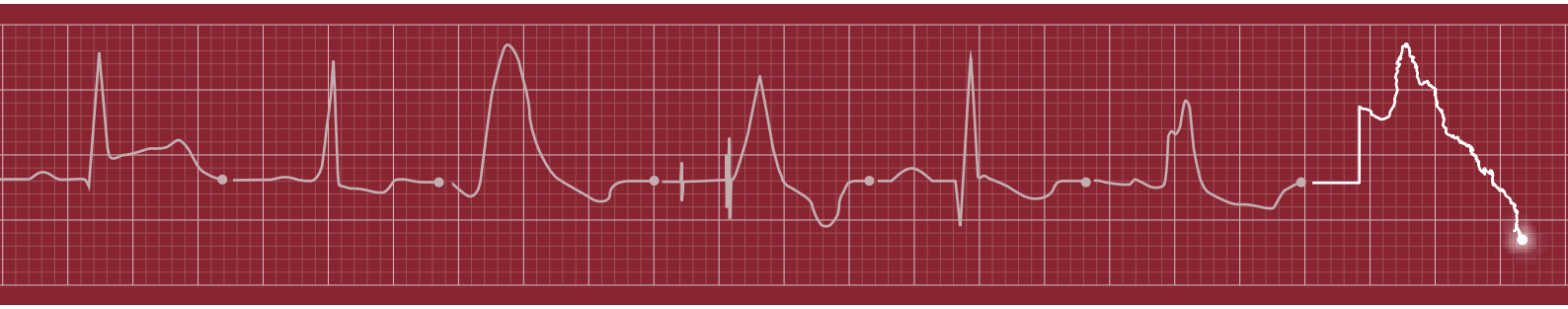
Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry

2020 Annual Report



Queensland Cardiac Outcomes Registry 2020 Annual Report

Published by the State of Queensland (Queensland Health), December 2021

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

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1 Foreword

Dr John Wakefield PSM
Director-General
Queensland Health

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

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

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

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

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

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

2 Message from the SCCN Chair

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

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

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

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

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

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

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

3 Introduction

The Queensland Cardiac Outcomes Registry (QCOR) is an ever-evolving clinical registry and quality program established by the Statewide Cardiac Clinical Network (SCCN) in partnership with statewide cardiac clinicians and made possible through the funding and support of Clinical Excellence Queensland. QCOR provides access to quality, contextualised clinical and procedural data to inform and improve patient care and support quality improvement activities across cardiac and cardiothoracic surgical services in Queensland.

QCOR is a clinician-led program, and the strength of the Registry would not be possible without this input. The Registry is governed by clinical committees providing direction and oversight over Registry activities for each cardiac and cardiothoracic specialty area, with each committee reporting to the SCCN and overarching QCOR Advisory Committee. Through the QCOR committees, clinicians are continually developing and shaping the scope of the Registry based on contemporary best practices and the unique requirements of each clinical domain.

Registry data collections and application are maintained and administered by the Statewide Cardiac Clinical Informatics Unit (SCCIU), which forms the business unit of QCOR. The SCCIU performs data quality, audit and analysis functions, and coordinates individual QCOR committees, whilst also providing expert technical and informatics resources and subject matter expertise to support continuous improvement and development of specialist Registry application modules and reporting.

The SCCIU team consists of:

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

* Principal contact officer/QCOR program lead

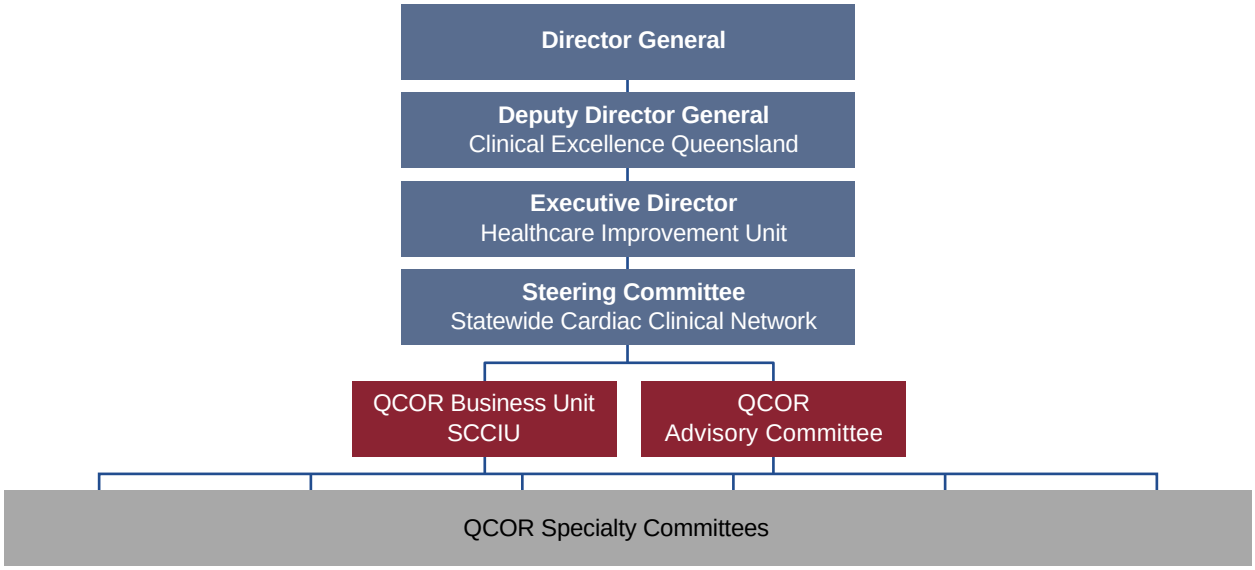
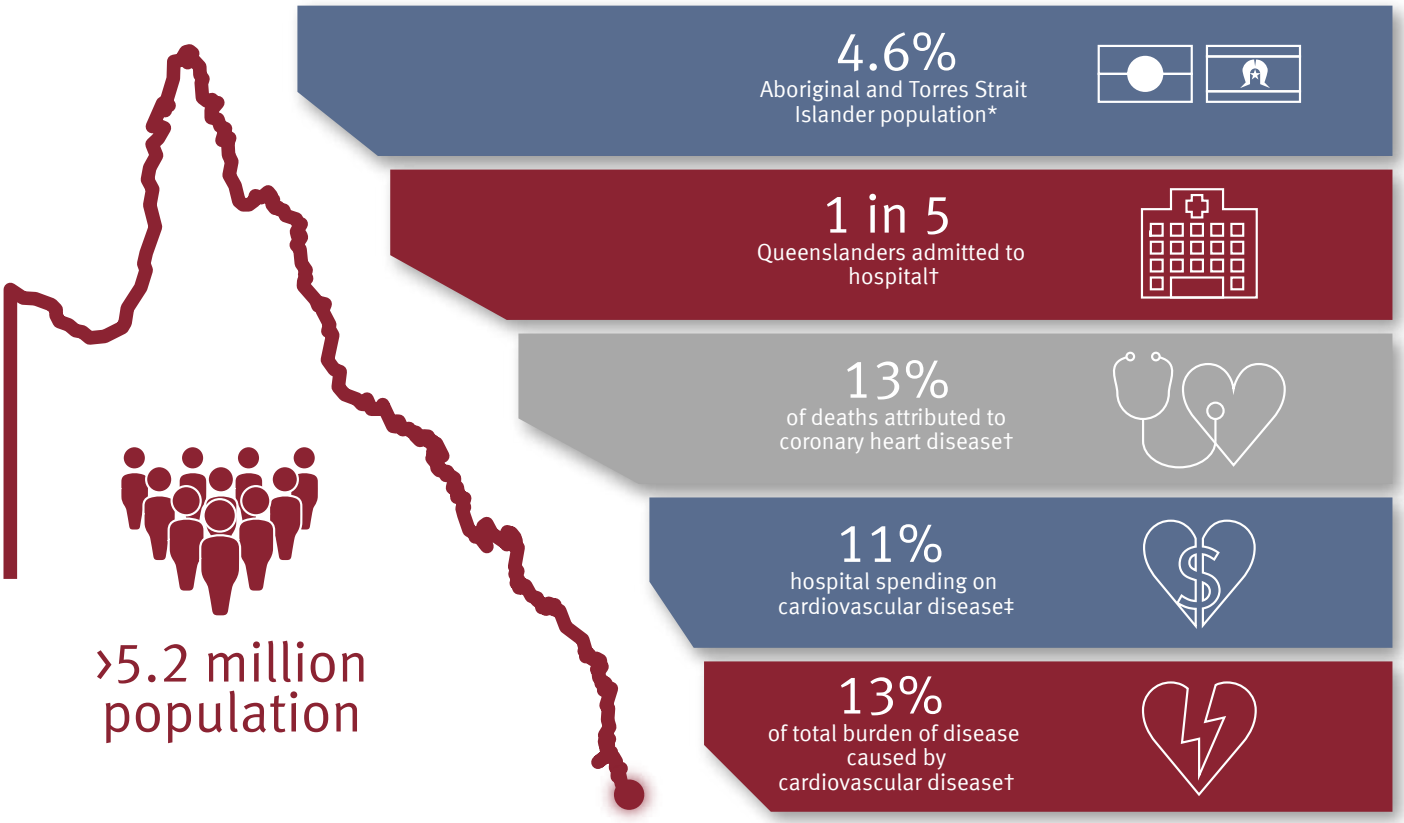


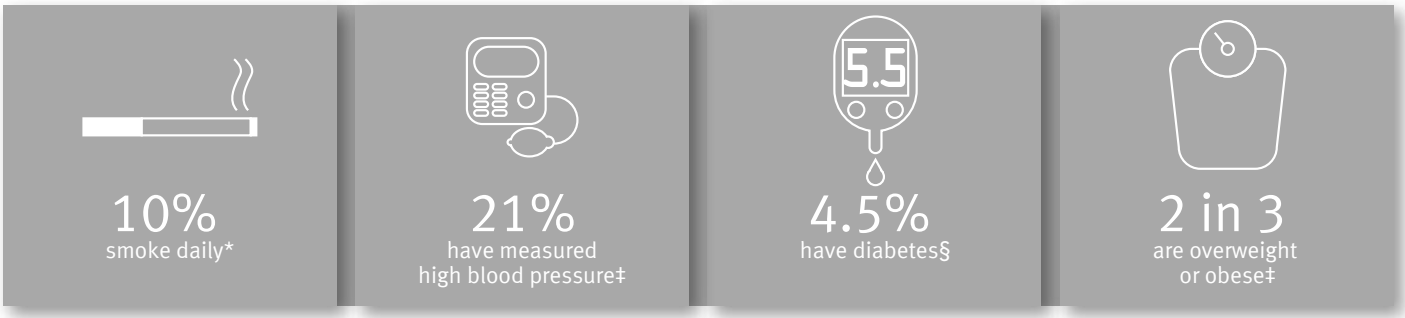
Figure 1: Governance structure

Queensland Cardiac Outcomes Registry

The Health of Queenslanders



Comorbidities



Mortality

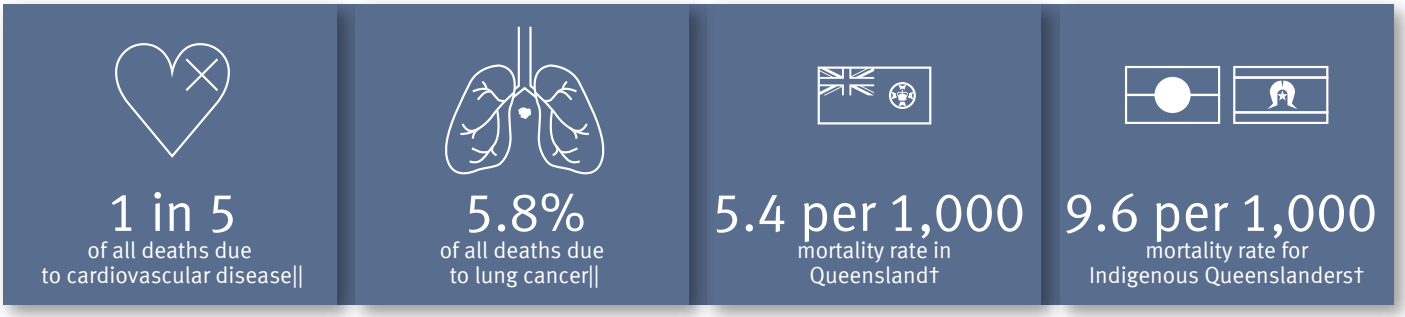


Figure 2: QCOR 2020 infographic

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

† Queensland Health. (2020). The health of Queenslanders 2020. *Report of the Chief Health Officer Queensland*. Queensland Government: Brisbane

‡ Australian Bureau of Statistics. (2019). *National health survey: first results, 2017-18*. Cat. no. 4364.0.55.001. ABS: Canberra.

§ Diabetes Australia. (2018). *State statistical snapshot: Queensland*. As at 30 June 2018

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

2020 Activity at a Glance

What's New?

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

Interventional Cardiology

4,966
percutaneous coronary interventions

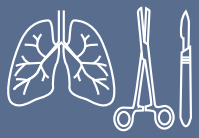
468
structural heart disease interventions

249
transcatheter aortic valve replacements

15,491
total coronary procedures

Cardiothoracic Surgery

2,651
adult cardiac surgeries



1,093
adult thoracic surgeries

Electrophysiology & Pacing

5,201
electrophysiology and pacing procedures

3,551
cardiac implantable electronic device procedures

Heart Failure Support Services

5,664
heart failure support services referrals

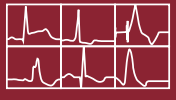
Cardiac Rehabilitation

11,177
cardiac rehabilitation referrals

Rheumatic Heart Disease

483
unknown rheumatic heart disease patients identified

Clinical Indicator Progress



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

0.2%
procedural tamponade rate for cardiac device and electrophysiology procedures

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

93%
of cardiac rehabilitation referrals within 3 days of discharge

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

QCOR Yearly Trends

Interventional Cardiology

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

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

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

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

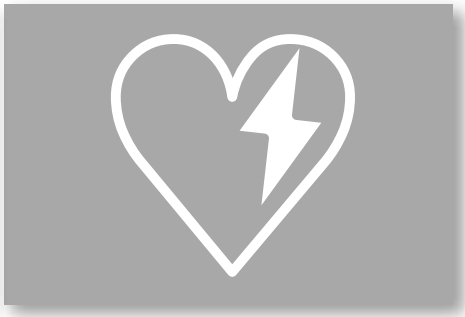
Cardiothoracic Surgery

12%
increase in cardiac surgery cases
– 2017 to 2020

29%
increase in thoracic surgery cases
– 2017 to 2020

Electrophysiology & Pacing

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



67%
increase in complex EP cases
– 2018 to 2020

Outpatient Support Services

›34,000
cardiac rehabilitation referrals
– 2018 to 2020

25%
increase in HFSS referrals
– 2017 to 2020

4 Acknowledgements

This collaborative report was produced by the SCCIU, audit lead for QCOR for and on behalf of the Statewide Cardiac Clinical Network. This would not be possible without the tireless work of clinicians in contributing quality data and providing quality patient care, while the contributions of QCOR committee members and others who had provided writing or other assistance with this year's Annual Report is also gratefully acknowledged.

QCOR Interventional Cardiology Committee

- Dr Sugeet Baveja, Townsville University Hospital
- Dr Niranjan Gaikwad, The Prince Charles Hospital
- Dr Paul Garrahy, Princess Alexandra Hospital
- Dr Christopher Hammett, Royal Brisbane & Women's Hospital
- Dr Rohan Poulter, Sunshine Coast University Hospital
- A/Prof Atifur Rahman, Gold Coast University Hospital
- Dr Shantisagar Vaidya, Mackay Base Hospital
- Dr Gregory Starmer, Cairns Hospital (Chair)

QCOR Cardiothoracic Surgery Committee

- Dr Anil Prabhu, The Prince Charles Hospital
- Dr Pallav Shah, Townsville University Hospital
- Dr Andrie Stroebel, Gold Coast University Hospital
- Dr Morgan Windsor, Metro North Hospital and Health Service
- Dr Christopher Cole, Princess Alexandra Hospital (Chair)

QCOR Cardiac Rehabilitation Committee

- Ms Michelle Aust, Sunshine Coast University Hospital
- Ms Maura Barnden, Metro North Hospital and Health Service
- Ms Jacqueline Cairns, Cairns Hospital
- Ms Yvonne Martin, Chronic Disease Brisbane South
- Dr Johanne Neill, Ipswich Hospital
- Ms Samara Phillips, Statewide Cardiac Rehabilitation Coordinator
- Ms Madonna Prenzler, West Moreton Hospital and Health Service
- Ms Deborah Snow, Gold Coast Hospital and Health Service
- Ms Natalie Thomas, South West Hospital and Health Service
- Mr Gary Bennett, Health Contact Centre (Chair)

Statewide Cardiac Clinical Informatics Unit

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

QCOR Electrophysiology and Pacing Committee

- Mr John Betts, The Prince Charles Hospital
- Mr Anthony Brown, Sunshine Coast University Hospital
- Mr Andrew Claughton, Princess Alexandra Hospital
- Dr Naresh Dayananda, Sunshine Coast University Hospital
- Dr Russell Denman, The Prince Charles Hospital
- Mr Braden Dinham, Gold Coast University Hospital
- Ms Sanja Doneva, Princess Alexandra Hospital
- Mr Nathan Engstrom, Townsville University Hospital
- A/Prof John Hill, Princess Alexandra Hospital
- Dr Bobby John, Townsville University Hospital
- Dr Paul Martin, Royal Brisbane & Women's Hospital
- Ms Sonya Naumann, Royal Brisbane & Women's Hospital
- Dr Kevin Ng, Cairns Hospital
- Dr Robert Park, Gold Coast University Hospital

QCOR Heart Failure Support Services Committee

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

Queensland Ambulance Service

- Dr Tan Doan, PhD
- Mr Brett Rogers

5 Executive summary

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

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

6 Spotlight: Cardiac Outreach

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

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

The initial investigative Report identified several key opportunities for improvement:

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

In response, an implementation framework recommended the following improvements:

Improve access, equity, quality & safety, and efficiency

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

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

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

  Build capability and capacity of regional teams to provide care for their own communities.

- **Coordination and integration**

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

- **Evidence, evaluation, and improvement**

  Evidence-based care informed by data.

- **Technology**

  Regional teams provided with and enabled to use technology to support healthcare.

- **Sustainable funding and resources**

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

- **Governance and accountability**

  Regions lead and are responsible for clinical and service outcomes via stakeholder engagement, formal governance arrangements and access to information.

- **Harness existing investments and programs**

  For exponential benefits and efficiency.

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

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

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

The QCOR Outreach Module provides Queensland Health practitioners with:

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

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

Table 1: QCOR cardiac outreach module – participating outreach units

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

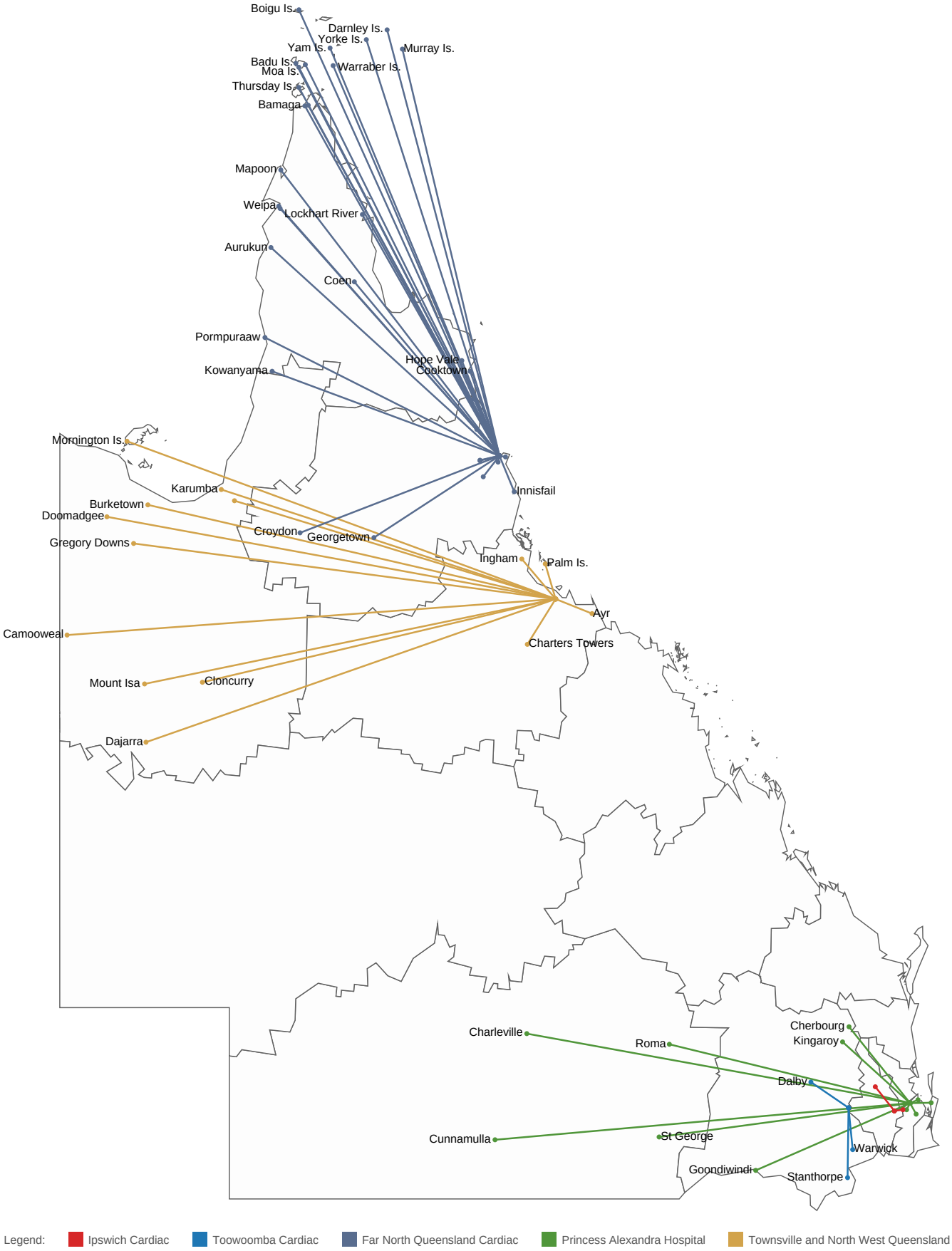


Figure 1: Cardiac outreach hub and spoke locations

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

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

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

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

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

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

* Note varying start dates of some services

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

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

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

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

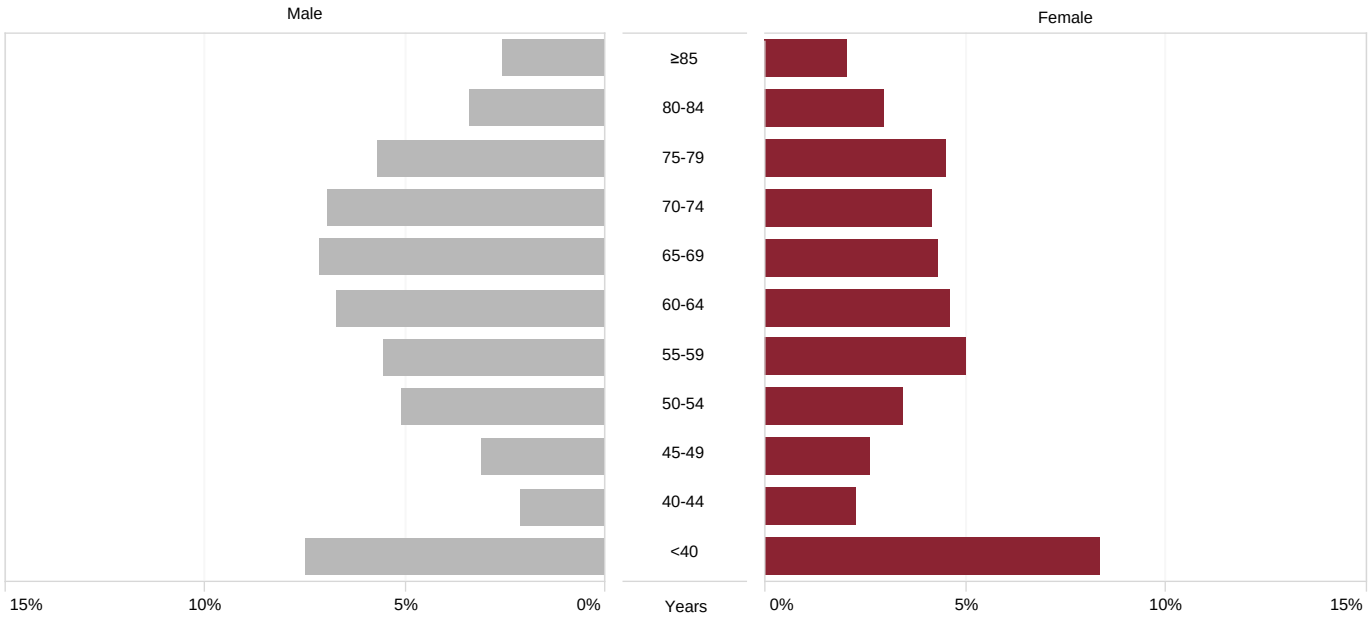


Figure 2: Proportion of outreach consults by age and gender

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

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

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

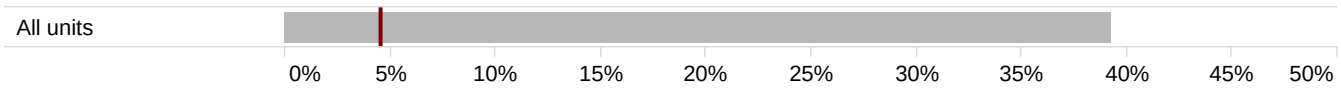


Figure 3: Proportion of Aboriginal and Torres Strait Islander patients seen in cardiac outreach

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

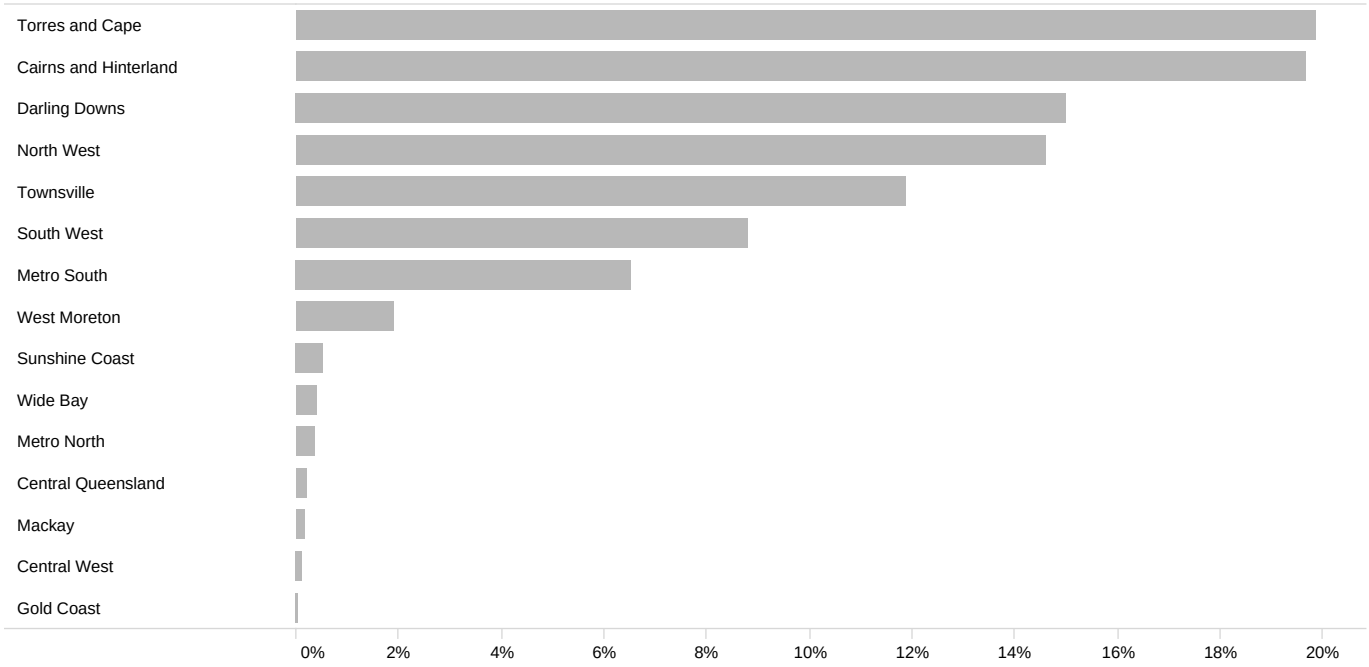


Figure 4: Proportion of patients by HHS of residence since commencement

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

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

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

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

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

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

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

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

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

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

Table 9: Median distance of patient address to hub sites

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

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

Table 10: Number of investigations performed in outreach clinics

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

7 Spotlight: ECG Flash

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

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

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

Table 1: ECG Flash – participating tertiary sites

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

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

8 Spotlight: Rheumatic Heart Disease Program

8.1 Background

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

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

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

8.2 The disease

ARF is an acute illness causing a generalised, autoimmune inflammatory response following repeated exposure to and infection with Group A Streptococcal bacteria. The inflammatory response occurs predominantly in the heart, joints, brain and skin. Presentations are often subtle, clients typically present with a history of a sore throat and/or infected skin sores, pain and swelling in one or more joints, fever and chest pain. Chorea (jerky, uncoordinated movements of the hands, feet, tongue and face), skin and subcutaneous manifestations are uncommon but do appear to vary in frequency across populations, gender and age.* Clinical investigations may identify prolonged atrioventricular junctional arrhythmias on an electrocardiogram, a heart murmur or carditis.

Once the initial acute illness has resolved, ARF leaves no lasting damage to the joints or skin however, sustained inflammation of the brain in clients with Sydenham's chorea can cause permanent damage and lead to the development of mental health and neurological sequalae. Similarly, the autoimmune response that inflames the heart can lead to permanent damage to the heart valves known as rheumatic heart disease (RHD). Repeated episodes of ARF inevitably lead to the development or worsening of RHD.

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

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

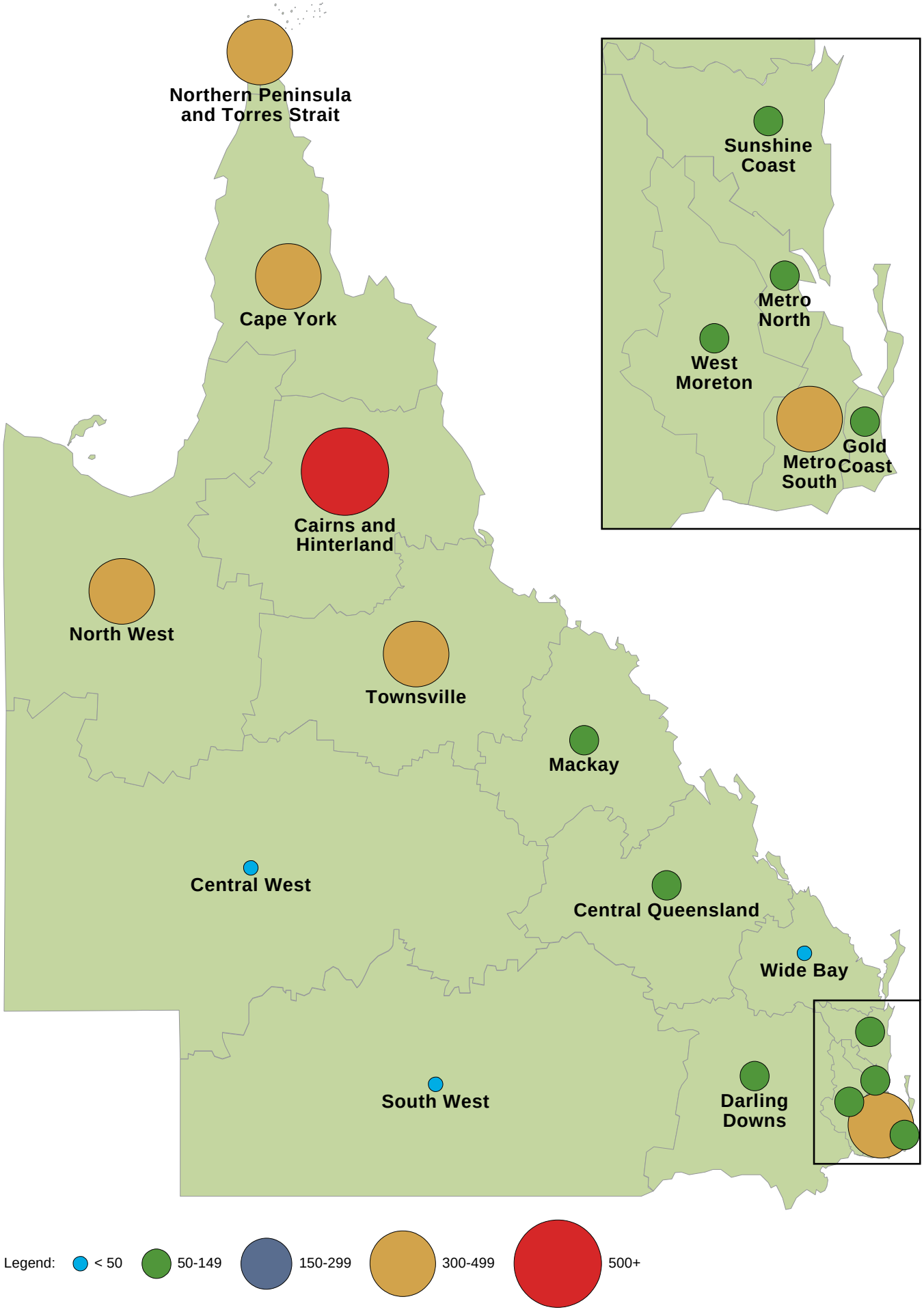


Figure 1: Rheumatic Heart Disease active clients by area of residence

8.3 Disease demographics

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

ARF and RHD are diseases that exemplify the 'gap' between Aboriginal and Torres Strait Islander peoples and Australians of other descent. In Queensland, 2019 the rate of ARF cases was 41.6 per 100,000 Aboriginal and Torres Strait Islander Australians whereas for all Queenslanders the rate was 2.2 per 100,000.† The prevalence of RHD was 627.4 cases per 100,000 Aboriginal and Torres Strait Islander Australians whereas for Australians of other descent the rate was 15.9 per 100,000.†

8.4 The costs of ARF and RHD

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

8.4.1 Human cost of RHD

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

8.4.2 Financial cost of ARF and RHD

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

Table 1: Costs of diagnosis and management of ARF and RHD

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

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

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

8.5 Disease prevention

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

8.6 Queensland RHD Program and Queensland Cardiac Outcomes Registry

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

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

Table 2: QCOR echocardiography module RHD notifications

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

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

Table 3: QCOR cardiac surgery module RHD notifications

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

9 Spotlight: COVID-19 pandemic

9.1 Introduction

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

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

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

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

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

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

9.2 Procedure volumes

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

Interventional cardiology

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

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

Cardiac surgery

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

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

Thoracic surgery

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

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

Electrophysiology and pacing

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

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

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

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

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

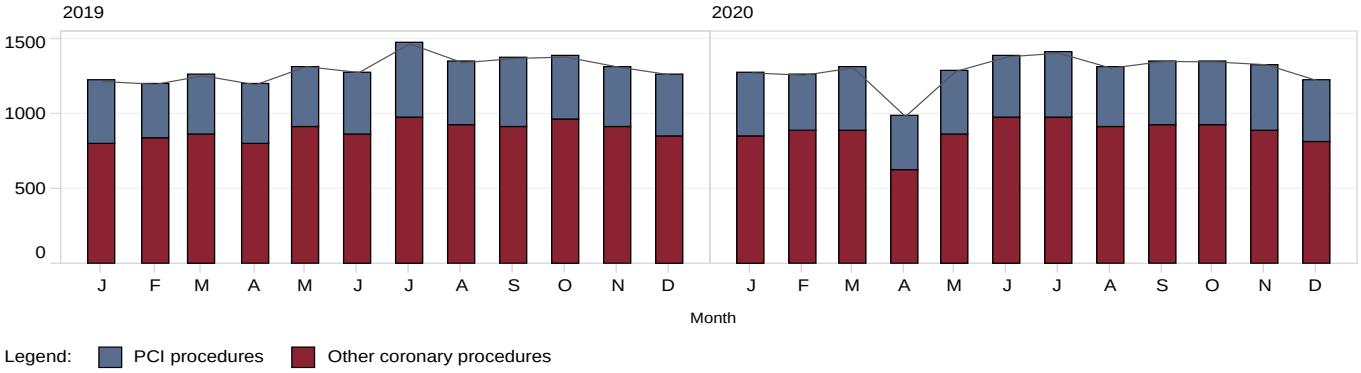


Figure 1: Proportion of all diagnostic and interventional cardiology cases by case category and month, 2019–2020

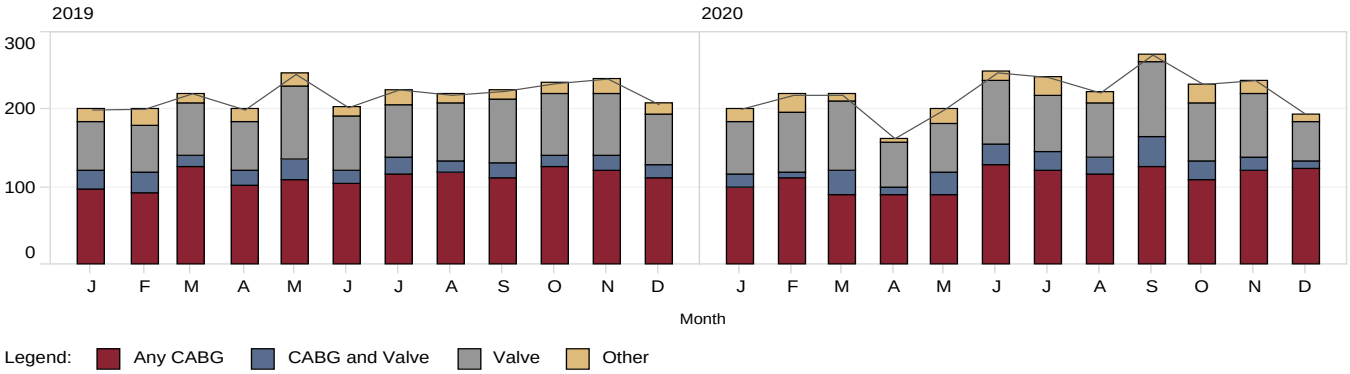


Figure 2: Proportion of all cardiac surgery cases by procedure category and month, 2019–2020

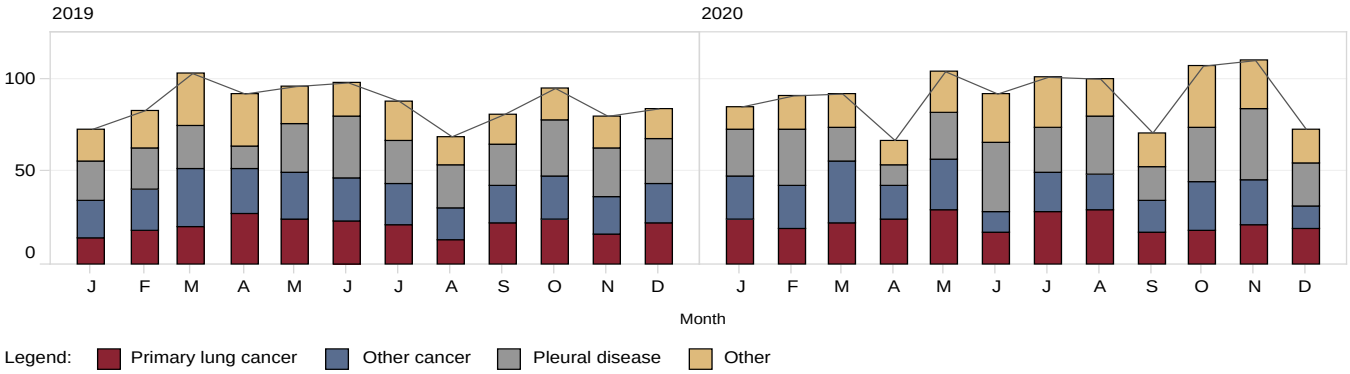


Figure 3: Proportion of all thoracic surgery cases by indication and month, 2019–2020

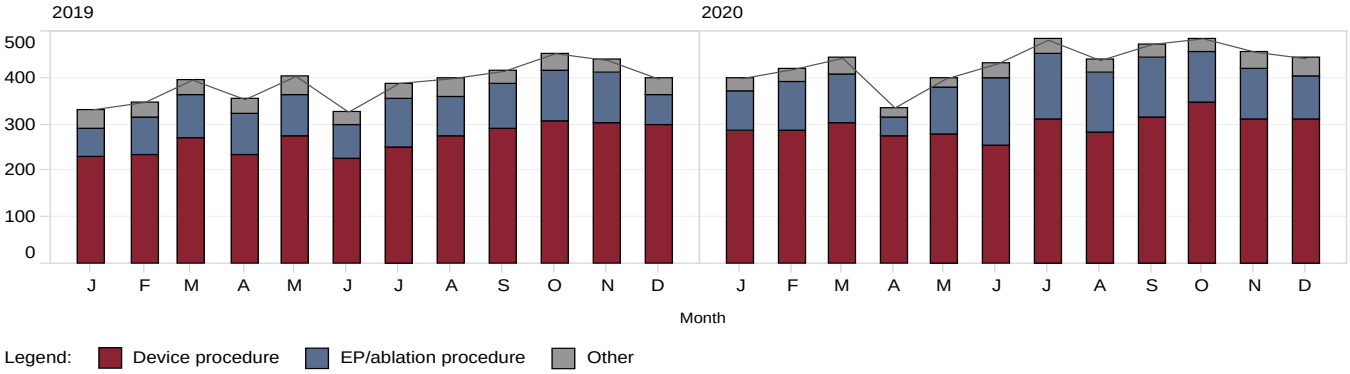


Figure 4: Proportion of all electrophysiology and pacing cases by procedure category and month, 2019–2020

9.3 Interstate and international patients

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

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

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

Excludes missing data (0.1%)

9.4 Admission status

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

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

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

Category 1: Clinically indicated within 30 days

Category 2: Clinically indicated within 90 days

Category 3: Clinically indicated within 365 days

* 7.0% missing data

† 6.3% missing data

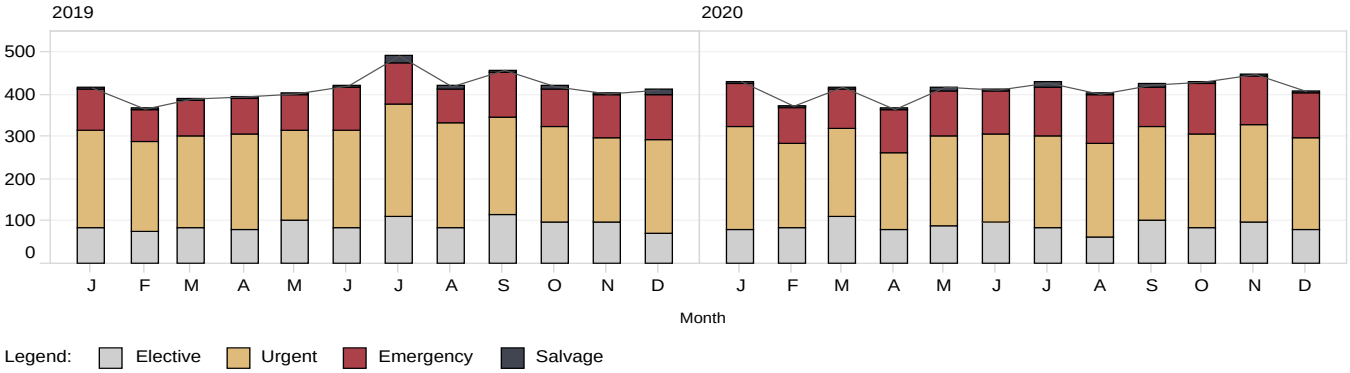


Figure 5: Proportion of all interventional cardiology cases by admission status and month, 2019–2020

