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Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry
2017 Annual Report

Clinical **Excellence** Division
Creating solutions for better healthcare

Queensland Government

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This report is available online at:

https://clinicalexcellence.qld.gov.au/priority-areas/clinician-engagement/statewide-clinical-networks/cardiac

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1 Message from the SCCN Chair

Introducing this third annual Queensland Cardiac Outcome Registry Report, I am pleased to announce comprehensive engagement across all 8 public cardiac units in Queensland. This report also profiles the addition of two additional modules to the outcomes registry, electrophysiology, and cardiac rehabilitation.

It is the aim of the registry to provide a comprehensive, quality, patient-based profile of cardiac care in Queensland. The benefits of this registry are becoming clear – not only is the registry seeking to provide data, engagement, and confidence to the physicians, surgeons, and clinicians providing care, but it is also providing clear information to administrators, service planners and consumers of health care that first-rate cardiac processes are "standard care". The critical element contributing thus far to the success of this project is that it is clinician-led, and broad. Continuing clinician engagement in supply of data, assessment, and interpretation of data and results of treatment is required for ongoing participation in the registry. The project has also facilitated service collaboration and support for the developing non-metropolitan units and early career practitioners.

In evaluating outcomes, it is now commonly acknowledged that short-term (30-day) outcomes are a very incomplete assessment of the adequacy and quality of medical care. In this report, we have begun to examine more extended follow up of heart failure, structural heart and TAVR patients, for the first time reporting 12-month mortality. It is planned to extend these longer-term outcome profiles to angioplasty and cardiac surgery patients. The registry is also actively investigating the addition of patient-reported outcomes as well as parameters such as length of stay, readmission and repeat presentations for care to supplement the panel of quality outcomes.

With data from consecutive years across all cardiac modalities, it will also now be possible to track multiple patient interventions e.g. revascularisation with both angioplasty and cardiac surgery as well as other cardiac procedures and presentation with subsequent events.

During 2017, the adequacy of outreach services has been a focus for the Queensland Cardiac Clinical Network. QCOR data has allowed us to profile the fact that for the larger metropolitan hospital and health services, 40%–50% of the patients treated live outside the boundaries of the metro health services. This has emphasised the need for the Clinical Network to participate in the provision of pathways for time-critical transfer, referral, and assessment as well as the provision of follow up care to consolidate the results of medical intervention.

2017 has been a very successful year in consolidating the efforts of the Queensland Cardiac Outcomes Registry and the report clearly documents the provision of high-quality safe interventions, very comparable with the results of national and international leaders in cardiac care.

In closing, I give my thanks and congratulations to the clinicians who are maintaining the enthusiasm for this important work, in addition to the QCOR technical and administrative staff without whose assistance this work would not be possible.

Dr Paul Garrahy
Chair
Statewide Cardiac Clinical Network

2 Introduction

The Statewide Cardiac Clinical Network's, Queensland Cardiac Outcomes Registry (QCOR) provides clinicians high quality, valuable clinical data. QCOR draws on multiple data sources to offer superior levels of analysis for stakeholders to use in both clinical decision-making and service improvement within cardiac services in Queensland.

QCOR data collections are governed by clinical committees which report to a central Advisory Committee. This provides direction to the QCOR business unit, the Statewide Cardiac Clinical Informatics Unit (SCCIU). All processes and groups report to the Statewide Cardiac Clinical Network, sponsored by the Clinical Excellence Division within Queensland Health.

A high level of clinical engagement ensures the quality and relevance of the data and, more broadly the Registry itself. QCOR committees are continually evolving and have recently moved to more structured operation and governance.

The SCCIU is responsible for the operation and data management of the QCOR, including data reporting and analysis for clinicians. It also offers data quality and audit functions. A clinician-led unit, the SCCIU coordinates individual QCOR committees.

The SCCIU supports administrative and mandatory reporting such as for financial incentive programs and departmental performance measures. The SCCIU is also responsible for the development and maintenance of registry applications. This QCOR 2017 Annual Report includes two new clinical audits, cardiac rehabilitation and electrophysiology and pacing, with a total of five audits encompassing cardiology and cardiothoracic surgery. With continued development, QCOR aims to support improved health care and outcomes of cardiac patients across Queensland.

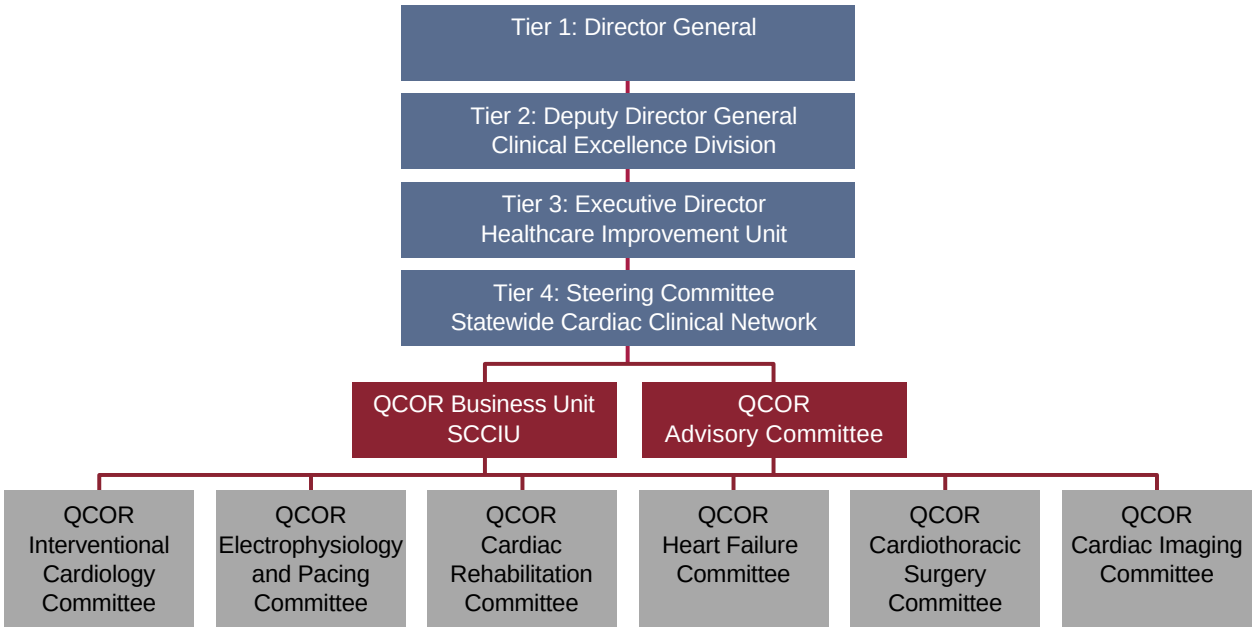

Figure A: Operational structure

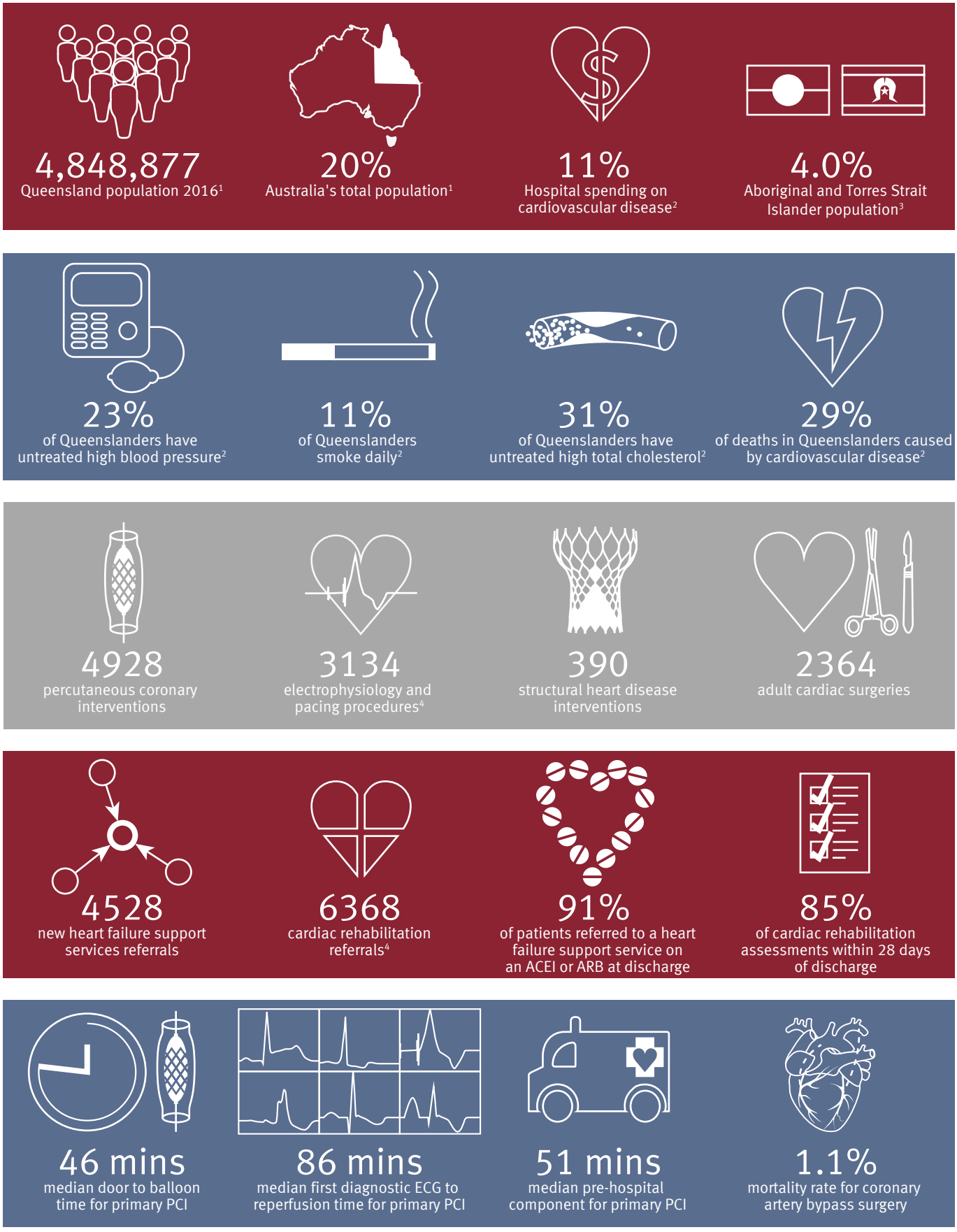

Figure B: QCOR 2017 infographic

3 Executive summary

- 15,293 diagnostic or interventional cases were performed across the 8 cardiac catheterisation laboratory facilities in Queensland public hospitals. Of these, 4,928 were percutaneous coronary intervention (PCI).
- The median age of Aboriginal and Torres Strait Islander patients undergoing PCI is 11 years younger than non- Aboriginal and Torres Strait Islander patients.
- 75% of all PCI patients residing in Queensland had a place of residence within 50km of the nearest PCI capable facility. 12% of patients reside more than 150km from the nearest facility.
- Mortality within 30 days following PCI was 1.9%. Of these 91 deaths, 80% were classed as either salvage or emergency PCI.
- Statewide, a 7-minute improvement in median reperfusion time was observed compared to 2016 PCI analysis.
- Observed rates for cardiac surgery mortality and most results for major morbidities are better than risk scores predict.
- Additions to the cardiac surgery database will allow for calculation of EuroSCORE II, aetiology and microbiology of infective endocarditis, prehospital use of Statins and Anti-hypertensive agents.
- Large proportions of patients have combinations of risk factors, for example obesity and diabetes, smoking and hypertension; emphasising the need for public health programs and primary care for cardiac surgery.
- The reoperation rate for coronary artery bypass graft surgery and deep sternal wound infection in 2017 will be reviewed in detail in the 2018 QCOR annual report.
- 74% of cardiac surgery patients are overweight or obese, including morbid obesity. This will be the focus of the supplement in the next report.
- Seven sites contributed electrophysiology and pacing data with staggered commencement dates for these data collections.
- 3,134 electrophysiology and pacing cases were performed across the 7 participating public Queensland sites.
- 2,131 device procedures and 889 electrophysiology procedures were performed with 114 procedures classed as other.
- The statewide aggregate for all device procedure complications was 4.6%, while all electrophysiology procedures had a 2.6% complication rate overall.
- 6,368 cardiac rehabilitation referrals were made to participating programs in the July–December 2017 period.
- The proportion of Aboriginal and Torres Strait Islander patients receiving a cardiac rehabilitation referral was 6.6%, with wide variation across the state. This population group was more vastly represented in north Queensland.
- A timely cardiac rehabilitation referral (within three days of patient discharge) occurred in 94% of cases.
- Of the timely referrals, a timely cardiac rehabilitation assessment (within 28 days of discharge) occurred in 85% of cases.
- There were 4,528 new heart failure support service referrals in 2017 (13% increase from 2016).
- Benchmarks were achieved for clinical indicators related to timely follow-up of referrals, assessment of left ventricular function, and prescription of angiotensin-converting-enzyme inhibitor or angiotensin II receptor blockers and appropriate beta blockers (bisoprolol, carvedilol, metoprolol sustained release, or nebivolol).
- Beta blocker titration was below recommended benchmarks with only 34% achieving target doses and 70% achieving target or maximum tolerated dose within 6 months from referral.
- Outcomes for the 2016 inpatient referrals highlights substantial disease burden with 14% dying and 58% rehospitalised within 12 months.
- Days alive and out of hospital analysis reveals over 90,000 days lost due to death or hospitalisation in the 2,491 inpatient referral cohort over the following 12 months.

4 Acknowledgements and authors

This collaborative report was produced by the Statewide Cardiac Clinical Informatics Unit, audit lead for the Queensland Cardiac Outcomes Registry for and on behalf of the Statewide Cardiac Clinical Network.

The work of the Queensland Cardiac Outcomes Registry would not be possible without the continued support and funding from the Clinical Excellence Division, Queensland Health. This publication draws on the expertise of many people. In particular, staff from the Statistical Services Branch the Healthcare Improvement Unit and the Queensland Ambulance Service within the Department of Health and Emergency Services each make significant contributions to ensure the success of the program. 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.

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6 Future plans

The QCOR report has expanded this year to include two new modules for statewide cardiac rehabilitation and electrophysiology and pacing services. The continued growth and success of the registry can be largely credited to the commitment of participating cardiac clinical staff across the state. This work has presented new opportunities for more sophisticated reporting and analyses.

Over the next year, the focus will remain on delivering enhanced and innovative information solutions to support Queensland clinicians in delivering world-class patient care.

- Through increasing insight into the care provided to Queensland cardiac patients across participating domains, more complete analyses regarding outcomes for patients attending across multiple cardiac services are now feasible. In reports to come, allowing more complete results to provide more complete insights into the quality of care provided to our cardiac patients as they journey between various clinical specialty groups. Areas which have been highlighted as a focus for future reports include outcomes for patients that have undergone percutaneous coronary intervention and then subsequent cardiac surgery and the inter-relationship between interventional and outpatient services.
- A new QCOR Structural Heart Disease module is currently being developed with deployment expected in early 2019. 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, and will enable future statewide participation in national quality and safety activities for transcatheter aortic valve replacement.
- The Annual Cardiac Surgery Audit continues to identify future enhancement opportunities. This is highlighted by this year's supplementary report on infective endocarditis surgical interventions, which recommends adding detail about the microbiology and aetiology of endocarditis infection to the registry. Given the tremendous impact and associated healthcare costs for patients undergoing repeat valve surgery due to prosthetic valve endocarditis, these additions are clearly warranted. These improvements as well as data fields allowing EuroSCORE II Risk Adjustment will be delivered in late 2018.
- In 2017/18 the QCOR provided data and reporting for the of the State Government funded Quality Incentive Payment for performance in cardiac rehabilitation. The registry will continue to build upon the excellent levels of clinician engagement to deliver a contemporary and evidence-based clinical indicator program to support quality improvement activities in this field. New system capabilities will be deployed over the next few months to allow more comprehensive assessment of patient activity and exercise levels and assist clinicians to perform everyday tasks and patient care.
- Electrophysiology and pacing services across Queensland have participated in their first QCOR review. This follows the delivery of a bespoke reporting application by the Statewide Cardiac Clinical Network's Cardiac Information Solutions Program. The project has seen a staggered uptake of the new application throughout 2017 with the final site beginning direct entry in early 2018. This has resulted in an unprecedented availability of data across services where reporting had been predominately paper-based. The report has identified several areas for improved data quality, while another focus will be to collaborate with electrophysiology and pacing clinicians to deliver a future clinical indicator program.
- Heart failure support services across Queensland have now been contributing to the QCOR quality registry since 2014. Over time, the growth of the registry has allowed more sophisticated analyses to be undertaken. This is highlighted by this year's reporting of statewide heart failure patient outcomes, which identified several priority areas for further development of the registry. Additional data points relating to mineralocorticoid receptor antagonists will be added to the data collection in late 2018, while an early investigation and scoping of a potentially new and expanded QCOR heart failure application is also underway.
- Contributions from the Queensland Ambulance Service (QAS) have been integral to the composition of this report. Collaboration between Queensland Health and QAS has been bolstered with continued investment by both organisations into cardiac outcomes. The future of this partnership is promising with a shared goal of improving patient outcomes and pre-hospital processes for Queenslanders suffering cardiovascular disease.

Interventional Cardiology Audit

7 Message from the QCOR Interventional Cardiology Committee Chair

The third Annual Report of interventional cardiology activity in Queensland sees further expansion and maturation of this clinical registry and, perhaps more importantly, it has become a component of the much broader analysis of cardiac service provision in Queensland. The interventional cardiology services analysed now include procedures performed at all 8 public cardiology catheter labs in Queensland, encompassing 4 metropolitan sites, and 4 regional sites. The geographical challenges associated with delivering tertiary cardiac care are highlighted in this year's report, with one in four people having to travel more than 50km to a cardiac catheter lab. The report also confirms the health "gap" attributable to cardiovascular disease between Indigenous and non-Indigenous Queenslanders, with the median age of Indigenous patients undergoing percutaneous coronary intervention observed to be 11 years younger than non-Indigenous patients.

One of the aims of this registry is to provide meaningful, quality information to facilitate improvements in systems, care and ultimately, outcomes, and it is therefore pleasing to also observe that there has been a year-on-year improvement in the important metric of "time to open artery" for people having an acute heart attack.

With the ongoing evolution of the Queensland Cardiac Outcomes Registry, the compilation and analysis of this ever-increasing volume of data is a significant undertaking, and I would certainly like to express my gratitude to the entire QCOR team, who are committed to quality improvement in cardiac care for all Queenslanders.

Dr Greg Starmer
Chair
QCOR Interventional Cardiology Committee

8 Key findings

This third audit describes key aspects of the care and treatment of cardiac patients receiving percutaneous coronary interventions (PCI) during 2017.

Key findings include:

- 15,293 diagnostic or interventional cases were performed across the 8 cardiac catheterisation laboratory facilities in Queensland public hospitals. Of these, 4,928 were PCI.
- The proportion of patients identified as Aboriginal and Torres Strait Islander again illustrates a stepwise gradient based on geographical area with the highest proportions found in the north of the state and the lowest in the South East corner. This is consistent with previous analyses.
- The median age of Aboriginal and Torres Strait Islander patients undergoing PCI was 11 years younger than non-Aboriginal and Torres Strait Islander patients.
- A large proportion of PCI patients (77%) were classed as having an unhealthy body mass index over 25kg/m^2.
- 75% of all PCI patients residing in Queensland had a place of residence within 50km of the nearest PCI capable facility, while 12% of patients resided more than 150km from the nearest facility.
- The majority of PCI cases (76%) were classed as urgent, emergent or salvage, highlighting the acute and often unstable patient cohort.
- Drug eluting stents (DES) were used in 85% of cases with a range between 63% and 98% across sites.
- PCI for non-ST elevation myocardial infarction (NSTEMI) represented 29% of all cases, with the median time to angiography of 53 hours. Patients presenting to a non-PCI capable facility have a median wait to coronary angiography 31 hours longer than those who present directly to a PCI capable facility (68 hours vs 37 hours).
- There were 1,434 PCI cases following presentation with ST elevation myocardial infarction (STEMI) in 2017, of which 56% were managed by primary PCI.
- Median time to reperfusion from first diagnostic ECG for STEMI patients presenting within 6 hours of symptom onset was 86 minutes (range 70 minutes to 98 minutes across sites). Statewide, a 7 minute improvement in median reperfusion time was observed compared to 2016.
- Median hospital door to device time for STEMI patients presenting within six hours of symptom onset was 46 minutes (range 34 minutes to 60 minutes across sites). There was a 5 minute improvement in median door to device time compared to 2016 analyses.
- Mortality within 30 days following PCI was 1.9%. Of these 91 deaths, 80% were classed as either salvage or emergency PCI.
- Of all cases, 0.49% recorded a major intra-procedural complication. Coronary artery perforation accounted for the majority (0.37%) of these events.
- Radiation doses were found to be under the high dose threshold in 97.9% of PCI cases across all sites and 99.9% of other coronary procedures.

9 Participating sites

During 2017, there were 8 public hospitals offering cardiac catheter laboratory (CCL) services across both metropolitan and regional Queensland. This includes the Sunshine Coast University Hospital (SCUH) which opened in March 2017, with invasive cardiology services moving from Nambour General Hospital (NGH). Cases for NGH for the earlier part of the year are included under SCUH.

Table 1: Participating sites

Site number	Site name	Acronym
1	Cairns Hospital	CH
2	The Townsville Hospital	TTH
3	Mackay Base Hospital	MBH
4	Sunshine Coast University Hospital	SCUH
5	The Prince Charles Hospital	TPCH
6	Royal Brisbane and Women's Hospital	RBWH
7	Princess Alexandra Hospital	PAH
8	Gold Coast University Hospital	GCUH

9.1 Statewide

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) except for Royal Brisbane and Women's Hospital, who treated 53% patients from outside their HHS boundary.

Total cases included 65 patients from overseas, accounting for 1.3% of all PCI cases across all sites.

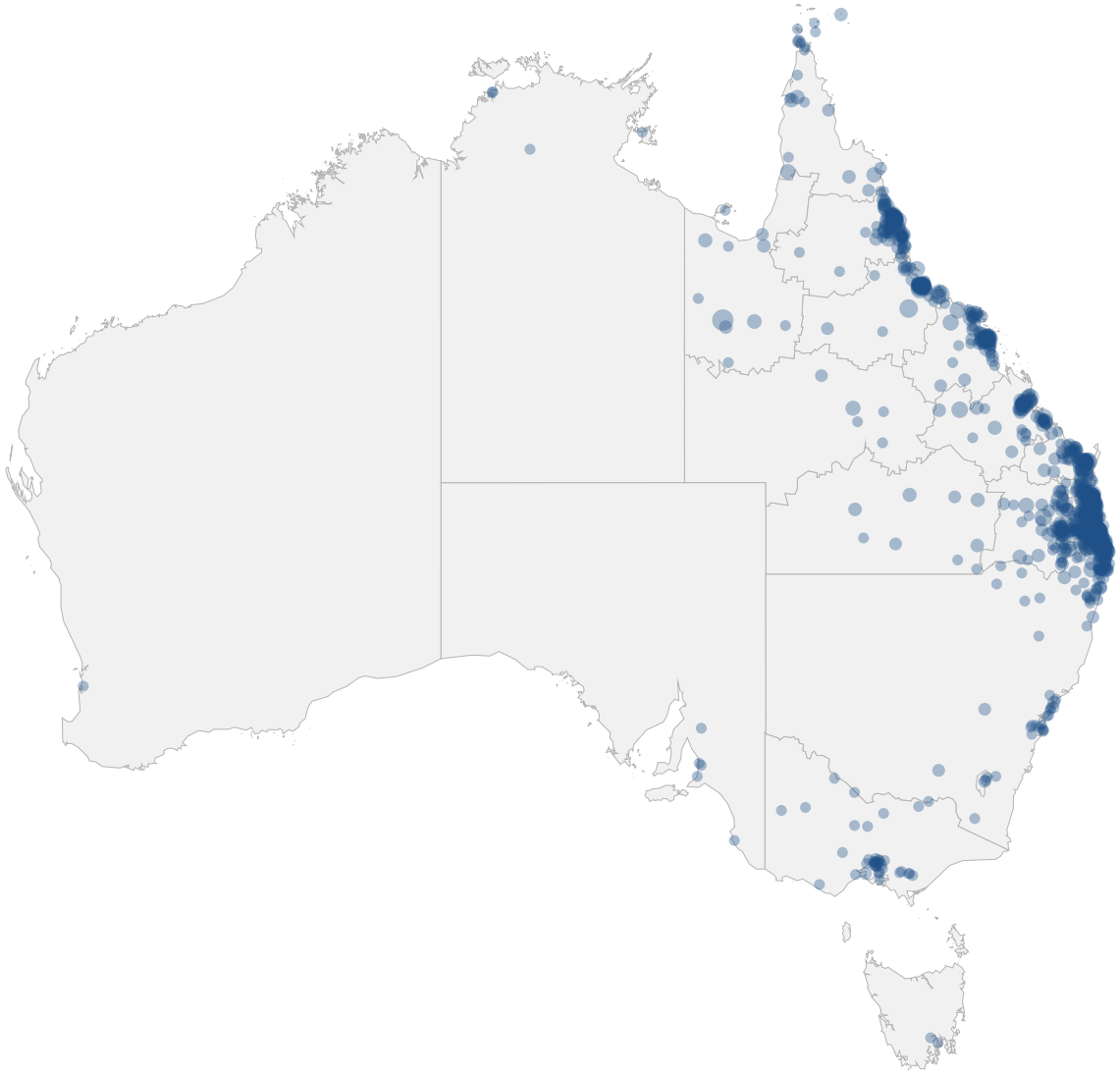


Figure 1: PCI cases by residential postcode

Table 2: Proportion of cases with patient residential postcode within the treating HHS boundaries

Site	Within HHS (%)
Cairns Hospital	80.2
The Townsville Hospital	73.0
Mackay Base Hospital	93.8
Sunshine Coast University Hospital	76.1
The Prince Charles Hospital	62.6
Royal Brisbane and Women's Hospital	47.3
Princess Alexandra Hospital	60.3
Gold Coast University Hospital	73.9

9.2 Cairns Hospital

Figure 2: 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 cardiac services provided at Cairns Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Pacemaker implantations
- One cardiac catheter laboratory with a dedicated service commencing in 2010
- 24/7 PCI service available since April 2015
- 5.4 FTE consultant cardiologists.

9.3 The Townsville Hospital

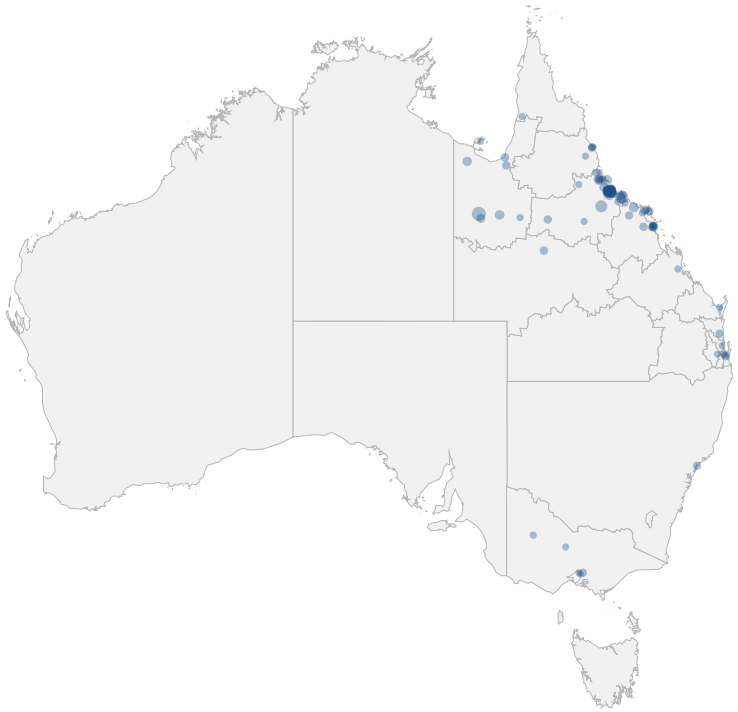


Figure 3: The Townsville Hospital

- Referral hospital for Townsville and North West Hospital and Health Services, serving a population of approximately 295,000
- Public tertiary level cardiac services provided at The Townsville Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiac surgery
- Two cardiac catheter laboratories with a dedicated service commencing in 1994
- 24/7 PCI service available since March 2016
- 7.1 FTE consultant cardiologists

9.4 Mackay Base Hospital

- Referral hospital for Mackay and Whitsunday regions, serving a population of approximately 182,000
- Public tertiary level cardiac services provided at Mackay Base Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - ICD and pacemaker implantation
- One cardiac catheter laboratory with a dedicated service commencing in 2014
- 4.6 FTE consultant cardiologists

Figure 4: Mackay Base Hospital

9.5 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 cardiac services provided at SCUH include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
- Three cardiac catheter laboratories with a dedicated service commencing in 2017
- 24/7 PCI service available since March 2017. Replaces NGH
- 9.1 FTE consultant cardiologists

Figure 5: Sunshine Coast University Hospital

9.6 The Prince Charles Hospital

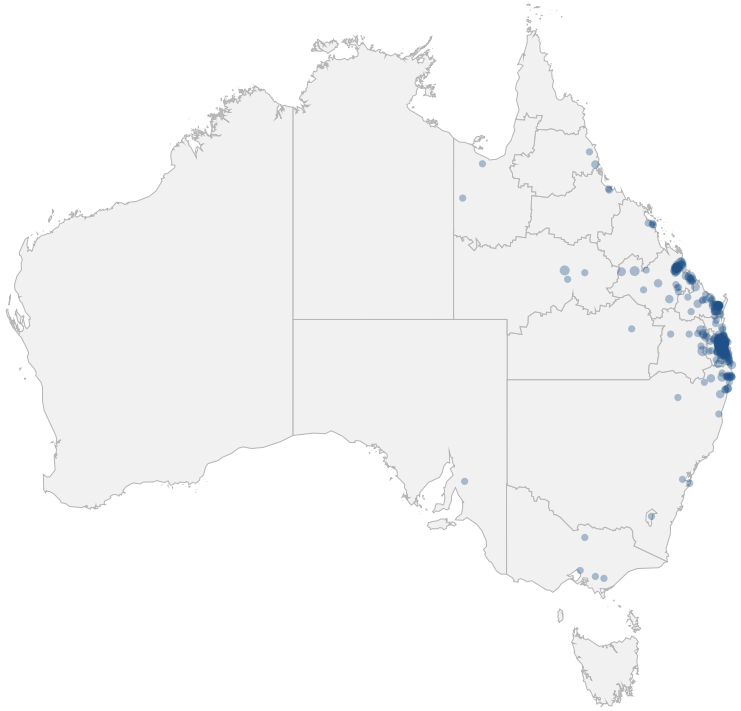


Figure 6: The Prince Charles Hospital

- 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 cardiac services provided at TPCH include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiac surgery
  - Heart / lung transplant unit
  - Adult congenital heart disease clinic
- Three cardiac catheter laboratories and one hybrid theatre. 24/7 PCI service available since 1995
- 19.89 FTE consultant cardiologists

9.7 Royal Brisbane and Women's Hospital

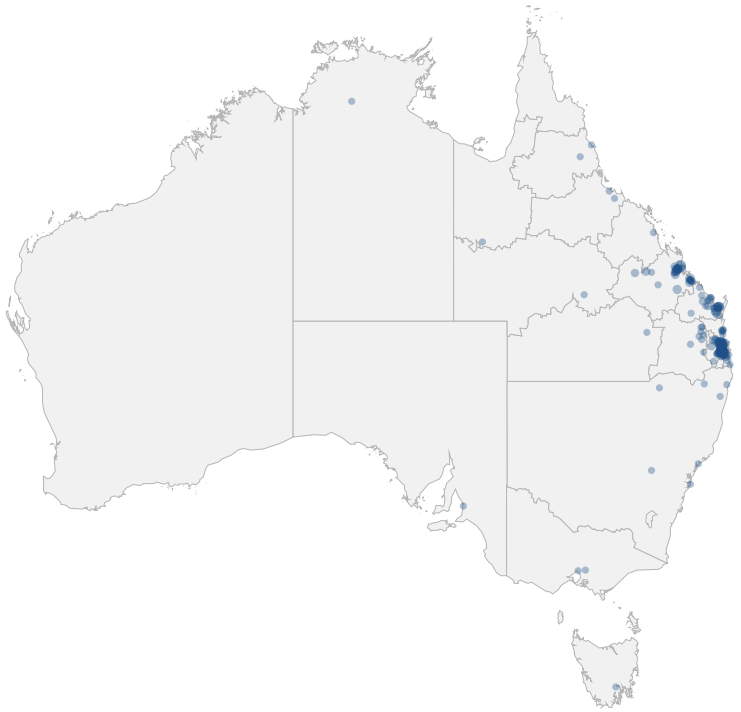


Figure 7: Royal Brisbane and Women's Hospital

- 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 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
- Two cardiac catheter laboratories with a dedicated service commencing in 1997
- 24/7 PCI service available since 1997
- 11 FTE consultant cardiologists

9.8 Princess Alexandra Hospital

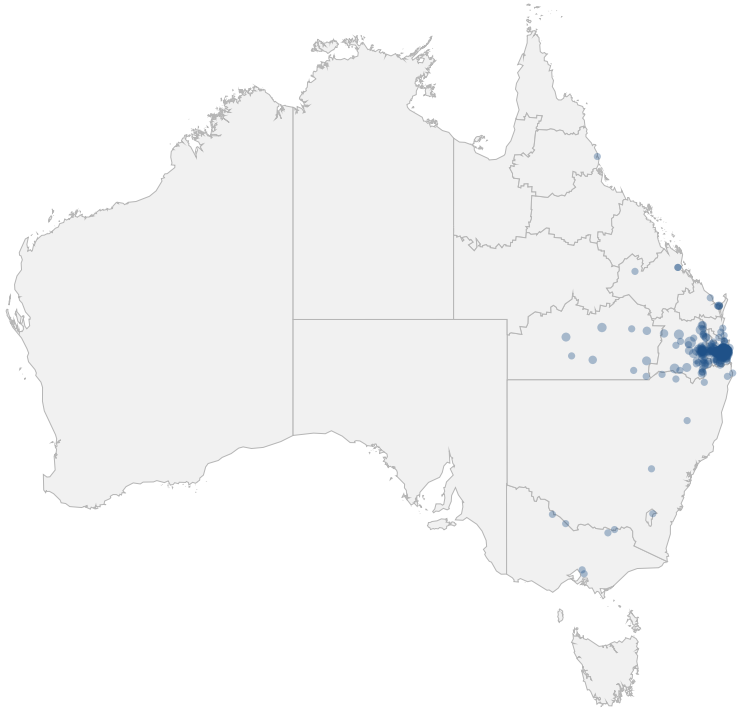


Figure 8: Princess Alexandra Hospital

- Referral hospital for Metro South and South West Hospital and Health Services, serving a population of approximately 1,000,000
- Public tertiary level cardiac services provided at the Princess Alexandra Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiac surgery
- Three cardiac catheter laboratories with a dedicated service commencing in 1998
- 24/7 PCI service available since November 1998
- 11.5 FTE consultant cardiologists

9.9 Gold Coast University Hospital

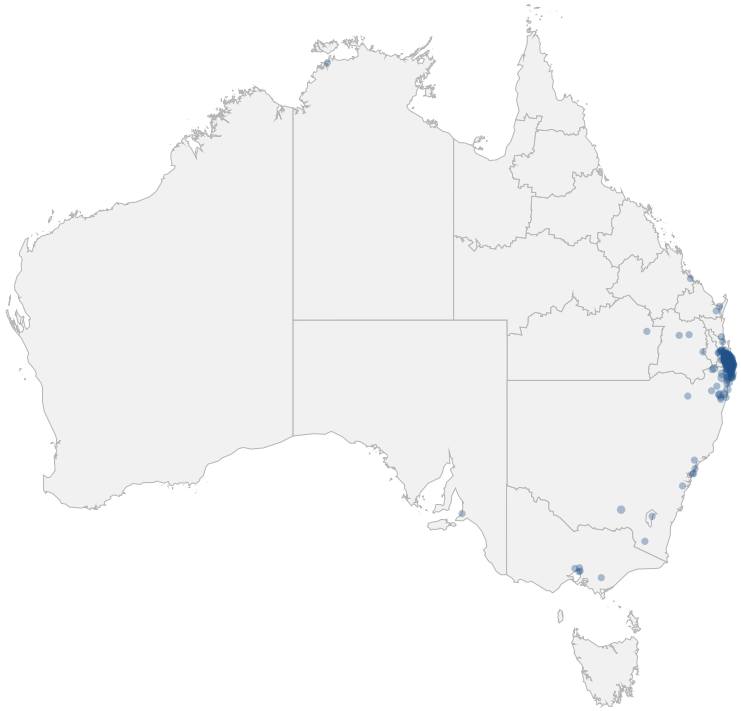


Figure 9: Gold Coast University Hospital

- Referral Hospital for Gold Coast and northern New South Wales regions, serving a population of approximately 700,000
- Public tertiary level 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
  - Cardiac surgery
- 24/7 PCI service available since 2006
- 8.25 FTE consultant cardiologists

10 Total cases

10.1 Procedure type

In 2017, there were a total of 15,293 coronary cases which were performed across the 8 participating public cardiac catheter laboratories.

Of the total cases, 4,928 (32%) involved percutaneous coronary interventions (PCI), with these cases the main subject of this report. Additional detail for 390 structural heart disease (SHD) cases have been included as a supplement to this report.

Table 3: Total number of cases by procedure category

Site	PCI procedure* n (%)	Other coronary procedure† n (%)	All cases n (%)
CH	501 (34.9)	934 (65.1)	1,435 (100.0)
TTH	398 (29.2)	965 (70.8)	1,363 (100.0)
MBH	258 (26.7)	708 (73.3)	966 (100.0)
SCUH	592 (39.9)	891 (60.1)	1,483 (100.0)
TPCH	1,066 (27.2)	2,847 (72.8)	3,913 (100.0)
RBWH	425 (32.0)	904 (68.0)	1,329 (100.0)
PAH	1,004 (35.2)	1,847 (64.8)	2,851 (100.0)
GCUH	684 (35.0)	1,269 (65.0)	1,953 (100.0)
STATEWIDE	**4,928 (32.2)**	**10,365 (67.8)**	**15,293 (100.0)**

* Includes POBA, 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, fractional flow reserve, intravascular ultrasound, optical coherence tomography and instantaneous wave free ratio

10.2 Total cases by diagnosis

The most common diagnosis across all cases was of an acute coronary syndrome (ACS), which accounted for approximately one third of all cases (33%), and almost two thirds of all PCI cases (61%).

The most common diagnosis was of Non-ST Elevation ACS (including both NSTEMI and unstable angina) while ST-Elevation ACS cases represented 11% of all cases, and 29% of all PCI cases.

Table 4: Total cases by diagnosis category

Site	STEMI n (%)	NSTEMI n (%)	Unstable angina n (%)	No ACS n (%)	All cases n (%)
CH	166 (11.6)	307 (21.4)	16 (1.1)	946 (65.9)	1,435 (100.0)
TTH	117 (8.6)	249 (18.3)	34 (2.5)	963 (70.7)	1,363 (100.0)
MBH	49 (5.1)	127 (13.1)	77 (8.0)	713 (73.8)	966 (100.0)
SCUH	266 (17.9)	331 (22.3)	32 (2.2)	854 (57.6)	1,483 (100.0)
TPCH	279 (7.1)	665 (17.0)	28 (0.7)	2,941 (75.2)	3,913 (100.0)
RBWH	123 (9.3)	363 (27.3)	26 (2.0)	817 (61.5)	1,329 (100.0)
PAH	494 (17.3)	678 (23.8)	121 (4.2)	1,558 (54.6)	2,851 (100.0)
GCUH	225 (11.5)	283 (14.5)	30 (1.5)	1,415 (72.5)	1,953 (100.0)
STATEWIDE	**1,719 (11.2)**	**3,003 (19.6)**	**364 (2.4)**	**10,207 (66.7)**	**15,293 (100.0)**

Table 5: PCI cases by diagnosis category

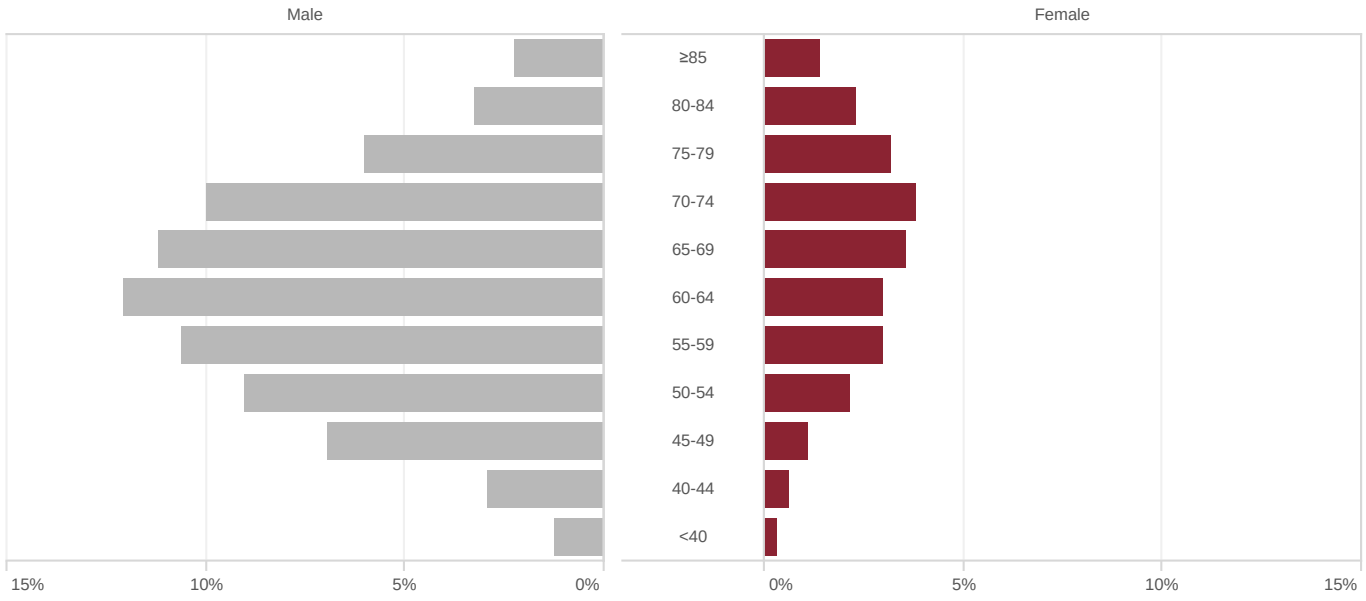
Site	STEMI n (%)	NSTEMI n (%)	Unstable angina n (%)	No ACS n (%)	All PCI cases n (%)
CH	139 (27.7)	164 (32.7)	11 (2.2)	187 (37.3)	501 (100.0)
TTH	104 (26.1)	78 (19.6)	12 (3.0)	204 (51.3)	398 (100.0)
MBH	35 (13.6)	61 (23.6)	22 (8.5)	140 (54.3)	258 (100.0)
SCUH	232 (39.2)	149 (25.2)	11 (1.9)	200 (33.8)	592 (100.0)
TPCH	241 (22.6)	309 (29.0)	5 (0.5)	511 (47.9)	1,066 (100.0)
RBWH	95 (22.4)	174 (40.9)	16 (3.8)	140 (32.9)	425 (100.0)
PAH	388 (38.6)	312 (31.1)	55 (5.5)	249 (24.8)	1,004 (100.0)
GCUH	200 (29.2)	160 (23.4)	12 (1.8)	312 (45.6)	684 (100.0)
STATEWIDE	**1,434 (29.1)**	**1,407 (28.6)**	**144 (2.9)**	**1,943 (39.4)**	**4,928 (100.0)**

11 Patient characteristics

11.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. The median age of patients undergoing PCI was 64 years of age and ranged from 61 years to 67 years across sites.

The median age for females was higher than males (68 years vs. 63 years).



% of total PCI (n=4,928)

Figure 10: Proportion of all PCI cases by gender and age group

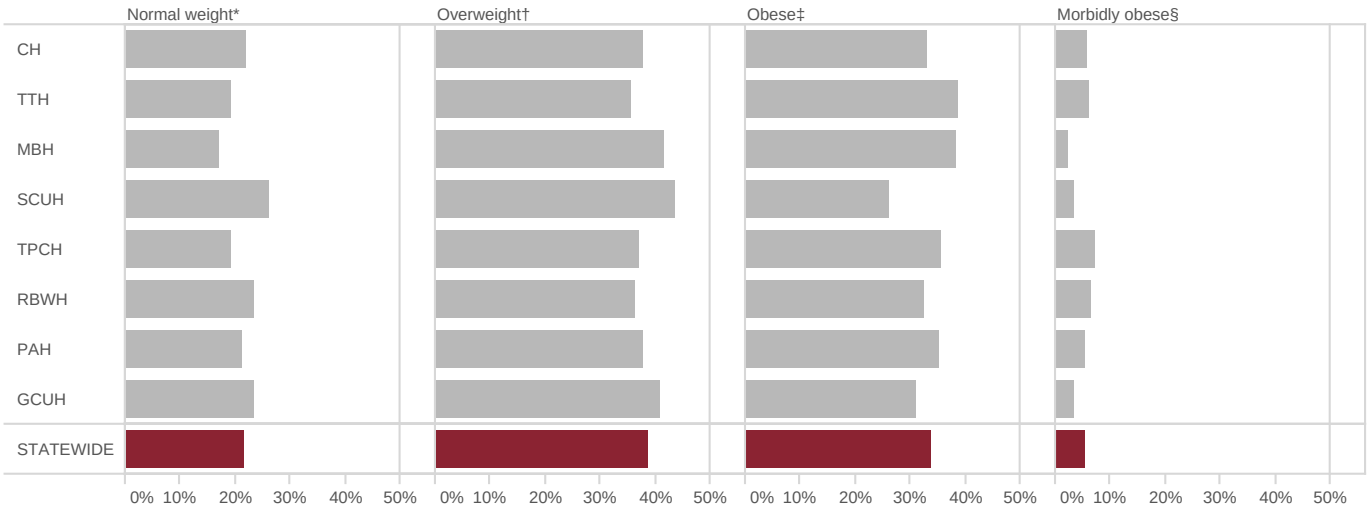
Table 6: Median age by gender for all PCI cases

	Male (years)	Female (years)	All (years)
CH	61.4	62.4	61.6
TTH	61.0	66.2	62.1
MBH	65.8	69.8	66.9
SCUH	65.8	68.0	66.3
TPCH	65.2	68.9	66.2
RBWH	61.4	68.8	62.9
PAH	60.0	65.7	61.3
GCUH	63.0	69.8	64.6
STATEWIDE	**63.1**	**67.8**	**64.1**

11.2 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 38%, 34% and 5% classified as overweight, obese and morbidly obese respectively. There were 1% of cases classified as underweight.

These analyses compare similarly with 2015 and 2016 data.



* 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 11: Proportion of all PCI cases by body mass index category

11.3 Place of residence

The majority (93%) of patients were recorded as having their usual place of residence within Queensland. This was similar across all sites with the exception of the Gold Coast University Hospital where 23% of PCI patients originated from outside of Queensland.

Of those patients residing in Queensland, the majority (75%) had a place of usual residence which was within 50 kilometres of the nearest PCI facility.

Table 7: PCI cases by place of usual residence

Site	Queensland (%)	Interstate (%)	Overseas (%)
CH	95.4	2.6	2.0
TTH	97.0	2.0	1.0
MBH	96.9	2.3	0.8
SCUH	94.9	3.2	1.9
TPCH	95.1	4.2	0.7
RBWH	95.7	2.8	1.4
PAH	97.3	1.4	1.3
GCUH	77.5	20.7	1.8
STATEWIDE	**93.4**	**5.3**	**1.3**

Table 8: Queensland PCI cases by distance from place of residence to nearest PCI facility

Site	<50 km (%)	50–150 km (%)	>150 km (%)
CH	62.6	25.0	12.5
TTH	61.2	21.9	16.9
MBH	72.0	20.4	7.6
SCUH	76.1	17.0	7.0
TPCH	75.5	7.6	16.9
RBWH	64.2	10.6	25.2
PAH	79.2	13.8	7.0
GCUH	98.7	0.6	0.8
STATEWIDE	**75.3**	**13.2**	**11.5**

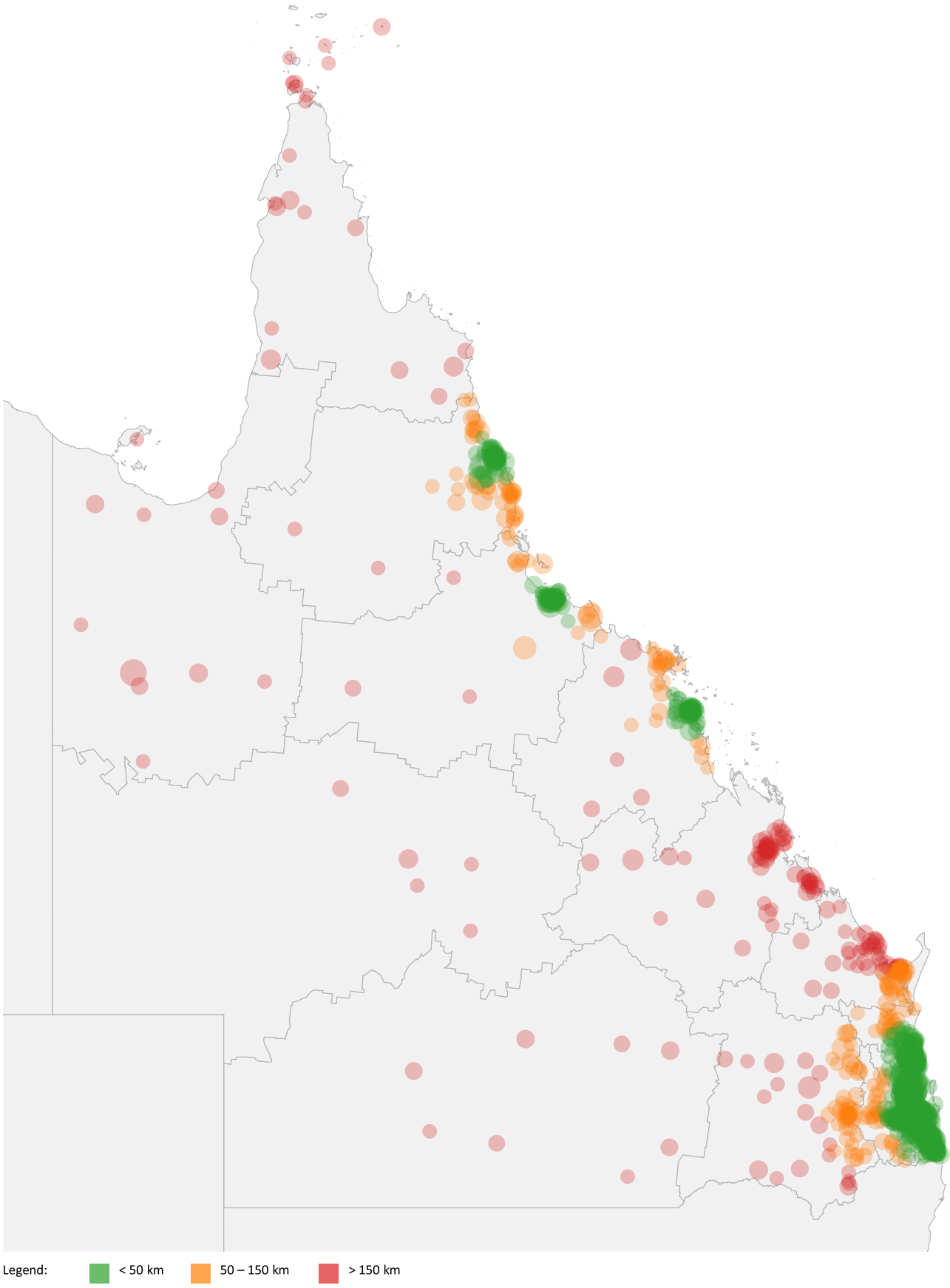


Figure 12: Queensland PCI cases by distance to nearest PCI facility

11.4 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.

The increased proportion of identified Aboriginal and Torres Strait Islander patients in the northern HHSs (CH, 23.6% and TTH, 15.6%) reflects the resident population within these areas and should be noted for future service provision and planning.

The proportion of identified Aboriginal and Torres Strait Islander patients requiring a PCI procedure across all sites (6.3%) exceeds the estimated proportion of Aboriginal and Torres Strait Islander persons within Queensland (4.0%).[3]

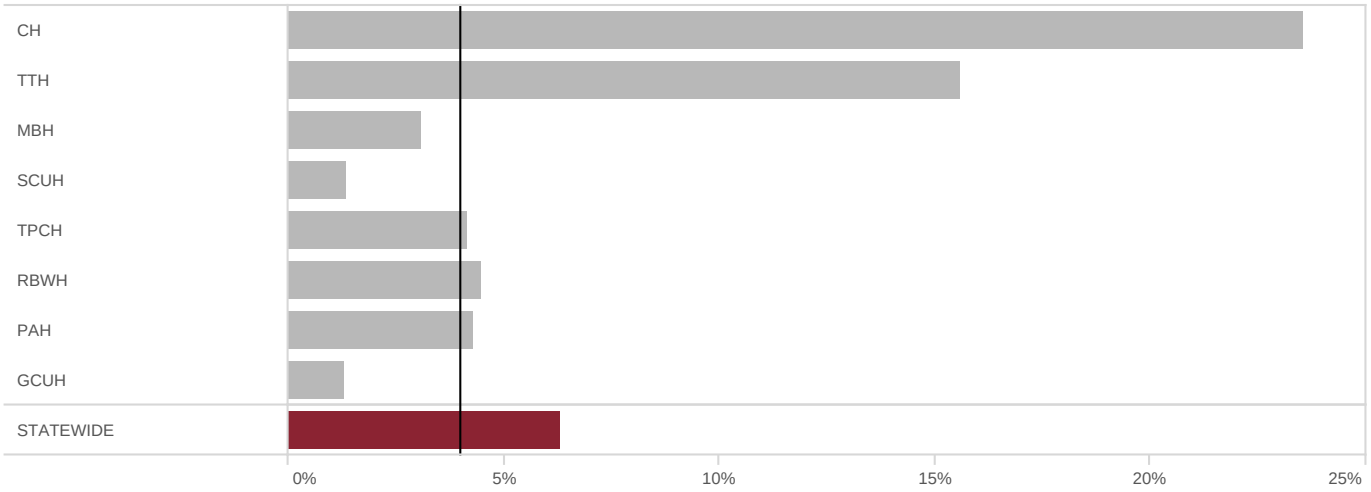
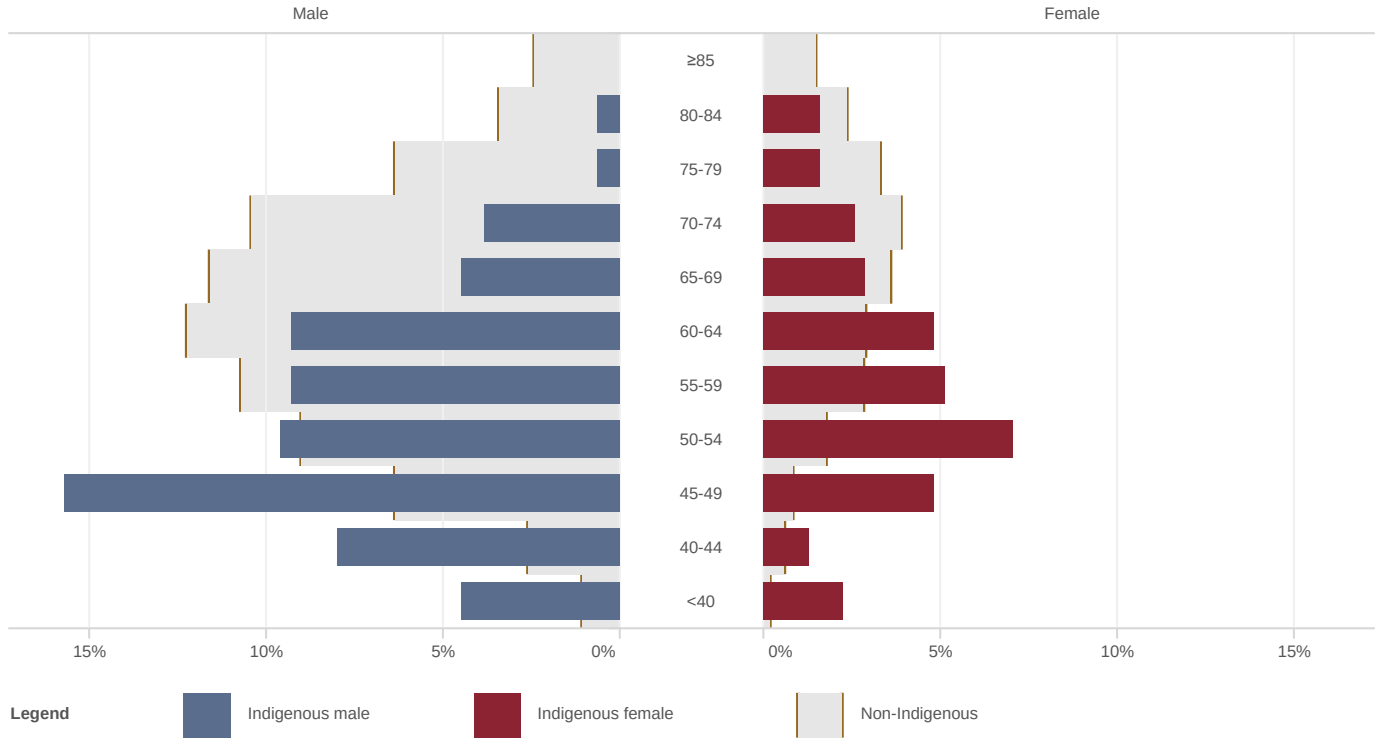


Figure 13: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

The median age of Aboriginal and Torres Strait Islander patients undergoing PCI was lower than that of non-Aboriginal and Torres Strait Islander patients (54 years vs 65 years).



% of total PCI cases (n=4,928)

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

Table 9: PCI cases median patient age by gender and Aboriginal and Torres Strait Islander status

	Total cases (n)	Male (years)	Female (years)	All (years)
Aboriginal and Torres Strait Islander	311	51.8	56.0	53.7
Non Aboriginal and Torres Strait Islander	4,617	63.6	68.5	64.7
ALL	**4,928**	**63.1**	**67.8**	**64.1**

12 Care and treatment of PCI patients

12.1 Admission status

A total of 4,928 PCI procedures were performed in 2017 by the 8 contributing cardiology centres across Queensland. Patients were classified into admission status defined by the National Cardiovascular Data Registry as follows:[4]

Despite published definitions, the percentage distribution varied considerably between institutions as classification of cases is sometimes operator-dependent.

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)

* Typically includes NSTEMI

† Typically includes STEMI

‡ Haemodynamically unstable

The majority (76%) of PCI cases were classed as urgent, emergent or salvage PCI. This reflects the acute and often complex case mix draining to Queensland public hospitals.

Salvage cases varied between institutions with CH and RBWH performing almost 3% of their PCI cases in these complex clinical scenarios.

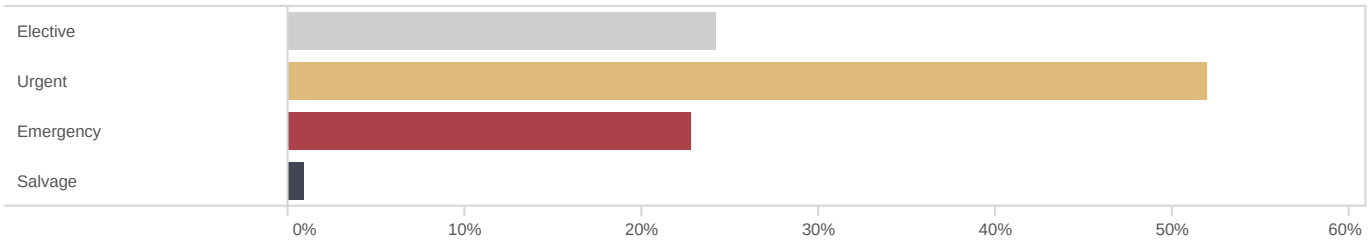


Figure 15: Proportion of all PCI cases by admission status

Table 11: PCI cases by site and admission status

	Total cases (n)	Elective (%)	Urgent (%)	Emergent (%)	Salvage (%)
CH	501	23.4	52.5	21.4	2.8
TTH	398	18.3	62.6	18.3	0.8
MBH	258	44.6	50.8	4.7	0.0
SCUH	592	17.4	50.5	31.8	0.3
TPCH	1,066	33.1	47.0	19.6	0.3
RBWH	425	15.8	61.9	19.5	2.8
PAH	1,004	19.9	53.9	25.8	0.4
GCUH	684	24.6	46.2	28.1	1.2
STATEWIDE	**4,928**	**24.3**	**52.0**	**22.8**	**0.9**

12.2 Access route

Across all sites, the majority of PCI cases (92%) used a single access route, with 57% being via the radial approach, 34% femoral, and less than one per cent via another access route including brachial or ulnar.

The use of the radial approach varied between different PCI centres (23% to 80%).

