions

This annual report captured information on patient referrals to 21 Queensland Heart Failure Support Services.

Referrals for Aboriginal and Torres Strait Islander patients grew by 40% this year comparative to 2017. The reason for this change may be due to better identification of Indigenous status. While improved cardiovascular disease survival of Indigenous Queenslanders[29] may contribute to an increase in the prevalence of heart failure, it is unlikely that this would happened suddenly in one year.

As with previous reports, most referrals to HFSS are for patients with HFrEF, even though evidence suggests that patients with HFpEF also benefit from support. Barriers to HFpEF referrals, could be due poor case finding and limited resources to grow caseloads. Further characterisation of heart failure beyond HFrEF and HFpEF would assist in understanding the treatment needs and outcomes of the cohort.

As prescribing practices for ACEI/ARB and beta blockers have remained consistently high over the three years of reporting, it may be timely to measure the use of other agents where there is likely to be room for improvement. Furthermore, information is needed about non-pharmacological care including cardiac implantable electronic devices (CIED) and exercise training.

Monitoring beta blocker use over 6 months continues to be a challenge with most sites (despite active education and support) not achieving benchmarks. Whilst the rate of titration to maximal tolerated dose approaches the 80% benchmark, there is concern that 33% of patients did not have a beta blocker review and that the definition of “maximal tolerated” relies on clinical judgement. As target dose is a more objective measure it would help in planning if reasons for not achieving target in the 6 month timeframe were provided.

Patient outcomes continue to illustrate the burden of the disease with 55% of patients spending additional time in hospital after their index admission. Unadjusted outcomes for the HFpEF phenotype are significantly poorer compared to the HFrEF. The current data set does not allow risk adjustment of the outcomes thus limiting the ability to discern independent associations. As unmeasured confounders may influence the observed associations, comparisons of patient outcomes across individual sites was intentionally avoided.

9 Recommendations

Update data collection to:

- Introduce a new clinical indicator regarding mineralocorticoid receptor antagonists (MRA) prescription (underway for 2019 cohort).
- Expand clinical indicators for prescription of ACEI or ARB to include angiotensin receptor-neprilysin inhibitors (ARNI) as an acceptable alternative (underway for 2019 cohort).
- Further characterise HF phenotypes to include HF with associated valvular disease and right heart failure (underway for 2019 cohort).
- Provide reasons for not achieving beta blocker target dose in 6 months (underway for 2019 cohort).
- Record the use of cardiac implantable electronic devices (CIED) (under development for 2020 cohort).
- Include a clinical indicator related to exercise training.
- Collect covariates to allow for risk-adjustment of patient outcomes.

Quality improvement activities:

- Develop systems of care to improve the review and titration of medications post hospital discharge and to address variances in clinical performance.

New recommendations:

- Support HFSS to improve beta blocker titration by: promoting nurse and pharmacist facilitation of titration (when managed by GP); advocating for more pharmacy and nurse practitioner involvement in care; and providing systems to track patients under titration and for generating titration plans.
- Introduce targeted non-pharmacological interventions known to improve quality of life and relieve symptoms; for example, exercise therapy and psycho-social support.
- Measure outcomes for all patients regardless of referral source (i.e. for outpatient as well as inpatient referrals).

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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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