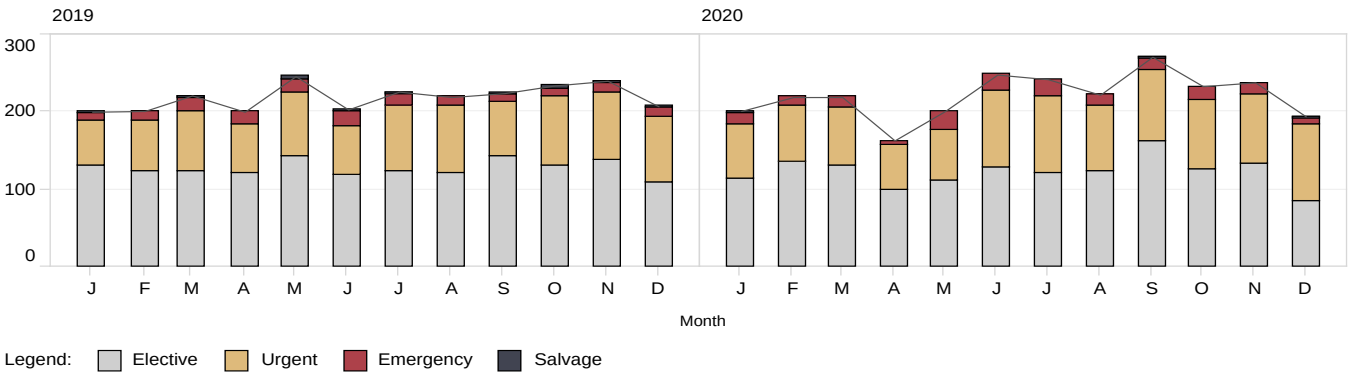


Figure 6: Proportion of all cardiac surgery cases by admission status and month, 2019–2020

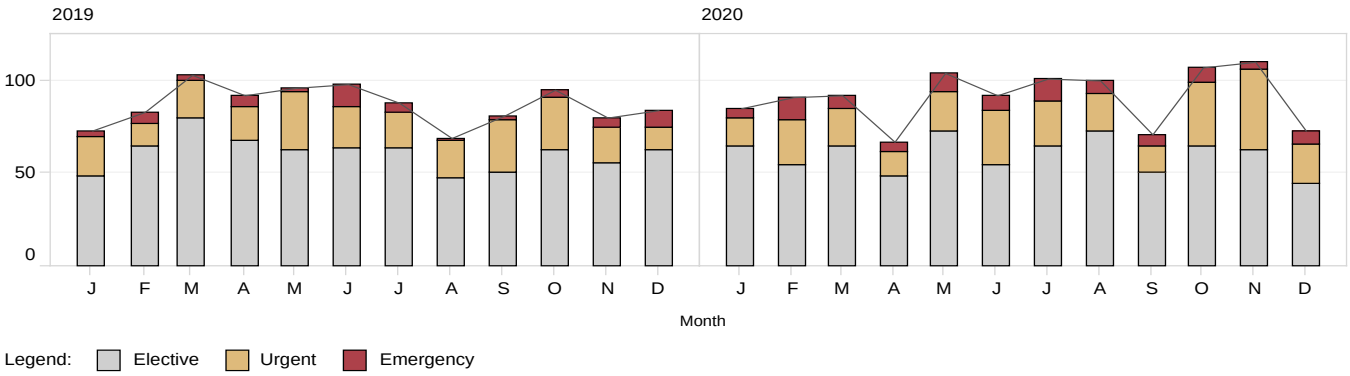
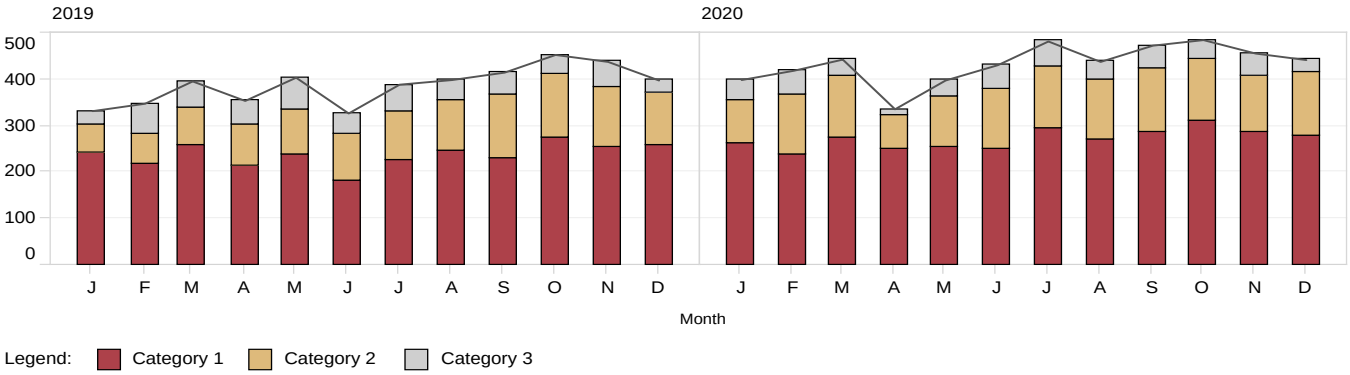


Figure 7: Proportion of all thoracic surgery cases by admission status and month, 2019–2020



Note: imputed missing data

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

9.5 Outpatient support services

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

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

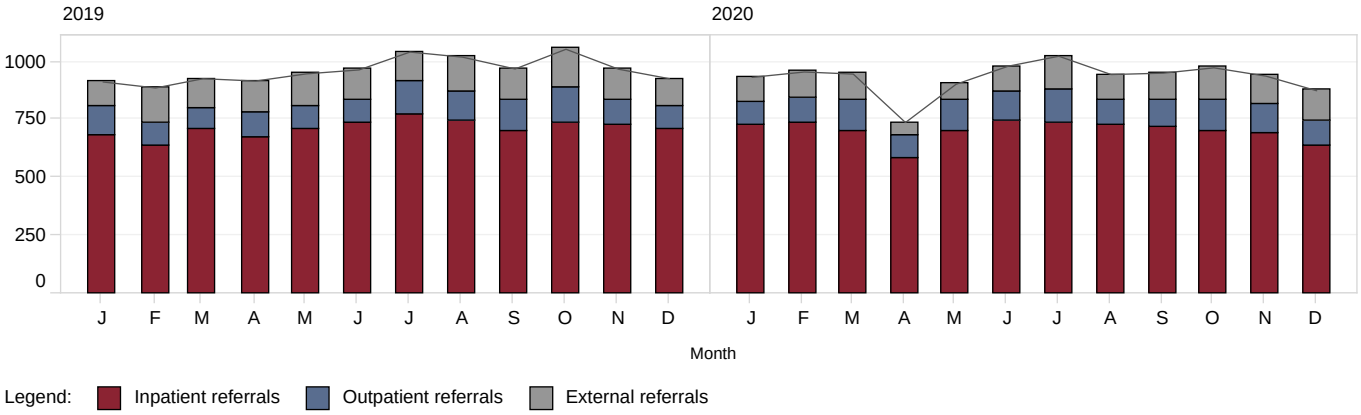


Figure 9: Cardiac rehabilitation referral source, 2019–2020

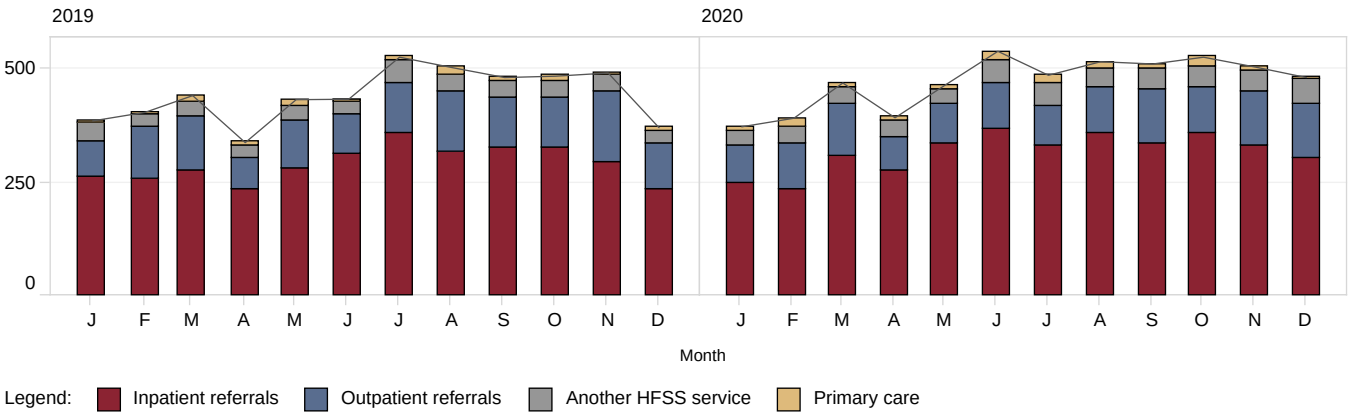


Figure 10: Heart failure support services referral source, 2019–2020

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

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

9.6 Clinical performance indicators

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

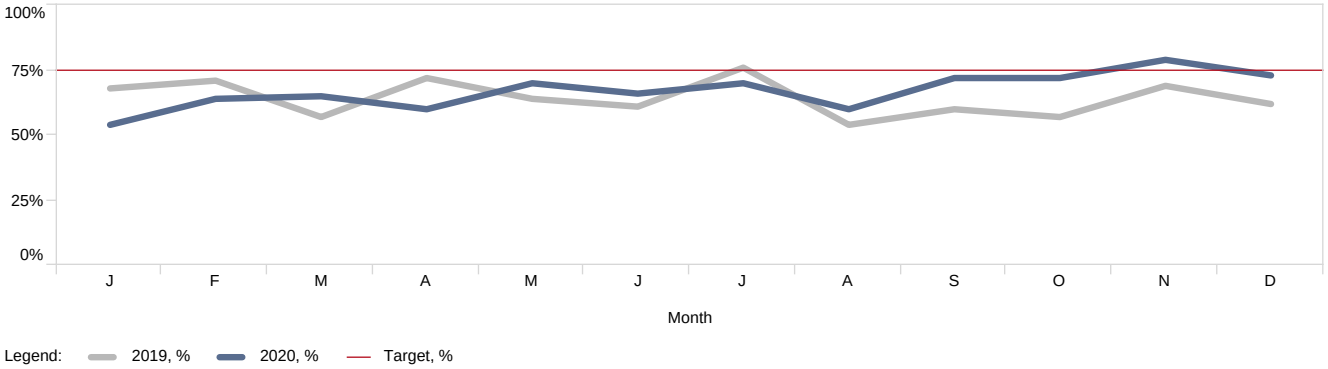


Figure 11: Proportion of ST-elevation myocardial infarction patients presenting within six hours of symptom onset who received an intervention within 90 minutes of first diagnostic electrocardiograph, 2019–2020

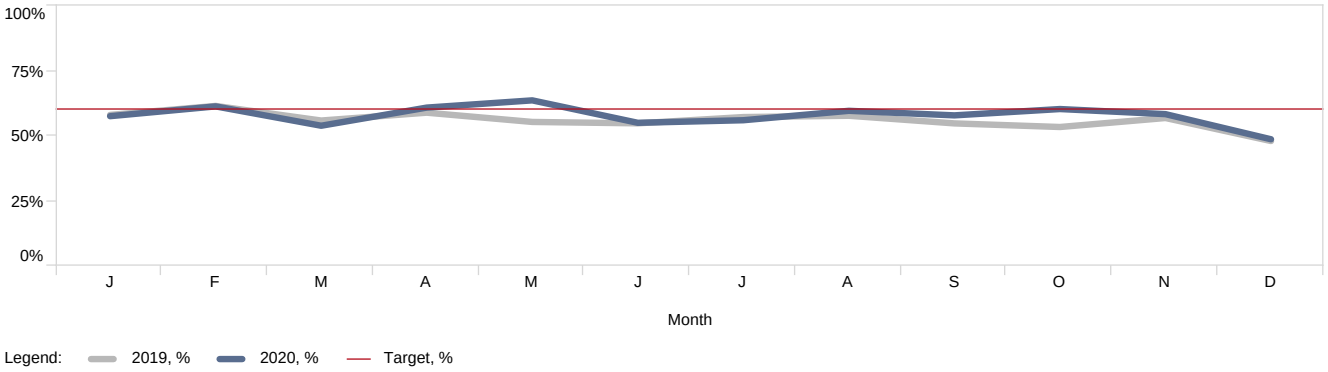


Figure 12: Cardiac rehabilitation performance measure, 2019–2020

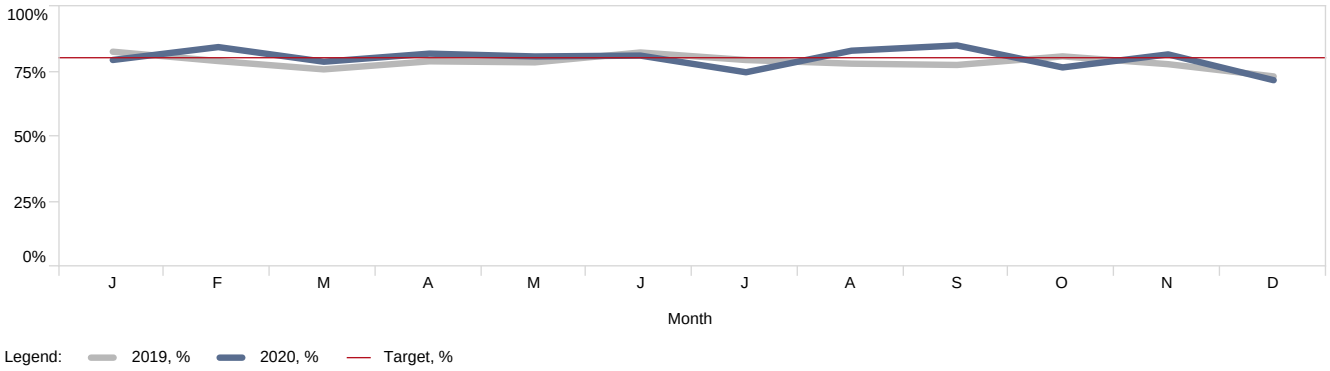


Figure 13: Heart failure support services clinical follow-up of acute patients within two weeks, 2019–2020

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

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

* ST-elevation myocardial infarction

† Non-ST-elevation myocardial infarction

‡ Implantable cardioverter defibrillator

§ Angiotensin converting enzyme inhibitor/angiotensin II receptor blocker

‖ Angiotensin receptor-neprilysin inhibitor

Mineralocorticoid receptor antagonists

** Heart failure with reduced ejection fraction

†† Heart failure with preserved ejection fraction

10 Facility profiles

10.1 Cairns Hospital

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

10.2 Townsville University Hospital

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

10.3 Mackay Base Hospital

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

10.4 Sunshine Coast University Hospital

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

10.5 The Prince Charles Hospital

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

10.6 Royal Brisbane & Women's Hospital

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

10.7 Queensland Children's Hospital

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

10.8 Princess Alexandra Hospital

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

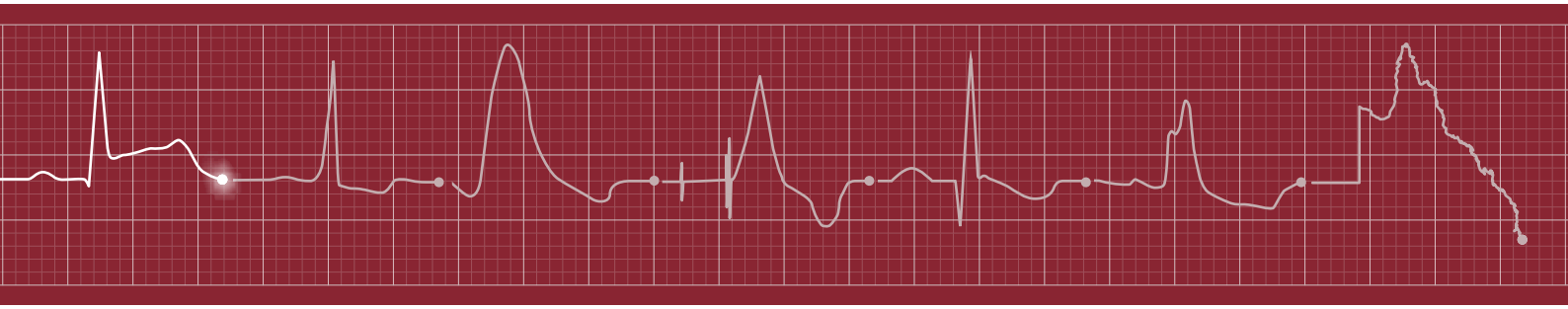
10.9 Toowoomba Hospital

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

10.10 Gold Coast University Hospital

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

Interventional Cardiology Audit



1 Message from the Interventional Cardiology Committee Chair

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

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

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

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

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

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

Dr Greg Starmer
Chair
QCOR Interventional Cardiology Committee

2 Key findings

The Interventional Cardiology Audit describes key aspects of the care and treatment of cardiac patients receiving percutaneous coronary interventions (PCI) during 2020.

Key findings include:

- 15,491 diagnostic coronary or interventional cases were performed across the eight cardiac catheterisation laboratory facilities in Queensland public hospitals, including 4,966 PCI cases.
- 78% of all PCI patients residing in Queensland had a place of residence within 50 km of the nearest PCI capable facility, while 11% of patients resided more than 150 km from the nearest facility.
- A large proportion of PCI patients (78%) were classed as having an unhealthy body mass index over 25 kg/m^2.
- The proportion of patients identified as Aboriginal and Torres Strait Islander (7.0%) illustrates a stepwise gradient based on geographical area, with the highest proportions found in the north of the state and lower proportions in the South East corner. This is consistent with previous analyses. The median age of Aboriginal and Torres Strait Islander patients was 10 years younger than non Aboriginal and Torres Strait Islander patients.
- The majority of PCI cases (79%) were classed as urgent, emergent or salvage, highlighting the acute and often unstable patient cohort.
- There were 1,600 PCI cases following presentation with ST elevation myocardial infarction (STEMI), of which 58% were managed by primary PCI.
- There was a total of 411 thrombolysed STEMI presentations, for whom the median time from first diagnostic ECG to the administration of thrombolysis was 37 minutes. The median time from thrombolysis to coronary angiography was 17 hours, with 64% of cases receiving angiography within 24 hours.
- Median time to reperfusion from first diagnostic ECG for STEMI patients presenting within six hours of symptom onset was 81 minutes (range 75 minutes to 90 minutes across sites).
- Median hospital door-to-device time for STEMI patients presenting within six hours of symptom onset was 40 minutes (range 31 minutes to 69 minutes across sites).
- PCI for non-ST elevation myocardial infarction (NSTEMI) represented 30% of all cases, with the median time to angiography of 48 hours. Patients presenting to a non PCI capable facility have a median wait time to coronary angiography of 32 hours longer than those who present directly to a PCI capable facility (65 hours vs. 33 hours).
- Mortality within 30 days following PCI was 1.5% (75 deaths). Of these 75 deaths, 69% were classed as either salvage or emergency PCI.
- Of all cases, 0.95% recorded a major intra-procedural complication. Coronary artery perforation (0.61%) accounted for the majority of these events.
- Radiation doses were found to be under the high dose threshold in 99.2% of PCI cases across all sites and 99.9% of other coronary procedures.

3 Participating sites

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

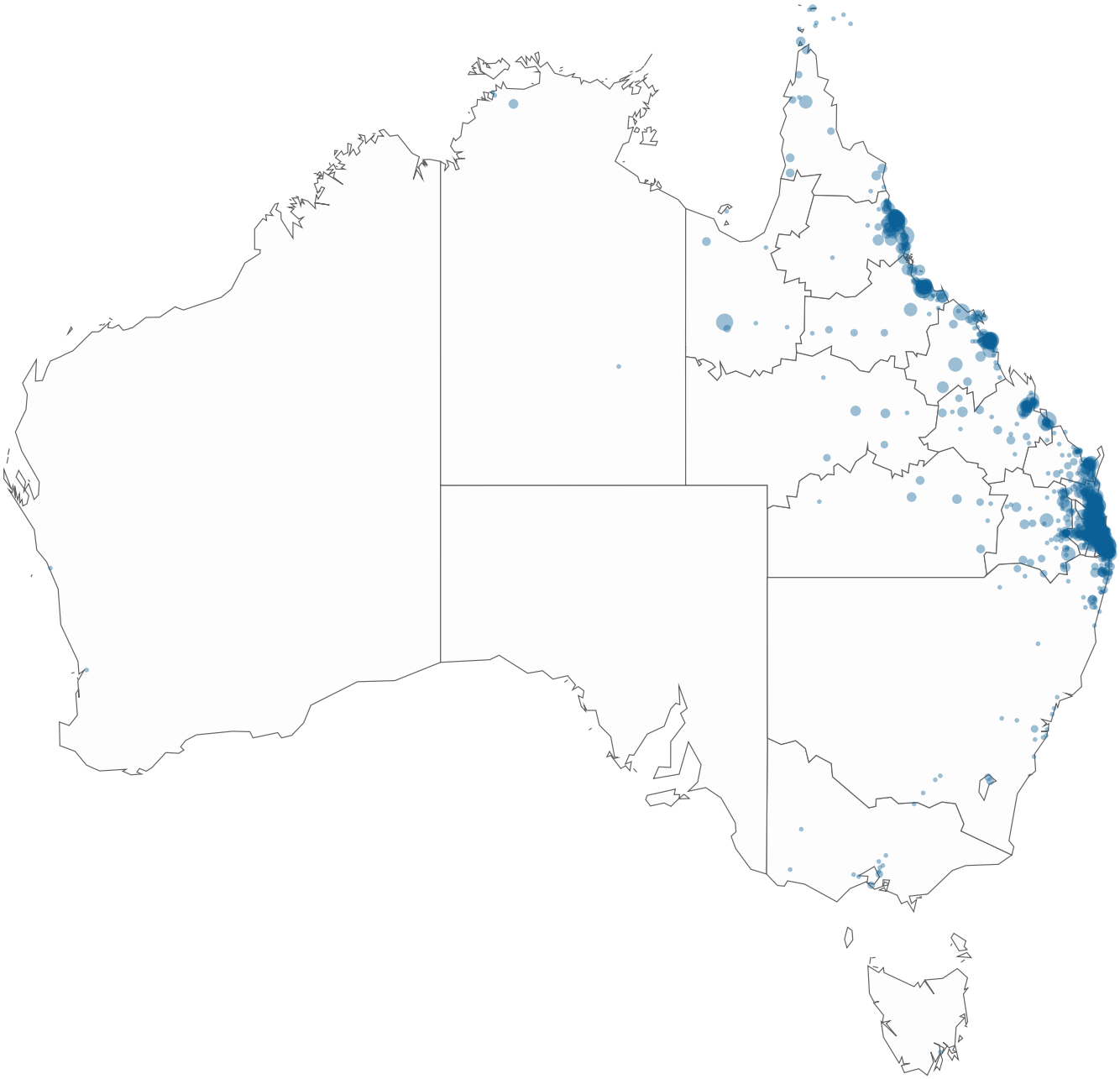


Figure 1: Statewide PCI cases by patient place of usual residence (by residential postcode)

Table 1: Participating sites

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

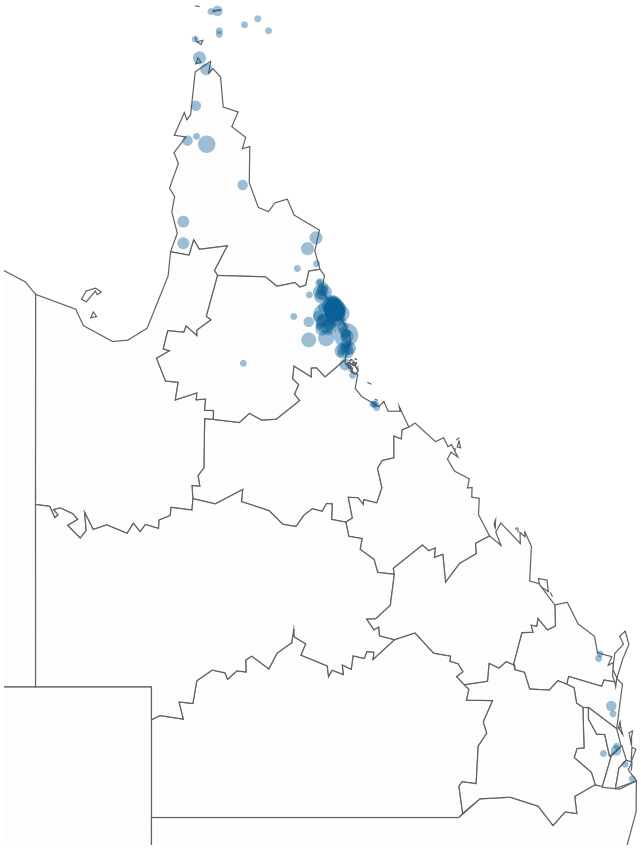


Figure 2: Cairns Hospital

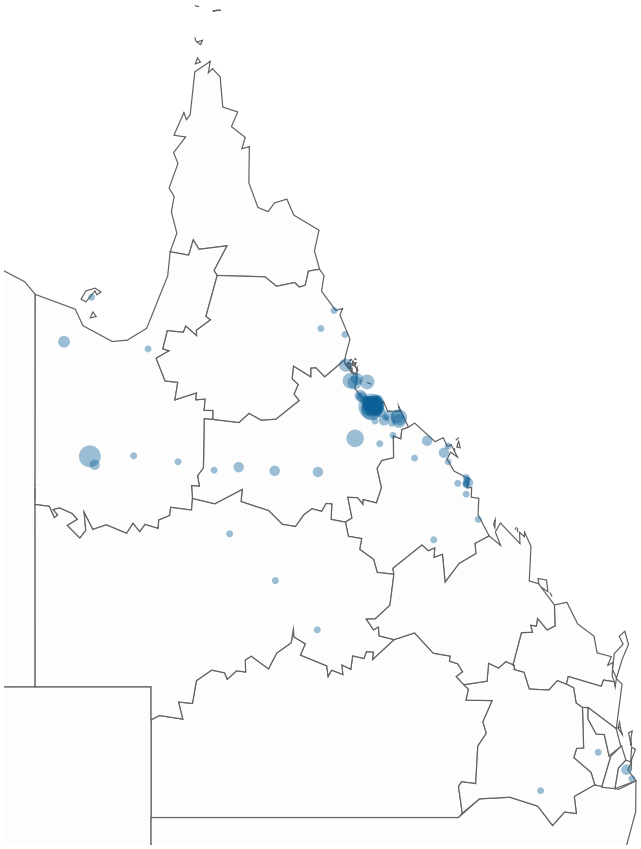


Figure 3: Townsville University Hospital

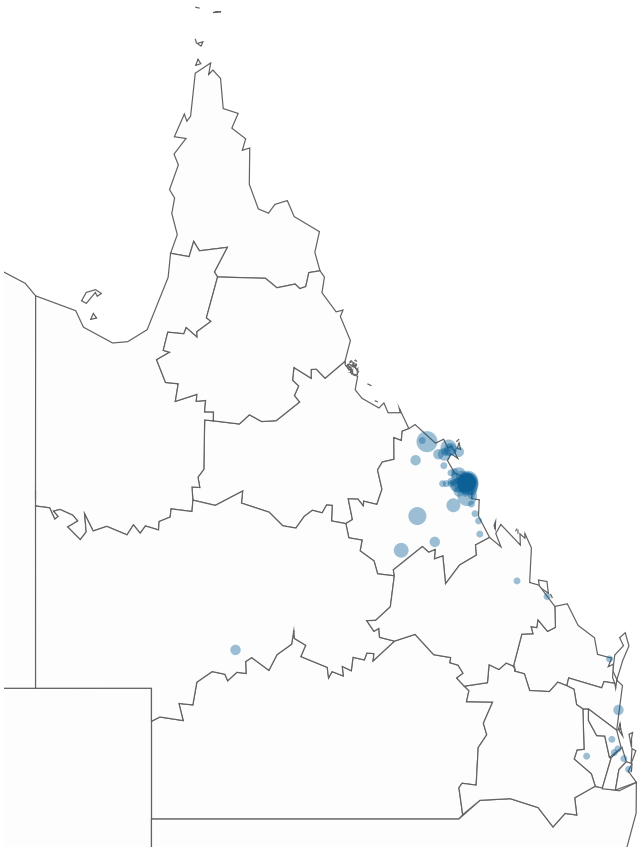


Figure 4: Mackay Base Hospital

Figure 5: Sunshine Coast University Hospital

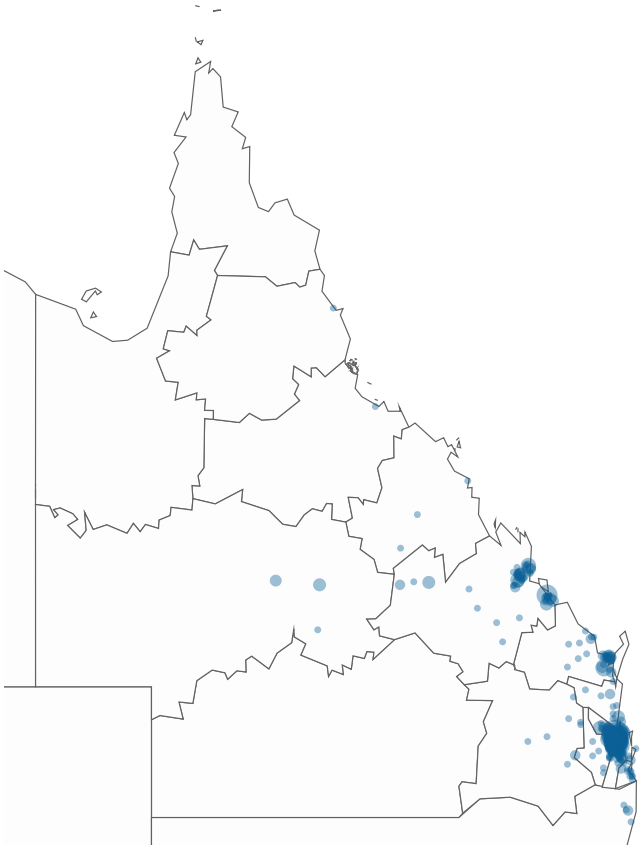


Figure 6: The Prince Charles Hospital

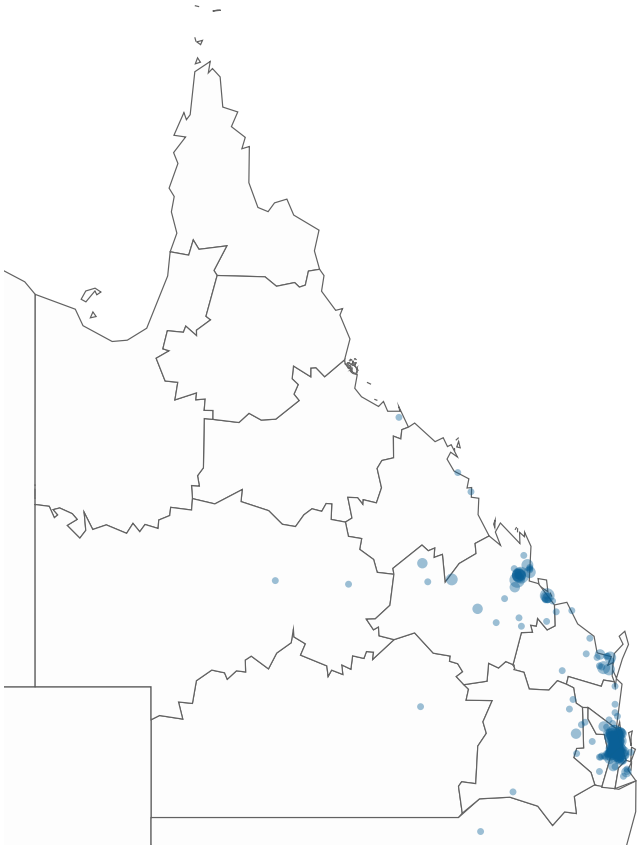


Figure 7: Royal Brisbane & Women's Hospital

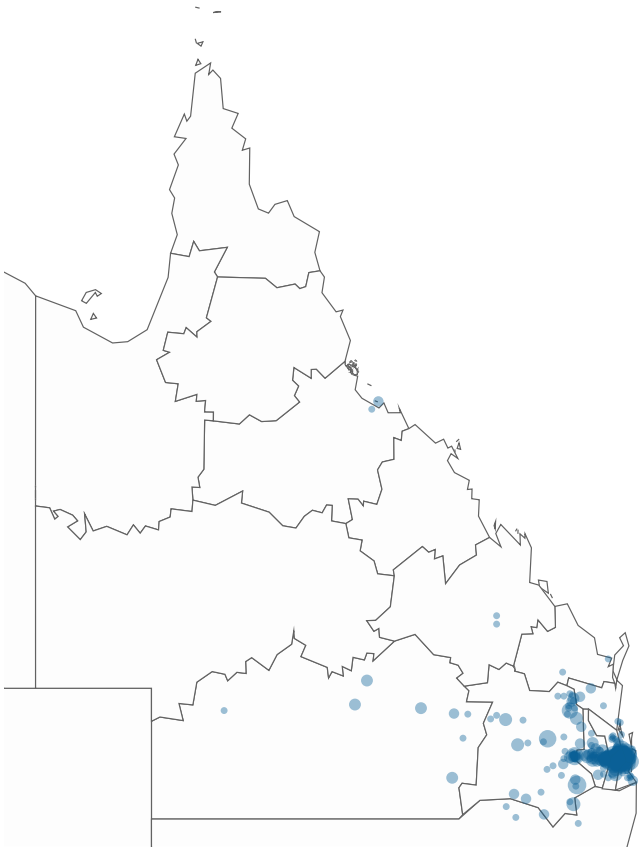


Figure 8: Princess Alexandra Hospital

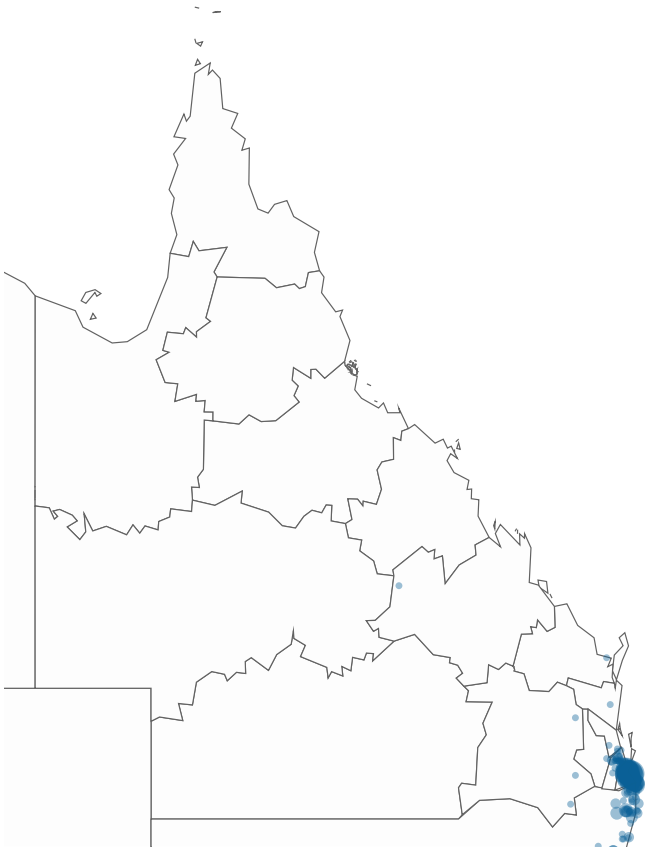


Figure 9: Gold Coast University Hospital

4 Total coronary cases

A total of 15,491 coronary cases were performed across the eight contributing cardiac catheterisation sites, with 4,966 patients (32%) undergoing a percutaneous coronary intervention (PCI). These patients form the cohort at the centre of this Audit.

Since the focus of this report is a specialised subset of invasive cardiology cases performed in the CCL, non coronary procedures such as right heart catheterisation, right ventricular cardiac biopsy and peripheral intervention cases are excluded from analysis.

In addition, detail for 468 structural heart disease interventions including percutaneous valve replacement, valvuloplasty and device closure procedures is included as a supplement to this Audit. Furthermore, Queensland electrophysiology and pacing procedure activity is included in a separate Audit within the QCOR Annual Report.

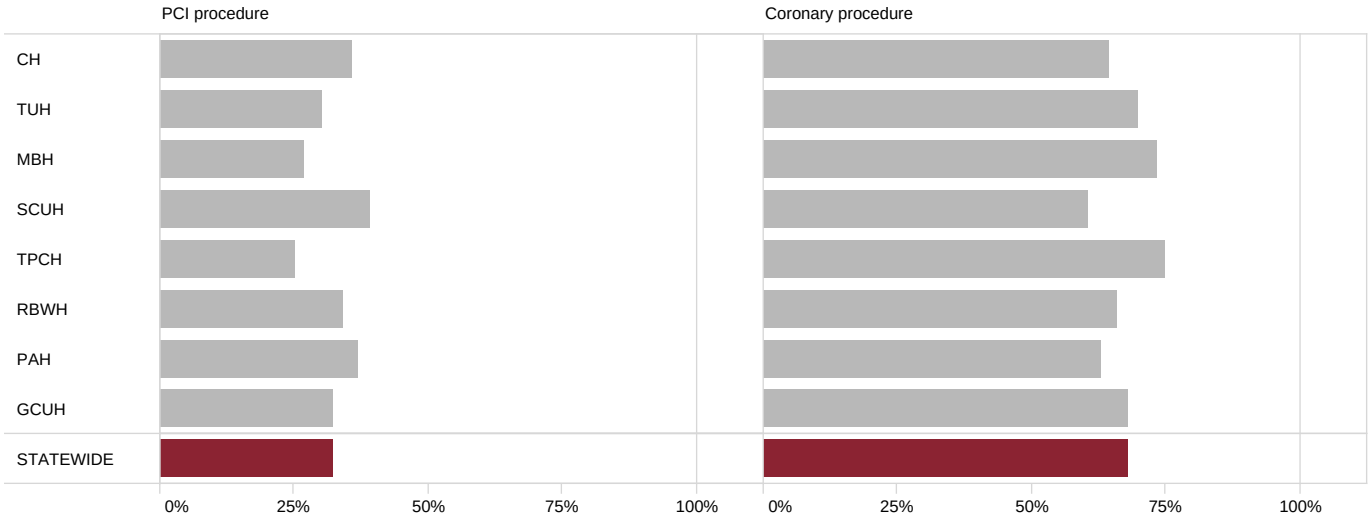


Figure 10: Proportion of cases by procedure category

Table 2: Total cases by procedure category

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

* Includes balloon angioplasty, coronary stenting, PTCRA/atherectomy and thrombectomy of coronary arteries

† Includes coronary angiography, aortogram, coronary artery bypass graft study, left ventriculography, left heart catheterisation, coronary fistula embolisation, intravascular ultrasound, optical coherence tomography, and pressure derived indices for assessing coronary artery stenosis

4.1 Total cases by clinical presentation

Within the larger cohort, the most common presentation category was of non-ST elevation myocardial infarction (NSTEMI), while ST-elevation myocardial infarction (STEMI) cases represented 13% of all cases, and 30% of all PCI cases.

The most common clinical presentation across all cases was acute coronary syndrome (ACS), which accounted for approximately one third of all cases (33%). Almost two thirds of PCI procedures undertaken were categorised as either STEMI or NSTEMI (62%).

Clinical presentation is derived from the procedural indication and reflects the diagnosis made with respect to the findings of the investigation/procedure. It must be acknowledged that there is some degree of variation in practice across sites which is a focus for future work.

Table 3: Total coronary cases by clinical presentation category

Site	STEMI n (%)	NSTEMI n (%)	Other n (%)
CH	158 (10.2)	330 (21.4)	1,054 (68.4)
TUH	112 (9.2)	233 (19.1)	876 (71.7)
MBH	67 (6.4)	150 (14.4)	827 (79.2)
SCUH	263 (18.5)	323 (22.7)	838 (58.8)
TPCH	357 (9.7)	626 (17.0)	2,709 (73.4)
RBWH	151 (11.9)	356 (28.1)	759 (60.0)
PAH	511 (18.5)	773 (28.0)	1,479 (53.5)
GCUH	322 (12.7)	390 (15.4)	1,827 (72.0)
STATEWIDE	**1,941 (12.5)**	**3,181 (20.5)**	**10,369 (66.9)**

Table 4: PCI cases by clinical presentation category

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

4.2 Place of residence

The vast majority of PCI patients (96%) had a usual place of residence within Queensland, with a smaller proportion originating from interstate (4%) and overseas (<1%). For the Gold Coast University Hospital, almost one fifth of PCI patients (18%) originated from outside of Queensland.

Patients came from a wide geographical area with a large proportion of patients residing on the Eastern Seaboard. Almost three quarters (74%) of all patients were seen inside their local Hospital and Health Service (HHS). Of those patients residing in Queensland, the majority (78%) had a usual place of residence within 50 kilometres of the nearest public PCI facility. While this proportion is high, it must be acknowledged that access to PCI services for a large number of Queenslanders involves considerable distance and travel.