Multiple access routes were recorded for 8% of cases. This includes the use of a dual approach (both radial and femoral) as well as unsuccessful approaches with subsequent crossover to another access route.

Table 12: PCI access route by site

	Radial (%)	Femoral (%)	Other (%)	Multiple approaches (%)
CH	74.9	16.6	-	8.6
TTH	49.5	46.5	0.8	3.3
MBH	63.8	27.2	-	9.1
SCUH	79.6	13.2	0.5	6.8
TPCH	58.3	27.0	0.1	14.6
RBWH	65.2	25.2	0.2	9.4
PAH	23.3	73.1	-	3.6
GCUH	70.3	20.9	-	8.8
STATEWIDE	**57.2**	**34.3**	**0.2**	**8.3**

12.3 Vessels treated

Of all vessels or grafts treated by PCI, the majority were native vessels. Of the native vessels treated, 45% involved the left anterior descending coronary artery (LAD), followed by the right coronary artery (RCA) at 37%, the circumflex coronary artery (LCx) at 23% and the left main coronary artery (LMCA) at less than three per cent. Coronary artery graft PCI accounted for 3% of case volume.

Table 13: Vessels treated by site

	LAD (%)	LMCA (%)	LCx (%)	RCA (%)	GRAFT (%)
CH	43.3	2.6	23.2	35.7	2.2
TTH	44.0	3.6	21.2	31.9	4.1
MBH	41.7	0.4	25.5	33.2	2.4
SCUH	44.3	2.9	23.8	38.0	3.7
TPCH	44.6	4.2	24.0	38.7	3.4
RBWH	45.8	1.2	22.4	41.0	2.8
PAH	46.3	1.5	19.4	36.1	3.4
GCUH	43.6	1.5	23.4	36.8	1.9
STATEWIDE	**44.5**	**2.5**	**22.6**	**36.9**	**3.1**

12.4 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, an average of 1.5 stents were used for each of the 4,642 PCI cases involving stent deployment. Drug eluting stents were used in 85% of cases, ranging 73% to 98% across centres, while BMS were used in 15% of cases. A BVS or covered stent was used in less than 1% of cases.

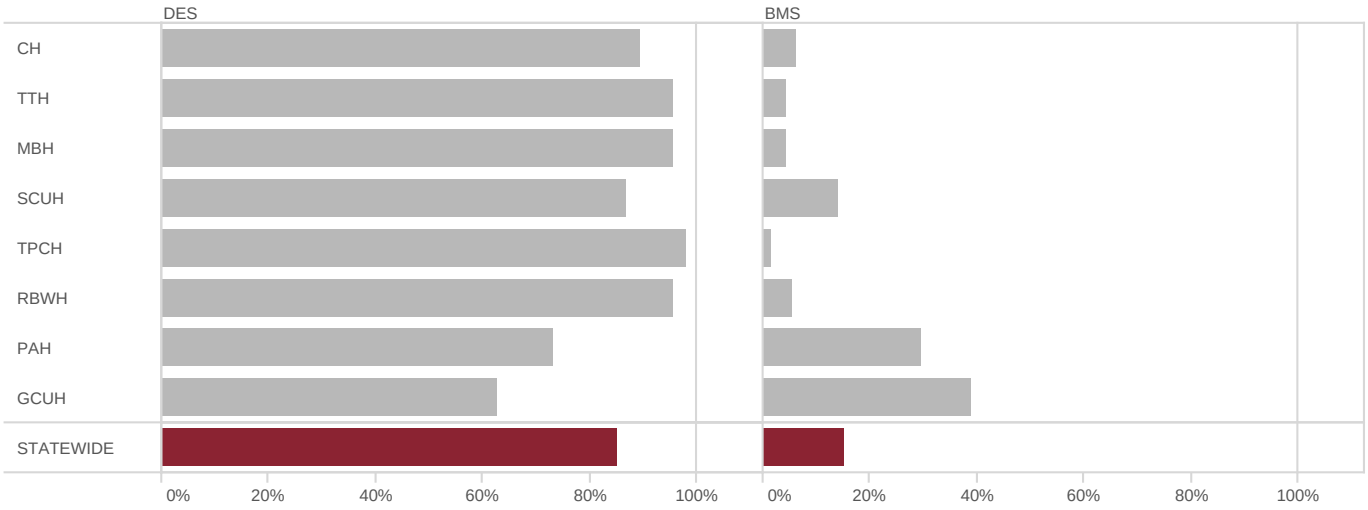


Figure 16: Proportion of cases including at least one stent by site and stent type

Table 14: 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	458	89.5	6.3	5.0	0.0	1.5
TTH	381	95.8	4.5	0.0	0.5	1.5
MBH	226	95.6	4.4	0.0	0.4	1.4
SCUH	564	86.9	14.0	0.0	0.7	1.5
TPCH	996	98.1	1.5	0.3	0.1	1.6
RBWH	408	95.8	5.6	0.0	0.5	1.7
PAH	976	73.2	29.5	0.0	0.2	1.5
GCUH	633	62.6	39.0	0.0	0.0	1.4
STATEWIDE	**4,642**	**85.3**	**15.2**	**0.6**	**0.3**	**1.5**

12.5 NSTEMI

12.5.1 Case load

Of all PCI and coronary cases performed in cardiac catheter suites during 2017, there were 3,003 (20%) which were coded with a procedural indication of NSTEMI.

NSTEMI cases accounted for 29% of PCI cases across all centres, with site variation ranging from 23% to 41%.

Table 15: NSTEMI cases

Site	Total NSTEMI cases (n)	NSTEMI receiving PCI n (%)	Proportion of all PCI cases (%)
CH	307	164 (53.4)	32.7
TTH	249	78 (31.3)	19.6
MBH	127	61 (46.0)	23.6
SCUH	331	149 (45.0)	25.2
TPCH	665	309 (46.5)	29.0
RBWH	363	174 (47.9)	40.9
PAH	678	312 (46.0)	31.1
GCUH	283	160 (56.5)	23.4
STATEWIDE	**3,003**	**1,407 (46.8)**	**28.6**

12.5.2 Admission source

Overall there were more NSTEMI cases where the patient was transferred from another facility than those presenting directly to the PCI capable facility (54% and 46% respectively).

Considerable variation was observed between participating sites, with the proportion of interhospital transfers for NSTEMI ranging from 41% to 70%.

Table 16: NSTEMI admission source to treating facility

Site	NSTEMI cases (n)	Direct to treating facility (%)	Interhospital transfer (%)
CH	307	59.3	40.7
TTH	249	59.4	40.6
MBH	127	54.3	45.7
SCUH	331	52.0	48.0
TPCH	665	51.1	48.9
RBWH	363	32.8	67.2
PAH	678	30.4	69.6
GCUH	283	49.8	50.2
STATEWIDE	**3,003**	**45.8**	**54.2**

12.5.3 Hospital performance – Time to angiography

Time to coronary angiography for patients presenting to hospital with a NSTEMI continues to be a key clinical quality indicator for QCOR. National and international guidelines remain unchanged since the 2015 report with recommendations stating coronary angiography should be offered and performed within 72 hours of diagnosis.[5]

A major barrier often cited in achieving this target is the time taken to transfer patients from non-PCI capable facilities to the accepting facility. There are multiple reasons delays can occur including capacity constraints and transfer logistics. The overall outcome of this indicator is presented later.

Compared with patients presenting directly to a PCI capable facility, patients arriving from another facility to a non-PCI capable facility have a median wait to coronary angiography of 31 hours longer (68 hours vs 37 hours) and are less likely to have angiography performed within the target timeframe of 72 hours (54% vs 78%).

Analysis was only possible in a proportion of NSTEMI cases as records with missing data or specific exclusion criteria were omitted. This detail is available in the clinical indicator section of this report.

Table 17: Time to angiography – direct to PCI facility

Site	Total cases (n)	Total analysed (n)	Median (hours)	Interquartile range (hours)	Met 72 hour target (%)
CH	182	157	53	23–112	63.1
TTH	148	127	50	32–83	68.5
MBH	69	60	38	23–70	78.3
SCUH	172	162	28	17–56	84.6
TPCH	340	301	27	14–54	84.4
RBWH	119	94	21	14–34	92.6
PAH	206	169	42	21–76	74.0
GCUH	141	138	43	22–72	74.6
STATEWIDE	**1,377**	**1,208**	**37**	**19–68**	**77.7**

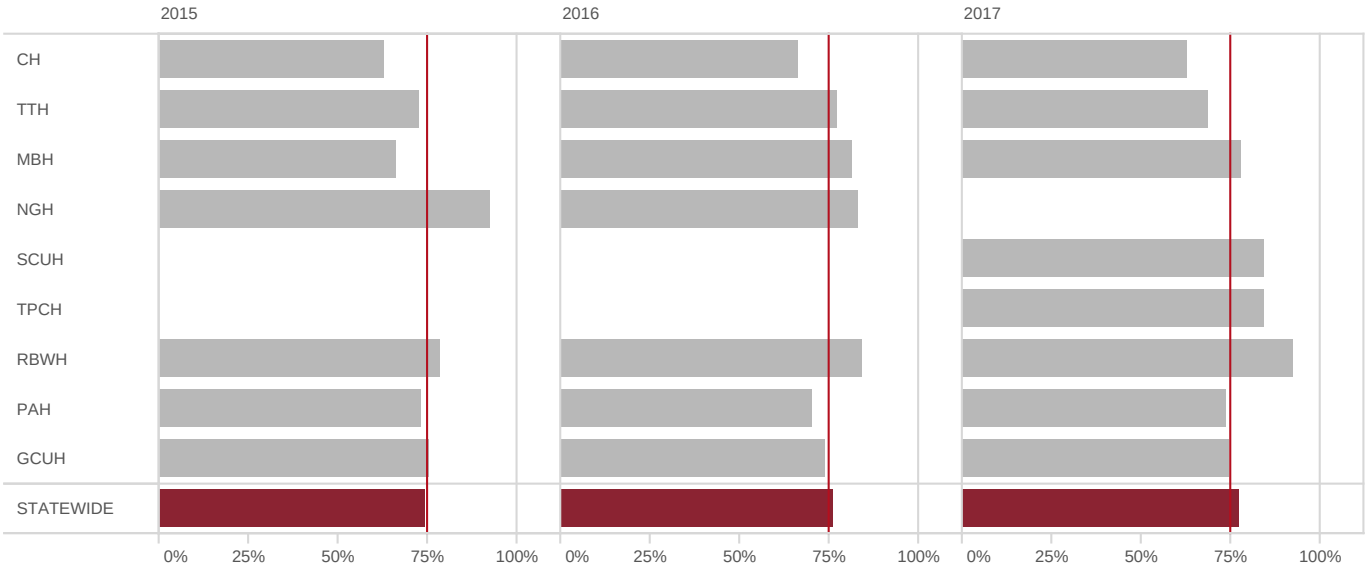


Figure 17: Proportion of NSTEMI direct presenters receiving angiography within 72 hours, 2015 to 2017

These data are similar to those observed in previous QCOR Annual Reports, highlighting the continuing need for overall system improvement and a potential statewide strategy for referring and transferring patients who require coronary angiography following NSTEMI.

Table 18: Time to angiography – interhospital transfers

SITE	Total cases (n)	Total analysed (n)	Median (hours)	Interquartile range (hours)	Met 72 hour target (%)
CH	125	111	73	36–131	47.7
TTH	101	96	71	39–118	52.1
MBH	58	36	38	25–53	80.6
SCUH	159	133	35	22–67	79.7
TPCH	326	284	72	43–117	50.0
RBWH	244	219	65	46–92	57.5
PAH	472	412	82	54–117	43.2
GCUH	142	80	55	35–84	68.8
STATEWIDE	**1,627**	**1,371**	**68**	**41–107**	**53.9**

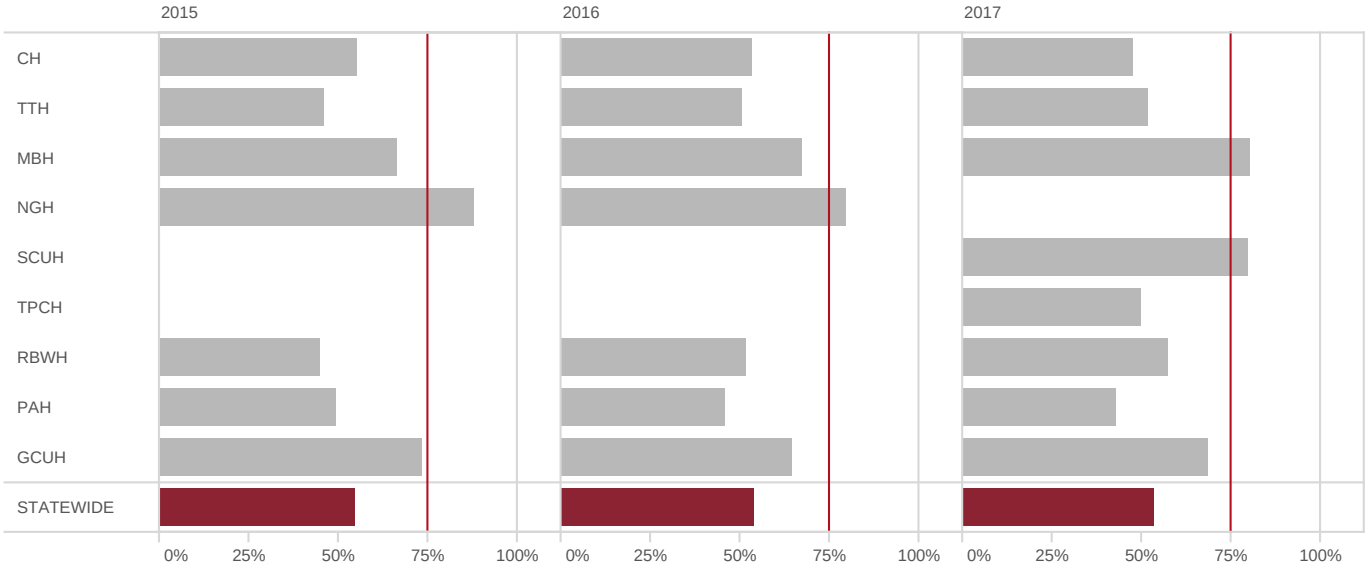


Figure 18: Proportion of NSTEMI interhospital transfers receiving angiography within 72 hours, 2015 to 2017

12.6 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 cardiac catheter laboratory 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. If the patient is in a location that allows for timely transportation to a PCI capable hospital, primary PCI is the preferred treatment choice. If the patient is not able to be transported in a timely manner, fibrinolytic therapy is preferable.

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.

12.6.1 First medical contact

Across all sites, 58% of patients with a STEMI presented via the Queensland Ambulance Service (QAS). A smaller proportion of patients presented to the emergency department (DEM) of either a PCI (on-site DEM) or non-PCI capable (satellite DEM) facility (8% and 28% respectively). The remaining 7% presented to other facilities such as GP clinics, community health facilities or other outpatient clinics.

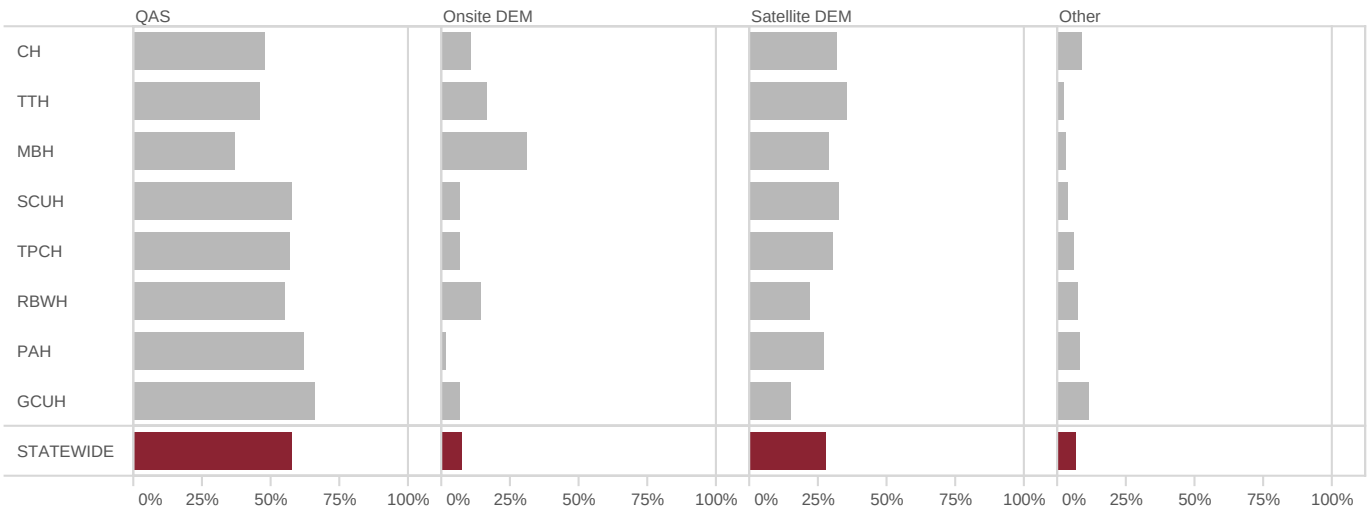


Figure 19: Proportion of STEMI cases by first medical contact

12.6.2 Clinical presentation

In 2017, there were 1,434 documented PCI STEMI cases with more than half (56%) presenting as primary PCI cases and 11% presenting after 12 hours (late presenters).

There were 23% of reperfusion-eligible patients who had received fibrinolysis (lysis), including 6% requiring rescue PCI because lysis had been unsuccessful.

Table 19: Proportion of STEMI cases by presentation

Site	Total STEMI (n)	Transient STEMI (%)	STEMI <6 hours (%)	STEMI 6–12 hours (%)	Late Presentation (%)	Post successful lysis (%)	Rescue PCI (failed lysis) (%)
CH	139	8.6	48.2	4.3	15.8	16.5	6.5
TTH	104	4.8	50.0	2.9	19.2	18.3	4.8
MBH	35	2.9	17.1	2.9	11.4	60.0	5.7
SCUH	232	12.1	46.1	3.9	6.0	22.4	9.5
TPCH	241	6.2	56.0	3.3	11.6	16.6	6.2
RBWH	95	4.2	55.8	9.5	15.8	12.6	2.1
PAH	388	16.5	47.4	3.6	8.8	17.0	6.7
GCUH	200	4.5	69.0	7.0	11.5	4.0	4.0
STATEWIDE	**1,434**	**9.6**	**51.7**	**4.5**	**11.2**	**16.8**	**6.2**

13 Clinical indicators

The clinical quality indicator program is a valuable focus of QCOR. The indicators outlined in this document have been selected after considering international PCI and STEMI treatment guidelines and are in line with current best practice. Many key guidelines advise the use of defined and validated quality indicators as a means to measure and improve patient care.

The clinical indicators reported for diagnostic and interventional cardiology are:

1 Risk adjusted all-cause 30-day mortality post PCI.

2 Proportion of STEMI patients presenting within six hours of symptom onset, who received an intervention within 90 minutes of first diagnostic ECG.

3 Proportion of all NSTEMI patients who received angiography within 72 hours of first hospital admission.

4 Proportion of majorprocedural complications for PCI (perforation requiring intervention, 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).

13.1 Mortality outcomes

13.1.1 Risk adjusted all-cause 30-day mortality post PCI

This clinical indicator includes all patients who die 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.

Table 20 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). There were no deaths among stable patients undergoing elective PCI; conversely, mortality was 51% in the critically ill patients who underwent salvage PCI. The overall 30-day unadjusted mortality rate for patients undergoing PCI procedures at hospitals participating in the QCOR analysis for 2017 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).[6]

Table 20: All-cause unadjusted mortality within 30 days post PCI by admission status

Site	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)	Case count (n)	Total deaths n (%)
CH	0 (0)	1 (0.4)	2 (1.9)	6 (42.9)	501	9 (1.8)
TTH	0 (0)	2 (0.8)	1 (1.4)	1 (33.3)	398	4 (1.0)
MBH	0 (0)	1 (0.8)	0 (0.0)	–	258	1 (0.4)
SCUH	0 (0)	1 (0.3)	7 (3.7)	2 (100.0)	592	10 (1.7)
TPCH	0 (0)	6 (1.2)	13 (6.7)	3 (100.0)	1,066	22 (2.1)
RBWH	0 (0)	2 (0.8)	2 (2.4)	11 (91.7)	425	15 (3.5)
PAH	0 (0)	5 (0.9)	14 (5.4)	0 (0.0)	1,004	19 (1.9)
GCUH	0 (0)	0 (0.0)	10 (5.2)	1 (12.5)	684	11 (1.6)
STATEWIDE	**0 (0)**	**18 (0.7)**	**49 (4.4)**	**24 (51.1)**	**4,928**	**91 (1.9)**

% of total cases by presentation and site

Figure 20 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.[7] (This analysis used an imputed dataset accounting for missing data; for TPCH, the nature of the distribution of the missing data precludes calculation of a predicted rate).

Reassuringly, 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 involvement, eGFR, LVEF, and cardiogenic shock. Other critical presentations with very high mortality risk, such as out of hospital ventricular fibrillation (VF) arrest with uncertain neurological recovery, are not adjusted for and therefore the model is likely to underestimate true mortality risk. This is relevant in our dataset, where there were marked differences between hospitals in the proportion of high-risk salvage patients taken for PCI. This ranged from 0.3% of cases at SCUH and TPCH, to 2.8% of cases at CH and RBWH.

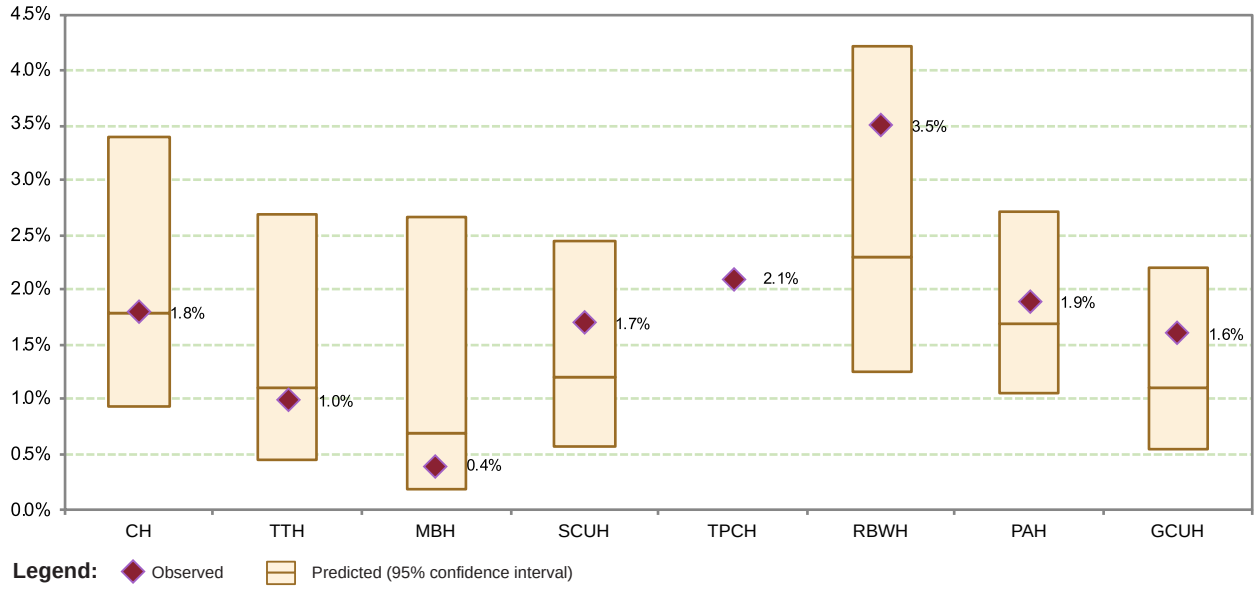
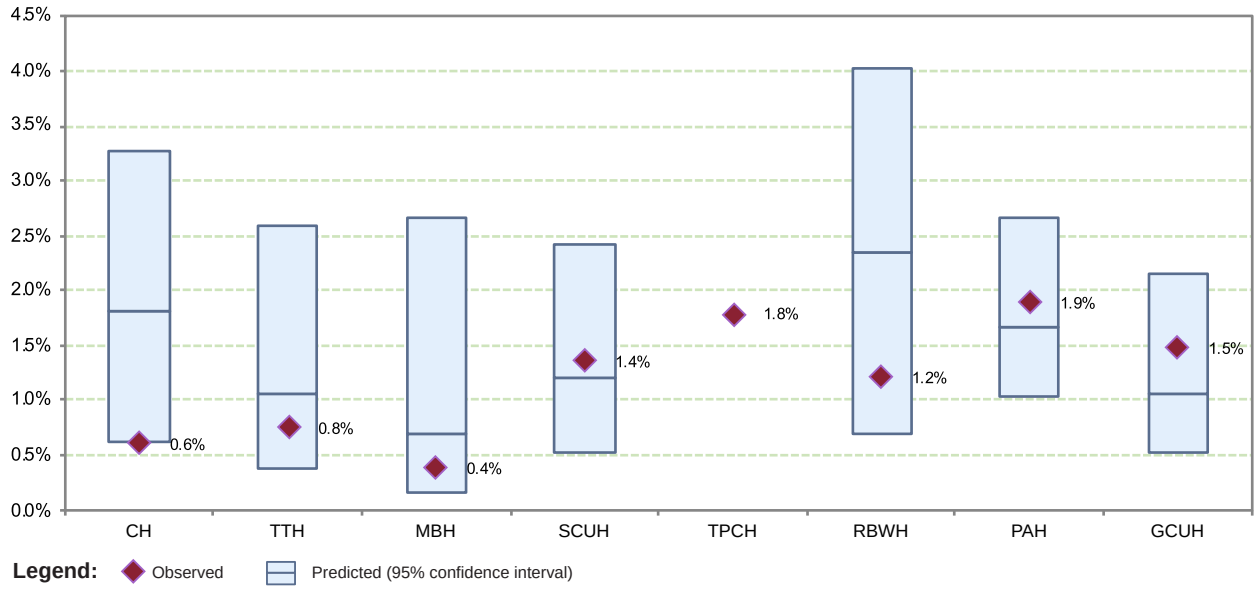


Figure 20: Comparison of observed and predicted mortality rates by site

There were also marked differences in salvage case mortality rates across different hospitals (Table 20). 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 our current risk prediction model to accurately predict expected mortality in the extreme-risk salvage category, Figure 21 presents the observed and predicted mortality rates excluding salvage.



Excludes salvage cases (n=46)

Figure 21: Comparison of observed and predicted mortality rates by site, excluding salvage

As was outlined in the 2016 report, 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 dataset, compared to other models such as those of the BCIS[6], and the American College of Cardiology (ACC) CathPCI registry.[8] These models are critically dependant on completeness of data elements. Further effort is needed from all participating sites to improve the completeness of the datasets.

With an expanded dataset of reliable data, a more thorough evaluation of the available risk models (BCIS, ACC, and VCOR) 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 VCOR risk prediction model we are currently applying.

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.

13.1.1 All STEMI mortality

A separate analysis was performed to assess mortality in patients presenting with STEMI. Of the 1,719 documented STEMI cases in 2017, 1,434 cases (83%) included a PCI intervention and are the subject of the following outcomes analyses. For this analysis, patients presenting as salvage are excluded, which allows focus to be retained on the measurement of PCI outcomes.

The outcomes for cohort of STEMI patients who underwent primary PCI remain encouraging.

All-cause mortality rates at 30 days varied from 1.6% to 3.8% with a statewide rate of 3.1%. Of these 1,398 patients analysed, a total of 44 mortalities were recorded using death registry linkage. The majority (89%) of mortalities occurred in-hospital.

Table 21: STEMI mortality up to 30 days in patients who underwent primary PCI

Site	Total cases* (n)	In lab (n)	In hospital (n)	Post discharge to 30 days (n)	Total n (%)
CH	129	0	2	0	2 (1.6)
TTH	101	0	1	1	2 (2.0)
MBH	35	0	1	0	1 (2.9)
SCUH	230	0	6	1	7 (3.0)
TPCH	238	1	8	0	9 (3.8)
RBWH	87	0	2	0	2 (2.3)
PAH	386	2	11	0	13 (3.4)
GCUH	192	0	7	0	7 (3.6)
STATEWIDE	**1,398**	**3**	**39**	**2**	**44 (3.1)**

* Excludes STEMI salvage cases (n=36)

13.1.2 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 all-cause 30-day mortality rates between 0% and 4.5% across centres, with the statewide rate at 3.7%.

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

Table 22: STEMI mortality up to 30 days for patients who underwent a primary PCI and presented within 6 hours of symptom onset

Site	Total cases* (n)	In lab (n)	In hospital (n)	Post discharge to 30 days (n)	Total n (%)
CH	61	0	1	0	1 (1.6)
TTH	51	0	1	0	1 (2.0)
MBH	6	0	0	0	0 (0)
SCUH	105	0	4	1	5 (4.8)
TPCH	133	1	5	0	6 (4.5)
RBWH	48	0	1	0	1 (2.1)
PAH	184	2	6	0	8 (4.3)
GCUH	134	0	4	0	4 (3.0)
STATEWIDE	**723**	**3**	**23**	**1**	**27 (3.7)**

* Excludes STEMI presenting within 6 hours of symptom onset salvage cases (n=19)

13.2 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 (FdECG)-to-device time as an important modifiable and objective measure of overall STEMI system performance.[9]

Both the European and American STEMI guidelines recommend a target FdECG-to-device time less than 90 minutes. For patients who present initially to a non-PCI hospital then transfer to a PCI facility (inter-hospital transfer), the accepted FdECG-to-device target is less than 120 minutes.[9,10] It is widely recognised that these targets are ambitious and difficult to achieve in real-world practice as primary PCI becomes more available to larger catchment populations.

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

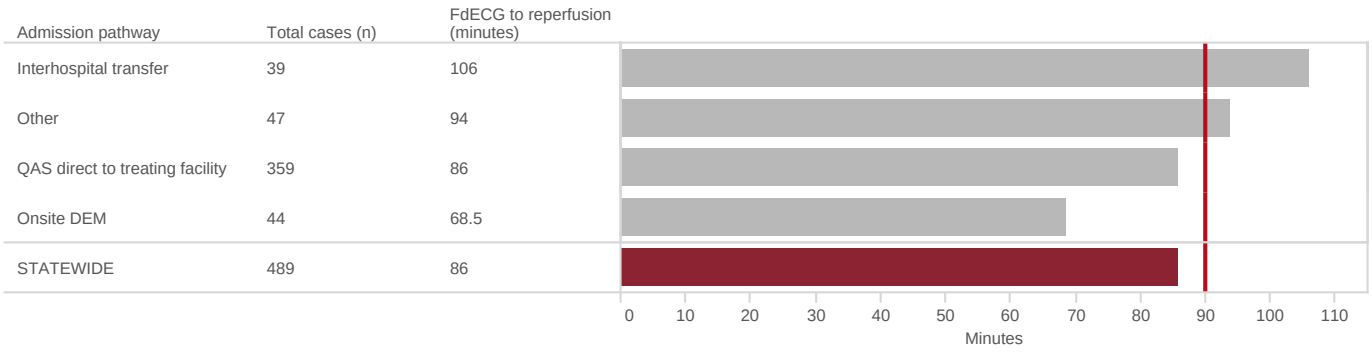
Table 23: Definitions for STEMI time to reperfusion

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

The steering committee established the benchmark target of 75% of patients to receive timely reperfusion measured from first diagnostic ECG to reperfusion as well as from arrival at PCI facility to reperfusion.

In total, there were 742 STEMI primary PCI cases presenting within six hours of symptom onset. Of these, there were 126 cases which had been excluded per the criteria in Table 24 leaving 616 cases which are eligible for the following analysis. Further cases are excluded from the clinical indicators where the timestamps required to measure time to reperfusion were not recorded in the system.

Considerable variation was observed depending on the admission pathway to the treating facility.



Other includes GP, inpatient and outpatient referrals

Figure 22: STEMI presenting within 6 hours of symptom onset – median first diagnostic ECG to first device time by admission pathway

Table 24: STEMI <6 hours cases ineligible for analysis

Summary	**n**
Out of hospital arrest	34
Salvage	19
Significant comorbidities/frailty	16
Previous coronary artery bypass graft surgery	14
Thrombolysis contraindicated	12
Intubation	12
Shock/acute pulmonary oedema	12
Unsuccessful PCI	4
Significant non-cardiac comorbidity	3
Total ineligible	**126**

13.2.1 Time from first diagnostic ECG to first device

The all-site median time from first diagnostic ECG to reperfusion was 86 minutes, with median individual site times ranging from 70 minutes to 98 minutes. These results indicate that overall Queensland public facilities are approaching the ambitious benchmark of 90 minutes from time of first diagnostic ECG to first device. However, only 57% of patients analysed receive timely reperfusion per current guidelines (FdECG to reperfusion)6, supporting the view that the current target is optimistic.

This is currently the focus of international review as more achievable objectives are explored. Nonetheless, the metric 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 25: First diagnostic ECG (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	67	51	70	60–87	74.5
TTH	52	44	76	63–95	70.5
MBH*	6	3	–	–	–
SCUH	107	88	88	72–106	58.0
TPCH†	135	0	–	–	–
RBWH	53	44	82	66–101	65.9
PAH	184	145	98	84–114	39.3
GCUH	138	114	84	69–99	61.4
STATEWIDE	**742**	**489**	**86**	**71–106**	**56.6**

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

† TPCH is not included as it has not collected FdECG timestamps until 2018

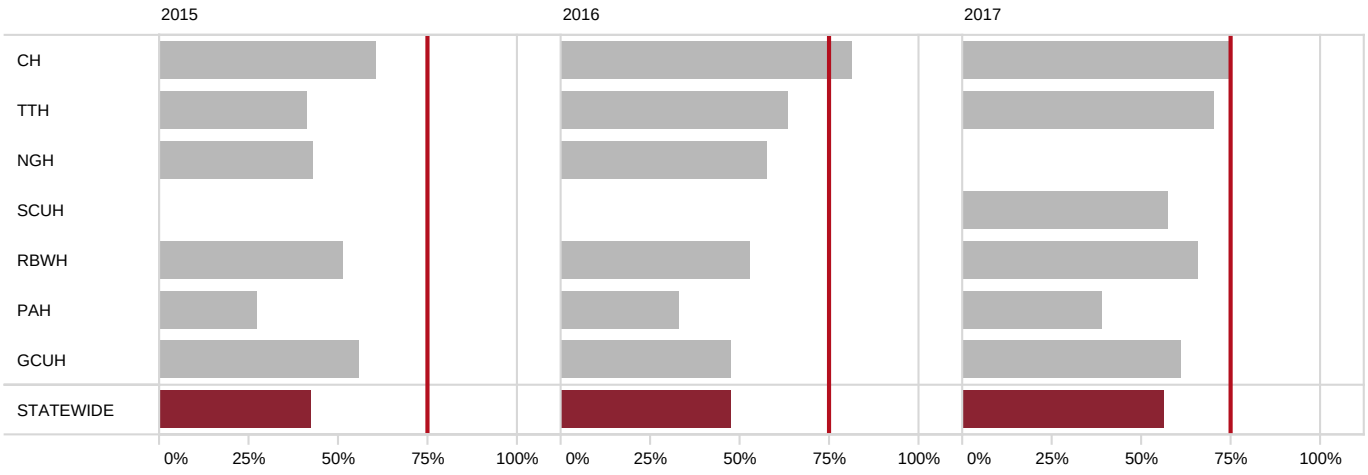
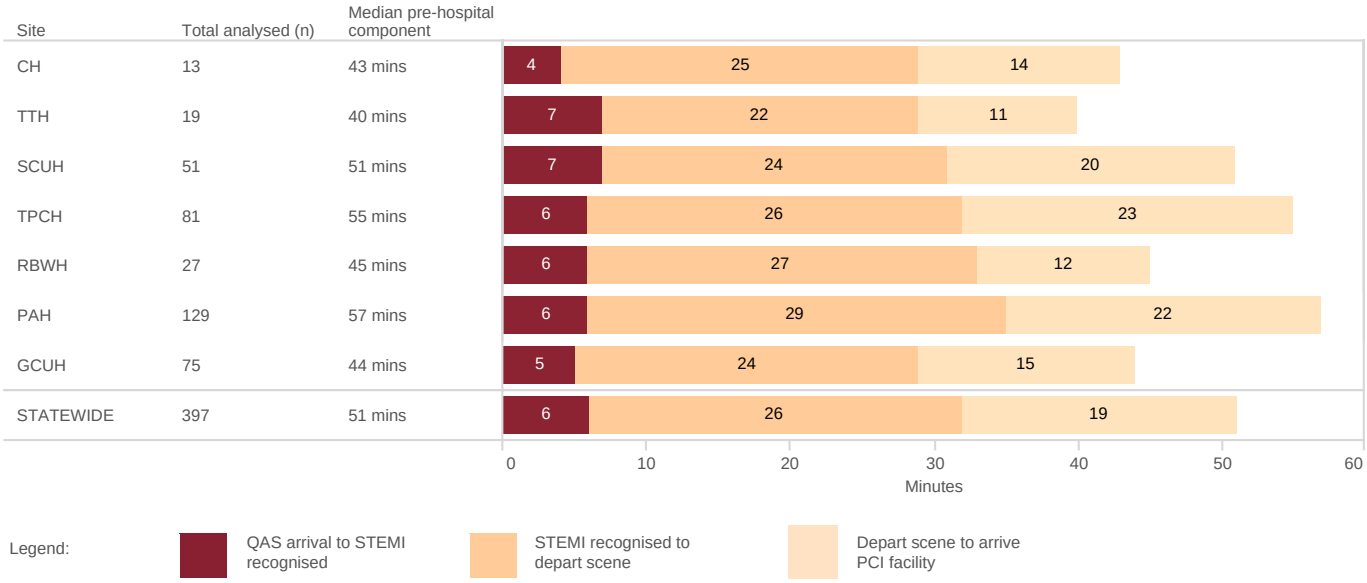


Figure 23: Proportion of STEMI cases (<6 hours of symptom onset) where time from first diagnostic ECG to reperfusion met 90 minute target, 2015–2017

1. Pre-hospital notification processes

The Queensland Ambulance Service has a long-established record of developing pre-hospital processes for the management of STEMI. On recognition of STEMI meeting criteria for primary PCI by a QAS paramedic trained in coronary reperfusion, 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 and the cardiac catheter lab is activated. This referral, however, could not occur if a QAS paramedic trained in coronary reperfusion was not available to attend the patient.

Since 2008, Critical Care Paramedics have always been trained in reperfusion and more recently, QAS has implemented a strategy to provide this training to all Advanced Care Paramedics to promote faster activation of the cardiac catheter lab for more STEMI patients. It is likely that as this strategy takes effect, more STEMI patients will be referred earlier.



MBH not displayed due to ‹10 cases available for analysis

Figure 24: STEMI under 6 hours pre-hospital component breakdown – QAS direct to PCI facility

2. Hospital processes

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

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.

13.2.2 Time from arrival PCI capable facility to first device

The time between PCI hospital arrival and reperfusion ('door-to-device time') is currently the accepted measure of PCI hospital system performance in STEMI. Historically, hospitals have worked to a goal of less than 90 minutes, although more recent guidelines have shortened this target time to less than 60 minutes.[7,10]

Results demonstrate that for over half of cases (69%), participating PCI facilities are meeting a target door-to-device time of less than 60 minutes, with an overall all-site median time of 46 minutes (range 34 minutes to 60 minutes).

Table 26: 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	67	47	54	33–75	57.4
TTH	52	43	60	43–87	51.2
MBH	6	3	–	–	–
SCUH	107	87	34	25–58	77.0
TPCH	135	118	39	30–64	73.7
RBWH	53	42	48	35–81	69.0
PAH	184	145	44	32–57	77.9
GCUH	138	106	52	36–78	59.4
STATEWIDE	**742**	**591**	**46**	**31–67**	**69.2**

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

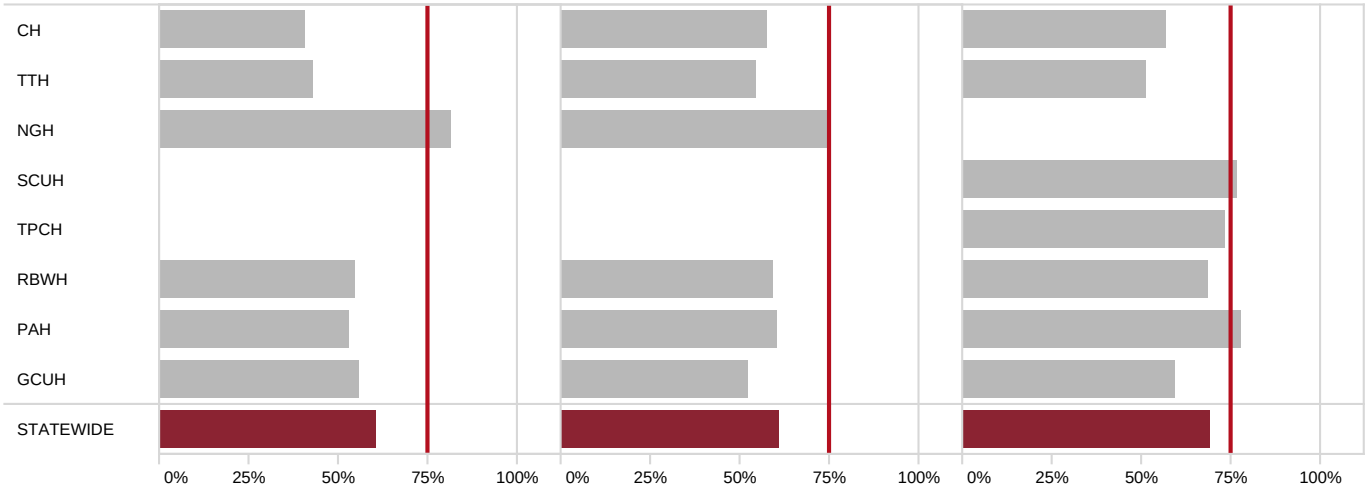


Figure 25: Proportion of cases where door to device ≤60 minutes was met for STEMI presenting within 6 hours of symptom onset, 2015–2017

13.3 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 acute coronary syndromes. National and international guidelines recommend that coronary angiography 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.[5]

For this indicator, the QCOR committee recommended that the treatment timeframe for analysis should be 72 hours in order to capture all patients with the working diagnosis of NSTEMI, acknowledging that a universal risk prediction score has not been applied.

Table 27 lists the cases that were excluded from the analysis and the reason for exclusion.

Table 27: NSTEMI time to angiography – cases ineligible for analysis

	n
Admitted with an unrelated principal diagnosis	127
Planned or staged PCI	104
Transferred from an interstate hospital	69
Coronary angiography not performed at index admission	37
Transferred from a private hospital	32
Stable non-admitted patients transferred directly to lab for planned angiography	23
Incomplete data	32
Total ineligible	**424**

The median time to angiography with or without PCI was 53 hours (direct transfers 37 hours vs inter-hospital transfers 68 hours). Of the 3003 NSTEMI cases, 54% were inter-hospital transfers and, 47% received PCI. Figure 26 depicts the proportions of cases meeting the Committee target.

Across the state, the baseline for each PCI centre likely reflects the demographics, logistics and pathways that pertain to that centre. Overall, there appears to be better performance from year to year with room for improvement that may be maximised by auditing local practice.

Table 28: NSTEMI time to angiography by site

SITE	Total NSTEMI cases (n)	Total analysed (n)	Median (hours)	Interquartile range (hours)	Met 72 hour target (%)
CH	307	268	62	27–115	56.7
TTH	249	223	60	35–95	61.4
MBH	127	96	38	23–68	79.2
SCUH	331	295	33	20–61	82.4
TPCH	665	585	47	22–88	67.7
RBWH	363	313	54	27–84	68.1
PAH	678	581	70	42–110	52.2
GCUH	283	218	49	24–77	72.5
STATEWIDE	**3,003**	**2,579**	**53**	**26–91**	**65.1**

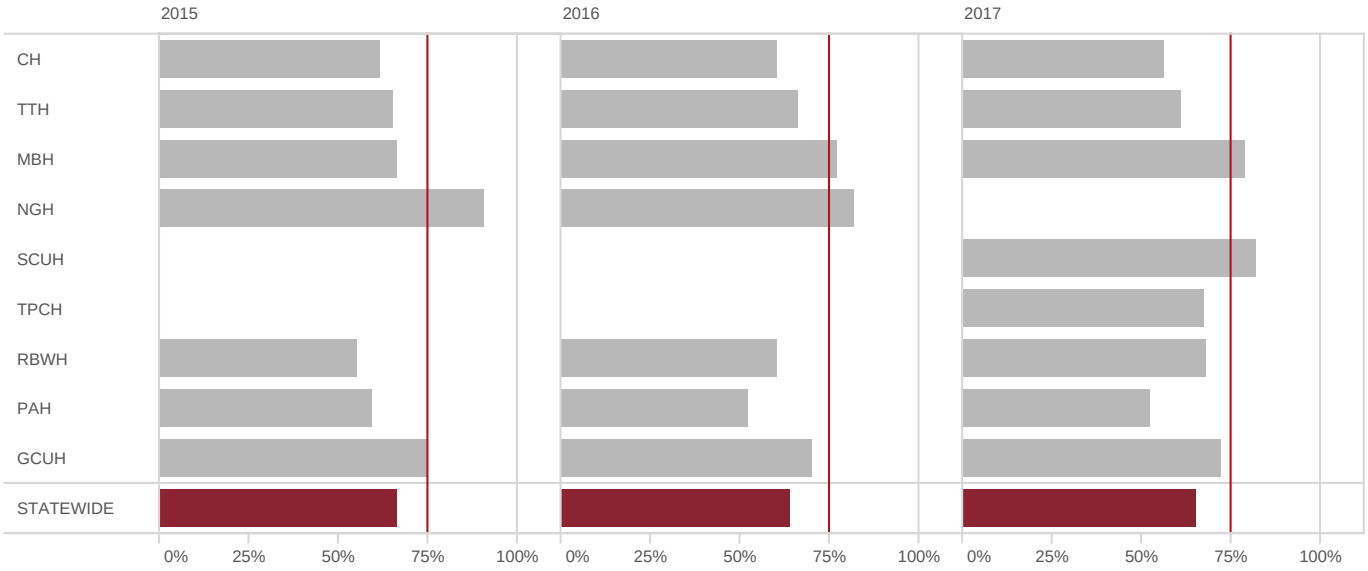


Figure 26: Proportion of NSTEMI cases meeting time to angiography target of 72 hours, 2015–2017

13.4 Major procedural complications

This quality indicator examines in lab intra-procedural complications. In 2017, 24 cases (0.49%) recorded an immediate major procedural complication. Events included in this analysis are coronary artery perforation, in-lab death, pericardial tamponade, emergency coronary artery bypass graft surgery and cerebrovascular accident. Overall, the numbers are far too low for further comment, other than to state that it is obviously reassuring.

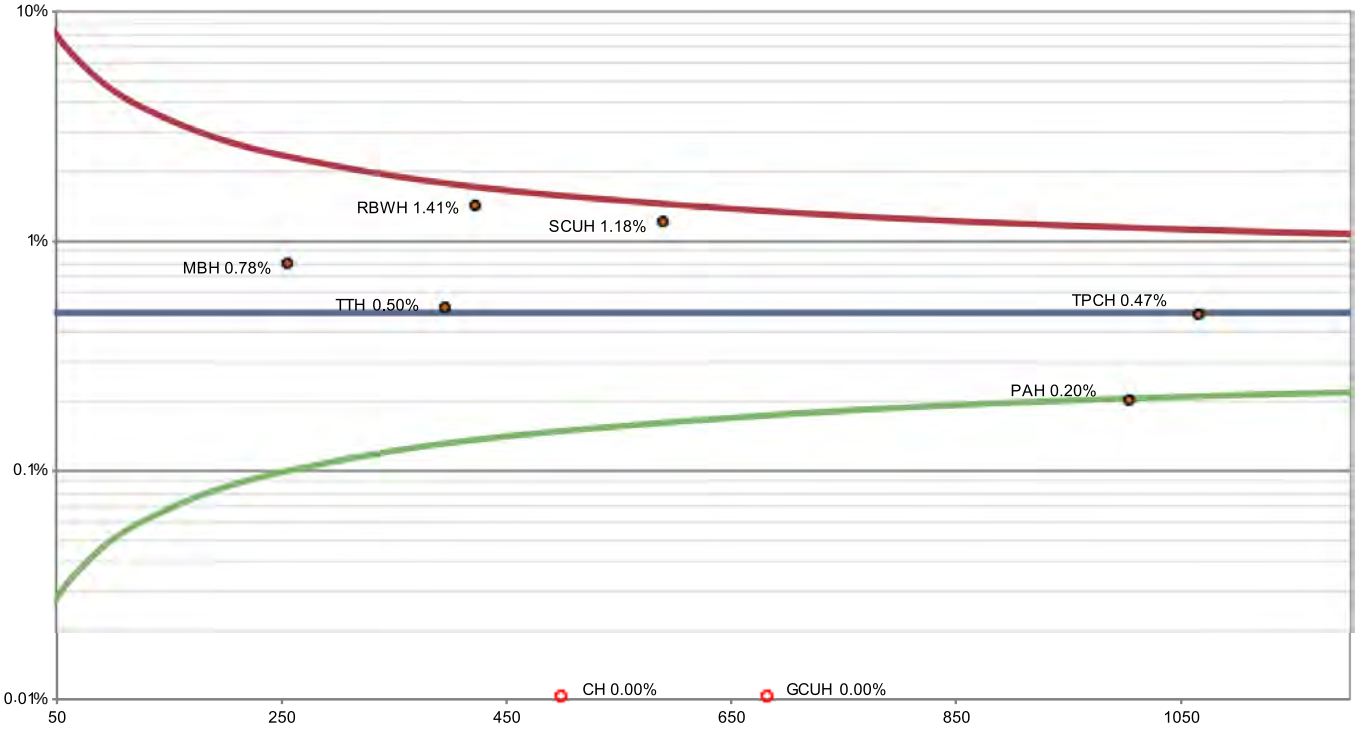


Figure 27: Documented immediate major procedural complications by site

Table 29: All PCI cases by immediate major procedural complication type

Major complication type	Count	%
Coronary artery perforation	18	0.37
In lab death	4	0.08
Tamponade	1	0.02
Emergency CABG	1	0.02
Cerebrovascular accident	0	0.00
No immediate major procedural complication	4,904	99.51
Total	**4,928**	**100.00**

13.5 Safe radiation doses

Staff and patients are exposed to ionising radiation during almost all procedures performed in the cardiac catheter laboratory. Whilst ionising radiation is known to cause both delayed and deterministic (non-delayed) 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 the 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 30: Proportion of cases meeting the safe dose threshold by case type

Site	PCI procedures (%)	Other coronary procedures (%)
CH	99.8	100.0
TTH	98.5	100.0
MBH	100.0	100.0
SCUH	99.3	99.9
TPCH	97.8	99.9
RBWH	98.1	100.0
PAH	94.2	99.8
GCUH	99.7	99.9
STATEWIDE	**97.9**	**99.9**

14 Conclusions

This 2017 report continues to demonstrate encouraging results for all public cardiac catheter laboratory sites across Queensland. Of the 8 sites it is apparent that there are reassuring mortality and morbidity rates observed despite a varied and sometimes complex cohort of presenting patients.

Collection of supporting risk adjustment data continues to be a challenge given that some of these data elements may not be readily available at the time of urgent or emergency procedures. The efforts of site quality improvement coordinators and data managers are to be commended however, with rates of data completion showing promising improvement throughout 2017. It is hoped that the QCOR data quality audit program will be extended to encompass all sites in the future to facilitate full analyses of risk adjusted outcomes.

The input of the Queensland Ambulance Service in this year's report further demonstrates the positive relationship between the two Government Departments continuing to produce encouraging results. This collaboration will hopefully be the basis for further opportunities for service improvement across both clinical services with the focus on optimising patient outcomes.

With the results demonstrated across all clinical indicators and benchmark activities, Queenslanders can be assured of treatment that exceeds international benchmarks and that the registries developed to promote this care are providing the support and evidence clinicians require.

15 Recommendations

The development of future reports that document the patient journey between QCOR specialty areas is a point of focus for future work. With linkage of patient presentations and participation across other QCOR applications, it is hoped that an overview of the incidence of patients requiring reinvestigation or repeat revascularisation can be developed.

Development of a new QCOR structural heart disease module remains a priority. The module developed to provide superior reporting capabilities for structural heart disease interventions including device closure, and percutaneous valve replacement and repair procedures. Use of the new system is expected to commence in early 2019. It is anticipated that this will enable future statewide participation in national quality and safety activities for transcatheter aortic valve replacement as well as offer an unprecedented insight into the quality of care of patients undergoing interventions in this emerging area of cardiac services.

Facilitating the planning and commissioning of new health infrastructure is also a key aim of publications such as this. With the included geographic analysis, including proximity to treating facility in this years' report, greater insight into the barriers encountered by patients with respect to health access can be demonstrated and should be expanded for future reports. These analyses are particularly pertinent given the current objectives of better cardiac care for all Queenslanders closer to home.

Inclusion of private facilities continues to be an aim for QCOR as a whole, with a particular desire for participation in the interventional cardiology audit program apparent. Future work will be focused on facilitating this participation. Queensland's participation in national registries also continues to be a focus for the group. With the development of a new framework for a nationwide cardiac registry underway, Queensland interventional cardiology practitioners are eagerly awaiting the opportunity to contribute to this important initiative.

16 Supplement: Structural heart disease

The QCOR structural heart disease (SHD) initiative is a continued focus of the the QCOR interventional cardiology committee with the development of a bespoke QCOR module catering towards these procedures underway. The new module has been developed to provide clinicians with enhanced procedure reporting capabilities at the point of care with prospective clinical use expected to commence in early 2019.

This QCOR supplementary report has expanded to encompass SHD interventions performed across all Queensland public cardiac catheterisation laboratories in 2017. In future it is hoped that the registry would be able to extend participation toward private facilities as well.

16.1 Participating sites

In 2017, there were seven participating cardiac catheter laboratories performing a total of 390 SHD interventions.

Table 1: Total SHD cases by participating site

Site	Device closure* n (%)	Valvular intervention† n (%)	Other‡ n (%)	All cases n (%)
CH	13 (72.2)	5 (27.8)	-	18 (100.0)
TTH	10 (62.5)	6 (37.5)	-	16 (100.0)
SCUH	7 (77.8)	2 (22.2)	-	9 (100.0)
TPCH	50 (17.9)	218 (78.1)	11 (3.9)	279 (100.0)
RBWH	1 (33.3)	2 (66.7)	-	3 (100.0)
PAH	15 (29.4)	33 (64.7)	3 (5.9)	51 (100.0)
GCUH	5 (35.7)	9 (64.3)	-	14 (100.0)
STATEWIDE	**101 (25.9)**	**275 (70.5)**	**14 (3.6)**	**390 (100.0)**

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

† Percutaneous valve replacement and valvuloplasty

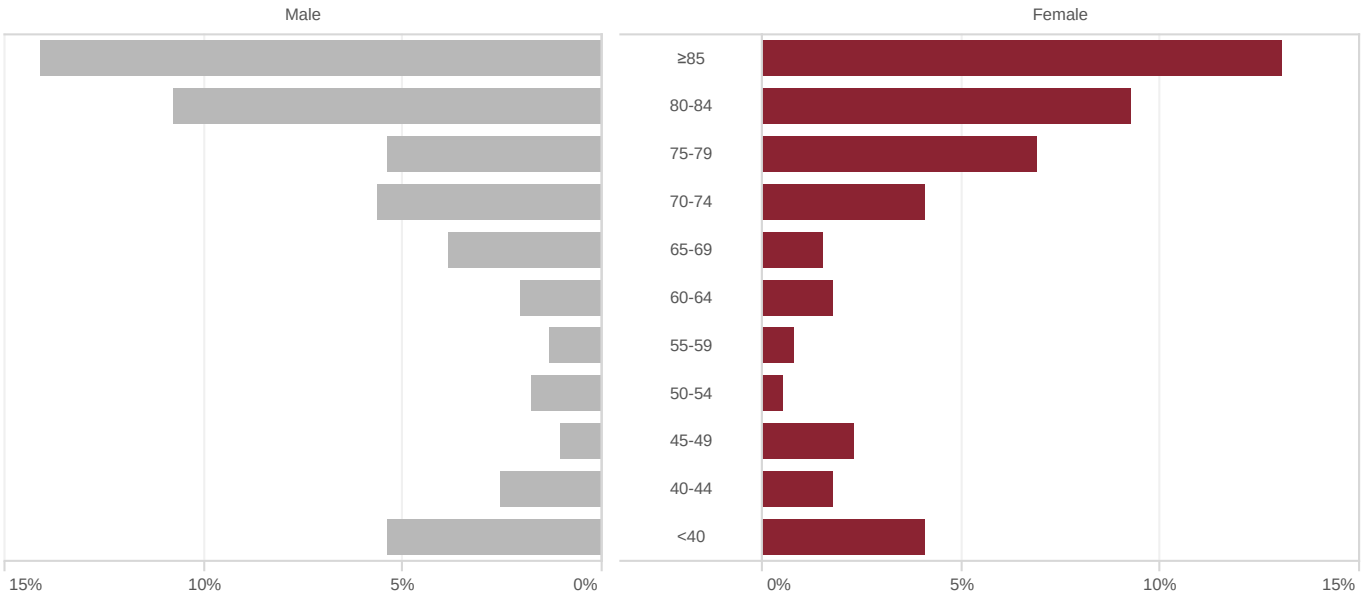
‡ Myocardial septal ablation, ASD balloon occlusion and percutaneous insertion of pulmonary arterial pressure monitoring device

16.2 Patient characteristics

16.2.1 Age and gender

Patients undergoing an SHD intervention were almost evenly distributed between genders at 54% male and 46% female.

Age varied considerably by procedure category, with patients undergoing a valvular intervention having an overall median age of 82 years compared to 49 years for device closure procedures.



% of total (n=390)

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	50	49	49
Valvular intervention	82	83	82
Other	63	63	63
ALL	**79**	**80**	**79**

16.3 Care and treatment of SHD patients

16.3.1 Device closures

In 2017 there were a total of 101 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 40% and 36% of overall case volumes respectively.

Table 3: Device closure procedures by participating site

Site	Aortic Pseudo-aneurysm n (%)	ASD* n (%)	PDA† n (%)	LAA‡ n (%)	Para-valvular leak n (%)	PFO§ n (%)	VSD‖ n (%)	All n (%)
CH	-	5 (38.5)	-	-	-	8 (61.5)	-	13 (100.0)
TTH	-	7 (70.0)	-	-	-	3 (30.0)	-	10 (100.0)
SCUH	-	2 (28.6)	-	-	1 (14.3)	4 (57.1)	-	7 (100.0)
TPCH	2 (4.0)	12 (24.0)	3 (6.0)	11 (22.0)	3 (6.0)	17 (34.0)	2 (4.0)	50 (100.0)
RBWH	-	1 (100.0)	-	-	-	-	-	1 (100.0)
PAH	-	8 (53.3)	-	-	2 (13.3)	4 (26.7)	1 (6.7)	15 (100.0)
GCUH	-	1 (20.0)	-	-	-	4 (80.0)	-	5 (100.0)
STATEWIDE	**2 (2.0)**	**36 (35.6)**	**3 (3.0)**	**11 (10.9)**	**6 (5.9)**	**40 (39.6)**	**3 (3.0)**	**101 (100.0)**

* Atrial septal defect

† Patent ductus arteriosus (includes 2 device closures and 1 device coiling of PDA)

‡ Left atrial appendage

§ Patent foramen ovale

‖ Ventricular septal defect

16.3.2 Valvular interventions

In 2017, there were 275 valvular interventions performed across 7 participating sites. Valvular interventions comprised of transcatheter valvular repair (Table 6) and transcatheter valve replacement (Table 7) procedures. Valvular interventions were almost evenly distributed with 137 transcatheter valve replacements and 138 transcatheter valve repairs.

The aortic valve was the most common valve requiring intervention and accounted for 86% of overall cases and majority of cases across all participating sites.