Table 5: PCI cases by place of usual residence category

Site	Queensland %	Within HHS %	Interstate %	Overseas %
CH	98.5	86.0	0.7	0.7
TUH	98.9	83.7	0.8	0.3
MBH	99.3	94.6	0.7	–
SCUH	98.7	77.6	1.1	0.2
TPCH	98.2	72.1	1.7	0.1
RBWH	97.4	54.8	1.4	1.2
PAH	98.8	62.3	0.7	0.5
GCUH	82.3	77.4	17.0	0.7
STATEWIDE	**95.8**	**73.7**	**3.7**	**0.5**

Excludes missing data (0.2%)

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

Site	<50 km %	50–150 km %	>150 km %
CH	66.9	23.5	9.6
TUH	70.9	17.3	11.8
MBH	71.5	13.0	15.5
SCUH	68.4	20.5	11.1
TPCH	79.4	4.2	16.4
RBWH	72.2	4.5	23.2
PAH	81.0	12.8	6.2
GCUH	99.1	0.3	0.6
STATEWIDE	**78.1**	**11.1**	**10.8**

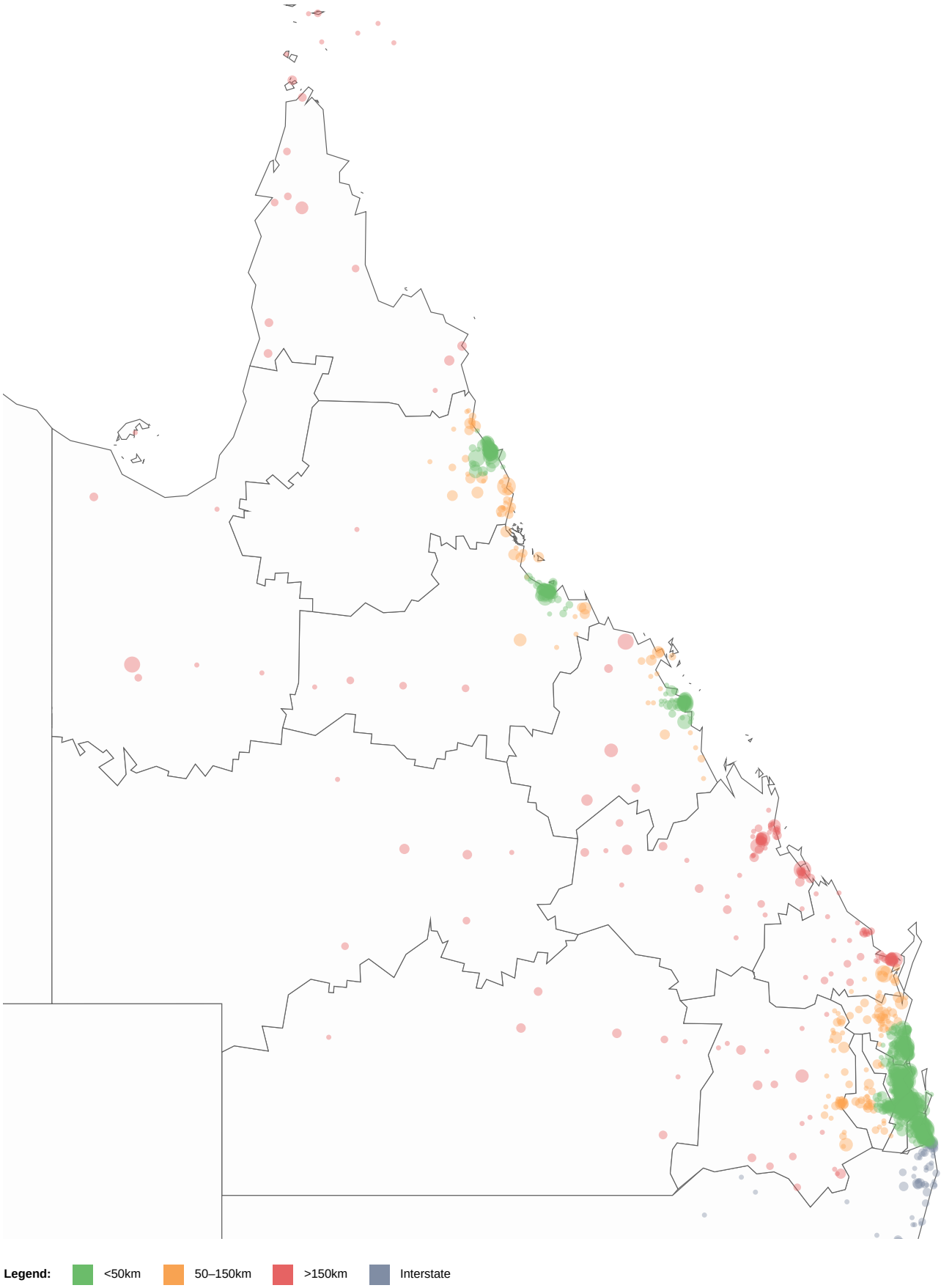


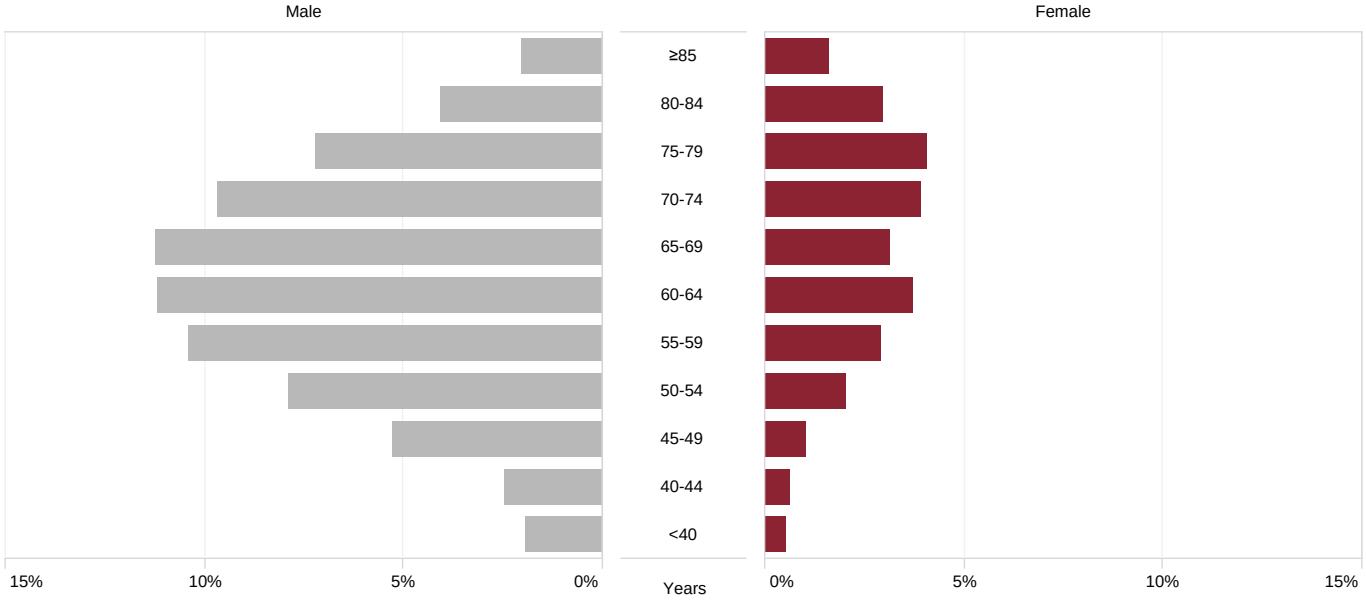
Figure 11: Queensland PCI cases by distance to nearest public PCI facility

5 Patient characteristics

5.1 Age and gender

Age is a well described risk factor in the development of cardiovascular disease. The median age of patients undergoing PCI was 65 years of age and ranged from 63 years to 67 years across sites.

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



% of total PCI (n=4,966)

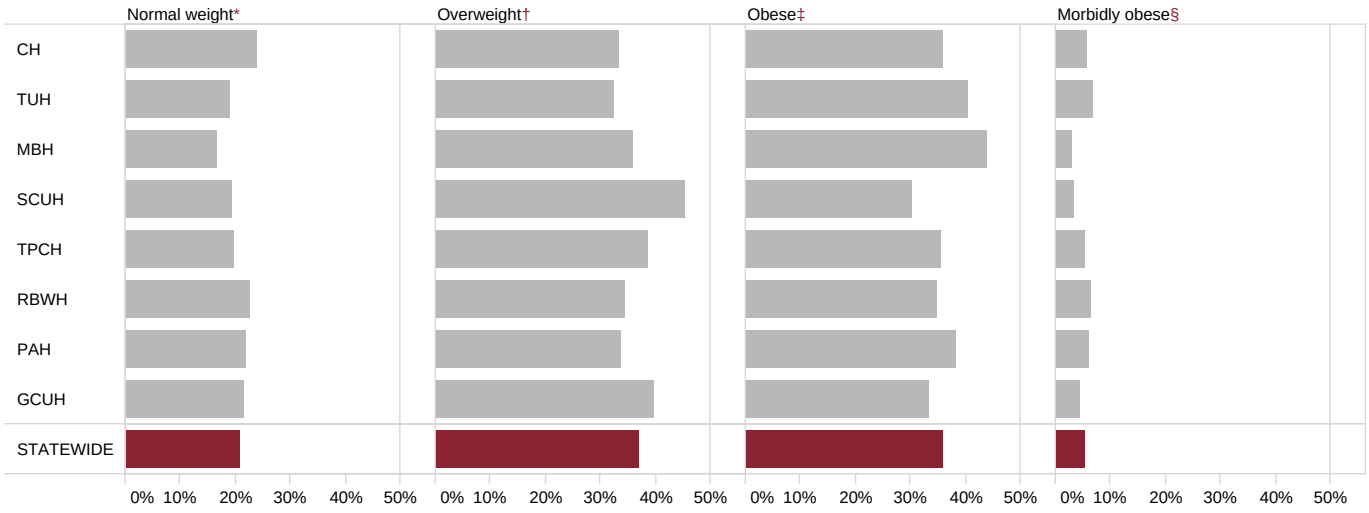
Figure 12: Proportion of all PCI cases by gender and age group

Table 7: Median PCI patient age by gender and site

Site	Male years	Female years	All years
CH	65	68	65
TUH	63	63	63
MBH	64	70	65
SCUH	66	67	66
TPCH	66	70	67
RBWH	60	72	63
PAH	63	66	63
GCUH	64	73	67
STATEWIDE	**64**	**69**	**65**

5.2 Body mass index

Patients across all sites displayed similar trends for body mass index (BMI), with less than one quarter of patients (21%) in the normal BMI range and 37%, 36% and 5% classified as overweight, obese and morbidly obese respectively. There were 1% of cases classified as underweight (BMI ‹18.5 kg/m²).



Excludes missing/invalid data (0.3%)

* BMI 18.5–24.9 kg/m²

† BMI 25.0–29.9 kg/m²

‡ BMI 30.0–39.9 kg/m²

§ BMI ≥40.0 kg/m²

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

Table 8: All PCI cases by body mass index category

Site	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
CH	8 (1.5)	131 (23.9)	181 (33.1)	196 (35.8)	31 (5.7)
TUH	6 (1.6)	69 (18.8)	119 (32.4)	148 (40.3)	25 (6.8)
MBH	2 (0.7)	47 (16.8)	100 (35.7)	123 (43.9)	8 (2.9)
SCUH	9 (1.6)	108 (19.4)	253 (45.3)	169 (30.3)	19 (3.4)
TPCH	6 (0.6)	184 (19.7)	361 (38.7)	331 (35.5)	51 (5.5)
RBWH	8 (1.9)	98 (22.7)	148 (34.3)	149 (34.6)	28 (6.5)
PAH	7 (0.7)	222 (21.8)	343 (33.6)	387 (37.9)	61 (6.0)
GCUH	9 (1.1)	176 (21.5)	324 (39.7)	271 (33.2)	37 (4.5)
STATEWIDE	**55 (1.1)**	**1,035 (20.9)**	**1,829 (36.9)**	**1,774 (35.8)**	**260 (5.2)**

Excludes missing/invalid data (0.3%)

5.3 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of health with a particular impact on the development of cardiovascular disease. It is recognised that the Aboriginal and Torres Strait Islander people experience high levels of health inequality resulting in a higher incidence and prevalence of coronary artery disease.[1]

The increased proportion of identified Aboriginal and Torres Strait Islander patients undergoing PCI in the northern HHSs (CH, 25% and TUH, 19%) is reflective of the resident population within these areas and should be noted for service provision and planning.

The proportion of identified Aboriginal and Torres Strait Islander patients requiring a PCI procedure across all sites (7.0%) exceeds the estimated proportion of Aboriginal and Torres Strait Islander people within Queensland (4.6%).[2]

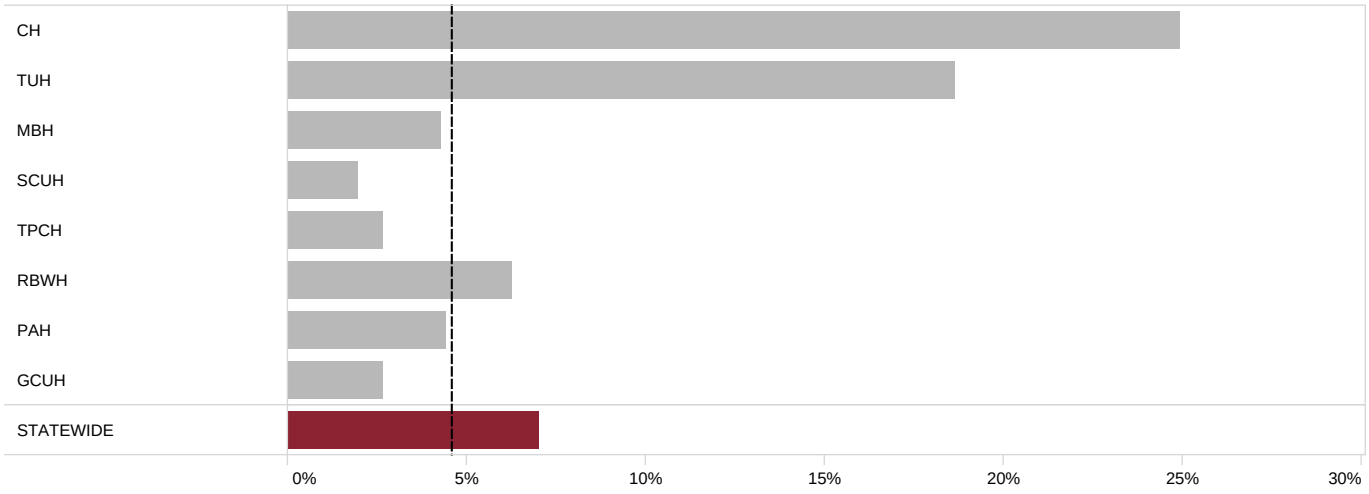


Figure 14: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

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

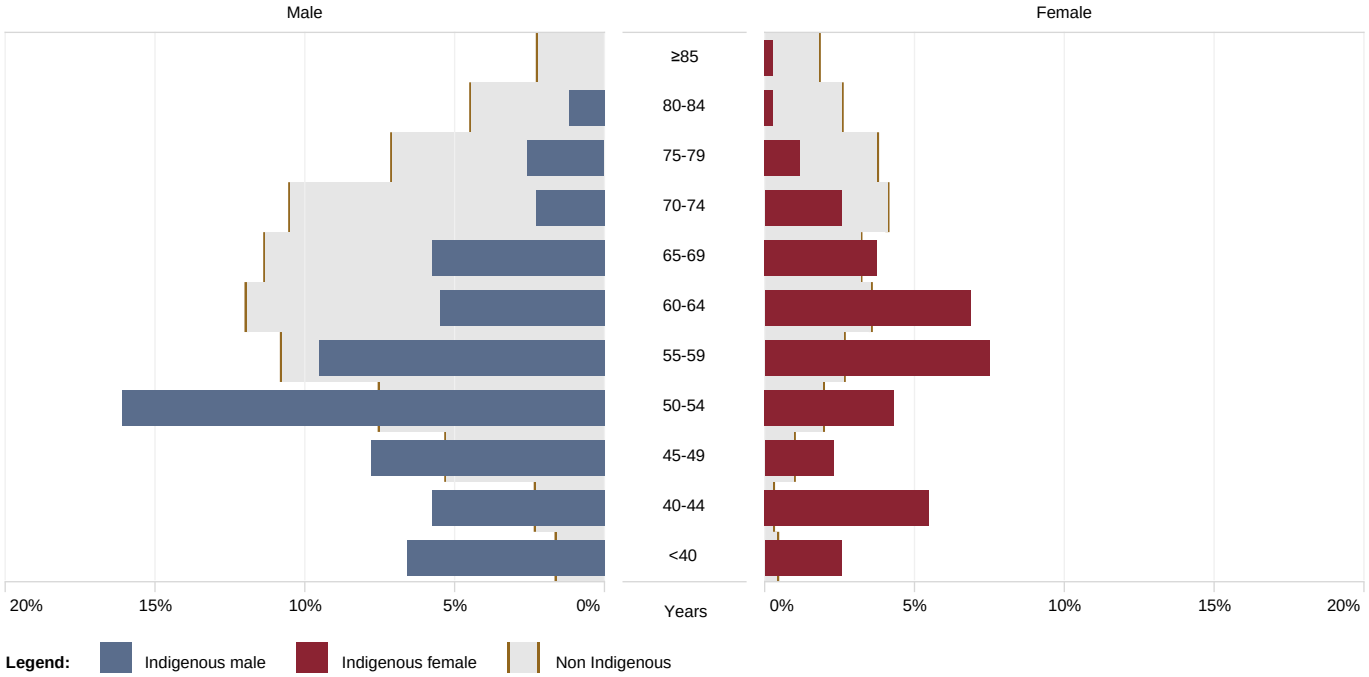


Figure 15: Proportion of all PCI cases by age group and Indigenous status

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

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

6 Care and treatment of PCI patients

6.1 Admission status

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

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

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

Table 10: Diagnostic coronary angiography status

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

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

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

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

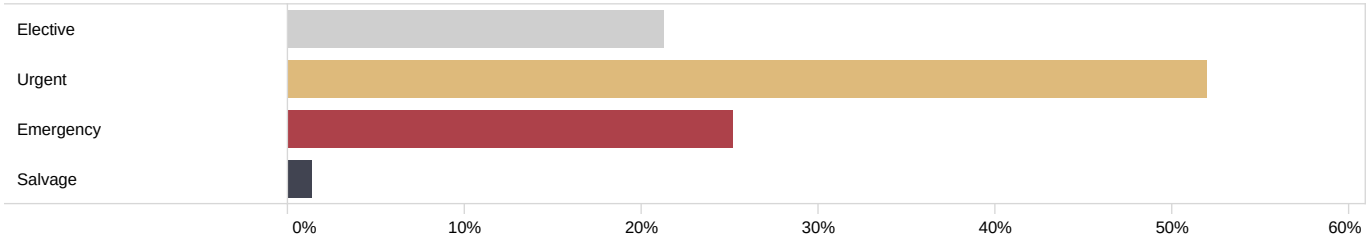


Figure 16: Proportion of all PCI cases by admission status

Table 11: PCI cases by site and admission status

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

6.2 Access route

The majority of PCI cases (93%) used a single access route, with 78% being via the radial approach and 28% femoral. Another access route including brachial or ulnar was utilised in less than 1% of cases. The use of the radial approach varied between different PCI centres (58% to 94%) which is a smaller range than observed in previous years.

Table 12: PCI access route by site

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

Totals >100% due to multiple access sites

Table 13: PCI total access routes by site

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

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

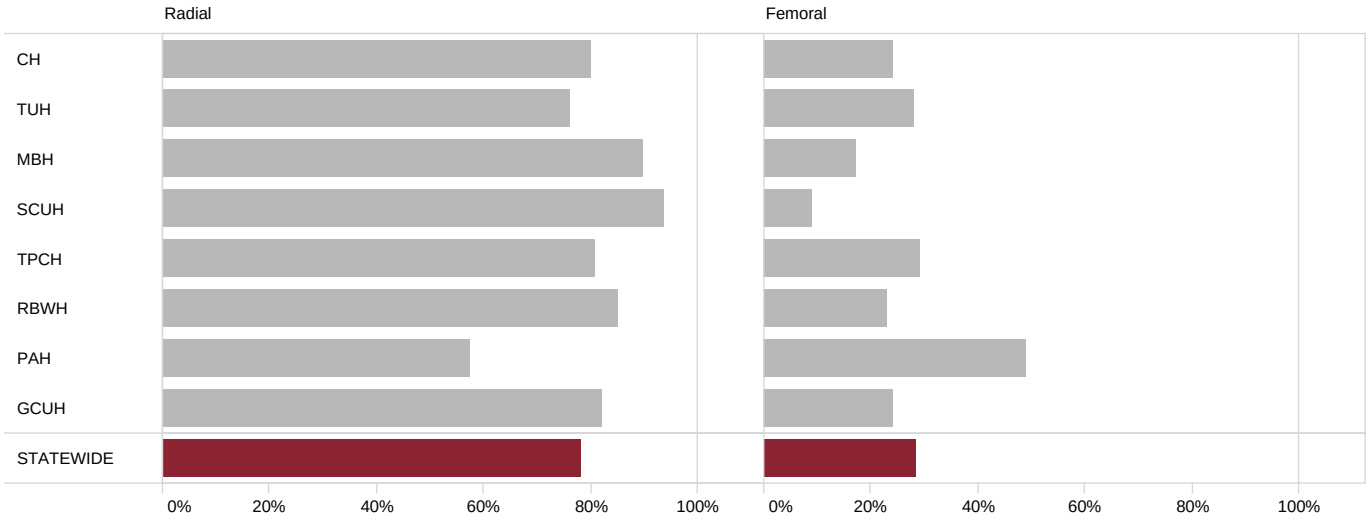


Figure 17: Proportion of PCI cases using radial and femoral access routes by site

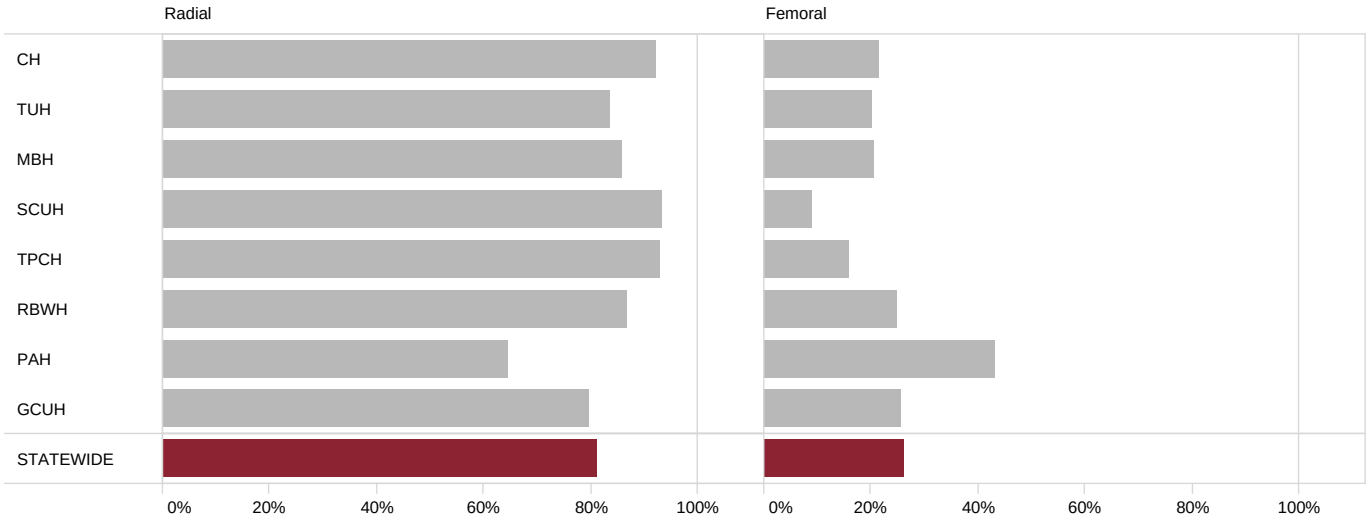


Figure 18: Proportion of STEMI presenting within six hours PCI cases using radial and femoral access routes by site

6.3 Vessels treated

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

Of the vessels treated, 46% of cases involved the left anterior descending coronary artery (LAD), followed by the right coronary artery (RCA) at 37%, the circumflex coronary artery (LCx) at 24% and the left main coronary artery (LMCA) at 3%.

Multi-vessel PCI to native coronary arteries was performed in 10% of cases.

Table 14: Grafts and vessels treated by site

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

Table 15: Total native vessels treated by site

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

Excludes any graft PCI (n=158)

Table 16: Grafts treated by site

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

6.4 Stent type

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

Across all centres, there was an average of 1.5 stents used for each of the 4,624 PCI cases involving stent deployment. DES were used in 99.6% of cases, with some sites using DES exclusively. The proportion of cases utilising DES has increased from previous years (98% and 93% in 2019 and 2018 respectively).

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

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

	Total cases n	DES %	BMS %	BVS %	Covered stent %	Stents per case mean
CH	507	98.6	0.0	1.4	0.0	1.5
TUH	351	100.0	0.0	0.0	0.0	1.4
MBH	248	100.0	0.0	0.0	0.0	1.3
SCUH	529	99.5	0.0	0.0	0.5	1.8
TPCH	868	100.0	0.0	0.0	0.0	1.4
RBWH	409	100.0	0.0	0.0	0.0	1.5
PAH	969	99.3	0.4	0.0	0.3	1.5
GCUH	737	99.6	0.4	0.0	0.0	1.4
STATEWIDE	**4,618**	**99.6**	**0.1**	**0.1**	**0.1**	**1.5**

6.5 PCI following presentation with STEMI

Acute STEMI is a recognised medical emergency in which time to treatment is critical to both short and long term patient outcomes. PCI capable hospitals have therefore developed rapid triage and transfer strategies to fast-track STEMI patients into the CCL for rapid mechanical revascularisation (primary PCI).

Choice of reperfusion method depends on many factors including the timeliness of treatment, individual patient characteristics and access to interventional facilities. Given the time-critical nature of this condition, ongoing improvement and honing of hospital and pre-hospital processes is vital to meet the recommended timeframes for reperfusion in STEMI patients.

It is important to recognise there remains a group of STEMI patients who do not present to hospital or are conservatively managed, however this element of care is outside the scope of this procedure-based registry.

6.5.1 Clinical presentation

There were 1,600 documented STEMI PCI cases, with over half (58%) presenting as primary PCI cases and 10% presenting after 12 hours (late presenters).

Less than one quarter (19%) of patients had received thrombolysis (lysis) prior to invasive coronary revascularisation including 6% requiring rescue PCI as thrombolysis had been unsuccessful.

Table 18: Proportion of STEMI PCI cases by presentation

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

6.5.2 Admission pathway

After first medical contact, 71% of STEMI PCI patients were admitted directly to the treating centre.

As expected, admission pathway varied considerably by STEMI presentation. For lysed and rescue PCI, there were 76% and 77% admitted via interhospital transfer respectively, whereas a large proportion (94%) of the STEMI presenting within six hours of symptom onset cohort presented directly to a PCI facility.

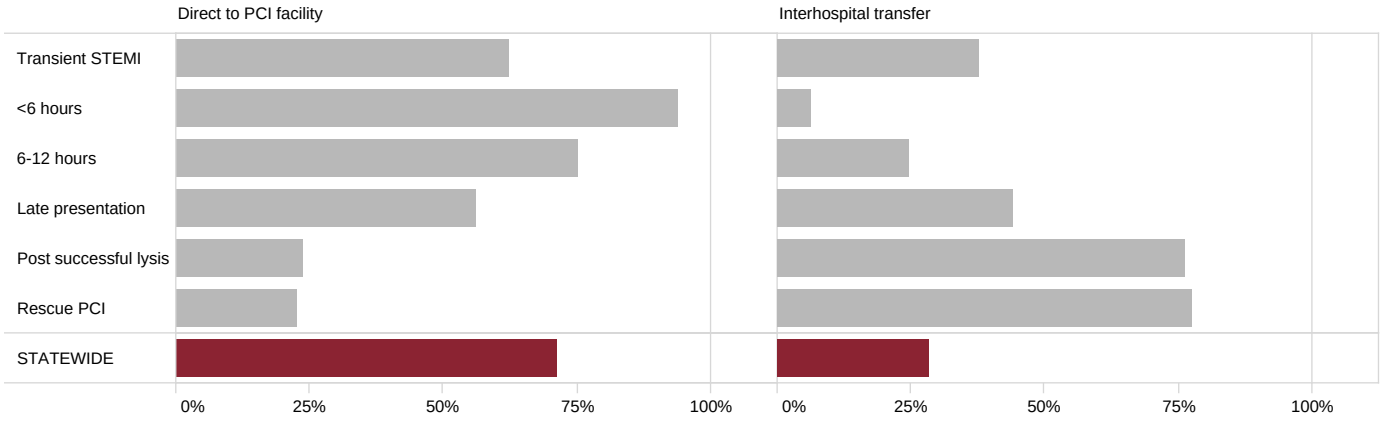


Figure 19: Proportion of STEMI PCI cases by admission pathway and clinical presentation

6.5.3 First medical contact

For STEMI cases presenting for PCI within six hours of symptom onset, most patients presented via the Queensland Ambulance Service (QAS) (82%), while a smaller proportion self-presented to the emergency department (ED) of either a PCI (on-site ED) or non PCI capable (satellite ED) facility (8% and 4% respectively). The remaining 6% presented to other health facilities such as GP clinics, community health centres or any other outpatient setting.

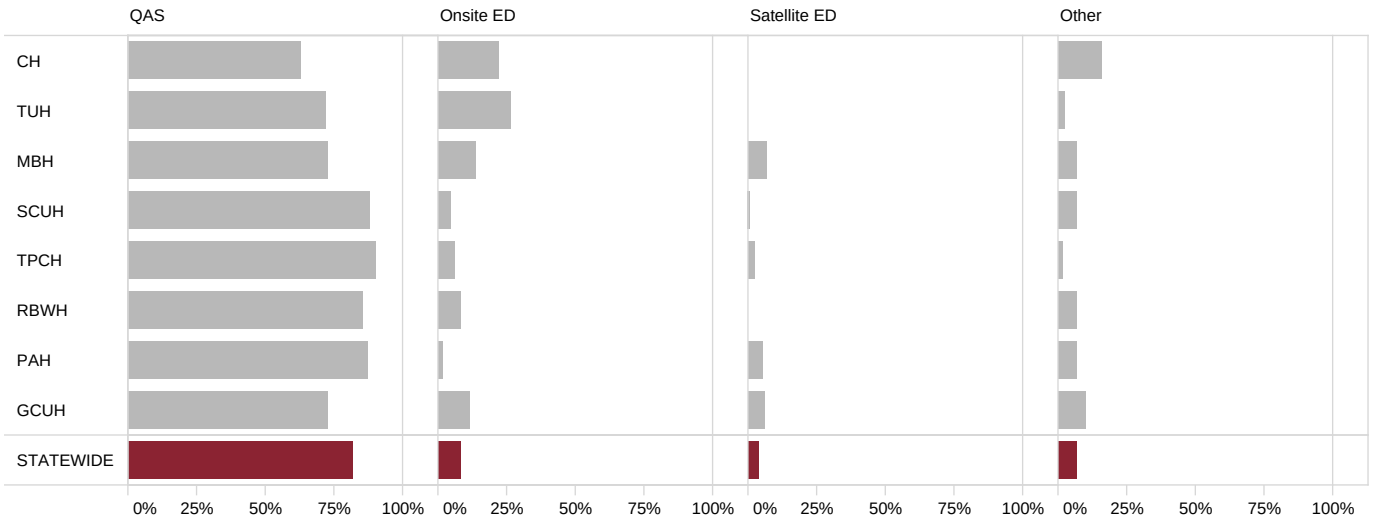


Figure 20: Proportion of STEMI PCI cases presenting within six hours of symptom onset by first medical contact

6.5.4 Thrombolysed patients

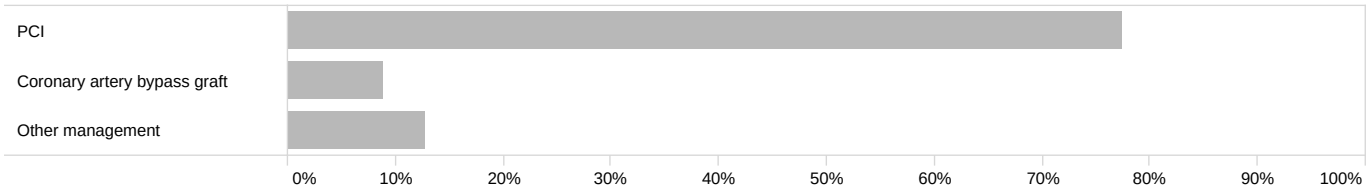
As mentioned above, the method of reperfusion depends on many factors which together determine the treatment method most appropriate for the particular presentation.

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

There was a total of 411 thrombolysed STEMI presentations with the majority (76%) receiving a PCI, which increased to 77% when accounting for subsequent staged interventions within 90 days (Table 20). A smaller proportion (9%) went on to receive coronary artery bypass graft surgery (CABG) at a Queensland Health facility within 90 days.

Table 19: Total lysed STEMI cases by tertiary cardiac centre

Site	Total lysed STEMIs n	Receiving a PCI n (%)	Proportion of all PCI cases %
CH	56	41 (73.2)	7.5
TUH	32	24 (75.0)	6.5
MBH	16	12 (75.0)	4.3
SCUH	84	66 (78.6)	11.8
TPCH	58	41 (70.7)	4.4
RBWH	34	26 (76.5)	6.0
PAH	98	75 (76.5)	7.3
GCUH	33	26 (78.8)	3.2
STATEWIDE	**411**	**311 (75.7)**	**6.3**



PCI and CABG revascularisation not displayed (1.0%)

Figure 21: Proportion of lysed patients by clinical management

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

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

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

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

Reassuringly, the median time from FdECG to thrombolysis was similar across the patients receiving pre-hospital thrombolysis by QAS and the patients who presented directly to the thrombolysis facility (31 minutes vs. 36 minutes).

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

Table 21: Definitions for STEMI time to thrombolysis

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

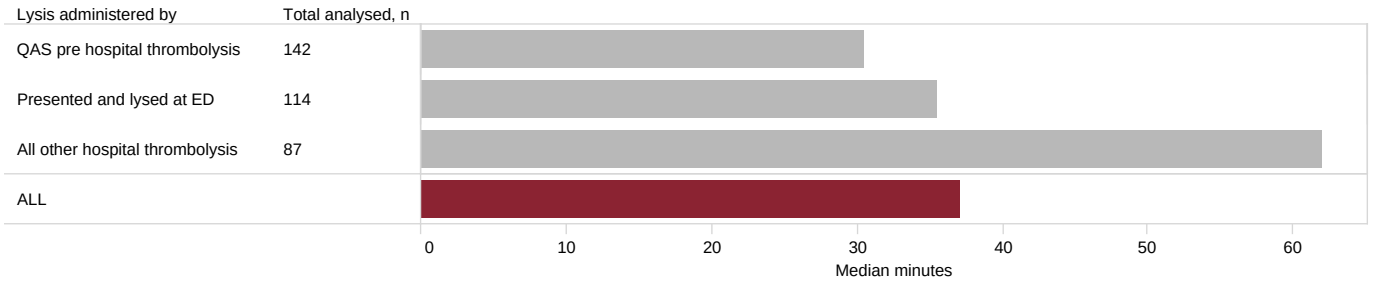
Table 22: Total lysed STEMI cases by thrombolysis administration pathway

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

NA: Not displayed due to <20 cases for analysis

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

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

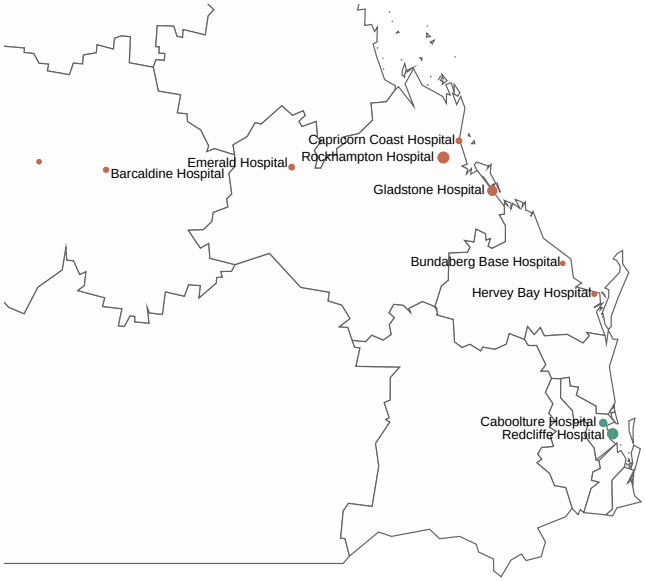


Excludes other pre-hospital thrombolysis (n=7)

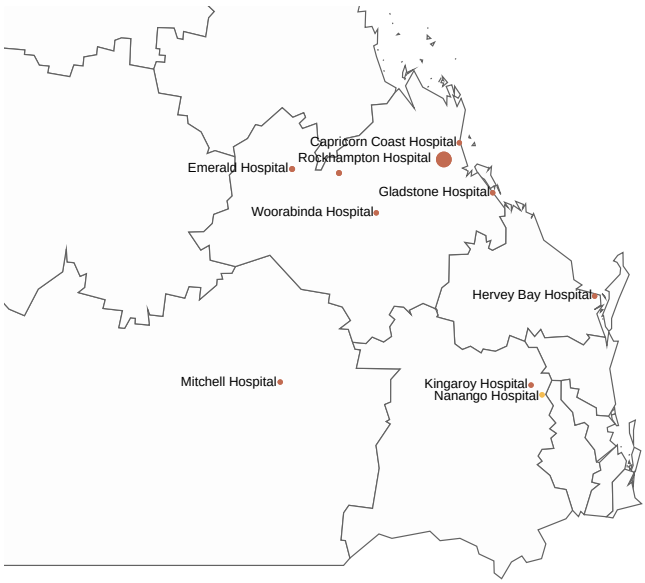
Figure 22: Median time from first diagnostic ECG to thrombolysis therapy by administration pathway

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

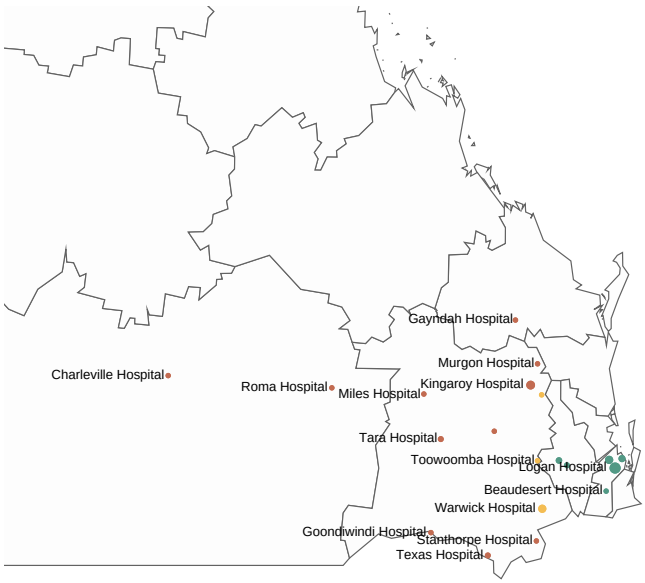
Inset A: Sunshine Coast University Hospital



Inset B: The Prince Charles Hospital



Inset C: Royal Brisbane & Women's Hospital



Inset D: Princess Alexandra Hospital

Inset E: Gold Coast University Hospital

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

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

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

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

* Glasgow Coma Scale

Table 24: Median time from thrombolysis to angiography by site

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

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

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

6.6 NSTEMI presentations

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

Of patients presenting with NSTEMI, 47% were revascularised via PCI, which increased to 51% when accounting for staged interventions within 90 days of index presentation (Table 27). A further 15% underwent CABG, while the remainder were medically managed or referred outside of Queensland Health.

6.6.1 Case load

Table 26: NSTEMI cases by site

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

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

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

* Medical management or referred outside of Queensland Health

6.6.2 Admission source

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

Considerable variation was observed between sites, with the proportion of interhospital transfers for NSTEMI ranging from 37% to 71%, largely explained by catchment area. Where higher volumes and larger median distances to PCI centres exist, it is reasonable to expect that the proportion of cases meeting targets would be smaller. Table 29 and Figure 25 provide perspective based on cases where geographical data were available.