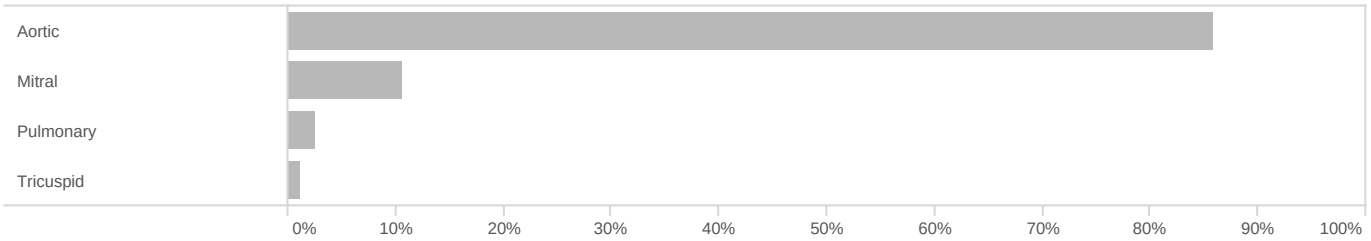


Figure 2: Proportion of all transcatheter valvular interventions by valve type

Table 4: Transcatheter valvular interventions by type of valve

Site	Aortic n (%)	Mitral n (%)	Pulmonary n (%)	Tricuspid n (%)	All cases n (%)
CH	5 (100.0)	-	-	-	5 (100.0)
TTH	4 (66.7)	2 (33.3)	-	-	6 (100.0)
SCUH	2 (100.0)	-	-	-	2 (100.0)
TPCH	184 (84.4)	26 (11.9)	5 (2.3)	3 (1.4)	218 (100.0)
RBWH	2 (100.0)	-	-	-	2 (100.0)
PAH	30 (90.9)	1 (3.0)	2 (6.1)	-	33 (100.0)
GCUH	9 (100.0)	-	-	-	9 (100.0)
STATEWIDE	**236 (85.8)**	**29 (10.5)**	**7 (2.5)**	**3 (1.1)**	**275 (100.0)**

Table 5: Transcatheter valvular interventions

Site	Transcatheter valvuloplasty n (%)	Transcatheter valve replacement n (%)	All cases n (%)
CH	5 (100.0)	-	5 (100.0)
TTH	6 (100.0)	-	6 (100.0)
SCUH	2 (100.0)	-	2 (100.0)
TPCH	107 (49.1)	111 (50.9)	218 (100.0)
RBWH	2 (100.0)	-	2 (100.0)
PAH	11 (33.3)	22 (66.7)	33 (100.0)
GCUH	5 (55.6)	4 (44.4)	9 (100.0)
STATEWIDE	**138 (50.2)**	**137 (49.8)**	**275 (100.0)**

Table 6: Transcatheter interventional valve procedures

Site	Balloon aortic valvuloplasty n (%)	Balloon mitral valvuloplasty n (%)	MitraClip n (%)	PASCAL n (%)	REDUCE FMR Trial n (%)	Balloon pulmonary valvuloplasty n (%)	Balloon tricuspid valvuloplasty n (%)
CH	5 (100.0)	-	-	-	-	-	-
TTH	4 (66.7)	2 (33.3)	-	-	-	-	-
SCUH	2 (100.0)	-	-	-	-	-	-
TPCH	81 (75.7)	3 (2.8)	12 (11.2)	3 (2.8)	4 (3.7)	1 (0.9)	3 (2.8)
RBWH	2 (100.0)	-	-	-	-	-	-
PAH	9 (81.8)	1 (9.1)	-	-	-	1 (9.1)	-
GCUH	5 (100.0)	-	-	-	-	-	-
STATEWIDE	**108 (78.3)**	**6 (4.3)**	**12 (8.7)**	**3 (2.2)**	**4 (2.9)**	**2 (1.4)**	**3 (2.2)**

Table 7: Transcatheter valve replacement procedures

Site	TAVR* n (%)	TMVR† n (%)	TPVR‡ n (%)
TPCH	103 (92.8)	4 (3.6)	4 (3.6)
PAH	21 (95.5)	-	1 (4.5)
GCUH	4 (100.0)	-	-
STATEWIDE	**128 (93.4)**	**4 (2.9)**	**5 (3.6)**

* Transcatheter aortic valve replacement

† Transcatheter mitral valve replacement

‡ Transcatheter pulmonary valve replacement

Table 8: Other structural heart disease interventions

Site	ASD* balloon occlusion n (%)	Myocardial septal ablation n (%)	Pulmonary arterial pressure monitoring device n (%)
TPCH	1 (9.1)	5 (45.5)	5 (45.5)
PAH	-	3 (100.0)	-
STATEWIDE	**1 (7.1)**	**8 (57.1)**	**5 (35.7)**

* Atrial septal defect

16.4 Patient outcomes

16.4.1 All cause 30 day mortality

For the participating sites performing structural heart disease interventions within 2017, there was an overall all cause unadjusted mortality rate within 30 days of 4.1%.

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	18	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
TTH	16	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
SCUH	9	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
TPCH	279	1 (2.0)	12 (5.5)	1 (9.1)	14 (5.0)
RBWH	3	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
PAH	51	1 (6.7)	1 (3.0)	0 (0.0)	2 (3.9)
GCUH	14	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
STATEWIDE	**390**	**2 (2.0)**	**13 (4.7)**	**1 (7.1)**	**16 (4.1)**

16.4.2 All TAVR cases

2017 cases

Of the three sites performing TAVR in 2017, the overall all cause unadjusted mortality rate within 30 days of the procedure was 3.1%.

Table 10: All cause unadjusted 30 day mortality post SHD intervention by site

Site	Total cases (n)	30 day mortality n (%)
TPCH	103	4 (3.9)
PAH	21	0 (0.0)
GCUH	4	0 (0.0)
STATEWIDE	**128**	**4 (3.1)**

2016 cases

Of the two sites performing TAVR within 2016, the overall all cause unadjusted mortality rate within 30 days of the procedure was 1.0%, and 9.8% at 365 days.

Table 11: All cause unadjusted 30 day and 365 day mortality post SHD intervention by site, 2016

Site	Total cases (n)	30 day mortality n (%)	365 day mortality n (%)
TPCH	86	1 (1.1)	9 (10.3)
PAH	15	0 (0.0)	1 (6.7)
STATEWIDE	**101**	**1 (1.0)**	**10 (9.8)**

Cardiac Surgery Audit

17 Message from the QCOR Cardiothoracic Committee Chair

With this report on cardiac surgery in Queensland in 2017, we continue the project of ensuring that each individual Queenslander who faces the daunting prospect of cardiac surgery is receiving the best level of care we can provide as cardiac surgical teams.

Since the 2016 report, there have been several changes. Where the 2016 report only included data from three hospitals, the 2017 report includes all public units in Queensland that perform cardiac surgery.

Apart from reporting a standard set of data about activity and demographics, particular subsets of cardiac surgical conditions have been identified by the committee as deserving detailed reporting. Detailed reports on particular conditions allow us to identify information gaps in the database, information that once we start to collect can assist in targeting strategies to change the incidence of treatment of that disease. For this report, our detailed report is on endocarditis. Being a surgical database, this means the data is restricted to patients who have had surgery for endocarditis. The QCOR project as a whole serves as the denominator for conditions for which surgery is the numerator. Understanding which patients undergo resource intensive surgery for particular conditions allows us to serve as a guide for those who would seek to improve health outcomes for Queenslanders, particularly for health conditions that have preventable aspects, such as illicit intravenous drug use.

All surgical units now contribute directly to the QCOR cardiac surgery database directly through the web portal. The database is being improved by the addition of new data points, but also by adding the ability for individual units to generate reports themselves on their unit data, rather than requesting a report through the database team. This allows for individual units to rapidly answer unit specific queries, guiding changes their systems and processes.

The QCOR database is a conduit to the Australian and New Zealand Society of Cardiac and Thoracic Surgeons (ANZSCTS) database, with all data from the QCOR cardiac surgery database submitted to the national database, which itself undertakes quality assurance activities, further reassuring Queenslanders that our performance as cardiac surgical teams is well within expected levels of performance. Analysis of individual unit and surgeon performance is done through the ANZSCTS database, with a well-established feedback loop and quality assurance programme.

The individual units and the committee have reviewed individual cases of, and the incidence of deep sternal wound infections (DSWI) in 2016, and report on these findings in this report. The issue with DSWI arose because of our analysis of 2016 that used an American based risk score. That this risk score does not seem to be predictive in our patients demonstrates one of the issues with reliance on risk scores to justify decision making. This is particularly relevant to cardiac surgery and cardiology because risk scores are often used to justify decisions for and against either open surgical options or catheter-based techniques.

With each iteration of this report, we seek to improve the report itself and hope that the addition of a detailed supplemental report achieves this aim.

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

18 Key findings

This second Queensland cardiac surgery audit describes baseline demographics, risk factors, surgeries performed and surgery outcomes for 2017.

Key findings include:

- In 2017, 2,364 surgeries were performed across the 4 public adult cardiac surgery units in Queensland.
- The majority of patients were between 61 years and 80 years of age (61%) with a median age of 66 years old.
- Approximately three-quarters of patients were male (74%).
- The majority of all patients were overweight or obese (74%).
- The proportion of Indigenous patients overall was 7.1%, however there was wide variation with 24% of patients in Townsville identifying as Aboriginal and Torres Strait Islander.
- Smoking and hypertension were present in over half of all coronary artery bypass graft (CABG) patients and diabetes in around one quarter of all patients (27%).
- 18% of patients were current smokers at the time of their operation.
- 30% of patients had an element of left ventricular dysfunction.
- 52% of patients were elective admissions.
- Same day admission rates for elective surgery were 14% for all surgery types.
- Over half (61%) of all cardiac surgery procedures included a CABG.
- 30% of elective cases required blood products compared to 77% of emergency cases.
- Mitral valve repair (66%) was the most common form of valve repair surgery and aortic valve replacement (75%) the most frequently performed replacement surgery.
- The average number of bypass grafts used was 2.7. In multi-vessel CABG the mean number increased to 2.9.
- Calcific valve disease (49%) was the primary pathology for aortic valve replacement with myxomatous disease (36%) the most frequently encountered pathology leading to mitral valve intervention.
- The mortality rate after surgery is significantly less than expected, depending on the risk model used to evaluate this outcome.
- Major morbidities were evaluated using STS models with most results demonstrating that the observed rate of adverse events is within expectations.

19 Participating sites

In 2017, there were 4 public cardiac surgery units spread across metropolitan and regional Queensland all of which entered data directly into the QCOR cardiac surgery database.

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

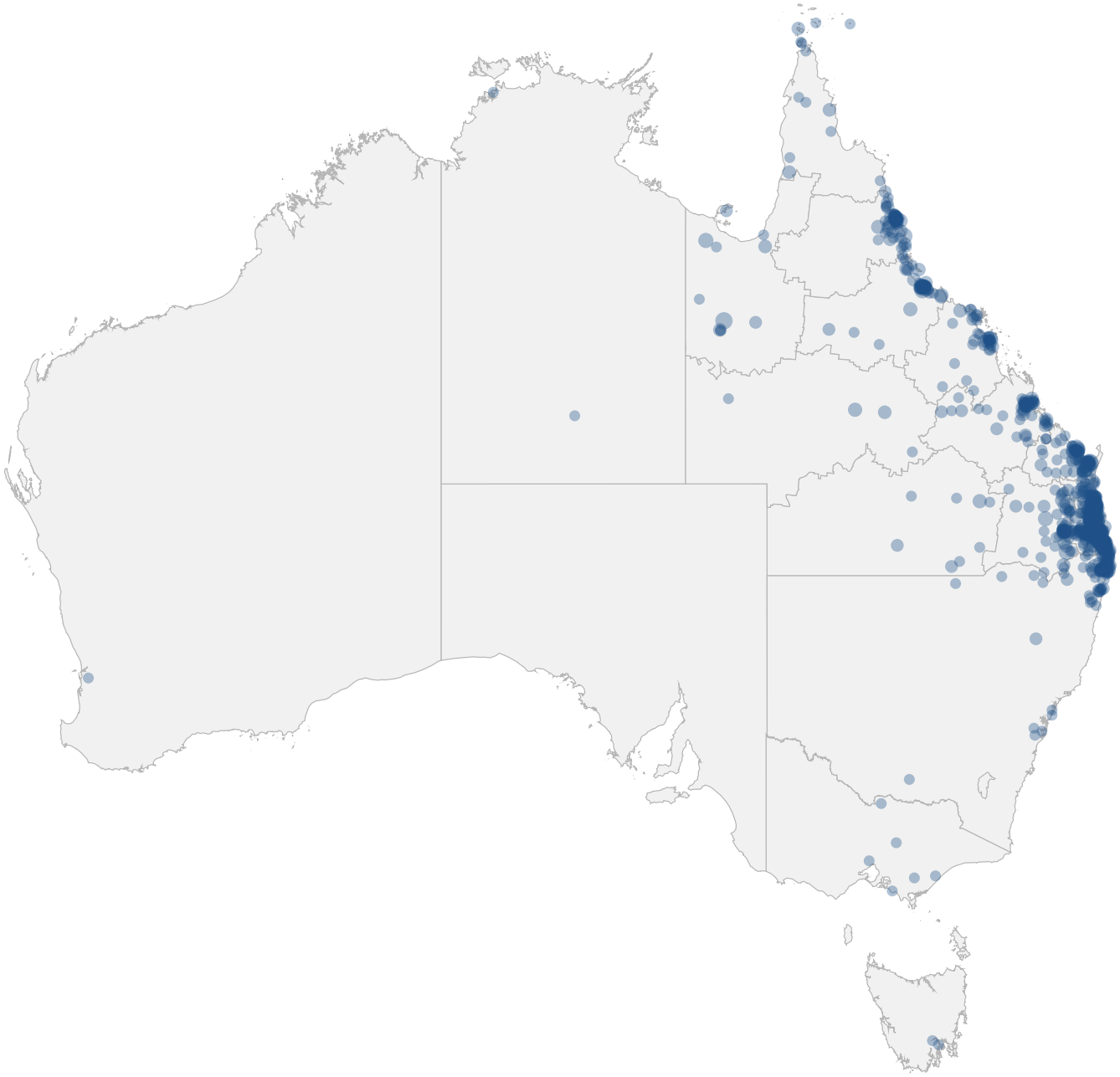


Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

Site Number	Site Name	Location	Acronym
1	The Townsville Hospital	Regional	TTH
2	The Prince Charles Hospital	Metropolitan	TPCH
3	Princess Alexandra Hospital	Metropolitan	PAH
4	Gold Coast University Hospital	Metropolitan	GCUH

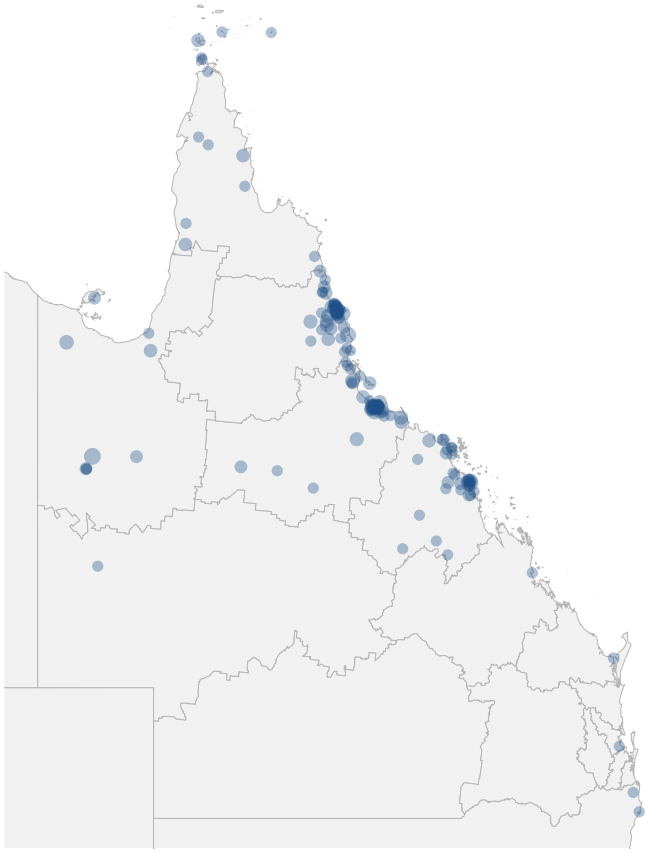


Figure 2: The Townsville Hospital

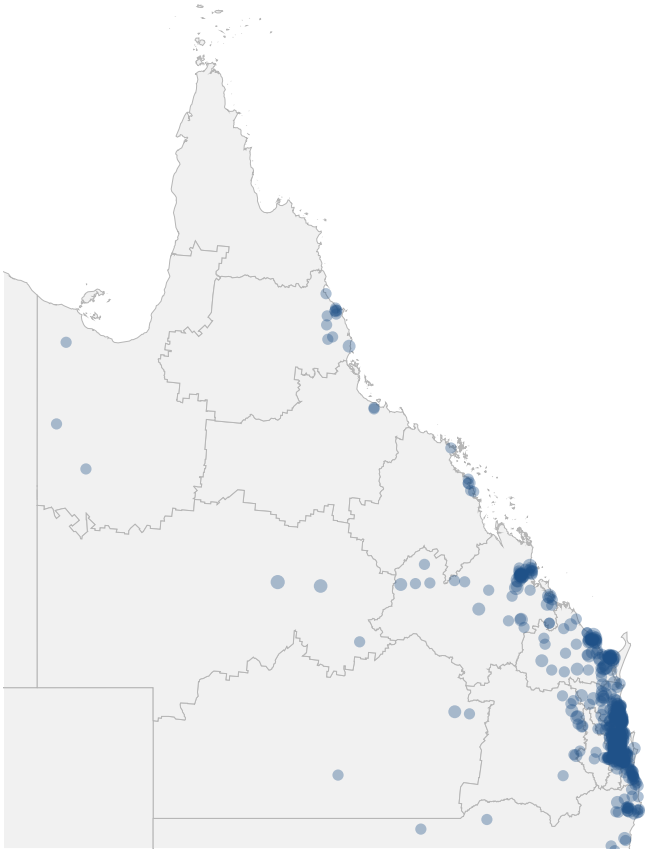


Figure 3: The Prince Charles Hospital

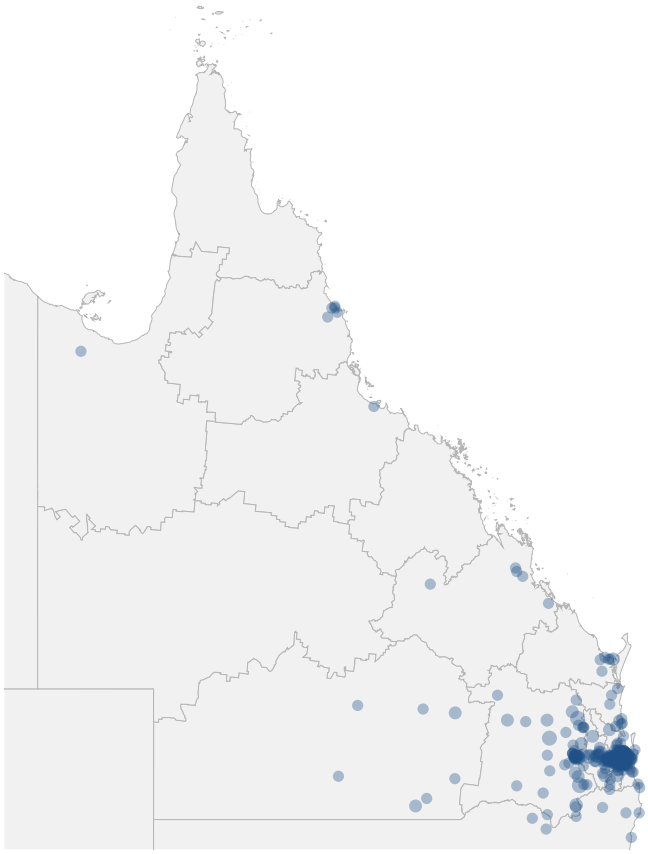


Figure 4: Princess Alexandra Hospital

Figure 5: Gold Coast University Hospital

20 Case totals

20.1 Total cases

In 2017, 2,364 cardiac surgical procedures were performed across the state at the 4 public hospitals that directly entered data in the QCOR database. Each of the procedure combinations included in those cases have been allocated to a cardiac surgery procedure category for the purpose of this report.

Table 2: Procedure counts and surgery category

Procedure combination	Count	Category*
CABG	1,147	ANY CABG
CABG + other cardiac procedure	24	
CABG + other non-cardiac procedure	13	
CABG + aortic procedure	6	
CABG + other cardiac procedure + other non-cardiac procedure	1	
CABG + valve	218	CABG + VALVE
CABG + valve + aortic procedure	20	
CABG + valve + other cardiac procedure	12	
CABG + valve + aortic procedure + other cardiac procedure	3	
CABG + valve + other non-cardiac procedure	2	
Valve procedure†	541	VALVE
Valve + aortic procedure	115	
Valve + other cardiac procedure	76	
Valve + aortic procedure + other cardiac procedure	12	
Valve + other non-cardiac procedure	2	
Valve + aortic procedure + other non-cardiac procedure	1	
Valve + other cardiac procedure + other non-cardiac procedure	1	
Other cardiac procedure	106	OTHER
Aortic procedure	44	
Other cardiac procedure + other non-cardiac procedure	12	
Aortic procedure + other cardiac procedure	4	
Aortic procedure + other non-cardiac procedure	4	
STATEWIDE	**2,364**	

Note, final column outlines allocation of procedures to surgery categories

* Category procedure combination allocated

† Includes TAVR procedures (n=40)

20.2 Cases by category

More than half (61%) of all cardiac surgery procedures involved CABG. Of these, 11% involved a simultaneous valve procedure while 50% did not.

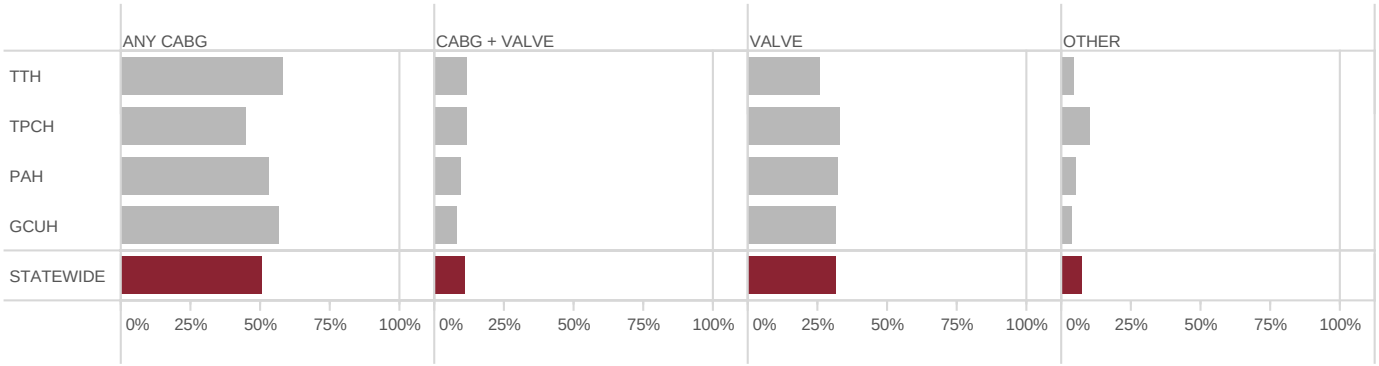


Figure 6: Proportion of cases by site and surgery category

Table 3: Proportion of cases by surgery category

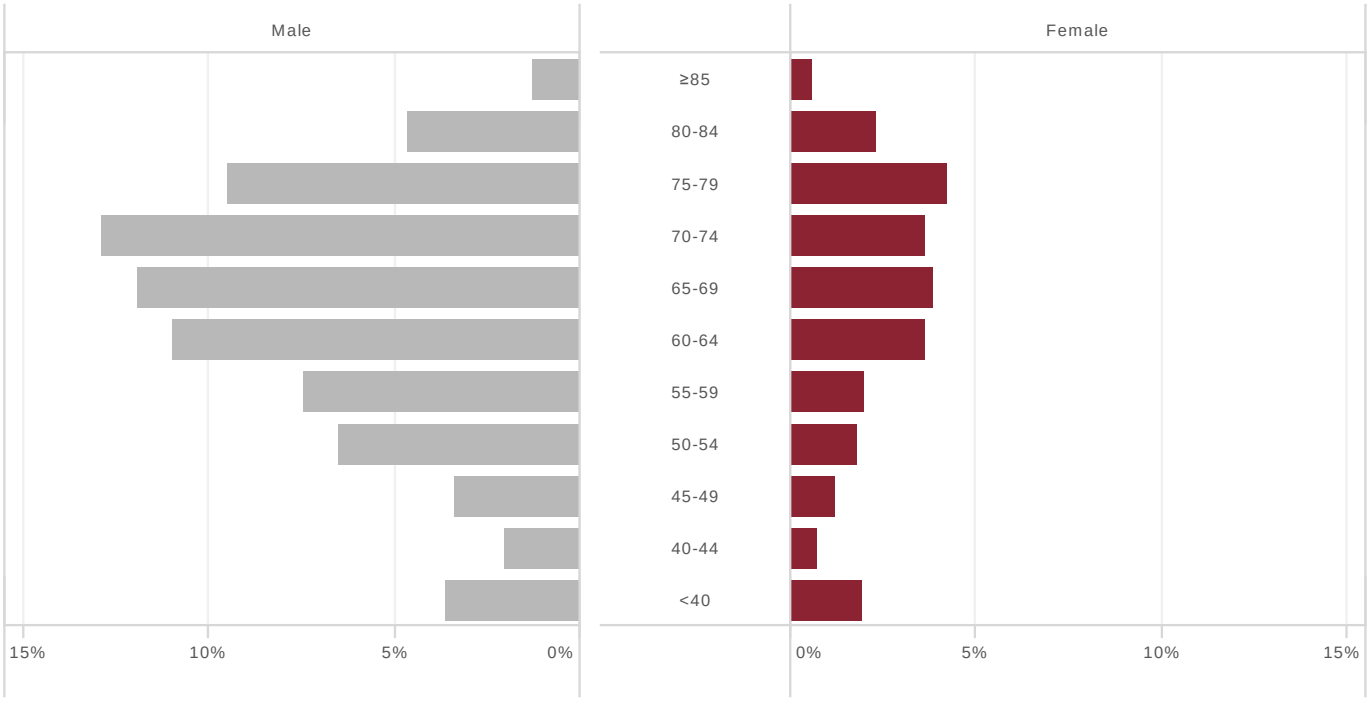
SITE	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	Total cases n (%)
TTH	206 (58.2)	41 (11.6)	91 (25.7)	16 (4.5)	354 (100.0)
TPCH	498 (44.8)	131 (11.8)	370 (33.3)	113 (10.2)	1,112 (100.0)
PAH	304 (53.1)	56 (9.8)	184 (32.1)	29 (5.1)	573 (100.0)
GCUH	183 (56.3)	27 (8.3)	103 (31.7)	12 (3.7)	325 (100.0)
STATEWIDE	**1,191 (50.4)**	**255 (10.8)**	**748 (31.6)**	**170 (7.2)**	**2,364 (100.0)**

21 Patient characteristics

21.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. Most patients were aged between 61 and 80 (61%). The male, 70 years to 74 years cohort accounted for the largest proportion of cases (13% of all cases or 17% of males).

The median age of all patients undergoing cardiac surgery was 66 years of age. This was similar for both males and females (median age of 66 years and 67 years respectively).



% of total (n=2,364)

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)	ALL (years)
ANY CABG	1,191	66	67	66
CABG + VALVE	255	71	72	72
VALVE	748	64	67	66
OTHER	170	55	59	57
STATEWIDE	**2,364**	**66**	**67**	**66**

Overall, around three-quarters of patients were male (74%) with the largest proportion of females represented in the valve and other cardiac surgery categories (35% and 45% respectively). This reflects the increased risk of coronary artery disease in men.

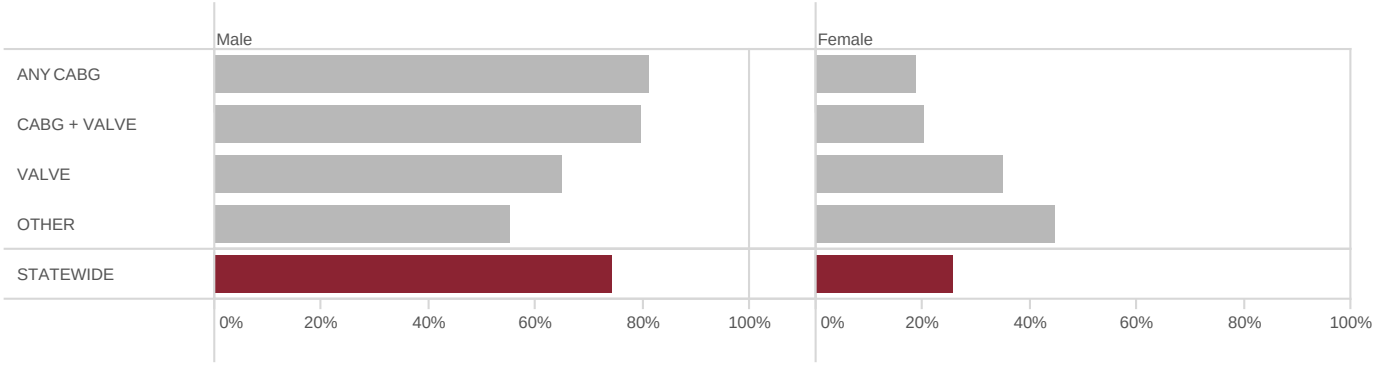
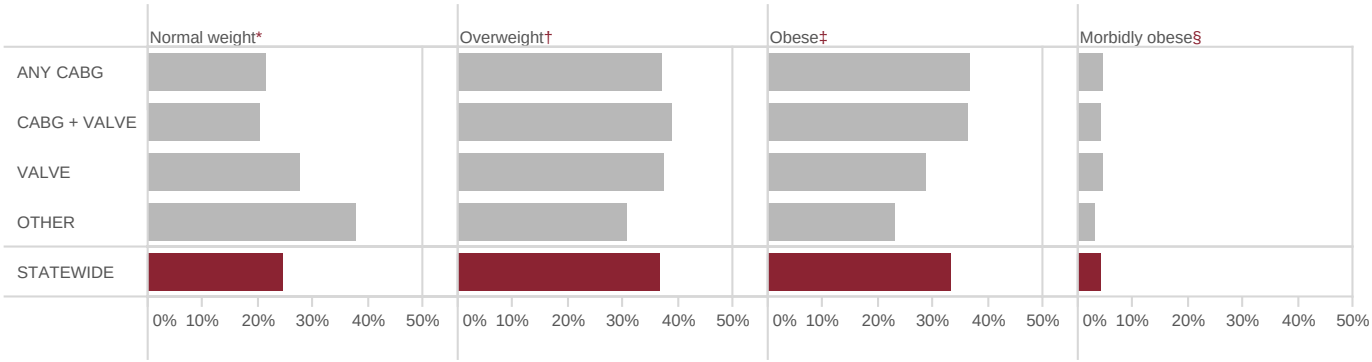


Figure 8: Proportion of cases by gender and surgery category

21.2 Body mass index

Less than one-quarter (24%) of cardiac surgery patients had a healthy body mass index (BMI), while patients having a BMI category of overweight, obese or morbidly obese represented around three quarters of cardiac surgery patients (74%).

There were less obese patients in the valve only surgery category (29%) than other categories that include CABG surgery (37% and 36%). Patients classed as underweight (BMI<18.5kg/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: Proportion of cases by BMI and surgery category

	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
ANY CABG	8 (0.7)	255 (21.4)	440 (36.9)	436 (36.6)	52 (4.4)
CABG + VALVE	1 (0.4)	52 (20.4)	99 (38.8)	92 (36.1)	11 (4.3)
VALVE	13 (1.7)	207 (27.7)	279 (37.3)	215 (28.7)	34 (4.5)
OTHER	10 (5.9)	64 (37.6)	52 (30.6)	39 (22.9)	5 (2.9)
STATEWIDE	**32 (1.4)**	**578 (24.5)**	**870 (36.8)**	**782 (33.1)**	**102 (4.3)**

21.3 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of health with a known 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 than other ethnicities.[11]

Overall, the proportion of identified Aboriginal and Torres Strait Islander patients undergoing cardiac surgery was 7.1%. This proportion is larger than the estimated 4.0% of the overall Queensland population that Aboriginal and Torres Strait Islander people account for.[3]

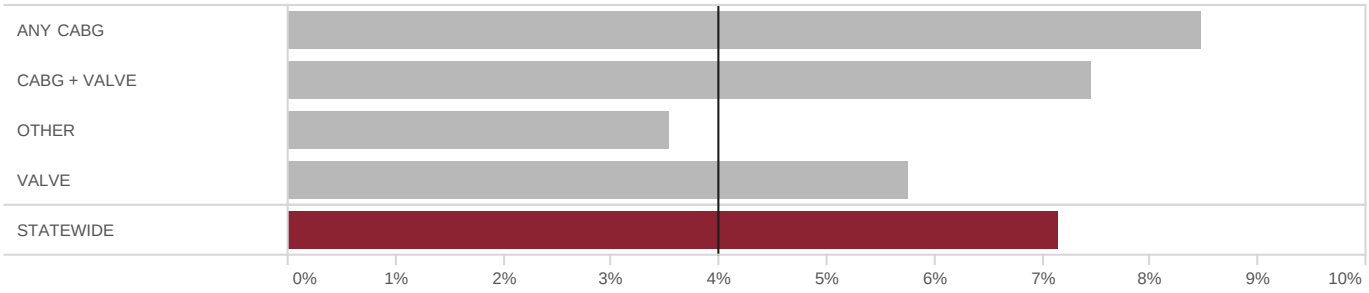


Figure 10: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

22 Risk factor profile

22.1 Smoking history

Overall, 60% of patients had a history of tobacco use including 18% current smokers (defined as smoking within 30 days of the procedure) and 42% former smokers. The remaining 35% reported never having smoked and 5% had an unknown smoking history.

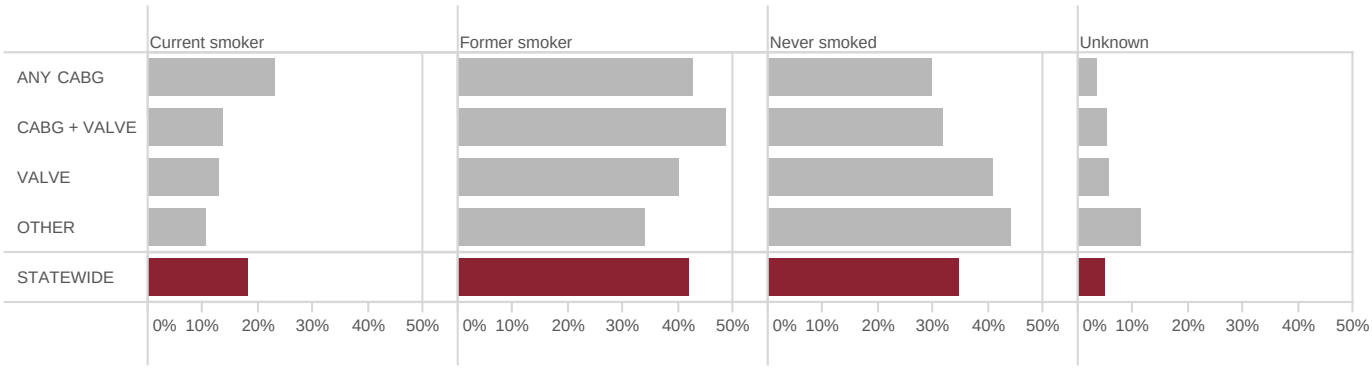


Figure 11: Proportion of cases by smoking status and surgery category

22.2 Diabetes

The prevalence of diabetes was highest in the CABG group, with 35% of patients known to be diabetic.

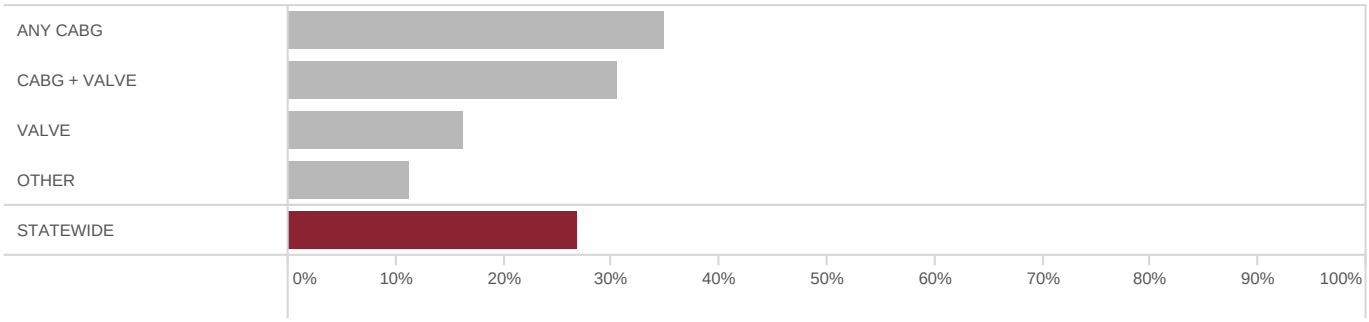


Figure 12: Proportion of cases by diabetes status and surgery category

22.3 Hypertension

Hypertension, defined as receiving antihypertensive medications at the time of surgery, was present in 69% of patients with considerable variation by surgery type (range 38% to 80%).

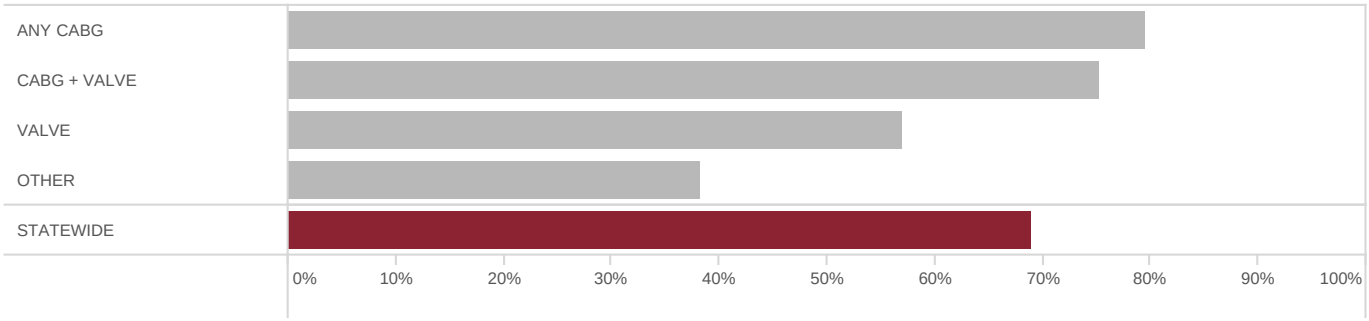


Figure 13: Proportion of cases by hypertension status and surgery category

22.4 Statin therapy

Overall, 64% of patients were treated with statins for abnormal cholesterol at the time of surgery, ranging from 81% in the CABG category to 29% in the other surgery category. This does not account for statin treatment rates prior to admission or investigation for coronary artery disease. This metric will be the focus of an enhancement to data collection methods for future reporting.

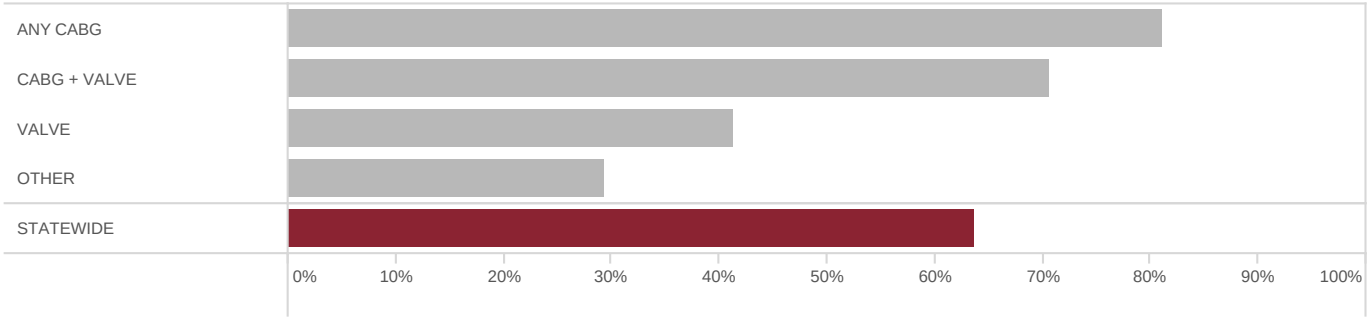


Figure 14: Proportion of cases by statin therapy status and surgery category

22.5 Renal impairment

54% of all patients were identified as having impaired renal function (eGFR ≤89 mL/min/1.73 m^2) at the time of their surgery. Of these patients, the CABG and valve group had the highest incidence of renal impairment (68%).

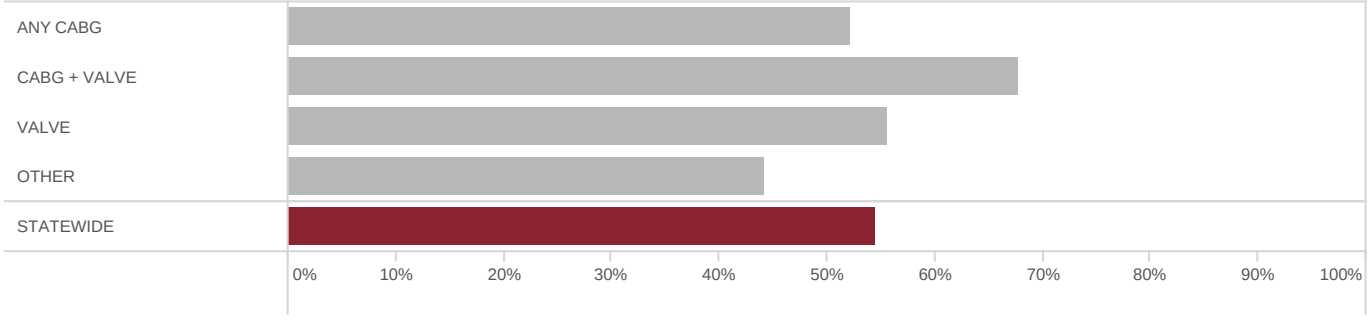


Figure 15: Proportion of cases by renal impairment status and surgery category

22.6 Severe renal dysfunction

There were 2.7% of patients identified as having renal dysfunction (preoperative creatinine >200 µmol/L), ranging from 2% to 5% across surgery categories. This cut-off is used by the EuroSCORE for predicting risk.

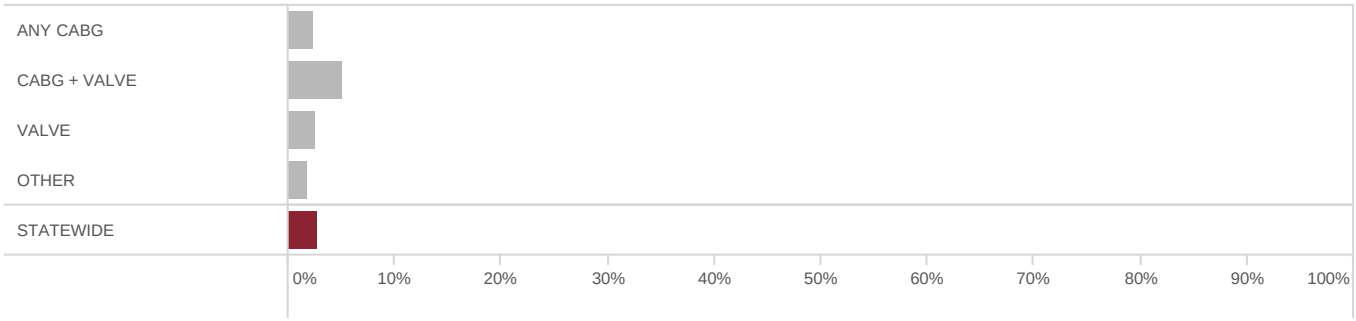


Figure 16: Proportion of cases by severe renal dysfunction status and surgery category

22.7 Left ventricular function

Almost a third (30%) of patients were classed as having an impaired left ventricular ejection fraction (LVEF), including 19% with mild LV dysfunction (LVEF between 40% to 50%), 7% with moderate LV dysfunction (LVEF between 30% to 39%) and 4% with severe LV dysfunction (LVEF less than 30%).

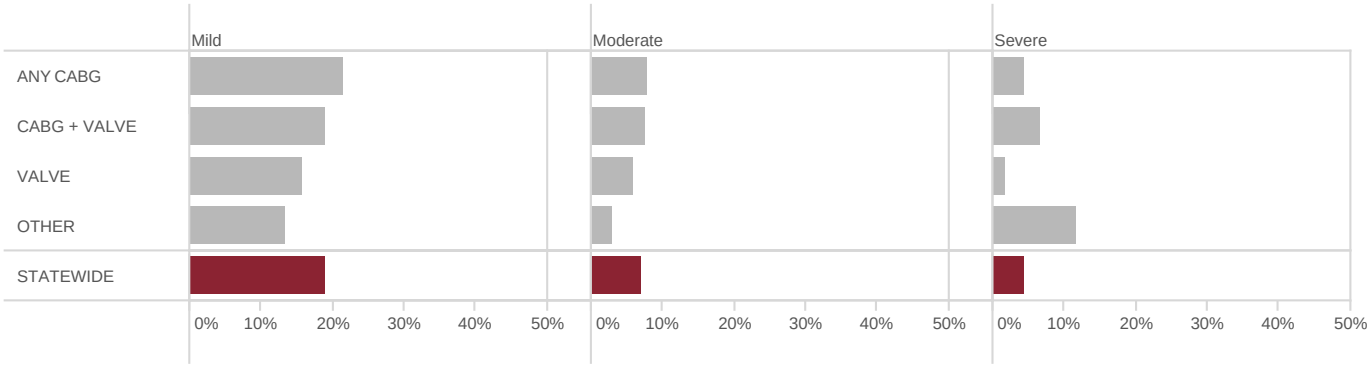


Figure 17: Proportion of cases by LV dysfunction category and surgery category

22.8 Summary of risk factors

The development of coronary artery disease is dependent on a number of background variables and risk factors. Analysis of risk factors and surgical categories has found that there are 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	274 (23.0)	35 (13.7)	97 (13.0)	18 (10.6)	424 (17.9)
Former smoker	510 (42.8)	124 (48.6)	300 (40.1)	58 (34.1)	992 (42.0)
Diabetes	417 (35.0)	78 (30.6)	121 (16.2)	19 (11.2)	635 (26.9)
Hypertension	947 (79.5)	192 (75.3)	426 (57.0)	65 (38.2)	1,630 (69.0)
Statin therapy	965 (81.0)	180 (70.6)	309 (41.3)	50 (29.4)	1,504 (63.6)
eGFR ≤89 mL/min/1.73m²	621 (52.1)	173 (67.8)	416 (55.6)	75 (44.1)	1,285 (54.4)
Severe renal dysfunction	29 (2.4)	13 (5.1)	19 (2.5)	3 (1.8)	64 (2.7)
LVEF 40%–50%	258 (21.7)	48 (18.8)	118 (15.8)	23 (13.5)	447 (18.9)
LVEF 30%–39%	95 (8.0)	19 (7.5)	43 (5.7)	5 (2.9)	162 (6.9)
LVEF ‹30%	51 (4.3)	17 (6.7)	14 (1.9)	20 (11.8)	102 (4.3)
BMI ≥30 kg/m²	488 (41.0)	103 (40.4)	249 (33.3)	44 (25.9)	884 (37.4)

Table 7: Summary of combined risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
Hypertension + Statin therapy	804 (67.5)	148 (58.0)	251 (33.6)	35 (20.6)	1,238 (52.4)
Current/former smoker + Hypertension	622 (52.2)	121 (47.5)	238 (31.8)	33 (19.4)	1,014 (42.9)
Current/former smoker + Hypertension + Statin therapy	539 (45.3)	99 (38.8)	147 (19.7)	17 (10.0)	802 (33.9)
BMI ≥30 kg/m² + Statin therapy	397 (33.3)	74 (29.0)	143 (19.1)	16 (9.4)	630 (26.6)
Diabetes + Hypertension + Statin therapy	320 (26.9)	62 (24.3)	82 (11.0)	5 (2.9)	469 (19.8)
Diabetes + eGFR ≤89mL min/1.73m²	215 (18.1)	50 (19.6)	73 (9.8)	6 (3.5)	344 (14.6)
Current/former smoker + BMI ≥30 kg/m² + Diabetes	155 (13.0)	29 (11.4)	34 (4.5)	4 (2.4)	222 (9.4)
BMI ≥30 kg/m² + Diabetes	227 (19.1)	47 (18.4)	68 (9.1)	5 (2.9)	347 (14.7)

23 Care and treatment of patients

23.1 Admission status

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

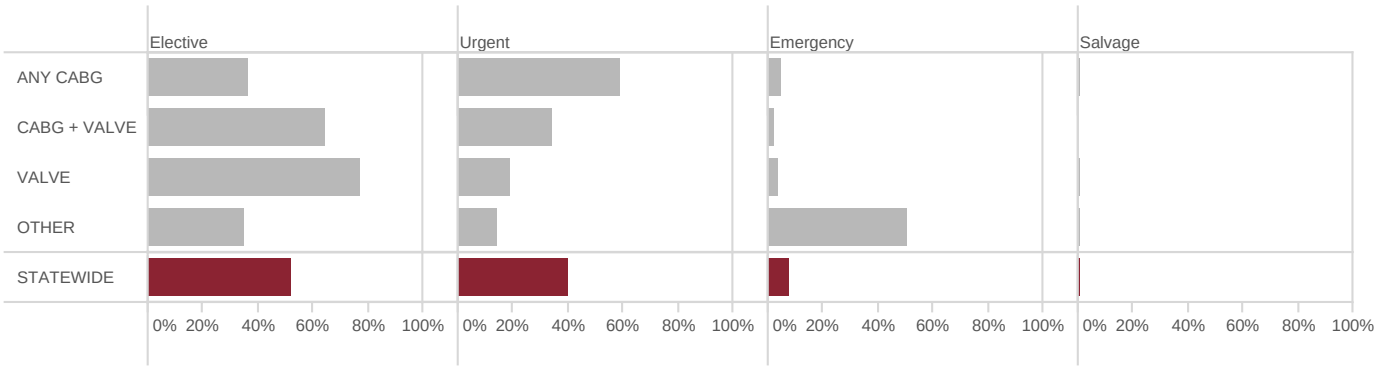


Figure 18: Proportion of cases by admission status and surgery category

Table 8: Proportion of cases by admission status and surgery category

	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)
ANY CABG	433 (36.4)	702 (58.9)	54 (4.5)	2 (0.2)
CABG + VALVE	163 (63.9)	87 (34.1)	5 (2.0)	0 (0.0)
VALVE	577 (77.1)	139 (18.6)	31 (4.1)	1 (0.1)
OTHER	59 (34.7)	24 (14.1)	86 (50.6)	1 (0.6)
STATEWIDE	**1,232 (52.1)**	**952 (40.3)**	**176 (7.4)**	**4 (0.2)**

23.2 Day of surgery admission

Day of surgery admission (DOSA) rates accounted for 14% of all elective cases, with minor variations observed across most surgery categories.

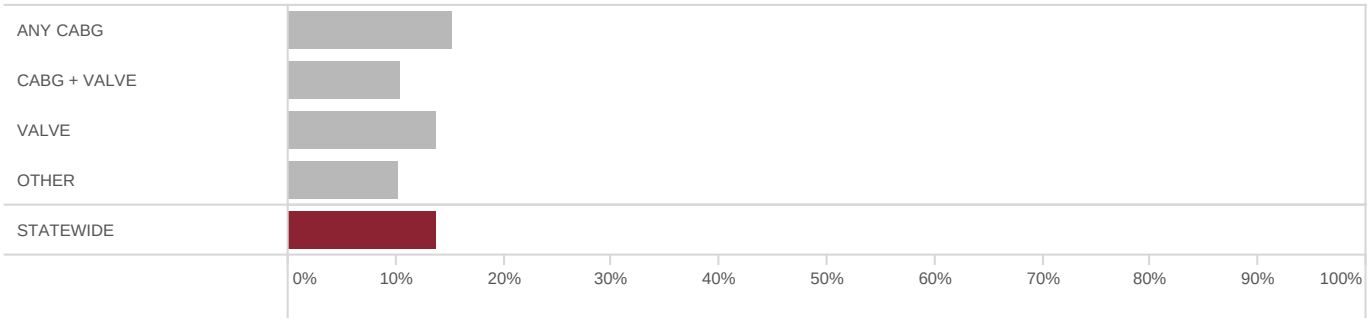


Figure 19: Proportion of elective cases for DOSA by surgery category

Table 9: Proportion of DOSA cases by surgery category

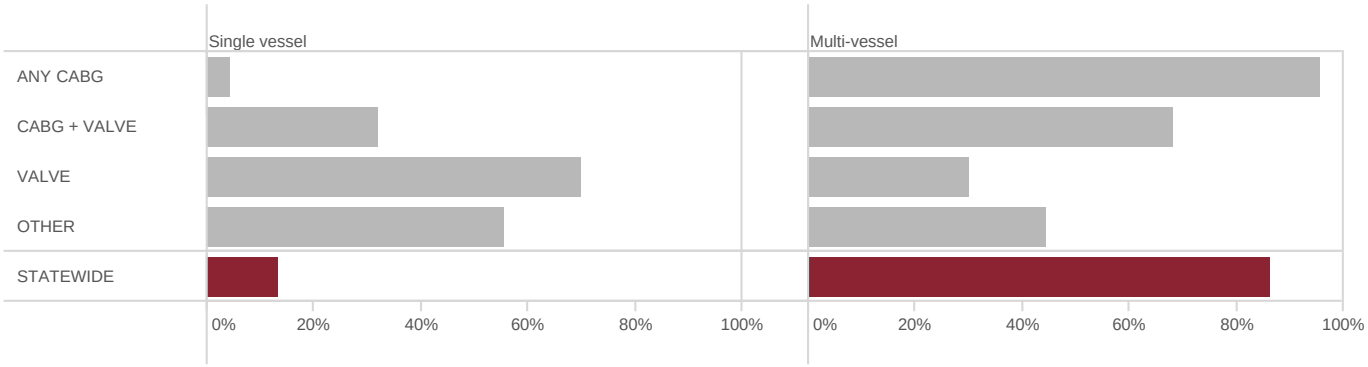
	Total elective cases n	DOSA cases n (%)
ANY CABG	433	66 (15.2)
CABG + VALVE	163	17 (10.4)
VALVE	577	79 (13.7)
OTHER	59	6 (10.2)
STATEWIDE	**1,232**	**168 (13.6)**

23.3 Coronary artery bypass grafts

23.3.1 Number of diseased vessels

In total, 1,446 patients had a CABG procedure. The majority (91%) had multi-vessel disease.

When CABG was performed in conjunction with a valve procedure, 68% of patients had multi-vessel disease compared to 96% when CABG was performed without a valve procedure.



Excludes missing data/not applicable (total n=6)

Figure 20: Number of diseased vessels

Table 10: Number of diseased vessels

	Single vessel n (%)	Multi-vessel n (%)	ALL* n (%)
ANY CABG	49 (4.1)	1,138 (95.9)	1,187 (100.0)
CABG + VALVE	81 (32.0)	172 (68.0)	253 (100.0)
STATEWIDE	**130 (9.0)**	**1,310 (91.0)**	**1,440 (100.0)**

* Excludes missing data/not applicable (total n=6)

23.3.2 Mean number of grafts

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

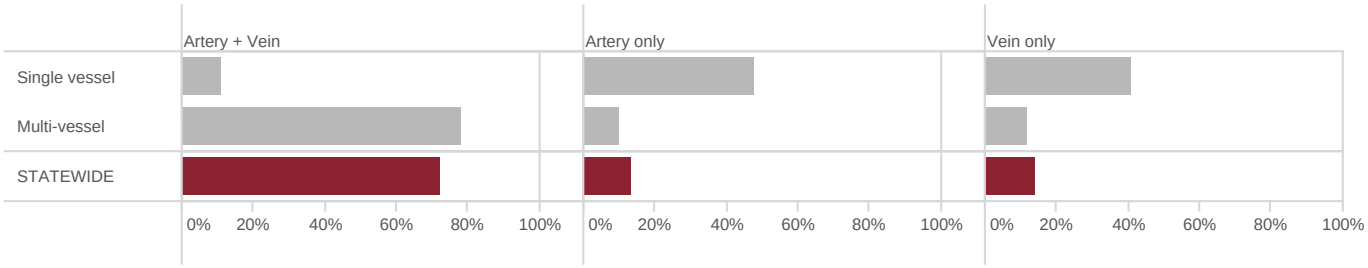
Table 11: Mean number of grafts by number of diseased vessels

	Single vessel (mean)	Multi vessel (mean)	Multi vessel (median)	ALL* (mean)
ANY CABG	1.3	3.0	3	2.9
CABG + VALVE	1.1	2.4	2	2.0
STATEWIDE	**1.2**	**2.9**	**3**	**2.7**

* Excludes missing data/not applicable (total n=6)

23.3.3 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 (72%). Total arterial revascularisation occurred in 13% of cases.



Excludes missing data/not applicable (total n=7)

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	14 (10.9)	62 (48.1)	53 (41.1)
Multi-vessel	1,027 (78.4)	132 (10.1)	151 (11.5)
STATEWIDE	**1,041 (72.3)**	**194 (13.5)**	**204 (14.2)**

Excludes missing data/not applicable (total n=7)

23.3.4 Off pump CABG

Approximately 2% of isolated CABG were performed without cardiopulmonary bypass.

Table 13: Off pump CABG

	Total n	Off pump n (%)
Isolated CABG	1,147	22 (1.9)

23.3.5 Y or T grafts

Overall, 4% of CABGs included a Y or T graft.

Table 14: Y or T graft used by procedure category

	Total n	Y or T graft n (%)
ANY CABG	1,191	57 (4.8)
CABG + VALVE	255	6 (2.4)
STATEWIDE	**1,446**	**63 (4.4)**

23.4 Aortic surgery

There was a total of 209 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 (68%), while surgery to replace both the ascending aorta and aortic arch accounted for 15% of cases.

Aortic aneurysm was the primary reason for aortic surgery (52%).

Table 15: Aortic surgery by procedure type

Aortic surgery type	n (%)
Replacement	183 (87.6)
Ascending	142 (67.9)
Ascending + Arch	32 (15.3)
Arch	4 (1.9)
Ascending + Arch + Descending	2 (1.0)
Descending + Thoracoabdominal	1 (0.5)
Descending	1 (0.5)
Arch + Thoracic	1 (0.5)
Aortoplasty	24 (11.5)
Patch repair	19 (9.1)
Direct aortoplasty	3 (1.4)
Endarterectomy	1 (0.5)
Patch repair + Endarterectomy	1 (0.5)
Aortoplasty and Replacement	2 (1.0)
Patch repair + Ascending + Arch	2 (1.0)
STATEWIDE	**209 (100.0)**

23.4.1 Aortic pathology

Table 16: Aortic surgery cases by pathology type

Aortic pathology type	n (%)
Aortic aneurysm	108 (51.7)
Aortic dissection (≤2 weeks)	45 (21.5)
Other	28 (13.4)
Calcification	18 (8.6)
Aortic dissection (>2 weeks)	8 (3.8)
Traumatic transection	2 (1.0)
STATEWIDE	**209 (100.0)**

23.5 Valve surgery

In participating sites, valve surgery was performed in 1,003 cases during 2017. The aortic valve was the most commonly operated on valve either with or without other valves (67%). Mitral valve surgery accounted for the next most common valvular surgery.

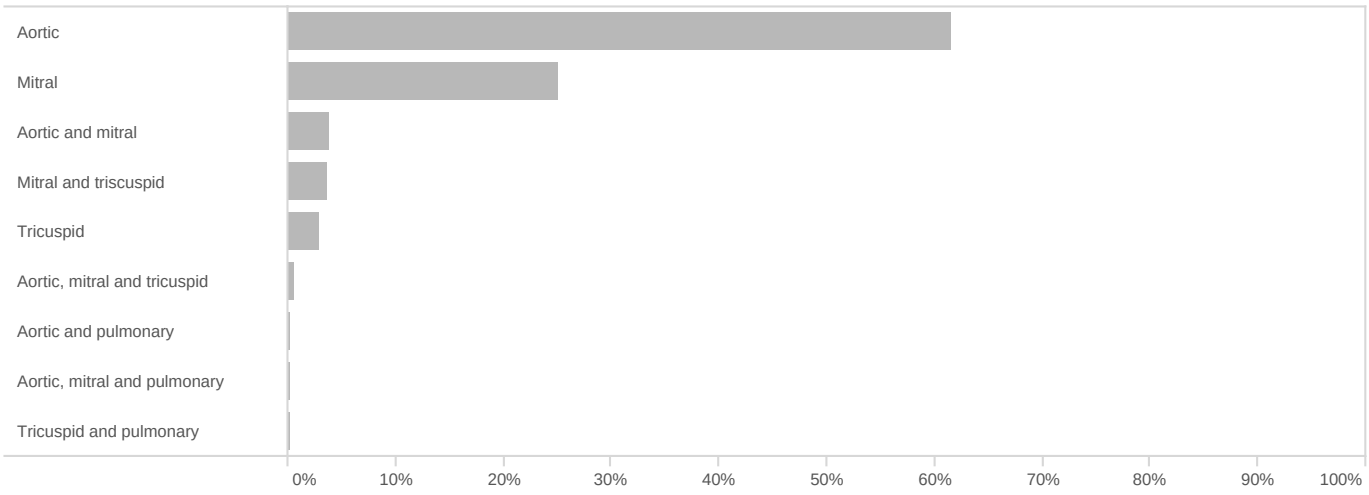


Figure 22: Proportion of valve surgery cases by valve

Table 17: Valve surgery cases by valve

Type of valve surgery	n (%)
Aortic	618 (61.6)
Mitral	251 (25.0)
Aortic and mitral	38 (3.8)
Mitral and tricuspid	37 (3.7)
Tricuspid	30 (3.0)
Pulmonary	11 (1.1)
Aortic and tricuspid	7 (0.7)
Aortic, mitral and tricuspid	6 (0.6)
Tricuspid and pulmonary	2 (0.2)
Aortic and pulmonary	2 (0.2)
Aortic, mitral and pulmonary	1 (0.1)
STATEWIDE	**1,003 (100.0)**

22.5.1 Valve pathology

The most common valve pathology across all valve types was calcific (32%), and accounted for almost half (49%) of all aortic valve procedures.

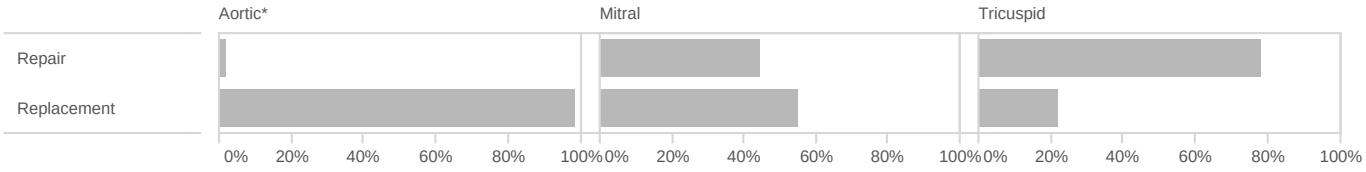
Table 18: Valve pathology by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	ALL n (%)
Calcific	326 (48.5)	27 (8.1)	-	-	353 (32.0)
Myxomatous	54 (8.0)	119 (35.7)	10 (12.2)	2 (12.5)	185 (16.8)
Congenital	103 (15.3)	6 (1.8)	4 (4.9)	6 (37.5)	119 (10.8)
Infection	52 (7.7)	44 (13.2)	13 (15.9)	2 (12.5)	111 (10.1)
Degenerative	46 (6.8)	35 (10.5)	24 (29.3)	-	105 (9.5)
Rheumatic	16 (2.4)	47 (14.1)	11 (13.4)	-	74 (6.7)
Other	32 (4.8)	28 (8.4)	15 (18.3)	1 (6.3)	76 (6.9)
Prosthesis failure	22 (3.3)	13 (3.9)	-	1 (6.3)	36 (3.3)
Ischaemic	-	14 (4.2)	-	-	14 (1.3)
Dissection	12 (1.8)	-	-	-	12 (1.1)
Annuloaortic ectasia	8 (1.2)	-	-	-	8 (0.7)
Functional	-	-	4 (4.9)	-	4 (0.4)
Failed prior repair	-	-	1 (1.2)	3 (18.8)	4 (0.4)
Iatrogenic	1 (0.1)	-	-	-	1 (0.1)
Inspection only	-	-	-	1 (6.3)	1 (0.1)
STATEWIDE	**672 (100.0)**	**333 (100.0)**	**82 (100.0)**	**16 (100.0)**	**1,103 (100.0)**

23.5.2 Types of valve surgery

The majority of valve surgery cases involved aortic valve intervention (67%).

The most common aortic valve procedure was replacement surgery (98%) with remainder involving valve repair. Similarly for the mitral valve, replacement was more frequent than repair (55% vs 44%).



* Aortic replacement category includes transcatheter aortic valve replacement cases

Figure 23: Valve surgery category by valve

Table 19: Valve surgery category by valve type

Surgery category	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	ALL n (%)
Repair	12 (1.8)	148 (44.4)	64 (78.0)	0 (0.0)	224 (20.3)
Replacement	660 (98.2)	184 (55.3)	18 (22.0)	15 (93.8)	877 (79.5)
Inspection only	0 (0.0)	1 (0.3)	0 (0.0)	1 (6.3)	2 (0.2)
STATEWIDE	**672 (100.0)**	**333 (100.0)**	**82 (100.0)**	**16 (100.0)**	**1,103 (100.0)**

23.5.3 Valve repair surgery

The most common form of valve repair surgery was repair/reconstruction with annuloplasty (77%), followed then by annuloplasty only (9%). Mitral valve repair/reconstruction with annuloplasty was the most common individual valve repair surgery comprising 57% of overall valve repair surgery.

It has been identified that there is an opportunity to improve data collection in cases involving mitral and tricuspid valve repair as the definitions relating to this surgery and the reporting application may be ambiguous. A future focus for this report will be the enhancement of data quality relating to these elements.

Table 20: Valve repair surgery by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	ALL n (%)
Repair/reconstruction with annuloplasty	-	128 (86.5)	44 (68.8)	-	172 (76.8)
Annuloplasty only	-	6 (4.1)	13 (20.3)	-	19 (8.5)
Repair/reconstruction without annuloplasty	-	11 (7.4)	5 (7.8)	-	16 (7.1)
Root reconstruction with valve sparing	8 (66.7)	-	-	-	8 (3.6)
Resuspension of aortic valve	3 (25.0)	-	-	-	3 (1.3)
Tumour tissue removal	-	1 (0.7)	1 (1.6)	-	2 (0.9)
Decalcification of valve only	1 (8.3)	1 (0.7)	-	-	2 (0.9)
Commissurotomy with annuloplasty ring	-	1 (0.7)	-	-	1 (0.4)
Thrombus removal	-	-	1 (1.6)	-	1 (0.4)
STATEWIDE	**12 (100.0)**	**148 (100.0)**	**64 (100.0)**	**-**	**224 (100.0)**

23.5.4 Valve replacement surgery

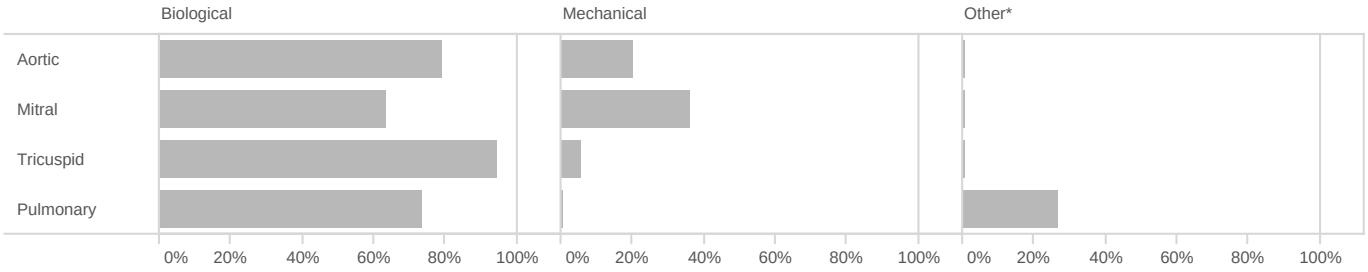
Aortic valve replacement accounted for the majority of valve replacement surgeries (75%). The reported number of TAVR cases reflects those in which a cardiothoracic surgeon was present during the procedure and does not represent the total number of these surgeries performed throughout Queensland in 2017.

Further detail regarding TAVR procedures are outlined in the structural heart disease supplement of the interventional cardiology chapter of this Annual Report.

Table 21: Valve replacement surgery by valve type

Surgery type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	ALL n (%)
Replacement	540 (81.8)	184 (100.0)	18 (100.0)	15 (100.0)	757 (86.3)
Root reconstruction with valve conduit	79 (12.0)	-	-	-	79 (9.0)
TAVR	40 (6.1)	-	-	-	40 (4.6)
Pulmonary autograft aortic root replacement	1 (0.2)	-	-	-	1 (0.1)
STATEWIDE	**660 (100.0)**	**184 (100.0)**	**18 (100.0)**	**15 (100.0)**	**877 (100.0)**

The most common form of valve prostheses used across all valve types were biological (76%). Mechanical prostheses were used in 31% 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 (34%).



* Includes homograft/allograft and autograft

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

Table 22: Types of valve prosthesis by valve type

Prosthesis type	Aortic* n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	ALL n (%)
Biological – bovine pericardial	297 (45.0)	54 (29.3)	4 (22.2)	11 (73.3)	366 (41.7)
Biological – porcine	226 (34.2)	63 (34.2)	13 (72.2)	0 (0.0)	302 (34.4)
Mechanical	134 (20.3)	67 (36.4)	1 (5.6)	0 (0.0)	201 (22.9)
Homograft/allograft	2 (0.3)	0 (0.0)	0 (0.0)	2 (13.3)	4 (0.5)
Autograft	1 (0.2)	0 (0.0)	0 (0.0)	2 (13.3)	3 (0.3)
STATEWIDE	**660 (100.0)**	**184 (100.0)**	**18 (100.0)**	**15 (100.0)**	**877 (100.0)**

23.6 Other cardiac surgery

The most common forms of other cardiac surgery were left atrial appendage closure (19%), followed by bilateral sequential single lung transplantation (14%).

Table 23: Other cardiac procedures

Procedure	n (%)
Left atrial appendage closure	55 (19.2)
Other reason	44 (15.4)
BSSLTX*	40 (14.0)
Atrial septal defect repair	39 (13.6)
Atrial arrhythmia surgery	26 (9.1)
LVOT‡ myectomy	17 (5.9)
Cardiac tumour surgery	12 (4.2)
Other congenital repair	9 (3.1)
Cardiac transplant	8 (2.8)
Pulmonary thrombo-endarterectomy	7 (2.4)
Pericardiectomy	6 (2.1)
Ventricular septal defect repair	6 (2.1)
LV rupture repair	4 (1.4)
PFO† closure	3 (1.0)
Cardiopulmonary transplant	3 (1.0)
Permanent LV epicardial lead	3 (1.0)
Lung transplant	2 (0.7)
Trauma	2 (0.7)
STATEWIDE	**286 (100.0)**

* Bilateral sequential single lung transplantation

† Patent foramen ovale

‡ Left ventricular outflow tract

23.7 Blood product usage

The majority of surgeries did not require blood product transfusion. As the urgency of operations increased, a stepwise greater requirement for red blood cells (RBC) and non-red blood cells (NRBC) was observed. Emergency and salvage cases had much higher transfusion rates.

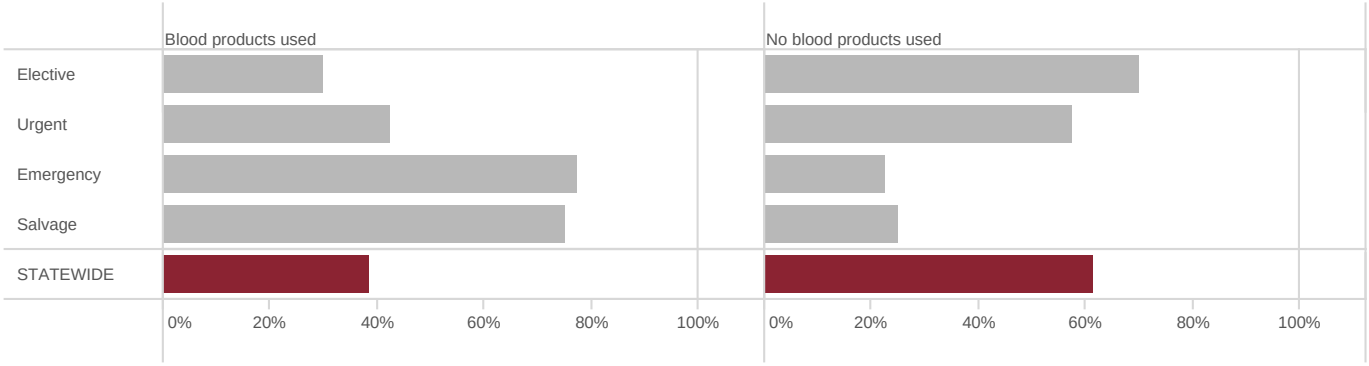


Figure 25: Blood product usage by admission status

Table 24: Blood product usage by admission status

	Both RBC and NRBC n (%)	RBC n (%)	NRBC n (%)	No blood products n (%)
Elective	131 (10.6)	144 (11.7)	94 (7.6)	863 (70.0)
Urgent	149 (15.7)	182 (19.1)	74 (7.8)	547 (57.5)
Emergency	87 (49.4)	26 (14.8)	23 (13.1)	40 (22.7)
Salvage	3 (75.0)	-	-	1 (25.0)
STATEWIDE	**370 (15.7)**	**352 (14.9)**	**191 (8.1)**	**1,451 (61.4)**

24 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 report focuses on the risk of complications from procedures and compared the aggregated outcomes of the 4 adult cardiac surgical units against calculated risk scores.

24.1 Risk prediction models

Risk adjustment algorithms are a means of estimating the likelihood of an outcome based on patient and clinical factors known at the time of surgery. Risk scores in cardiac surgery are developed on large patient cohorts and are usually relevant for a particular period in time and in a particular geographic area. In developing the scores, patient and surgical factors are analysed, and factors that are identified as statistically associated with the level of risk of surgery are identified. This statistical analysis 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 risk of complications (morbidity) after an operation. The risk models used in evaluating the 2017 clinical outcomes for cardiac surgical cases are:

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

While EuroSCORE[12] and the ANZSCTS General Score[13] can be applied to evaluate deaths for all types of cardiac surgical cases, the AusSCORE model[14] has been developed to be applied to deaths in CABG cases only. As previously noted, the STS scores provide an estimate of the risk for mortality as well as a range of morbidities, however, these are specific to limited subgroups of cardiac surgery procedures (CABG model: isolated coronary artery bypass only.[15] Valve model: isolated aortic valve replacement, isolated mitral valve replacement or isolated mitral valve repair.[16] Valve + CABG model: CABG plus one of aortic valve replacement, mitral valve replacement or isolated repair.)[17]

Although EuroSCORE (published 1999) has, with the passage of time, become less calibrated to contemporary outcomes in cardiac surgery, it retains its ability to discriminate risk. In this evaluation it has been retained to provide a benchmark for comparison to historical performance and as such provides a useful reminder of how far practice has improved in the past 20 years. Although EuroSCORE II has been developed to address the calibration issue of the original model, it was not used in this evaluation as the full suite of factors required for the risk score are not universally collected in the QCOR dataset. Only one site calculates this score routinely as a separate data point. The database will be modified to include the data required for EuroSCORE II so that it can be calculated in future reports.

The graphs provided in the following sections compare the actual observed rates of mortality and morbidities to that predicted using each risk model. However, when interpreting the messages provided by this 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. Several aspects of the patient's entire journey to disease and through treatment and recovery may combine to influence the outcome of surgery.

When reviewing the document outcomes it is important to remember that there are five 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 adequate 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?

In preparing the analysis presented here, significant effort has been expended to ensure the data is of an acceptable quality both in terms of completeness and uniformity of definition.

24.1.1 Mortality

The most commonly evaluated outcome (reflecting its significance) in a risk-adjusted analysis is death within 30 days of surgery. In this evaluation, the mortality rate of patients undergoing cardiac surgery in 2017 has been evaluated using the previously described risk models.

As the STS provide models that are applicable only to defined subgroups of procedures, it is important to note that the STS models have been used to evaluate outcomes only in the range of cases meeting the inclusion criteria. The Total outcome chart for the STS models has been derived by pooling all results for the CABG Only, Valve Only and CABG + Valve models. Likewise, the AusSCORE model has been used for CABG only cases and is presented side-by-side with the other risk score predictions for CABG only cases.

In all evaluations, the observed mortality rate (shown as a red diamond) is either within or significantly better than expected.

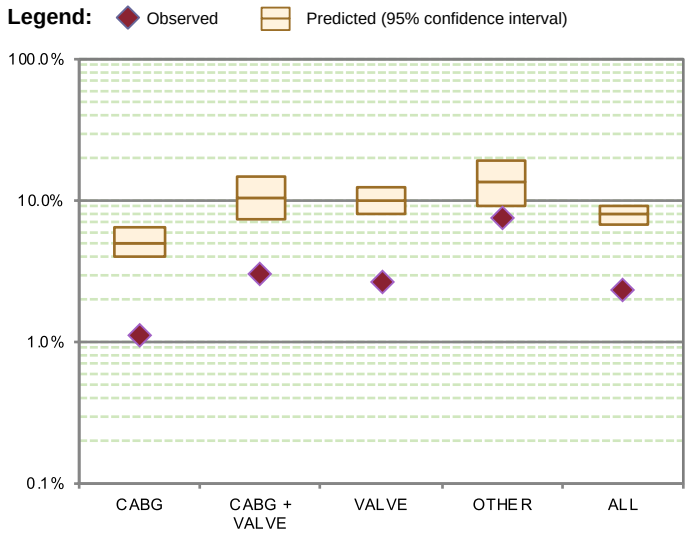


Figure 26: EuroSCORE

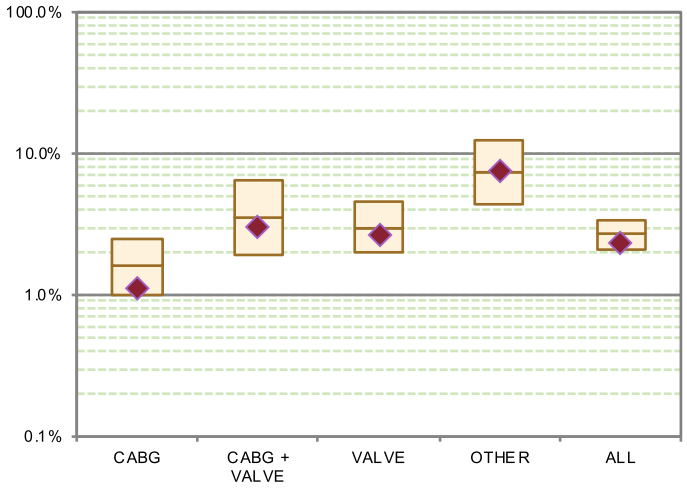


Figure 27: ANZSCTS General Score

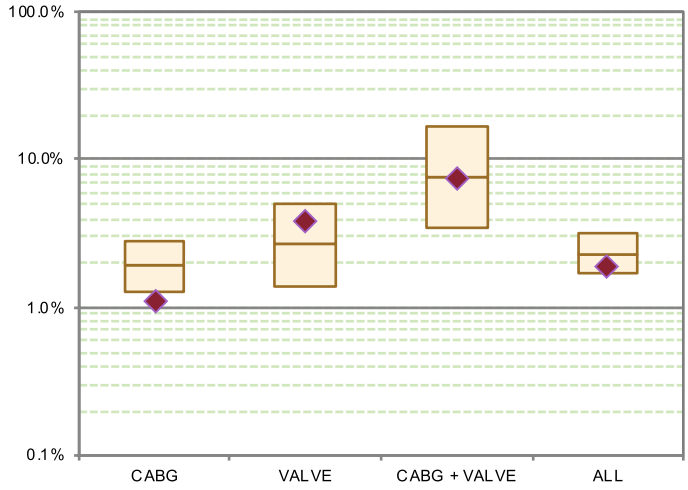


Figure 28: STS (death)

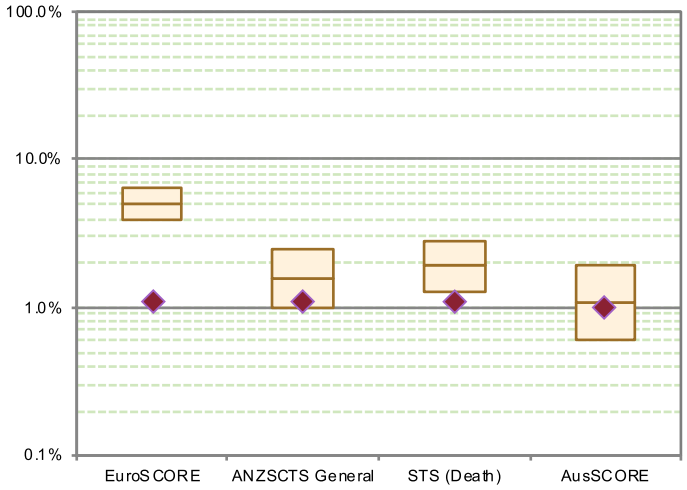


Figure 29: CABG

24.1.2 Morbidity

Apart from death, patients undergoing cardiac surgery are at risk of experiencing a range of significant morbidities. The STS risk models provide an estimate of the level risk for a patient of experiencing these morbidities. These models have been applied to the defined subgroups using the defined inclusion criteria.

The aggregated morbidities chart (Figure 34) represents the observed rate of cases involving at least one of the five morbidities.

For 2017, 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 significantly higher. This data is not directly comparable with 2016 because that dataset was from three units, whereas 2017 included four units, and the significant variations in caseload with the addition of the fourth unit means that statistical comparisons from year to year cannot be made. Nevertheless, the data again demonstrates a higher observed rate than expected from the STS risk score calculator.

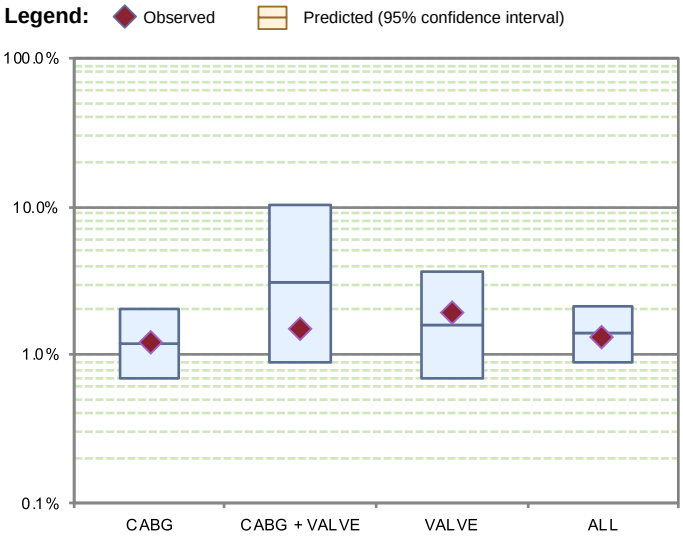


Figure 30: CVA

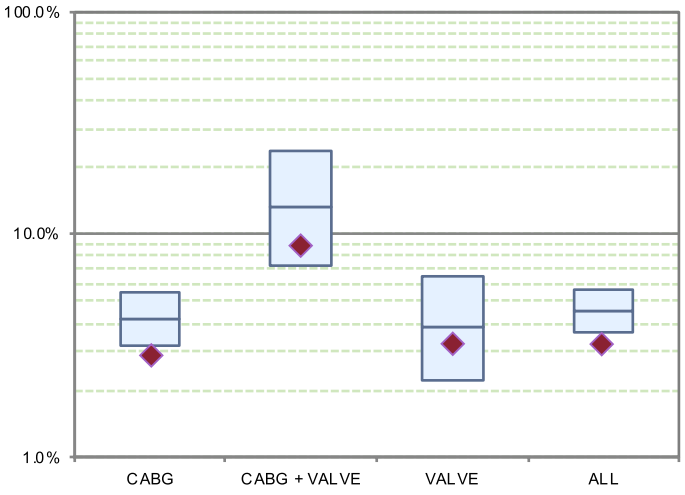


Figure 31: Renal failure

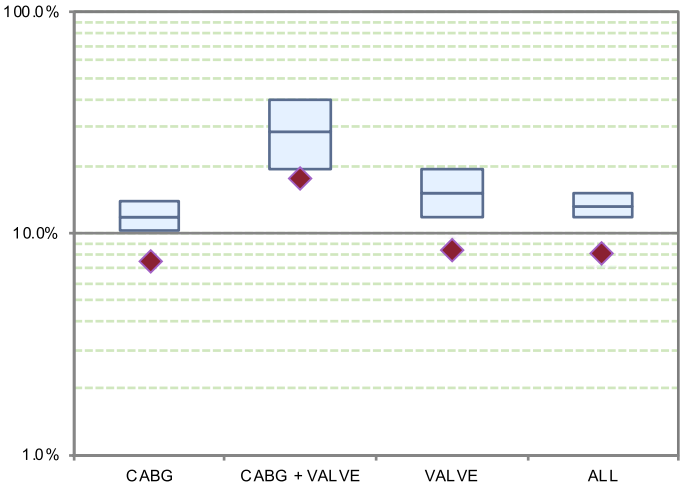


Figure 32: Ventilation >24 hours

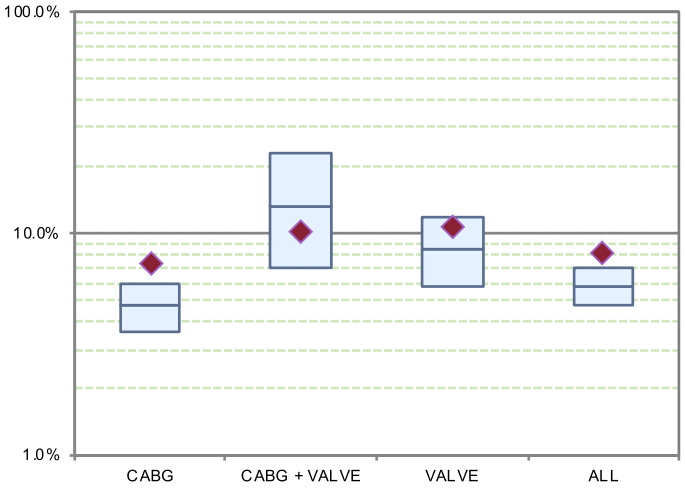


Figure 33: Reoperation

The 2016 rate is discussed in the next section. With respect the 2017 rate, we will audit two aspects: DSWI cases, and the reopen rate for CABG, to first ascertain whether these two markers are indeed linked, and secondly to ensure that the rates are reliable. Secondly, we will ask the ANZSCTS national database to make comment on the individual units when compared to a national standard, as 2017 is the first year in which the ANZSCTS national database also includes data from all public Queensland units. The ANZSCTS national database performs analysis of individual unit performance and identifies outliers as part of that process. Thus their input will help clarify whether the observed statewide rate is significant or not.

Overall, when evaluated using the STS morbidity models, the rate of morbidity remains within a statistically predicted rate.

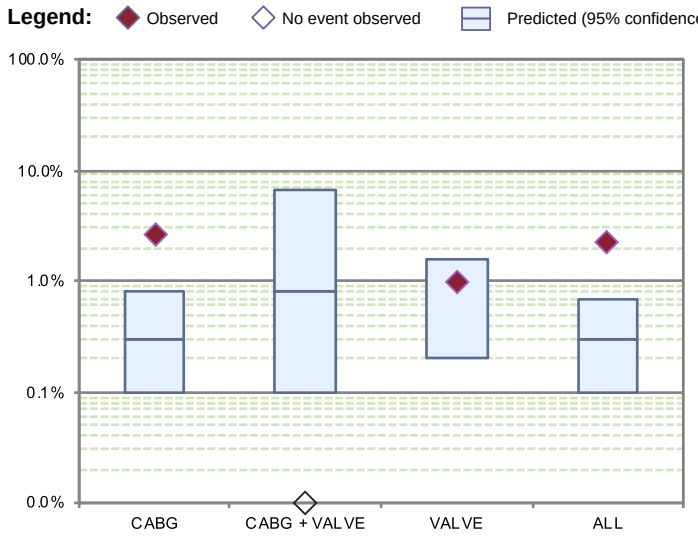


Figure 34: Deep sternal wound infection

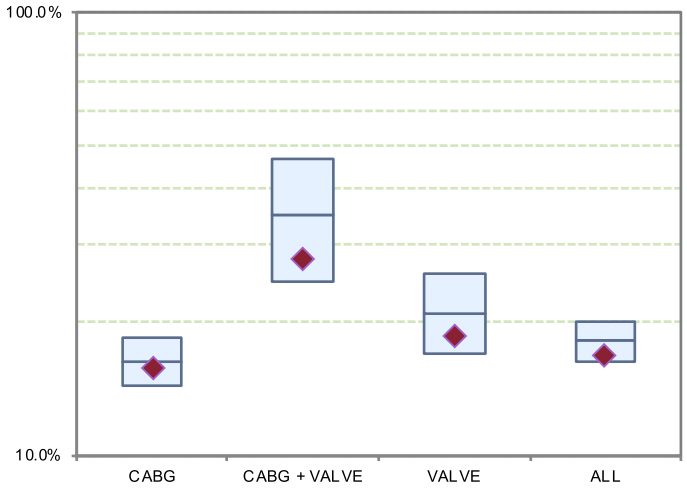


Figure 35: Major morbidity

24.1.3 Measures of process

The following charts evaluate 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.

This comparison suggests that the proportion of cases staying less than 6 days is better than expected, that is, more patients that are discharged before 6 days than predicted. Additionally, the proportion of patients who stay longer than 14 days is greater than expected, perhaps indicating that those who cannot return home immediately post surgery are instead facing delays being transferred to other institutions within the health service, such as rehabilitation, regional hospitals or nursing homes.

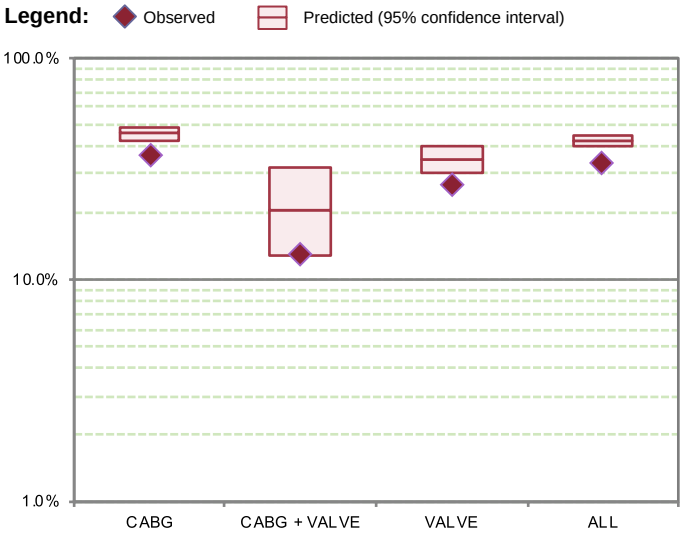


Figure 36: LOS ‹6 days

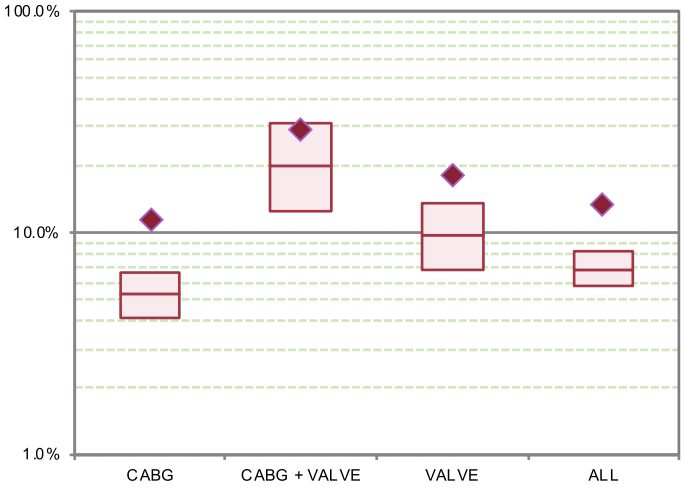


Figure 37: LOS ›14 days

24.1.4 Failure to rescue

One explanation for improved outcomes in high volume centres is that patients who suffer a complication are better treated, and hence are rescued from further progression of complications that can lead to death. Failure to rescue is a measure 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 rescued by the hospital processes.

Based on this analysis, the failure to rescue observed rate for CABG cases (shown as a red diamond) is statistically better than predicted and the rate for valve, and combined CABG and valve cases is within the expected range. It is reasonable to conclude that hospital processes to deal with adverse events are functioning better than expected.

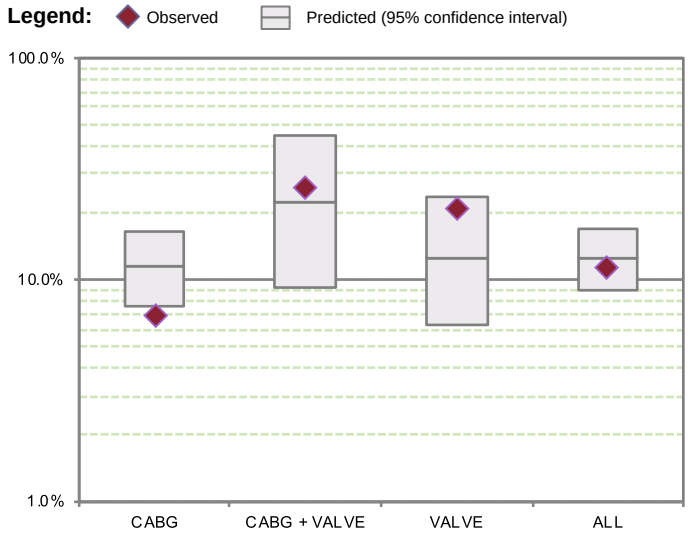


Figure 38: Failure to rescue

24.1.5 DSWI 2016

The 2016 report identified an observed rate of deep sternal wound infection (DSWI) that was higher than expected from the STS risk prediction model. The committee asked each unit that contributed to the 2016 report to audit the cases identified as DSWI. The definition of DSWI according to the STS model is a return to theatre for debridement or reopening of the mediastinum, positive blood cultures unless on antibiotics, and prolonged treatment with antibiotics. Auditing the data identified patients who were identified as having DSWI in the complications, but were either coded more than once or did not actually meet all three STS criteria. This revised the observed rate down to within the confidence interval around the STS predicted rate.

The 2016 ANZSCTS National Annual Report[18] identifies rates of DSWI from between 0.2% to 3.5% depending on the type of procedure, on the presence or absence of diabetes or renal dysfunction and the increasing age of the patient. The average overall rate was 1.6% for 2016, and 1.0% to 1.5% for 2012–2015 depending on the procedure. In our analysis of the 2016 QCOR data, the STS model predicted an overall rate of 0.3%. This rate is much lower than the rate observed across Australia, and hence our data, though in line with the national rate, raised a statistical flag. It is reasonable thus to assume, as researchers from the UK have done, that there is a fixed relationship between the STS prediction model and the observed rate in the 2016 data.[19] They found a relationship of approximately four times, which is similar to the relationship between the predicted and observed rates in our 2016 data.

As in the aforementioned discussion about the 2017 data, the 2016 data is not comparable. Thus, we will approach 2017 with the same approach as 2016, with assistance from the ANZSCTS database, and make further comment on the ongoing presence of a fixed relationship in the next report.

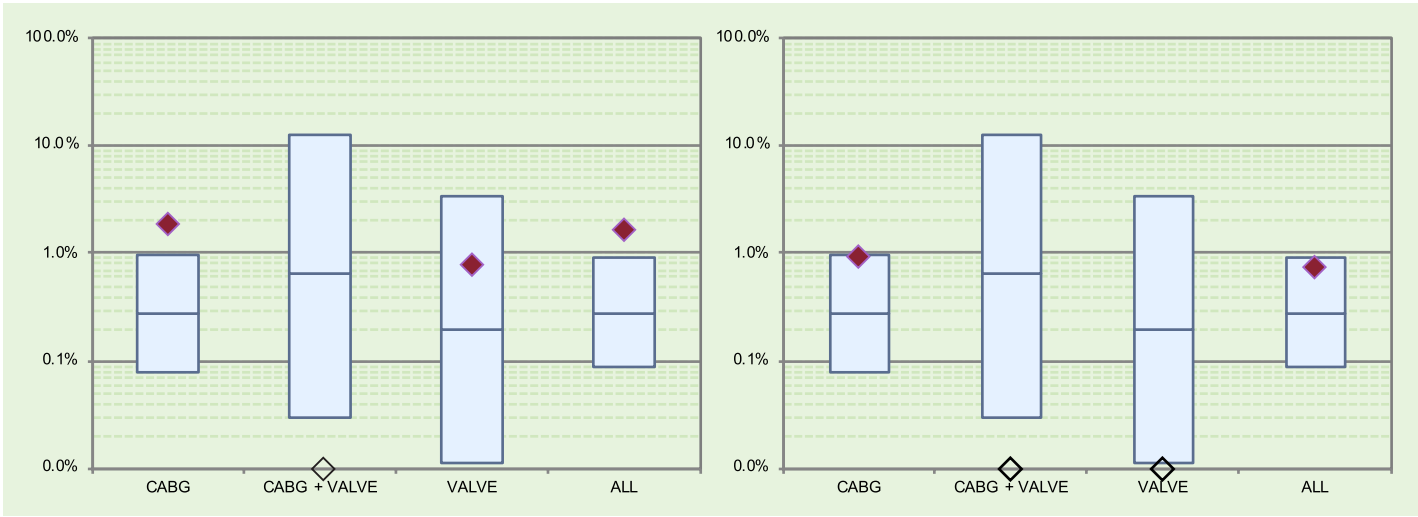


Figure 39: Comparison of 2016 deep sternal wound infection rates, pre vs. post audit

25 Conclusions

This report again demonstrates that cardiac surgery is performed with high quality results and safety in Queensland. We can now conclude this across all public sites in Queensland because of the involvement of all public units in the database. The expected rates of mortality and morbidity derived from well established and widely used risk scores are much higher than we see in our database, reflecting that cardiac surgery in Queensland is performed at higher than expected levels of safety.

We see from this report that the most likely description of a patient undergoing cardiac surgery in Queensland is a 70-year-old male with obesity, hypertension who used to smoke and has some degree of renal dysfunction. There are patients who do not fit this description, with both the very young and the very old undergoing surgery, as well as those of normal weight, normal renal function and those who have never smoked. However, focusing on the most common patient, the impact of obesity stands out as an issue requiring further investigation. Some research reports that surgery is safer for those who are overweight compared to those who are normal weight, while anecdotally, those with morbid obesity may not have higher risks of death, but consume greater resources post surgery. Thus, the next report will look deeper into the issue of obesity in cardiac surgery in Queensland.

The fact that patients are most likely to be former smokers is a reflection on the benefits of public health programs that have reduced smoking rates. To reduce the rates of smoking, the proportion of people who identify as “former smokers” needs to increase, so it is gratifying to see that most patients are in this group. There was a day when most patients were “current smokers”.

The combined risk factors data is in its infancy. It may be that trends appear over time allowing for comments to be made. At present, one can see that most patients have a combination of risk factors. Work needs to be done to improve the database to identify the degree of patients who are not treated for their risk factors prior to admission to hospital, identifying primary care opportunities to improve cardiac disease.

The role and limitations of risk scores are again demonstrated, particularly when risk scores are not derived from similar contemporaneous populations. Nevertheless, for a project that covers four sites, comparison to risk scores rather than to each other, is a reasonable process, and will evolve with each iteration of this report.

26 Recommendations

The detail captured in the cardiac surgical database is being refined with changes planed for valve repair, microbiology and aetiology of endocarditis. The review process ensures that there is consistent categorisation of data across sites, allowing for comparision and analysis of the data statewide.

The endocarditis supplement highlighted that this disease as a distinct entity needs investigation by the network. The surgical series of endocarditis is the numerator on the denominator of medically treated endocarditis. The high mortality risk of prosthetic valve endocarditis highlights that the aetiology of endocarditis needs to be tracked and public health measures instituted to modify an patterns that emerge. It is a high risk and resource intense disease when surgery is needed.

The current cardiac surgery database data elements do not encompass all required fields to enable EuroSCORE II modelling and calculation. With these data elements included, more risk calculation and comparison can be undertaken. These changes are a current work in progress and will be implemented for use in the 2019 calendar year.

The utility of the cardiac surgery database within QCOR is that the use of surgery within cardiac disease can be analysed as part of the entire cardiac disease network, for example, the rates of coronary surgery compared to PCI, or the rates of TAVR compared to AVR, which is part of the emphasis on disease focused reporting, rather than service level analysis. Integrated analysis and reporting is part of the work ahead for QCOR.

27 Supplement: Infective endocarditis

Infective endocarditis is a condition in which infection takes up residence in the structures of the heart, resulting in destruction and dysfunction. As this is a surgical database, the cases analysed here are those patients who have reached a severity of infection that requires surgery to attempt to remove the infected tissue and to repair the destroyed structures, restoring function. These operations range in degrees of technical challenge and risk because the extent of infection within the heart can vary, the virulence of the infecting organism ranges from slow growing, to rapidly destructive, and the degree to which the rest of the body is infected and affected as an entire system is different for each patient.

The committee felt that more detailed analysis of this problem may enlighten us on strategies to manage this condition, and at the very least identify gaps in the database that are relevant to this clinical condition.

The distinction between active and treated endocarditis deserves clarification. Treated endocarditis is a condition in which the infection has been controlled and sterilised with antibiotics and the patient is now undergoing surgery for residual cardiac dysfunction. Active endocarditis is the condition in which bacterial infection is active at the time of surgery, and surgery is for heart failure, valve dysfunction, risk of embolisation or to control the infection in addition to antibiotics. To clarify, the distinction between “active” and “treated” does not imply that active infections are not treated with antibiotics at the time of surgery.

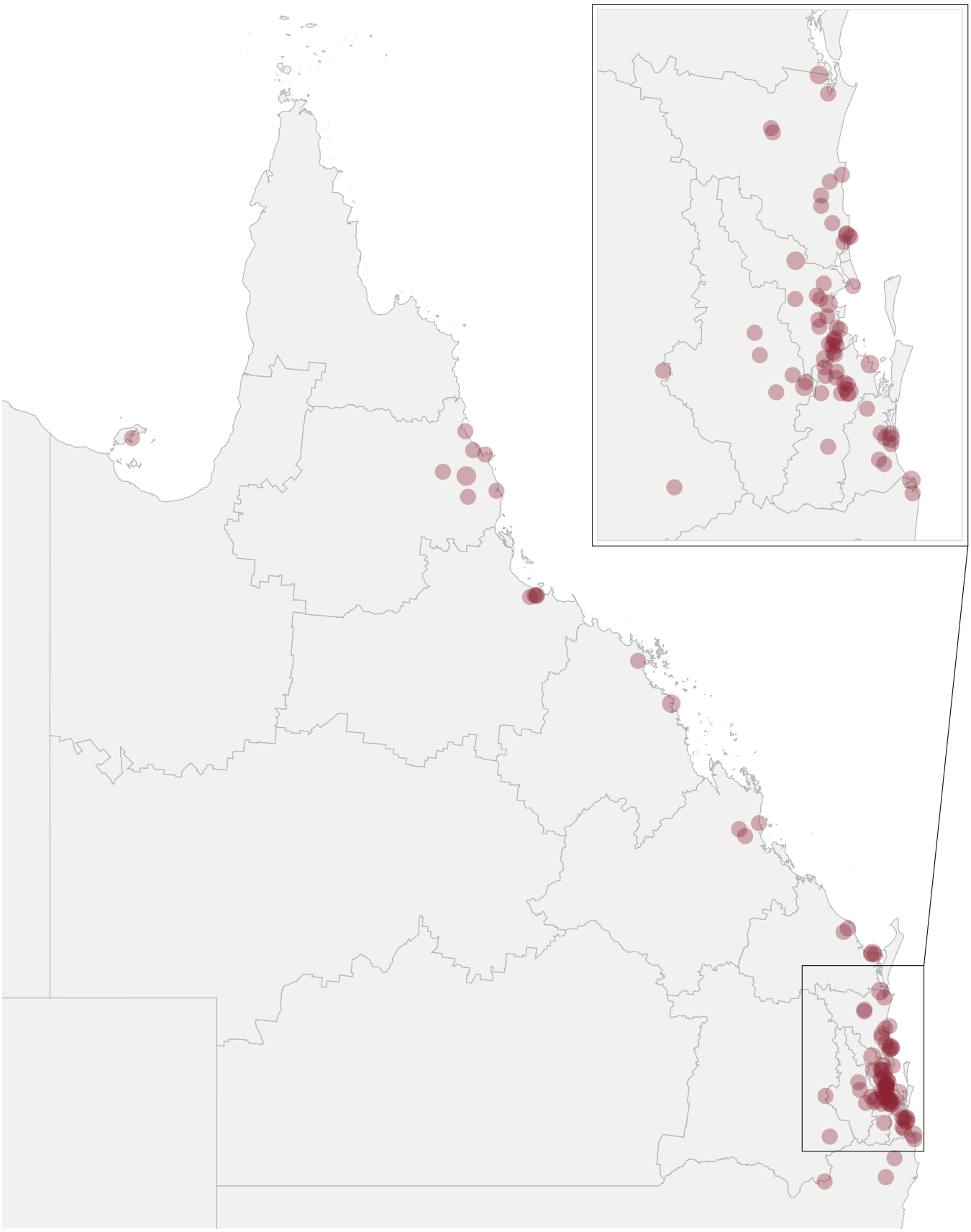


Figure 1: Infective endocarditis cases by residential postcode

27.1 Patient characteristics

More than three-quarters of infective endocarditis patients were male (79%), with a greater median age of 56 years for males than 46 years for females. The proportionally largest group of patients however, were males aged below 40 years of age (17%).

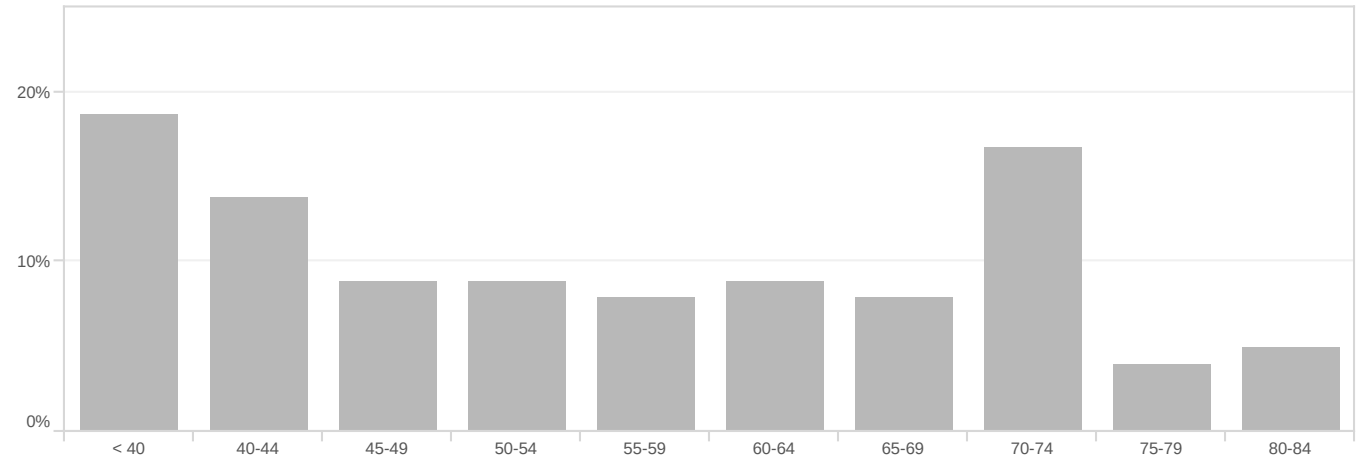


Figure 2: Infective endocarditis cases by age category

Table 1: Infective endocarditis cases by gender and age category

Age	Male n (%)	Female n (%)	ALL n (%)
‹40	17 (16.7)	2 (2.0)	19 (18.6)
40–44	8 (7.8)	6 (5.9)	14 (13.7)
45–49	4 (3.9)	5 (4.9)	9 (8.8)
50–54	9 (8.8)	-	9 (8.8)
55–59	8 (7.8)	-	8 (7.8)
60–64	6 (5.9)	3 (2.9)	9 (8.8)
65–69	7 (6.9)	1 (1.0)	8 (7.8)
70–74	13 (12.7)	4 (3.9)	17 (16.7)
75–79	3 (2.9)	1 (1.0)	4 (3.9)
80–84	5 (4.9)	-	5 (4.9)
ALL	**80 (78.4)**	**22 (21.6)**	**102 (100.0)**

27.2 Care and treatment of infective endocarditis patients

The majority of patients undergoing surgical treatment for infective endocarditis had a valve procedure only (86%). 12% also underwent coronary bypass surgery with these two groups accounting for the vast majority of cases (98%).

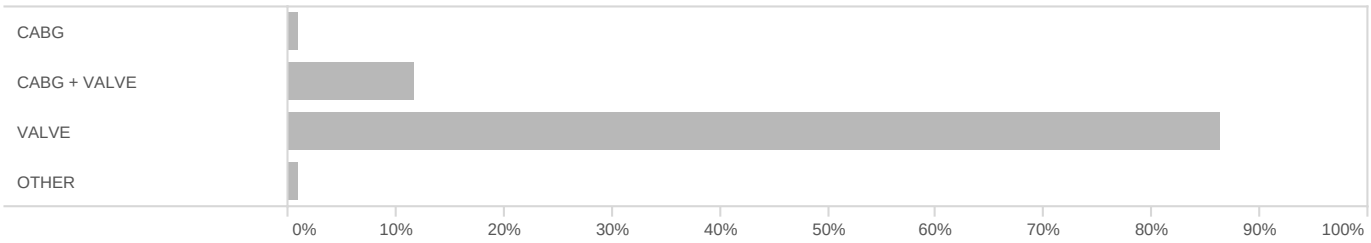


Figure 3: Infective endocarditis cases by surgery category

Table 2: Infective endocarditis cases by surgery category

	n (%)
CABG	1 (1.0)
CABG + VALVE	12 (11.8)
VALVE	88 (86.3)
OTHER	1 (1.0)
ALL	**102 (100.0)**

Aortic valve endocarditis necessitating intervention was the most commonly performed surgery either with or without other valves (53% vs 40%). Aortic and mitral valve surgery was the most commonly performed multiple valve operation accounting for 10% of all cases. In total, 18% of surgeries for endocarditis involved intervention to multiple valves.

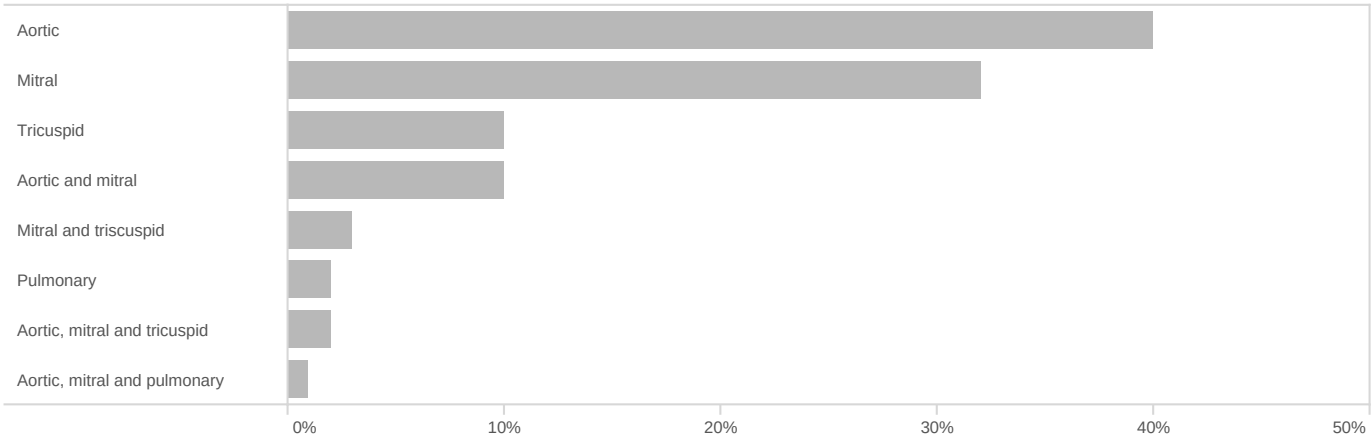


Figure 4: Infective endocarditis cases by type of valve

Table 3: Infective endocarditis valve surgery cases by type of valve

Valve type	n (%)
Aortic	40 (40.0)
Mitral	32 (32.0)
Tricuspid	10 (10.0)
Aortic and mitral	10 (10.0)
Mitral and tricuspid	3 (3.0)
Aortic, mitral and tricuspid	2 (2.0)
Pulmonary	2 (2.0)
Aortic, mitral and pulmonary	1 (1.0)
ALL	**100 (100.0)**

Table 4: Valve surgery procedures by valve type

Procedure type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	ALL n (%)
Repair	1 (1.9)	14 (29.2)	7 (46.7)	0 (0.0)	22 (18.5)
Replacement	52 (98.1)	34 (70.8)	8 (53.3)	2 (66.7)	96 (80.7)
Inspection only	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)	1 (0.8)
ALL	**53 (100.0)**	**48 (100.0)**	**15 (100.0)**	**3 (100.0)**	**119 (100.0)**

27.3 Comorbidities

Heart failure is a frequent clinical complication of infective endocarditis and a very common surgical indication.[20] The 2017 cohort included 22% patients with congestive heart failure at the time of operation. Of these patients, 82% were defined as NYHA Class III or above. Overall, 21% of patients had some degree of left ventricular systolic dysfunction.

The analysis was not able to determine the subset of patients who are current or reformed self-administered intravenous drug users (IVDU) due to insufficient data capture.

Table 5: Selected comorbidities for patients undergoing valve intervention for infective endocarditis

Comorbidity	n (%)
Cardiogenic shock	6 (5.9)
Arrhythmia	28 (27.5)
Atrial	26 (25.5)
Heart block	1 (1.0)
Ventricular	1 (1.0)
Inotrope requirement	3 (2.9)
Diabetes	20 (19.6)
Renal failure*	54 (52.9)
Severe renal dysfunction†	5 (4.9)
Cerebrovascular accident	19 (18.6)
Intravenous drug use‡	N/A
Current	N/A
Previous	N/A
Congestive heart failure	22 (21.6)
NYHA Class I	1 (4.5)
NYHA Class II	3 (13.7)
NYHA Class III	11 (50.0)
NYHA Class IV	7 (31.8)
Left ventricular systolic dysfunction	22 (21.6)
Mild (LVEF 40–50%)	16 (15.7)
Moderate (LVEF 30–39%)	4 (3.9)
Severe (LVEF <30)	2 (2.0)

* eGFG ≤89mL/min/1.73m^2

† Pre operative creatinine >200µmol

‡ Insufficient data for analysis

27.4 Microbiology

74 cases were classified as involving an active infection. Where clinical detail was available, the most common organism was methicillin-sensitive Staphylococcus aureus (MSSA) which accounted for 42%.

Of these 72 analysed active cases, 67% were native valve endocarditis with the remainder involving valvular prostheses. Detail regarding microbiology investigations were obtained by utilising other applications, revealing a possible enhancement for future data collections. Further to this, the aetiology of infection is a useful data element to capture, further assisting in analyses and identification of trends in patient presentation.

Table 6: Infective endocarditis cases by infection status

Status	n (%)
Active	74 (72.5)
Treated	28 (27.5)
Total	**102 (100.0)**

Table 7: Active infective endocarditis cases by organism type

Organism	n (%)
MSSA	30 (41.7)
Streptococcus	16 (22.2)
Enterococcus	10 (13.9)
Other	10 (13.9)
Staphylococcus (other)	6 (8.3)
Total	**72 (100.0)**

Excludes missing data (n=2)

Table 8: Active infective endocarditis cases by native versus prosthetic valve

Status	n (%)
Native	48 (66.7)
Prosthetic	24 (33.3)
Total	**72 (100.0)**

Excludes missing data (n=2)

27.5 Patient outcomes

An unadjusted 30-day all-cause mortality rate of 9% was observed for all procedures. Prosthetic valve endocarditis carried a mortality rate of 25% compared to 8% of native valve infective endocarditis.

Table 9: All cause 30 day mortality by infection status and native versus prosthetic valve

Infection status		Total cases (n)	Mortality n (%)
Active		74	9 (12.2)
	Native	49	4 (8.2)
	Prosthetic	25	5 (25.0)
Treated		28	0 (0.0)
ALL		**102**	**9 (8.8)**

27.6 Discussion

There are several points to highlight from this data.

As this is a surgically treated group of patients, and one indication for surgery is heart failure, the data reflects this with 82% of patients in significant heart failure, with NYHA heart failure III and above. The surgery performed often involves multiple valves (18%), again a marker of the severity of this condition.

A particular subset of patients is those who have had cardiac surgery previously in which prosthetic material was used to either repair or replace a heart valve or other structures. This foreign material, essential to their first operation, can become infected later in life and require redo-surgery. Prosthetic valve endocarditis is a particularly challenging and high-risk situation when compared to native valve endocarditis, as demonstrated by the marked postoperative mortality in this group of 25%. To put this in context of the larger report and the community, there were close to a thousand valve operations in this year alone, in addition to all the patients in the community who have had valve operations in previous years, but only 28 operations for infected prosthetic valves. Thus, the risk of infecting a prosthetic valve is very low, but if that infection requires surgery, patients face a very high risk of death.

As expected, patients with active infection at the time of surgery have a higher mortality than those who have had their infections resolve with antibiotics prior to surgery. If the clinical situation indicates surgery is needed prior to the infection being controlled, or indeed surgery is needed to control the infection because antibiotics alone are insufficient, then those patients have a more severe degree of infection and have a higher risk of death.

Endocarditis is a bloodstream infection, in which there is an entry of bacteria into the bloodstream and carriage to the heart. Thus, it can be associated with other sites of infection, such as skin wounds or spinal infections, and with procedures, such as dental extractions or endoscopies in which bacteria can enter the bloodstream. It can also be associated with illicit intravenous drug use, making this condition relevant to legislators and public health policy. Inserting needles into veins requires clean techniques to minimise the risk of introducing bacteria into the bloodstream.

Illicit administration is often inadequately clean, resulting in the introduction of bacteria, and is often a repeated behaviour, and hence repeated exposure. The registry team were able to identify at least 17 cases of documented IVDU, but whether this is remote or current is not clear, there can be no conclusions drawn about the range of aetiologies, nor where efforts can be focused, if at all.

We can see from the analysis that there are two peaks of endocarditis. The young person under the age of 40, and those in the 70 to 75-year age group. Without data on the aetiology of endocarditis, we cannot explain this distribution. Again, amendments to the dataset will help explain this distribution with data.

Electrophysiology and Pacing Audit

28 Message from the QCOR Electrophysiology and Pacing Committee Chair

The 2017 QCOR report expands to include for the first time data profiling demographics, activity and quality related to cardiac electrophysiology and pacing procedures in Queensland Health (QH) patients. This branch of cardiology practice has evolved to be responsible for, *inter alia*, significant and increasing rates of cardioverter/defibrillator (ICD) implants for prevention of sudden cardiac death, more complex time-consuming bi-ventricular pacing (otherwise known as cardiac resynchronisation therapy, CRT) procedures for heart failure patients, complex and increasingly numerous ablation procedures for atrial fibrillation (AF) and ventricular tachycardia (VT), an increasing demand for sophisticated pacemaker and ICD lead extraction techniques and deployment of technologies for remote monitoring of pacemaker and ICD patients. The advent of implantable loop recorders (ILRs) two decades ago provided the most valuable tool for diagnosis of the arrhythmic mechanism of unexplained syncope. Recently the introduction of an additional medical benefit schedule item number for ILR implant in the investigation of cryptogenic stroke has resulted in a very large increase in demand for these devices. In the background, increasing numbers of *curative* ablation interventions for (non-AF) supraventricular tachycardias continue to remove patients from QH care and increasing numbers of pacemaker interventions continue to enhance the lives of QH patients.

Increases in demand for and numbers of device and electrophysiological procedures will continue to be driven by an increasing, aging population with improved survival of other cardiovascular procedures, by adverse lifestyle trends and by technological advances. Authoritative activity and quality mapping is therefore mandatory for guidance of planning to address adequately these inescapable facts.

This initial data represents a snapshot of procedures in 2017; future reports will enable analysis of procedural success over time. The snapshot itself contains incomplete data by reason of logistics and some variation by site in completeness of data, but these issues will resolve as future reports are compiled.

The scope of this report builds substantially on activity data published previously by the Electrophysiology Working Group[21], which is developing clinical indicators for benchmarking of many aspects of procedures. Future analysis guided by these indicators will yield very important learnings about the journeys of QH patients who undergo procedures for heart rhythm disorders. Quality and performance metrics will naturally include assessment of waiting periods for procedures.

In the generation of this report, I wish to acknowledge the hard work of QCOR administrative staff, the indefatigable cardiac scientists who formulated the database, and the fortitude, confidence and cooperation of my clinical colleagues. Those qualities are traditional hallmarks of those who work in heart rhythm management.

Associate Professor John Hill
Chair
QCOR Electrophysiology and Pacing Committee

29 Key findings

This 2017 inaugural Queensland Electrophysiology and Pacing audit describes baseline demographics, risk factors, procedures performed and outcomes for an incomplete year of data collection.

Key findings include:

- Across Queensland, 7 public sites contributed data with staggered commencement dates for these data collections.
- 3,134 electrophysiology and pacing cases were performed across the 7 participating public Queensland sites including 2,131 device procedures and 889 electrophysiology procedures.
- The majority of all patients were aged over 60 years (57%) with a median age of 68 years.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 3.9%.
- The vast majority of patients (70%) were classed as having an unhealthy body mass index (BMI) of greater than 30kg/m^2.
- The majority of procedures (52%) were classified as high urgency procedures that are clinically indicated within 30 days.
- Outpatient procedures accounted for 54% of all cases.
- 519 standard electrophysiology procedures were performed with a further 370 complex procedures undertaken utilising three-dimensional mapping technology and/or involving pulmonary vein isolation.
- Radiofrequency ablation was employed in the vast majority of ablation cases (91%).
- Cavo-tricuspid isthmus (atrial flutter), pulmonary veins (atrial fibrillation) and atrioventricular node slow pathway ablations accounted for 80% of all ablation cases.
- The most frequently ablated supraventricular arrhythmia was atrial fibrillation accounting for 28% of all cases with ventricular tachycardia making up 54% of all ventricular arrhythmia ablations.
- The statewide aggregate for all device procedure complications was 4.6%, while all electrophysiology procedures had a 2.6% complication rate overall.

30 Participating sites

In 2017, there were eight public electrophysiology and pacing units spread across metropolitan and regional Queensland. Seven 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 2018.