Table 28: NSTEMI admission source to treating facility

Site	Direct to PCI facility n (%)	Interhospital transfer n (%)
CH	187 (56.7)	143 (43.3)
TUH	148 (63.5)	85 (36.5)
MBH	91 (60.7)	59 (39.3)
SCUH	164 (50.8)	159 (49.2)
TPCH	333 (53.2)	293 (46.8)
RBWH	122 (34.3)	234 (65.7)
PAH	226 (29.2)	547 (70.8)
GCUH	245 (62.8)	145 (37.2)
STATEWIDE	**1,516 (47.7)**	**1,665 (52.3)**

Table 29: NSTEMI interhospital transfers by estimated distance to transfer

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

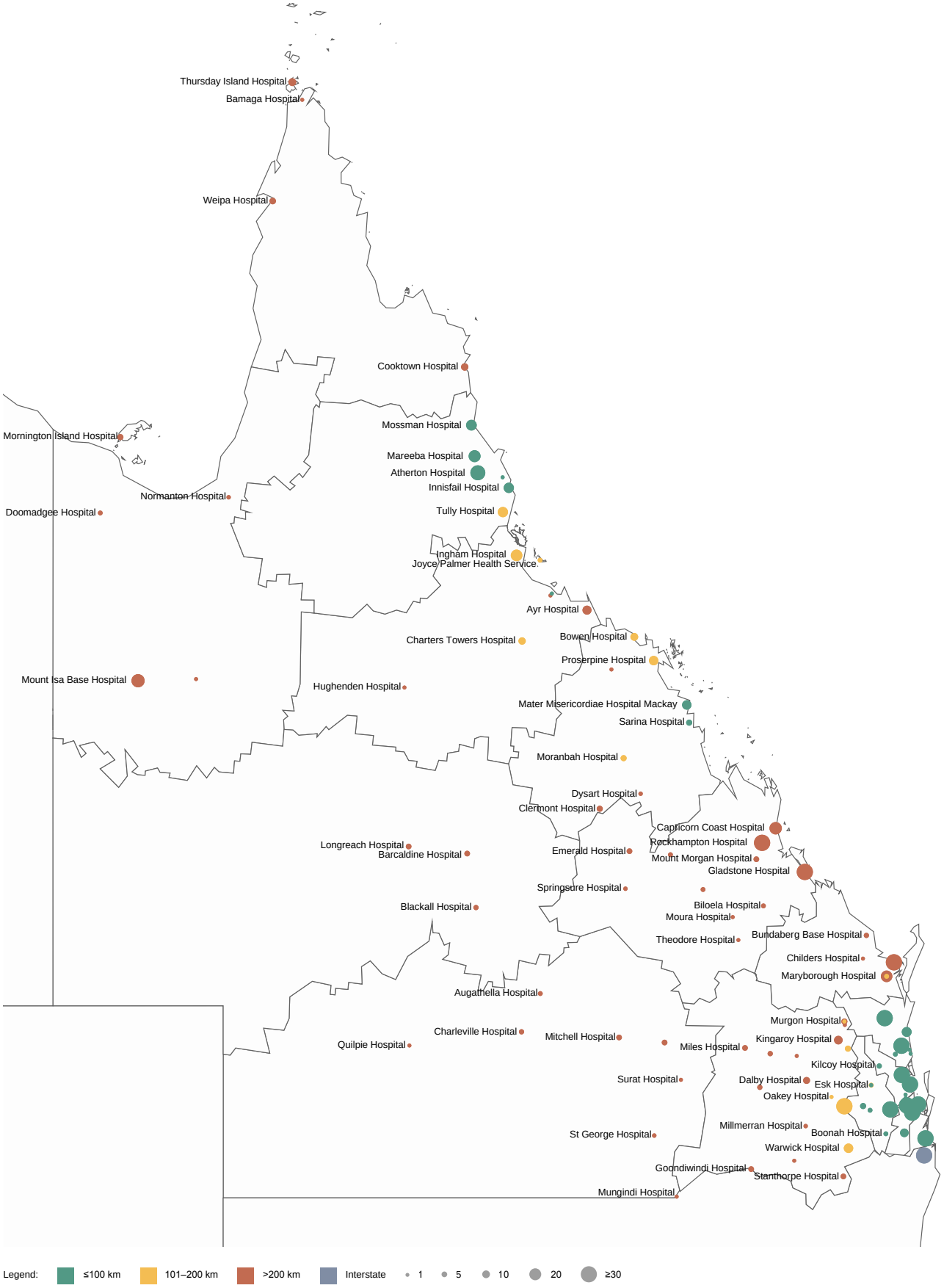
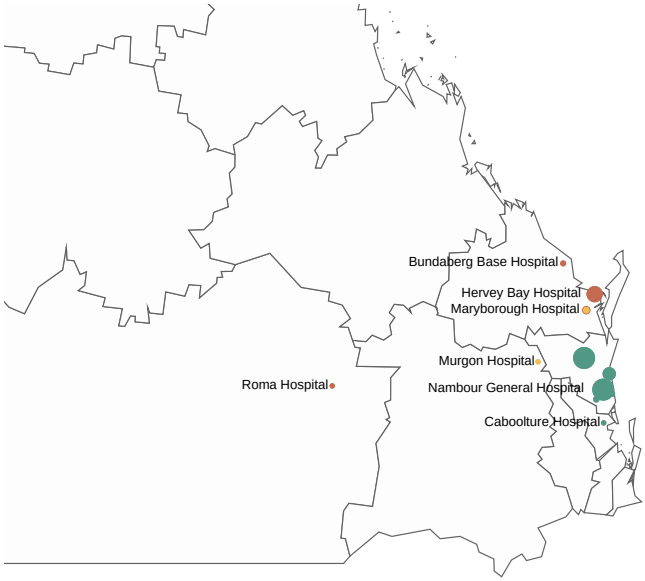
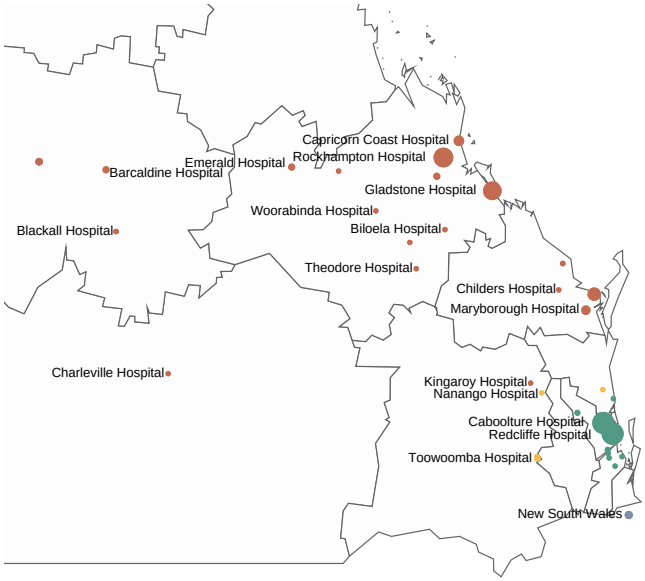


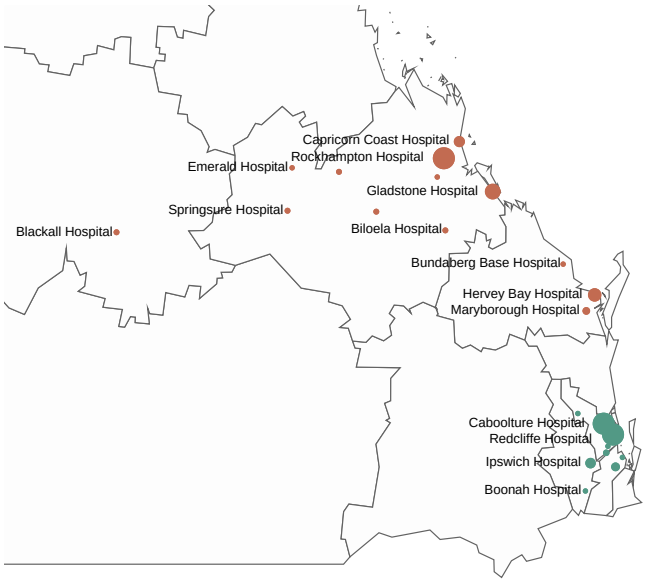
Figure 24: NSTEMI interhospital transfers by estimated distance to transfer



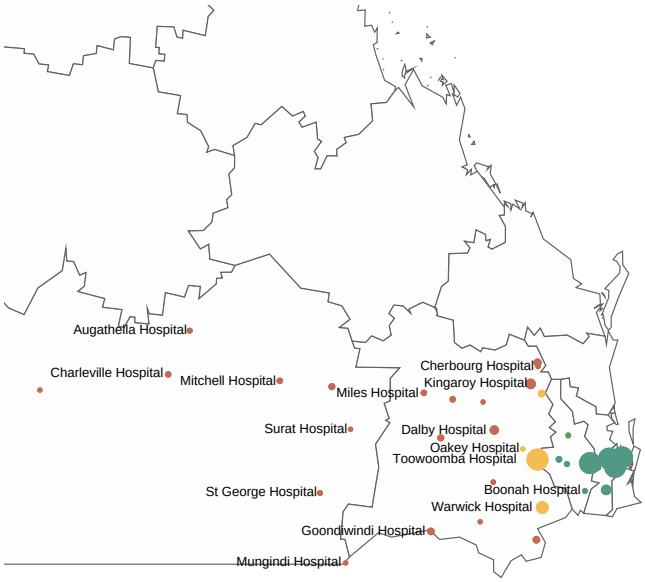
Inset A: Sunshine Coast University Hospital



Inset B: The Prince Charles Hospital



Inset C: Royal Brisbane & Women's Hospital



Inset D: Princess Alexandra Hospital

Inset E: Gold Coast University Hospital

7 Clinical indicators

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

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

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

Table 30: Diagnostic and interventional cardiology clinical indicators

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

7.1 Mortality outcomes

7.1.1 Risk adjusted all-cause 30 day mortality post PCI

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

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

Table 31 presents unadjusted mortality according to admission status. As should be expected, the risk of death increases according to the severity of the patient's condition (admission status). 30 day mortality was 36% in the critically ill patients who underwent salvage PCI.

Table 31: All-cause unadjusted mortality within 30 days post PCI by admission status (% of total cases by presentation and site)

Site	Total cases n	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)	Total deaths n (%)
CH	550	0 (0.0)	3 (0.9)	4 (4.5)	2 (20.0)	9 (1.6)
TUH	370	0 (0.0)	2 (1.0)	2 (2.9)	2 (66.7)	6 (1.6)
MBH	280	0 (0.0)	1 (0.9)	2 (4.4)	0 (0.0)	3 (1.1)
SCUH	560	0 (0.0)	3 (1.0)	3 (1.9)	1 (50.0)	7 (1.3)
TPCH	934	1 (0.4)	5 (1.2)	4 (1.5)	5 (41.7)	15 (1.6)
RBWH	431	0 (0.0)	1 (0.4)	3 (3.4)	3 (37.5)	7 (1.6)
PAH	1,022	0 (0.0)	4 (0.7)	6 (2.1)	8 (42.1)	18 (1.8)
GCUH	819	0 (0.0)	3 (0.8)	3 (1.2)	4 (26.7)	10 (1.2)
STATEWIDE	**4,966**	**1 (0.1)**	**22 (0.9)**	**27 (2.2)**	**25 (35.7)**	**75 (1.5)**

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

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

There were also considerable differences in salvage case mortality rates across different hospitals (Table 31). This variation may relate to differences in case mix at different hospitals, differences in the threshold for performing PCI in critically ill unstable patients, differences in classification of admission status, or a combination of all three factors. Given this variation, and the inability of the current risk prediction model to accurately predict expected mortality in the extreme risk salvage category, Figure 26 presents the observed and expected mortality rates excluding salvage.

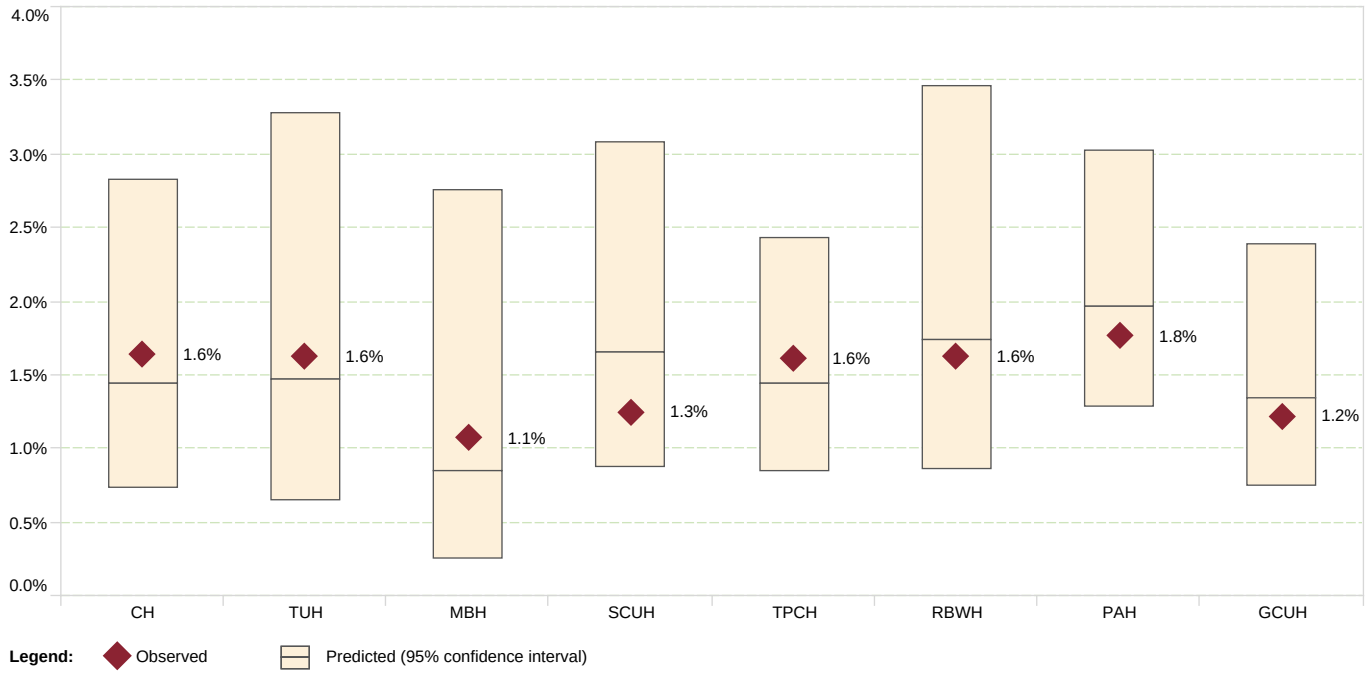
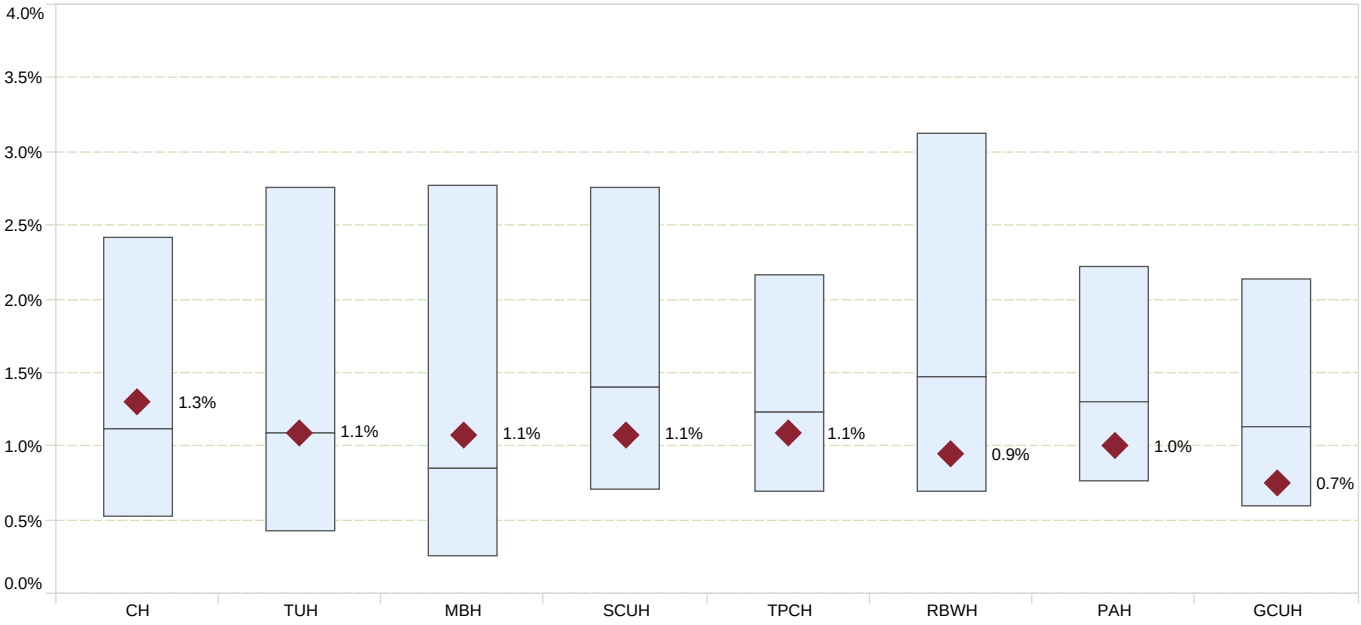


Figure 25: Comparison of observed and predicted mortality rates by site

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

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

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



Excluding salvage cases (n=70)

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

7.1.2 STEMI mortality

A separate analysis was performed to assess mortality in patients presenting with STEMI. Of the 1,941 documented STEMI cases in 2020, 1,600 cases (82%) included a PCI intervention and are the subject of the following outcomes analyses. For this analysis, patients presenting as salvage are excluded, allowing focus to be retained on the measurement of PCI outcomes.

The outcomes for cohort of STEMI patients who underwent primary PCI remain encouraging. All-cause mortality rates at 30 days varied from 1.4% to 4.8% between participating centres with a statewide rate of 2.1%. Of these 1,543 patients analysed, a total of 32 mortalities were identified with the majority (66%) occurring in hospital.

Table 32: STEMI mortality up to 30 days in patients who underwent primary PCI

Site	In-lab n	In hospital n	Post discharge to 30 days n	Total cases* n	Total mortality n (%)
CH	0	2	4	126	6 (4.8)
TUH	0	3	0	88	3 (3.4)
MBH	0	1	1	52	2 (3.8)
SCUH	0	2	1	212	3 (1.4)
TPCH	0	4	0	277	4 (1.4)
RBWH	0	3	0	112	3 (2.7)
PAH	2	4	1	403	7 (1.7)
GCUH	0	2	2	273	4 (1.5)
STATEWIDE	**2**	**21**	**9**	**1,543**	**32 (2.1)**

* Excluding salvage cases (n=57)

7.1.3 STEMI presentation within 6 hours from symptom onset

Further analysis of the STEMI cohort who underwent primary PCI within six hours of symptom onset demonstrates a statewide all-cause 30 day mortality rate of 2.5%.

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

Table 33: STEMI mortality up to 30 days for patients who underwent a primary PCI and presented within six hours of symptom onset

Site	In-lab n	In hospital n	Post discharge to 30 days n	Total cases* n	Total mortality n (%)
CH	0	0	2	45	2 (4.4)
TUH	0	2	0	47	2 (4.3)
MBH	0	1	1	29	2 (6.9)
SCUH	0	2	1	89	3 (3.4)
TPCH	0	2	0	156	2 (1.3)
RBWH	0	3	0	57	3 (5.3)
PAH	1	3	0	220	4 (1.8)
GCUH	0	1	1	168	2 (1.2)
STATEWIDE	**1**	**14**	**5**	**811**	**20 (2.5)**

* Excluding salvage cases (n=36)

7.1.4 Out of hospital cardiac arrest

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

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

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

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

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

Table 35: Out of hospital cardiac arrest mortality up to 30 days post procedure

	Total cases n	In-lab n	In hospital n	Post discharge to 30 days n	Total deaths n (%)
STATEWIDE	**99**	**1**	**14**	**0**	**15 (15.2)**

7.2 STEMI less than six hours from symptom onset – time to reperfusion

The most critical factor influencing outcome for patients who experience a STEMI is the total ischaemic time, defined as the time interval from symptom onset to successful reperfusion. The exact time of symptom onset is often difficult to ascertain, and the time between symptom onset and call for help is primarily a patient dependent factor.

Therefore, STEMI guidelines worldwide now advocate first diagnostic ECG (FdECG)-to-device time as an important modifiable and objective measure of overall STEMI system performance.[12]

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

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

Table 36: Definitions for STEMI time to reperfusion

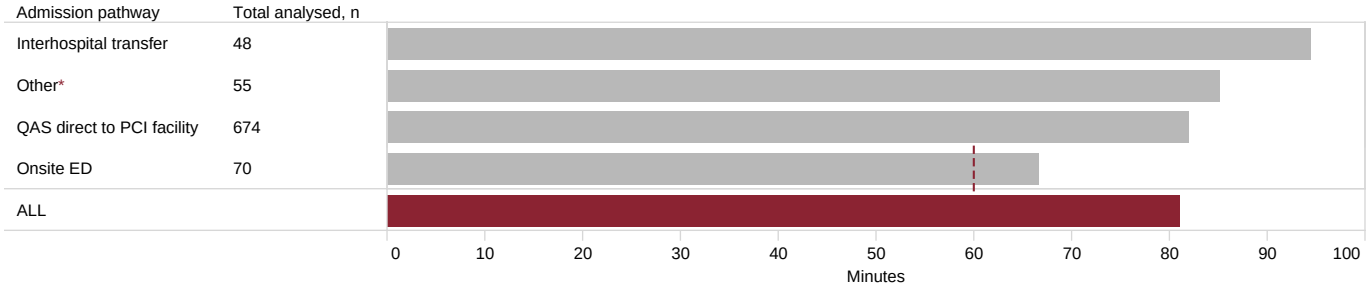
Time	Definition
First diagnostic ECG	First diagnostic ECG refers to the timestamp when the ECG shows ST-segment elevation (or equivalent) and can be regarded as time zero in the therapeutic pathway. The interpretation of the first diagnostic ECG may be undertaken by ambulance personnel, general practitioners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

* Grade 3 (complete perfusion)[14]

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

In total, there were 847 STEMI primary PCI cases presenting within six hours of symptom onset. Of these, there were 127 cases which had been excluded per the criteria in Table 37 leaving 720 cases which are eligible for the following analysis.

As observed in previous annual reports, there was considerable variation in time from first diagnostic ECG to reperfusion depending on the admission pathway to the treating facility, ranging from 95 minutes to 67 minutes for interhospital transfers and PCI facility onsite ED respectively.



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

Figure 27: STEMI presenting within six hours of symptom onset – median first diagnostic ECG to first device time by admission pathway

Table 37: STEMI presenting within six hours of symptom onset cases ineligible for analysis

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

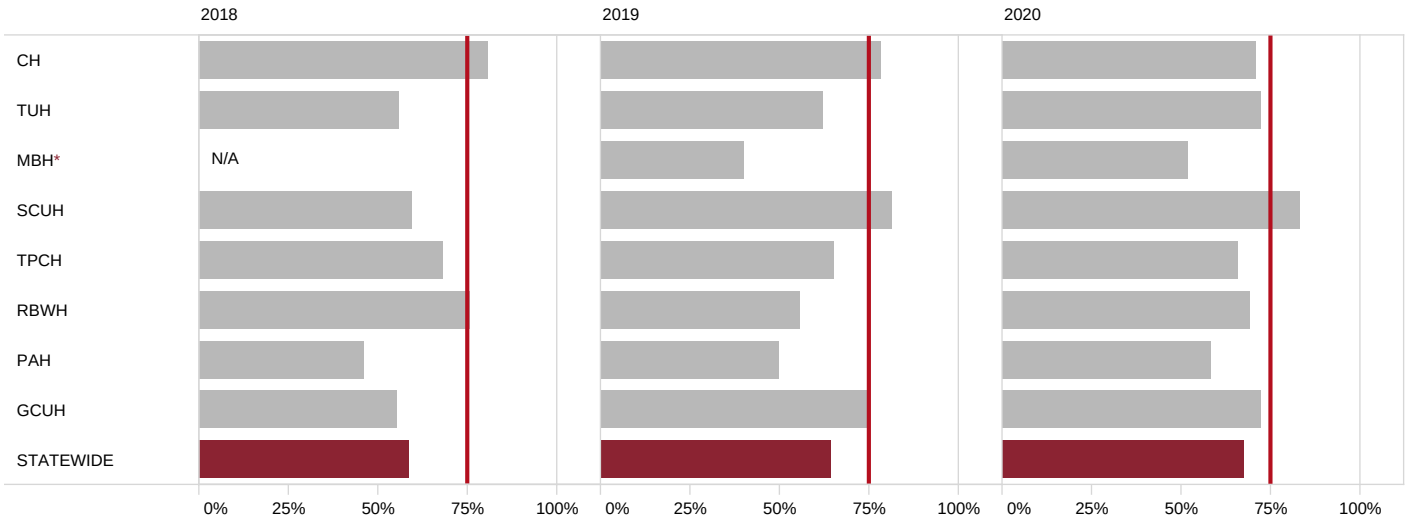
7.2.1 Time from first diagnostic ECG to first device

The all-site median time from first diagnostic ECG to reperfusion was 81 minutes, with median individual site times ranging from 75 minutes to 90 minutes. These results indicate that overall Queensland public facilities are approaching the ambitious benchmark of 90 minutes from time of first diagnostic ECG to first device. However, only 67% of patients analysed receive timely reperfusion per current guidelines (FdECG to reperfusion), supporting the view that the current target is idealistic.

FdECG to reperfusion is a multi layered metric with the involvement of QAS, emergency and cardiology physicians and, along with the large geographical variations across Queensland, presents a clinical and logistical challenge for all involved. Nonetheless, the measure of time to reperfusion remains a useful tool for monitoring processes and efficiencies and demonstrates the potential for improvement or maintenance of system and hospital performance.

Table 38: First diagnostic ECG (FdECG) to reperfusion for STEMI presenting within six hours of symptom onset

Site	Total cases n	Total analysed n	Median minutes	Interquartile range minutes	Met 90 min target %
CH	51	42	76	66–98	71.4
TUH	49	40	78	73–94	72.5
MBH	29	25	90	75–113	52.0
SCUH	90	77	75	62–86	83.1
TPCH	162	137	81	71–97	65.7
RBWH	60	52	77	62–101	69.2
PAH	232	197	87	75–108	58.4
GCUH	174	150	82	68–93	72.0
STATEWIDE	**847**	**720**	**81**	**69–98**	**67.4**



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

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

7.2.1.1 Pre-hospital notification processes

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

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

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

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

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

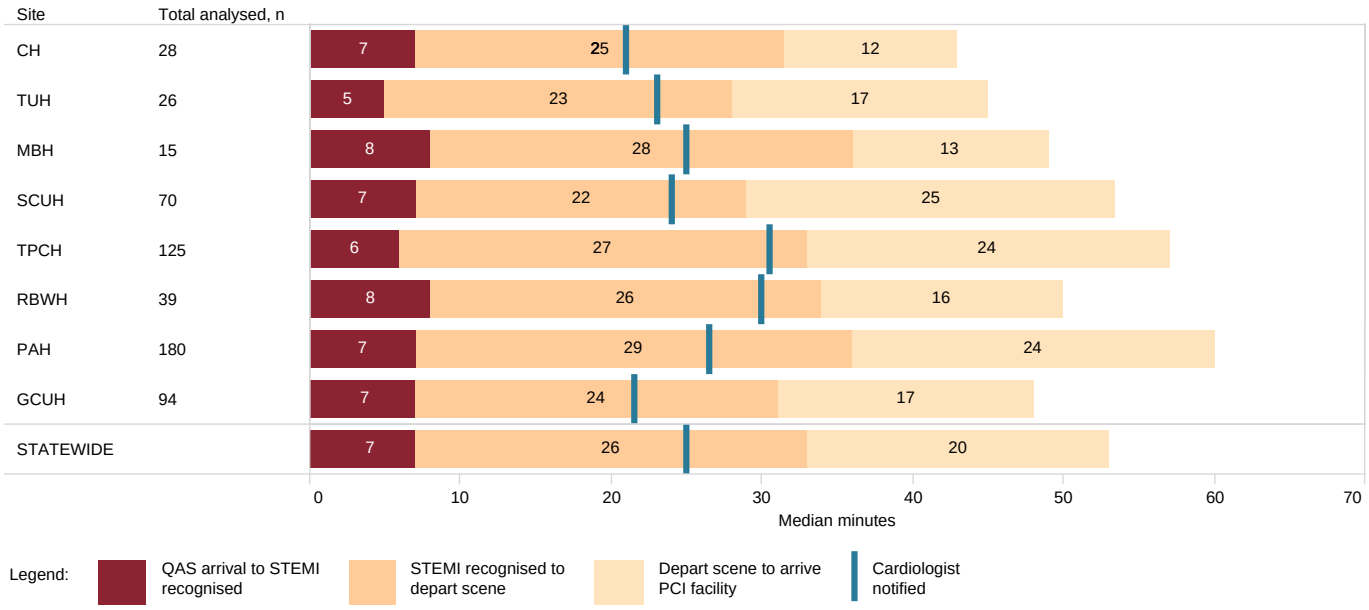


Figure 29: STEMI presenting within six hours of symptom onset pre-hospital component breakdown – QAS direct to PCI facility

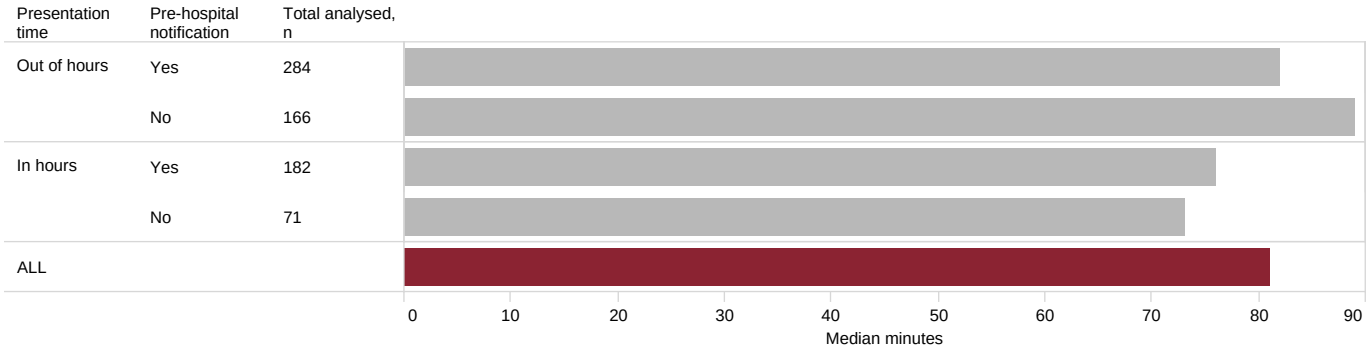
7.2.1.2 Hospital processes

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

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

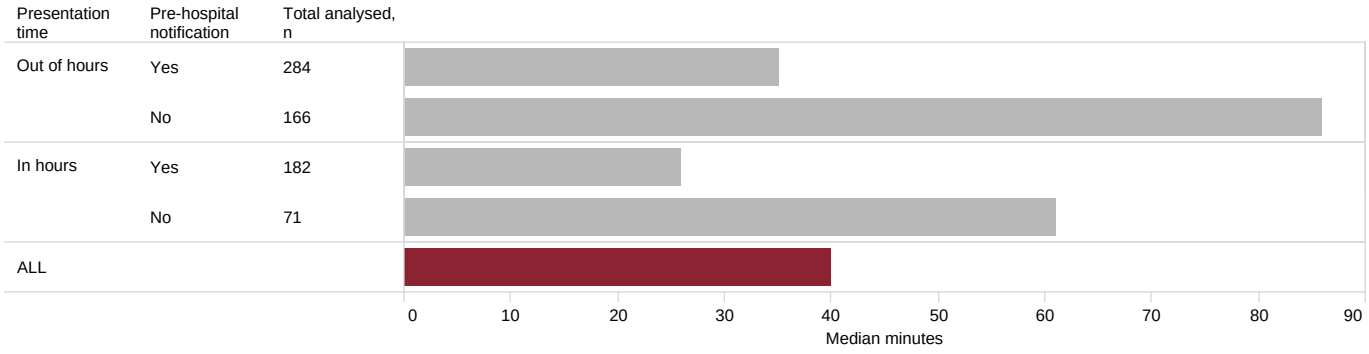
Total time to reperfusion was lowest in the in hours cohort. There was slight variation in median time to reperfusion when pre-hospital notification was examined. A small cohort size may explain the counterintuitive finding that patients without pre-hospital notification have a swifter time to reperfusion.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

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



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

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



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

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

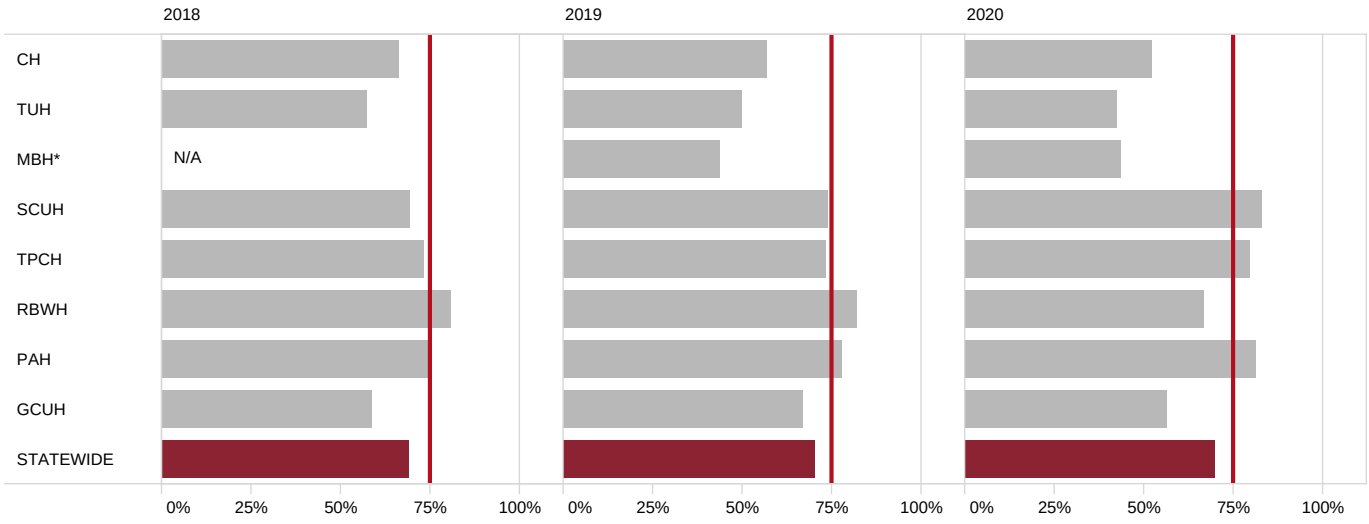
7.2.2 Time from arrival PCI capable facility to first device

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

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

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

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



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

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

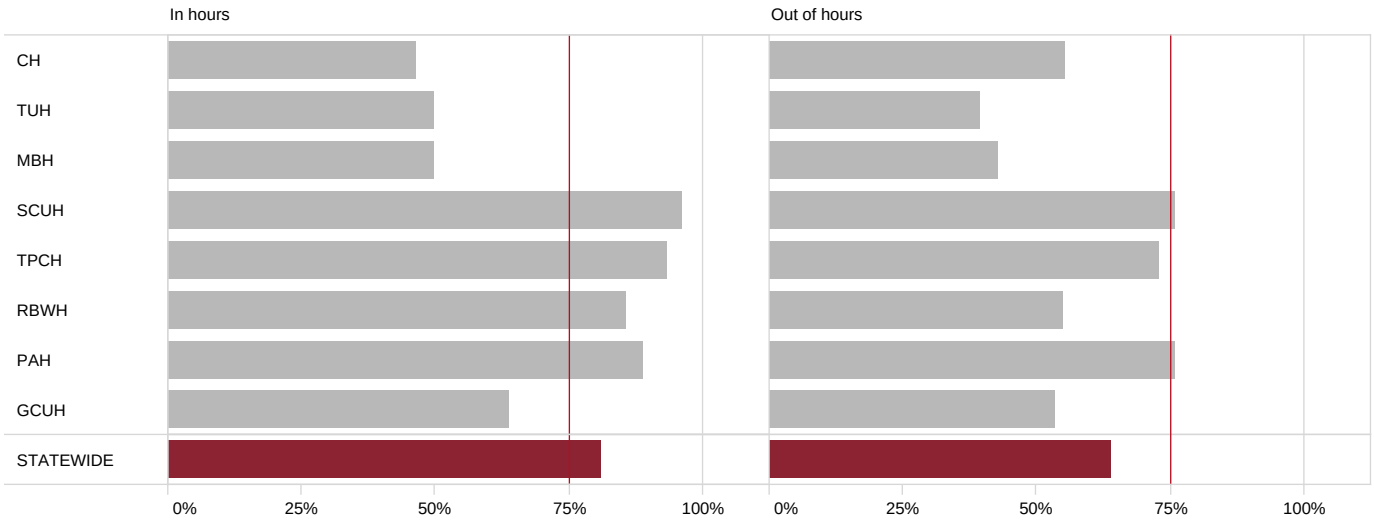
7.2.2.1 In hours versus out of hours presentation

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

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

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

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



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

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

7.2.2.2 Pre-hospital notification

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

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

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

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

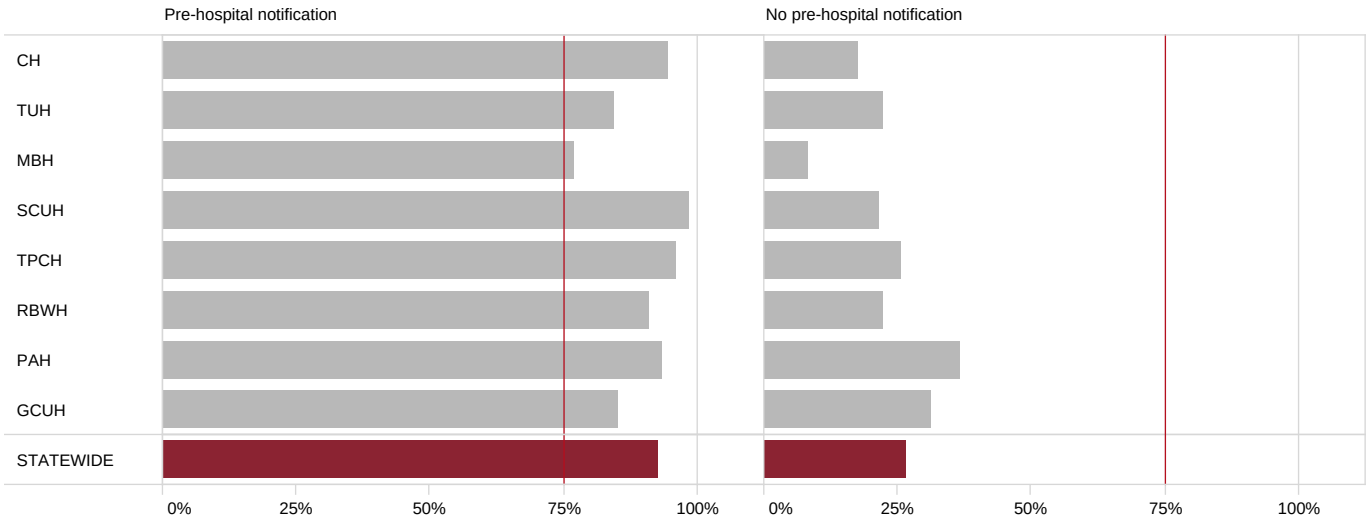


Figure 34: STEMI presenting within six hours of symptom onset – proportion of cases where arrival at PCI hospital to first device ≤60 minutes by site and pre-hospital notification

7.3 NSTEMI – time to angiography

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

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

A major barrier to achieving this target is the time taken to transfer patients from non PCI capable facilities to the accepting PCI centre. Multiple reasons for delays include delay in referral to tertiary facility, capacity constraints and patient transfer logistics in a large geographic area. Many of these factors are more complicated to improve than changes to local practice or departmental efficiency.

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

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

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

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

For direct presenters, the wide range of 21 hours to 50 hours before angiography is influenced by several factors including patient demographics, clinical case mix and competing caseloads. The centres with ‹75% meeting target had the widest interquartile ranges, providing opportunity to review local factors that may be modifiable to promote time efficiencies.

Across the state, in comparison with 2019, there was for direct presenters (Table 43) a sizeable increase in analysable NSTEMI cases (1,343 vs. 1,290) and an improved proportion meeting target (80% vs. 74%). While for interhospital transfers (Table 44), there was a slight decrease in analysable cases (1,343 vs. 1,356) but a reassuring increase in the proportion meeting the target (57% vs. 46%).

Table 43: Time to angiography – direct to PCI facility

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

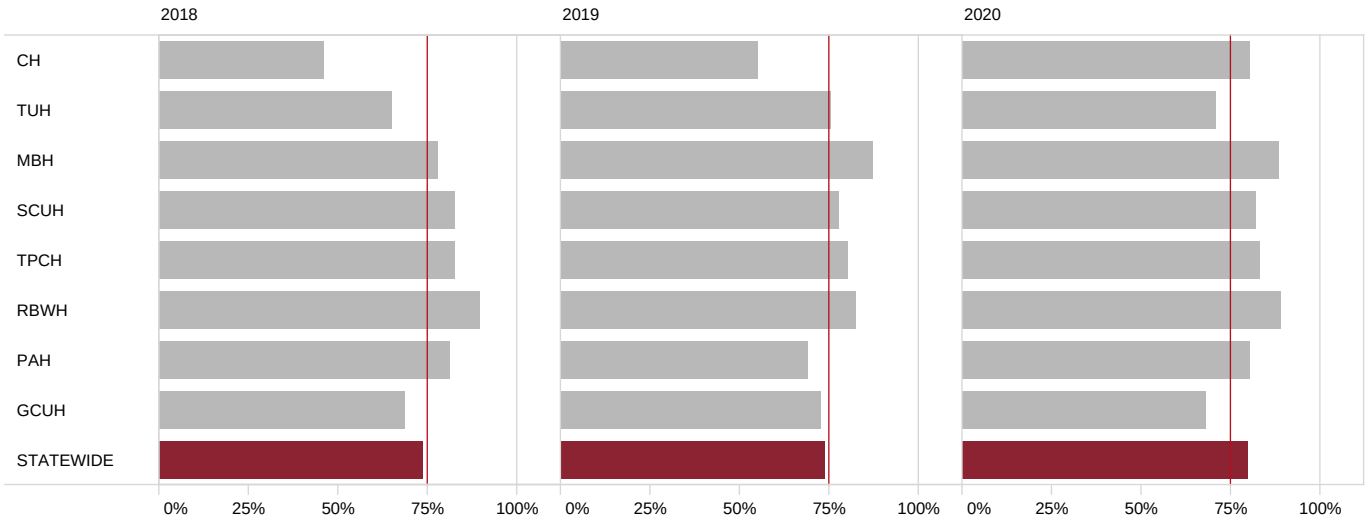


Figure 35: Proportion of NSTEMI direct presenters receiving angiography within 72 hours, 2018–2020

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

Table 44: Time to angiography – interhospital transfers

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

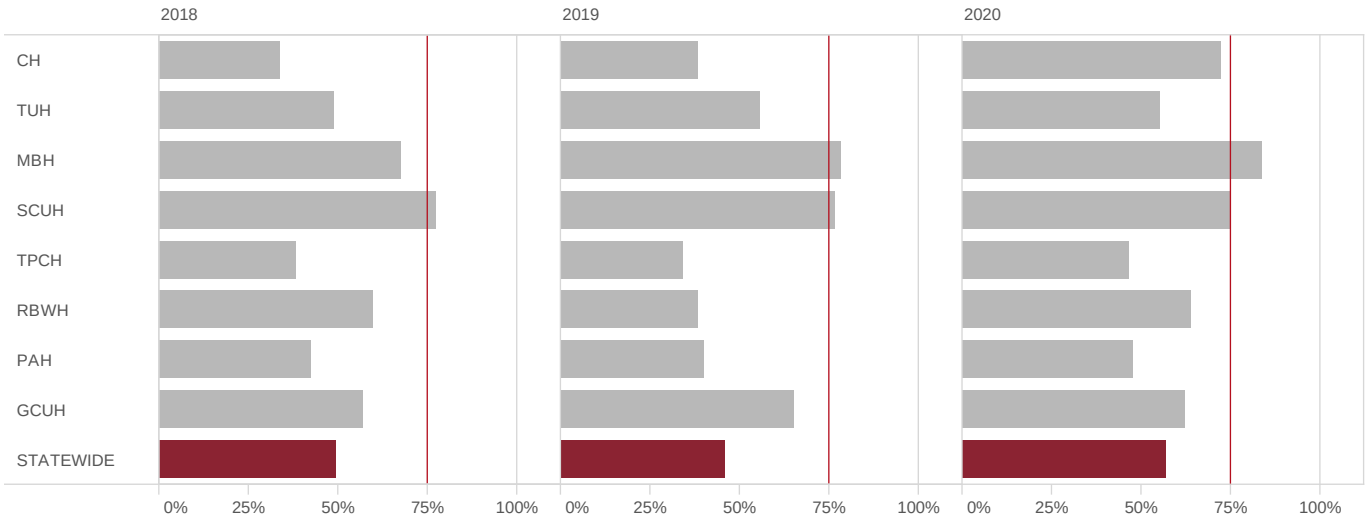


Figure 36: Proportion of NSTEMI interhospital transfers receiving angiography within 72 hours, 2018–2020

7.3.1 NSTEMI interhospital transfers – time to transfer to PCI facility

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

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

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

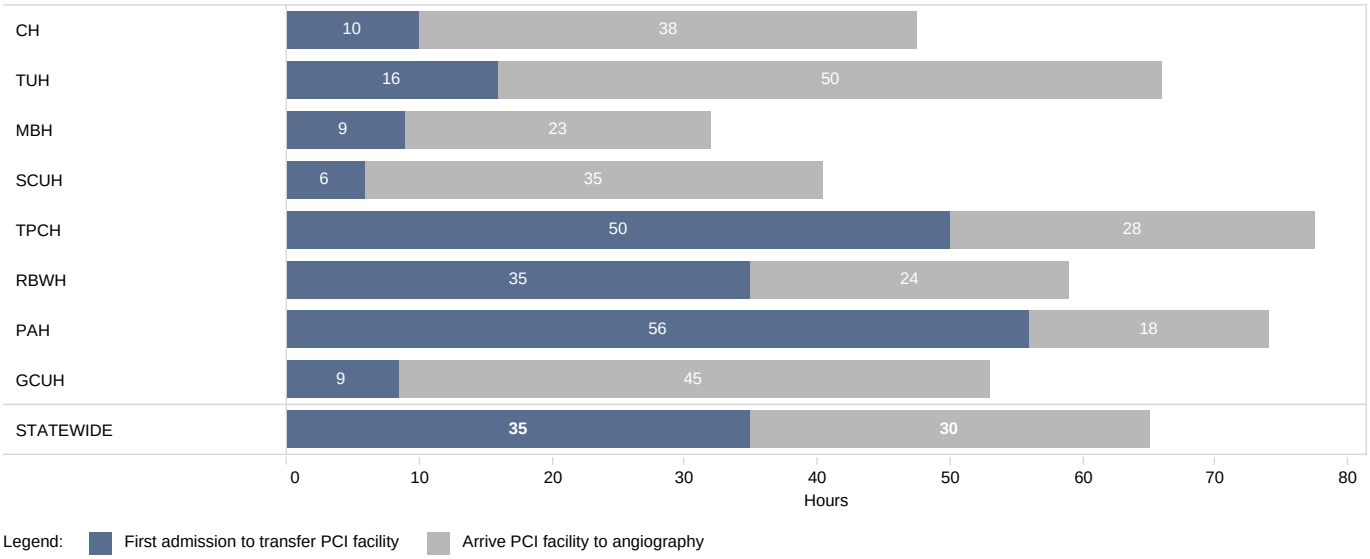


Figure 37: Median duration to transfer to PCI facility for angiography, NSTEMI interhospital transfers