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

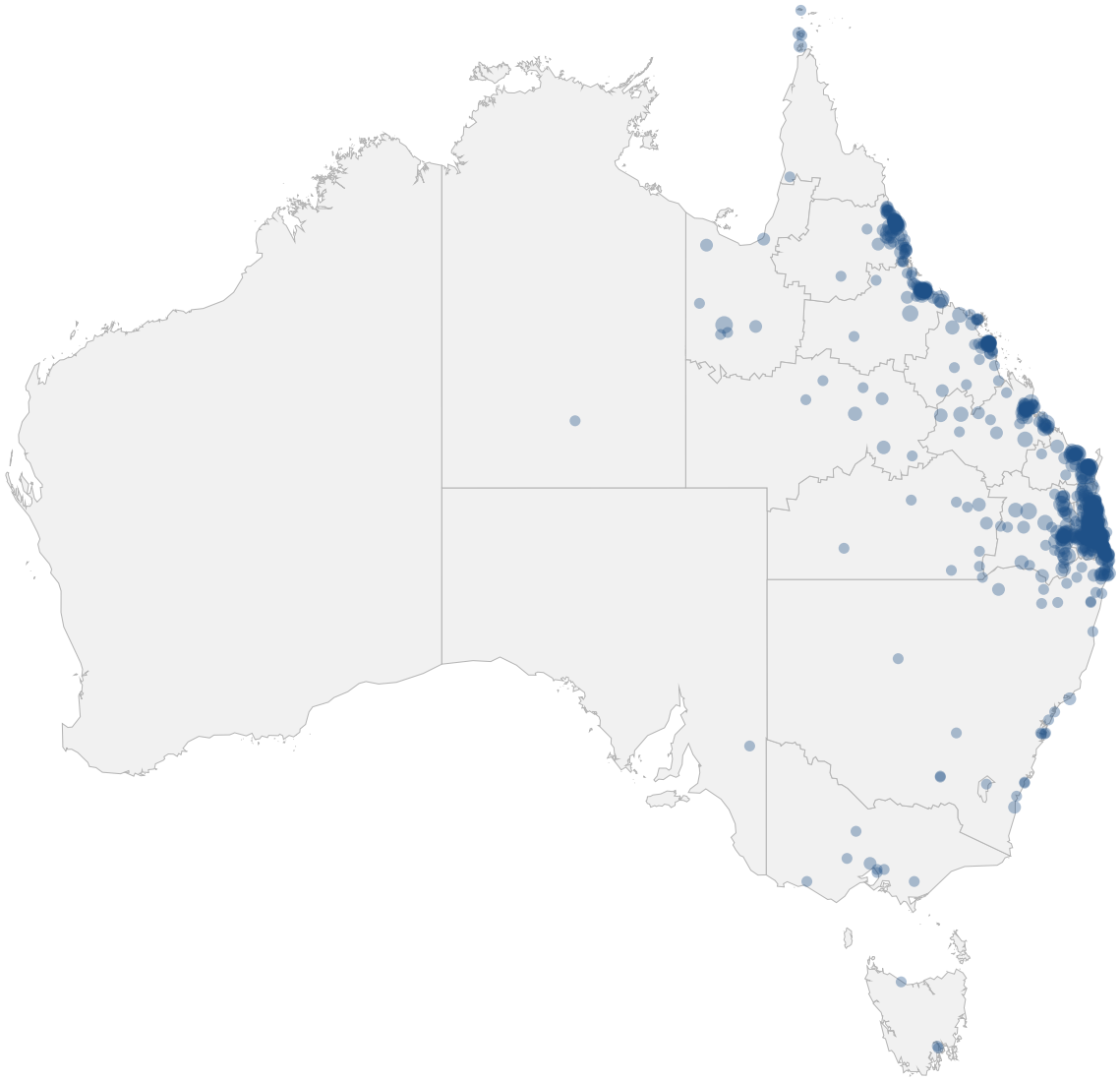


Figure 1: Electrophysiology and pacing cases by residential postcode

Table 1: Participating sites

Site number	Site name	Date commenced	Location	Acronym
1	Cairns Hospital	5 April 2017	Regional	CH
2	The Townsville Hospital	3 April 2017	Regional	TTH
3	Mackay Base Hospital	26 April 2017	Regional	MBH
4	Sunshine Coast University Hospital	6 July 2017	Regional	SCUH
5	The Prince Charles Hospital	11 January 2017	Metropolitan	TPCH
6	Royal Brisbane and Women's Hospital	3 April 2017	Metropolitan	RBWH
7	Princess Alexandra Hospital	9 January 2017	Metropolitan	PAH

Gold Coast University Hospital commenced direct data entry 29 January 2018

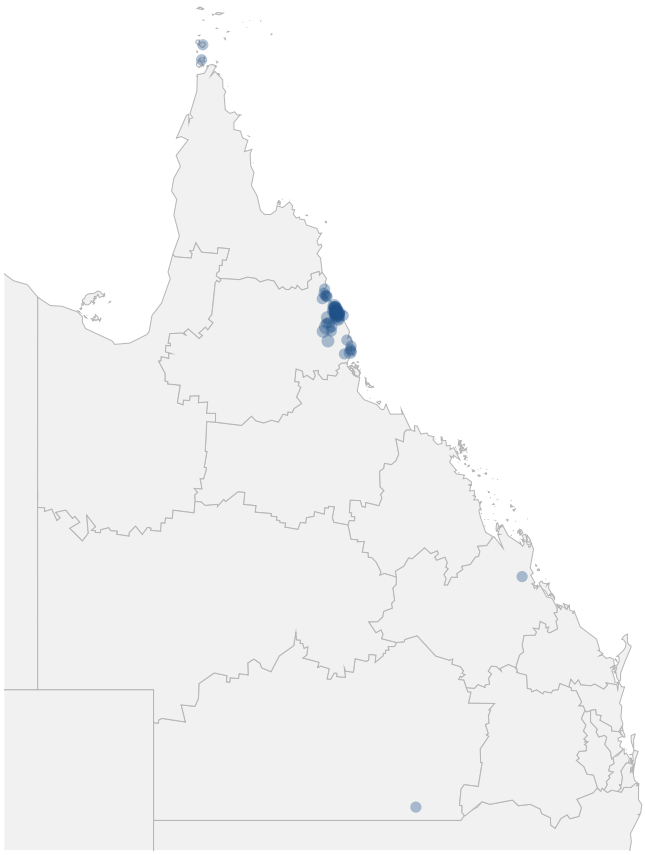


Figure 2: Cairns Hospital

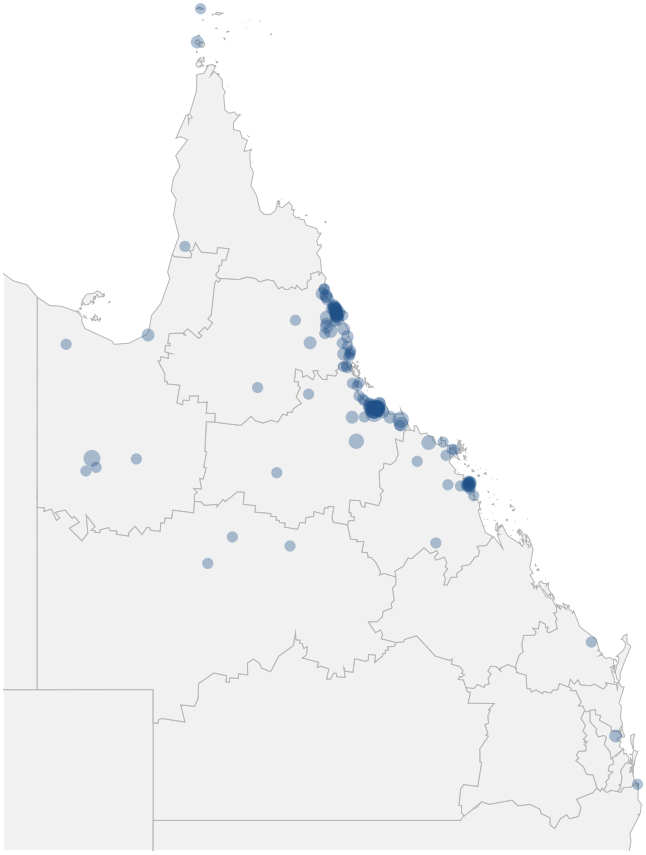


Figure 3: The Townsville Hospital

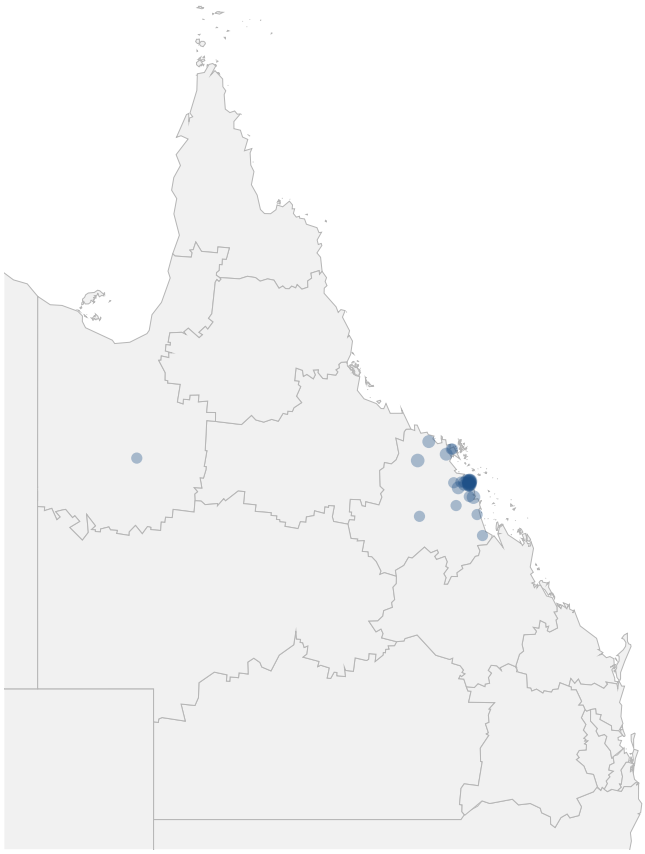


Figure 4: Mackay Base Hospital

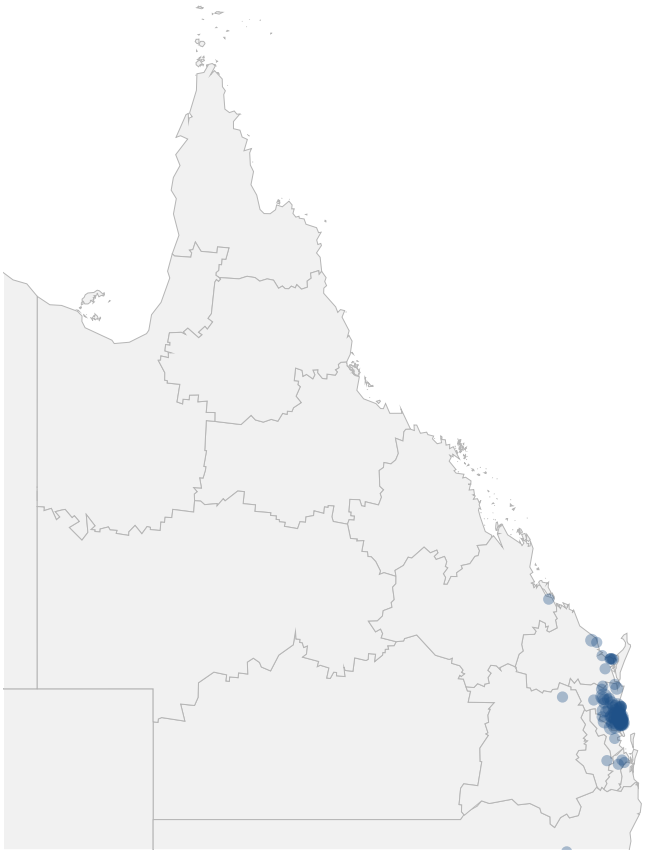


Figure 5: Sunshine Coast University Hospital

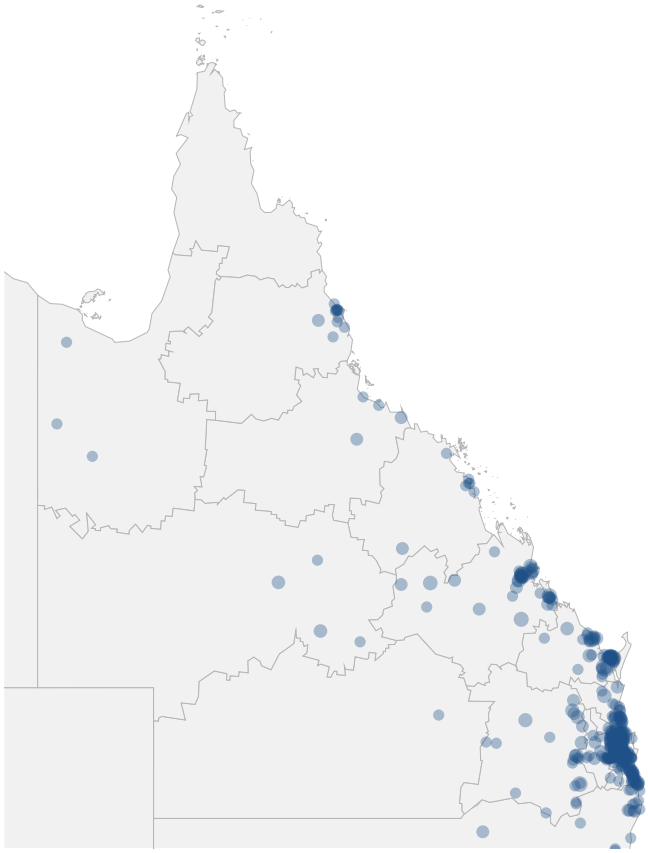


Figure 6: The Prince Charles Hospital

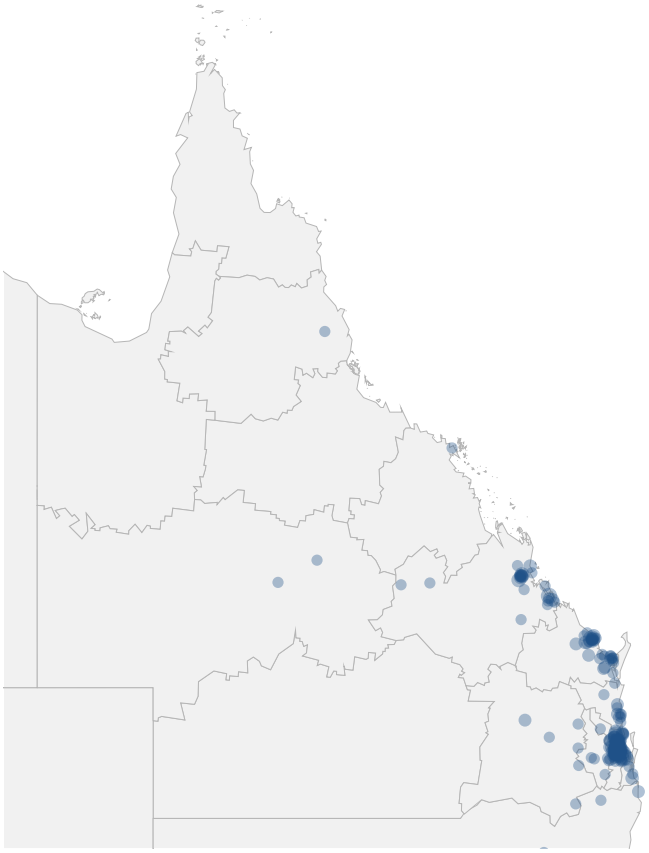


Figure 7: Royal Brisbane & Women's Hospital

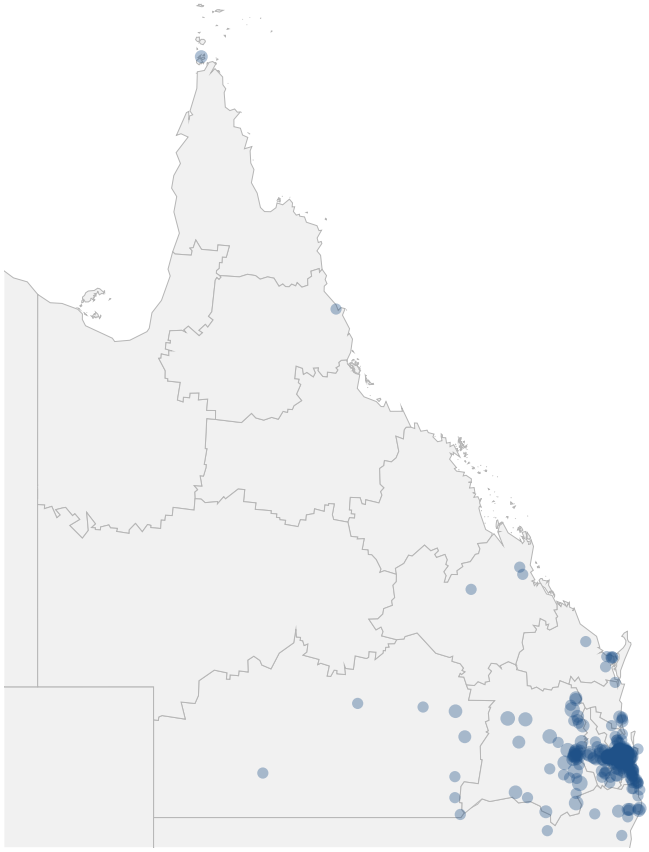


Figure 8: Princess Alexandra Hospital

31 Case totals

31.1 Total cases

In 2017, 3,134 electrophysiology and pacing procedures were documented using the Queensland Cardiac Outcomes Registry Electrophysiology and Pacing application. This number does not reflect the overall case totals as uptake of this new application was staggered across 2017.

Table 2: Total cases by category

Procedure combination	Total cases n (%)	Category
Cardiac device procedure	2,112 (67.4)	Device
Cardiac device procedure + EP study	16 (0.5)	
Cardiac device procedure + drug challenge	2 (0.1)	
Cardiac device procedure + EP study + ablation	1 (<0.1)	
EP study + ablation	554 (17.7)	EP
EP study	236 (7.5)	
Ablation	70 (2.2)	
EP study + ablation + cardioversion	20 (0.6)	
EP study + drug challenge	5 (0.2)	
EP study + cardioversion	4 (0.1)	
Cardioversion	73 (2.3)	Other
Drug challenge	29 (0.9)	
Other procedure	11 (0.4)	
Cardioversion + other procedure	1 (<0.1)	
ALL	**3,134 (100.0)**	

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

31.2 Cases by category

The majority of cases performed were cardiac device procedures accounting for approximately two-thirds (68%) of documented procedures. The remainder of cases were electrophysiology and ablation procedures (28%) with the remainder categorised as other procedures (4%).

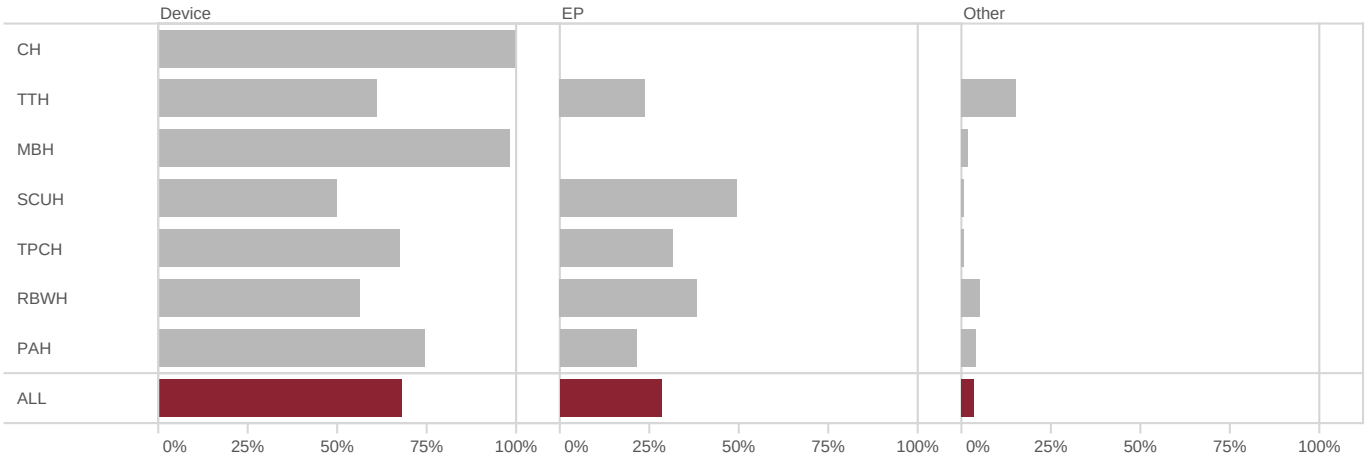


Figure 9: Proportion of cases by site and category

Table 3: Proportion of cases by case category

SITE	Cardiac Device Procedure n (%)	EP n (%)	Other n (%)	Total n (%)
CH	112 (100.0)	-	-	112 (3.6)
TTH	208 (61.2)	81 (23.8)	51 (15.0)	340 (10.8)
MBH	60 (98.4)	-	1 (1.6)	61 (1.9)
SCUH	103 (50.2)	101 (49.3)	1 (0.5)	205 (6.5)
TPCH	781 (67.8)	363 (31.5)	8 (0.7)	1,152 (36.8)
RBWH	238 (56.7)	161 (38.3)	21 (5.0)	420 (13.4)
PAH	629 (74.5)	183 (21.7)	32 (3.8)	844 (26.9)
ALL	**2,131 (68.0)**	**889 (28.4)**	**114 (3.6)**	**3,134 (100.0)**

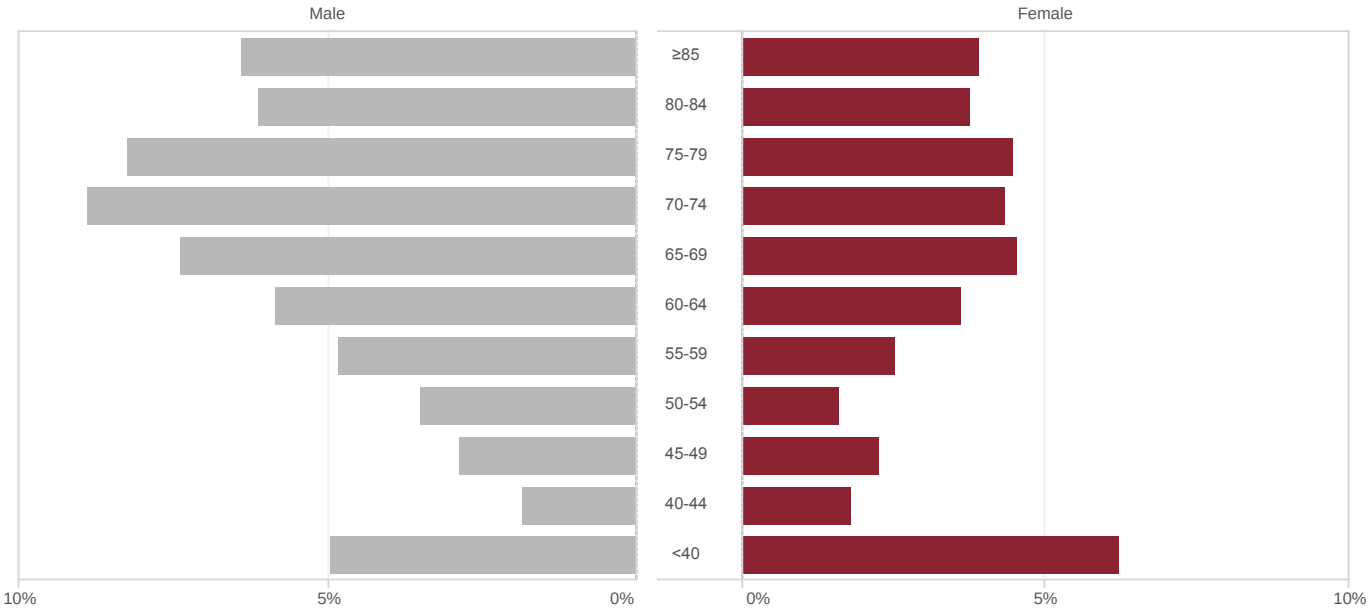
Case totals do not reflect all activity due to incomplete year of data acquisition

32 Patient characteristics

32.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. The majority of patients were aged 60 years and above (57%). The median age of the overall electrophysiology and pacing patient cohort was 68 years of age.

Males had a higher median age of 69 years of age compared to females with a median age of 66 years. The median age of patients undergoing electrophysiology procedures was 57 years compared to 72 years for the cardiac device procedure category.



% of total (n=3,134)

Figure 10: Proportion of all cases by age group and gender

The median age of the overall electrophysiology and pacing patient cohort was 68 years of age. Males had a higher median age of 69 years of age compared to females with a median age of 66 years. The median age of patients undergoing electrophysiology procedures was 57 years compared to 72 years for the cardiac device procedure category.

Table 4: Median age by gender and case category

	Total cases (n)	Female (years)	Male (years)	ALL (years)
Device	2,131	72	72	72
EP	889	50	59	57
Other	114	60	59	60
ALL	**3,134**	**66**	**69**	**68**

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

Overall, 61% of patients were male with all procedure categories demonstrating this trend also. The largest proportion of females was represented in the electrophysiology category (45%).

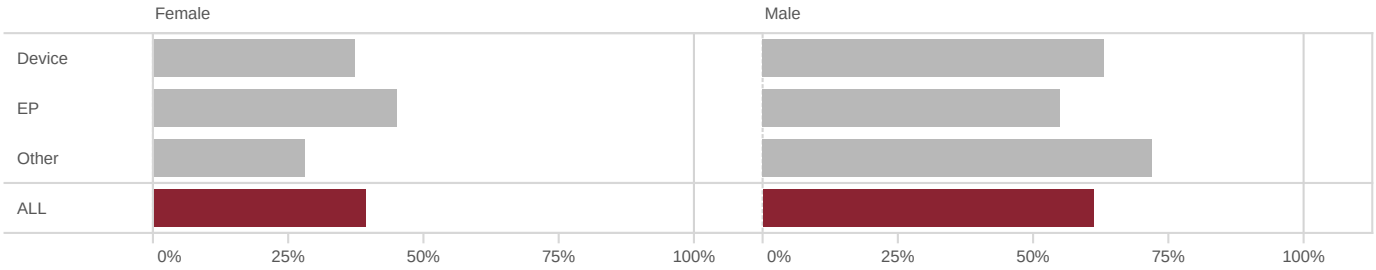


Figure 11: Proportion of cases by gender and category

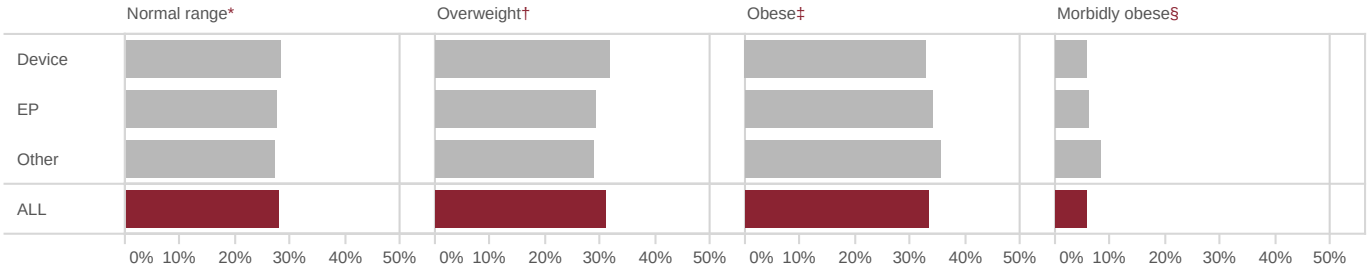
Table 5: Proportion of cases by gender and category

	Total cases (n)	Female n (%)	Male n (%)
Device	2,131	790 (37.1)	1,341 (62.9)
EP	889	400 (45.0)	489 (55.0)
Other	114	32 (28.3)	82 (71.7)
ALL	**3,134**	**1,222 (39.0)**	**1,912 (61.0)**

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

32.2 Body mass index

Patients classed as having a body mass index (BMI) category of overweight (31%), obese (33%) or morbidly obese (6%) represented slightly less than three quarters of electrophysiology and pacing patients. Patients classed as underweight represented 2% of all cases.



* 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 12: Proportion of cases by BMI and case category

32.3 Aboriginal and Torres Strait Islander status

Overall, the proportion of identified Aboriginal and Torres Strait Islander patients undergoing electrophysiology and pacing procedures was 3.9%. This correlates closely to the estimated proportion of Aboriginal and Torres Strait Islander persons within Queensland (4.0%)[3]. There was large variation between units, with the North Queensland sites seeing a larger proportion of Aboriginal and Torres Strait Islander patients (Figure 13).

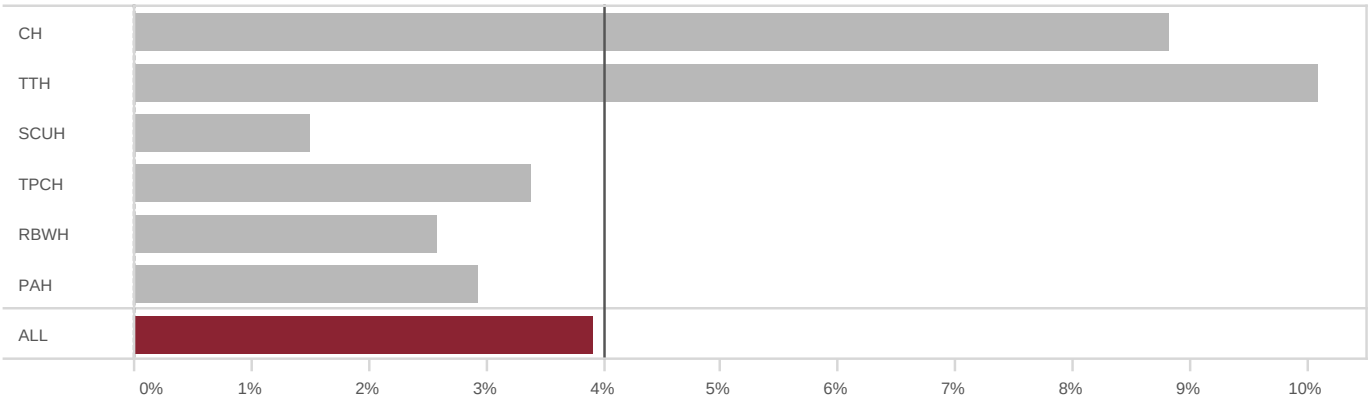
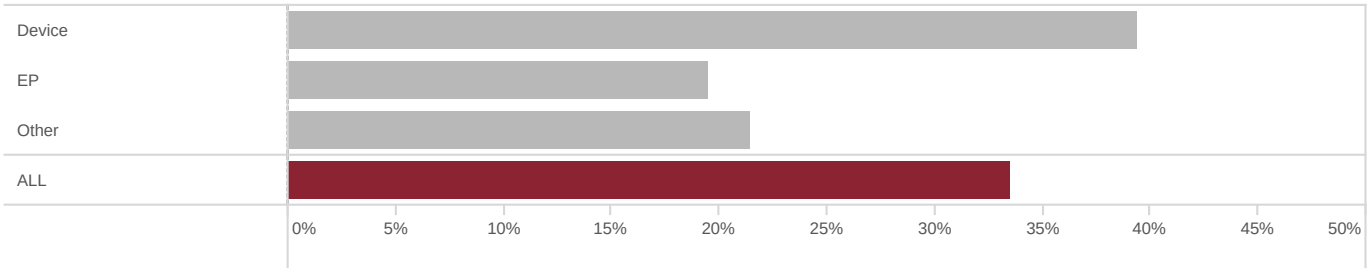


Figure 13: Proportion of cases by identified Aboriginal and Torres Strait Islander status and site

33 Risk factors and comorbidities

33.1 Coronary artery disease

Close to 40% of device patients have reported previous coronary artery disease with that figure almost halving among the electrophysiology patients.

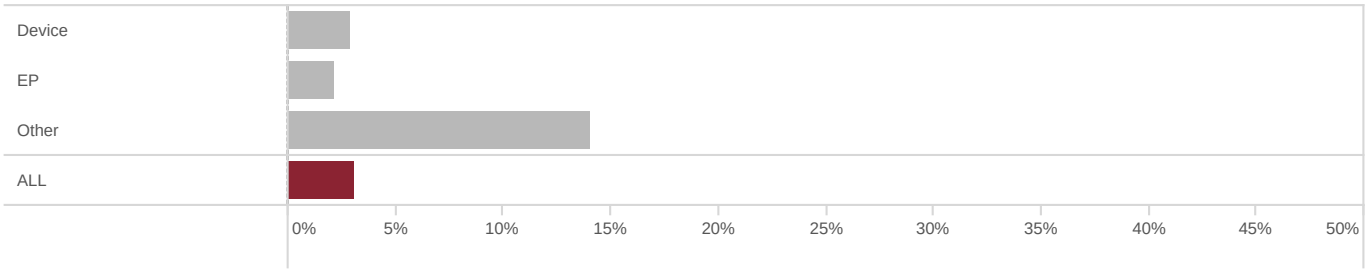


Excludes missing data (17%)

Figure 14: Proportion of cases by coronary artery disease history and case category

33.2 Family history of sudden cardiac death

During the surveyed period, 14% of patients with a family history of sudden cardiac death underwent other procedures. Overall, 75% of these patients had a drug challenge investigation performed.

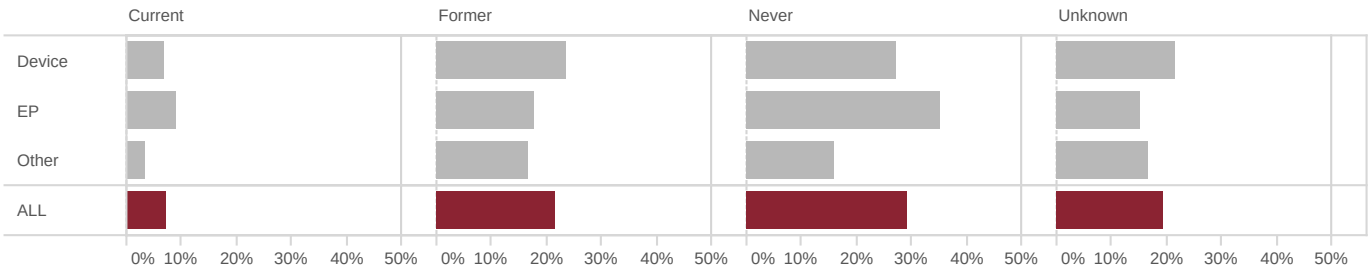


Excludes missing data (22%)

Figure 15: Proportion of cases by sudden cardiac death history and case category

33.3 Smoking history

Overall, 29% of patients had a history of tobacco use, including 7% being current smokers and 22% former smokers. 29% reported never having smoked and 19% had an unknown smoking history.

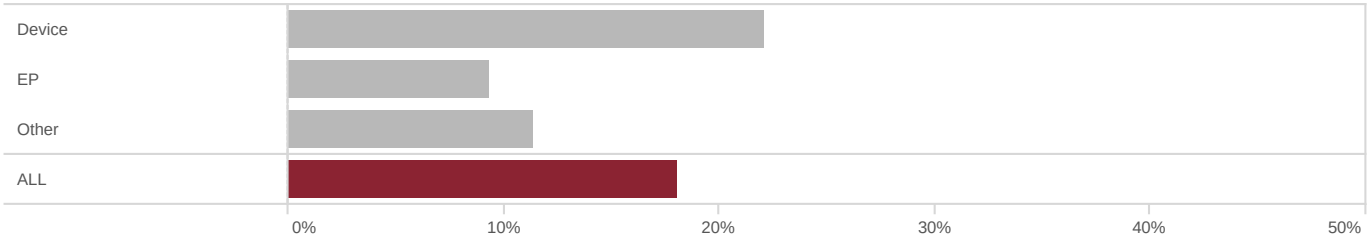


Excludes missing data (23%)

Figure 16: Proportion of cases by smoking status and case category

33.4 Diabetes

The prevalence of diabetes was highest in the cardiac device procedure group, with 22% of patients known to be diabetic. 18% of the overall cohort had some form of diabetes under treatment.

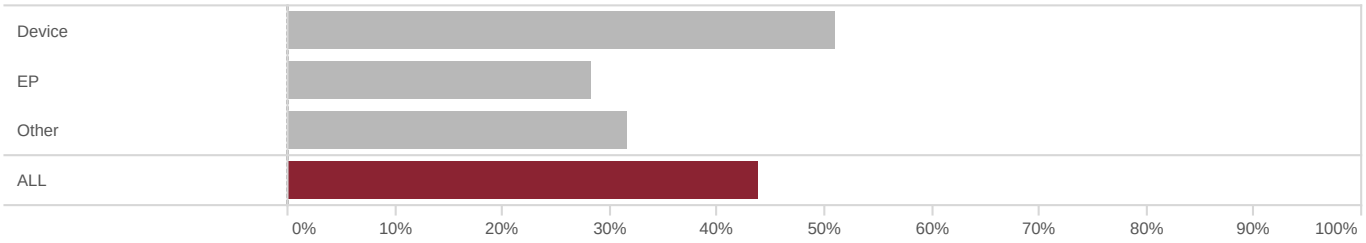


Excludes missing data (21%)

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

33.5 Hypertension

Hypertension, defined as receiving antihypertensive medications at the time of case, was present in over 44% of patients irrespective of case type. Patients in the cardiac device procedure category had a greater incidence of hypertension (51%).

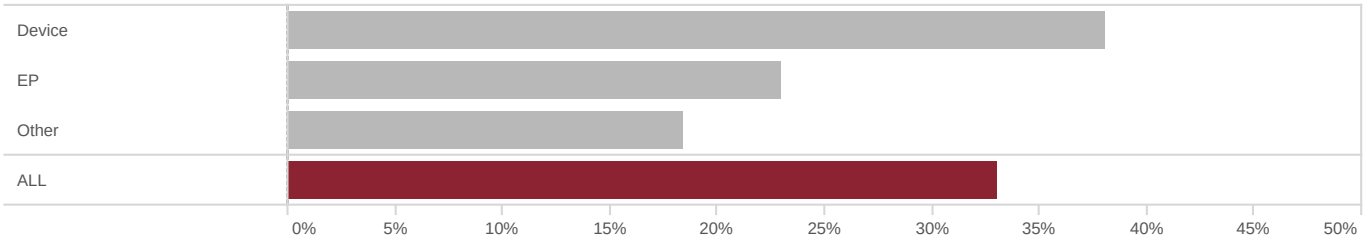


Excludes missing data (19%)

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

33.6 Dyslipidaemia

Overall, 33% of patients were treated with statins for dyslipidaemia at the time of case, ranging from 38% for device procedures to 23% in the electrophysiology category.

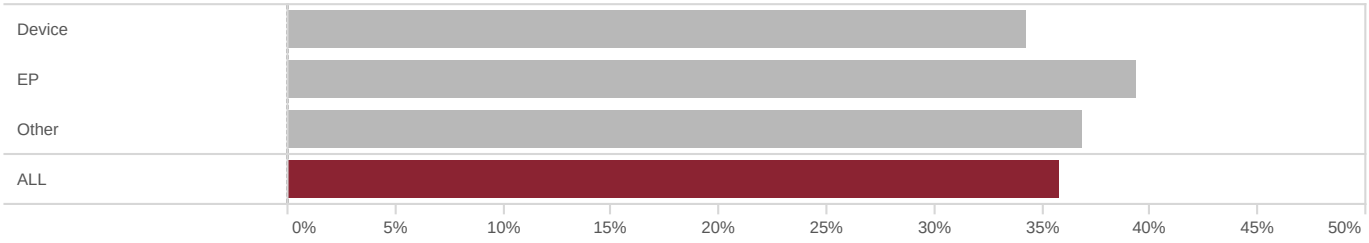


Excludes missing data (21%)

Figure 19: Proportion of cases by dyslipidaemia history status and case category

33.7 Atrial arrhythmia history

Overall, 36% of patients had a history of an atrial arrhythmia (atrial fibrillation, flutter or other atrial arrhythmia) at the time of case, ranging from 34% for device procedures to 39% in the electrophysiology category.

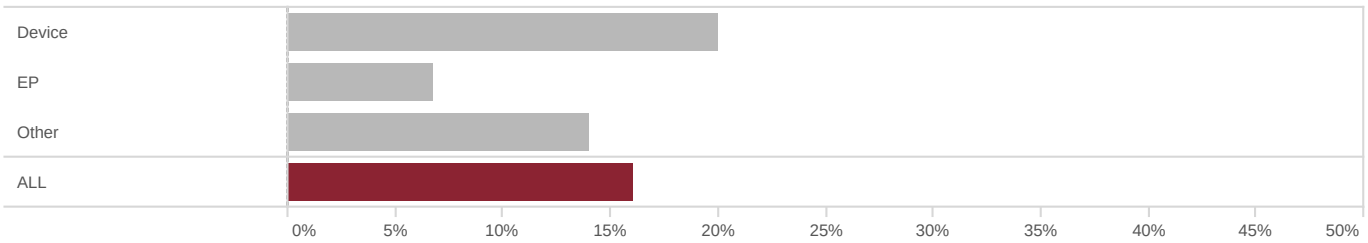


Excludes missing data (20%)

Figure 20: Proportion of cases by atrial arrhythmia history status and case category

33.8 Heart failure

Overall, 16% of patients had a classification of heart failure at the time of case, ranging from 20% for device procedures to 7% in the electrophysiology category.

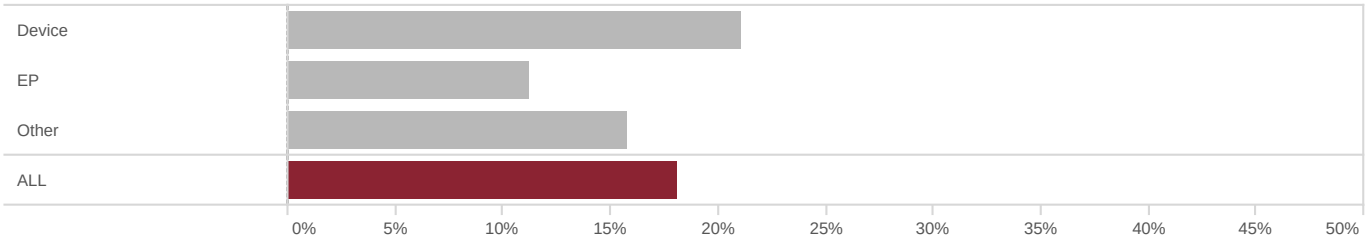


Excludes missing data (24%)

Figure 21: Proportion of cases by heart failure history status and case category

33.9 Valvular heart disease

18% of patients had a history of valvular heart disease at the time of case, ranging from 21% for device procedures to 11% in the electrophysiology category.

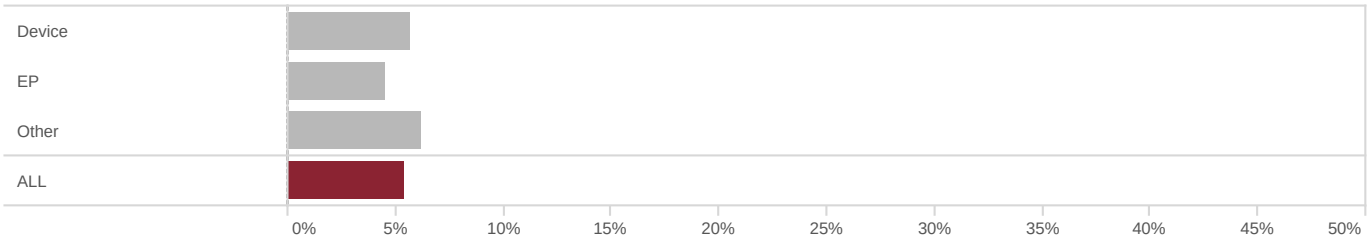


Excludes missing data (23%)

Figure 22: Proportion of cases by valvular heart disease history and case category

33.10 Other cardiovascular disease and co-morbidities

Overall, 5% of patients had a form of other cardiovascular (CV) disease or co-morbidity at the time of case, ranging from 6% for device procedures to 5% in the electrophysiology category.



Excludes missing data (28%)

Figure 23: Proportion of cases by CV disease history/co-morbidity and case category

33.11 Renal impairment

Across the state, 15% of all patients were identified as having impaired renal function (eGFR ≤89 mL/min/1.73 m^2) at the time of their case. Of these patients, the device procedure group had the highest incidence of renal impairment.

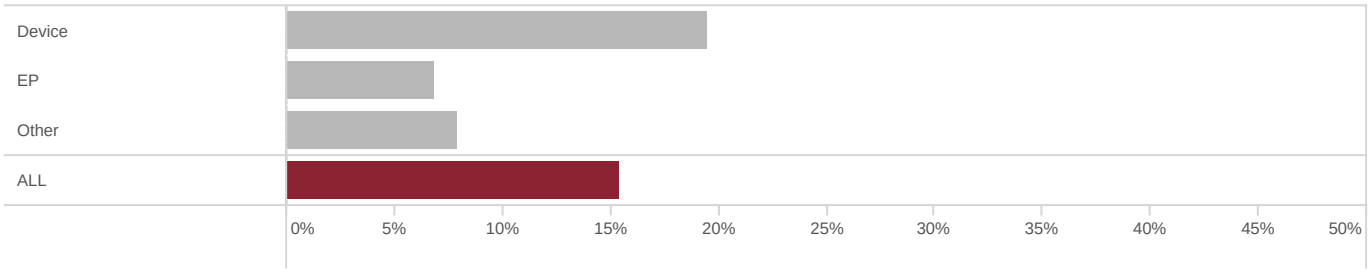


Figure 24: Proportion of cases by renal impairment status and case category

33.12 Anticoagulation

Patients identified as being anticoagulated using either warfarin or non-vitamin K antagonist oral anticoagulants (NOAC) at the time of case made up 29% of the total cohort. Of these, patients in the other procedure category had the highest use of anticoagulants followed by those in the electrophysiology category.

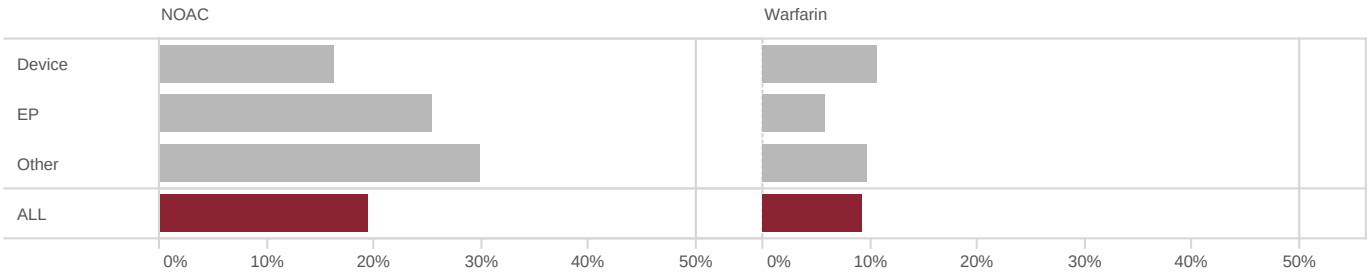
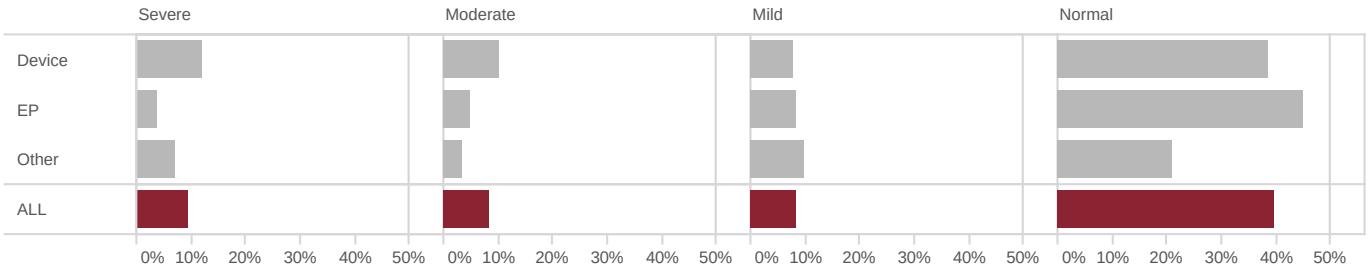


Figure 25: Proportion of cases by anticoagulation status and case category

33.13 LV function

Overall, 39% of patients were classed as having an impaired left ventricular ejection fraction (LVEF), including 12% with mild LV dysfunction (LVEF between 40%–50%), 13% with moderate LV dysfunction (LVEF between 30%–39%) and 14% with severe LV dysfunction (LVEF less than 30%).



Excludes missing data (34%)

Figure 26: Proportion of cases by LV function category and case category

34 Care and treatment of patients

34.1 Urgency category

Urgency categories are based on the time frame 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 27% to 65%. Further disparity was noted within category three, with statewide variation noted from as little as 5% of case volume through to 48%.

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

	Total cases (n)	Category 1* n (%)	Category 2† n (%)	Category 3‡ n (%)
CH	112	49 (43.8)	50 (44.6)	8 (7.1)
TTH	340	133 (39.1)	33 (9.7)	4 (1.2)
MBH	61	39 (63.9)	13 (21.3)	2 (3.3)
SCUH	211	57 (27.8)	36 (17.6)	90 (43.9)
TPCH	1154	749 (65.0)	258 (22.4)	112 (9.7)
RBWH	420	145 (34.5)	68 (16.2)	202 (48.1)
PAH	844	466 (55.2)	172 (20.4)	138 (16.4)
ALL	**3,134**	**1,638 (52.3)**	**630 (20.1)**	**556 (17.7)**

Includes missing data 9.9%

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

* Procedures that are clinically indicated within 30 days

† Procedures that are clinically indicated within 90 days

‡ Procedures that are clinically indicated within 365 days

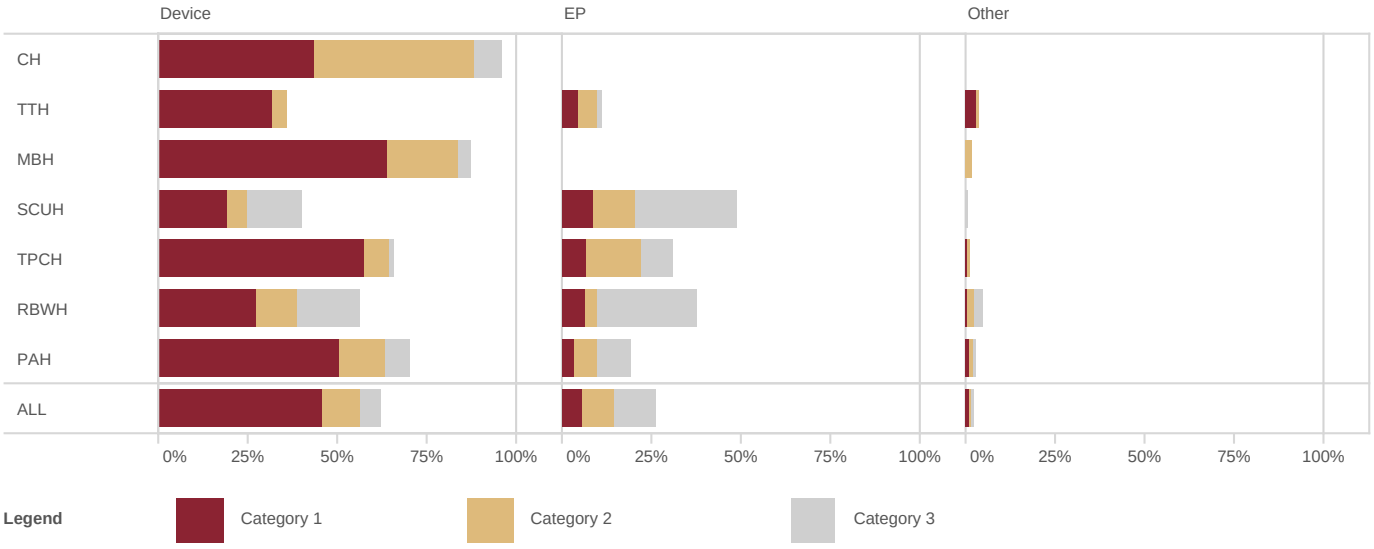


Figure 27: Proportion of all cases by urgency category, procedure category and site

34.2 Admission source

The majority of all cases were performed on patients classed as outpatients. CH and TTH were the only sites to perform more inpatient procedures than outpatient. Non-admitted inter-hospital transfers accounted for less than 1.0% of all case volume.

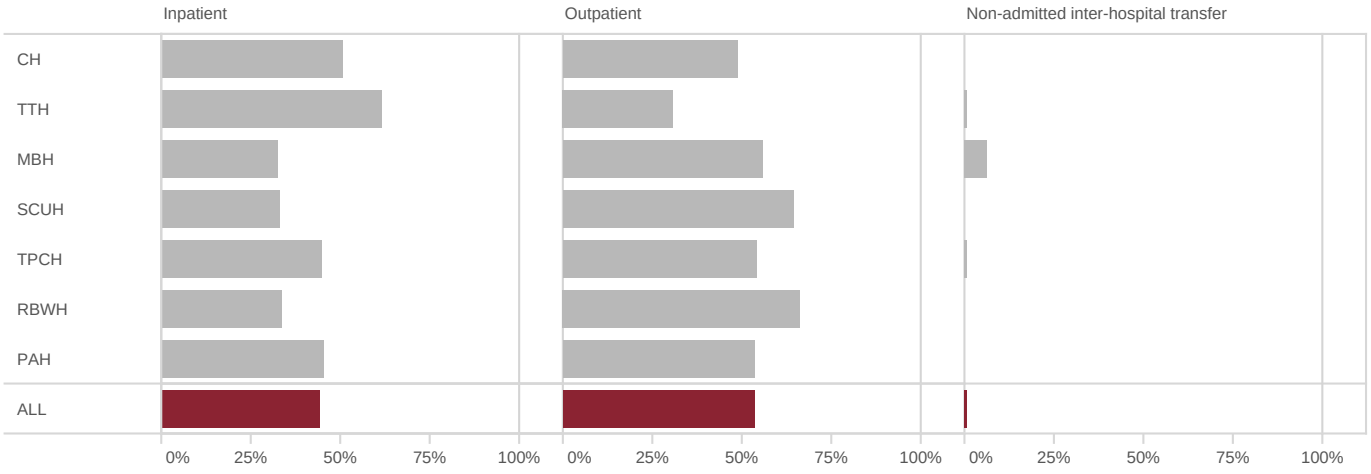


Figure 28: Admission source by site

Table 7: Admission source by site

	Total cases (n)*	Outpatient n (%)	Inpatient n (%)	Non-admitted inter-hospital transfer n (%)
CH	112	55 (49.1)	57 (50.9)	-
TTH	340	106 (31.2)	210 (61.8)	1 (0.3)
MBH	61	34 (55.7)	20 (32.8)	4 (6.6)
SCUH	205	133 (64.9)	68 (32.2)	-
TPCH	1152	626 (54.3)	515 (44.7)	10 (0.9)
RBWH	420	278 (66.2)	142 (33.8)	-
PAH	844	454 (53.8)	384 (45.4)	-
ALL	**3,134**	**1,686 (53.8)**	**1,396 (44.5)**	**15 (0.5)**

* Includes missing data 1.2%

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

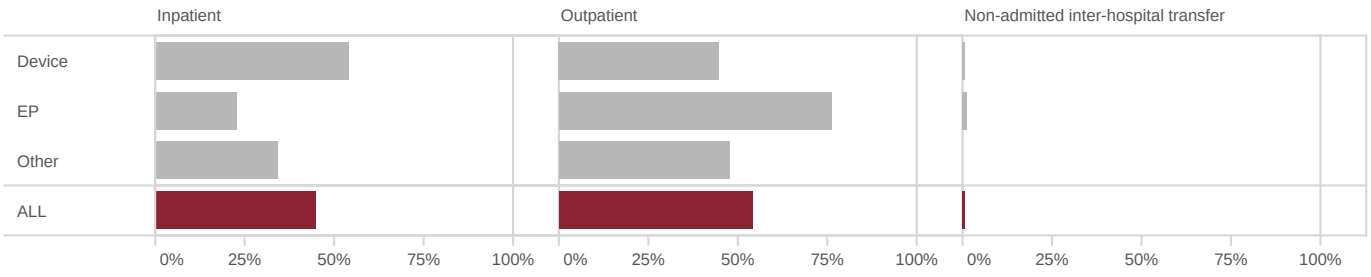


Figure 29: Admission source by case category

34.3 Admission source and urgency category

Category one procedures accounted for the majority of both 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. Outpatient procedures demonstrated almost 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	55	11 (20.0)	34 (61.8)	8 (14.5)
TTH	106	46 (43.4)	24 (22.6)	3 (2.8)
MBH	34	17 (50.0)	12 (35.3)	1 (2.9)
SCUH	139	1 (0.7)	35 (25.2)	95 (68.3)
TPCH	627	291 (46.4)	217 (34.6)	99 (15.8)
RBWH	278	22 (7.9)	58 (20.9)	193 (69.4)
PAH	454	158 (34.8)	143 (31.4)	109 (24.0)
ALL	**1,686**	**546 (32.3)**	**523 (30.9)**	**508 (30.0)**

* Includes 6.9% missing data

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

Table 9: Inpatient cases by urgency category

Inpatient site	Total cases (n)*	Category 1 n (%)	Category 2 n (%)	Category 3 n (%)
CH	57	38 (66.7)	16 (28.1)	-
TTH	210	85 (40.5)	9 (4.3)	1 (0.5)
MBH	20	17 (85.0)	1 (5.0)	-
SCUH	68	55 (80.9)	1 (1.5)	1 (1.5)
TPCH	515	456 (88.5)	35 (6.8)	11 (2.1)
RBWH	142	123 (86.6)	10 (7.0)	9 (6.3)
PAH	384	307 (79.9)	29 (7.6)	29 (7.6)
ALL	**1,396**	**1,081 (77.4)**	**101 (7.2)**	**51 (3.7)**

* Includes 11.7% missing data

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

34.4 Device procedures

Case types and procedure combinations varied across the state and relates primarily to services provided by individual sites. Single and dual chamber pacemaker implants/generator changes accounted for the majority of cases across the state. In 2018, 5 sites across the state offered biventricular pacemaker (BiV)/ implantable cardioverter defibrillator (ICD) implants 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	75 (67.0)
	Loop recorder implant/explant	32 (28.6)
	Device explant	3 (2.7)
	Lead revision/replacement/pocket revision	2 (1.8)
TTH	Pacemaker implant/generator change	87 (41.8)
	ICD implant/generator change/upgrade	78 (37.5)
	BiV ICD implant/generator change/upgrade	15 (7.2)
	Loop recorder implant/explant	13 (6.3)
	Lead revision/replacement/pocket revision	7 (3.4)
	Device explant	3 (1.4)
	BiV pacemaker implant/generator change/upgrade	3 (1.4)
	Leadless pacemaker implant	2 (1.0)
MBH	Pacemaker implant/generator change	38 (63.3)
	Loop recorder implant/explant	17 (28.3)
	Lead revision/replacement/pocket revision	3 (5.0)
	ICD implant/generator change/upgrade	1 (1.7)
	Device explant	1 (1.7)
SCUH	Pacemaker implant/generator change	85 (82.5)
	ICD implant/generator change/upgrade	11 (10.7)
	BiV ICD implant/generator change/upgrade	3 (2.9)
	BiV pacemaker implant/generator change/upgrade BiV	2 (1.9)
	Device explant	1 (1.0)
	Lead revision/replacement/pocket revision	1 (1.0)
TPCH	Pacemaker implant/generator change	365 (46.7)
	ICD implant/generator change/upgrade	161 (20.6)
	Device explant	68 (8.7)
	Loop recorder implant/explant	52 (6.7)
	ICD implant/generator change/upgrade BiV	52 (6.7)
	BiV pacemaker implant/generator change/upgrade BiV	31 (4.0)
	Leadless pacemaker implant	28 (3.6)
	Lead revision/replacement/pocket revision	23 (2.9)
	Temporary pacing system	1 (0.1)
RBWH	Pacemaker implant/generator change	85 (35.7)
	Loop recorder implant/explant	62 (26.1)
	ICD implant/generator change/upgrade	46 (19.3)
	BiV ICD implant/generator change/upgrade	20 (8.4)
	BiV pacemaker implant/generator change/upgrade	11 (4.6)
	Lead revision/replacement/pocket revision	7 (2.9)
	Device explant	6 (2.5)
	Temporary pacing system	1 (0.4)
PAH	Pacemaker implant/generator change	397 (63.1)
	ICD implant/generator change/upgrade	115 (18.3)
	Loop recorder implant/explant	48 (7.6)
	BiV ICD implant/generator change/upgrade	41 (6.5)
	Lead revision/replacement/pocket revision	13 (2.1)
	BiV pacemaker implant/generator change/upgrade	4 (0.6)
	Device explant	7 (1.1)
	Leadless pacemaker implant	3 (0.5)
	Insertion of epicardial lead	1 (0.2)
ALL		**2,131**

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

34.5 Electrophysiology studies/ablations

Electrophysiology studies including radiofrequency ablation were the most common individual procedure performed across all sites, ranging from 46% at TTH to 64% at RBWH.

Table 11: Electrophysiology study/ablation types by site

Site	Procedure type	Case n (%)
TTH	Electrophysiology study and radiofrequency ablation	37 (45.7)
	Electrophysiology study	20 (24.7)
	Radiofrequency ablation	13 (16.0)
	Cryotherapy ablation	9 (11.1)
	Electrophysiology study and cryotherapy ablation	2 (2.5)
SCUH	Electrophysiology study and radiofrequency ablation	62 (61.4)
	Electrophysiology study	23 (22.8)
	Electrophysiology study and cryotherapy ablation	11 (10.9)
	Cryotherapy ablation	2 (2.0)
	Radiofrequency ablation	1 (1.0)
	Electrophysiology study with radiofrequency and cryotherapy ablation	1 (1.0)
	Electrophysiology study with drug challenge	1 (1.0)
TPCH	Electrophysiology study and radiofrequency ablation	191 (52.6)
	Radiofrequency ablation	73 (20.1)
	Electrophysiology study	71 (19.6)
	Electrophysiology study and cryotherapy ablation	12 (3.3)
	Cryotherapy ablation	7 (1.9)
	Electrophysiology study with drug challenge	5 (1.4)
	Electrophysiology study with radiofrequency and cryotherapy ablation	4 (1.1)
RBWH	Electrophysiology study and radiofrequency ablation	103 (64.0)
	Electrophysiology study	40 (24.8)
	Electrophysiology study and cryotherapy ablation	10 (6.2)
	Radiofrequency ablation	3 (1.9)
	Electrophysiology study with radiofrequency and cryotherapy ablation	3 (1.9)
	Electrophysiology study and drug challenge	2 (1.2)
PAH	Electrophysiology study and radiofrequency ablation	95 (51.9)
	Radiofrequency ablation	49 (26.8)
	Electrophysiology study	36 (19.7)
	Electrophysiology study and cryotherapy ablation	3 (1.6)
ALL		**889**

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

34.5.1 Standard vs complex electrophysiology

Complex electrophysiology cases using three-dimensional mapping technology or involving pulmonary vein isolation accounted for 42% of the total electrophysiology cases performed in 2017 across five sites.

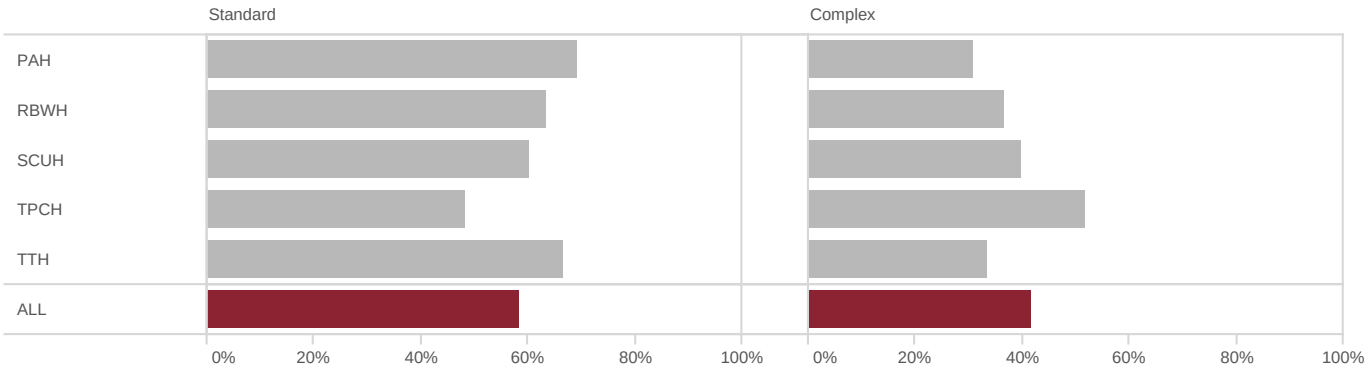


Figure 30: Complexity of electrophysiology procedures by site

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

Site	Case type	Total (n)	Complex EP (n)	Standard EP (n)
TTH	Radiofrequency ablation	50	16	34
	Cryotherapy ablation	11	9	2
	Electrophysiology study	20	2	18
SCUH	Radiofrequency ablation	63	24	39
	Electrophysiology study	23	3	20
	Cryotherapy ablation	13	12	1
	Electrophysiology study with drug challenge	1	-	1
	Radiofrequency and cryotherapy ablation	1	1	-
TPCH	Radiofrequency ablation	264	144	120
	Electrophysiology study	71	21	50
	Cryotherapy ablation	19	18	1
	Electrophysiology study with drug challenge	5	1	4
	Radiofrequency and cryotherapy ablation	4	4	-
RBWH	Radiofrequency ablation	106	44	62
	Electrophysiology study	40	7	33
	Cryotherapy ablation	10	7	3
	Electrophysiology study with drug challenge	2	-	2
	Radiofrequency and cryotherapy ablation	3	1	2
PAH	Radiofrequency ablation	144	52	92
	Electrophysiology study	36	4	32
	Cryotherapy ablation	3	-	3
ALL		**889**	**370**	**519**

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

34.5.2 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 account for 91% 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 (%)
TTH	18	8 (44.4)	10 (55.6)	-	-
SCUH	27	-	15 (55.6)	12 (44.4)	-
TPCH	171	93 (54.4)	60 (35.1)	17 (9.9)	1 (0.6)
RBWH	57	5 (8.8)	52 (91.2)	-	-
PAH	56	34 (60.7)	22 (39.3)	-	-
ALL	**329**	**140 (42.6)**	**159 (48.3)**	**29 (8.8)**	**1 (0.3)**

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

34.5.3 Ablation type

Radiofrequency ablation is the principal method across all sites, with 91% of all cases utilising this energy.

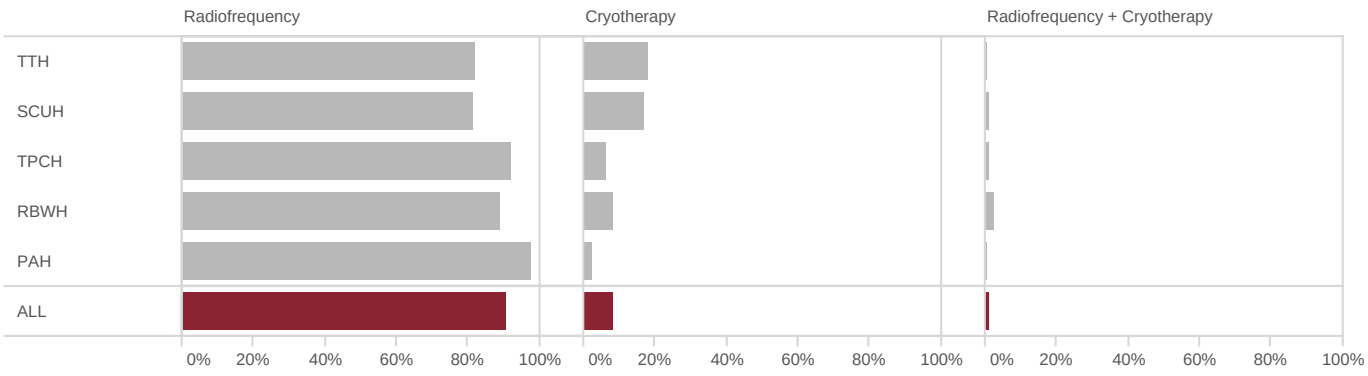


Figure 31: Ablation type by site

Table 14: Ablation type by site

	Total cases (n)	Radiofrequency n (%)	Cryotherapy n (%)	Radiofrequency + Cryotherapy n (%)
TTH	61	50 (82.0)	11 (18.0)	-
SCUH	77	63 (81.8)	13 (16.9)	1 (1.3)
TPCH	287	264 (92.0)	19 (6.6)	4 (1.4)
RBWH	119	106 (89.1)	10 (8.4)	3 (2.5)
PAH	147	144 (98.0)	3 (2.0)	-
ALL	**691**	**627 (90.7)**	**56 (8.1)**	**8 (1.2)**

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

34.5.4 Ablation chamber

The most common site for ablation is within the atria, with ventricular ablation being the second most common.

Table 15: Ablation chamber by site

	Atrial (n)	Ventricular (n)	Bypass Tract (n)	Bypass tract and atrial (n)	Epicardium (n)	Atrial and Ventricular (n)
TTH	43	1	7	-	-	-
SCUH	63	3	-	-	-	-
TPCH	207	64	13	1	1	1
RBWH	106	6	7	-	-	-
PAH	126	8	6	1	-	-
ALL	**545**	**82**	**33**	**2**	**1**	**1**

Includes 3.9% missing data

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

34.5.5 Ablation location – supraventricular

The anatomical location of supra ventricular ablation differs slightly across sites. Cavo-tricuspid isthmus (atrial flutter), pulmonary veins (atrial fibrillation) and slow pathway (atrial tachycardia) ablations accounting for 80% of all cases. The remainder of procedures were for accessory pathway ablation.

Table 16: Supraventricular ablation according to anatomical location

Site	Ablation category	Count (n)
TTH	Slow pathway	14
	Pulmonary veins	12
	Cavo-tricuspid isthmus	9
	Tricuspid annulus	6
	Mitral annulus	4
	Coronary sinus ostium	1
	Right septum	1
SCUH	Pulmonary veins	21
	Slow pathway	17
	Cavo-tricuspid isthmus	15
	Atrioventricular node	4
	Coronary sinus ostium	2
	Mitral annulus	2
	Crista terminalis mid	1
	Tricuspid annulus	1
	Other	4
TPCH	Pulmonary veins	62
	Cavo-tricuspid isthmus	56
	Slow pathway	48
	Mitral annulus	13
	Tricuspid annulus	10
	Atrioventricular node	7
	Coronary sinus ostium	3
	Crista terminalis	2
	Posteroseptal	2
	Right septum	2
	Anteroseptal	1
	Crista terminalis mid and Right atrial appendage	1
	Coronary sinus ostium and Other and Slow pathway and Mitral annulus	1
	Slow pathway and Crista terminalis	1
	Slow pathway and Coronary sinus body and Other	1
	Slow pathway and Coronary sinus ostium	1
	Superior vena cava	1
	Other	10
RBWH	Slow pathway	43
	Pulmonary veins	27
	Cavo-tricuspid isthmus	25
	Atrioventricular node	5
	Tricuspid annulus	5
	Mitral annulus	2
	Posteroseptal	2
	Cavo-tricuspid isthmus and Slow pathway	1
	Crista terminalis	1
	Coronary sinus ostium	1
	Slow pathway and left septum	1
	Left septum and right septum	1
	Other	1
PAH	Slow pathway	45
	Cavo-tricuspid isthmus	36
	Pulmonary veins	36
	Atrioventricular node	6
	Mitral annulus	6
	Tricuspid annulus	6
	Right septum	1
	Other	3

34.5.6 Ablation location – ventricular

The anatomical location of ventricular ablation is variable according to site with right ventricular outflow tract ablation making up a quarter of all ventricular ablation cases.

Table 17: Ventricular ablation according to anatomical location

Site	Anatomical location	Count (n)
TTH	Right ventricular outflow tract	1
SCUH	Right ventricular outflow tract	1
TPCH	Right ventricular outflow tract	10
	Left ventricular endocardium	8
	Pulmonary artery	5
	Aorta-mitral continuity	4
	Parahisian	4
	Mitral annulus	1
	Right/left coronary cusp	4
	Tricuspid annulus	3
	Papillary muscle	2
	Aortico-mitral continuity and Right coronary cusp	1
	Left posterior fascicle	1
	Left ventricular summit	1
	Mitral annulus and Slow pathway	1
	Parahisian and Tricuspid annulus	1
	Postero-medial papillary muscle and Right/left coronary cusp	1
	Other	11
RBWH	Right ventricular outflow tract	5
	Other	1
PAH	Right ventricular outflow tract	3
	Mitral annulus	2
	Right/left coronary cusp	1
	Other	2

34.5.7 Ablation category – supraventricular

The most frequently ablated clinical arrhythmia was atrial fibrillation accounting for 28% of all supraventricular ablations across all sites, followed by atrial flutter (24%).

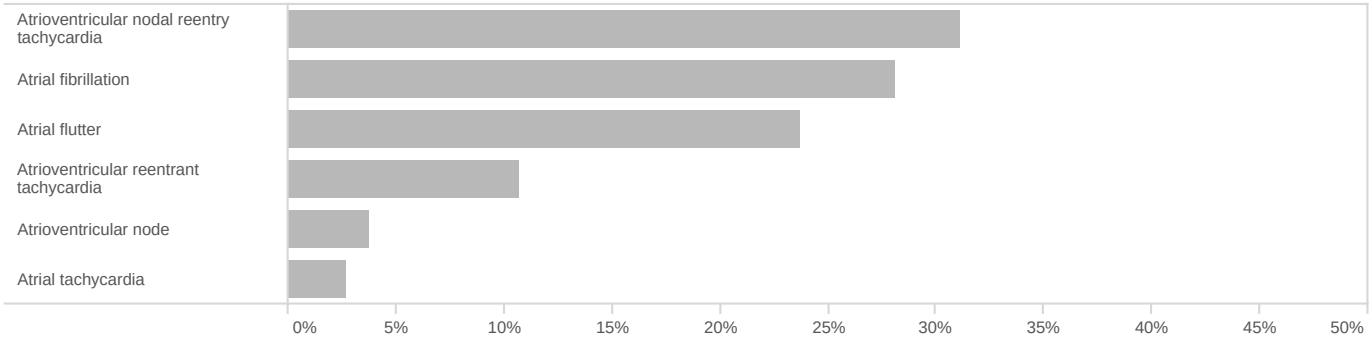


Figure 32: Proportion of supraventricular arrhythmia requiring ablation

Table 18: Supraventricular ablation according to arrhythmia

Site	Ablation category	Count (n)
TTH	Atrial fibrillation	12
	Atrial flutter	10
	Atrioventricular reentrant tachycardia	10
	Atrioventricular nodal reentry tachycardia	15
SCUH	Atrial fibrillation	21
	Atrial flutter	16
	Atrioventricular reentrant tachycardia	3
	Atrioventricular nodal reentry tachycardia	17
	Atrial tachycardia	1
	Atrioventricular node	4
TPCH	Atrial fibrillation	62
	Atrial flutter	51
	Atrioventricular reentrant tachycardia	28
	Atrioventricular nodal reentry tachycardia	50
	Atrial tachycardia	12
	Atrioventricular node	7
RBWH	Atrial fibrillation	27
	Atrial flutter	27
	Atrioventricular reentrant tachycardia	7
	Atrioventricular nodal reentry tachycardia	45
	Atrial tachycardia	2
	Atrioventricular node	4
PAH	Atrial fibrillation	36
	Atrial flutter	29
	Atrioventricular reentrant tachycardia	12
	Atrioventricular nodal reentry tachycardia	48
	Atrioventricular node	6
ALL		**562**

Includes 3.4% missing data

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

34.5.8 Ablation category – ventricular

Ventricular tachycardia ablation accounted for 54% of all ventricular ablations, with 35% of procedures indicated for ventricular ectopy.

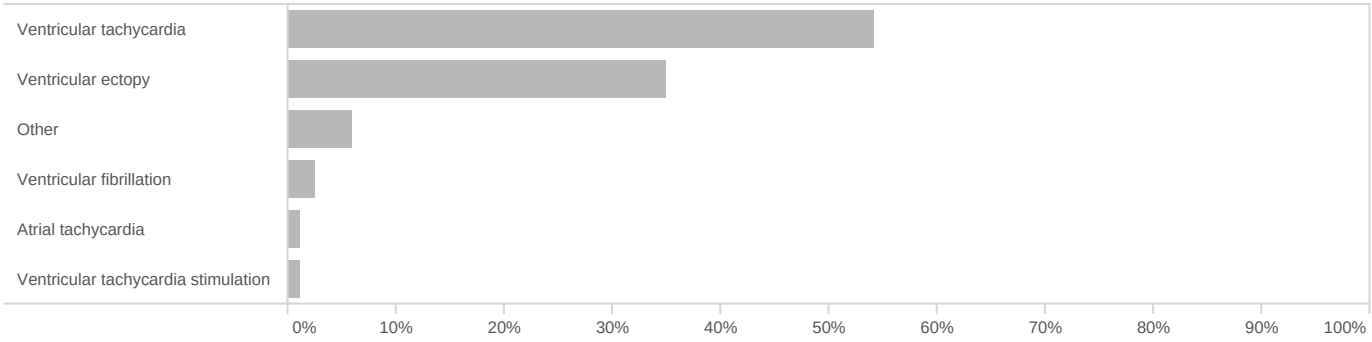


Figure 33: Proportion of ventricular arrhythmia requiring ablation

Table 19: Ventricular ablation according to arrhythmia

Site	Ablation category	Count (n)
TTH	Ventricular ectopy	1
SCUH	Ventricular ectopy	1
	Ventricular tachycardia	1
TPCH	Ventricular tachycardia	37
	Ventricular ectopy	24
	Other	5
	Ventricular fibrillation	2
RBWH	Ventricular tachycardia	3
	Ventricular ectopy	2
	Atrial tachycardia	1
PAH	Ventricular tachycardia	4
	Ventricular tachycardia stimulation	1
	Ventricular ectopy	1
ALL		**83**

Includes 11.9% missing data

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

34.6 Other procedures

The most common forms of other procedure were cardioversions (65%). Variations in clinical practice across sites can be observed here, with not all cardioversions performed being carried out in the electrophysiology laboratory environment.

Table 20: Other procedures

	Total (n)	Cardioversion n (%)	Drug challenge n (%)	Other n (%)
TTH	51	40 (78.4)	11 (21.6)	-
MBH	1	1 (100.0)	-	-
SCUH	1	-	1 (100.0)	-
TPCH	8	-	1 (12.5)	7 (87.5)
RBWH	21	5 (23.8)	14 (66.7)	2 (9.5)
PAH	32	28 (87.5)	2 (6.3)	2 (6.3)
ALL	**114**	**74 (64.9)**	**29 (25.4)**	**11 (9.6)**

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

35 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 complications observed intraprocedurally as well as post procedure. Notation of complications within the QCOR electrophysiology application is the responsibility of site practitioners.

The complication rates for procedures in Tables 21 and 22 are reflected as the proportion of the total number of device and electrophysiology procedures respectively. Rarely, the development of an intraprocedural complication such as coronary sinus dissection necessitated a switch of procedure type from BiV implant/ upgrade to a non-BiV device procedure. These are categorised as the final procedure type.

The aggregate for all device procedure complications was 4.6%, while all electrophysiology procedures had a 2.6% complication rate.

Table 21: Cardiac device procedure complications

Procedure type	Complication	Total n (%)
Pacemaker implant/generator change	Lead complication	17 (0.8)
	Pericardial effusion with or without tamponade	6 (0.3)
	Haematoma	5 (0.2)
	Cardiac arrest	4 (0.2)
	Infection	3 (0.1)
	Pneumothorax	3 (0.1)
	Venous access complication	3 (0.1)
	Coronary sinus dissection	2 (0.1)
	Other	9 (0.4)
Loop recorder implant/explant	Device erosion	1 (<0.1)
	Drug reaction	1 (<0.1)
ICD implant/generator change/ upgrade	Infection	4 (0.2)
	Cardiac arrest	3 (0.1)
	Lead complication	3 (0.1)
	Drug reaction	3 (0.1)
	Haematoma	1 (<0.1)
	Pericardial effusion with or without tamponade	1 (<0.1)
BiV ICD implant/generator change/ upgrade	Coronary sinus dissection	3 (0.1)
	Lead dislodgement	3 (0.1)
	Haematoma	2 (0.1)
	Cardiac arrest	1 (<0.1)
	Infection	1 (<0.1)
	Other	5 (0.2)
BiV pacemaker implant/ generator change/upgrade	Coronary sinus dissection	3 (0.1)
	Cerebrovascular accident	1 (<0.1)
	Lead complication	1 (<0.1)
Device explant	Lead complication	2 (0.1)
	Conduction block	1 (<0.1)
	Coronary sinus dissection	1 (<0.1)
	Infection	1 (<0.1)
Lead revision/replacement/ pocket revision	Lead complication	2 (0.1)
	Pericardial effusion with or without tamponade	1 (<0.1)
ALL		**97 (4.6)**

% as proportion of device procedures

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

Table 22: Electrophysiology procedure complications

Procedure Type	Complexity	Complication	Total n (%)
Ablation – cryotherapy	Complex EP	Resolved phrenic nerve injury	1 (0.1)
Ablation – radiofrequency	Complex EP	Pericardial effusion with tamponade	3 (0.3)
		Readmission for return of arrhythmia	1 (0.1)
		Infection	1 (0.1)
		Transient ischaemic attack	1 (0.1)
	Standard EP	Conduction block	4 (0.4)
		Atrial arrhythmia requiring cardioversion	2 (0.2)
		Pericardial effusion with tamponade	2 (0.2)
		Vasovagal and chest pain	2 (0.2)
		Readmission for return of arrhythmia	1 (0.1)
		Sustained atrial fibrillation	1 (0.1)
EP study	Complex EP	Pericardial effusion with tamponade	1 (0.1)
	Standard EP	Pericardial effusion with tamponade	1 (0.1)
		Atrial arrhythmia requiring cardioversion	1 (0.1)
		Venous access complication	1 (4.3)
ALL			**23 (2.6)**

% as proportion of electrophysiology procedures

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

36 Conclusions

This first QCOR electrophysiology and pacing report details the mix of patients and clinical workloads encountered at seven of the eight public cardiac electrophysiology services. It demonstrates the first levels of analysis of robust Queensland Health data. With increasing sophistication and in unprecedented detail, future reports will be capable of informing processes of benchmarking, service review, audit and research.

Opportunities for improvement have been identified in some areas of data collection. One of these is the documentation of catheter ablation outcomes at intervals after the procedures, to evaluate the key metric of endurance of procedural success. This refinement could assist predictive and risk adjustment modelling for these procedures.

Subsequent QCOR electrophysiology and pacing reports, containing more comprehensive data from all sites, will highlight data regarding booking-to-procedure waiting times, for example as they apply to ablation procedures for atrial fibrillation. This should focus attention on longstanding deficiencies in workforce and laboratory access for cardiac ablation procedures in general. The current report details demographics and outcomes for patients who have undergone procedures, but makes no comment on the increasing and potentially unhealthy waiting times for cardiac ablation.

International clinical guidelines regarding management of heart rhythm disorders continue to evolve as rapidly as the evidence-based applications of new technologies in the most dynamic sub-specialty in cardiology. Future QCOR electrophysiology and pacing reports will frame data analysis around clinical indicators agreed by the Electrophysiology Working Group of the Statewide Cardiac Clinical Network, so as to assess the quality of care uniformly, meticulously, continuously and authoritatively for the first time on a Queensland Health statewide basis. Reporting on the QCOR platform should reinforce the continuing international standard of care for public patients with heart rhythm disorders.

37 Recommendations

With ongoing improvement and greater detail of electrophysiology and pacing data contained in QCOR, clinicians are now able to access quality reports and information. Collection and analysis of this information will continue to be moulded by the experience and requirements of clinicians as well as by changes in international guidelines and evidence-based practice.

The QCOR electrophysiology committee embraces these changes; the development of clinical indicators will build continuously on previously defined areas of interest. Through the work of the steering committee and associated departmental staff, contributions to and outputs from QCOR will continue to evolve and to play a pivotal role in guiding everyday practice and decision support for public patients with heart rhythm disorders.

Cardiac Rehabilitation Audit

38 Message from the QCOR Cardiac Rehabilitation Committee Chair

A lot of activity has occurred within the realm of cardiac rehabilitation (CR) over the last few years, and we are excited to publish the first annual report of clinical indicators and service throughput for the latter part of 2017. Evidence suggests that a secondary prevention program such as CR reduces hospital readmission and death within the first year after a coronary event by as much as 56% and 30% respectively, and reduces the risk of repeat myocardial infarction.[22] Furthermore, some UK analyses have found that more than half (57%) of all potentially eligible patients leave hospital without a referral to an outpatient CR program. Despite this, 71% of patients state they would go to CR if a health professional discussed it with them before leaving hospital.[23]

The introduction of a CR Quality Incentive Payment (QIP) in December 2016 directed clinical focus toward ensuring that timely Queensland Health referrals were made to CR and that those patients were assessed within 28 days of being discharged from hospital.

Concurrently, the incoming Queensland Government provided three-year project funding to improve referral to, uptake of, and quality of outpatient CR services. With this financial support, QCOR was able to concentrate on and generate a CR-specific web-based module that supported clinical practice. A new registry tool was built to not only capture clinical indicators and key data points for reporting purposes, but also supported the practice of CR service delivery at the point of care. The QCOR CR module enables the generation of electronic referrals as well as pre- and post CR intervention assessments.

In July 2017, the QCOR CR module was released for use among all Queensland public outpatient CR programs and was mandated as the tool to capture CR QIP activity. The initial utilisation of QCOR data has been focused on generating reports that support the CR QIP initiative. For this process, 53 outpatient CR sites were identified and included (some programs deliver from multiple sites) with the vast majority of these programs using the application as part of routine practice by 31 December 2017.

As a frontline CR clinician who has utilised this module since its inception, I can attest to its wide-reaching benefit to our field. The current usability and multifaceted features (data collection, pre/post outcome comparison and report generation), as well as its future capabilities, positions the QCOR CR module as an industry leader.

This first annual report focuses on the front end of the outpatient CR patient journey. There is sufficient data available to comment on the referral to, and uptake of outpatient CR, as well as identified clinical indicators extracted from the pre- assessment phase. Future reports will incorporate post assessment data and allow analysis of changes and improvements in clinical status made by the CR model of care employed.

Stephen Woodruffe
Chair
QCOR Cardiac Rehabilitation Committee

Samara Phillips
Project Manager
Statewide Cardiac Rehabilitation Project

39 Key findings

This first Cardiac Rehabilitation (CR) report includes the first 6 months of data collected through the statewide CR database (QCOR Cardiac Rehabilitation module) implemented on 1 July 2017.

Findings of the report include:

- 6,368 referrals were made to participating CR programs in the July–December 2017 period.
- Overall there were 44 public outpatient CR programs that participated in CR data reporting.
- Male patients aged between 65 years and 69 years comprised the largest cohort based on age category and gender.
- Of all referrals, 68% patients were male.
- The proportion of Aboriginal and Torres Strait Islander patients was 6.6%, with wide variation across the state. This population group was more vastly represented in north Queensland.
- Over three-quarters of patients (81%) were overweight, obese or morbidly obese.
- Only 34% of patients meet the physical activity guidelines for their age and are sufficiently active.
- The majority of patients presented with ischaemic heart disease (65%) with the remainder having either valvular disease (7%) or other diagnoses (28%).
- 59% of all referrals received an outpatient CR assessment within any timeframe.
- Patients electing to decline (35%), clinically inappropriate referrals (14%) and referred outside Queensland Health (10%) are the main reasons that patients don't attend an outpatient CR assessment.
- A timely referral (within three days of patient discharge) occurred in 94% of cases.
- Of the timely referrals, a timely assessment (within 28 days of discharge) occurred in 85% of cases.

40 Participating sites

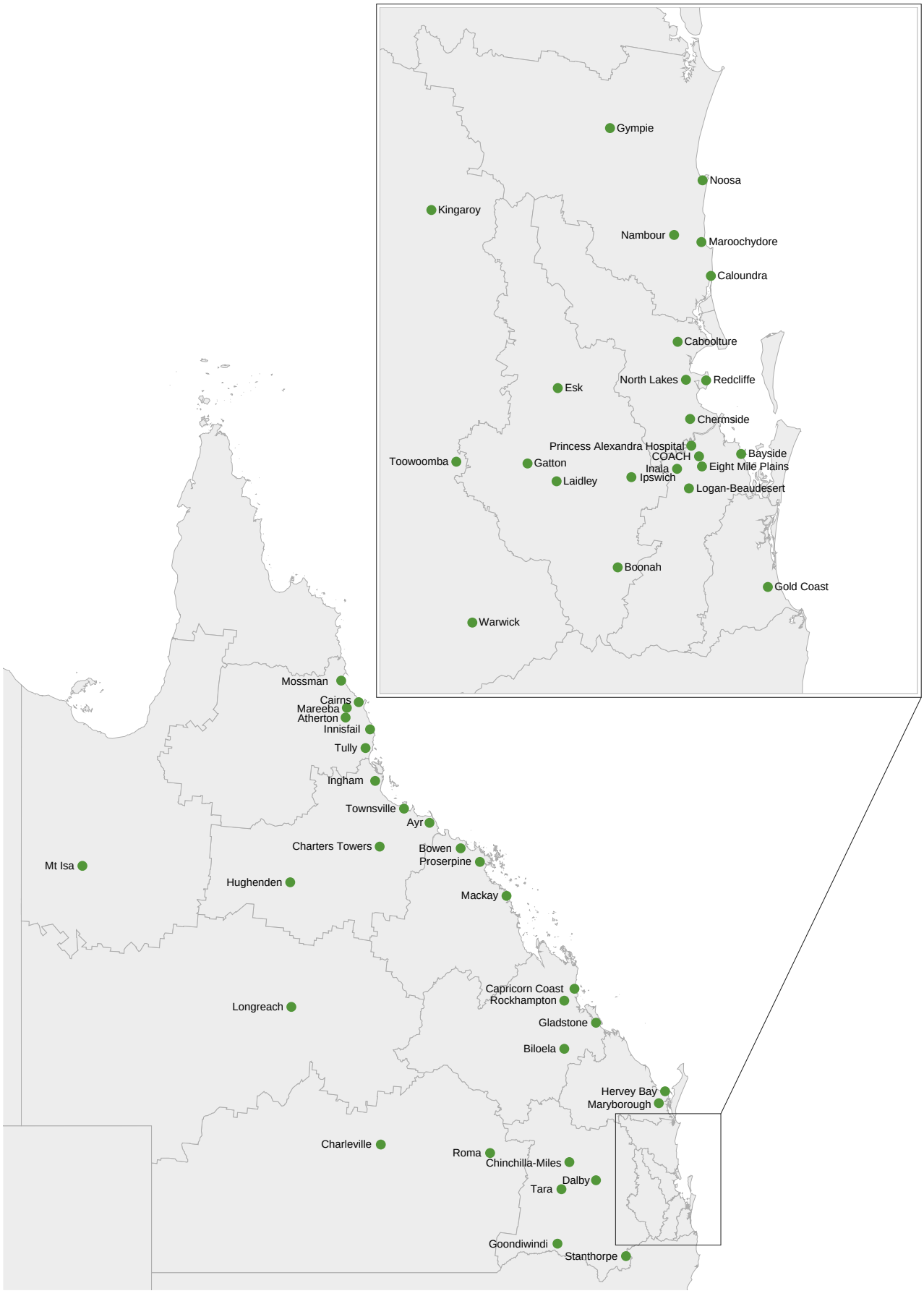


Figure 1: Queensland public CR sites

Table 1: Participating CR sites by Hospital and Health Service

HHS	Cardiac rehabilitation program	Participating
Cairns and Hinterland	Atherton	Y
	Cairns	Y
	Innisfail	Y
	Mareeba	Y
	Mossman	Y
	Tully	Y
Central Queensland	Biloela	Y
	Capricorn Coast	Y
	Gladstone	Y
	Rockhampton	Y
Central West	Longreach	Y
Darling Downs	Chinchilla-Miles	Y
	Dalby	Y
	Goondiwindi	Y
	Kingaroy	Y
	Stanthorpe	–
	Tara	Y
	Toowoomba	Y
	Warwick	Y
Gold Coast	Gold Coast University Hospital	Y
Health Contact Centre	COACH	Y
Mackay	Bowen	–
	Mackay	Y
	Proserpine	Y
Metro North	Caboolture	Y
	Chermside	Y
	North Lakes	Y
	Redcliffe	Y
Metro South	Bayside	Y
	Eight Mile Plains	Y
	Inala	Y
	Logan-Beaudesert	Y
	Princess Alexandra Hospital	Y
North West	Mt Isa	Y
South West	Charleville	Y
	Roma	Y
Sunshine Coast	Caloundra	Y
	Gympie	Y
	Maroochydore	Y
	Nambour	Y
	Noosa	Y
Townsville	Ayr	–
	Charters Towers	–
	Hughenden	–
	Ingham	Y
	Townsville	Y
West Moreton	Boonah	Y*
	Esk	Y*
	Gatton	Y*
	Ipswich	Y
	Laidley	Y*
Wide Bay	Hervey Bay	Y
	Maryborough	Y

* Totals for Boonah, Esk, Gatton and Laidley are reported under Ipswich

41 Total referrals

44 CR programs (undertaken at 48 sites) participated in data collection for the latter half of 2017. The programs received a total of 6,368 referrals, the majority of which (78%) originated from the inpatient setting.

It is important to note that the total referral count may be understated as not all CR programs had been entering referrals from private practice, general practitioners, and self-referrals due to the initial focus on capturing inpatient referrals from public hospitals.

Table 2: Referral sources by CR outpatient program HHS

HHS	Inpatient n (%)	Outpatient n (%)	External n (%)
Cairns and Hinterland	289 (81.9)	21 (5.9)	43 (12.2)
Central Queensland	521 (62.8)	150 (18.1)	159 (19.2)
Central West	12 (75.0)	3 (18.8)	1 (6.3)
Darling Downs	190 (76.3)	20 (8.0)	39 (15.7)
Gold Coast	639 (80.0)	80 (10.0)	80 (10.0)
Health Contact Centre	916 (90.9)	86 (8.5)	6 (0.6)
Mackay	101 (80.8)	18 (14.4)	6 (4.8)
Metro North	451 (67.6)	51 (7.6)	165 (24.7)
Metro South	757 (83.2)	27 (3.0)	126 (13.8)
North West	34 (68.0)	11 (22.0)	5 (10.0)
South West	19 (95.0)	1 (5.0)	-
Sunshine Coast	496 (90.8)	28 (5.1)	22 (4.0)
Townsville	225 (89.3)	24 (9.5)	3 (1.2)
West Moreton	195 (48.6)	69 (17.2)	137 (34.2)
Wide Bay	119 (83.8)	22 (15.5)	1 (0.7)
STATEWIDE	**4,964 (78.0)**	**611 (9.6)**	**793 (12.5)**

For referrals originating from an inpatient setting, the largest referrer was Metro North Hospital and Health Service (HHS) which accounted for over a quarter (28%) of referrals. The largest CR program was the COACH Program (Health Contact Centre) which received 19% of all inpatient referrals.

Table 3: CR inpatient referrals by source and destination HHS

HHS	Outgoing inpatient referrals n (%)	Incoming inpatient referrals n (%)
Cairns and Hinterland	250 (5.0)	289 (5.8)
Central Queensland	393 (7.9)	521 (10.5)
Central West	-	12 (0.2)
Darling Downs	92 (1.9)	190 (3.8)
Gold Coast	640 (12.9)	639 (12.9)
Health Contact Centre	-	916 (18.5)
Mackay	108 (2.2)	101 (2.0)
Mater Health Services	51 (1.0)	-
Metro North	1,363 (27.5)	451 (9.1)
Metro South	1,002 (20.2)	757 (15.2)
North West	5 (0.1)	34 (0.7)
South West	-	19 (0.4)
Sunshine Coast	467 (9.4)	496 (10.0)
Townsville	431 (8.7)	225 (4.5)
West Moreton	83 (1.7)	195 (3.9)
Wide Bay	79 (1.6)	119 (2.4)
STATEWIDE	**4,964 (100.0)**	**4,964 (100.0)**

The flow of inpatient referrals from the originating HHS (acute site) to the CR outpatient program HHS is illustrated in the diagram below. The majority of inpatient referrals remained within the originating HHS, though this varied between sites.

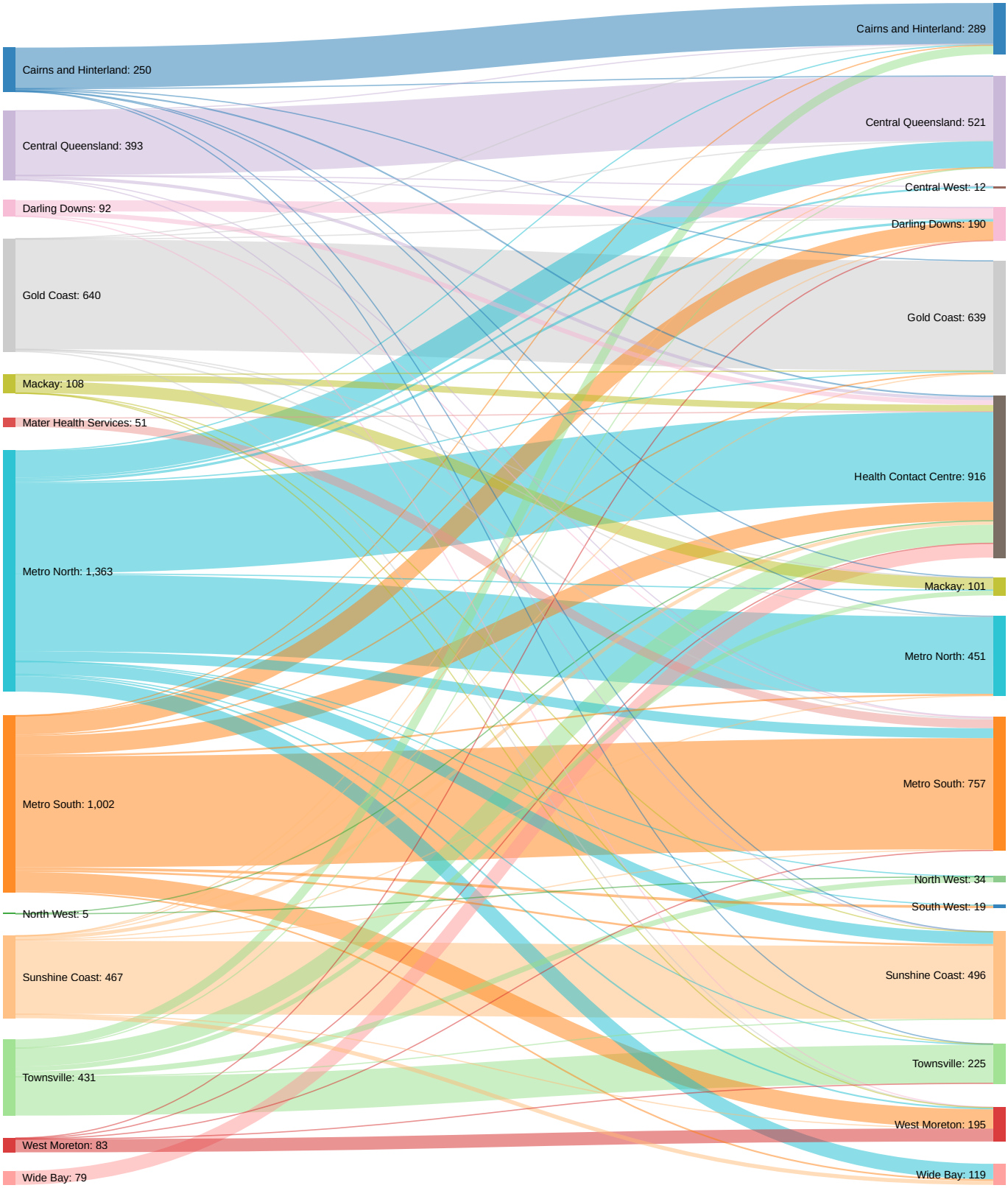


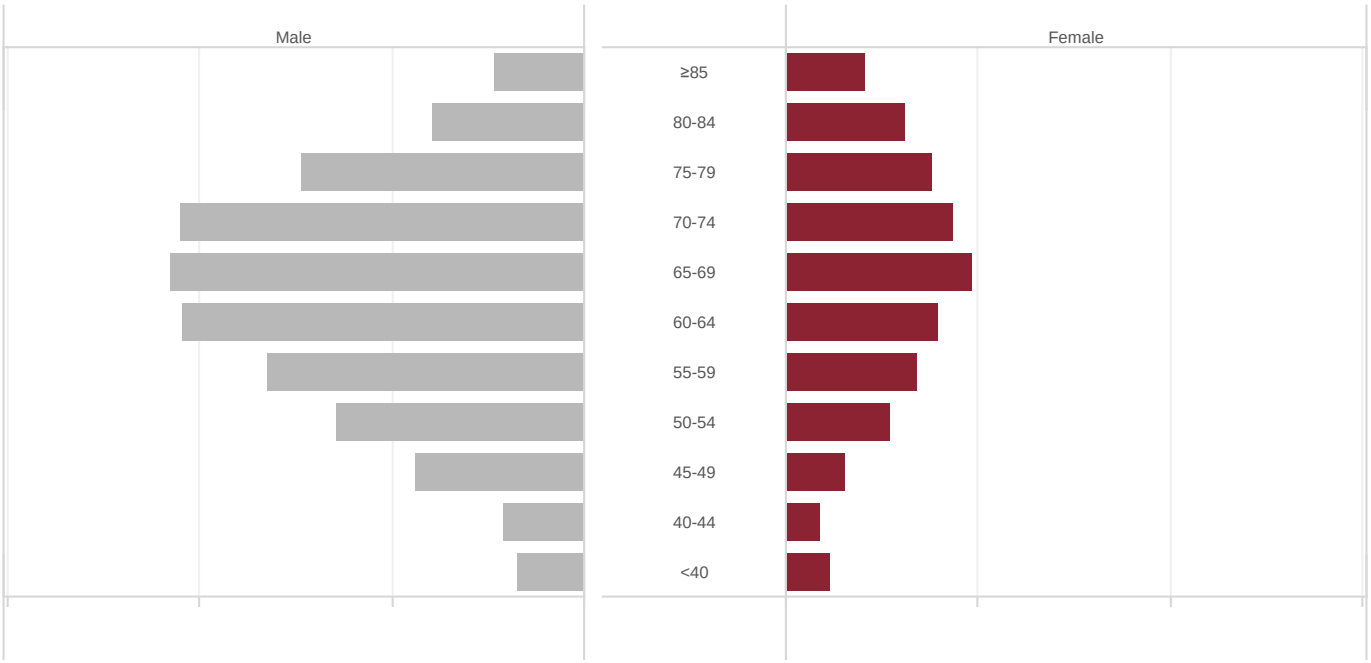
Figure 2: CR inpatient referrals by source and destination HHS

42 Patient characteristics

42.1 Age and gender

The age distribution of referrals differed for gender. The highest proportion of referrals for both males and females was in the 65 year to 69 year age group, which included 16% of all referrals.

Overall, 68% of patients were male and 32% female.



% of total referrals (n=6,368)

Figure 3: Referrals by patient gender and age group

Table 4: Median patient age by gender and HHS

HHS	Male (years)	Female (years)	ALL (years)
Cairns and Hinterland	61.3	60.2	61.2
Central Queensland	65.5	67.5	66.3
Central West	65.2	66.2	65.2
Darling Downs	65.7	66.4	65.8
Gold Coast	65.8	69.2	67.2
Health Contact Centre	65.3	69.8	66.8
Mackay	63.2	66.9	63.4
Metro North	66.3	68.8	67.1
Metro South	64.1	65.9	64.4
North West	56.2	60.6	59.1
South West	65.5	62.6	64.2
Sunshine Coast	68.9	67.5	68.6
Townsville	63.7	62.5	62.9
West Moreton	64.7	65.7	65.0
Wide Bay	69.3	65.1	69.1
STATEWIDE	**65.3**	**67.3**	**65.9**

42.2 Aboriginal and Torres Strait Islander status

Aboriginal and Torres Strait Islander patients represented 6.6% of all statewide referrals with considerable variation observed across HHSs.

Cairns, North West, South West and Townsville HHSs all reported greater than 15% of case load identifying as Aboriginal and Torres Strait Islander.

Table 5: Aboriginal and Torres Strait Islander status by HHS

HHS	Indigenous n (%)	Non-Indigenous n (%)	Not stated/unknown n (%)
Cairns and Hinterland	101 (28.6)	240 (68.0)	12 (3.4)
Central Queensland	60 (7.2)	705 (84.9)	65 (7.8)
Central West	2 (12.5)	14 (87.5)	-
Darling Downs	17 (6.8)	229 (92.0)	3 (1.2)
Gold Coast	7 (0.9)	748 (93.6)	44 (5.5)
Health Contact Centre	87 (8.6)	916 (90.9)	5 (0.5)
Mackay	1 (0.8)	122 (97.6)	2 (1.6)
Metro North	23 (3.4)	617 (92.5)	27 (4.0)
Metro South	25 (2.7)	866 (95.2)	19 (2.1)
North West	17 (34.0)	33 (66.0)	-
South West	4 (20.0)	16 (80.0)	-
Sunshine Coast	15 (2.7)	525 (96.2)	6 (1.1)
Townsville	40 (15.9)	212 (84.1)	-
West Moreton	16 (4.0)	267 (66.6)	118 (29.4)
Wide Bay	7 (4.9)	132 (93.0)	3 (2.1)
STATEWIDE	**422 (6.6)**	**5,642 (88.6)**	**304 (4.8)**

43 Total assessments

CR programs consist of multidisciplinary teams providing health education, physical activity, counselling, behaviour modification strategies and support for patient self-management.

The model of care each program implements is dependent upon the local resources and demands. All have a common aim to maximise the physical, psychological and social functioning of people with cardiac disease as well as introduce and encourage behaviours that are known to minimise the risk of further cardiac events and reduce avoidable hospital admissions. The team may comprise of a CR nurse, physiotherapist or exercise physiologist, and other health professionals.

CR service delivery may be individual or group-based, and may be located in the home, centre or via virtual means. Regardless of the specific model of care employed by individual CR programs, the main elements of outpatient CR are consistent and include:

1 Assessment, review and follow-up,

2 Low or moderate intensity physical activity, and

3 Education, discussion and counselling.

The pre-assessment comprises a review of the presenting, medical and social history as well as a comprehensive cardiac disease risk factor review. The pre-assessment occurs prior to the patient attending a CR program and can be undertaken over the phone or face-to-face. When the identified assessment minimum dataset has been obtained, the assessment is considered complete and for the purposes of QIP, deemed eligible.

The number of total referrals proceeded to a pre-assessment (within any timeframe) is 60%.

Table 6: Total pre-assessments completed by HHS

HHS	Fully assessed n (%)	Not assessed n (%)	Missing data n (%)
Cairns and Hinterland	232 (65.7)	103 (29.2)	18 (5.1)
Central Queensland	409 (49.3)	407 (49.0)	14 (1.7)
Central West	13 (81.3)	3 (18.8)	-
Darling Downs	129 (51.8)	113 (45.4)	7 (2.8)
Gold Coast	391 (48.9)	408 (51.1)	-
Health Contact Centre	578 (57.3)	421 (41.8)	9 (0.9)
Mackay	81 (64.8)	44 (35.2)	-
Metro North	386 (57.9)	281 (42.1)	-
Metro South	691 (75.9)	219 (24.1)	-
North West	46 (92.0)	4 (8.0)	-
South West	14 (70.0)	3 (15.0)	3 (15.0)
Sunshine Coast	355 (65.0)	188 (34.4)	3 (0.5)
Townsville	116 (46.0)	135 (53.6)	1 (0.4)
West Moreton	255 (63.6)	134 (33.4)	12 (3.0)
Wide Bay	99 (69.7)	43 (30.3)	-
STATEWIDE	**3,795 (59.6)**	**2,506 (39.4)**	**67 (1.1)**

There are several reasons why patients may not proceed through to a complete assessment. Patients may decline the service, be uncontactable or medically unsuitable for program completion. Interstate referrals also account for a significant proportion of patients not assessed, particularly in the Gold Coast HHS where a high number of patients referred reside in New South Wales.

Of those patients referred to CR, 39% do not complete a full assessment which highlights the difficulties encountered in providing services. Patients choosing to decline assessment and intervention represented the most common reason for not proceeding with the CR program.

This decline usually occurs when the clinician makes initial contact with the patient. In some instances, the clinician may still opportunistically provide education and advice though this is difficult to document.

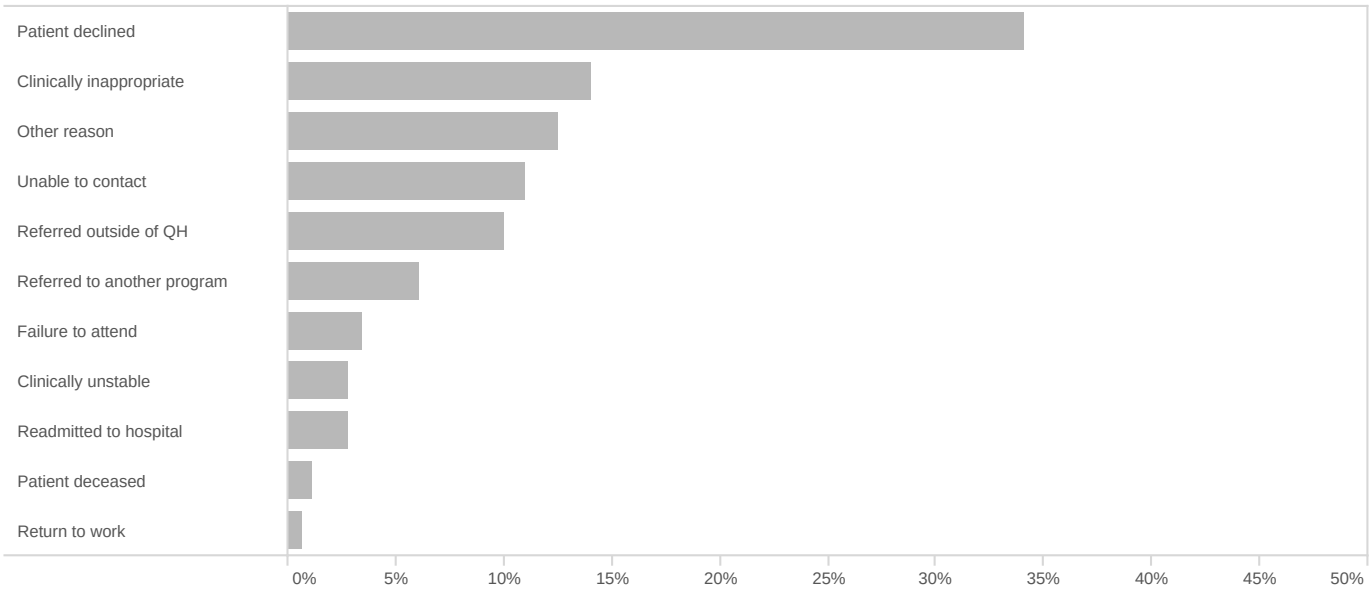


Figure 4: Reasons pre assessment was not conducted

44 Clinical presentation

44.1 Diagnosis

Patients have been grouped into a diagnosis category for the following analysis. The majority of assessments (65%) were related to a previous diagnosis of ischaemic heart disease (IHD).

Table 7: Assessments by diagnosis and diagnosis category

Diagnosis	Category	Total n (%)
NSTEMI	IHD	2,455 (64.7)
NSTEMI, Arrhythmia		
NSTEMI, Arrhythmia, Other		
NSTEMI, CHF		
NSTEMI, CHF, Arrhythmia		
NSTEMI, CHF, Arrhythmia, Other		
NSTEMI, CHF, Valvular disease		
NSTEMI, Other		
NSTEMI, Stable angina		
NSTEMI, Unstable angina		
NSTEMI, Unstable angina, Valvular disease		
NSTEMI, Valvular disease		
Stable angina		
Stable angina, Arrhythmia		
Stable angina, Other		
Stable angina, Unstable angina		
Stable angina, Unstable angina, Other		
Stable angina, Valvular disease		
Stable angina, Valvular disease, Other		
STEMI		
STEMI, Arrhythmia		
STEMI, Arrhythmia, Other		
STEMI, NSTEMI		
STEMI, Other		
Unstable angina		
Unstable angina, Arrhythmia		
Unstable angina, Arrhythmia, Other		
Unstable angina, Other		
Unstable angina, Valvular disease		
Arrhythmia, Valvular disease	Valvular disease	278 (7.3)
Arrhythmia, Valvular disease, Other		
CHF, Valvular disease		
Valvular disease		
Valvular disease, Other		
Arrhythmia	Other	1,062 (28.0)
Arrhythmia, Other		
CHF		
CHF, Arrhythmia		
CHF, Other		
Other		
Total		**3,795 (100.0)**

44.2 Risk factors and comorbidities

The following risk factors and comorbidities are presented according to the diagnosis categories listed in Table 7. These areas are discussed during the assessment phase and self-reported by the patient.

It is important to note with self-reporting instances, sometimes the responses are not accurately communicated while the patient and clinician are in the establishment phase of their relationship. As a result, it is expected that some of the risk factor metrics may be understated.

There are a number of opportunities for data quality improvement with the steering committee identifying the data definitions as a focus for development. This will ensure that a consistent approach and categorisation can be applied which would allow uniform analyses and comparison between sites.

44.2.1 Smoking

At the time of the pre-assessment, 10% of patients were identified as current smokers (defined as smoking within 30 days prior to assessment).

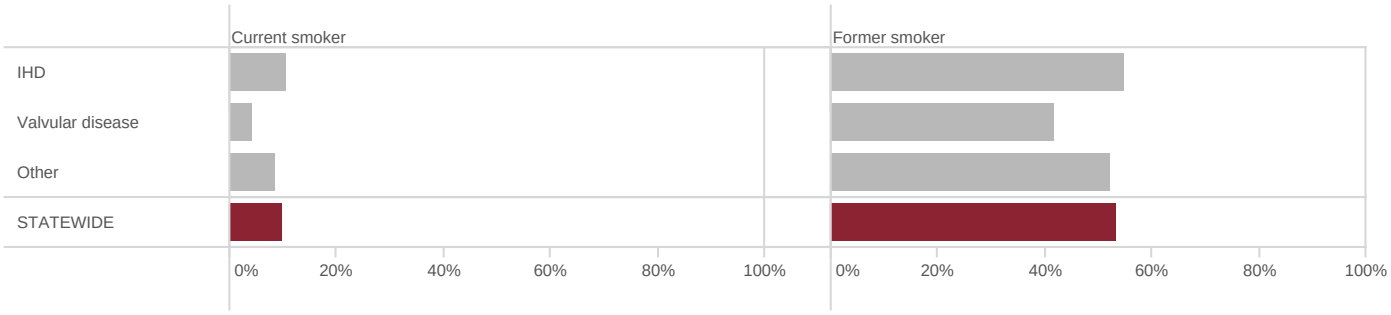
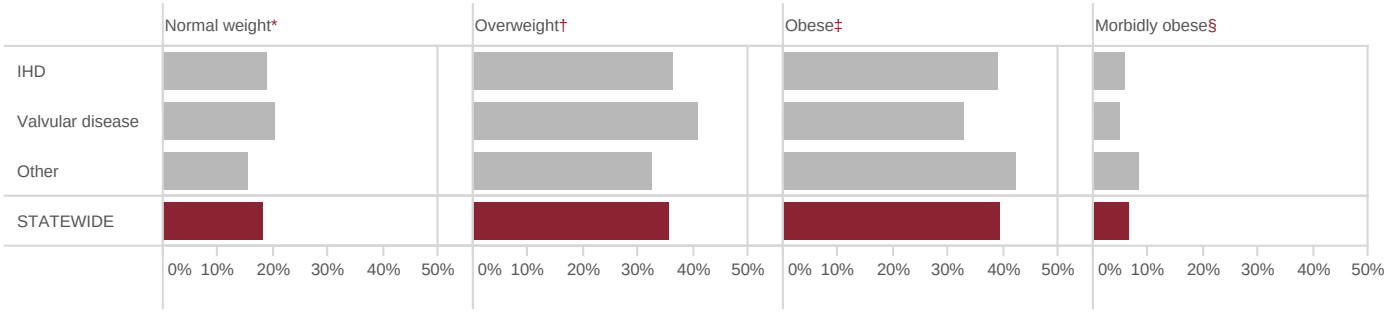


Figure 5: Smoking status by diagnosis category

44.2.2 Body mass index

Less than one quarter (18%) of patients were identified as having a BMI within the normal range, while the majority (81%) of patients attending outpatient CR were classified as overweight, obese or morbidly obese. Less than 1% of patients were classified as underweight (BMI ‹18.5 kg/m²).



* BMI 18.5–24.9 kg/m²

† BMI 25–29.9 kg/m²

‡ BMI 30–39.9 kg/m²

§ BMI ≥40 kg/m²

Figure 6: BMI category by diagnosis category

44.2.3 Diabetes

Overall, 27% of patients had diabetes as a comorbidity with considerable variation observed between diagnosis categories, ranging from 16% to 31%.

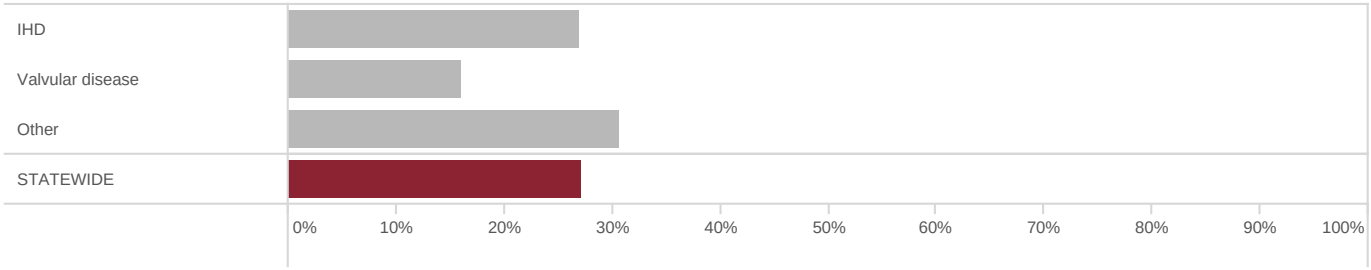


Figure 7: Diabetes by diagnosis category

44.2.4 High blood pressure

More than half of patients (62%) were identified as having hypertension, ranging from 53% to 69% across diagnosis categories.

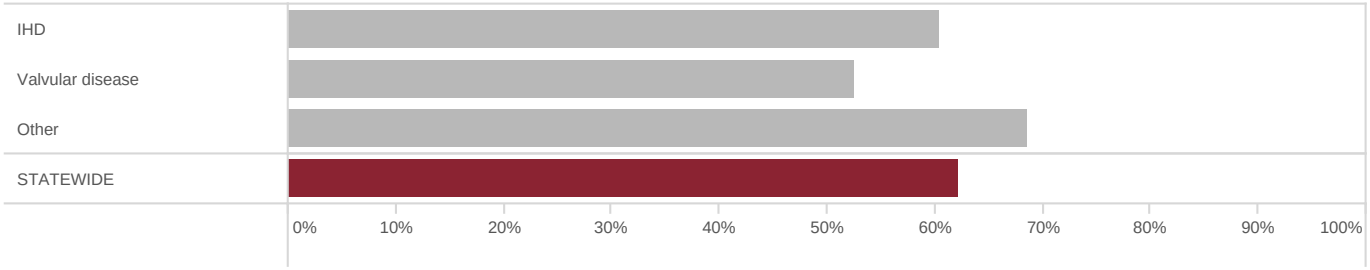


Figure 8: High blood pressure by diagnosis category

44.2.5 Abnormal cholesterol

65% of patients had abnormal cholesterol levels. Abnormal cholesterol levels for patients with known cardiovascular disease include a measure of:

- Total cholesterol ‹4.ommol/L
- HDL ›1.ommol/L
- LDL ‹2.ommol/L
- Triglycerides ‹2.ommol/L.[24]

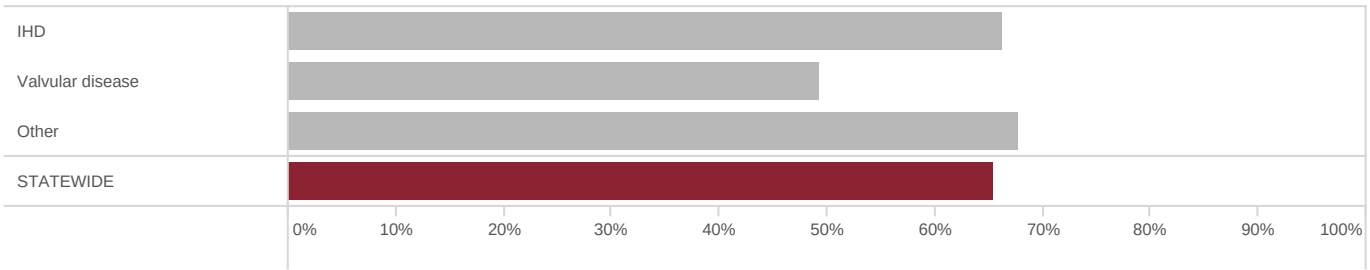


Figure 9: Abnormal cholesterol by diagnosis category

44.2.6 Family history of cardiovascular disease

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.

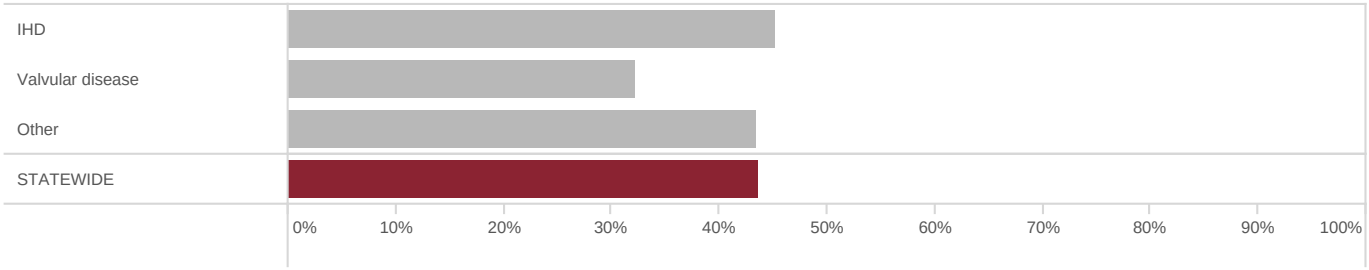


Figure 10: Family history of cardiovascular disease by diagnosis category

44.2.7 Heart failure

12% of patients assessed for outpatient CR were documented as having heart failure as a comorbidity.