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

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

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

Table 46: NSTEMI time to angiography by site

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

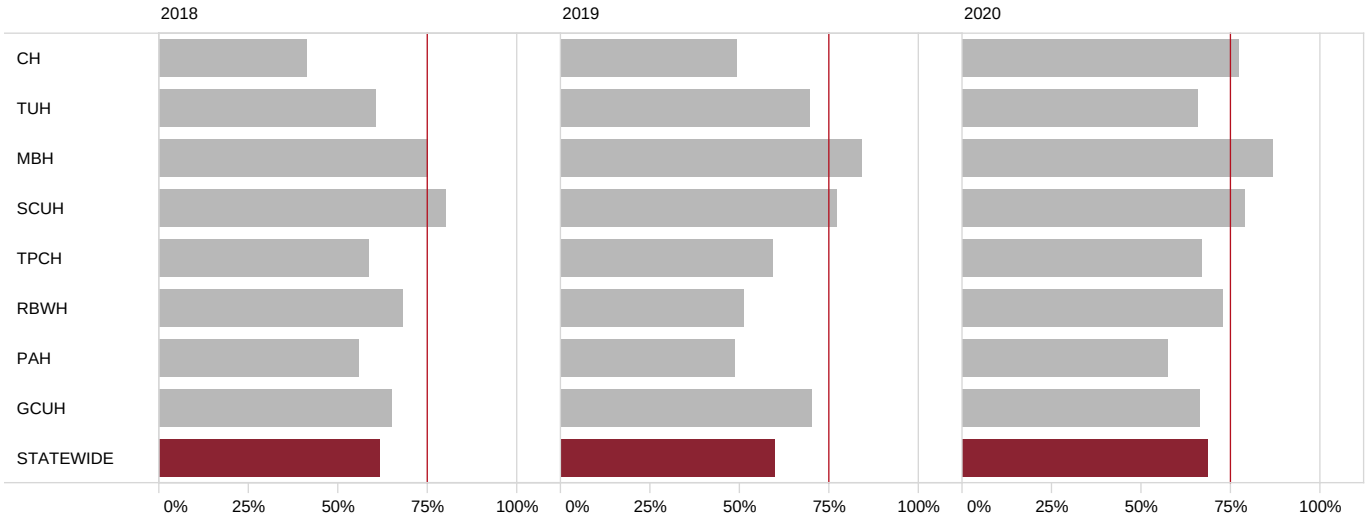


Figure 38: Proportion of NSTEMI cases meeting time to angiography target of 72 hours, 2018–2020

7.4 Major procedural complications

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

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

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

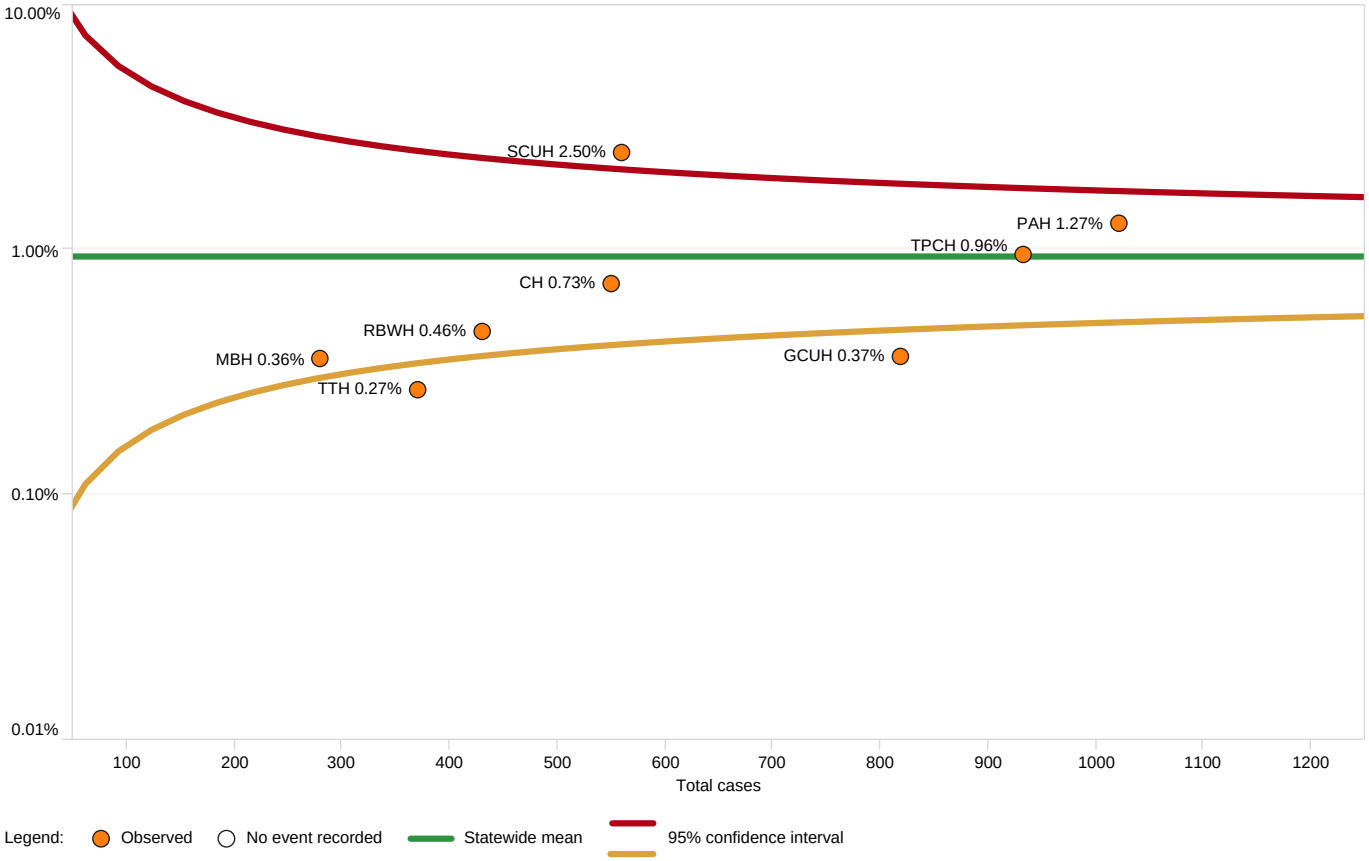


Figure 39: Proportion of PCI cases with immediate major procedure complication by site

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

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

* Excluding salvage deaths

7.5 High radiation doses

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

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

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

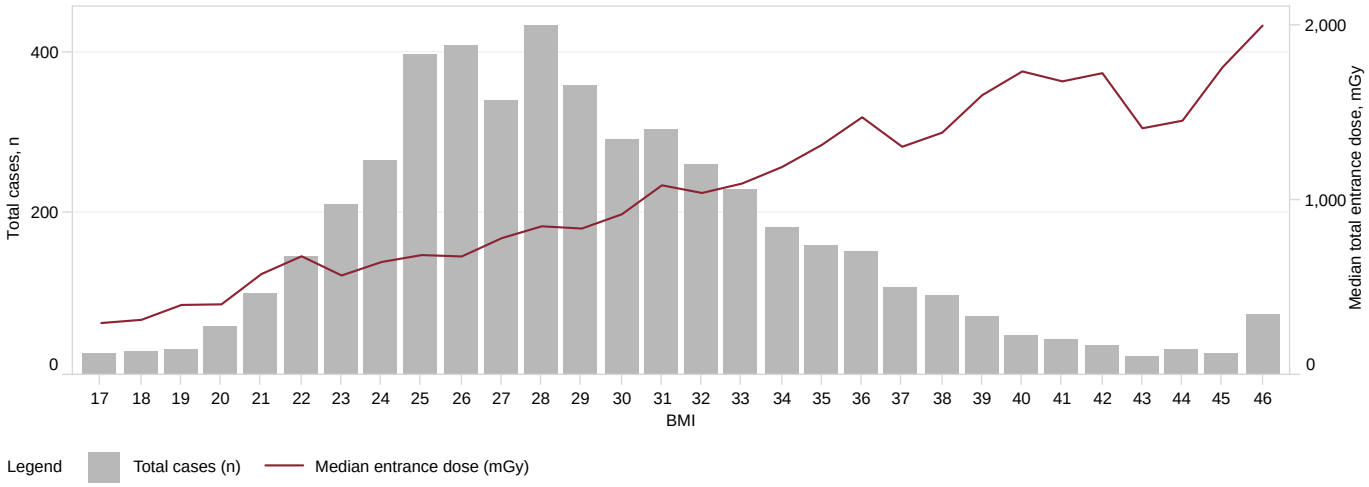


Figure 40: All coronary and PCI procedures median total entrance dose by body mass index

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

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

8 Supplement: Structural heart disease

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

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

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

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

Table 1: QCOR SHD application go live dates

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

8.1 Participating sites

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

Table 2: Total SHD cases by participating site

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

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

† Percutaneous valve replacement and valvuloplasty

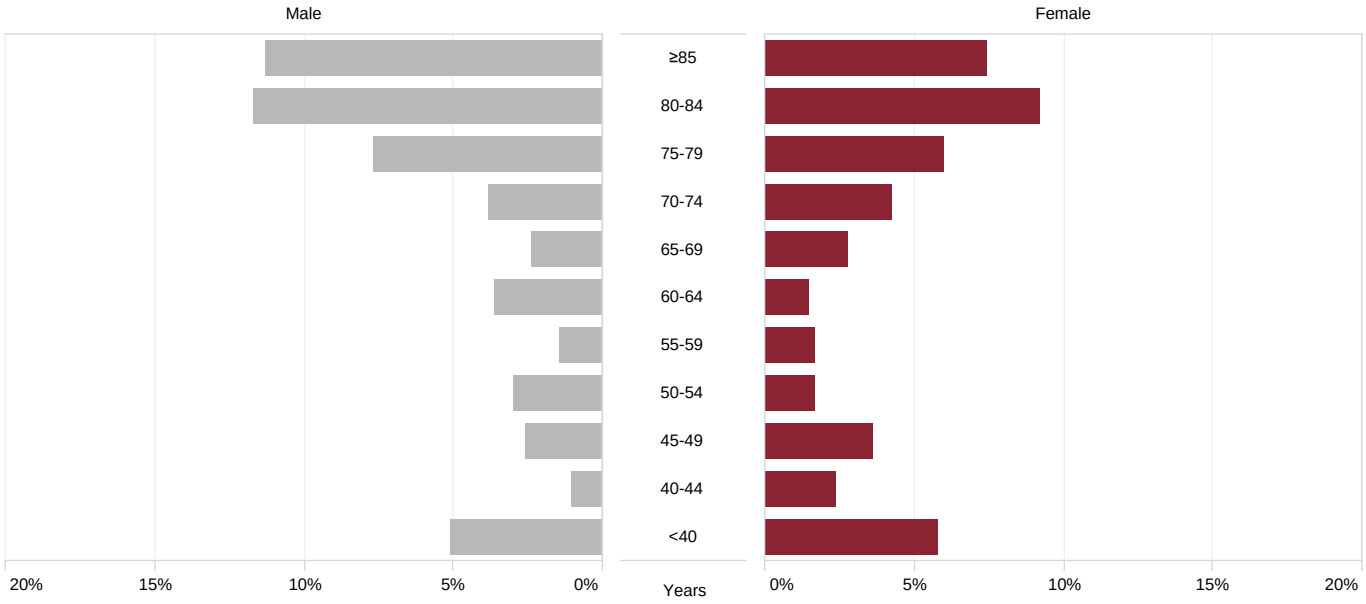
‡ Myocardial septal ablation and renal denervation

8.2 Patient characteristics

8.2.1 Age and gender

Gender of patients undergoing an SHD intervention were closely distributed with 54% male and 46% female. Almost one fifth (19%) of all procedures were performed on patients aged 85 years and older.

Age varied considerably by procedure category, with patients undergoing a valvular intervention having an overall median age of 81 years compared to 46 years for device closure procedures.



% of total (n=468)

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

Table 3: Median age by gender and procedure category

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

8.3 Care and treatment of SHD patients

8.3.1 Device closures

There were 138 device closures performed across the seven participating centres. The majority of device closure procedures were for the correction of a patent foramen ovale (PFO), followed by atrial septal defect (ASD), at 81% and 15% of case volumes respectively.

Table 4: Device closure procedures by participating site

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

* Patent foramen ovale

† Atrial septal defect

‡ Patent ductus arteriosus

§ Left atrial appendage

8.3.2 Valvular interventions

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

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

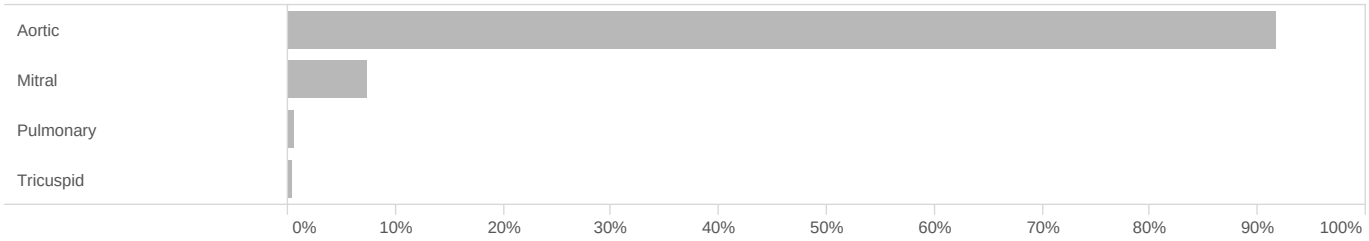


Figure 2: Proportion of all transcatheter valvular interventions by valve type

Table 5: Transcatheter valvular interventions by cardiac valve

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

Table 6: Transcatheter valvular interventions by type

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

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

Table 7: Transcatheter valvuloplasty procedures

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

Table 8: Transcatheter valve replacement procedures

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

* Transcatheter aortic valve replacement/implantation

† Transcatheter mitral valve replacement

‡ Transcatheter tricuspid valve replacement

§ Transcatheter pulmonary valve replacement

Table 9: Other structural heart disease interventions

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

8.4 Patient outcomes

8.4.1 All-cause 30 day mortality

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

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

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

8.4.2 All TAVR cases

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

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

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

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

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

2020 cases

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

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

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

2019 and 2018 cases

Of the four sites performing TAVR in 2019, the overall all-cause unadjusted mortality rate within 30 days of the procedure was 2.0%, and 12.0% at one year. For the TAVR procedures performed in 2018, the overall all-cause unadjusted mortality rate at two years post procedure was 13.5%.

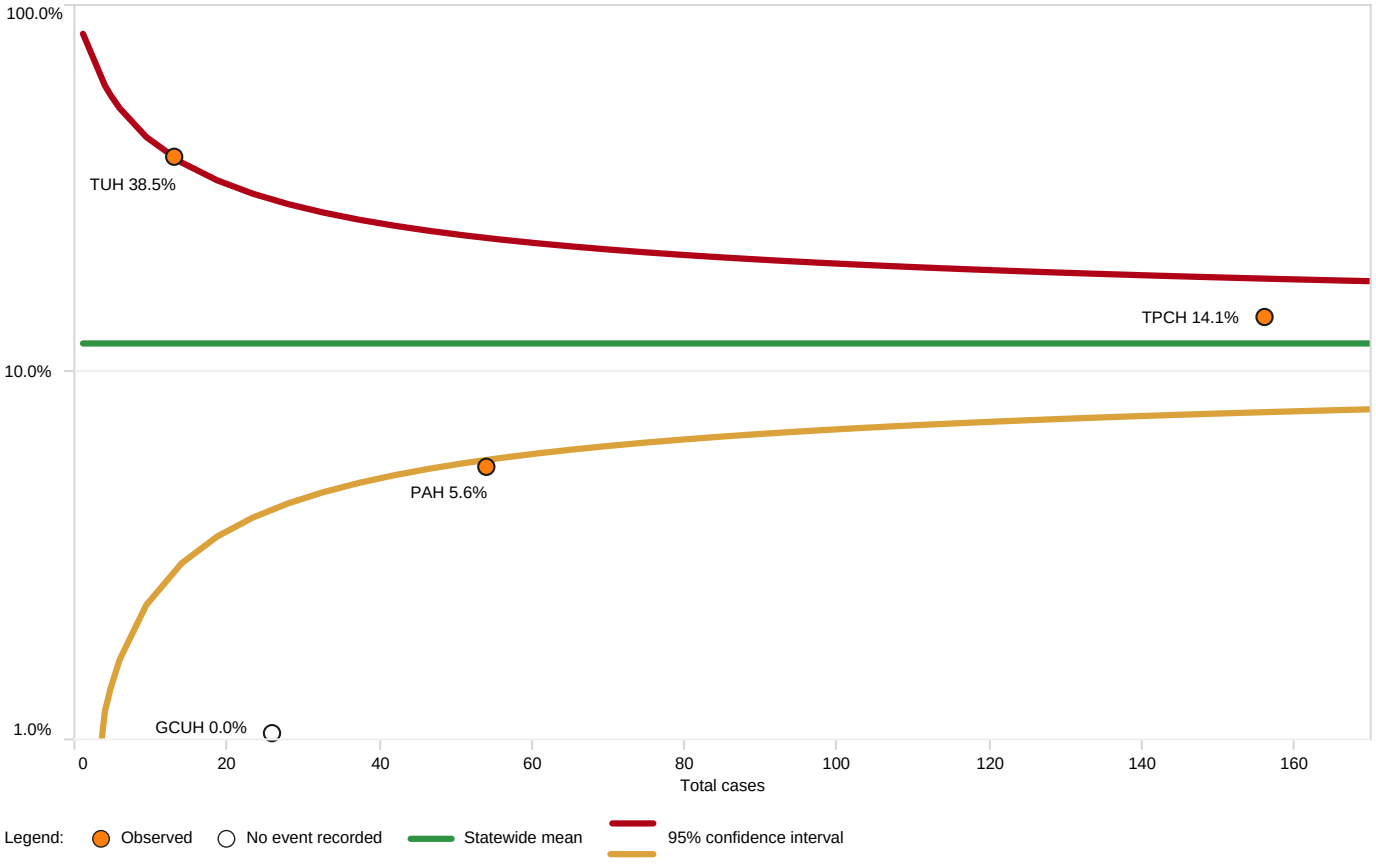


Figure 3: One year mortality post TAVR by site (2019 cohort)

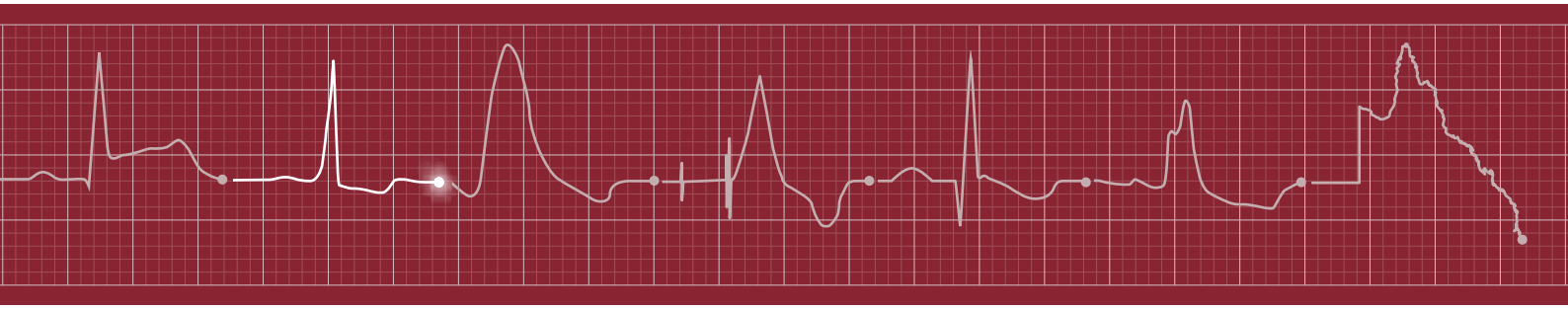
Table 12: One year mortality post TAVR by site (2019 cohort)

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

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

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

Cardiac Surgery Audit



1 Message from the Cardiothoracic Surgery Steering Committee Chair

In reviewing 2020, cardiac surgery is being provided to Queenslanders with a high degree of safety for a range of potentially life-threatening conditions. Several themes stand out for 2020.

The strengths of this statewide surgical database are that it captures all surgical activity within the specialty and has done so for multiple years. It is now an important resource in assessing the overall management of cardiac disease. The cardiac surgical data collection has been able to provide data linkage to the Rheumatic Heart Disease Register and Control Program which has identified 343 patients over two years that would otherwise not be known to the Register. Being able to identify this number of people helps in the ongoing fight against rheumatic heart disease in Queensland and is evidence of the marked contribution a database such as this makes. The implementation of regular data linkage from the cardiac surgical database to the Rheumatic Heart Disease Register and Control Program will continue to identify patients that may not be identified in any other source of information.

Overall volumes across the state for the year are increased, despite the COVID-19 pandemic reducing the activity for a significant portion of the time in the first and second quarters of the year. The slowdown in activity associated with COVID-19 had several effects, the first of which was a reduction in trauma admissions due to less social activity and a resultant increase in hospital bed availability, but this was also offset by a subsequent decrease in intensive care unit bed availability later in the year. The view was postulated that a delay in diagnosis of patients with cardiac disease would result in more urgent and emergent cases, but this trend has not been identified in this Report.

After the endocarditis supplement to the Annual Report was published in 2018, further database fields were added to capture activity and specific aspects of infective endocarditis to hopefully gain insights into a disease that can often be prevented. In the 2020 cohort, we see an increase in patients with infective endocarditis undergoing surgery with a reported history of intravenous drug use. The rate was 18% in the previous year and was 25% in the current group. Thus, a quarter of patients in Queensland having surgery for endocarditis have a history of intravenous drug use, either recent or remote. This is a significant public health issue and needs to be addressed systematically. The patients who undergo surgery are not the entire cohort of intravenous drug use related endocarditis, and hence the problem is greater than the cases in this report. In the previous supplement, the risk of death from prosthetic valve endocarditis in Queensland was 25%. Recreational intravenous drug use is a significant risk for prosthetic valve endocarditis. These patients can be dramatically unwell and their treatment highly resource intense, all for a comorbidity that may be highly modifiable with public health intervention. This needs to be addressed with a coordinated approach from Queensland Health, as this is a significant public health issue as well as a surgical issue in Queensland.

Understanding the resource that is the cardiac surgical database, the Committee has established a Quality Assurance Committee in which statistical analysis of performance is presented to identify high performance, as well as to alert units to signals that a specific aspect of surgical performance needs attention. The Committee is also seeking to increase the frequency of contribution to the Australia and New Zealand Society of Cardiac and Thoracic Surgery database.

The cardiac surgeons involved in the QCOR Cardiothoracic Surgery Committee would like to thank the ongoing work of the Statewide Cardiac Clinical Informatics Unit who are essential to the performance, the smooth running and analysis of the data that we present here. Ongoing opportunities for improvement are best identified through analysis of well-collected, clean data, and this project is continuing apace.

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

2 Key findings

This Queensland Cardiac Surgery Audit describes baseline demographics, risk factors, surgeries performed and surgery outcomes for 2020.

Key findings include:

- The number of surgeries performed across the four public adult cardiac surgery units in Queensland were 2,651.
- The majority of patients were aged between 61 years and 80 years of age (60%) 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 (75%), with less than one quarter (24%) of patients having a body mass index within the normal range.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 7.6%, and had a wide variation between sites with 26% of patients in Townsville identifying as Aboriginal and Torres Strait Islander.
- The majority of patients had high blood pressure (70%) or high cholesterol (67%). Over half of all patients presented with both of these risk factors combined.
- Almost one third of patients (29%) were reported to be diabetic at the time of their operation, increasing to 39% of all patients undergoing coronary artery bypass grafting (CABG).
- Close to one third (32%) of patients had an element of left ventricular systolic dysfunction.
- Over half (56%) of all cases were elective admissions with 19% of elective patients being admitted on the day of surgery.
- In 2020, 1,581 patients had a CABG procedure, the majority (91%) of patients had multi-vessel disease.
- There were 272 patients who underwent aortic surgery. The majority of aortic procedures were aortic replacements, with 53% undergoing ascending aorta replacement.
- Among the 1,142 patients undergoing valve surgery in 2020, the most common interventions performed were isolated replacement of the aortic valve (65%) or mitral valve (20%). Around 12% of valve surgeries involved multiple valves.
- The primary pathology for patients undergoing valvular surgery was degenerative valve disease (51%).
- Cardiac surgeons played a part in 43% of the 249 transcatheter aortic valve replacements performed in Queensland public hospitals.
- Major morbidities were evaluated using Society of Thoracic Surgeons (STS) models with most results demonstrating that the observed rate of adverse events is within or better than expected. The exception is the rate of deep sternal wound infection for CABG which was outside the expected range.
- The mortality rate after surgery is either within the expected range or significantly less than expected, depending on the risk model used to evaluate this outcome.

3 Participating sites

There are four public cardiac surgery units spread across metropolitan and regional locations within Queensland. Each surgical unit entered data directly into the QCOR cardiac surgery database application.

Patients came from a wide geographical area, including interstate, with most patients residing close to the 7,000 kilometre stretch of eastern coastline.

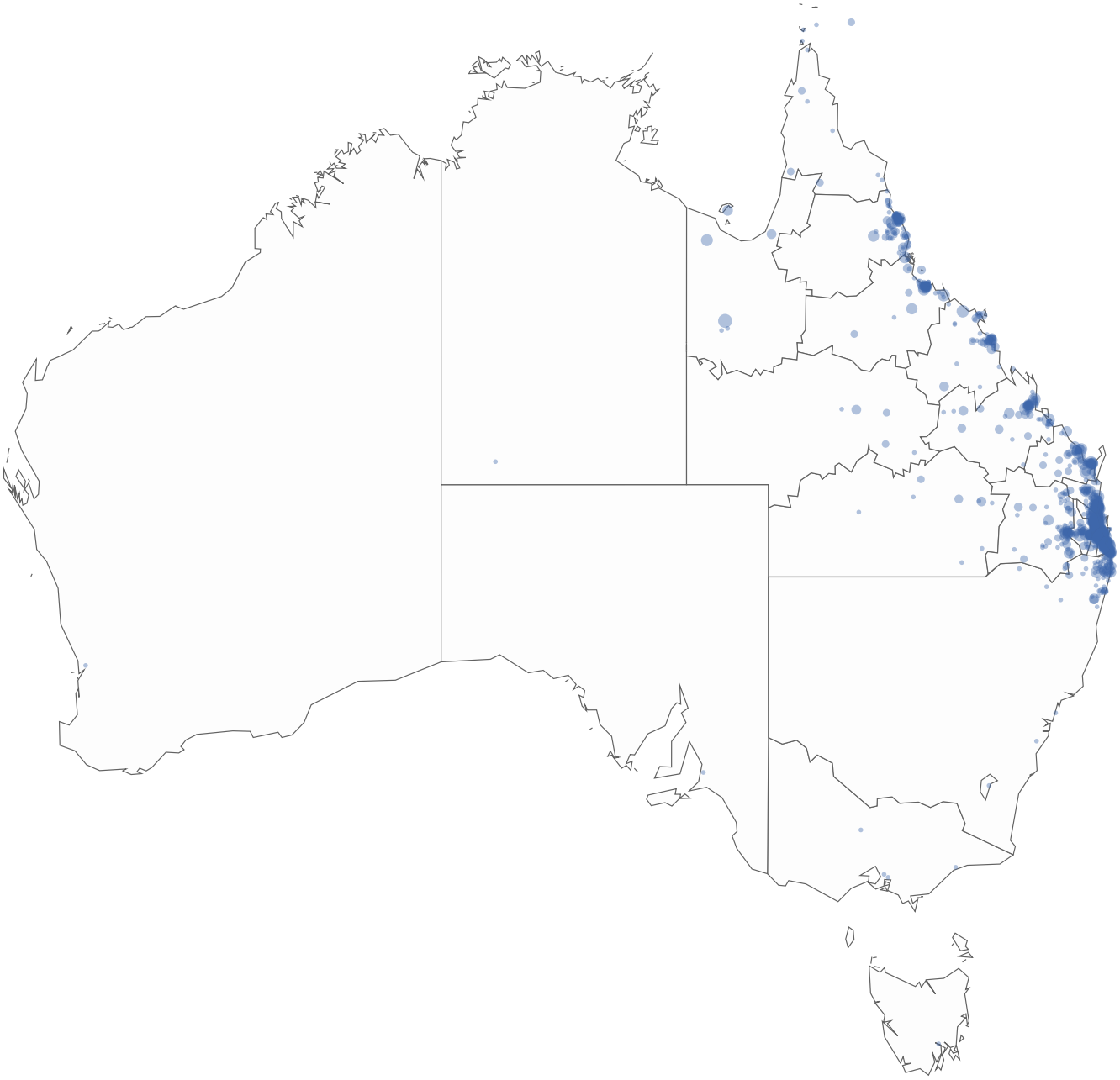


Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

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

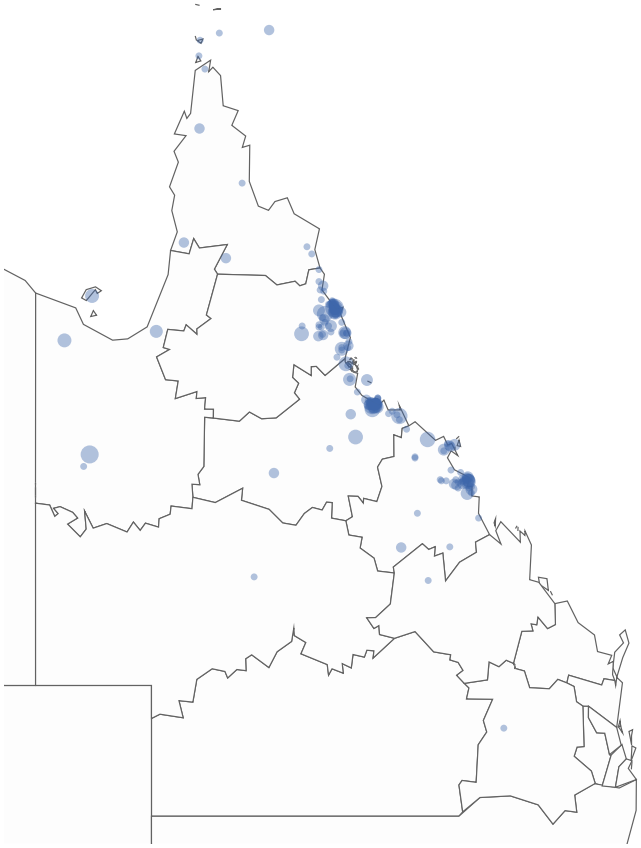


Figure 2: Townsville University Hospital

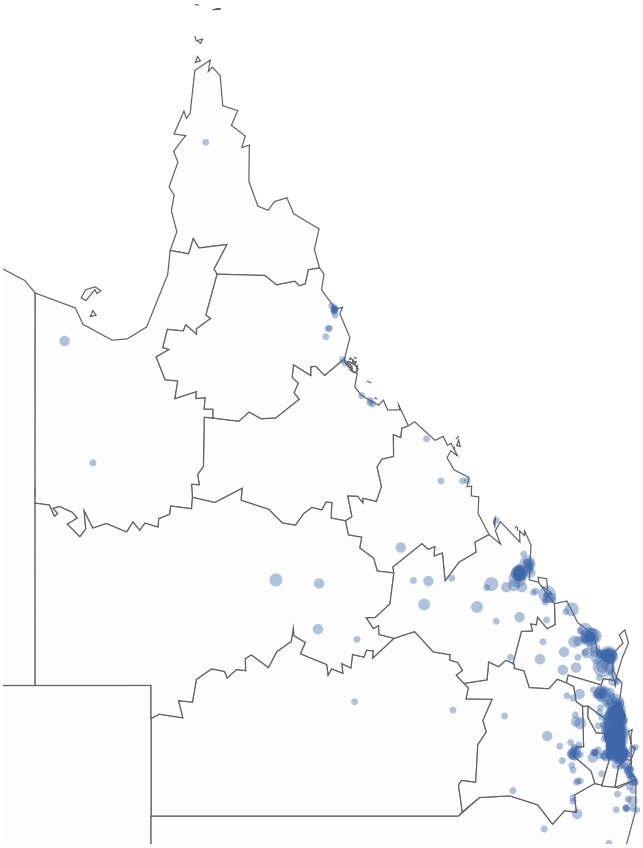


Figure 3: The Prince Charles Hospital

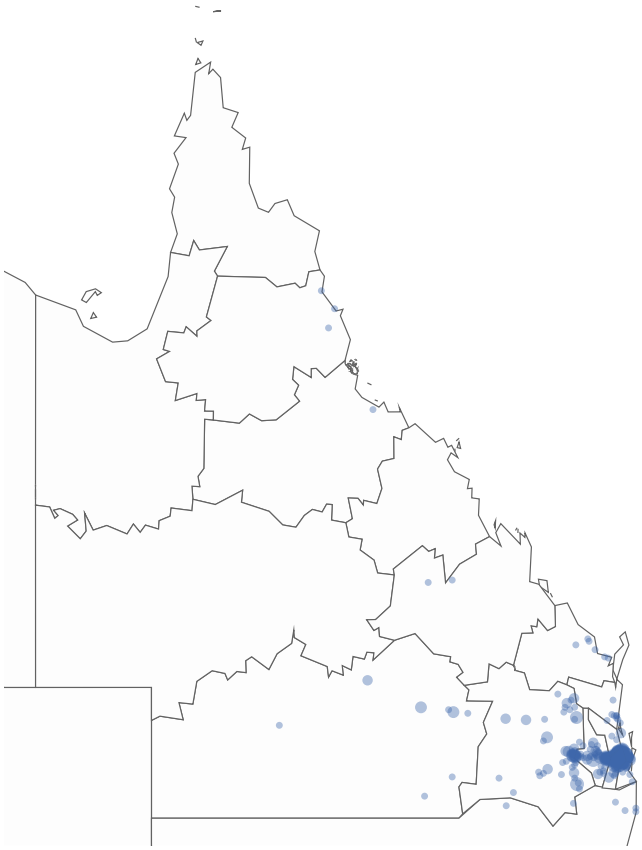


Figure 4: Princess Alexandra Hospital

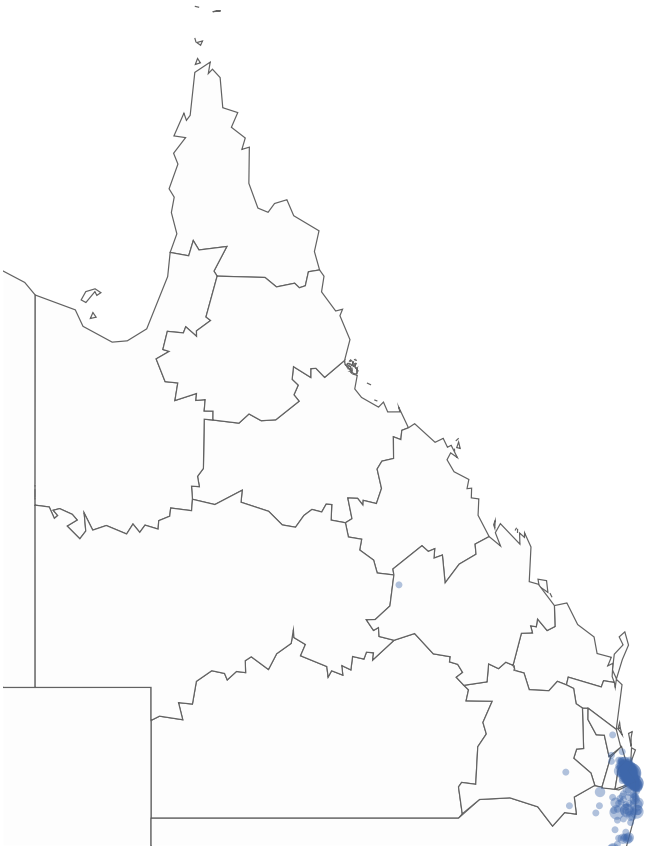


Figure 5: Gold Coast University Hospital

4 Case totals

4.1 Total surgeries

The total number of cardiac surgical procedures performed at the four public hospitals in 2020 was 2,651. 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	Category*	Count
CABG	ANY CABG	1,277
CABG + other cardiac procedure		30
CABG + aortic procedure		15
CABG + other non cardiac procedure		2
CABG + other cardiac procedure + other non cardiac procedure		1
CABG + aortic procedure + other cardiac procedure		1
CABG + valve	CABG + VALVE	193
CABG + valve + aortic procedure		29
CABG + valve + other cardiac procedure		24
CABG + valve + aortic procedure + other cardiac procedure		7
CABG + valve + other non cardiac procedure		1
CABG + valve + other cardiac procedure + other non cardiac procedure		1
Valve†	VALVE	614
Valve + aortic procedure		122
Valve + other cardiac procedure		110
Valve + aortic procedure + other cardiac procedure		33
Valve + other cardiac procedure + other non cardiac procedure		5
Valve + aortic procedure + other non cardiac procedure		2
Valve + aortic procedure + other cardiac procedure + other non cardiac procedure		1
Other cardiac procedure	OTHER	117
Aortic procedure		49
Aortic procedure + other cardiac procedure		10
Other cardiac procedure + other non cardiac procedure		4
Aortic procedure + other non cardiac procedure		3
ALL		**2,651**

* Category procedure combination allocated

† Includes TAVR procedures (n=108)

4.2 Cases by category

Sixty percent of all cardiac surgery procedures involved coronary artery bypass grafting (CABG) with 10% involving a simultaneous CABG and valve procedure.

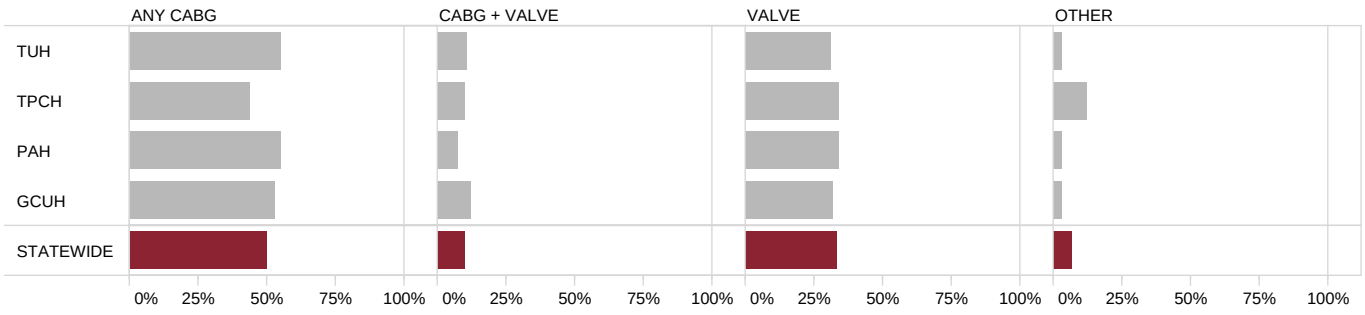


Figure 6: Proportion of cases by site and surgery category

Table 3: Proportion of cases by surgery category

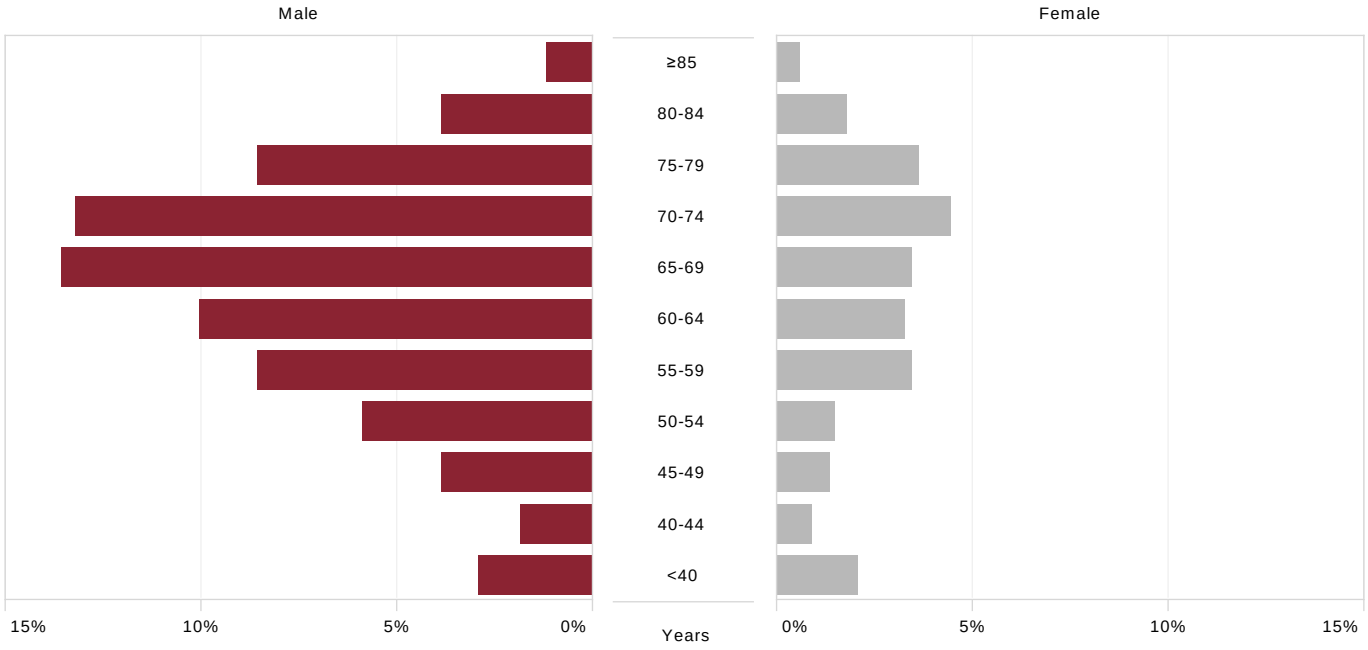
SITE	All cases n	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)
TUH	386	214 (55.4)	41 (10.6)	120 (31.1)	11 (2.8)
TPCH	1,191	526 (44.2)	114 (9.6)	409 (34.3)	142 (11.9)
PAH	643	357 (55.4)	48 (7.5)	220 (34.3)	18 (2.8)
GCUH	431	229 (53.3)	52 (12.1)	138 (31.9)	12 (2.8)
STATEWIDE	**2,651**	**1,326 (50.0)**	**255 (9.6)**	**887 (33.5)**	**183 (6.9)**

5 Patient characteristics

5.1 Age and gender

Age is a demonstrated risk factor for developing cardiovascular disease. Almost two thirds of patients were aged between 61 years and 80 years (65%). The male cohort of 65 years to 69 years accounted for the largest proportion of cases (13% of all cases or 18% of males). Approximately 5% of cases were performed on patients younger than 45 years of age.

The median age of all patients undergoing cardiac surgery was 67 years of age. The median age of males and females undergoing cardiac surgery was 66 years and 67 years respectively.



% of total (n=2,651)

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

Table 4: Median age by gender and surgery category

	Total cases n	Male years	Female years	Total years
ANY CABG	1,326	66	66	66
CABG + VALVE	255	71	73	72
VALVE	887	66	66	66
OTHER	183	58	55	57
ALL	**2,651**	**67**	**66**	**66**

Overall, around three quarters of patients were male (74%), with the largest proportion of females represented in the valve (38%) and other cardiac surgery (41%) categories. This reflects the increased risk of coronary artery disease in men.