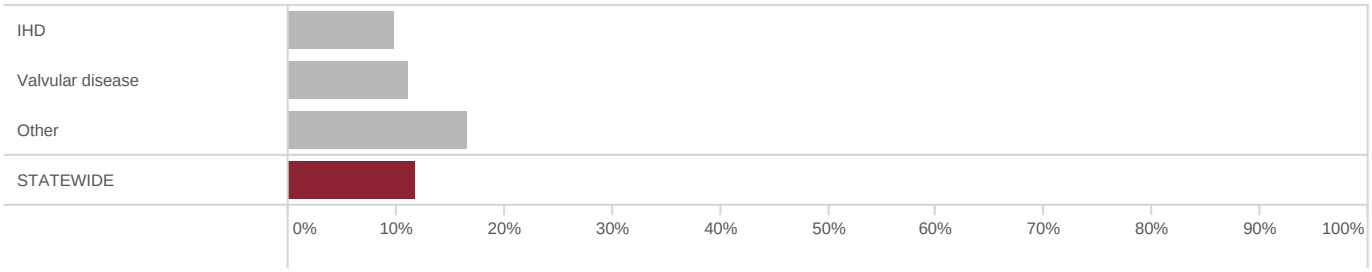
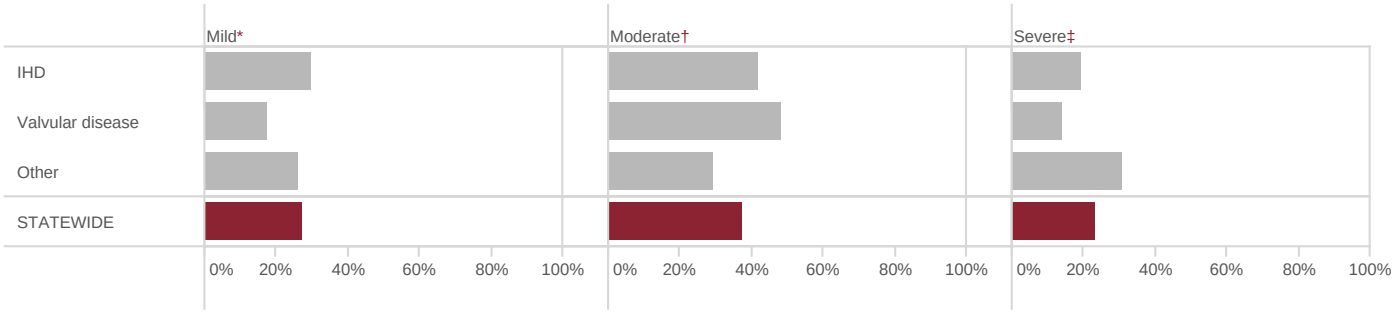


Figure 11: Heart failure by diagnosis category

44.2.7.1 LV dysfunction

Of the patients documented to have heart failure as a comorbidity (Figure 11), 88% were classed as having impaired left ventricular ejection fraction (LVEF). This included 27% with mild LV dysfunction, 37% with moderate LV dysfunction and 23% with severe LV dysfunction. The remainder (12%) were documented as having normal LV function (LVEF >50%).



* LVEF 40%–49%

† LVEF 30%–39%

‡ LVEF <30%

Figure 12: Severity of LV dysfunction by diagnosis category

44.2.8 History of depression

Over one-quarter of patients (27%) had a history of depression prior to experiencing the most recent cardiac event.

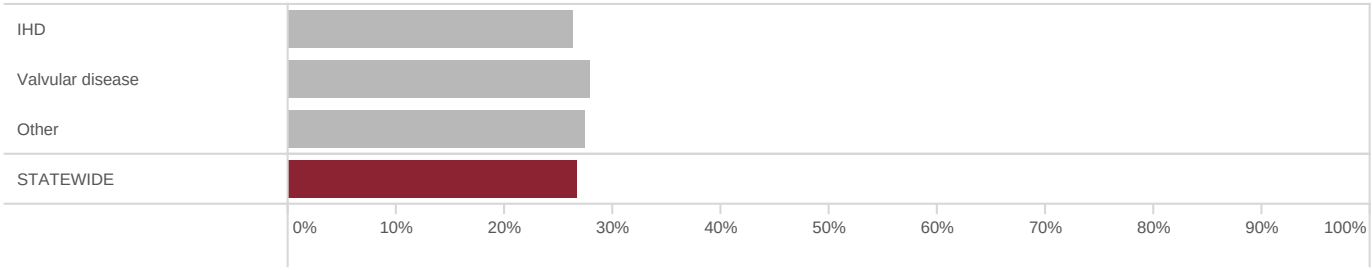


Figure 13: History of depression by diagnosis category

44.2.9 Activity level

34% of patients met the physical activity guidelines for their age and were sufficiently active. Conversely, 19% of patients were classed as inactive meaning they only undertake activities associated with daily living.

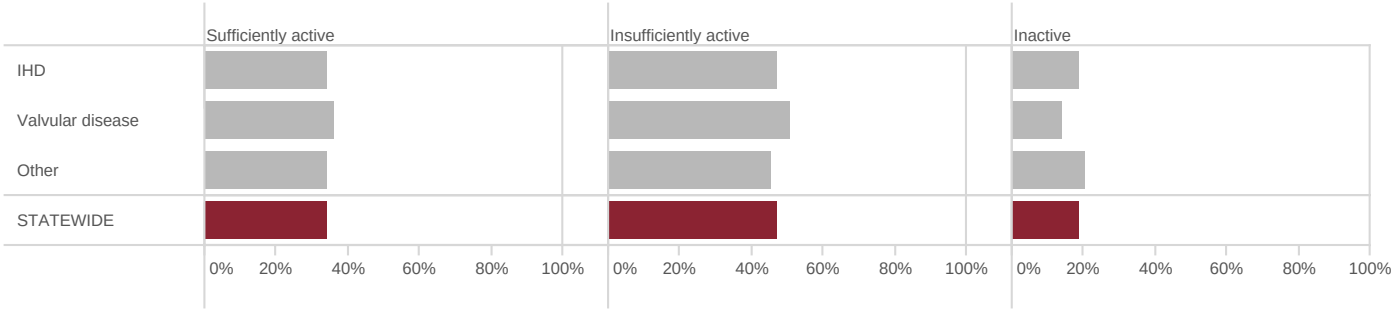


Figure 14: Activity level by diagnosis category

44.2.10 Alcohol consumption

The majority of patients indicated at the initial assessment that they did not consume any alcohol at all (60%).[25] 12% of patients exceeded the guideline of two standard drinks per day.[25]

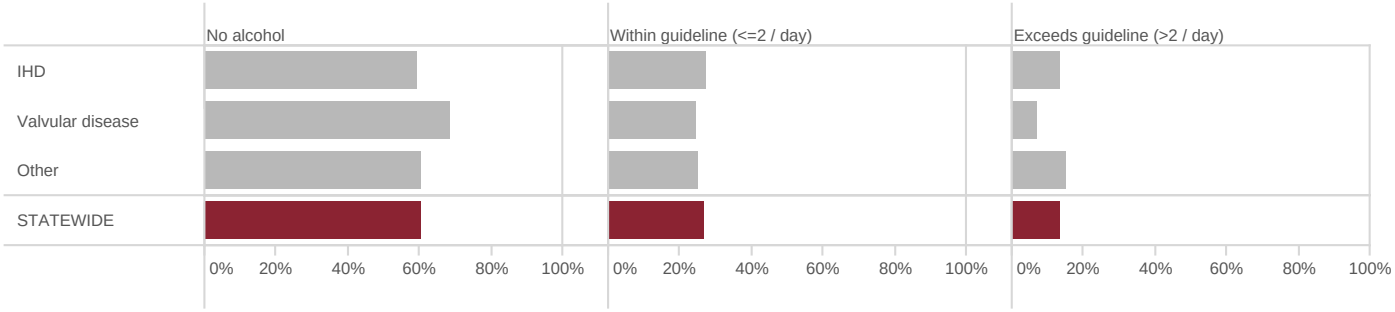


Figure 15: Alcohol consumption by diagnosis category

44.3 Current medications

Table 8: Current medications by diagnosis category

Medications	IHD (%)	Valvular disease (%)	Other (%)	ALL (%)
Aspirin	87.2	57.7	66.9	79.3
ACEI / ARB	61.2	42.3	52.9	57.5
Antiplatelet	64.3	10.0	35.3	52.2
Anticoagulant	15.2	55.9	25.3	21.0
Beta blocker	62.4	48.0	54.0	59.0
Lipid lowering	86.2	53.4	71.0	79.5
Sublingual nitrate	54.6	4.3	28.0	43.5
Diabetic medications	20.4	10.7	21.8	20.1
Diuretic	10.5	29.2	19.2	14.3
Other medications	44.3	57.3	49.6	46.8

45 Clinical indicators

For this first annual report, the initial emphasis has been towards the introduction of the QCOR CR module to outpatient programs and the collection of data supporting the CR QIP. The two clinical indicators included are similar to those used by Queensland Health to determine eligibility for the CR QIP reward:

1. Timely referral – proportion of patients receiving a referral to CR within three calendar days of hospital discharge.
2. Timely assessment – proportion of timely referrals to CR where the patient completed an initial CR assessment within 28 days of hospital discharge.

For reporting purposes the QCOR CR committee determined that these indicators would be applied to all public inpatient referrals regardless of whether the patient had had an overnight stay (which is required for CR QIP eligibility).

Future reports will expand the clinical indicator analysis to include additional clinical performance and quality benchmarks. This will include an analysis of changes in patient risk factors between the CR pre-assessment and post assessment.

As data collection continues to evolve, opportunities to examine outcome measures such as patient rehospitalisation and mortality will be explored.

45.1 Timely referral

The vast majority (94%) of referrals generated within a public hospital to a participating CR program were made within three days of the patient being discharged.

Performance was consistent across most sites, however, there were some challenges associated with the implementation of the new QCOR module due to logistical and technical barriers. This may explain some observed variation.

Table 9: Inpatient referrals created within three days of discharge from a Queensland Health facility

	Referrals (n)
Eligible for analysis	4,724
Achieved target	4,440
Target not achieved	284
Ineligible for analysis	1,404
Not a Queensland Health referral	757
Not an inpatient referral	647
Incomplete data	240
Total referrals	**6,368**

Table 10: Proportion of CR referrals completed within 3 days of hospital discharge by acute site

HHS	Acute site	Total analysed (n)	Met 3 day target (%)
Cairns and Hinterland	Cairns Hospital	238	94.5
Central Queensland	Gladstone Hospital	6	–
	Rockhampton Hospital	350	97.1
Darling Downs	Chinchilla Hospital	1	–
	Toowoomba Hospital	84	94.0
Gold Coast	Gold Coast University Hospital	610	82.8
Mackay	Mackay Base Hospital	100	99.0
	Proserpine Hospital	1	–
Mater Health Services	Mater Hospital Brisbane	30	73.3
Metro North	Caboolture Hospital	84	96.4
	Redcliffe Hospital	13	–
	Royal Brisbane & Women's Hospital	245	79.6
	The Prince Charles Hospital	969	97.5
Metro South	Logan Hospital	123	99.2
	Princess Alexandra Hospital	800	98.4
	Queen Elizabeth II Jubilee Hospital	29	96.6
	Redland Hospital	44	97.7
North West	Mount Isa Base Hospital	5	–
Sunshine Coast	Gympie Hospital	6	–
	Sunshine Coast University Hospital	457	98.5
Townsville	The Townsville Hospital	409	93.2
West Moreton	Ipswich Hospital	41	85.4
Wide Bay	Bundaberg Base Hospital	79	96.2
STATEWIDE		**4,724**	**94.0**

Sites not displayed where there are less than 20 cases available for analysis

45.2 Timely assessment

From the sub-group of patients that receive a timely referral, the timely assessment indicator is calculated. The target is that a comprehensive patient initial assessment occurs within 28 days of the patient being discharged from hospital.

There was a total of 4,440 acute referrals which met the target for timely referral, and are thus eligible for this indicator.

Table 11: Acute referrals assessed within 28 days of hospital discharge

	Referrals (n)
Eligible for analysis	2,624
Achieved target	2,236
Target not achieved	388
Ineligible for analysis	1,771
Patient declined	615
Other reason	375
Clinically unstable / inappropriate	292
Unable to contact	199
Referred outside of Queensland Health	162
Failure to attend	60
Readmitted to hospital	47
Patient deceased	21
Incomplete data	45
Total timely inpatient referrals	**4,440**

Table 12: Proportion of pre assessments completed within 28 days of hospital discharge by HHS

HHS	Total analysed (n)	Met 28 day target (%)	Median days to assessment
Cairns and Hinterland	180	87.2	21
Central Queensland	189	31.2	46
Central West*	9	–	–
Darling Downs	79	83.5	18
Gold Coast	238	91.2	7
Health Contact Centre	464	85.8	14
Mackay	61	75.4	19
Metro North	254	85.4	15
Metro South	522	92.9	10
North West	29	86.2	14
South West*	13	–	–
Sunshine Coast	319	97.8	13
Townsville	90	94.4	8
West Moreton	103	91.3	13
Wide Bay	74	82.4	20
STATEWIDE	**2,624**	**85.2**	**14**

* Not displayed due to less than 20 assessments available for analysis

Table 13: Proportion of pre assessments completed within 28 days of hospital discharge by site

HHS	CR program	Total analysed (n)	Met 28 day target (%)	Median days to assessment
Cairns and Hinterland	Atherton	4	–	–
	Cairns	146	91.8	20
	Innisfail	11	–	–
	Mareeba	5	–	–
	Mossman	9	–	–
	Tully	5	–	–
Central Queensland	Biloela	5	–	–
	Capricorn Coast	3	–	–
	Gladstone	42	50.0	28.5
	Rockhampton	139	25.9	52
Central West	Longreach	9	–	20
Darling Downs	Chinchilla-Miles	1	–	–
	Dalby	4	–	–
	Kingaroy	18	–	–
	Toowoomba	46	91.3	16
	Warwick	10	–	–
Gold Coast	Gold Coast University Hospital	238	91.2	7
Health Contact Centre	COACH	464	85.8	14
Mackay	Mackay	52	76.9	19
	Proserpine	9	–	–
Metro North	Caboolture	51	92.2	15
	Chermside	88	88.6	11
	North Lakes	86	75.6	21
	Redcliffe	29	93.1	15
Metro South	Bayside	122	91.8	11.5
	Eight Mile Plains	51	98.0	8
	Inala	43	97.7	8
	Logan-Beaudesert	213	96.7	7
	Princess Alexandra Hospital	93	80.6	21
North West	Mt Isa	29	86.2	14
South West	Charleville	5	–	–
	Roma	8	–	–
Sunshine Coast	Caloundra	82	100.0	12.5
	Gympie	56	98.2	13
	Maroochydore	42	100.0	13
	Nambour	83	95.2	14
	Noosa	56	96.4	14.5
Townsville	Ingham	7	–	–
	Townsville	83	100.0	8
West Moreton	Ipswich	103	91.3	13
Wide Bay	Hervey Bay	51	82.4	20
	Maryborough	23	82.6	20
STATEWIDE		**2,624**	**85.2**	**14**

Sites not displayed where there are less than 20 cases available for analysis

46 Conclusions

This first QCOR report captures 6 months of activity and data relating to 6,368 referrals to 44 participating outpatient CR programs from July through December 2017. The information provides an initial snapshot of the clinical characteristics of patients referred to outpatient CR, while the initial focus has been towards the initial implementation of the CR module to capture CR QIP activity.

Going forward, it is hoped that outpatient CR programs would use the QCOR CR solution to capture all inpatient, outpatient, private, GP and self-referrals, which would allow comprehensive reporting across the breadth of outpatient CR. This will provide great opportunities for CR programs to undertake service planning and reviews using QCOR data.

The report shows that acute sites are performing well, with 94% of referrals made within three days of hospital discharge even though not all hospitals have a dedicated CR nurse seven days per week. This high level of performance indicates that this responsibility can be shared across the hospital community.

Timely assessment by the CR outpatient program (pre assessment conducted within 28 days of hospital discharge) occurred in 84% of cases. The majority of HHSs achieved this target in over 80% of cases, however there is considerable variation in target achievement across the state. This should prompt further exploration and mapping of resourcing, staffing and CR service delivery models. Furthermore, investigation of the underlying reasons for patients declining to attend outpatient CR has been identified as a priority for further expansion of the dataset.

The Queensland Health CR QIP ceased on 30 June 2018, however key indicators will continue to be monitored through QCOR. The QCOR CR module has proven to be very useful in capturing quality data to enable benchmarking and allow service improvements to be measured. The transition to the ongoing use of QCOR and implementation of an ongoing clinical indicator program in the absence of CR QIP is essential to ensure ongoing quality measurement and benchmarking of care delivery for this patient cohort.

47 Recommendations

The introduction of QCOR CR module has provided a standardised means for capturing structured CR data for the first time. This initial review generates an unprecedented snapshot of statewide CR practice that will be instrumental in development and further refining of services offered to Queenslanders. To assist and maintain success of the program, it is recommended that:

1. CR clinicians continue the support and commitment toward the QCOR initiative in order to build a more comprehensive view of a patient's journey through CR in Queensland. This would include using the CR module for all patients attending outpatient CR, such as referrals from general practitioners, private hospitals and self-referrals.
2. The registry builds upon existing collaboration with Queensland Health internal partners such as the Clinical Excellence Division and System Performance Reporting to ensure continued delivery of health service economic benefits beyond the initial period of the CR QIP.
3. The QCOR CR module is enhanced to further provide a platform that accommodates the breadth of CR services now and into the future. These enhancements may consider the increasing role of mobile devices, telephone-based programs such as COACH and local challenges of individual site resourcing and regional accessibility.
4. The potential to enhance QCOR beyond the existing dataset is explored, and developed into an extended specification that encompasses further measures in the areas of physical wellbeing and exercise. Similarly, exploration of alternative quality of life measures with the goal of being able to provide enhanced patient-centred outcome indicators.
5. The CR module builds upon existing site-based initiatives to understand patient needs outside traditional CR offerings. This would include investigation of declined and non-assessment reasons for service planning as well as developing the capabilities of QCOR to link with non-Queensland Health services such as interstate health agencies and private CR programs.
6. CR clinicians continue to work collaboratively to expand and develop a comprehensive evidence-based clinical indicator frame-work. This will enable enhanced data quality and improvement in the ability to benchmark statewide clinical practice across participating sites.

Heart Failure Support Services Audit

48 Message from the Heart Failure Services Steering Committee Chairs

It is our pleasure to release the second annual report of clinical performance for Heart Failure Support Services (HFSS) in Queensland Health. The 2017 report presents findings for patients with a diagnosis of heart failure who are referred to one of the 23 multidisciplinary support services across Queensland Health.

Similar to last year, this report presents findings on a range of clinical performance indicators for patients referred to the services in the 2017 calendar year. In addition, this year we are pleased to present 30-day through to 12-month outcome data (mortality, readmission, and time out of hospital) for the 2016 cohort.

The report includes information on a select group of clinical indicators reflective of best practice at a state-wide and local level. Patient outcomes are reported at a statewide level.

We would like to thank the dedicated heart failure nurses and other healthcare providers whose commitment to data collection allows the monitoring of both process and outcome measures of healthcare. This report provides reassurance regarding a number of quality performance measures, and reveals some variations in practice, which will inform healthcare planning and practice at a local level. This report also allows for benchmarking with other jurisdictions and provides valuable information about overall standards of care for patients with chronic heart failure in Queensland.

Finally, we would like to acknowledge the patients and their families referred to heart failure services who have to manage a multitude of factors as a consequence of their 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.

A/Prof John Atherton and Ms Tracey Nunan
Co-chairs
Queensland Heart Failure Services Steering Committee of the SCCN

49 Key findings

Heart Failure Support Services (HFSS) help patients at high risk of hospitalisation and are comprised of multidisciplinary teams with specialist medical support. Audit findings are summarised below:

Characteristics of referrals to the 21 participating HFSS for 2017

- There were 4,528 new referrals (13% increase from 2016)
- Identified Aboriginal and Torres Strait Islander patients made up 4.1% of all referrals
- Most referrals to HFSS were: located in South East Queensland (84%); from inpatient settings (71%); male (65%) and with heart failure associated with a reduced left ventricular ejection fraction (HFrEF) (79%)
- The overall median age was 70 years with: males younger than females (69 vs 74 years); and those with HFrEF ten years younger than those with a preserved left ventricular ejection fraction (HFpEF) (68 vs 78 years).
- A higher proportion of patients with HFpEF were female (55%), whereas patients with HFrEF were predominately male (67%).

Clinical indicators for 2017

Process indicators measured the proportion of eligible patients who received specific interventions. At a statewide level, most indicators met benchmarks except for those relating to beta blocker titration review and achievement.

Table 1: Summary of clinical process indicator performance

#	Clinical process indicator measure	% referrals
1a	First clinical review within 2 weeks for inpatient referrals	79
1b	First clinical review within 4 weeks for non-acute referrals	87*
2	Left ventricular ejection fraction (LVEF) assessed within 2 years of referral	94*
3a	ACEI/ARB† prescription at hospital discharge	91*
3b	ACEI/ARB† prescription at time of first clinical review	92*
4a	Beta blocker‡ prescription at hospital discharge	88*
4b	Beta blocker‡ prescription at time of first clinical review	89*
5a	Beta blocker‡ titration review within six months of first clinical review	71
5b	Beta blocker‡ clinical guideline target dose achieved at time of titration review	34
5c	Beta blocker‡ clinical guideline target or maximum tolerated dose achieved at time of titration review	70

* 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 analyses are based on the 2016 cohort to allow for measures to be applied up to 12 months from the index hospitalisation discharge date. Key findings for patients referred from an inpatient setting are summarised in Table 2. Subgroup analysis suggests differences in outcomes according to age and heart failure phenotype.

Table 2: Summary of patient outcomes within one year

#	Measures post index hospitalisation*	30 days	1 year
1	All-cause mortality	1.6%	13.6%
2	a) All-cause rehospitalisation	18.3%	57.7%
	b) Heart failure rehospitalisation	5.8%	22.5%
3	Composite all-cause hospitalisation or all-cause mortality	18.7%	58.7%
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 60% of patients had additional time in hospital

Recommendations

Overall performance with respect to clinical indicators is very high, however the review and titration of beta blockers for up to 6 months remains a challenge for most services. Initial works are currently underway to provide patient management tools to assist HFSS with patient tracking. Departmental resourcing considerations and strategies such as increased nurse-led titration clinics may also assist in ensuring patients receive optimal therapies.

Patient outcomes provide important baseline information and will be further enhanced with the collection of clinical data necessary for risk adjustment. While the majority of reported clinical indicators are pharmacological, the dataset should be extended so that non-pharmacological interventions, such as exercise programs, which also impact upon patient outcomes are included for analysis.

50 Participating sites

Queensland HFSS are multidisciplinary teams that assist patients with heart failure (HF) to adhere to treatment and manage symptoms. These teams are comprised of HF nurses with specialist medical support. Some services may include pharmacists, physiotherapists or exercise physiologists, and other allied health professionals.

Statewide coordination of these services provides training and promotes an evidence-based, consistent approach in delivery of care across the state.

Services provided by Queensland HFSS include:

- Active case finding throughout the hospital with an opt-out approach
- Patient and carer education during and post hospitalisation
- Discharge coordination between the inpatient treating team and primary care services, including GP
- Heart failure multidisciplinary clinic and/or telephone-based follow-up or home visits or exercise program
- Medical follow-up that may include heart failure, general cardiology or medical outpatient clinics depending on local resources and patient preferences.

HF nurses entered data relating to all patients referred to their HFSS as part of routine care, using a web-based system which allows reporting of patient characteristics and benchmarking on five clinical indicators. Nurses are provided with weekly reminders regarding fields that require completion and patients due for a review of medication titration status at six months post referral.

When patients are referred onto another HFSS, the audit is completed only for the specific aspect of the journey of care delivered by the site.

Of the 23 HFSS in Queensland, 21 contributed data to this report. The Advanced Heart Failure and Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital) was not included this year due to interrupted data entry. Toowoomba Hospital was excluded from analysis due to incomplete data, leaving 20 HFSS included in the reporting of clinical indicators.

Figure 1: Heart Failure Support Service (HFSS) locations

Table 3 shows the range of activities offered by Queensland HFSS in 2017. All HFSS provide telephone support.

Table 3: Activities offered by Queensland HFSS

HHS*	HFSS	Inpatient support	Pharmacist	Exercise therapist	Group rehab	Nurse clinics	Home visits	NP†	Specialist medical review onsite‡
Cairns and Hinterland	Cairns Hospital	Y	-	Y	Y	Y	Y	Y	Y
Central Queensland	Gladstone Hospital	-	-	Y	Y	-	Y	-	Telehealth
	Rockhampton Hospital	Y	Y	Y	Y	Y	Y	Y	Y
Darling Downs	Toowoomba Hospital	Y	-	Y	-	Y	Y	-	Y
Gold Coast	Gold Coast Community Health	Y	Y	Y	Y	Y	Y	-	Y
Mackay	Mackay Base Hospital	Y	-	Y	Y	Y	Y	-	Y
Metro North	Caboolture Hospital	Y	Y	-	-	Y	-	-	Y
	Redcliffe Hospital	-	-	-	-	-	Y	-	Y
	RBWH§	Y	Y	Y	Y	Y	-	-	Y
	TPCH‖	Y	Y	Y	Y	Y	Y	Y	Y
Metro South	Logan Hospital	Y	Y	Y	Y	Y	Y	Y	Y
	Mater Adult Brisbane	Y	-	-	-	Y	Y	Y	Y
	PAH#	Y	Y	Y	Y	Y	Y	Y	Y
	QEII**	Y	Y	-	-	Y	Y	Y	Y
	Redland Hospital	Y	-	Y	Y	Y	Y	Y	Y
North West	Mt Isa	Y	-	-	-	-	Y	Y	Outreach
Sunshine Coast	Gympie Hospital	Y	-	-	-	Y	Y	Y	Outreach
	SCUH‡‡	Y	-	-	-	Y	Y	Y	Y
Townville	Townsville Hospital	Y	Y	Y	-	Y	Y	Y	Y
West Moreton	Ipswich Community Health	Y	Y	Y	Y	Y	Y	Y	Y
Wide Bay	Bundaberg	Y	-	Y	Y	-	-	-	Y
	Hervey Bay Hospital	Y	-	Y	Y	Y	Y	Y	Telehealth
STATEWIDE		**91%**	**45%**	**73%**	**64%**	**82%**	**86%**	**64%**	**82%**

* Hospital and Health Service

† Nurse practitioner who can prescribe medications

‡ Review by cardiologist or general physician with interest in heart failure

§ Royal Brisbane & Women's Hospital

‖ The Prince Charles Hospital

\# Princess Alexandra Hospital

** Queen Elizabeth II Hospital

‡‡ Includes Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital (SCUH) in March 2017

51 New referrals

In 2017, there were 4,528 new referrals reported by 21 participating HFSS. This represents a 12.6% increase from the first Queensland Cardiac Outcomes Registry (QCOR) HFSS annual report in 2016, where the total number of referrals reported was 4,021.

Patients readmitted to hospital whilst being monitored by a HFSS are not counted as a new referral. Most patients are monitored for at least six months to review medication titration.

51.1 Location of referrals

The two services reporting the highest number of new referrals were Princess Alexandra Hospital (n=721), followed by The Prince Charles Hospital (n=576).

Table 4: Distribution of new referrals by HFSS location

HHS	HFSS	n	%
Cairns and Hinterland	Cairns Hospital	128	2.8%
Central Queensland	Gladstone Hospital	33	0.7%
	Rockhampton Hospital	197	4.4%
Darling Downs	Toowoomba Hospital	-	-
Gold Coast	Gold Coast Community Health	421	9.3%
Mackay	Mackay Base Hospital	102	2.3%
Metro North	Caboolture Hospital	181	4.0%
	Redcliffe Hospital	92	2.0%
	Royal Brisbane & Women's Hospital	307	6.8%
	The Prince Charles Hospital	576	12.7%
Metro South	Logan Hospital	350	7.7%
	Mater Adult Hospital	111	2.5%
	Princess Alexandra Hospital	721	15.9%
	Queen Elizabeth II Hospital	116	2.6%
	Redland Hospital	165	3.6%
North West	Mt Isa Hospital	22	0.5%
Sunshine Coast	Gympie Hospital	125	2.8%
	Sunshine Coast University Hospital*	365	8.1%
Townsville	Townsville Hospital	175	3.9%
West Moreton	Ipswich Community Health	286	6.3%
Wide Bay	Bundaberg Hospital	-	-
	Hervey Bay Hospital	55	1.2%
STATEWIDE		**4,528**	**100.0%**

* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

The distribution of referrals between South East Queensland (84%) and the rest of the state (16%) is consistent with the findings of the previous QCOR annual report.

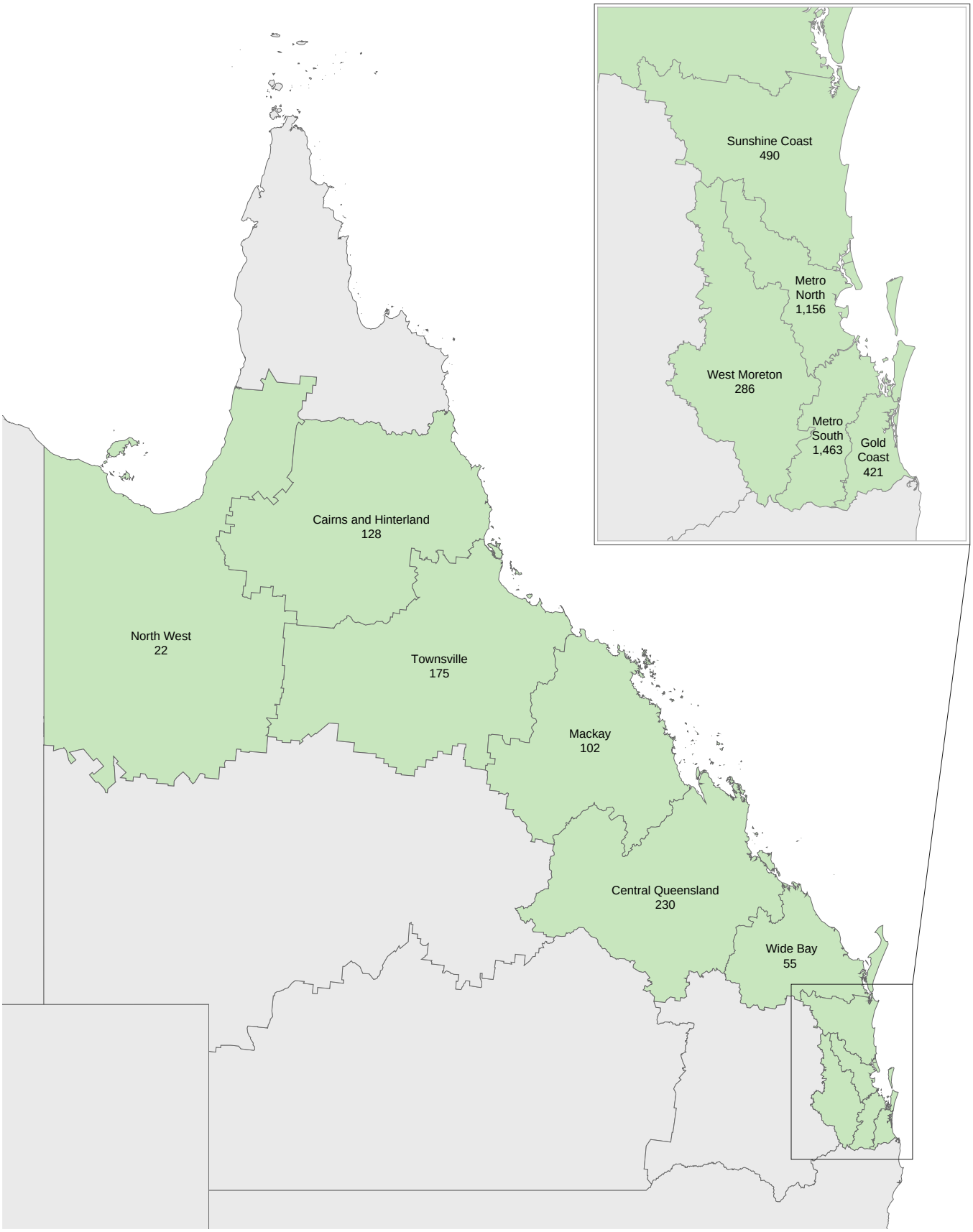


Figure 2: Regional distribution of new referrals

51.2 Referral source

Most referrals originate from an inpatient setting (71%).

Few non-acute referrals came directly from primary care (4%), which may be due to these referrals flowing to specialty outpatient clinics for diagnosis and treatment optimisation prior to referral to a HFSS.

Table 5: Proportion by referral source

HHS	HFSS	Inpatient n (%)	Outpatient n (%)	Another HFSS n (%)	Primary care n (%)
Cairns and Hinterland	Cairns Hospital	58 (45.3)	68 (53.1)	2 (1.6)	-
Central Queensland	Gladstone Hospital	13 (39.4)	1 (3.0)	18 (54.5)	1 (3.0)
	Rockhampton Hospital	104 (52.8)	48 (24.4)	14 (7.1)	31 (15.7)
Gold Coast	Gold Coast Community Health	291 (69.1)	82 (19.5)	18 (4.3)	30 (7.1)
Mackay	Mackay Base Hospital	56 (54.9)	42 (41.2)	3 (2.9)	1 (1.0)
Metro North	Caboolture Hospital	26 (14.4)	53 (29.3)	2 (1.1)	100 (55.2)
	Redcliffe Hospital	77 (83.7)	13 (14.1)	2 (2.2)	-
	Royal Brisbane & Women's Hospital	249 (81.1)	54 (17.6)	4 (1.3)	-
	The Prince Charles Hospital	533 (92.5)	35 (6.1)	7 (1.2)	1 (0.2)
Metro South	Logan Hospital	253 (72.3)	29 (8.3)	67 (19.1)	1 (0.3)
	Mater Adult Hospital	87 (78.4)	23 (20.7)	1 (0.9)	-
	Princess Alexandra Hospital	680 (94.3)	30 (4.2)	11 (1.5)	-
	Queen Elizabeth II Hospital	87 (75.0)	18 (15.5)	10 (8.6)	1 (0.9)
	Redland Hospital	60 (36.4)	33 (20.0)	69 (41.8)	3 (1.8)
North West	Mt Isa Hospital	5 (22.7)	16 (72.7)	-	1 (4.5)
Sunshine Coast	Gympie Hospital	68 (54.4)	18 (14.4)	38 (30.4)	1 (0.8)
	Sunshine Coast University Hospital*	312 (85.5)	44 (12.1)	7 (1.9)	2 (0.5)
Townsville	Townsville Hospital	110 (62.9)	57 (32.6)	3 (1.7)	5 (2.9)
West Moreton	Ipswich Community Health	133 (46.5)	106 (37.1)	46 (16.1)	1 (0.3)
Wide Bay	Hervey Bay Hospital	5 (9.1)	15 (27.3)	31 (56.4)	4 (7.3)
STATEWIDE		**3,207 (70.8)**	**785 (17.3)**	**353 (7.8)**	**183 (4.0)**

* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

52 Patient characteristics

52.1 Age

The statewide median age of patients managed by a HFSS was 70 years. The median age of women (74 years) was five years older than for men.

The Mt Isa Hospital reported the youngest median age of 56 years and Redcliffe Hospital the oldest median of 79 years. Nearly a quarter of patients were 80 years of age and older.

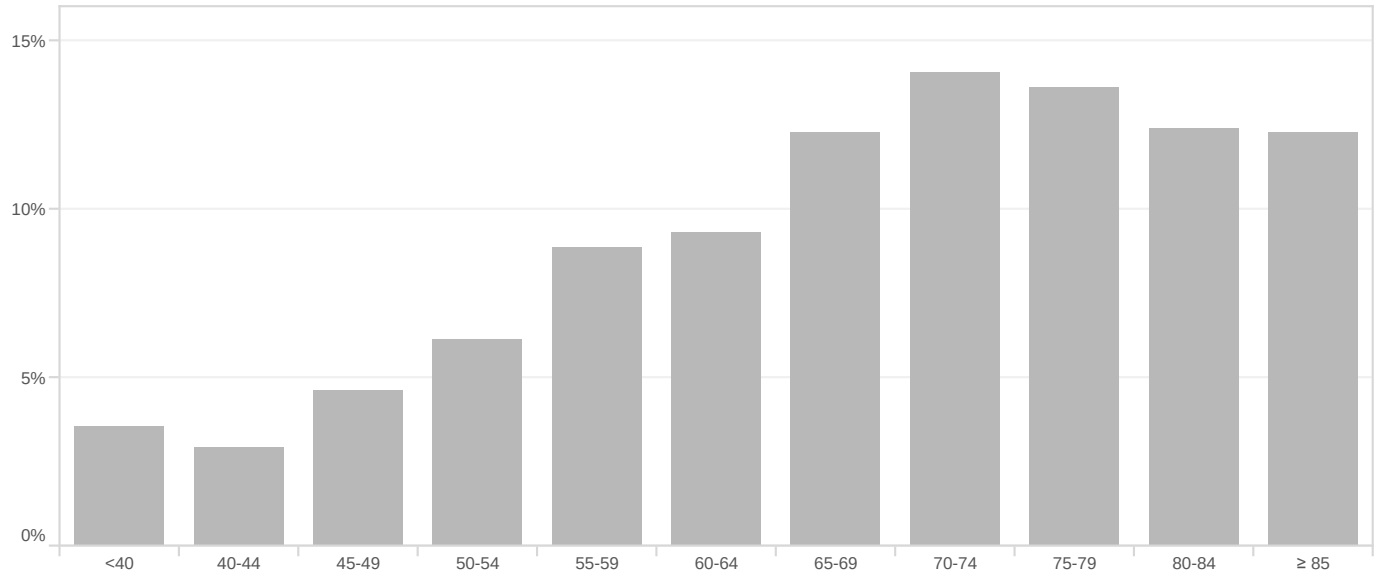


Figure 3: Age groups at referral to a HFSS

Table 6: Median age (years) of referrals by gender

HHS	HFSS	Male	Female	ALL
Cairns and Hinterland	Cairns Hospital	62	63	62
Central Queensland	Gladstone Hospital	66	63	64
	Rockhampton Hospital	67	71	68
Gold Coast	Gold Coast Community Health	71	77	73
Mackay	Mackay Base Hospital	72	65	69
Metro North	Caboolture Hospital	71	69	70
	Redcliffe Hospital	78	79	79
	Royal Brisbane & Women's Hospital	67	71	68
	The Prince Charles Hospital	72	78	74
Metro South	Logan Hospital	68	74	70
	Mater Adult Hospital	67	69	68
	Princess Alexandra Hospital	66	71	67
	Queen Elizabeth II Hospital	73	75	74
	Redland Hospital	71	73	71
North West	Mt Isa Hospital	57	44	56
Sunshine Coast	Gympie Hospital	74	78	76
	Sunshine Coast University Hospital*	70	77	72
Townsville	Townsville Hospital	63	69	64
West Moreton	Ipswich Community Health	67	70	67
Wide Bay	Hervey Bay Hospital	72	72	72
STATEWIDE		**69**	**74**	**70**

* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

52.2 Gender

The majority of referrals were males (65%), ranging from 53% to 74% across sites.

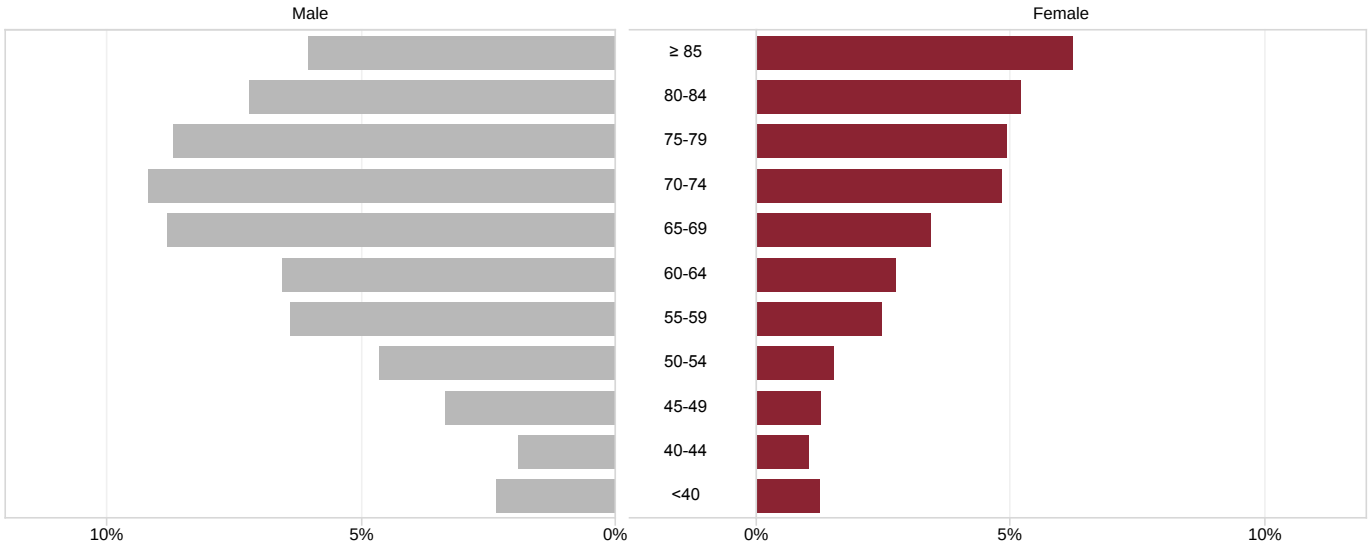
Table 7: Number and proportion of referrals to HFSS by gender

HHS	HFSS	Male n (%)	Female n (%)
Cairns and Hinterland	Cairns Hospital	84 (65.6)	44 (34.4)
Central Queensland	Gladstone Hospital	21 (63.6)	12 (36.4)
	Rockhampton Hospital	127 (64.5)	70 (35.5)
Gold Coast	Gold Coast Community Health	277 (65.8)	144 (34.2)
Mackay	Mackay Base Hospital	74 (72.5)	28 (27.5)
Metro North	Caboolture Hospital	118 (65.2)	63 (34.8)
	Redcliffe Hospital	49 (53.3)	43 (46.7)
	Royal Brisbane & Women's Hospital	215 (70.0)	92 (30.0)
	The Prince Charles Hospital	386 (67.0)	190 (33.0)
Metro South	Logan Hospital	211 (60.3)	139 (39.7)
	Mater Adult Hospital	63 (56.8)	48 (43.2)
	Princess Alexandra Hospital	493 (68.4)	228 (31.6)
	Queen Elizabeth II Hospital	66 (56.9)	50 (43.1)
	Redland Hospital	99 (60.0)	66 (40.0)
North West	Mt Isa Hospital	15 (68.2)	7 (31.8)
Sunshine Coast	Gympie Hospital	73 (58.4)	52 (41.6)
	Sunshine Coast University Hospital*	240 (65.8)	125 (34.2)
Townsville	Townsville Hospital	114 (65.1)	61 (34.9)
West Moreton	Ipswich Community Health	179 (62.6)	107 (37.4)
Wide Bay	Hervey Bay Hospital	41 (74.5)	14 (25.5)
STATEWIDE		**2,945 (65.0)**	**1,583 (35.0)**

* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

52.2.1 Gender by age group

The age distribution of referrals differed for gender. The highest proportion of referrals for males was in the 70 to 74 years age group (9% of all referrals or 14% of males), and for females the over 85 years category (6% of all referrals or 18% of females).



% of total (n=4,528)

Figure 4: Proportion of referrals to HFSS by gender and age group

52.3 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of health with a particular impact on the development of cardiovascular disease. In Aboriginal and Torres Strait Islander populations a higher age-adjusted incidence and prevalence of hypertension, coronary artery disease, and rheumatic heart disease has been observed. These are well-recognised pathological precursors for the pathogenesis of symptomatic HF.[26]

Patients of identified Aboriginal and Torres Strait Islander status made up 4.1% of all HFSS referrals, with considerable variation between services. Cairns, Mount Isa, and Townsville all reported greater than 15% of case load as being Aboriginal and Torres Strait Islander.

The highest proportion of Aboriginal and Torres Strait Islander patient referrals was reported by Mt Isa Hospital (46%), while the highest absolute number of referrals for Aboriginal and Torres Strait Islander patients reported by Princess Alexandra Hospital (n=33), followed by Townsville Hospital (n=28).

Table 8: Proportion of identified Aboriginal and Torres Strait Islander patients by HFSS

HHS	HFSS	n	%
Cairns and Hinterland	Cairns Hospital	23	18.0
Central Queensland	Gladstone Hospital	2	6.1
	Rockhampton Hospital	13	6.6
Gold Coast	Gold Coast Community Health	2	0.5
Mackay	Mackay Base Hospital	4	3.9
Metro North	Caboolture Hospital	4	2.2
	Redcliffe Hospital	0	0.0
	Royal Brisbane & Women's Hospital	15	4.9
	The Prince Charles Hospital	12	2.1
Metro South	Logan Hospital	10	2.9
	Mater Adult Hospital	5	4.5
	Princess Alexandra Hospital	33	4.6
	Queen Elizabeth II Hospital	2	1.7
	Redland Hospital	3	1.8
North West	Mt Isa Hospital	10	45.5
Sunshine Coast	Gympie Hospital	2	1.6
	Sunshine Coast University Hospital*	3	0.8
Townsville	Townsville Hospital	28	16.0
West Moreton	Ipswich Community Health	12	4.2
Wide Bay	Hervey Bay Hospital	2	3.6
STATEWIDE		**185**	**4.1**

* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

52.4 Classification of heart failure by left ventricular ejection fraction

Heart failure with reduced left ventricular ejection fraction (HFrEF) was defined as patients with an ejection fraction (EF) less than 50% at time of diagnosis. Some patients may return to a normal ejection fraction (greater than 50%) but still require ongoing medications to manage HFrEF.[27]

The majority (79%) of patients had HFrEF at the time of diagnosis. While information about EF was missing for 5% of patients there was a lot of variation between sites. This suggests that diagnosis is less than optimal at some sites due to poor access to echocardiography.

Table 9: Proportion of patients by heart failure type

HHS	HFSS	HFrEF* n (%)	HFpEF† n (%)	Missing/unsure n (%)
Cairns and Hinterland	Cairns Hospital	123 (96.1)	4 (3.1)	1 (0.8)
Central Queensland	Gladstone Hospital	29 (87.9)	1 (3.0)	3 (9.1)
	Rockhampton Hospital	170 (86.3)	26 (13.2)	1 (0.5)
Gold Coast	Gold Coast Community Health	301 (71.5)	107 (25.4)	13 (3.1)
Mackay	Mackay Base Hospital	97 (95.1)	5 (4.9)	-
Metro North	Caboolture Hospital	139 (76.8)	32 (17.7)	10 (5.5)
	Redcliffe Hospital	38 (41.3)	22 (23.9)	32 (34.8)
	Royal Brisbane & Women's Hospital	255 (83.1)	44 (14.3)	8 (2.6)
	The Prince Charles Hospital	406 (70.5)	116 (20.1)	54 (9.4)
Metro South	Logan Hospital	233 (66.6)	92 (26.3)	25 (7.1)
	Mater Adult Hospital	96 (86.5)	6 (5.4)	9 (8.1)
	Princess Alexandra Hospital	610 (84.6)	99 (13.7)	12 (1.7)
	Queen Elizabeth II Hospital	90 (77.6)	20 (17.2)	6 (5.2)
	Redland Hospital	118 (71.5)	15 (9.1)	32 (19.4)
North West	Mt Isa Hospital	21 (95.5)	1 (4.5)	-
Sunshine Coast	Gympie Hospital	78 (62.4)	40 (32.0)	7 (5.6)
	Sunshine Coast University Hospital‡	311 (85.2)	50 (13.7)	4 (1.1)
Townsville	Townsville Hospital	162 (92.6)	6 (3.4)	7 (4.0)
West Moreton	Ipswich Community Health	236 (82.5)	47 (16.4)	3 (1.0)
Wide Bay	Hervey Bay Hospital	46 (83.6)	9 (16.4)	-
STATEWIDE		**3,559 (78.6)**	**742 (16.4)**	**227 (5.0)**

* Heart failure with reduced ejection fraction

† Heart failure with preserved ejection fraction

‡ Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

The median age for patients with HFrEF was 68 years, compared to a median age of 78 years for patients with HFpEF. The higher proportion of patients with HFpEF were female (55%), whereas patients with HFrEF were predominately male (70%).

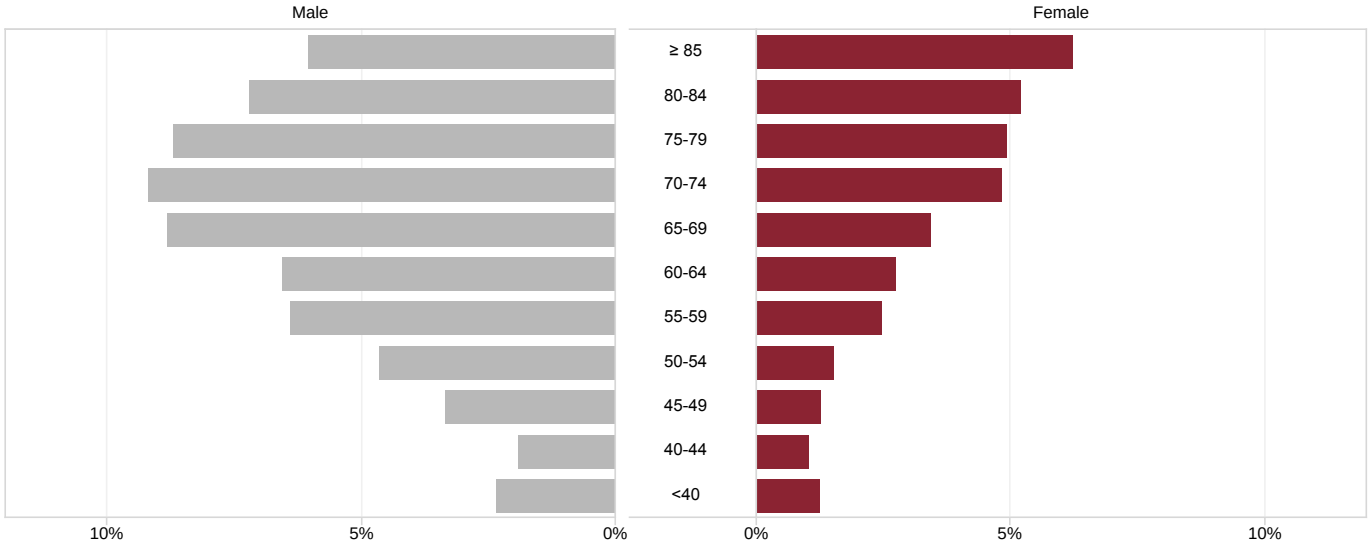
Table 10: Type of heart failure by age, gender, and Aboriginal and Torres Strait Islander status

	HFrEF*	HFpEF†
Number	3,559	742
Age (median years)	68	78
Male %	69.8%	45%
Indigenous %	4.4%	3.2%

Excluding missing data (5.0%)

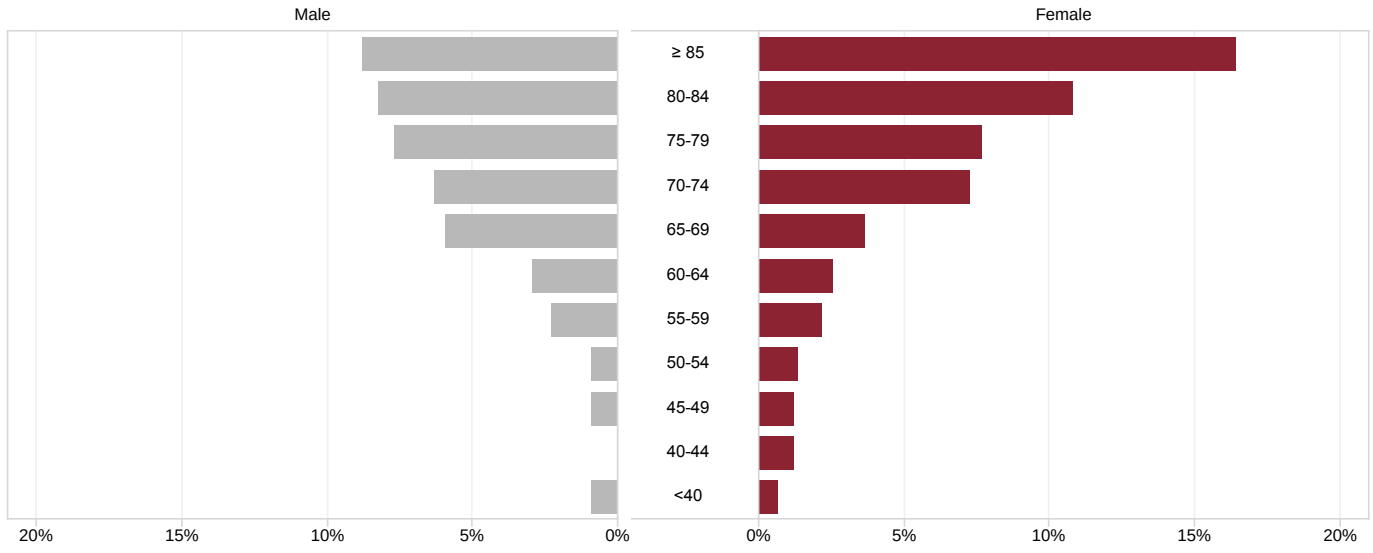
* Heart failure with reduced ejection fraction

† Heart failure with preserved ejection fraction



% of total with HFrEF (n=3,559)

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



% of total with HFpEF (n=742)

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

52.5 Summary of patient characteristics

An outline of patient characteristics for all referrals to HFSS is included below.

Table 11: Summary of patient characteristics

Characteristic	Summary
Participating HFSS	21
New referrals	4,528
Referrals from South East Queensland	84.3%
Referral source:	
Inpatient	70.8%
Outpatient	17.3%
Another HFSS	7.8%
Primary care	4.0%
Age (median years):	
All (median, range by service)	70 (56–79) years
Male vs. Female	74 vs 69 years
Indigenous vs. non-Indigenous	55 vs 71 years
80 years and over	24.6%
Males	65.1%
Indigenous	4.1%
HFrEF*	78.6% (69.8% male, median age 68 years)
HFpEF†	16.4% (45.0% male, median age 78 years)

* Heart failure with reduced ejection fraction

† Heart failure with preserved ejection fraction

53 Clinical indicators

The number of clinical indicators collected was intentionally limited to allow pragmatic data entry as part of routine clinical practice. Consensus on the content and methods of collecting data was reached following a Delphi method involving all HFSS in Queensland. Five process indicators were agreed upon as shown in Table 12. 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%.[28]

Table 12: 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 (LVEF) 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

53.1 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.

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).

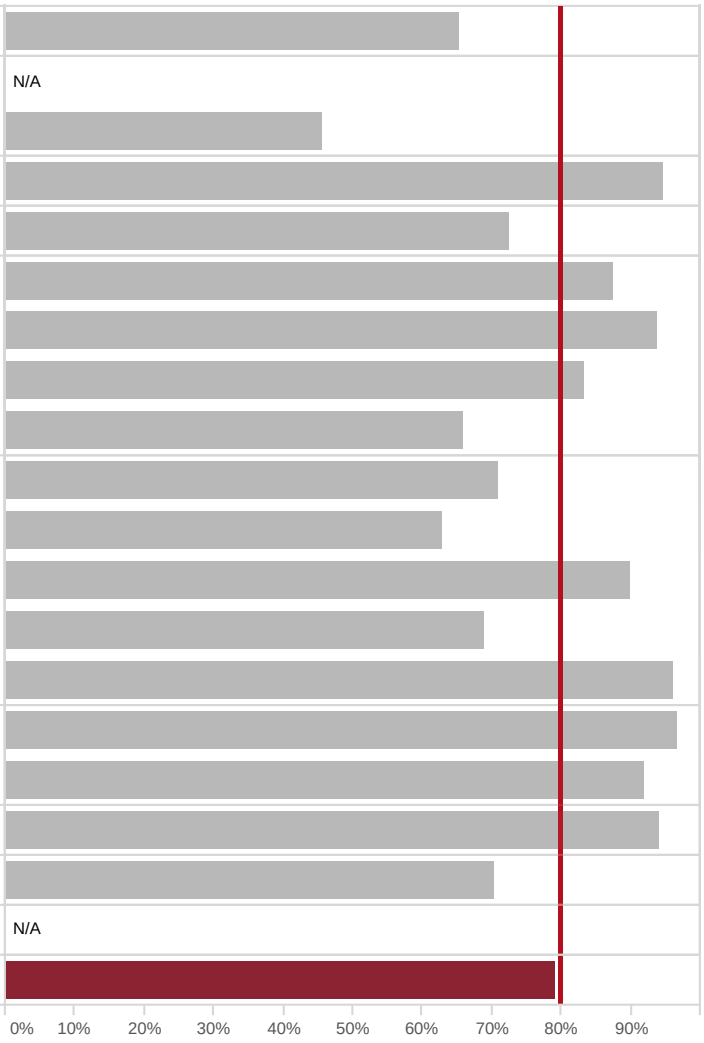
Early post discharge follow-up is recommended for patients with HF to monitor symptoms, provide education and support self-management principles. The appropriate timeframe chosen for this intervention was review within two weeks of hospital discharge or date of referral after recent hospitalisation.

Of the 2,097 eligible patients referred from an acute setting, 79% received a clinical review by HFSS within two weeks of hospital discharge. The desired benchmark of 80% was achieved by 9/17 (53%) of HFSS that had more than 20 cases eligible for analysis.

Table 13: Inpatients receiving first HFSS clinical review within 2 weeks of hospital discharge

	n	%
Eligible for analysis	2,097	
Achieved benchmark	1,656	79.0%
Benchmark not achieved	441	21.0%
Ineligible	1,078	
Referred to another HFS	603	
Other reason	212	
Patient declined service	144	
Patient could not be contacted	80	
Patient deceased	39	
Missing data	32	
Total acute patients	**3,207**	

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	49
Central Queensland	Gladstone Hospital	10
	Rockhampton Hospital	101
Gold Coast	Gold Coast Community Health	225
Mackay	Mackay Base Hospital	51
Metro North	Caboolture Hospital	24
	Redcliffe Hospital	32
	Royal Brisbane & Women's Hospital	150
	The Prince Charles Hospital	356
Metro South	Logan Hospital	185
	Mater Adult Hospital	51
	Princess Alexandra Hospital	243
	Queen Elizabeth II Hospital	74
	Redland Hospital	52
Sunshine Coast	Gympie Hospital	59
	Sunshine Coast University Hospital*	236
Townsville	Townsville Hospital	85
West Moreton	Ipswich Community Health	105
Wide Bay	Hervey Bay Hospital	5
STATEWIDE		



Note: Mt Isa Hospital (North West HHS) is not displayed due to no cases eligible for analysis

* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

Figure 7: Proportion of inpatients who received first HF Support Service clinical review within 2 weeks of hospital discharge or date of referral if received after discharge

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

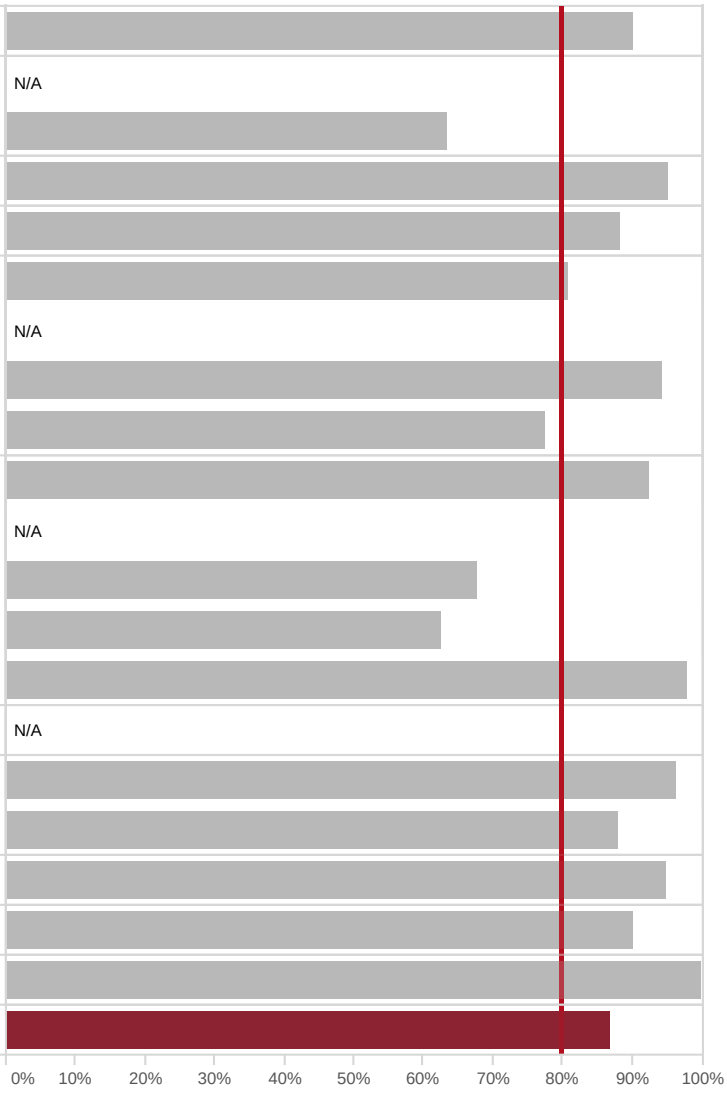
For non-acute patients, the Statewide HF Steering Committee determined four weeks following referral to be the recommended time frame for first clinical review.

Referrals for 1,182 eligible patients came from non-acute services, of which 87% received a clinical review within 4 weeks of referral. The desired benchmark of 80% was achieved by 12/16 (75%) of HFSS that had more than 20 cases eligible for analysis.

Table 14: Non-acute patients receiving first HFSS clinical review within 4 weeks of referral

	n	%
Eligible for analysis	1,182	
Achieved benchmark	1,026	86.8%
Benchmark not achieved	156	13.2%
Ineligible	126	
Patient declined service	39	
Other reason	31	
Patient could not be contacted	29	
Referred to another HFS	21	
Patient deceased	6	
Incomplete data	13	
Total non-acute patients	**1,321**	

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	60
Central Queensland	Gladstone Hospital	17
	Rockhampton Hospital	90
Gold Coast	Gold Coast Community Health	106
Mackay	Mackay Base Hospital	43
Metro North	Caboolture Hospital	147
	Redcliffe Hospital	9
	Royal Brisbane & Women's Hospital	52
	The Prince Charles Hospital	31
Metro South	Logan Hospital	81
	Mater Adult Hospital	18
	Princess Alexandra Hospital	34
	Queen Elizabeth II Hospital	24
	Redland Hospital	96
North West	Mt Isa Hospital	16
Sunshine Coast	Gympie Hospital	56
	Sunshine Coast University Hospital*	50
Townsville	Townsville Hospital	60
West Moreton	Ipswich Community Health	142
Wide Bay	Hervey Bay Hospital	50
STATEWIDE		



* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

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

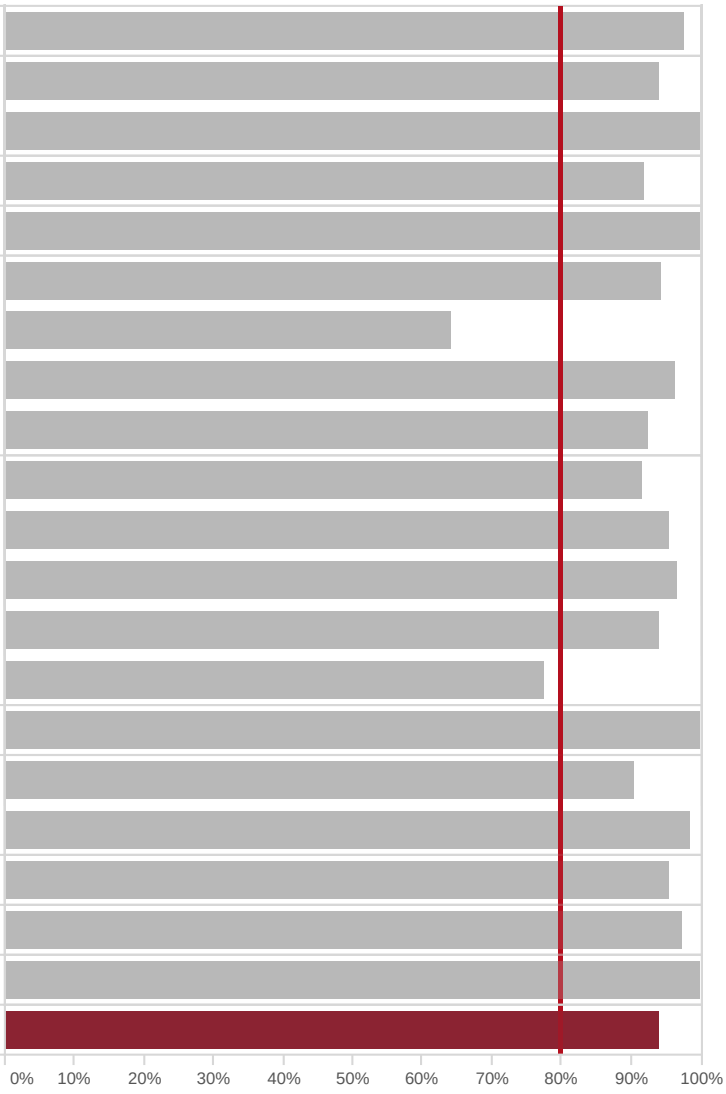
Australian clinical guidelines recommend that all patients with HF should have an assessment of left ventricular function.[27] In 94% of cases, LVEF was assessed within two years of referral to HFSS.

The benchmark of 80% was achieved by 18 out of 20 (90%) HFSS that had more than 20 cases eligible for analysis.

Table 15: Patients who had LVEF assessed within two years of referral

	n	%
Eligible for analysis	4,513	
Achieved benchmark	4,243	94.0%
Benchmark not achieved	270	6.0%
Ineligible	N/A	
Incomplete data	15	
Total referrals	**4,528**	

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	128
Central Queensland	Gladstone Hospital	33
	Rockhampton Hospital	197
Gold Coast	Gold Coast Community Health	421
Mackay	Mackay Base Hospital	102
Metro North	Caboolture Hospital	179
	Redcliffe Hospital	92
	Royal Brisbane & Women's Hospital	307
	The Prince Charles Hospital	564
Metro South	Logan Hospital	350
	Mater Adult Hospital	110
	Princess Alexandra Hospital	721
	Queen Elizabeth II Hospital	116
	Redland Hospital	165
North West	Mt Isa Hospital	22
Sunshine Coast	Gympie Hospital	125
	Sunshine Coast University Hospital*	365
Townsville	Townsville Hospital	175
West Moreton	Ipswich Community Health	286
Wide Bay	Hervey Bay Hospital	55
STATEWIDE		



* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

53.3 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

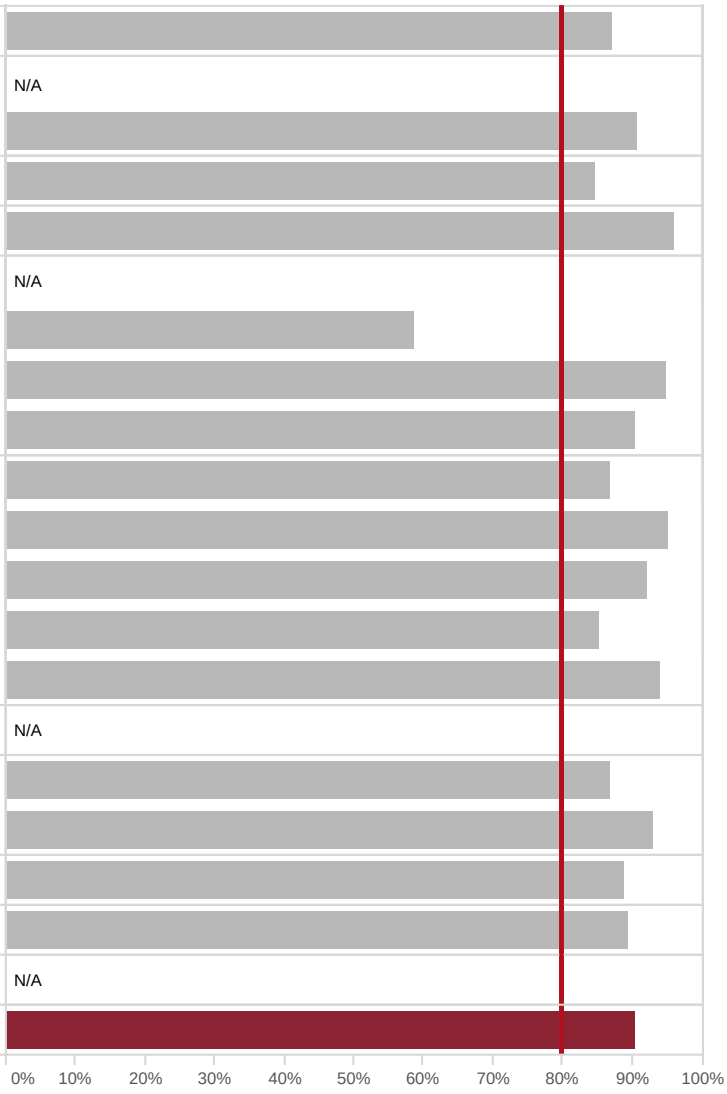
In 2017, 91% of patients referred to a HFSS were prescribed an ACEI or ARB therapy on hospital discharge. The benchmark of 80% was achieved by 16/17 (90%) of HFSS that had more than 20 cases eligible for analysis.

Table 16: Inpatients on ACEI or ARB at time of hospital discharge

	n	%
Eligible for analysis	2,182	
Achieved benchmark	1,974	90.5%
Benchmark not achieved	208	9.5%
Ineligible	907	
Documented contraindication*	159	
Not HFrEF	613	
LV Function assessment not available	135	
Incomplete data	118	
Total acute patients	**3,207**	

* 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

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	55
Central Queensland	Gladstone Hospital	11
	Rockhampton Hospital	76
Gold Coast	Gold Coast Community Health	190
Mackay	Mackay Base Hospital	50
Metro North	Caboolture Hospital	13
	Redcliffe Hospital	29
	Royal Brisbane & Women's Hospital	197
	The Prince Charles Hospital	260
Metro South	Logan Hospital	143
	Mater Adult Hospital	61
	Princess Alexandra Hospital	534
	Queen Elizabeth II Hospital	55
	Redland Hospital	34
North West	Mt Isa Hospital	4
Sunshine Coast	Gympie	23
	Sunshine Coast University Hospital*	250
Townsville	Townsville Hospital	99
West Moreton	Ipswich Community Health	96
Wide Bay	Hervey Bay Hospital	2
STATEWIDE		



* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

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

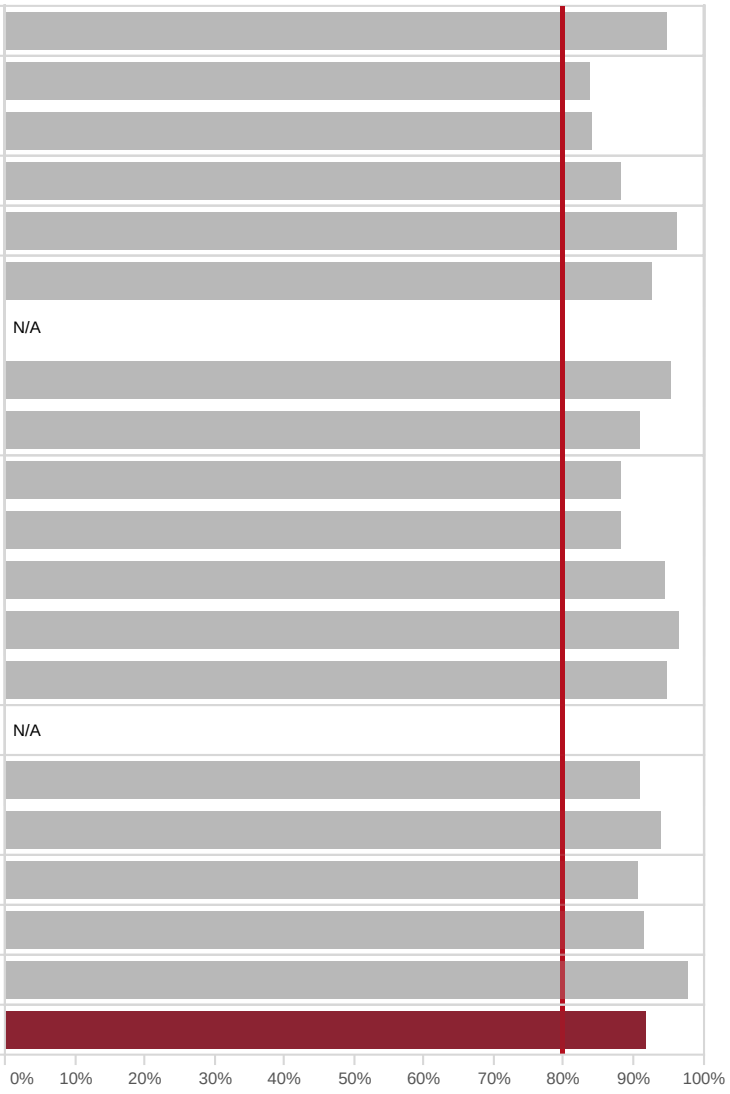
At the time of first clinical review, the target for prescription of ACEI or ARB was met for 92% of patients. The benchmark of 80% was achieved by 18/18 (100%) of HFSS that had more than 20 cases eligible for analysis.

Table 17: Patients on an ACEI or ARB at first clinical review

	n	%
Eligible for analysis	2,385	
Achieved benchmark	2,191	91.9%
Benchmark not achieved	194	8.1%
Ineligible	2,053	
Referred to another HFSS	624	
Not HFrEF	608	
Other reason	243	
Patient declined service	183	
Documented contraindication*	141	
Patient could not be contacted	109	
LV function assessment not available	100	
Patient deceased	45	
Incomplete data	90	
Total referrals	**4,528**	

* 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

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	101
Central Queensland	Gladstone Hospital	25
	Rockhampton Hospital	158
Gold Coast	Gold Coast Community Health	225
Mackay	Mackay Base Hospital	87
Metro North	Caboolture Hospital	111
	Redcliffe Hospital	11
	Royal Brisbane & Women's Hospital	155
	The Prince Charles Hospital	221
Metro South	Logan Hospital	172
	Mater Adult Hospital	60
	Princess Alexandra Hospital	210
	Queen Elizabeth II Hospital	63
	Redland Hospital	100
North West	Mt Isa Hospital	19
Sunshine Coast	Gympie	66
	Sunshine Coast University Hospital*	231
Townsville	Townsville Hospital	131
West Moreton	Ipswich Community Health	194
Wide Bay	Hervey Bay Hospital	45
STATEWIDE		



* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

53.4 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

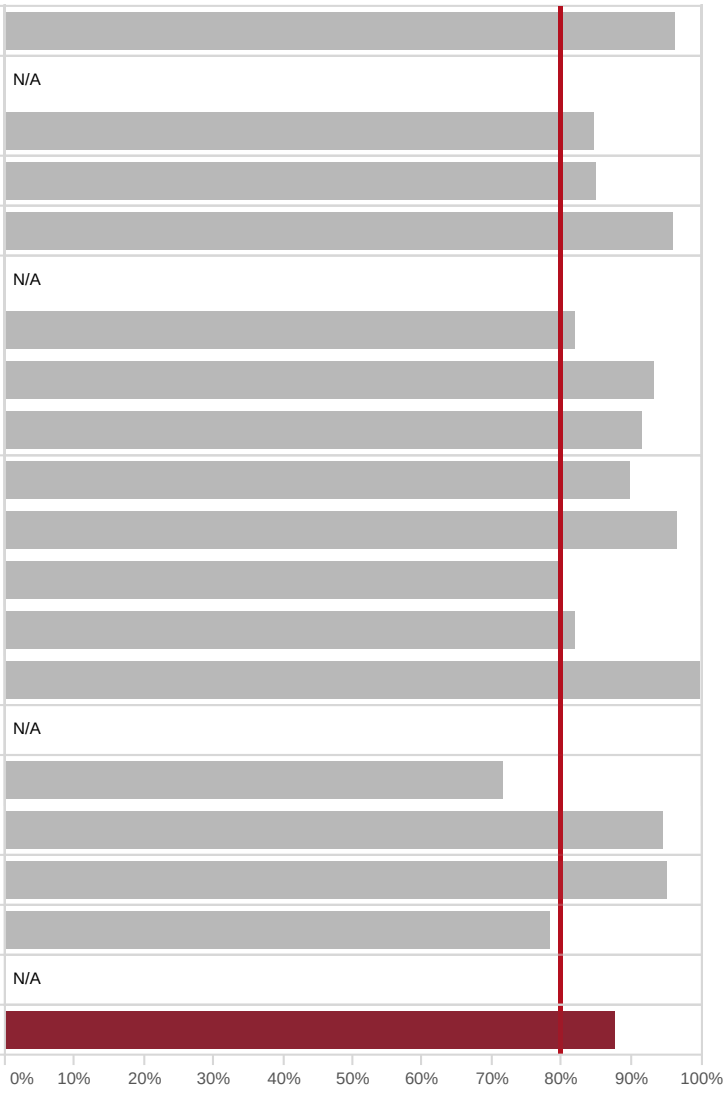
In 2017, 88% of referrals were reported to be on a guideline recommended beta blocker at the time of discharge from hospital. The benchmark of 80% was achieved by 13 out of 16 (81%) of HFSS that had more than 20 cases eligible for analysis.

Table 18: Patients on guideline recommended beta blocker at hospital discharge

	n	%
Eligible for analysis	2,281	
Achieved benchmark	2,003	87.8%
Benchmark not achieved	278	12.2%
Ineligible	808	
Not HFrEF	613	
LV Function assessment not available	135	
Documented contraindication*	60	
Incomplete data	118	
Total acute patients	**3,207**	

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

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	56
Central Queensland	Gladstone Hospital	11
	Rockhampton Hospital	78
Gold Coast	Gold Coast Community Health	201
Mackay	Mackay Base Hospital	51
Metro North	Caboolture Hospital	15
	Redcliffe Hospital	28
	Royal Brisbane & Women's Hospital	199
	The Prince Charles Hospital	278
Metro South	Logan Hospital	155
	Mater Adult Hospital	63
	Princess Alexandra Hospital	554
	Queen Elizabeth II Hospital	61
	Redland Hospital	37
North West	Mt Isa Hospital	4
Sunshine Coast	Gympie	28
	Sunshine Coast University Hospital*	256
Townsville	Townsville Hospital	102
West Moreton	Ipswich Community Health	102
Wide Bay	Hervey Bay Hospital	2
STATEWIDE		



* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

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

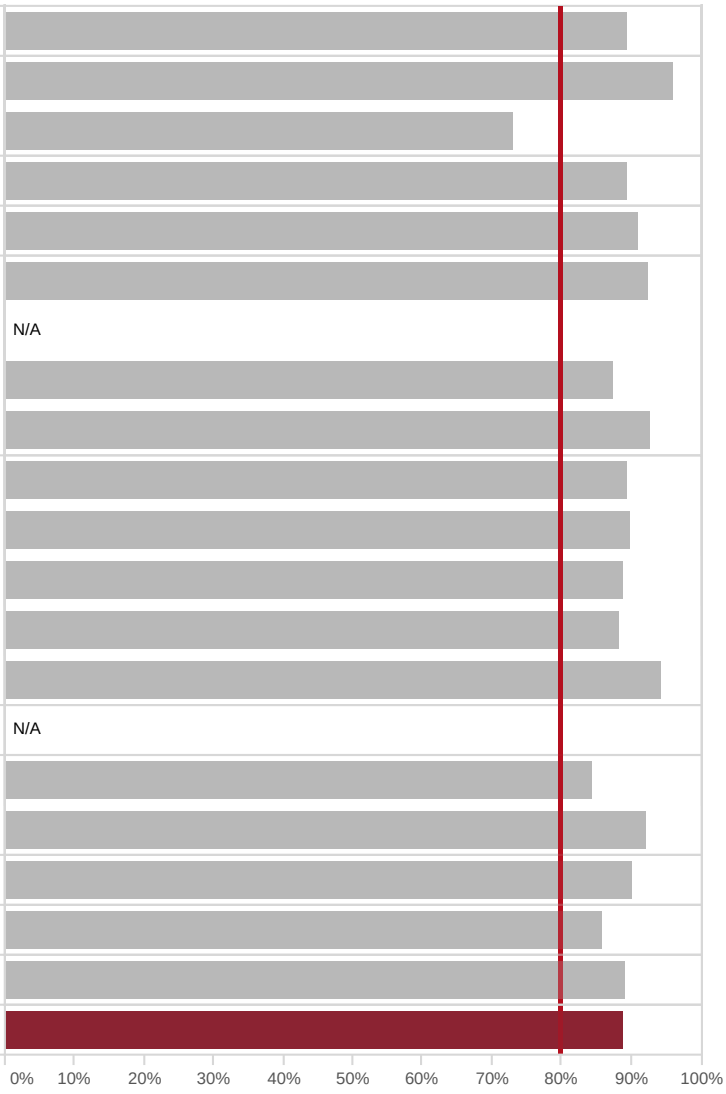
In 2017, 89% of referrals to HFSS were reported to be on a guideline recommended beta blocker at the time of first clinical review. The desired benchmark of 80% was achieved by 17 out of 18 (94%) of HFSS that had more than 20 cases eligible for analysis.

Table 19: Patients on guideline recommended beta blocker at first clinical review

	n	%
Eligible for analysis	2,465	
Achieved benchmark	2,193	89.0%
Benchmark not achieved	272	11.0%
Ineligible	1,971	
Referred to another HFSS	624	
Not HFrEF	608	
Other reason	243	
Patient declined service	183	
Patient could not be contacted	109	
LV function assessment not available	100	
Documented contraindication	59	
Patient deceased	45	
Incomplete data	92	
Total referrals	**4,528**	

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

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	105
Central Queensland	Gladstone Hospital	26
	Rockhampton Hospital	160
Gold Coast	Gold Coast Community Health	232
Mackay	Mackay Base Hospital	88
Metro North	Caboolture Hospital	121
	Redcliffe Hospital	11
	Royal Brisbane & Women's Hospital	158
	The Prince Charles Hospital	233
Metro South	Logan Hospital	174
	Mater Adult Hospital	59
	Princess Alexandra Hospital	215
	Queen Elizabeth II Hospital	77
	Redland Hospital	106
North West	Mt Isa Hospital	19
Sunshine Coast	Gympie	70
	Sunshine Coast University Hospital*	235
Townsville	Townsville Hospital	132
West Moreton	Ipswich Community Health	198
Wide Bay	Hervey Bay Hospital	46
STATEWIDE		



* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

53.5 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 time frame 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

Patients who received a beta blocker titration review at six months from referral or at the time of deactivation from the HFSS (whichever is sooner).

In 2017, 71% of patients received a beta blocker titration review at six months from referral or at the time of deactivation from the HFSS (whichever was sooner). The benchmark of 80% was achieved by 7/17 (41%) of HFSS that had more than 20 cases eligible for analysis.

Table 20: Patients who had a beta blocker titration review within six months

	n	%
Eligible for analysis	1,588	
Achieved benchmark	1,123	70.7%
Benchmark not achieved	465	29.3%
Ineligible	1,624	
Not HFrEF	547	
Patient on target dose at the time of referral	395	
Other reason	242	
LV function assessment not available	93	
Patient declined service	91	
Referred to another HFSS	84	
Documented contraindication*	66	
Patient could not be contacted	62	
Patient deceased	44	
Incomplete data	95	
Cases due for beta blocker review	**3,313**	

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

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	92
Central Queensland	Gladstone Hospital	21
	Rockhampton Hospital	178
Gold Coast	Gold Coast Community Health	112
Mackay	Mackay Base Hospital	73
Metro North	Caboolture Hospital	13
	Royal Brisbane & Women's Hospital	113
	The Prince Charles Hospital	130
Metro South	Logan Hospital	126
	Mater Adult Hospital	38
	Princess Alexandra Hospital	114
	Queen Elizabeth II Hospital	60
	Redland Hospital	34
North West	Mt Isa Hospital	8
Sunshine Coast	Gympie	46
	Sunshine Coast University Hospital*	146
Townsville	Townsville Hospital	112
West Moreton	Ipswich Community Health	115
Wide Bay	Hervey Bay Hospital	57
STATEWIDE		

* Note: Redcliffe Hospital (Metro North HHS) is not displayed due to no cases eligible for analysis

† Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

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

Daily target doses are:

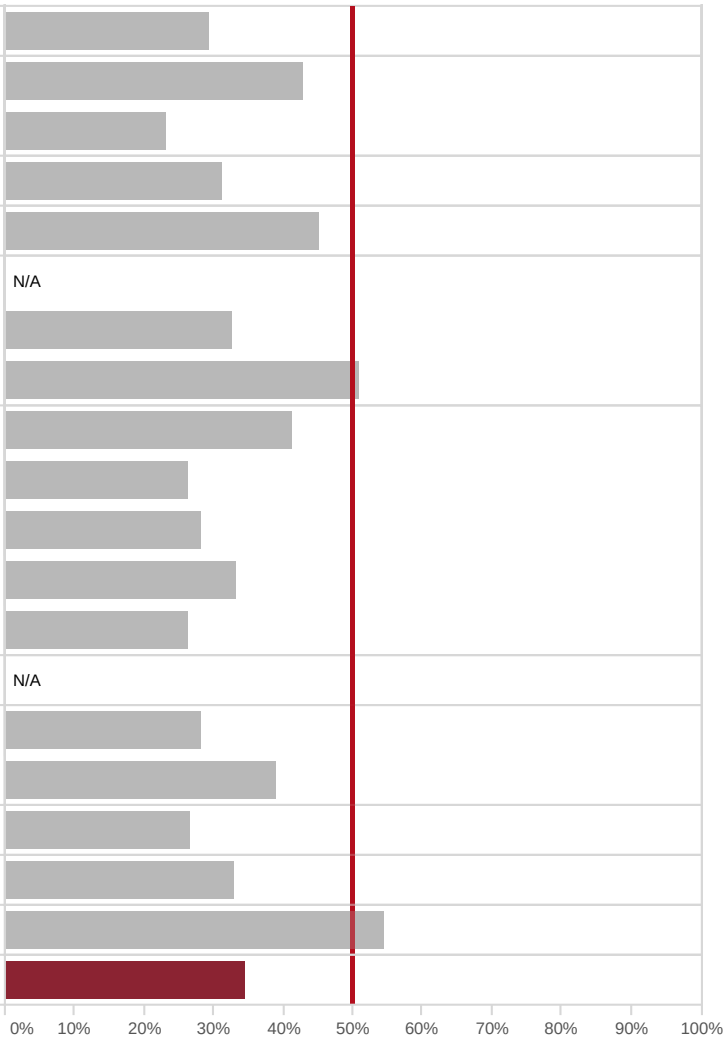
- Carvedilol 50–100 mg
- Metoprolol sustained release 190 mg
- Bisoprolol 10 mg
- Nebivolol 10 mg

Only 34% of referrals achieved target dose for guideline recommended beta blocker medication by the time of titration review at six months. The benchmark of 50% was achieved by 2 out of 17 (12%) of HFSS that had more than 20 cases eligible for analysis.

Table 21: Patients who achieved target beta blocker dose at time of titration review

	n	%
Titration reviews conducted	1,588	
Achieved benchmark	545	34.3%
Benchmark not achieved	1,043	65.7%

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	92
Central Queensland	Gladstone Hospital	21
	Rockhampton Hospital	178
Gold Coast	Gold Coast Community Health	112
Mackay	Mackay Base Hospital	73
Metro North	Caboolture Hospital	13
	Royal Brisbane & Women's Hospital	113
	The Prince Charles Hospital	130
Metro South	Logan Hospital	126
	Mater Adult Hospital	38
	Princess Alexandra Hospital	114
	Queen Elizabeth II Hospital	60
	Redland Hospital	34
North West	Mt Isa Hospital	8
Sunshine Coast	Gympie	46
	Sunshine Coast University Hospital*	146
Townsville	Townsville Hospital	112
West Moreton	Ipswich Community Health	115
Wide Bay	Hervey Bay Hospital	57
STATEWIDE		



* Note: Redcliffe Hospital (Metro North HHS) is not displayed due to no cases eligible for analysis

† Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

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

The number of patients reaching the target dose or maximum tolerated dose of guideline recommended beta blocker medication by the time of titration review at six months was 70%. The benchmark of 80% was achieved by 5/17 (29%) of HFSS that had more than 20 cases eligible for analysis.

Table 22: Patients who achieved target or maximum tolerated beta blocker dose at time of titration review

	n	%
Titration reviews conducted	1,588	
Achieved benchmark	1,106	69.6%
Benchmark not achieved	482	30.4%

HHS	HFSS	n
Cairns and Hinterland	Cairns Hospital	92
Central Queensland	Gladstone Hospital	21
	Rockhampton Hospital	178
Gold Coast	Gold Coast Community Health	112
Mackay	Mackay Base Hospital	73
Metro North	Caboolture Hospital	13
	Royal Brisbane & Women's Hospital	113
	The Prince Charles Hospital	130
Metro South	Logan Hospital	126
	Mater Adult Hospital	38
	Princess Alexandra Hospital	114
	Queen Elizabeth II Hospital	60
	Redland Hospital	34
North West	Mt Isa Hospital	8
Sunshine Coast	Gympie	46
	Sunshine Coast University Hospital*	146
Townsville	Townsville Hospital	112
West Moreton	Ipswich Community Health	115
Wide Bay	Hervey Bay Hospital	57
STATEWIDE		

* Note: Redcliffe Hospital (Metro North HHS) is not displayed due to no cases eligible for analysis

† Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

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

53.6 Summary of clinical indicators

The performance on clinical indicators is summarised in the Table 23, showing the proportions of all eligible (ideal) patients who received specific interventions. Benchmarks were set at 80% for all indicators except 5b (titration of beta blockers to clinical guideline target dose), which was 50%.

Performance was at or above benchmarks for:

- CI 1b (follow-up of non-acute patients in four weeks)
- CI 2 (LVEF assessment within two years)
- CI 3 (ACEI/ARB prescription at hospital discharge and at first clinical review)
- CI 4a and 4b (beta blocker prescription at hospital discharge and at first clinical review).

Areas in need of improvement were:

- CI 1a (follow-up of inpatients in two weeks); and
- CI 5a, 5b and 5c (beta blocker titration review and achievement of clinical guideline target dose). Variation between sites allows for targeted quality improvement interventions.

Table 23: 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	65	90	98	87	95	96	90	96	29	53
Central Queensland	Gladstone Hospital	–	–	94	–	84	–	96	52	43	57
	Rockhampton Hospital	46	63	100	91	84	85	73	15	23	47
Gold Coast	Gold Coast Community Health	95	95	92	85	88	85	90	77	31	69
Mackay	Mackay Base Hospital	73	88	100	96	97	96	91	70	45	78
Metro North	Caboolture Hospital	88	81	94	–	93	–	93	–	–	–
	Redcliffe Hospital	94	–	64	59	–	82	–	–	–	–
	Royal Brisbane & Women's Hospital	83	94	96	95	95	93	87	56	33	76
	The Prince Charles Hospital HFS	66	77	93	90	91	92	93	71	51	80
Metro South	Logan Hospital	71	93	92	87	88	90	90	96	41	84
	Mater Adult Hospital	63	–	96	95	88	97	90	97	26	42
	Princess Alexandra Hospital	90	68	97	92	95	80	89	89	28	67
	Queen Elizabeth II Hospital	69	63	94	86	97	82	88	58	33	75
	Redland Hospital	96	98	78	94	95	100	94	71	26	65
North West	Mt Isa Hospital	–	–	100	–	–	–	–	–	–	–
Sunshine Coast	Gympie Hospital	97	96	90	87	91	71	84	98	28	91
	Sunshine Coast University Hospital*	92	88	99	93	94	95	92	84	39	88
Townsville	Townsville Hospital	94	95	95	89	91	95	90	100	27	57
West Moreton	Ipswich Community Health	70	90	97	90	92	78	86	61	33	59
Wide Bay	Hervey Bay Hospital	–	100	100	–	98	–	89	42	54	89
STATEWIDE		**79**	**87**	**94**	**91**	**92**	**88**	**89**	**71**	**34**	**70**

* Totals include Nambour General Hospital prior to HFSS relocation to Sunshine Coast University Hospital in March 2017

Legend:

1a Follow-up of acute patients within 2 weeks

1b Follow-up of non-acute patients within 4 weeks

2 Assessment of left ventricular ejection fraction within 2 years

3a Angiotensin-converting-enzyme inhibitor or angiotensin II receptor blockers prescription at hospital discharge

3b Angiotensin-converting-enzyme inhibitor or angiotensin II receptor blockers prescription at first clinical review

4a Guideline recommended beta blocker prescription at hospital discharge

4b Guideline recommended beta blocker prescription at first clinical review

5a Beta blocker titration status review at six months post referral

5b Beta blockers achievement of guideline recommended target dose (bench mark 50%)

5c Beta blockers achievement of guideline recommended target dose or maximum tolerated dose

54 Patient outcomes

Heart failure hospitalisations are associated with subsequent increased risk of mortality and recurrent hospitalisation. Multidisciplinary HF disease management programmes such as HFSS and adherence to guideline recommended therapies are associated with improved post-discharge outcomes.

As part of this continuing quality improvement initiative, we sought to report the clinical outcomes of inpatient referrals to HFSS during 2016.

54.1 Methods

54.1.1 Data source

This analysis utilised the previously reported 2016 patient cohort[29] in the QCOR HFSS registry to examine the early (30-day) and one year clinical outcomes (rehospitalisation and mortality) among patients referred to HFSS through probabilistic data linkage using Queensland Hospital Admitted Patient Data Collection (QHAPDC) and Queensland Registry of Births, Deaths and Marriages.

54.1.2 Analysis eligibility criteria

For the purpose of this report, only HFSS referrals initiated during an inpatient encounter for 2016 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).

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

54.1.3 Clinical outcome measures and statistical analysis

The patient outcome measures of interest are summarised in Table 24. All-cause mortality survival curves were constructed using the Kaplan–Meier method. Cumulative incidence function 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. Differences in DAOH between sub-groups were compared using Mann-Whitney test. Categorical variables were summarised as frequencies and percentages.

Table 24: 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

54.2 Findings

In 2016, there were 2,868 inpatient referrals reported of which 2,608 referrals were eligible for data linkage. The success rate for linking referrals to administrative and death registry data was 95.5% (n=2,491).

A further 51 (1.8%) patients did not have complete follow up of 365 days to allow calculation of DAOH (Table 25).

Table 25: Eligibility criteria for patient outcome indicators

	n	%
Total 2016 inpatient referrals	**2,868**	**100.0**
Ineligible at index admission:		
Duplicate patient record	124	4.3
Not a Queensland resident	65	2.3
Transferred to private hospital	25	0.9
Index admission is not overnight	24	0.8
Died during index admission	22	0.8
No linkage data available	117	4.1
Included in readmission and mortality analysis	**2,491**	**86.9**
Ineligible at subsequent admissions for 1 year:		
Transferred to private hospital	49	1.7
Moved outside of Queensland	2	0.1
Included in days alive and out of hospital analysis	**2,440**	**85.1**

54.2.1 All-cause mortality

Among patients referred to HFSS during an inpatient encounter, the 30-day and one year unadjusted all-cause mortality rate were 1.6% and 13.6% respectively (Table 26). Survival curves suggest that gender was not associated with all-cause mortality at one year (Figure 17). In contrast, older age was associated with increased all-cause mortality at one year (Figure 18).

As an exploratory analysis, we examined the univariate association between the documented HF phenotype and subsequent all-cause mortality (Figure 3). Among this cohort of patients (i.e. those referred to HFSS), patients with documented HFpEF phenotype was associated with increased mortality. However, patients with either unknown or missing HF phenotype documentation were associated with the worst un-adjusted mortality risk (Figure 19).

Table 26: 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	41 (1.6)	125 (5.0)	201 (8.0)	340 (13.6)
Died during subsequent admission*	28 (1.1)	75 (3.0)	123 (4.9)	208 (8.4)
All other deaths	13 (0.5)	50 (2.0)	77 (3.1)	132 (5.3)
Total at risk	2,450 (98.4)	2,365 (95.0)	2,288 (92.0)	2,149 (86.4)

* Data available for Queensland public hospitals only

Table 27: 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	1,621	27 (1.7)	88 (5.4)	137 (8.4)	231 (14.3)
Female	870	14 (1.6)	37 (4.3)	64 (7.4)	109 (12.5)
Age group					
<65 years	852	8 (0.9)	21 (2.5)	29 (3.4)	50 (5.9)
65–74 years	662	12 (1.8)	33 (5.0)	49 (7.4)	78 (11.8)
≥75 years	977	21 (2.1)	71 (7.3)	123 (12.6)	212 (21.7)
Heart failure phenotype					
HFrEF	1,898	30 (1.6)	85 (4.5)	128 (6.7)	225 (11.9)
HFpEF	486	7 (1.4)	29 (6.0)	53 (10.9)	89 (18.3)
Missing/unsure	107	4 (3.7)	11 (10.3)	20 (18.7)	26 (24.3)

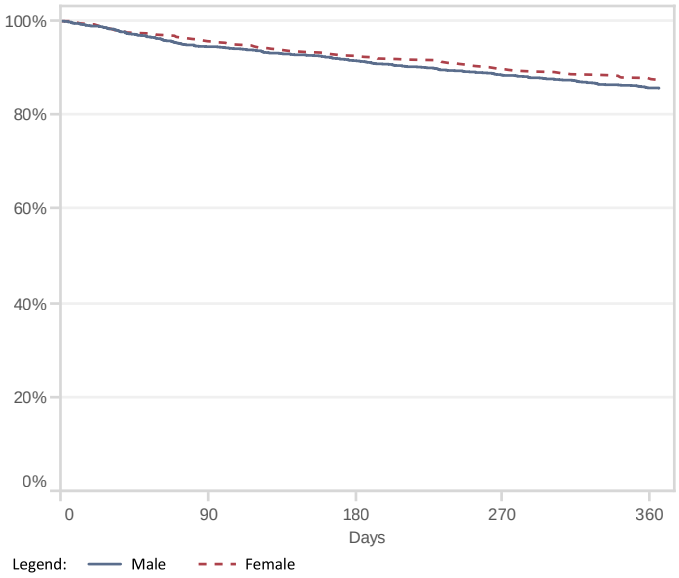


Figure 17: Heart failure survival by gender

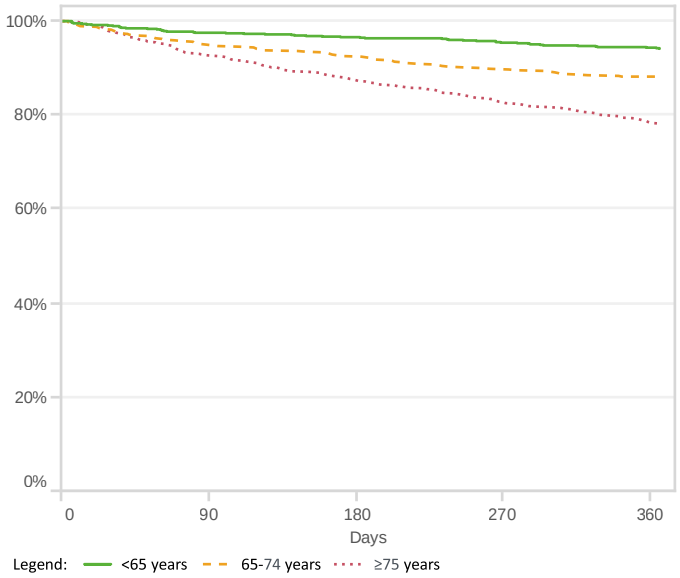


Figure 18: Heart failure survival by age group

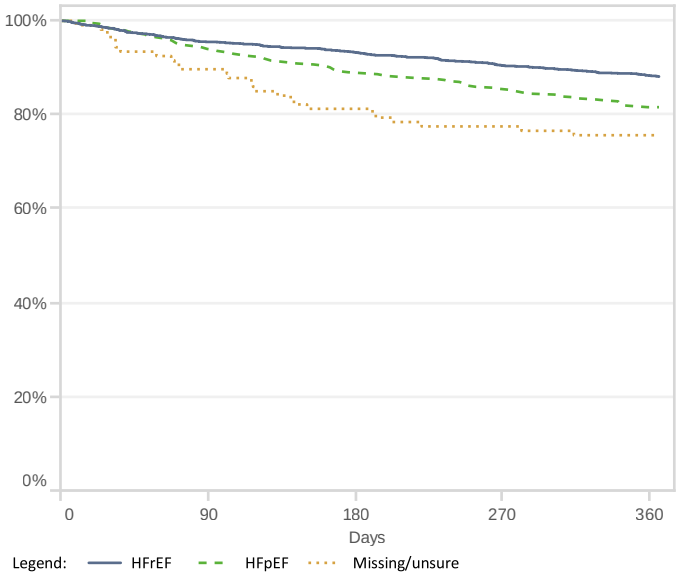


Figure 19: Heart failure survival by phenotype

54.2.2 All-cause and heart failure rehospitalisation

Cumulative incidence curves for all-cause and HF hospitalisation are shown in Figure 20 and 21. Of the 2,491 eligible patients referred to HFSS during 2016, the unadjusted rate of all-cause hospitalisation was 18.3% at 30-day, increasing to 57.7% at one year. HF related hospitalisation rates, as defined by primary discharge diagnosis coding (Appendix A), were 5.8% and 22.5% at 30-day and one year respectively.

Collectively, the risk of hospitalisation or death within 12 months after initial discharge among patients referred to HFSS during a hospitalisation was 58.7% at one year (Figure 22). Over 30% of patients referred to HFSS experienced two or more rehospitalisation during the subsequent year (Table 28).

Table 28: Number of rehospitalisations per patient over one year since discharge

	All cause rehospitalisation n (%)	Heart failure rehospitalisation n (%)
None	1,091 (43.8)	1,975 (79.3)
1 rehospitalisation	642 (25.8)	318 (12.8)
2 rehospitalisations	318 (12.8)	123 (4.9)
3 rehospitalisations	182 (7.3)	42 (1.7)
4 rehospitalisations	106 (4.3)	16 (0.6)
≥5 rehospitalisations	152 (6.1)	17 (0.7)

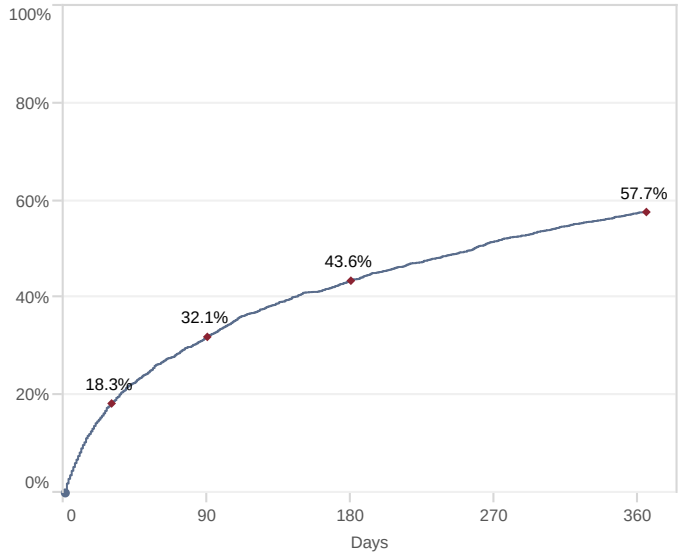


Figure 20: Cumulative incidence of all cause rehospitalisation

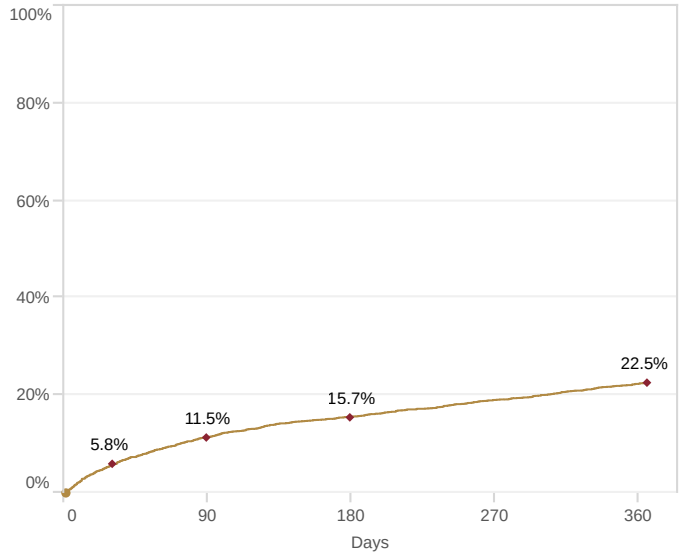


Figure 21: Cumulative incidence of heart failure rehospitalisation

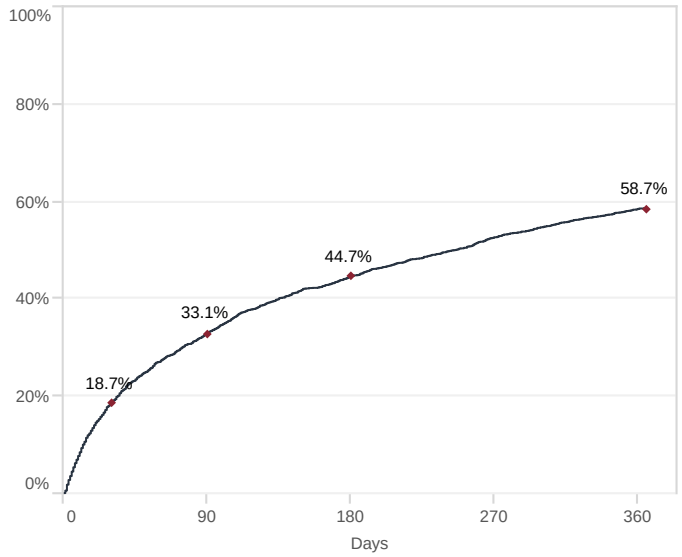


Figure 22: Cumulative incidence of all-cause rehospitalisation or death

54.2.2 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 into a single measure that reflects the patient's experience of living with this chronic condition. Although the median DAOH was 363.3 days, only approximately 40% of patients managed to spend no additional time in hospital after initial discharge.

Given that days lost due to early mortality or rehospitalisation with prolonged length of stay were driven by a small proportion of patients, we also present mean values to better capture overall burden for the patient cohort (with over 90,000 days lost due to death or hospitalisation in the total cohort of 2,440 patients over 12 months).

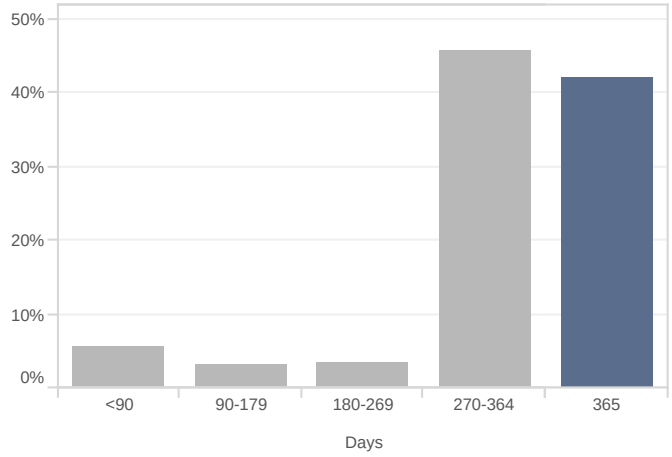
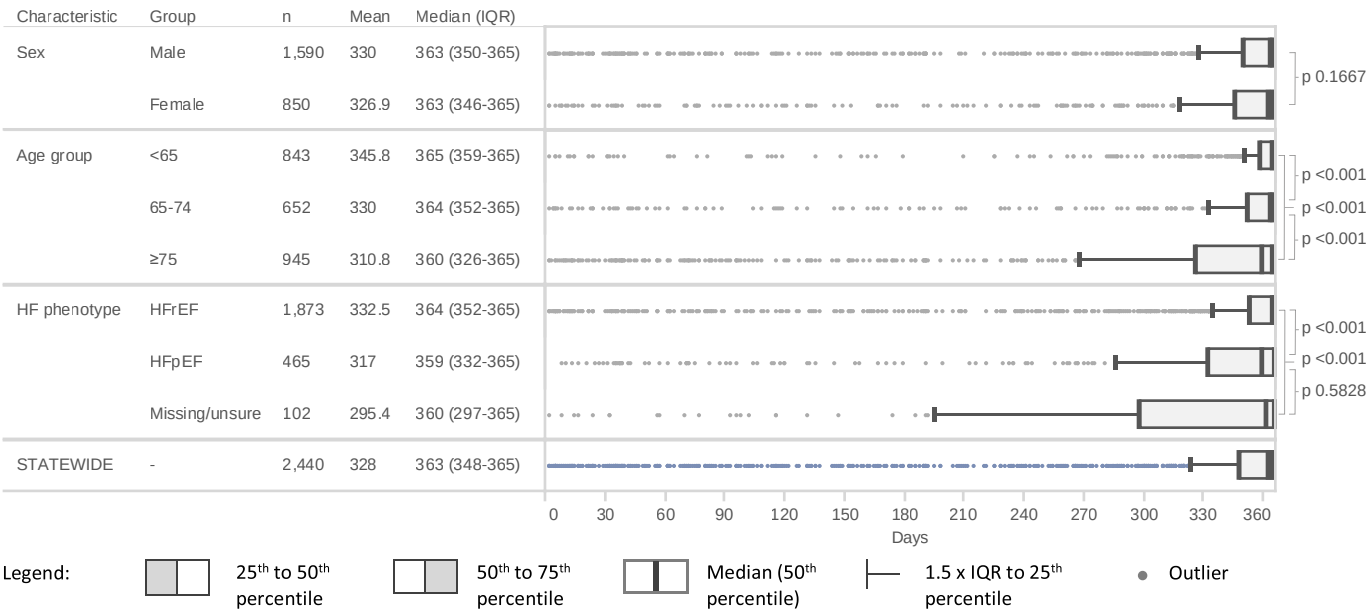


Figure 23: Days alive and out of hospital within one year after hospital discharge

Similar to mortality risk, we observed a lower DAOH among HFSS referrals with HFpEF phenotype compared to HFrEF (median 359.2 vs 364, p<0.001). Elderly patients (aged >75 years) referred to HFSS were also associated with significantly lower DAOH compared to younger (aged <65 years) patients (median 359.7 vs 365, p<0.001) (Figure 24).



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

54.3 Discussion

Due to the limited variables collected, multivariate adjustment of clinical outcomes risks was not available for this analysis. This limits our ability to discern independent associations, hence unmeasured confounders may influence the associations observed in this analysis. For the same reason, comparisons of clinical outcomes across individual sites were intentionally avoided in this analysis.

This first report of clinical outcomes for patients referred to HFSS highlight the significant burden of morbidity and mortality among patients with HF after hospitalisation, and the impact this has on health care resources. With expanded future analyses, it is expected that improved insight and understanding can be gained.

Findings of this analysis also identify that the unadjusted outcomes for the HFpEF phenotype are significantly poorer compared to the HFrEF phenotype. Further investigation into the factors associated with increased risk for the HFpEF cohort is needed.

55 Conclusions

This second annual QCOR HFSS report captures information on patient referrals to 21 Queensland Heart Failure Support Services. While the statewide figures provide an overview of clinical performance, data from individual services should be treated with caution as underreporting or small patient numbers may not accurately reflect performance.

Pleasingly, performance on most clinical process indicators is at or above benchmarks except for review and titration of beta blockers. Measuring the review and titration of beta blocker therapy up to 6 months from referral provides unique information about chronic disease management. This supports the notion that continuity of treatment between acute and primary care sectors is rarely routinely measured and is a significant challenge encountered on a daily basis.

While performance on most clinical indicators is high, the variance between sites is considerable and this benchmarking provides valuable information needed for quality improvement initiatives. This vital information is integral to addressing local challenges and barriers to providing contiguous care.

Patient outcomes of mortality, readmission, and days alive and out of hospital are measured for the previous cohort for up to 12 months. This provides valuable information about the true impact of heart failure and extends the analytic capacity of this report. Future work that utilises this platform for analysis promises to deliver greater awareness and understanding of the true overarching burden of disease.

56 Recommendations

The first report in 2016 made many recommendations that have been implemented or are in development as follows:

- Patient outcomes of mortality, readmissions, days alive and out of hospital rates are now reported
- The benchmarking information for clinical process indicators has been reviewed at each site and has resulted in changes in work practices to improve efficiencies as well as submissions for increased staffing (for example: closer review and monitoring of potentially missed referrals may explain the 13% increase in referrals)

Plans are currently underway to:

- Provide incentives for data completion by introducing elements that assist with patient management such as production of referrals, assessment and management information to aid in communication
- Introduce new indicators to reflect changes in prescribing, e.g. mineralocorticoid receptor antagonists (MRAs) and monitor the pattern of Angiotensin Receptor Neprilysin Inhibitor (ARNI) prescription
- Collect covariates to allow risk-adjustment of outcomes measures (e.g. eGFR, serum sodium, serum potassium, haemoglobin, iron studies, and comorbidities)

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)

57 Appendix: List of ICD10-AM Codes

ICD10-AM Code	Description
E87.7	Fluid overload
I13.0	Hypertensive heart and kidney disease with (congestive) heart failure
I13.2	Hypertensive heart and kidney disease with both (congestive) heart failure and kidney failure
I25.5	Ischaemic cardiomyopathy
I42.0	Dilated cardiomyopathy
I42.1	Obstructive hypertrophic cardiomyopathy
I42.2	Other hypertrophic cardiomyopathy
I42.5	Other restrictive cardiomyopathy
I42.6	Alcoholic cardiomyopathy
I42.7	Cardiomyopathy due to drugs and other external agents
I42.8	Other cardiomyopathies
I42.9	Cardiomyopathy, unspecified
I46.0	Cardiac arrest with successful resuscitation
I46.1	Sudden cardiac death so described
I46.9	Cardiac arrest unspecified
I50	Heart failure (includes: congestive heart failure; left ventricular failure; and, heart failure, unspecified)
J81	Pulmonary oedema
J90	Pleural effusion, not elsewhere classified
R18	Ascites
R57.0	Cardiogenic shock
R60.1	Generalised oedema

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59 Glossary

ACC	American College of Cardiology
ACEI	Angiotensin Converting Enzyme Inhibitor
ACS	Acute Coronary Syndromes
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
ARB	Angiotensin II Receptor Blocker
ARNI	Angiotensin Receptor-Neprilysin Inhibitors
ASD	Atrial Septal Defect
BCIS	British Cardiovascular Intervention Society
BiV	Biventricular
BMI	Body Mass Index
BMS	Bare Metal Stent
BVS	Bioresorbable Vascular Scaffold
CABG	Coronary Artery Bypass Graft
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
DEM	Department of Emergency Medicine
DES	Drug Eluting Stent
DOSA	Day Of Surgery Admission
DSWI	Deep Sternal Wound Infection
ECG	12 lead Electrocardiograph
eGFR	Estimated Glomerular Filtration Rate
EP	Electrophysiology
FdECG	First Diagnostic Electrocardiograph
FTE	Full Time Equivalent
GCUH	Gold Coast University Hospital
GP	General Practitioner
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HFS	Heart Failure Service
HFSS	Heart Failure Support Service
HHS	Hospital and Health Service
IC	Interventional Cardiology
ICD	Implantable Cardioverter Defibrillator
ICD-10	International Classification of Diseases 10th edition
IHT	Interhospital Transfer
IVDU	Intravenous Drug Use
KPI	Key Performance Indicator
LAA	Left Atrial Appendage
LAD	Left Anterior Descending Artery
LCX	Circumflex Artery
LOS	Length Of Stay
LV	Left Ventricle
LVEF	Left Ventricular Ejection Fraction
MBH	Mackay Base Hospital
MI	Myocardial Infarction
MRA	Mineralocorticoid Receptor Antagonists
MSSA	Methicillin-sensitive Staphylococcus aureus
NCDR	The National Cardiovascular Data Registry
NGH	Nambour General Hospital
NOAC	Non-Vitamin K Antagonist Oral Anticoagulants
NP	Nurse Practitioner
NRBC	Non-Red Blood Cells
NSTEMI	Non ST-Elevation Myocardial Infarction
PAH	The Princess Alexandra Hospital
PCI	Percutaneous Coronary Intervention
PDA	Patent Ductus Arteriosus
PFO	Patent Foramen Ovale
QAS	Queensland Ambulance Service
QCOR	Queensland Cardiac Outcomes Registry
QE II	Queen Elizabeth II Jubilee Hospital
QH	Queensland Health
QHAPDC	Queensland Hospital Admitted Patient Data Collection
QIP	Quality Incentive Payment
RBC	Red Blood Cells
RBWH	The Royal Women's and Brisbane Hospital
RCA	Right Coronary Artery
RHD	Rheumatic Heart Disease
SCCIU	Statewide Cardiac Clinical Informatics Unit
SCCN	Statewide Cardiac Clinical Network
SHD	Structural Heart Disease
STEMI	ST-Elevation Myocardial Infarction
STS	Society of Thoracic Surgery
TAVR	Transcatheter Aortic Valve Replacement
TMVR	Transcatheter Mitral Valve Replacement
TPCH	The Prince Charles Hospital
TPVR	Transcatheter Pulmonary Valve Replacement
TTH	The Townsville Hospital
VCOR	Victorian Cardiac Outcomes Registry
VF	Ventricular Fibrillation
VSD	Ventricular Septal Defect

60 Upcoming initiatives

- Improved collaboration with the Rheumatic Heart Disease (RHD) Register and Control Program is a key objective in the recently published RHD Action Plan. As of September 2018, rheumatic heart disease is a notifiable condition in Queensland. QCOR will work with the RHD Register to improve the quality and ease of access to related information. The QCOR currently reports to relevant National clinical registries and its currently participating in the development of the National Cardiac Registry and the National Cardiac Rehabilitation Registry.
- Cardiac outreach services are delivered to regional and remote sites across Queensland, primarily by staff from large tertiary hospitals. There is limited data about the quality and effectiveness of these services. QCOR will develop and deploy a centralised data collection and reporting module to enhance coordination of services and monitor the care provided to patients residing in rural and remote locations in Queensland. The new QCOR module is anticipated to be in place in early 2019.
- The final project for delivery from the Statewide Cardiac Clinical Network's Cardiac Information Solutions Program is currently being deployed. The ECG Flash: 24/7 Clinical Advice and ECG Interpretation Service connects clinical staff in rural and remote locations with cardiologists in metropolitan facilities. The system allows rapid inter-hospital clinical interpretation of 12-lead ECG readings and clinical advice for patients with challenging clinical presentation. To date, the system has been deployed in 5 Hospital and Health Services and will be deployed in most services by the end of 2019.

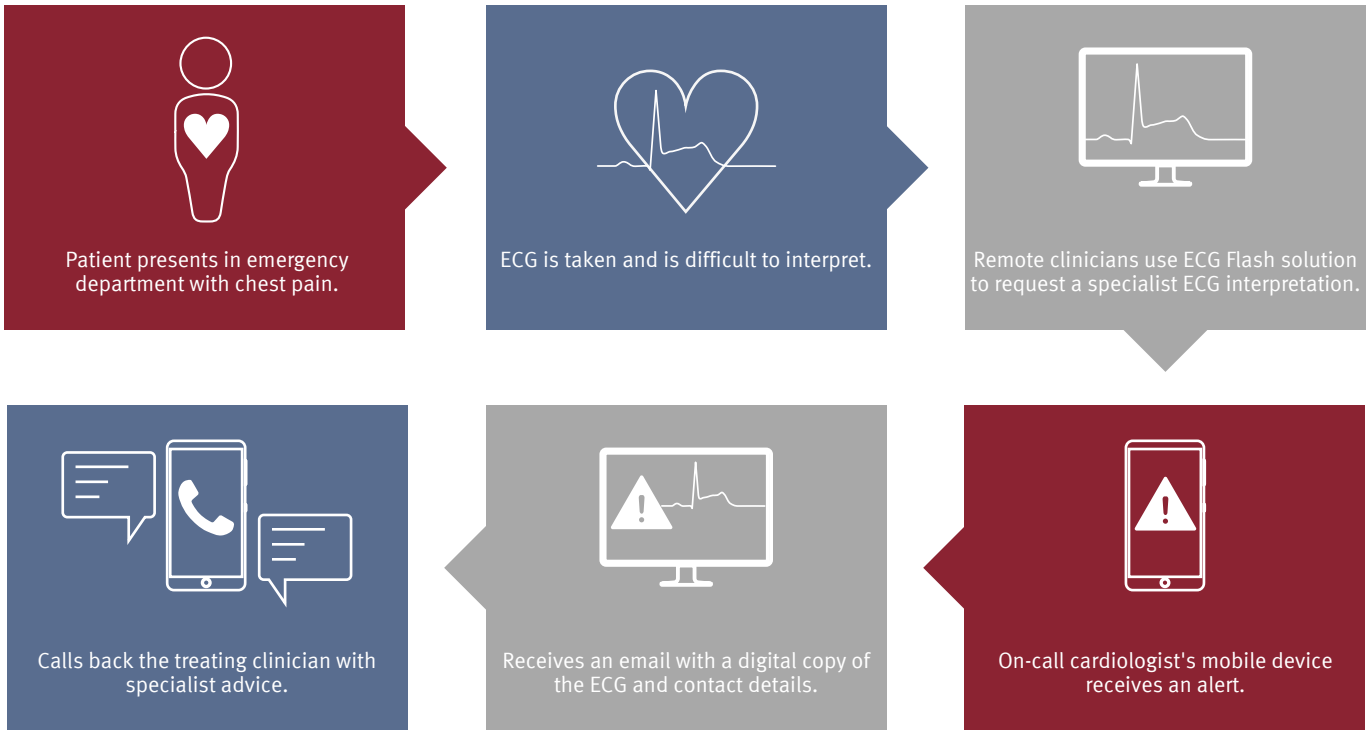

Figure C: Concept model for rapid inter-hospital clinical interpretation of 12-lead ECGs (CISP ECG Flash Project)