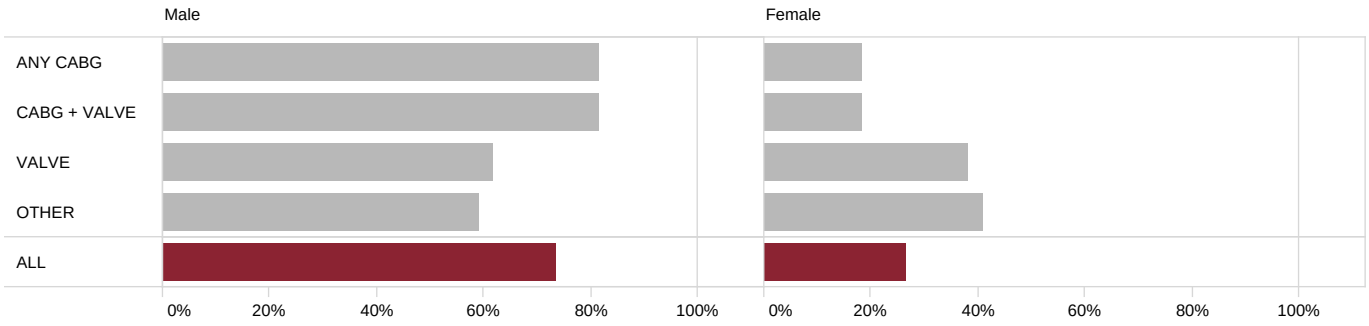


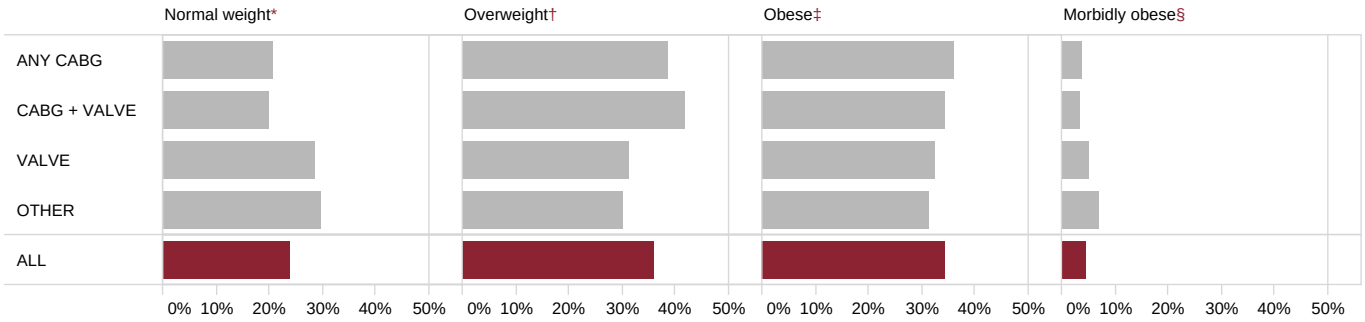
Figure 8: Proportion of cases by gender and surgery category

5.2 Body mass index

There were only 24% of cardiac surgery patients who had a healthy body mass index (BMI), while patients with a BMI category of overweight, obese or morbidly obese represented three quarters of all cardiac surgery patients (75%).

Just over one quarter (28%) of all patients undergoing valve surgery were classed as having a BMI in the normal range.

Patients classed as underweight (BMI ‹18.5kg/m²) represented approximately 1% of all cases.



Excludes missing data (‹0.1%)

* BMI 18.5–24.9 kg/m²

† BMI 25.0–29.9 kg/m²

‡ BMI 30.0–39.9 kg/m²

§ BMI ≥40.0 kg/m²

Figure 9: Proportion of cases by BMI and surgery category

Table 5: Cases by BMI and surgery category

	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
ANY CABG	7 (0.5)	273 (20.6)	515 (38.8)	478 (36.0)	53 (4.0)
CABG + VALVE	–	51 (20.0)	107 (42.0)	88 (34.5)	9 (3.5)
VALVE	27 (3.0)	252 (28.4)	276 (31.1)	287 (32.4)	45 (5.1)
OTHER	3 (1.6)	54 (29.5)	55 (30.1)	57 (31.1)	13 (7.1)
ALL	**37 (1.4)**	**630 (23.8)**	**953 (35.9)**	**910 (34.3)**	**120 (4.5)**

Excludes missing data (‹0.1%)

5.3 Aboriginal and Torres Strait Islander status

Coronary heart disease has complex causes and multiple risk factors, one of which is ethnicity. Ethnicity is an important determinant of the development of cardiovascular disease. It is recognised that Aboriginal and Torres Strait Islander peoples have a higher incidence and prevalence of coronary artery disease than other ethnicities.[1]

Overall, the proportion of identified Aboriginal and Torres Strait Islander patients undergoing cardiac surgery was 7.6%. This proportion is larger than the estimated 4.6% of the overall Queensland population that Aboriginal and Torres Strait Islander people account for.[2]

Over one quarter (26%) of patients undergoing cardiac surgery at TUH identified as Aboriginal and Torres Strait Islander.

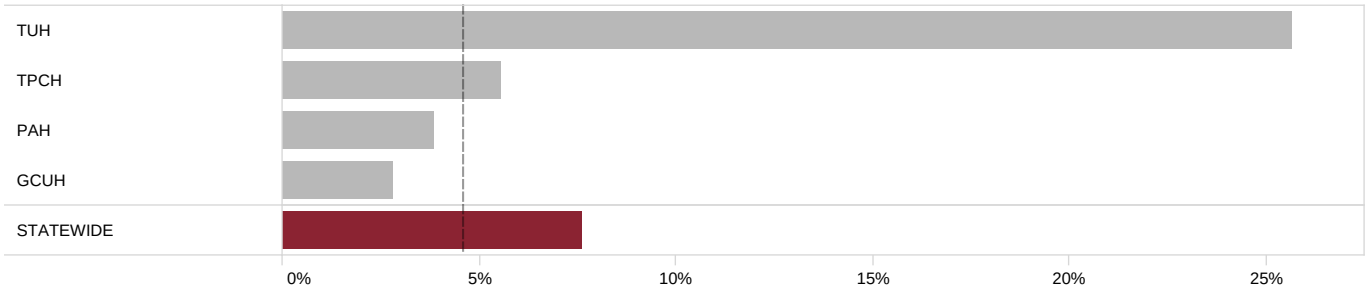


Figure 10: Proportion of all cardiac surgical cases by identified Aboriginal and Torres Strait Islander status and site

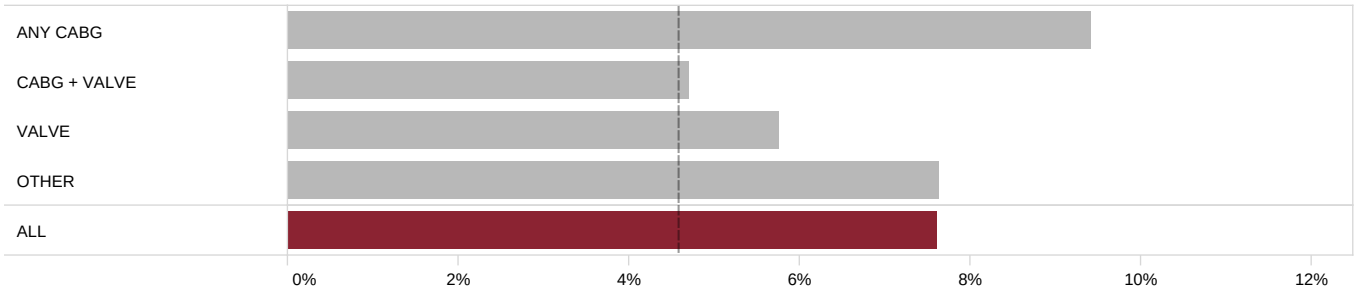
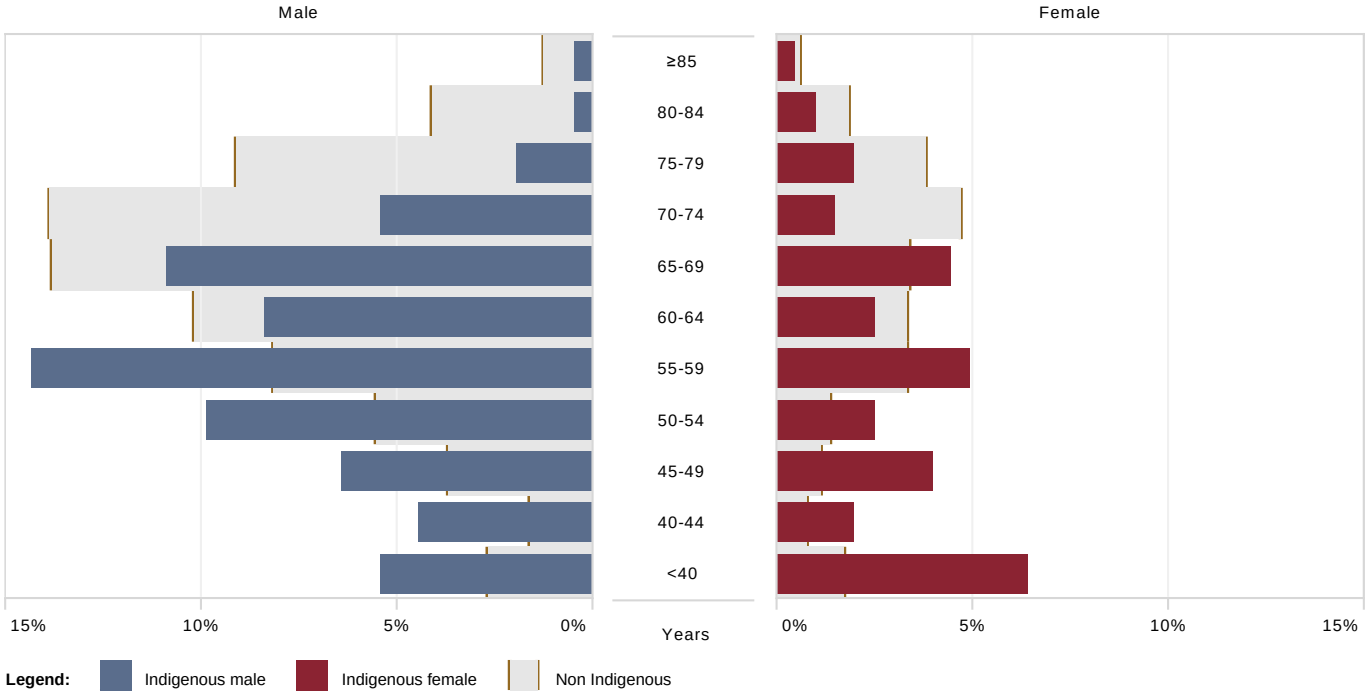


Figure 11: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

The median age for Aboriginal and Torres Strait Islander Queenslanders undergoing cardiac surgery was 57 years, whereas the median age of non-Indigenous patients was 67 years.



% of total Aboriginal and Torres Strait Islander (n=202) vs. total non-Indigenous (n=2,449)

Figure 12: Aboriginal and Torres Strait Islander status and age category

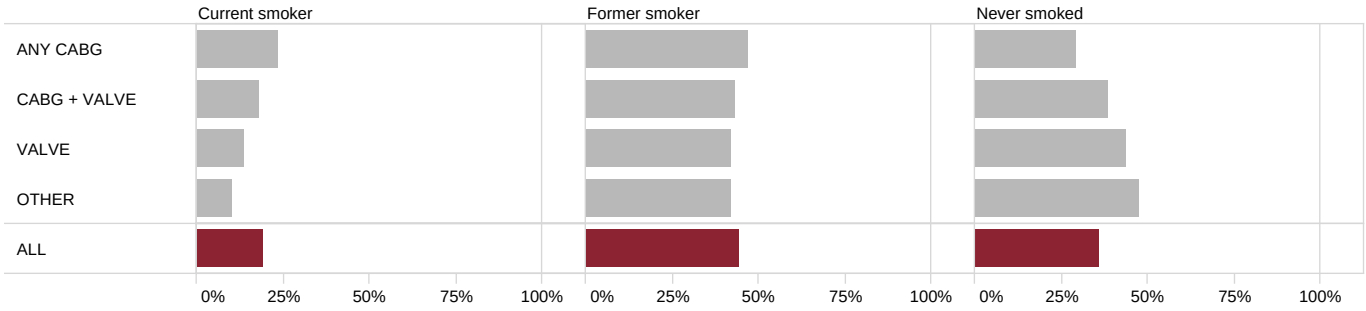
Table 6: Median patient age by gender and Aboriginal and Torres Strait Islander status

	Male years	Female years	All years
Aboriginal and Torres Strait Islander	56	57	57
Non Aboriginal and Torres Strait Islander	67	67	67
Total	**66**	**67**	**66**

6 Risk factor profile

6.1 Smoking history

Almost two thirds of patients (64%) had a history of tobacco use including 19% current smokers (defined as smoking within 30 days of the procedure) and 45% former smokers. Of the remaining patients, 36% reported never having smoked.



Unknown smoking status not displayed (3.7%)

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

6.2 Diabetes

Overall, 29% of all cardiac surgical patients were reported as diabetic. The prevalence of diabetes was highest in the CABG patient group (39%).

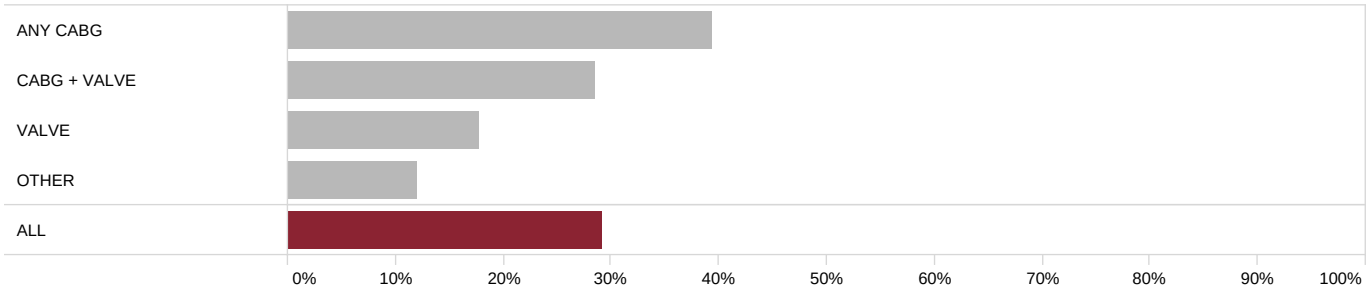


Figure 14: Proportion of cases by diabetes status and surgery category

6.3 Hypertension

Hypertension, defined as receiving antihypertensive medications at the time of surgery, was present in 70% of patients with considerable variation by surgery type (range 43% to 80%).

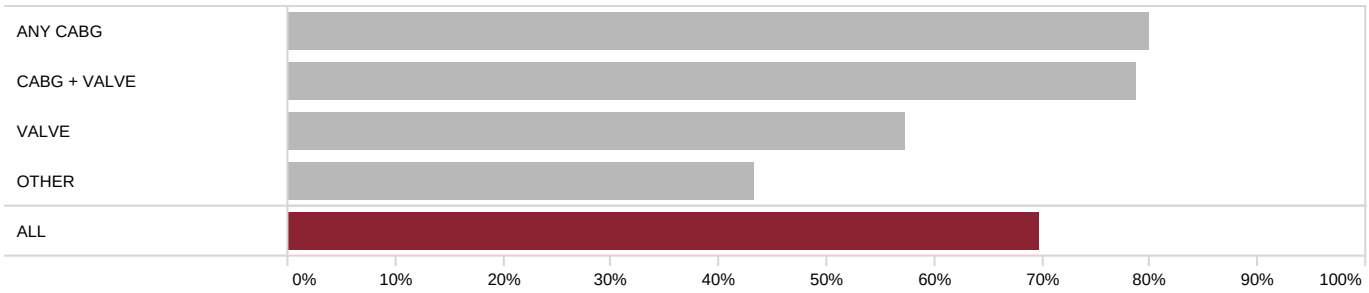


Figure 15: Proportion of cases by hypertension status and surgery category

6.4 Hypercholesterolaemia

Overall, 67% of patients had hypercholesterolaemia, ranging from 83% in the CABG category to 39% in the other surgery category.

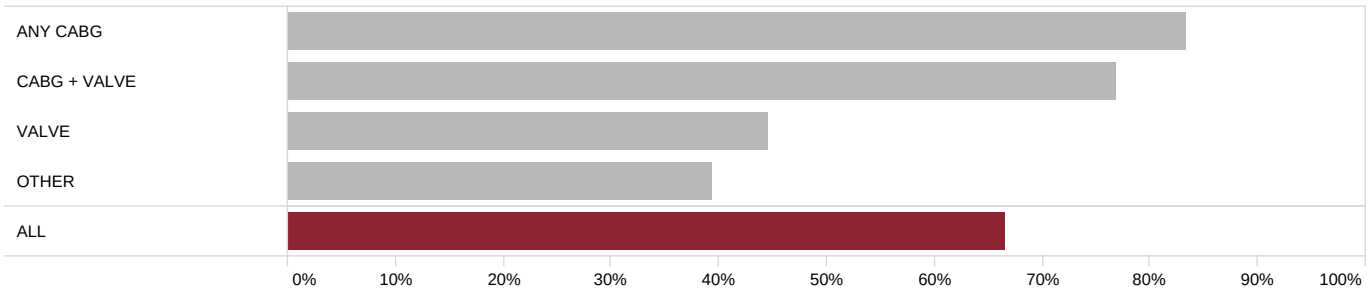
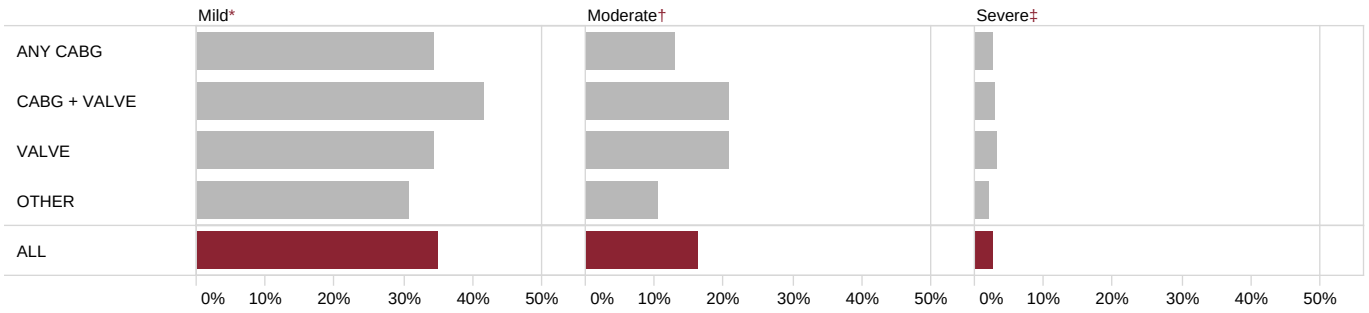


Figure 16: Proportion of cases by hypercholesterolaemia and surgery category

6.5 Renal impairment

Over half (54%) of all patients were identified as having impaired renal function (eGFR ≤89 mL/min/1.73 m2) at the time of their surgery. Of these, approximately 66% of patients undergoing CABG and valve surgery had documented renal impairment.



* eGFR 60–89 mL/min/1.73 m^2

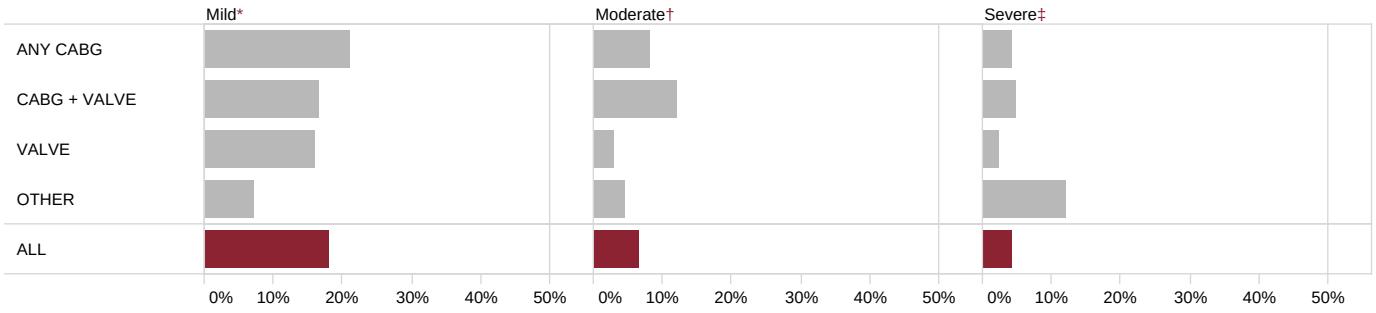
† eGFR 30–59 mL/min/1.73 m^2

‡ eGFR <30 mL/min/1.73 m^2

Figure 17: Proportion of cases by renal impairment status and surgery category

6.6 Left ventricular dysfunction

Almost one third (32%) of patients were classed as having an impaired left ventricular ejection fraction (LVEF), including 18% with mild LV dysfunction (LVEF between 40% to 49%), 7% with moderate LV dysfunction (LVEF between 30% to 39%) and 4% with severe LV dysfunction (LVEF less than 30%).



Excludes missing data (3.5%)

* LVEF 40–49%

† LVEF 30–39%

‡ LVEF <30%

Figure 18: Proportion of cases by LV dysfunction category and surgery category

6.7 Infective endocarditis

There were 96 cases of infective endocarditis (IE) that required cardiac surgical intervention. Of these, over three quarters (n=73) were active infections at the time of surgery.

Native valve endocarditis was noted in 75% of active infections, with prosthetic valve involvement in 8%.

Table 7: Infective endocarditis status

Endocarditis status	n (%)
Active	73 (76.0)
Treated	23 (24.0)
ALL	**96 (100.0)**

Table 8: Active infective endocarditis by site of infection

Active endocarditis site	n (%)
Native valve	55 (75.3)
Aortic root	6 (8.2)
Prosthetic valve	4 (5.5)
Mitral annulus	2 (2.7)
Aortic root + intracardiac shunt	1 (1.4)
Aortic root + mitral annulus + prosthetic valve + pacemaker	1 (1.4)
Aortic root + prosthetic valve	1 (1.4)
ALL	**70 (100.0)**

Excludes missing data (n=3)

6.7.1 Organism

Over one quarter (29%) of all active IE cases were identified as a methicillin susceptible Staphylococcus aureus (MSSA) infection, while the responsible organism was unidentified in 4% of cases.

Table 9: Identified organism in active IE cases

Active organism	n (%)
MSSA*	30 (41.1)
Streptococcus	17 (23.3)
Enterococcus faecalis	8 (11.0)
Candida parapsilosis	2 (2.7)
Streptococcus mutans	2 (2.7)
Streptococcus bacteremia – Group G	1 (1.4)
Other	10 (13.7)
Unknown/organism unidentified	3 (4.1)
ALL	**73 (100.0)**

* Methicillin susceptible Staphylococcus aureus

6.7.2 Intravenous drug use

One quarter (25%) of all active infective endocarditis cases were linked to a history of intravenous drug use (IVDU) with the majority being current IVDU.

Table 10: Proportion of intravenous drug use associated with active IE

IVDU history	n (%)
Current IVDU (≤3 months)	12 (16.4)
Previous IVDU (>3 months)	6 (8.2)
No history of IVDU	47 (64.4)
Unknown	8 (11.0)
ALL	**73 (100.0)**

6.8 Summary of risk factors

The development of coronary artery disease is dependent on several background variables and risk factors.

Overall, more than one quarter (26%) of patients undergoing cardiac surgery, and 35% of patients undergoing CABG had five or more risk factors. This demonstrates the variation of disease processes associated with underlying pathology. This also highlights the complicated medical history of this cohort.

Table 11: Summary of risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
Former smoker	608 (45.9)	108 (42.4)	355 (40.0)	69 (37.7)	1,140 (43.0)
Current smoker	304 (22.9)	45 (17.6)	119 (13.4)	17 (9.3)	485 (18.3)
Diabetes	522 (39.4)	78 (28.6)	157 (17.7)	21 (11.5)	773 (29.1)
Hypertension	1,059 (79.9)	201 (78.8)	508 (57.3)	79 (43.2)	1,847 (69.7)
Hypercholesterolaemia	1,105 (83.3)	196 (76.9)	395 (44.5)	72 (39.3)	1,768 (66.7)
eGFR 60–89 mL/min/1.73 m²	456 (34.4)	106 (41.6)	304 (34.2)	56 (30.6)	922 (34.8)
eGFR 30–59 mL/min/1.73 m²	172 (13.0)	53 (20.8)	186 (20.9)	19 (10.4)	430 (16.2)
eGFR <30 mL/min/1.73 m²	34 (2.6)	8 (3.1)	29 (3.3)	4 (2.2)	75 (2.8)
Infective endocarditis	1 (0.1)	5 (2.0)	89 (10.0)	1 (0.5)	96 (3.6)
LVEF 40–50%	280 (21.1)	42 (16.5)	142 (16.0)	13 (7.1)	477 (18.0)
LVEF 30–39%	109 (8.2)	31 (12.2)	26 (2.9)	8 (4.4)	174 (6.6)
LVEF <30%	55 (4.1)	12 (4.7)	22 (2.5)	22 (12.0)	111 (4.2)
BMI ≥30 kg/m²	531 (40.0)	97 (38.0)	332 (37.4)	70 (38.3)	1,030 (38.8)

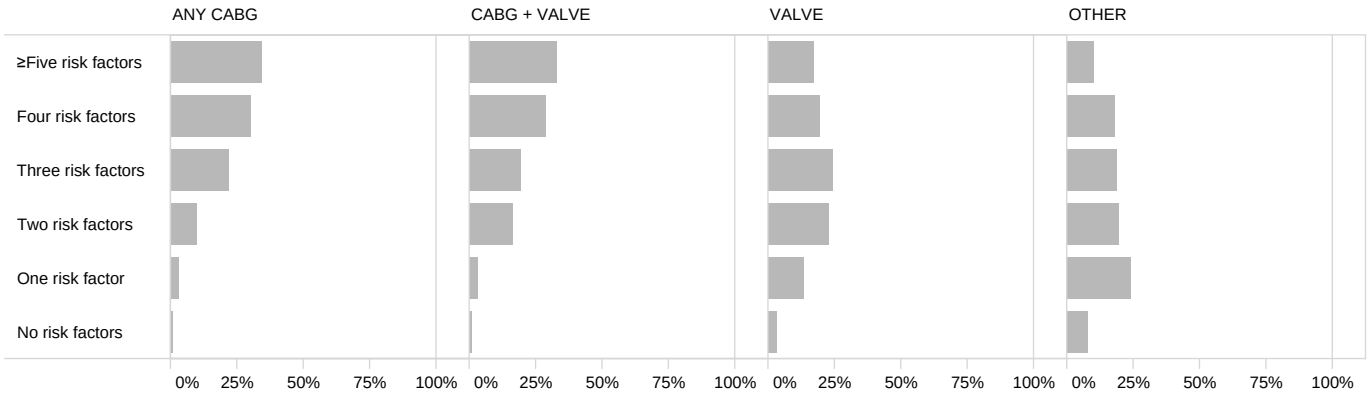


Figure 19: Number of patient risk factors by surgery category

Table 12: Aggregated patient risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
Five or more risk factors	458 (34.5)	83 (32.5)	150 (16.9)	19 (10.4)	710 (26.8)
Four risk factors	399 (30.1)	74 (29.0)	173 (19.5)	33 (18.0)	679 (25.6)
Three risk factors	288 (21.7)	49 (19.2)	218 (24.6)	35 (19.1)	590 (22.3)
Two risk factors	136 (10.3)	42 (16.5)	203 (22.9)	36 (19.7)	417 (15.7)
One risk factor	39 (2.9)	7 (2.7)	116 (13.1)	45 (24.6)	207 (7.8)
No risk factors	6 (0.5)	0 (0.0)	27 (3.0)	15 (1.8)	48 (1.8)
ALL	**1,326 (100.0)**	**255 (100.0)**	**887 (100.0)**	**183 (100.0)**	**2,651 (100.0)**

7 Care and treatment of patients

7.1 Admission status

Elective, urgent or emergent status varied widely between the various categories of surgeries. Most CABG cases were performed as urgent cases, whilst emergencies were predominately CABG followed by aortic surgery, in particular correction of aortic dissection. Valve procedures were most commonly undertaken on an elective basis.

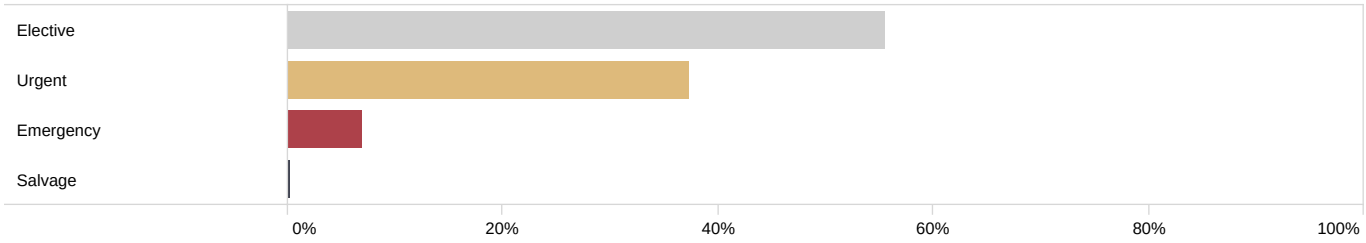


Figure 20: Proportion of cases by admission status

Table 13: Cases by admission status and surgery category

	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)
ANY CABG	534 (40.3)	723 (54.5)	68 (5.1)	1 (0.1)
CABG + VALVE	147 (57.6)	97 (38.0)	11 (4.3)	–
VALVE	703 (79.3)	145 (16.3)	36 (4.1)	3 (0.3)
OTHER	88 (48.1)	25 (13.7)	70 (38.3)	–
ALL	**1,472 (55.5)**	**990 (37.3)**	**185 (7.0)**	**4 (0.2)**

7.2 Day of surgery admission

Day of surgery admission (DOSA) rates accounted for 19% of all elective cases, with some variation observed across most surgery categories.

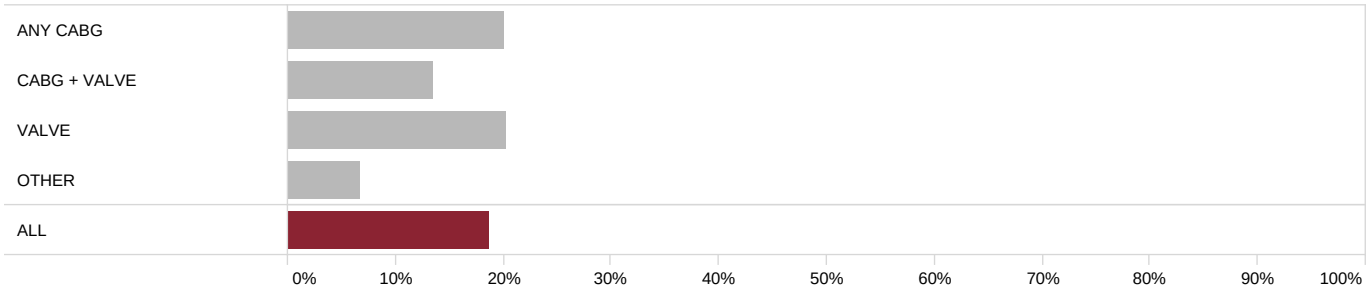


Figure 21: Proportion of elective cases for DOSA cases by surgery category

Table 14: DOSA cases by surgery category

	Total elective cases n	DOSA cases n (%)
ANY CABG	534	107 (20.0)
CABG + VALVE	147	20 (13.6)
VALVE	703	143 (20.3)
OTHER	88	6 (6.8)
ALL	**1,472**	**276 (18.8)**

7.3 Coronary artery bypass grafting

7.3.1 Number of diseased vessels

There were 1,578 CABG procedures performed across all sites. The majority (91%) had multi-vessel disease.

When CABG was performed in conjunction with a valve procedure, 72% of patients had multi-vessel disease compared to 94% when CABG surgery was performed without a valve intervention.

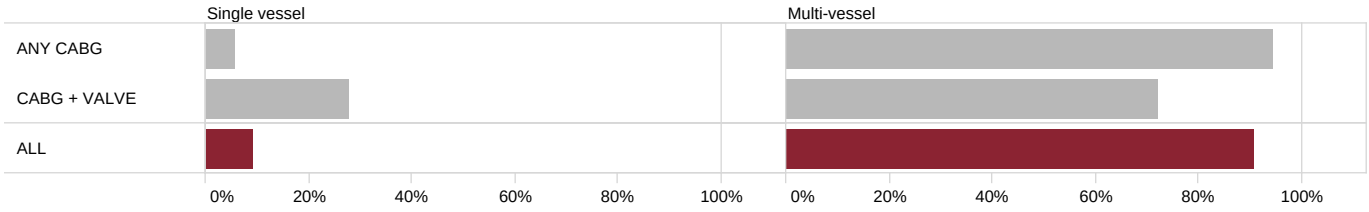


Figure 22: Number of diseased vessels by surgery category

Table 15: Number of diseased vessels by surgery category

	Single vessel n (%)	Multi-vessel n (%)	Total n (%)
ANY CABG	75 (5.7)	1,247 (94.1)	1,325 (100.0)
CABG + VALVE	71 (28.1)	181 (71.5)	253 (100.0)
ALL	**146 (9.3)**	**1,428 (90.5)**	**1,578 (100.0)**

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7.3.2 Number of grafts

For CABG procedures an average of 2.7 grafts were used. In multi-vessel CABG, the mean number of grafts utilised was 2.8.

Table 16: Number of grafts by number of diseased vessels

	Single vessel mean	Multi-vessel mean	Multi-vessel median	Total mean
ANY CABG	1.3	2.9	3.0	2.8
CABG + VALVE	1.0	2.4	2.0	1.9
ALL	**1.2**	**2.8**	**3.0**	**2.7**

7.3.3 Conduits used

In CABG, including surgeries involving valvular intervention, the most common form of revascularisation included the use of a combination of an arterial and vein graft (68%). Total arterial revascularisation occurred in 23% of cases.

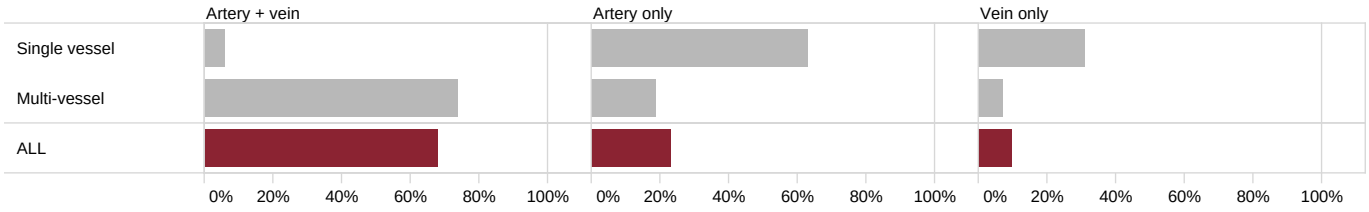


Figure 23: Proportion of diseased vessels by conduits used

Table 17: Conduits used by number of diseased vessels

	Artery + vein n (%)	Artery only n (%)	Vein only n (%)
Single vessel	9 (6.2)	92 (63.0)	43 (30.8)
Multi-vessel	1,058 (74.0)	266 (18.6)	105 (7.3)
ALL	**1,067 (67.7)**	**358 (22.7)**	**150 (9.4)**

7.3.4 Off-pump CABG

Overall, 2% of isolated CABG operations were performed without the use of cardiopulmonary bypass.

Table 18: Off-pump CABG

	Total cases n	Off-pump n (%)
Isolated CABG	1,277	31 (2.4)

7.3.5 Y or T grafts

Approximately 5% of all CABG surgeries utilised a Y or T graft.

Table 19: Y or T graft used by procedure category

	Total cases n	Y or T graft n (%)
ANY CABG	1,326	68 (5.1)
CABG + VALVE	255	9 (3.5)
ALL	**1,581**	**77 (4.9)**

7.4 Aortic surgery

There were a total of 272 cases that included a procedure involving the aorta (not including procedures conducted on the aortic valve). Aortic aneurysm was the primary reason for aortic surgery (56%).

Most aortic surgery procedures included replacement of the ascending aorta in isolation (53%), while surgery to replace both the ascending aorta and aortic arch accounted for 14% of cases.

Aortoplasty involving patch repair was performed in approximately 15% of aortic surgery cases.

Table 20: Aortic surgery by procedure type

Aortic surgery type	n (%)
Replacement	198 (72.8)
Ascending aorta	145 (53.3)
Ascending + aortic arch	39 (14.3)
Ascending aorta + aortic arch + descending aorta	5 (1.8)
Aortic arch	3 (1.1)
Descending aorta	3 (1.1)
Ascending + descending	3 (1.1)
Aortoplasty	60 (22.1)
Patch repair	39 (14.3)
Direct aortoplasty	21 (7.7)
Aortoplasty and replacement	14 (5.1)
Direct aortoplasty + ascending aorta	7 (2.6)
Direct aortoplasty + ascending aorta + aortic arch	3 (1.1)
Patch repair + ascending aorta	1 (0.4)
Patch repair + ascending aorta + aortic arch	1 (0.4)
ALL	**272 (100.0)**

7.4.1 Aortic pathology

Table 21: Aortic surgery cases by pathology type

Aortic pathology type	n (%)
Aortic aneurysm	153 (56.3)
Aortic dissection (≤2 weeks)	54 (19.9)
Calcification	19 (7.0)
Aortic abscess	7 (2.6)
Aortic dissection (>2 weeks)	6 (2.2)
Other	30 (11.0)
ALL	**272 (100.0)**

7.5 Valve surgery

There were 1,142 valve surgery procedures performed at the participating sites during 2020.

The aortic valve was the most commonly operated on valve either with or without other valves (71%). Isolated mitral valve surgery was the next most common valvular surgery (20%).

Overall, 16% of valve operations performed comprised of intervention to multiple valves.

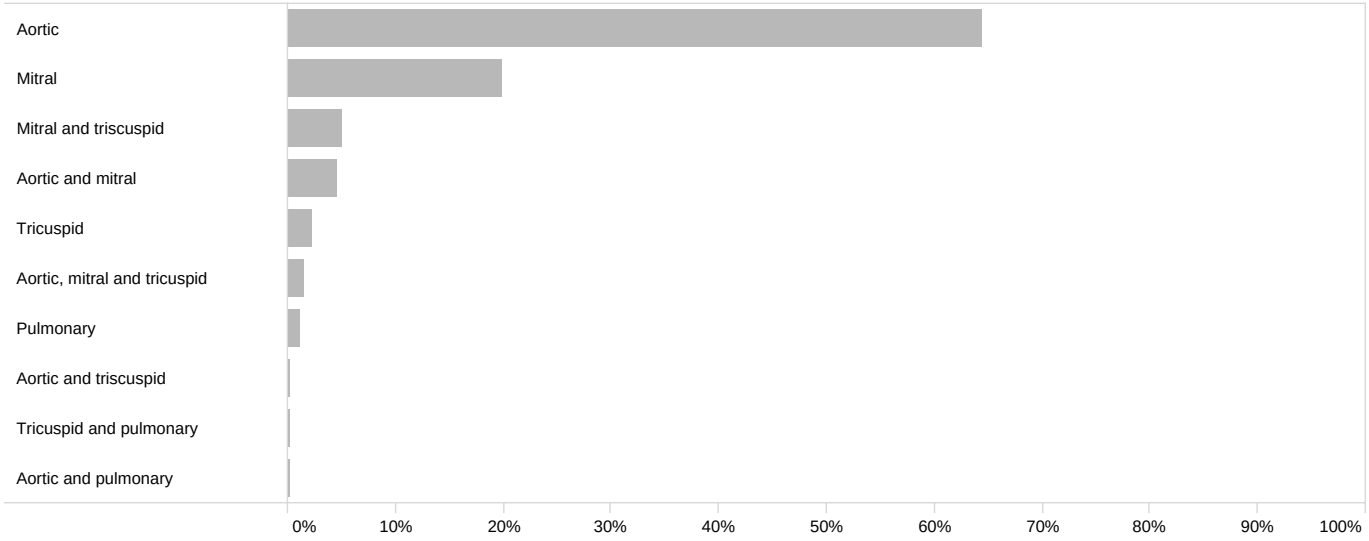


Figure 24: Proportion of valve surgery cases by valve

Table 22: Valve surgery cases by valve

Type of valve surgery	n (%)
Aortic	737 (64.5)
Mitral	227 (19.9)
Mitral and tricuspid	58 (5.1)
Aortic and mitral	53 (4.6)
Tricuspid	27 (2.4)
Aortic, mitral and tricuspid	18 (1.6)
Pulmonary	14 (1.2)
Aortic and tricuspid	3 (0.3)
Tricuspid and pulmonary	3 (0.3)
Aortic and pulmonary	2 (0.2)
ALL	**1,142 (100.0)**

7.5.1 Valve pathology

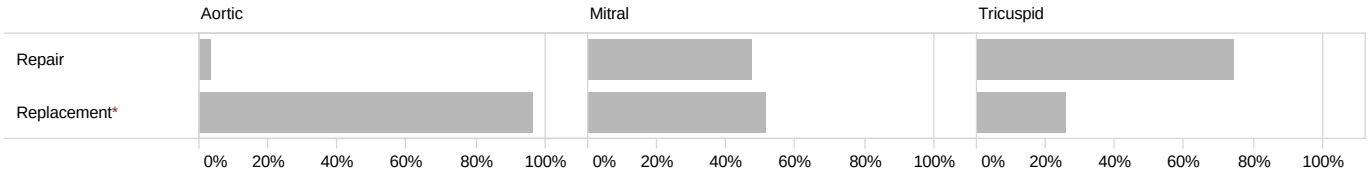
The most common valve pathology across all valve types was a degenerative cause (51%) which accounted for more than half of all aortic (54%) and mitral (52%) valve procedures.

Table 23: Valve pathology by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Degenerative	439 (54.0)	184 (51.7)	33 (30.3)	–	656 (50.6)
Congenital	160 (19.7)	11 (3.1)	6 (5.5)	13 (68.4)	190 (14.6)
Rheumatic	28 (3.4)	60 (16.9)	18 (16.5)	–	106 (8.2)
Infection	48 (5.9)	44 (12.4)	7 (6.4)	–	99 (7.6)
Prosthesis failure	43 (5.3)	15 (4.2)	1 (0.9)	1 (5.3)	60 (4.6)
Dissection	28 (3.4)	–	–	–	28 (2.2)
Annuloaortic ectasia	23 (2.8)	–	–	–	23 (1.8)
Functional	–	–	22 (20.2)	–	22 (1.7)
Ischaemic	–	19 (5.3)	–	–	19 (1.5)
Failed prior repair	–	–	3 (2.8)	4 (21.1)	7 (0.5)
Peri-prosthetic leak	3 (0.4)	–	1 (0.9)	–	4 (0.3)
Iatrogenic	1 (0.1)	–	–	–	1 (0.1)
Other	40 (4.9)	23 (6.5)	18 (16.5)	1 (5.3)	82 (6.3)
ALL	**813 (100.0)**	**356 (100.0)**	**109 (100.0)**	**19 (100.0)**	**1,297 (100.0)**

7.5.2 Types of valve surgery

Sixty three percent of valve interventions involved aortic valve surgery. The most common aortic valve procedure was replacement surgery (96%) with the remainder involving valve repair. Mitral valve procedures were more evenly distributed with replacement more frequent than repair (51% vs. 48%).



Inspection only procedures not shown (n=5)

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

Figure 25: Valve surgery category by valve

Table 24: Valve surgery category by valve type

Surgery category	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Repair	27 (3.3)	170 (47.8)	81 (74.3)	–	278 (21.4)
Replacement	784 (96.4)*	183 (51.4)	28 (25.7)	19 (100.0)†	1,014 (78.1)
Inspection only	2 (0.2)	3 (0.8)	–	–	5 (0.4)
ALL	**813 (100.0)**	**356 (100.0)**	**109 (100.0)**	**19 (100.0)**	**1,297 (100.0)**

* Includes TAVR procedure involving CTS

† Includes replacement of pulmonary root as part of a Ross-Yacoub procedure

Transcatheter aortic valve replacement (TAVR)

A multidisciplinary heart team involving both cardiologists and cardiac surgeons is often required to plan and perform a TAVR procedure. Despite the varied role of the surgeon in the heart team, 43% of all TAVR were performed with a cardiac surgeon involved in the valve procedure.

This Audit reflects those TAVR cases where a cardiothoracic surgeon was present during the procedure. As such, it does not represent the total number of these interventions performed in Queensland public hospitals in 2020.

More information regarding all TAVR procedures performed in Queensland public hospitals is included in the structural heart disease supplement to the Interventional Cardiology Audit of this Annual Report.

Table 25: TAVR cases by site and CS involvement

Site	All TAVR n	Combined CS and Cardiologist TAVR n (%)
TUH	21	21 (100.0)
TPCH	150	9 (6.0)
PAH	55	55 (100.0)
GCUH	23	23 (100.0)
STATEWIDE	**249**	**108 (43.4)**

7.5.3 Valve repair surgery

The most common forms of valve repair surgery were repair/reconstruction with annuloplasty (69%) followed by annuloplasty only (17%). The most common individual valve repair surgery type was mitral valve repair/reconstruction with annuloplasty, comprising over half of overall valve repair surgery (51%).

Table 26: Valve repair surgery by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Repair/reconstruction with annuloplasty	–	141 (83.0)	52 (64.2)	–	193 (69.4)
Annuloplasty only	–	18 (10.6)	29 (35.8)	–	47 (16.9)
Root reconstruction with valve sparing	11 (40.7)	–	–	–	11 (4.0)
Resuspension of aortic valve	8 (29.6)	–	–	–	8 (2.9)
Repair/reconstruction without annuloplasty	3 (11.1)	4 (2.4)	–	–	7 (2.5)
Decalcification	–	6 (3.6)	–	–	6 (2.2)
Tumour tissue removal	4 (14.8)	1 (0.6)	–	–	5 (1.8)
Repair paravalvular leak	1 (3.7)	–	–	–	1 (0.4)
ALL	**27 (100.0)**	**170 (100.0)**	**81 (100.0)**	**0 (0.0)**	**278 (100.0)**

7.5.4 Valve replacement surgery

Aortic valve replacement accounted for the majority of valve replacement surgeries (77%), which included 108 TAVR procedures and 97 aortic root reconstruction surgeries utilising a valved conduit.

Table 27: Valve replacement surgery by valve type

Surgery type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Replacement	579 (73.9)	183 (100.0)	28 (100.0)	19 (100.0)†	809 (79.8)
TAVR*	108 (13.8)	–	–	–	108 (10.7)
Root reconstruction with valve conduit	97 (12.4)	–	–	–	97 (9.6)
ALL	**784 (100.0)**	**183 (100.0)**	**28 (100.0)**	**19 (100.0)**	**1,014 (100.0)**

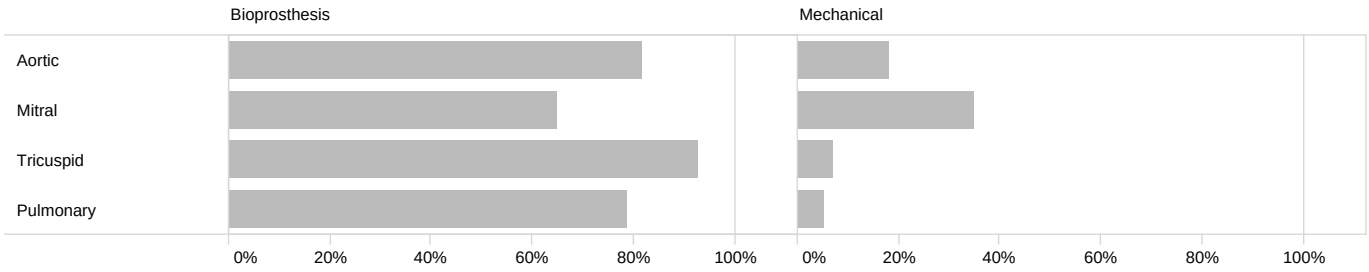
* Includes TAVR procedure involving CTS

† Includes replacement of pulmonary root as part of a Ross-Yacoub procedure

Prosthesis type

The most common form of valve prostheses used across all valve types were biological (79%), either porcine (45%) or bovine (34%). Mechanical prostheses were used in 21% of cases with a greater proportion represented in mitral valve replacement surgeries.

Bovine-derived aortic valve prostheses accounted for the largest proportion of all valves used, representing 36% of all aortic valve prostheses and 55% of the total valvular prostheses used.



Homograft/allograft and autograft prosthesis not displayed (0.5%)

Figure 26: Proportion of valve replacements by valve prosthesis category and valve type

Table 28: Types of valve prosthesis by valve type

Prosthesis type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Biological – bovine	428 (54.6)	21 (11.5)	0 (0.0)	3 (15.8)	452 (44.6)
Biological – porcine	211 (26.9)	98 (53.6)	26 (92.9)	12 (63.2)	347 (34.2)
Mechanical	143 (18.2)	64 (35.0)	2 (7.1)	1 (5.3)	210 (20.7)
Homograft/allograft	0 (0.0)	0 (0.0)	0 (0.0)	2 (10.5)	2 (0.2)
Autograft	2 (0.3)	0 (0.0)	0 (0.0)	1 (5.3)	3 (0.3)
ALL	**784 (100.0)**	**183 (100.0)**	**28 (100.0)**	**19 (100.0)**	**1,014 (100.0)**

7.6 Other cardiac surgery

The most common forms of other cardiac surgery were left atrial appendage closure (22%), followed by atrial arrhythmia surgery (12%). Approximately 11% of other surgeries were classified as various other cardiac surgery.

Table 29: Other cardiac procedures

Procedure	n (%)
Left atrial appendage closure	92 (22.0)
Atrial arrhythmia surgery	49 (11.7)
Atrial septal defect repair	36 (8.6)
BSSLTX*	25 (6.0)
Other congenital	24 (5.7)
LVOT† myectomy for HOCM‡	19 (4.5)
Cardiac transplant	16 (3.8)
Cardiac tumour removal	14 (3.3)
Patent foramen ovale closure	12 (2.9)
Left ventricular rupture repair	10 (2.4)
Permanent left ventricular epicardial lead	9 (2.1)
Pericardiectomy	9 (2.1)
VAD§ procedure	8 (1.9)
Ventricular septal defect repair	6 (1.4)
Pericardiocentesis	6 (1.4)
Cardiac thrombus removal	6 (1.4)
Left ventricular reconstruction	5 (1.2)
Left ventricular aneurysm repair	5 (1.2)
ECMO‖ procedure	5 (1.2)
Pulmonary thromboendarterectomy	3 (0.7)
PAPVD# repair	3 (0.7)
Other myectomy	3 (0.7)
Aortic root enlargement procedure	3 (0.7)
Single lung transplant	2 (0.5)
Pulmonary embolectomy	2 (0.5)
Catheter-based ventricular assist device procedure	2 (0.5)
Other	45 (10.7)
ALL	**419 (100.0)**

* Bilateral sequential single lung transplantation

† Left ventricular outflow tract

‡ Hypertrophic obstructive cardiomyopathy

§ Ventricular assist device

‖ Extracorporeal membrane oxygenation

\# Partial anomalous pulmonary venous drainage

7.7 Blood product usage

The majority of surgeries did not require blood product transfusion (65%). However, as the urgency of operations increased, so too did the requirement for red blood cells (RBC) and non-red blood cells (NRBC). Approximately three quarters (73%) of all emergency cases utilised at least one blood product.

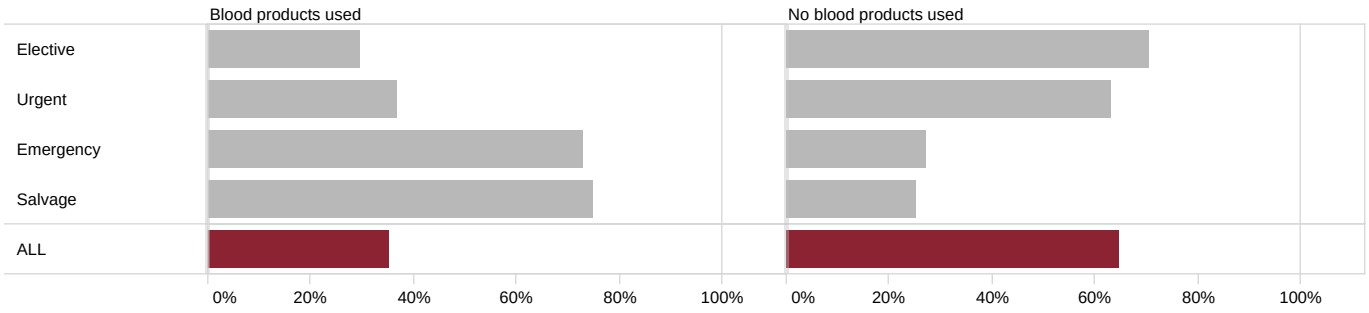


Figure 27: Blood products used by admission status

Table 30: Blood product type used by admission status

Admission status	Both RBC and NRBC n (%)	RBC only n (%)	NRBC only n (%)	No blood products n (%)
Elective	152 (10.3)	141 (9.6)	140 (9.5)	1,039 (70.6)
Urgent	148 (14.9)	150 (15.2)	68 (6.9)	624 (63.0)
Emergency	87 (47.0)	29 (15.7)	19 (10.3)	50 (27.0)
Salvage	3 (75.0)	–	–	1 (25.0)
ALL	**390 (14.7)**	**320 (12.1)**	**227 (8.6)**	**1,714 (64.7)**

8 Outcomes

Measures of outcomes in this cardiac surgery report comprise of factors that affect the risk of complications from procedures or operations and key targets for optimal procedural performance. The aim of this focus area is to compare the aggregated outcomes of the four Queensland adult cardiac surgical units against calculated risk scores which are in use both nationally and internationally.

8.1 Risk prediction models

Risk adjustment models are a commonly employed method of estimating patient outcomes based on patient-specific comorbidities and clinical factors known at the time of surgery. This statistical analysis enables the adjustment of risk for individual patients, attempting to correct for patients who may be undergoing surgery in a critical pre-operative state, for example cardiogenic shock as opposed to an elective procedure in a patient with limited comorbid factors.

Risk scores in cardiac surgery are established from large patient cohorts and are usually relevant for a particular period in time, and in a particular geographical area.

As such, it is important to explore multiple scores as a means of ensuring that relevant signals for potential improvement are not overlooked. Furthermore, it is important to adapt and adopt new risk scores as they are made available and incorporated into routine practice.

Mortality after an operation is the most common outcome evaluated using risk adjustment algorithms. However, the Society of Thoracic Surgeons (STS) has also developed a range of algorithms predictive of the post-operative risk of complications (morbidity).

The risk prediction models used in evaluating the 2020 clinical outcomes for cardiac surgical cases are:

- EuroSCORE[18]
- EuroSCORE II[19]
- ANZSCTS General Score[20]
- AusSCORE[21]
- STS Score (mortality and morbidity) [22,23,24]

8.1.1 Mortality

The risk adjustment analysis of 30 day mortality has been evaluated using a range of well described risk models. The EuroSCORE[18], EuroSCORE II[19], and ANZSCTS General Score[20] can be applied to evaluate deaths for all types of cardiac surgical cases, whereas the AusSCORE model[21] applies for mortality in CABG cases only.

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

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

Again, all risk adjustment evaluations show that the observed mortality rate is either within or lower than the predicted rate.

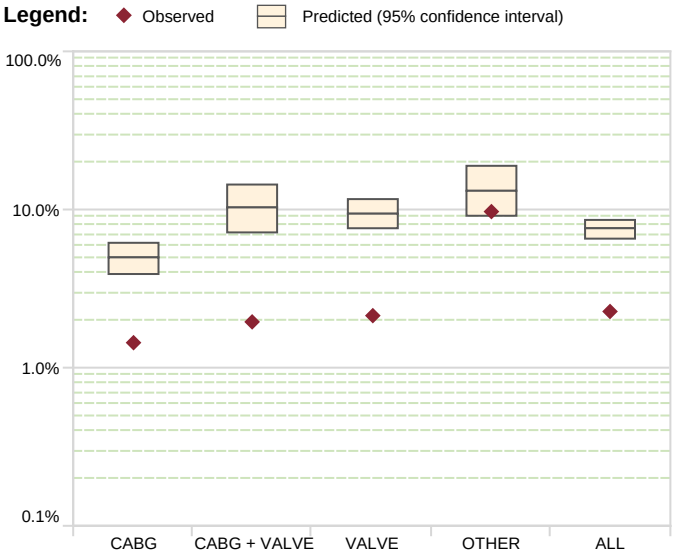


Figure 28: EuroSCORE

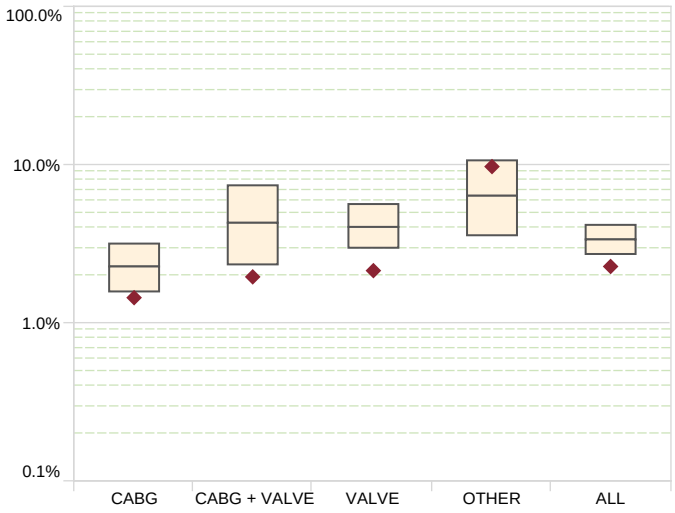


Figure 29: EuroSCORE II

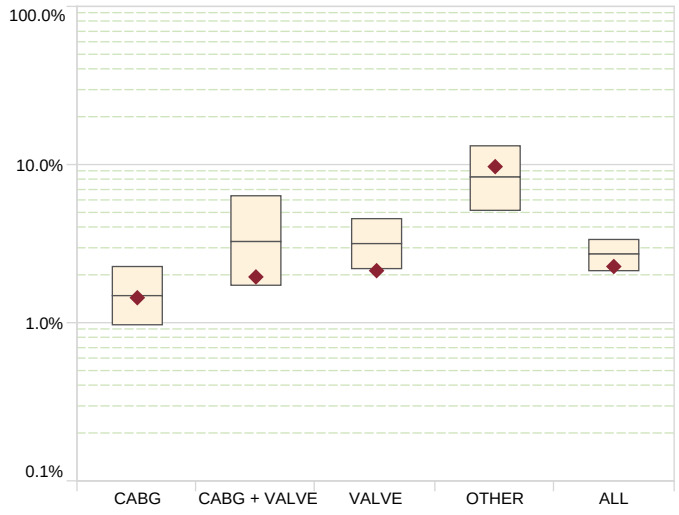


Figure 30: ANZSCTS (General Score)

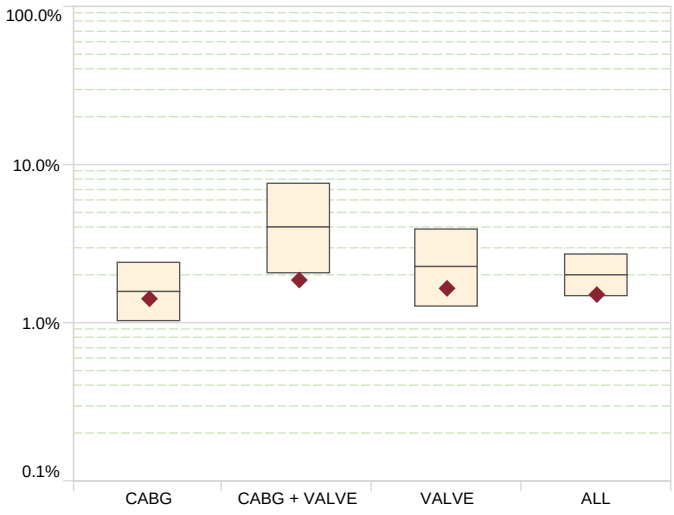


Figure 31: STS (death)

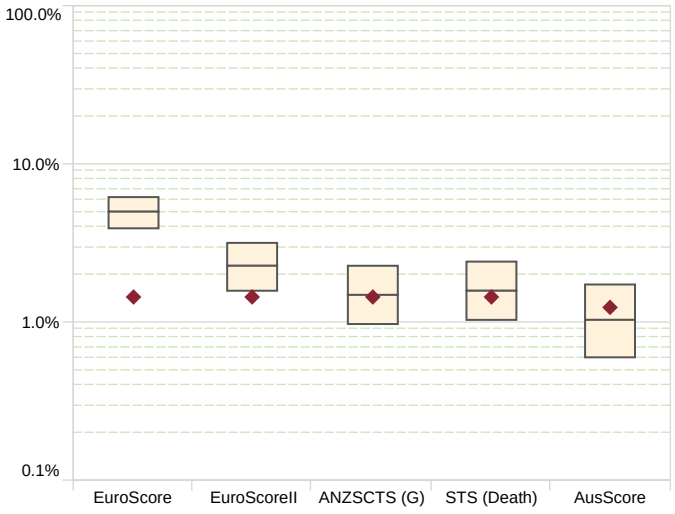


Figure 32: CABG

8.1.2 Morbidity

Patients undergoing cardiac surgery are at risk of experiencing a range of significant morbidities in the post-operative period. The STS risk models provide an estimate of the level risk for a patient who is afflicted with these morbidities. These models have been applied to the defined surgical subgroups using the distinct inclusion criteria.

The aggregated morbidities chart (Figure 38) represents the observed rate of cases involving at least one of the five morbidities.

Most comparisons between the observed event rate and the rate predicted using the respective risk scores demonstrate that outcomes are within expectation. The incidence of prolonged ventilation and new renal failure for CABG patients is better than predicted.

An exception continues to be deep sternal wound infection (DSWI) in CABG cases, where the rate is higher than predicted. A concerted effort to review this finding has been undertaken by all participating units, including a review of data entry and site processes. It is worth noting that the expected rate based on the STS model is derived from an overseas setting. Other jurisdictions have highlighted that this model may underpredict the risk of DSWI.[25]

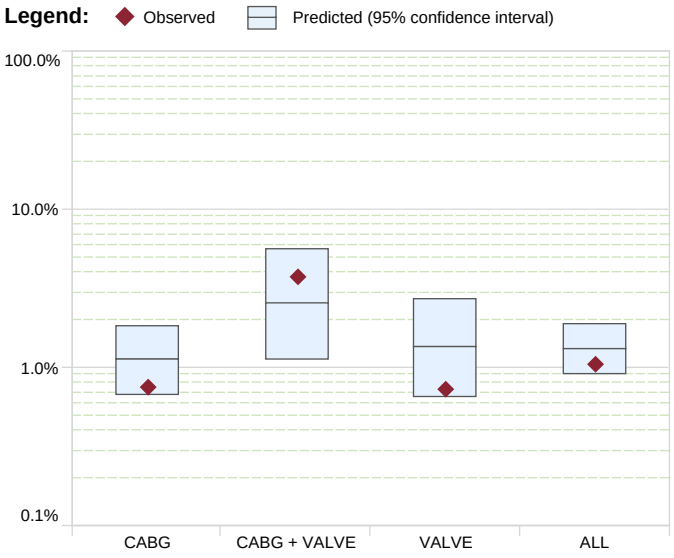


Figure 33: Cerebrovascular accident

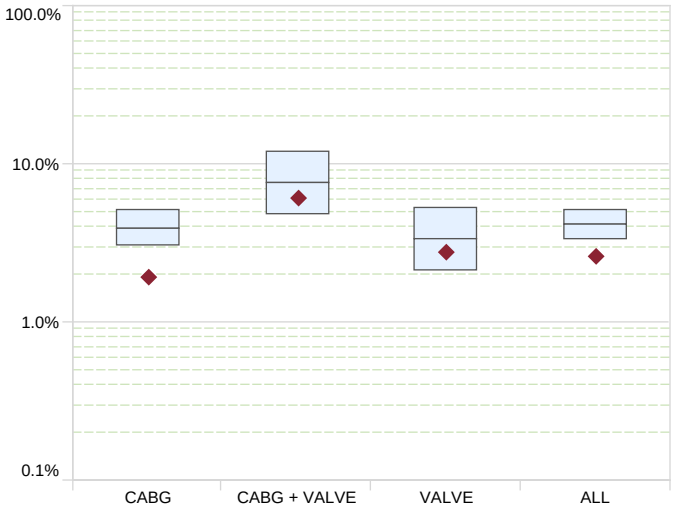


Figure 34: Renal failure

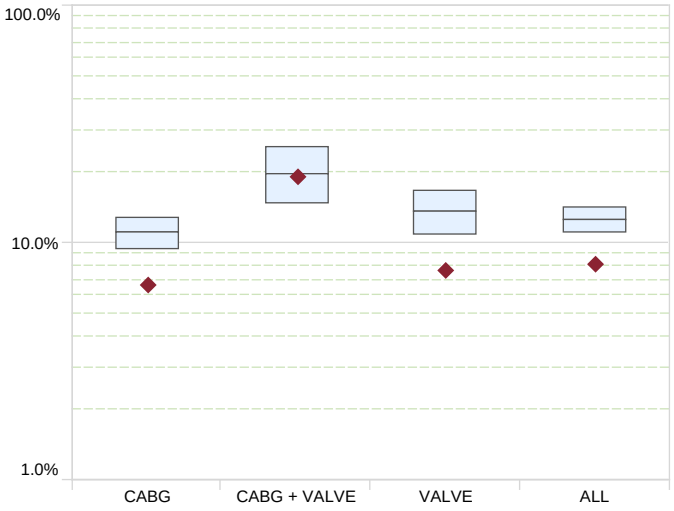


Figure 35: Ventilation >24 hours

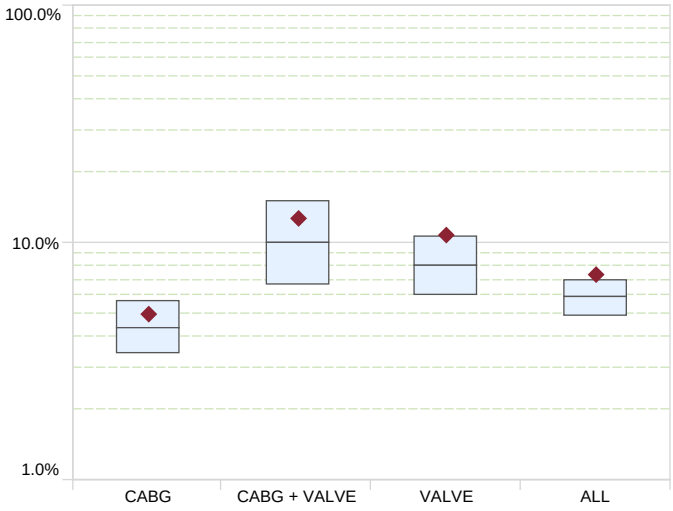


Figure 36: Reoperation

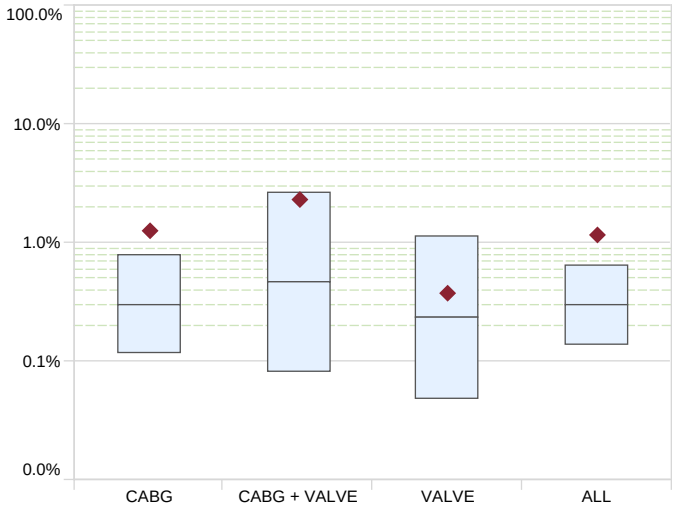


Figure 37: Deep sternal infection

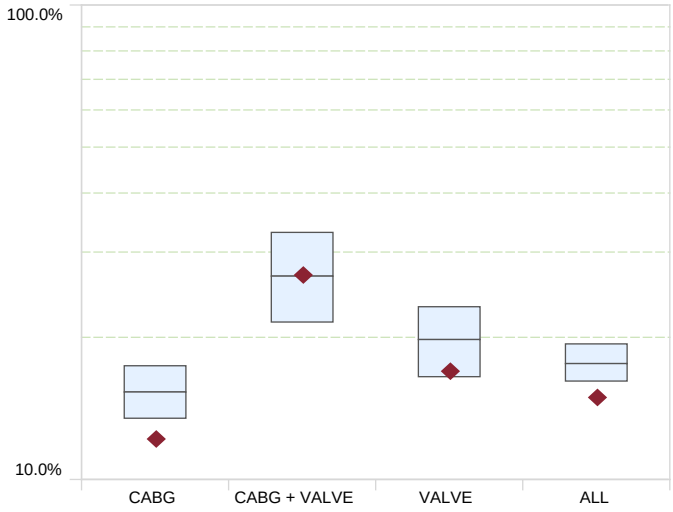


Figure 38: Major morbidity

8.1.3 Measures of process

The following graphs assesses the length of stay (LOS) of patients compared with that predicted by the STS score. LOS less than six 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 six day cut off for minor reasons, but instead are on a prolonged recovery pathway.

The LOS comparison indicates that the proportion of cases staying less than six days is less than expected, regardless of surgery category.

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

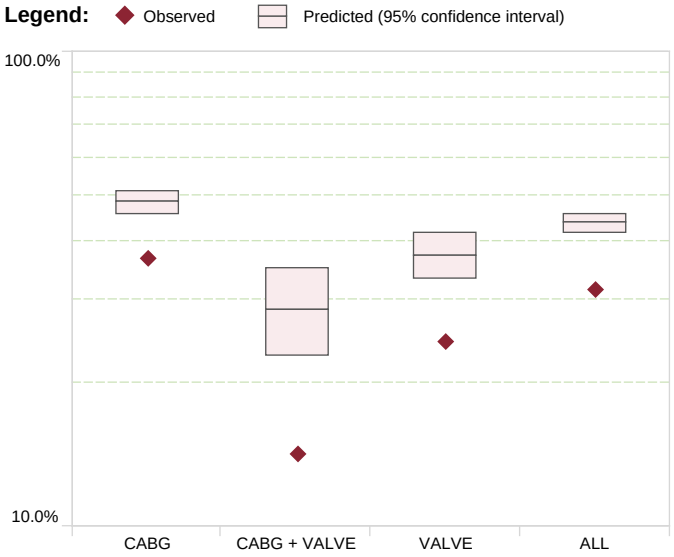


Figure 39: LOS ‹6 days

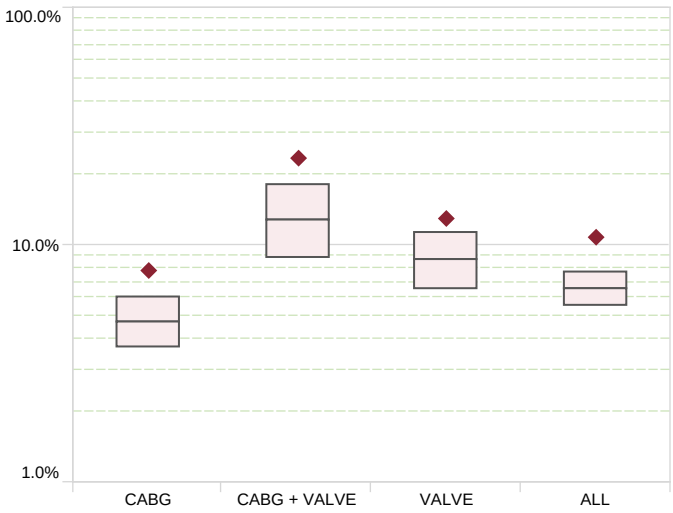


Figure 40: LOS ›14 days

8.1.4 Failure to rescue

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

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

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

This suggests that the processes in place to deal with adverse events appear to be functioning at or better than the expected level.

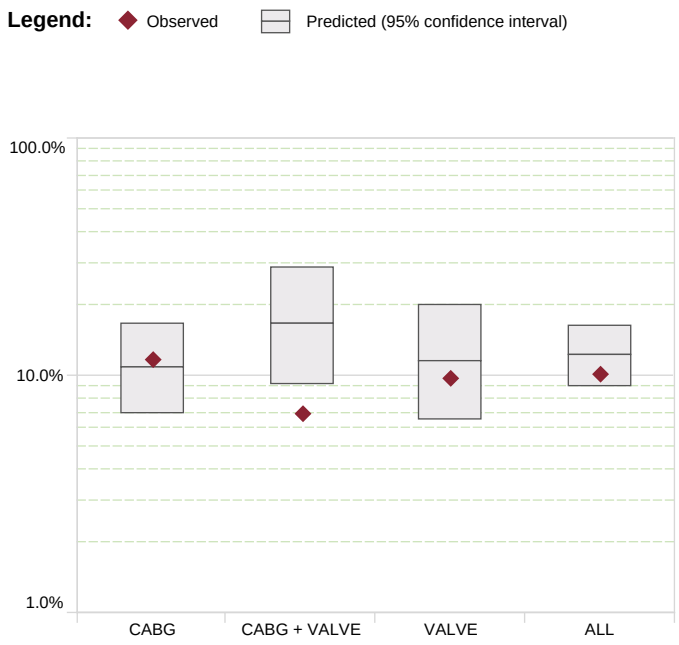


Figure 41: Failure to rescue

9 Supplement: Australia and New Zealand Congenital Outcomes Registry for Surgery

9.1 Message from the chair

It is my pleasure to present for the first time Queensland's paediatric cardiac surgical data from the Australia and New Zealand Congenital Outcomes Registry for Surgery (ANZCORS) as part of the Queensland Cardiac Outcomes Registry (QCOR) Annual Report for 2020. The inclusion of paediatric cardiac surgery results reflects the commitment of Queensland Health and specifically Clinical Excellence Queensland to the ongoing improvement in statewide cardiac surgical care. The Queensland Paediatric Cardiac Research Group (QPCR) at the Queensland Children's Hospital has validated all data included in this report.

ANZCORS was created in 2017 and represents a collaborative effort between all five institutions delivering paediatric cardiac surgery across Australia and New Zealand. The Registry is managed by the QPCR team based at the Children's Health Research Centre, Brisbane. Through ANZCORS, we aim to benchmark outcomes after paediatric cardiac surgery across the region and translate findings that are important to consumers into practice in a timely manner. The ANZCORS team also intends to disseminate their findings through peer-reviewed publications with several manuscripts currently in draft. The Registry will pilot and embed patient reported outcome measures and patient reported experience measures into routine clinical care with implementation planned initially in Queensland over the next twelve months. To better understand longer-term outcomes, the Registry will expand its data linkage activities.

It is important to acknowledge that 2020 marked a year of worldwide change. The year began with the emergence of COVID-19 and the consequent catastrophic pandemic that the world continues to battle. Health systems have been under enormous strain. However, even during this difficult time, clinical teams across our region have continued to work tirelessly to maintain the highest levels of care while supporting the activities and goals of the Registry.

I would like to take this opportunity to thank all those involved with the ongoing management of the Registry and the production of this report. The ANZCORS management team, steering committee members, and national data managers are to be congratulated for the quality of work and their dedication to the Registry and its outputs. The ANZCORS team is also very grateful for the support of the Queensland Health and QCOR, which provides funding for the Registry's core activities and advice and infrastructure support.

Finally, as always, a special thank you to the surgical teams across Australia and New Zealand, patients and parents for permitting us to use their data to build the Registry. Without their support, the work of the Registry would not be possible.

Dr Prem Venugopal
Director of Cardiac Surgery, Children's Health Queensland
Chair, Australia and New Zealand Congenital Outcomes Registry for Surgery (ANZCORS) Steering Committee

9.2 Acknowledgements

Data Custodian

- Dr Nelson Alphonso

ANZCORS Program Manager

- Ms Jessica Suna

ANZCORS Data Manager

- Ms Janelle Johnson

QPCR Team

- Dr Nelson Alphonso
- Dr Kim Betts, PhD
- Ms Janelle Johnson
- Dr Supreet Marathe
- Dr Greg Merlo, PhD
- Ms Morgan Sams
- Ms Jessica Suna
- Dr Prem Venugopal
- Ms Kathryn Versluis

ANZCORS Steering Committee

- Dr Prem Venugopal (Chair)
  Queensland Children's Hospital,
  Brisbane
- Mr Matthew Liava'a
  The Children's Hospital,
  Westmead, Sydney
- Prof Christian Brizard
  The Royal Children's Hospital,
  Melbourne
- Mr David Andrews
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  Perth
- Dr Kirsten Finucane
  Starship Children's Hospital,
  Auckland
- Dr Robert Justo
  Queensland Children's Hospital
  Brisbane
- Prof Tom Gentles
  Starship Children's Hospital,
  Auckland

The QPCR team Brisbane (from left): Dr Nelson Alphonso, Jessica Suna, Kathryn Versluis, Janelle Johnson, Morgan Sams, Dr Prem Venugopal, and Dr Supreet Marathe

Dr Kim Betts, PhD
Statistician

Dr Greg Merlo, PhD
Health Economist

9.3 Introduction

This report provides an overview of the major findings from the 2020 annual ANZCORS report for Queensland. The data covers the 5 year rolling period from January 2016 to December 2020 and includes 1,734 cardiothoracic procedures (1,147 using cardiopulmonary bypass, 358 without cardiopulmonary bypass, 229 delayed sternal closures).

Currently, there is only one hospital in Queensland (Queensland Children's Hospital) that provides paediatric cardiac surgical care to individuals across Queensland, Northern New South Wales, and the Torres Strait, as shown in the heat map below. Every year the paediatric cardiac service at Perth Children's Hospital also refers patients with complex congenital heart defects to the team at the Queensland Children's Hospital for surgical management.

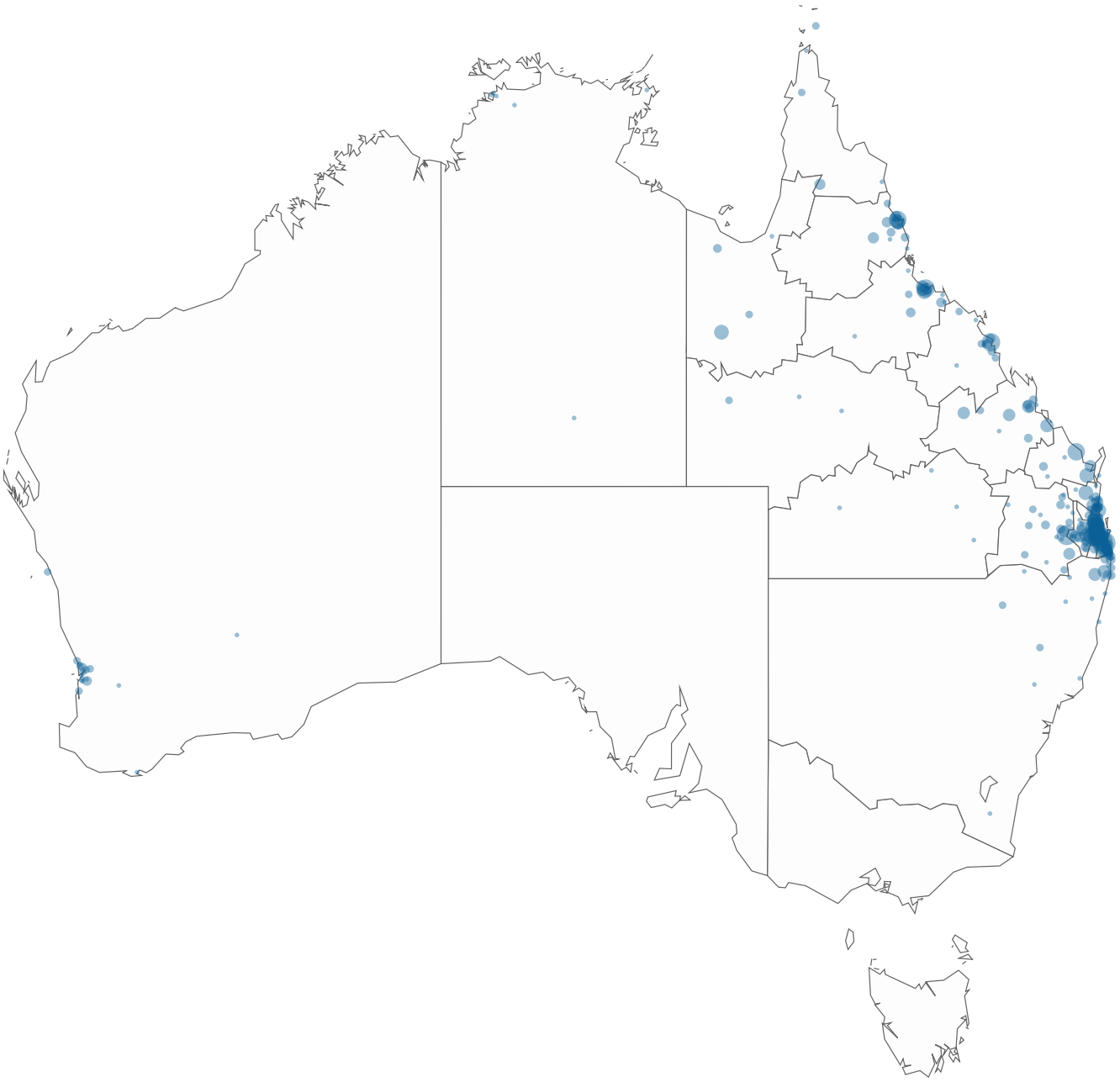


Figure 1: Cardiac patients treated by the Queensland Paediatric Cardiac Service between 2016–2020, by patient place of usual residence (residential postcode)

9.4 Childhood heart surgery patients and procedures 2016–2020

During the 5 year reporting period from 2016 to 2020 there were 2,446 procedures performed by the Queensland Paediatric Cardiac Service at the Queensland Children's Hospital. These procedures included cardiac surgical procedures with and without the use of cardiopulmonary bypass, extracorporeal membrane oxygenation (ECMO), thoracic and delayed sternal wound closure procedures (Table 1). The focus of this report is cardiac surgical procedures for childhood heart disease and as such delayed sternal closure, ECMO and thoracic procedures are excluded from the analysis.

Over the 5 year reporting period, there were 1,372 patients with childhood heart disease who underwent 1,505 cardiothoracic surgical procedures either with or without cardiopulmonary bypass (1,147 and 358 procedures respectively) at the Queensland Children's Hospital.

Table 1: Total procedures by procedure category, 2016–2020

Procedure category	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	2020 n (%)	ALL n (%)
CPB*	241	232	240	219	215	1,147 (46.9)
Non-CPB*	64	84	79	54	77	358 (14.6)
Delayed sternal closure	51	51	42	44	41	229 (9.4)
ECMO†	80	71	51	56	60	318 (13.0)
Thoracic‡	87	57	60	74	64	342 (14.0)
Other§	11	10	8	6	17	52 (2.1)
Total	**534**	**505**	**480**	**453**	**474**	**2,446 (100.0)**

* Cardiopulmonary bypass

† Extracorporeal membrane oxygenation – includes pre and post cardiotomy and all non cardiac ECMO

‡ Thoracic procedures include pectus procedures, lung procedures, pleural drain insertions and diaphragm plications

§ Other procedures include catheterisation procedures, hybrid procedures, ventricular assist device procedures and miscellaneous procedures

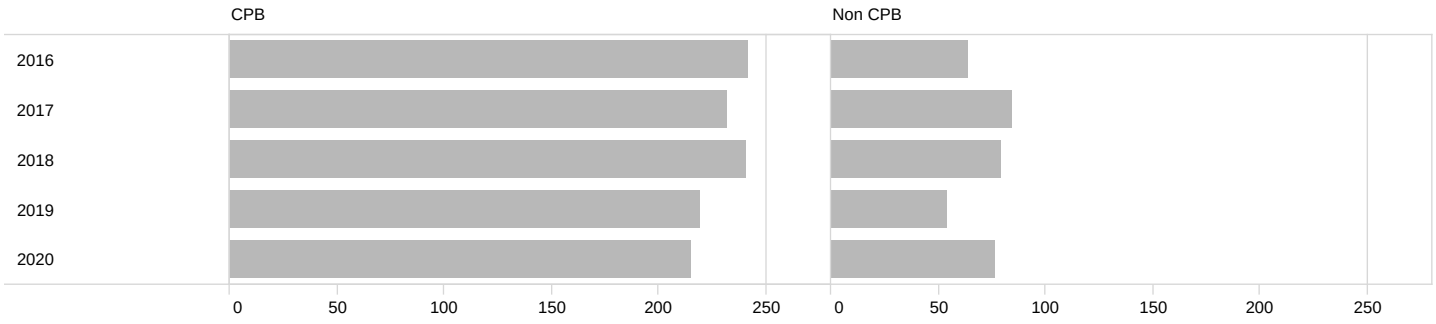


Figure 2: Number of cardiac patients by cardiopulmonary bypass utilisation, 2016–2020

Table 2: Total cardiac patients and procedures, 2016–2020

	2016 n	2017 n	2018 n	2019 n	2020 n	ALL n
Cardiac patients	281	282	280	250	279	1,372
Cardiac procedures	305	316	319	273	292	1,505

9.5 Patient characteristics

9.5.1 Age and gender

Approximately 20% of the patient population were neonates aged between 0 and 28 days. Thirty-three percent were infants aged between 29 days and 365 days. Forty-five percent of the cohort were aged between one and sixteen years, and 2% were over sixteen years of age.

Fifty-five percent of the patients were male and 45% were female.

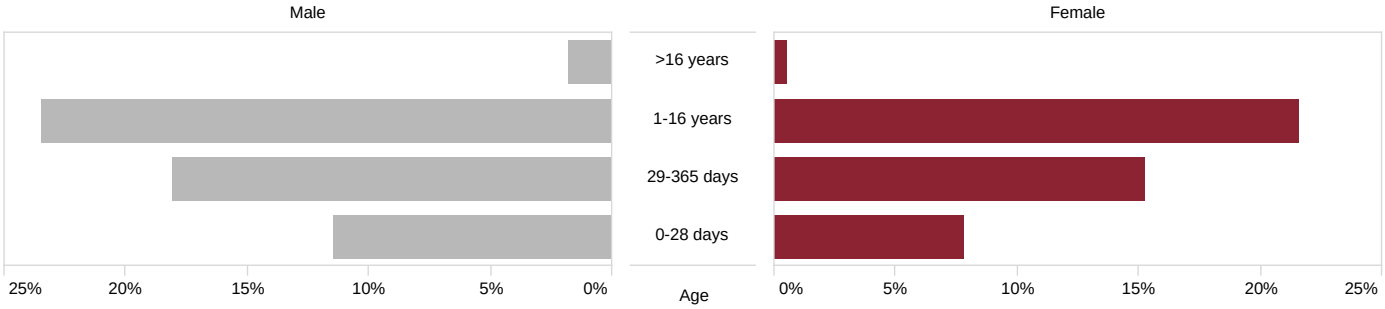


Figure 3: Proportion of all cardiac cases by age group and gender

Table 3: Cardiac cases by age group and year, 2016–2020

Age group	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	2020 n (%)	ALL n (%)
>16 years	10 (3.3)	8 (2.5)	9 (2.8)	4 (1.5)	4 (1.4)	35 (2.3)
1–16 years	110 (36.1)	139 (44.0)	163 (51.1)	128 (46.9)	138 (47.3)	678 (45.0)
29–365 days	126 (41.3)	107 (33.9)	92 (28.8)	81 (29.7)	96 (32.9)	502 (33.4)
0–28 days	59 (19.3)	62 (19.6)	55 (17.2)	60 (22.0)	54 (18.5)	290 (19.3)
Total	**305 (100.0)**	**316 (100.0)**	**319 (100.0)**	**273 (100.0)**	**292 (100.0)**	**1,505 (100.0)**

Table 4: Cardiac cases by gender and year, 2016–2020

Gender	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	2020 n (%)	ALL n (%)
Female	148 (48.5)	131 (41.5)	138 (43.3)	138 (50.5)	125 (42.8)	680 (45.2)
Male	157 (51.5)	185 (58.5)	181 (56.7)	135 (49.5)	167 (57.2)	825 (54.8)
Total	**305 (100.0)**	**316 (100.0)**	**319 (100.0)**	**273 (100.0)**	**292 (100.0)**	**1,505 (100.0)**

1.5.2 Aboriginal and Torres Strait Islander status

The overall proportion of identified Aboriginal and Torres Strait Islander patients undergoing cardiac surgery was 12% with an increasing trend over the 5 year period.

Table 5: Cardiac cases by Aboriginal and Torres Strait Islander status, 2016–2020

	2016 n (%)	2017 n (%)	2018 n (%)	2019 n (%)	2020 n (%)	ALL n (%)
Indigenous	29 (9.5)	33 (10.4)	37 (11.6)	39 (14.3)	42 (14.4)	180 (12.0)
Non-Indigenous	276 (90.5)	283 (89.6)	282 (88.4)	234 (85.7)	250 (85.6)	1,325 (88.0)
Total	**305 (100.0)**	**316 (100.0)**	**319 (100.0)**	**273 (100.0)**	**292 (100.0)**	**1,505 (100.0)**

NB: All cardiopulmonary bypass and non-cardiopulmonary bypass procedures excluding delayed sternal closures

9.6 Procedural complexity

9.6.1 Aristotle Comprehensive Complexity score

The Aristotle Comprehensive Complexity Score (ACC) is a risk stratification tool that rates the projected complexity of the surgical procedures performed. By stratifying patients by complexity, the ACC aims to facilitate more realistic evaluation of surgical outcomes and more meaningful comparison of outcomes between paediatric cardiac surgical centres. The complexity score is based on three subjective determinations; potential for mortality, potential for morbidity, and anticipated surgical difficulty. Complexity is calculated in two phases. Firstly, the basic complexity of the procedure involved is scored from 0.5 to 15.0. This rates only the simplest form of the cardiac surgical procedure. Secondly, a specific value is added, based on a precise analysis of the associated pathology along with any co-morbid conditions that are present. Procedure dependent factors include anatomical variations, associated procedures, and patient age, and can add a maximum of 5 points to the basic score. Procedure independent factors include patient characteristics which are more general but have the potential to significantly affect the outcome. Procedure independent factors can add an additional 5 points.[26]

Between 2016 and 2020, 1,372 patients underwent 1,505 cardiac procedures, including those performed without using cardiopulmonary bypass. Fifty-one percent of procedures belonged in the higher-risk categories, with an ACC score of ten or above and a predicted mortality of ›10%.

Table 6: Cardiac cases by Aristotle Comprehensive Complexity score, 2016–2020

Complexity category	2016 n	2017 n	2018 n	2019 n	2020 n	ALL n (%)
Level 1	32 (10.5)	39 (12.3)	40 (12.5)	33 (12.1)	36 (12.3)	180 (12.0)
Level 2	54 (17.7)	50 (15.8)	55 (17.2)	46 (16.8)	51 (17.5)	256 (17.0)
Level 3	58 (19.0)	47 (14.9)	66 (20.7)	47 (17.2)	58 (19.9)	276 (18.3)
Level 4	118 (38.7)	130 (41.1)	119 (37.3)	110 (40.3)	107 (36.6)	584 (38.8)
Level 5	32 (10.5)	22 (7.0)	19 (6.0)	12 (4.4)	23 (7.9)	108 (7.2)
Level 6	7 (2.3)	11 (3.5)	10 (3.1)	13 (4.8)	9 (3.1)	50 (3.3)
No score	4 (1.3)	17 (5.4)	10 (3.1)	12 (4.4)	8 (2.7)	51 (3.4)
Total	**305 (100.0)**	**316 (100.0)**	**319 (100.0)**	**273 (100.0)**	**292 (100.0)**	**1,505 (100.0)**

Level 1: ACC score 1.5–5.9; expected mortality ‹1%

Level 2: ACC score 6.0–7.9; expected mortality 1–5%

Level 3: ACC score 8.0–9.9; expected mortality 5–10%

Level 4: ACC score 10.0–15.0; expected mortality 10–20%

Level 5: ACC score 15.1–20.0; expected mortality ›20%

Level 6: ACC score ›20.1; expected mortality ›20%

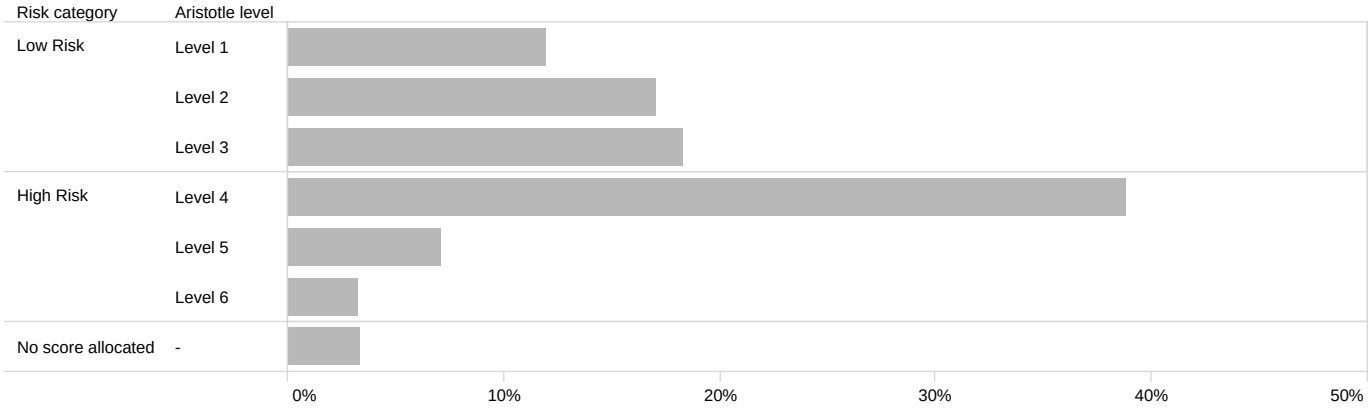


Figure 4: Proportion of all cardiac cases stratified by Aristotle Comprehensive Complexity score and risk category

9.7 Outcomes – length of stay

9.7.1 Paediatric intensive care unit length of stay for cardiac patients

In 2016–2020, the median length of stay in the paediatric intensive care unit (PICU) for cardiac patients was 2 days, with a mean of 6.9 days.

Table 7: Median PICU length of stay for cardiac patients by year

PICU length of stay	2016 days	2017 days	2018 days	2019 days	2020 days	ALL days
Maximum length of stay	143	294	109	506	131	506
Median length of stay	2	2	2	2	2	2
Mean length of stay	7.1	7.9	5.0	9.3	5.7	6.9

9.7.2 Hospital length of stay for cardiac patients

In 2016–2020, the median hospital length of stay for cardiac patients was 10 days, with a mean of 23.1 days.

Table 8: Hospital length of stay for cardiac patients by year

Hospital length of stay	2016 days	2017 days	2018 days	2019 days	2020 days	ALL days
Maximum length of stay	243	329	223	506	215	506
Median length of stay	11	10	10	10	9	10
Mean length of stay	23.3	24.5	21.8	24.5	21.6	23.1

9.8 Outcomes – mortality

9.8.1 30 day mortality by Aristotle Comprehensive Complexity score

Overall, the 30 day mortality after paediatric cardiac surgery from 2016-2020 was less than 1%. Most deaths (11 of 12) were within the high risk procedure categories (ACC level 4–6). One quarter (25%) of the deaths occurred after surgical procedures belonging in the highest risk ACC category. The observed incidence of mortality across the five year period was consistently below the predicted mortality for each ACC risk category.

There was some variation noted across the reporting period, reflective of the complex and unpredictable nature of the work. The mortality rate was higher for non-CPB patients compared to those performed with CPB (1.4% versus 0.7% over the five year reporting period). This relates primarily to the inclusion of premature babies with multiple non cardiac comorbidities undergoing ligation of a patent ductus arteriosus in this group.

Table 9 shows the 30 day mortality for only cardiac surgical procedures performed with or without using cardiopulmonary bypass over the five year period. In 2017 there were 3 deaths in patients who underwent ligation of a patent ductus arteriosus without using cardiopulmonary bypass. These 3 mortalities were related to non cardiac abnormalities and not to the cardiac surgical procedure. Of the 12 post-surgical deaths over the five year period, 11 belonged in the higher risk ACC categories.

Table 9: Cardiac patients 30 day surgical mortality by procedure category, 2016–2020

	2016	2017	2018	2019	2020	ALL
Patients, n	**281**	**282**	**280**	**250**	**279**	**1,372**
CPB, n	227	224	227	209	209	1,096
Non-CPB, n	54	58	53	41	70	276
Deaths, n (%)	**2 (0.7)**	**7 (2.5)**	**1 (0.4)**	**1 (0.4)**	**1 (0.4)**	**12 (0.9)**
CPB, n	2	4	1	1	0	8
Non-CPB, n	0	3	0	0	1	4

Figure 5 shows the observed mortality rate over the five year reporting period, superimposed on the predicted mortality rates given by the ACC score.

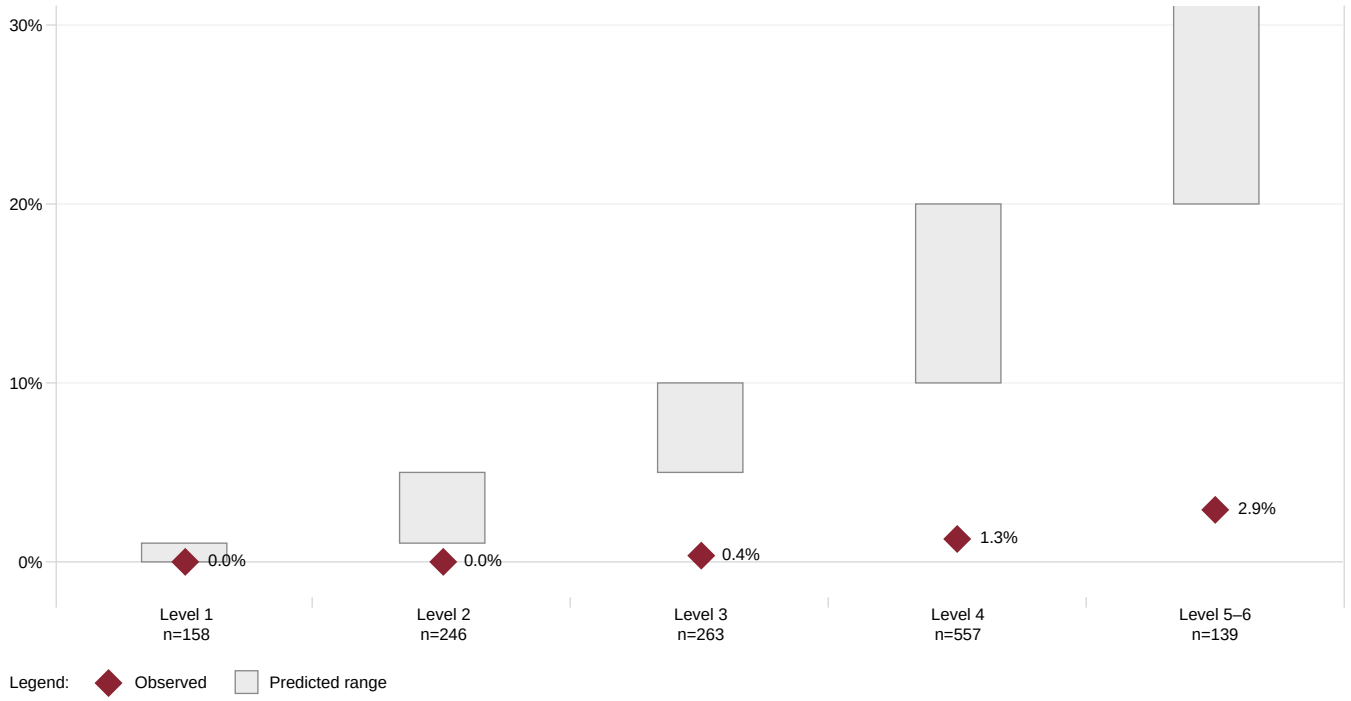


Figure 5: Cardiac patients 30 day mortality by Aristotle Comprehensive Complexity score, 2016–2020

Level 1: ACC score 1.5–5.9; expected mortality ‹1%

Level 2: ACC score 6.0–7.9; expected mortality 1–5%

Level 3: ACC score 8.0–9.9; expected mortality 5–10%

Level 4: ACC score 10.0–15.0; expected mortality 10–20%

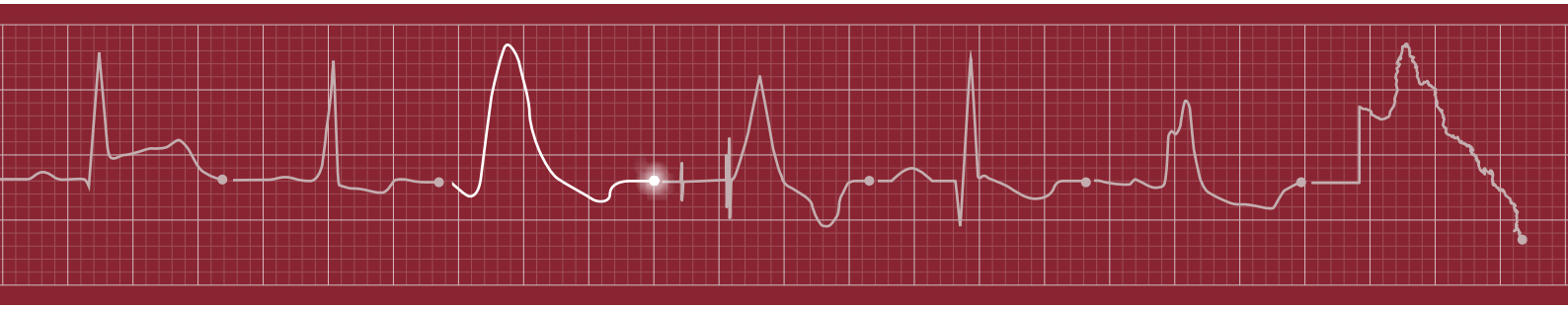
Level 5: ACC score 15.1–20.0; expected mortality ›20%

Level 6: ACC score ›20.1; expected mortality ›20%

Table 10: Cardiac patients 30 day surgical mortality by procedure category (patients), 2016–2020

	2016	2017	2018	2019	2020	ALL
Patients, n	**281**	**282**	**280**	**250**	**279**	**1,372**
Level 1, n	27	33	32	30	36	158
Level 2, n	52	48	51	45	50	246
Level 3, n	56	44	60	47	56	263
Level 4, n	111	127	113	102	104	557
Level 5, n	27	21	16	12	23	99
Level 6, n	6	8	8	11	7	40
No score, n	2	1	0	3	3	9
Deaths, n (%)	**2 (0.7)**	**7 (2.5)**	**1 (0.4)**	**1 (0.4)**	**1 (0.4)**	**12 (0.9)**
Level 1, n	0	0	0	0	0	0
Level 2, n	0	0	0	0	0	0
Level 3, n	0	0	0	1	0	1
Level 4, n	2	4	1	0	0	7
Level 5, n	0	1	0	0	0	1
Level 6, n	0	2	0	0	1	3
No score, n	0	0	0	0	0	0

Thoracic Surgery Audit



1 Message from the Chair

Queensland continues to lead with this third QCOR Thoracic Surgery Audit. Reporting in thoracic surgery is sparse, and this statewide presentation of activity from Queensland is a lead report within Australia. There is work ongoing to establish a binational thoracic surgery database, to which QCOR will contribute data.

In this Audit, we present a detailed analysis of thoracic surgical activity across five public units in Queensland. Overall, volumes of thoracic surgery in 2020 have increased despite the emergence of the COVID-19 pandemic. A common pathway for the discovery of primary lung cancer is an investigation for pulmonary symptoms, to which the pandemic has paid particular attention.

As in previous years, the rate of smoking among the thoracic surgery cohort is significantly higher than that of the general population, again illustrating the links between cigarette smoking and cancer. Despite the significant gains over the last decades, still more work is required to reduce cigarette consumption in the community.

For patients with lung cancer, a series of investigations estimate their stage of disease. In this year's analysis, we present a visual depiction of differences in pre-operative clinical staging and post-operative pathological staging. This is an area that needs more investigation, as the accurate staging of cancer predicates treatment decisions.

The safety data presented shows that thoracic surgery is being performed safely and appropriately with reassuring levels of patient survival in the immediate post-operative period. As with previous years, there was a wide and varied assortment of conditions requiring thoracic surgical intervention. Diagnoses such as advanced malignancies through to chest wall trauma illustrate the widespread resources and skills required to treat these patients. Due to the variety of conditions treated, outcome measures such as the survival rates of patients undergoing thoracic surgery have limited utility, but nonetheless are reassuringly high.

I would like to commend all thoracic surgical units in Queensland on their efforts in ensuring the sustained provision of surgical services to patients during the trying conditions of the COVID-19 pandemic. The continued efforts of the QCOR Cardiothoracic Surgery Committee within thoracic surgery is an opportunity for leadership in the area of developing key performance indicators, which are analysed in the recently established Quality Assurance Committee. This work is leading Australia and is intended to further improve the high quality of Thoracic Surgery within Queensland.

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

2 Key findings

Key findings include:

- There were 1,093 thoracic surgical cases entered for 2020 across the five public thoracic surgery units in Queensland.
- The median age of patients undergoing thoracic surgery was 62 years of age, with 20% of patients aged under 40 years of age.
- Almost one third of patients (32%) were within the normal body mass index (BMI) range, while patients classed as overweight or obese made up more than half of the patient cohort (63%) including 4% classed as morbidly obese.
- The proportion of Aboriginal and Torres Strait Islander patients undergoing thoracic surgery was 4.6% of the total cohort.
- Most operations were performed for preoperative diagnoses of primary lung cancer (24%) or pleural disease (29%), while a non cancer and other cancer diagnosis each accounted for 23% of cases.
- Over two thirds of patients had some smoking history, including 26% who were current smokers at the time of surgery.
- Elective procedures accounted for 66% of the total surgeries performed, while 8% of cases were emergency operations. Of elective cases, 46% were performed on a day of surgery admission pathway.
- Lobectomy (84%) was the most common procedure performed on patients with an indication of primary lung cancer.
- Overall, 7% of all cases required a blood product transfusion.
- The median postoperative length of stay for thoracic surgery patients was 4 days.
- There were 121 cases having one or more new major morbidities recorded post procedure. Prolonged air leak between three and seven days accounted for over a quarter (26%) of all major morbidity types.
- Pathological upstaging occurred in 42% of primary lung cancer cases while 16% were downstaged postoperatively and 42% had no change to the preoperative staging classification.
- Unadjusted all-cause mortality at 30 days was 0.7%, increasing to 1.9% at 90 days. The other cancer indication group had the highest unadjusted mortality rates at 30 and 90 days with 1.6% and 3.9% respectively.

3 Participating sites

There are five public thoracic surgery units in Queensland, all of which have participated in QCOR.

Four of the public sites offering thoracic surgery also performed cardiac surgery. The fifth public site, Royal Brisbane & Women's Hospital (RBWH), only offers thoracic surgery.

Figure 1: Thoracic surgery cases by residential postcode

Table 1: Participating sites

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

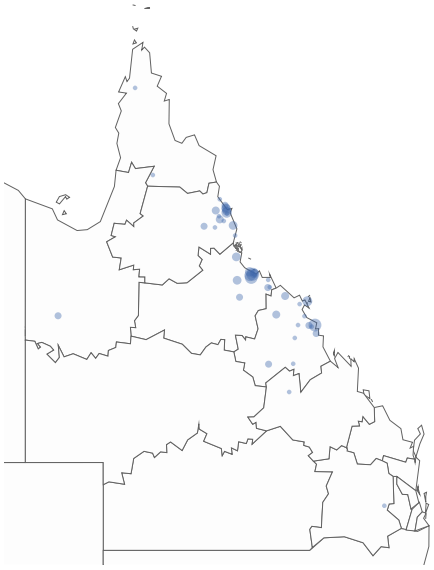


Figure 2: Townsville University Hospital

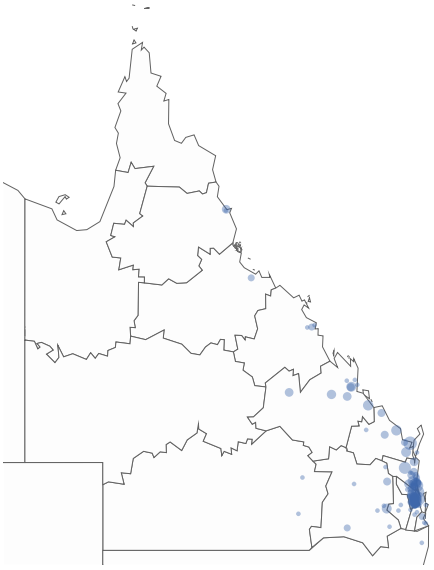


Figure 3: The Prince Charles Hospital

Figure 4: Royal Brisbane & Women's Hospital

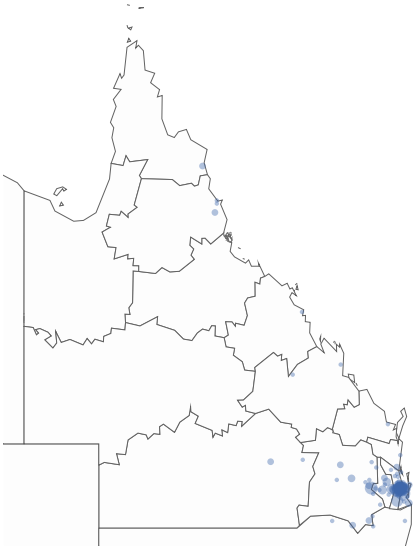


Figure 5: Princess Alexandra Hospital

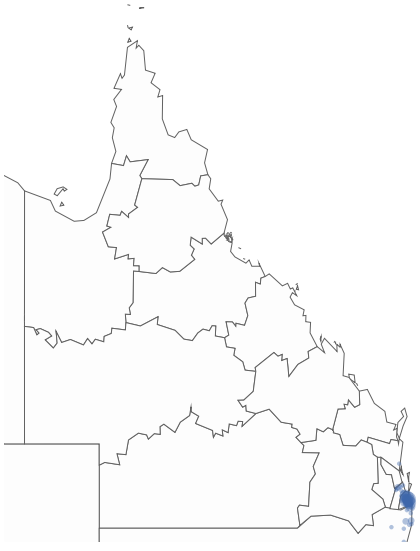


Figure 6: Gold Coast University Hospital

4 Case totals

4.1 Total surgeries

Patients undergoing thoracic surgery have been assigned an indication category of either primary lung cancer, other cancer, pleural disease or other indication for surgery.

Of the 1,093 cases performed across the five public thoracic surgery units in Queensland, almost half of patients (48%) presented with an indication including some form of cancer. Diagnosis of primary lung cancer accounted for 24% and 23% had another cancer diagnosis.

Non cancer diagnoses accounted for 52% of the overall cases, including pleural disease (29%) or other non cancer indication (23%).

Table 2: Cases by site and indication category

SITE	Total n	Primary lung cancer n (%)	Other cancer* n (%)	Pleural disease† n (%)	Other‡ n (%)
TUH	147	54 (36.7)	38 (25.9)	33 (22.4)	22 (15.0)
TPCH	359	101 (28.1)	72 (20.1)	132 (36.8)	54 (15.0)
RBWH	102	28 (27.5)	23 (22.5)	23 (22.5)	28 (27.5)
PAH	327	57 (17.4)	74 (22.6)	110 (33.6)	86 (26.3)
GCUH	158	25 (15.8)	47 (29.7)	22 (13.9)	64 (40.5)
STATEWIDE	**1,093**	**265 (24.3)**	**254 (23.2)**	**320 (29.3)**	**254 (23.2)**

* Lung metastases, solitary lung lesion of uncertain aetiology, pleural malignancy or other thoracic cancer

† Pneumothorax, haemothorax, empyema or pleural thickening/nodules

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

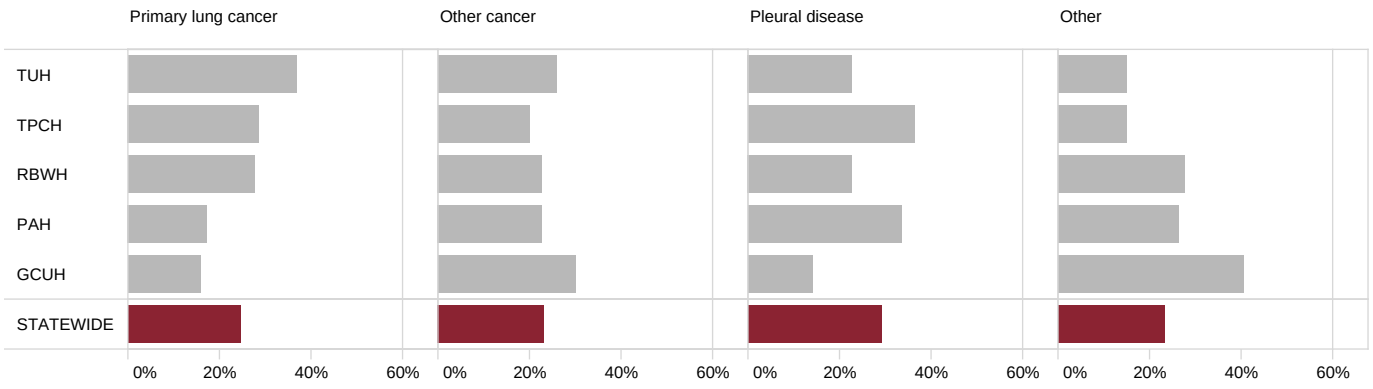


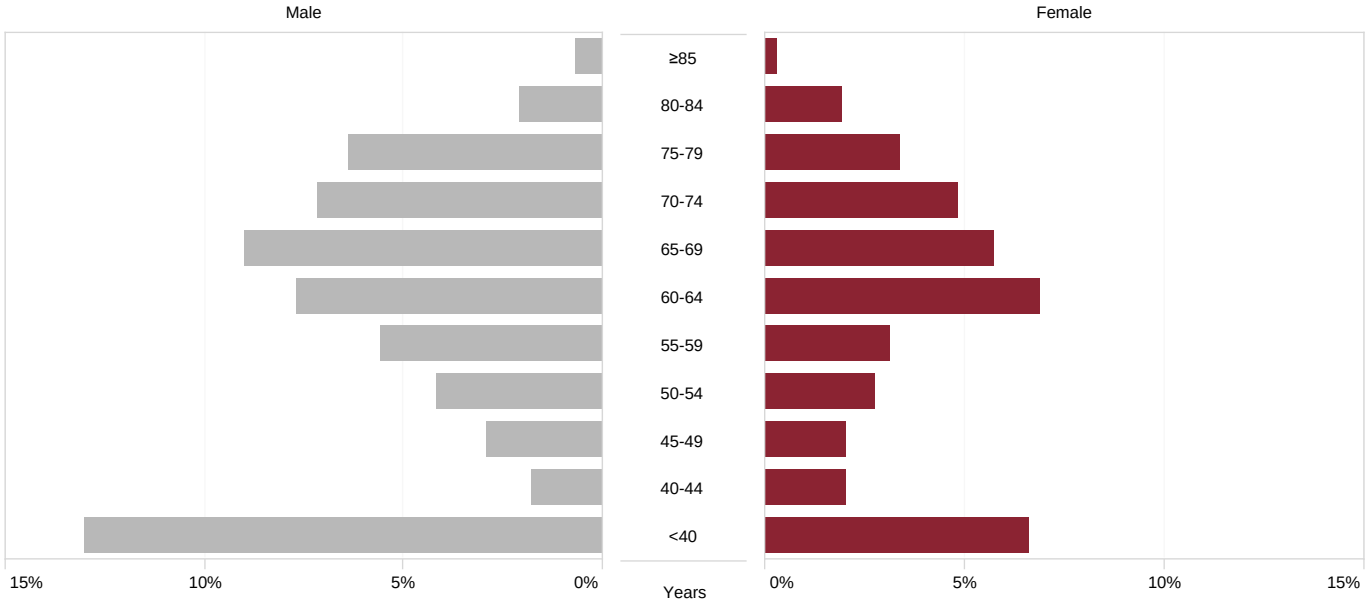
Figure 7: Proportion of cases by site and indication category

5 Patient characteristics

5.1 Age and gender

The median age for thoracic surgical patients was 62 years, while one in five (20%) patients were less than 40 years of age at the time of surgery.

Whilst the majority of patients were male (60%), there was an even distribution of cases between genders among patients with a preoperative cancer diagnosis (50% and 50% for males and females respectively). By contrast, three quarters of patients with pleural disease were male (75%).



% of total (n=1,093)

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

Table 3: Median age by gender and indication category

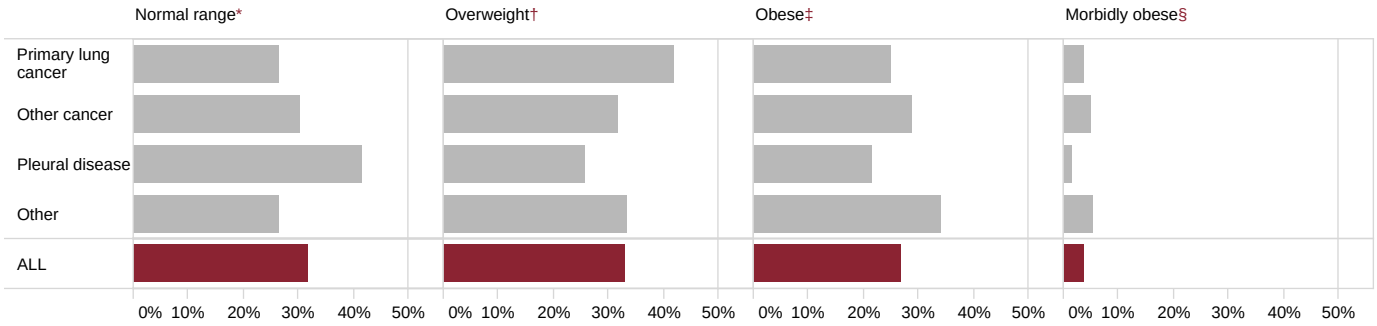
Indication	Male years	Female years	All years
Primary lung cancer	68	66	67
Other cancer	66	66	66
Pleural disease	51	44	49
Other	59	50	56
Total	**62**	**62**	**62**

Table 4: Proportion of cases by gender and indication category

Indication	Male n (%)	Female n (%)
Primary lung cancer	125 (47.2)	140 (52.8)
Other cancer	134 (52.8)	120 (47.2)
Pleural disease	239 (74.7)	81 (25.3)
Other	163 (64.2)	91 (35.8)
ALL	**661 (60.5)**	**432 (39.5)**

5.2 Body mass index

The majority of thoracic surgery patients (63%) were classed as overweight or obese, while 32% of patients had a body mass index (BMI) classed within the normal range. Approximately 5% of patients were classed as underweight.



Underweight category (BMI <18.5 kg/m²) is not displayed (6.2%)

Excludes missing data (11.6%)

* BMI 18.5–24.9 kg/m²

† BMI 25.0–29.9 kg/m²

‡ BMI 30.0–39.9 kg/m²

§ BMI ≥40.0 kg/m²

Figure 9: Proportion of cases by BMI and indication categories

Table 5: BMI category by indication category

Indication	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
Primary lung cancer	7 (3.0)	62 (26.3)	98 (41.9)	58 (24.8)	9 (3.8)
Other cancer	10 (4.5)	67 (30.2)	70 (31.5)	64 (28.8)	11 (5.0)
Pleural disease	27 (9.1)	123 (41.4)	77 (25.9)	65 (21.9)	5 (1.7)
Other	3 (1.4)	56 (26.3)	71 (33.3)	72 (33.8)	11 (5.2)
ALL	**47 (4.9)**	**308 (31.9)**	**316 (32.7)**	**259 (26.8)**	**36 (3.7)**

Excludes missing data (11.6%)

5.3 Aboriginal and Torres Strait Islander status

The overall proportion of identified Aboriginal and Torres Strait Islanders undergoing thoracic surgery was 4.6%.

Table 6: Aboriginal and Torres Strait Islander status by indication category

Indication	Indigenous n (%)	Non-Indigenous n (%)
Primary lung cancer	8 (3.0)	255 (97.0)
Other cancer	7 (2.8)	246 (97.2)
Pleural disease	27 (8.5)	290 (91.5)
Other	8 (3.2)	244 (96.8)
ALL	**50 (4.6)**	**1,035 (95.4)**

Excludes missing data (0.7%)

6 Risk factors and comorbidities

6.1 Smoking history

Over a quarter of patients (26%) were current smokers (defined as smoking within 30 days prior to surgery), while 41% of patients had a smoking history recorded. Only 23% of patients were identified as having never smoked. In 9% of cases, smoking status was unknown.

There was considerable variation for patients in the primary lung cancer category, where the majority (89%) were recorded as either current or former smokers.

Table 7: Smoking history by indication category

Indication	Current smoker n (%)	Former smoker n (%)	Never smoked n (%)	Unknown n (%)
Primary lung cancer	66 (27.8)	144 (60.8)	25 (10.5)	2 (0.8)
Other cancer	57 (24.7)	100 (43.3)	67 (29.0)	7 (3.0)
Pleural disease	96 (32.4)	100 (33.8)	75 (25.3)	25 (8.4)
Other	37 (16.8)	63 (28.6)	63 (28.6)	57 (25.9)
ALL	**256 (26.0)**	**407 (41.4)**	**230 (23.4)**	**91 (9.2)**

Excludes missing data (10.0%)

6.2 Respiratory disease

The majority of patients (72%) did not have respiratory disease, while one quarter (25%) were recorded as having mild or moderate respiratory disease.

Table 8: Respiratory disease according to indication category

Indication	Mild* n (%)	Moderate† n (%)	Severe‡ n (%)
Primary lung cancer	31 (13.9)	47 (21.1)	3 (1.3)
Other cancer	28 (12.7)	28 (12.7)	2 (0.9)
Pleural disease	37 (12.7	39 (13.4)	14 (4.8)
Other	24 (11.1)	8 (3.7)	3 (1.4)
ALL	**120 (12.6)**	**122 (12.8)**	**22 (2.3)**

Excludes missing data (12.8%)

* Patient is on chronic inhaled or oral bronchodilator therapy

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

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

6.3 Diabetes

There were 12% of thoracic surgery patients recorded as having diabetes. The incidence of diabetes was similar across indication categories, ranging from 14% in the primary lung cancer category to 10% in the other cancer cohort.

Table 9: Diabetes status by indication category

Indication	Diabetes n (%)	No diabetes n (%)
Primary lung cancer	32 (13.6)	204 (86.4)
Other cancer	23 (10.0)	208 (90.0)
Pleural disease	32 (10.8)	265 (89.2)
Other	27 (12.3)	193 (87.7)
ALL	**114 (11.6)**	**870 (88.4)**

Excludes missing data (10.0%)

6.4 Coronary artery disease

Overall, 11% of thoracic surgery patients were identified as having a preoperative history of coronary artery disease (CAD), while 7% of the cohort had an unknown CAD history.

Table 10: Coronary artery disease status by indication category

Indication	CAD n (%)	No CAD n (%)	Unknown n (%)
Primary lung cancer	27 (11.6)	190 (81.9)	15 (6.5)
Other cancer	15 (6.6)	190 (83.0)	24 (10.5)
Pleural disease	41 (13.9)	239 (80.7)	16 (5.4)
Other	22 (10.2)	184 (85.2)	10 (4.6)
ALL	**105 (10.8)**	**803 (82.5)**	**65 (6.7)**

Excludes missing data (11.0%)

6.5 Renal function

Over one quarter (28%) of patients had mild renal impairment at the time of surgery. Renal function has been determined using estimated glomerular filtration rate (eGFR) calculated from the creatinine measurement recorded preoperatively.

Table 11: Renal function by indication category

Indication	Normal* n (%)	Mild† n (%)	Moderate‡ n (%)	Severe§ n (%)
Primary lung cancer	97 (42.9)	88 (38.9)	39 (17.3)	2 (0.9)
Other cancer	120 (53.8)	72 (32.3)	30 (13.5)	1 (0.4)
Pleural disease	209 (72.1)	57 (19.7)	18 (6.2)	6 (2.1)
Other	141 (67.8)	44 (21.2)	20 (9.6)	3 (1.4)
ALL	**567 (59.9)**	**261 (27.6)**	**107 (11.3)**	**12 (1.3)**

Excludes missing data (13.4%)

* eGFR ≥90 mL/min/1.73 m^2

† eGFR 60–89 mL/min/1.73 m^2

‡ eGFR 30–59 mL/min/1.73 m^2

§ eGFR <30 mL/min/1.73 m^2

6.6 Cerebrovascular disease

Approximately 5% of patients were described as having a preoperative history of cerebrovascular disease. Of these patients, 4% were characterised by a reversible neurological deficit with a complete return of function within 72 hours while around 1% exhibited residual symptoms greater than 72 hours post onset.

Table 12: Cerebrovascular disease type by indication category

Indication	Reversible* n (%)	Irreversible† n (%)	No n (%)
Primary lung cancer	16 (6.8)	2 (0.8)	219 (92.4)
Other cancer	8 (3.5)	4 (1.7)	219 (94.8)
Pleural disease	8 (2.7)	4 (1.3)	285 (96.0)
Other	9 (4.1)	1 (0.5)	210 (95.5)
ALL	**41 (4.2)**	**11 (1.1)**	**933 (94.7)**

Excludes missing data (9.9%)

* Typically includes transient ischaemic attack

† Typically includes cerebrovascular accident

6.7 Peripheral vascular disease

The prevalence of peripheral vascular disease was 5% in patients undergoing thoracic surgery.

Table 13: Peripheral vascular disease status by indication category

Indication	Yes n (%)	No n (%)
Primary lung cancer	19 (8.0)	218 (92.0)
Other cancer	12 (5.2)	219 (94.8)
Pleural disease	12 (4.0)	285 (96.0)
Other	9 (4.1)	211 (95.9)
ALL	**52 (5.3)**	**933 (94.7)**

Excludes missing data (9.9%)

6.8 Previous interventions

6.8.1 Previous thoracic surgery

There were 14% of patients with a history of prior thoracic surgery, ranging from 7% in the primary lung cancer group to 23% in the pleural disease category.

Table 14: Previous thoracic surgery by indication category

Indication	Yes n (%)	No n (%)
Primary lung cancer	16 (6.9)	217 (93.1)
Other cancer	21 (9.2)	208 (90.8)
Pleural disease	68 (23.2)	225 (76.8)
Other	35 (16.0)	184 (84.0)
ALL	**140 (14.4)**	**834 (85.6)**

Excludes missing data (10.9%)

6.8.2 Previous pulmonary resection

Overall, 7% of patients had undergone a previous pulmonary resection operation.

Table 15: Previous pulmonary resection surgery by indication category

Indication	Yes n (%)	No n (%)
Primary lung cancer	11 (4.7)	224 (95.3)
Other cancer	16 (7.0)	214 (93.0)
Pleural disease	37 (12.5)	260 (87.5)
Other	9 (4.1)	209 (95.9)
ALL	**73 (7.4)**	**907 (92.6)**

Excludes missing data (10.3%)

7 Care and treatment of patients

7.1 Admission status

Approximately two thirds of all cases (66%) were classed as elective, while emergency admissions accounted for only 8% of cases.

An indication of pleural disease was noted in 58% of all emergency cases and 61% of all urgent cases.

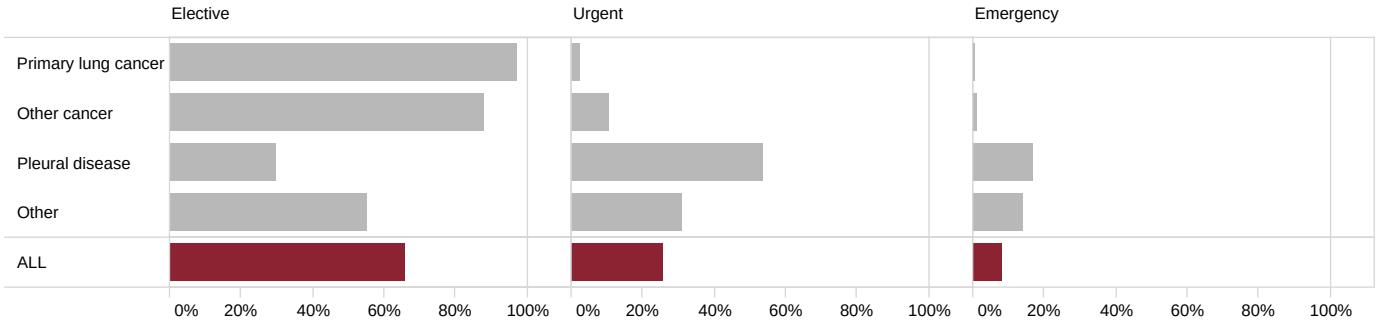


Figure 10: Admission status by indication category

Table 16: Admission status by indication category

Indication	Total cases n	Elective n (%)	Urgent n (%)	Emergency n (%)
Primary lung cancer	265	259 (97.7)	5 (1.9)	1 (0.4)
Other cancer	254	224 (88.2)	27 (10.6)	3 (1.2)
Pleural disease	320	95 (29.7)	172 (53.8)	53 (16.6)
Other	254	141 (55.5)	78 (30.7)	35 (13.8)
ALL	**1,093**	**719 (65.8)**	**282 (25.8)**	**92 (8.4)**

7.1.1 Elective day of surgery admissions

Of the 719 elective cases, 46% were recorded as day of surgery admissions (DOSA).

Table 17: Day of surgery admissions by indication category

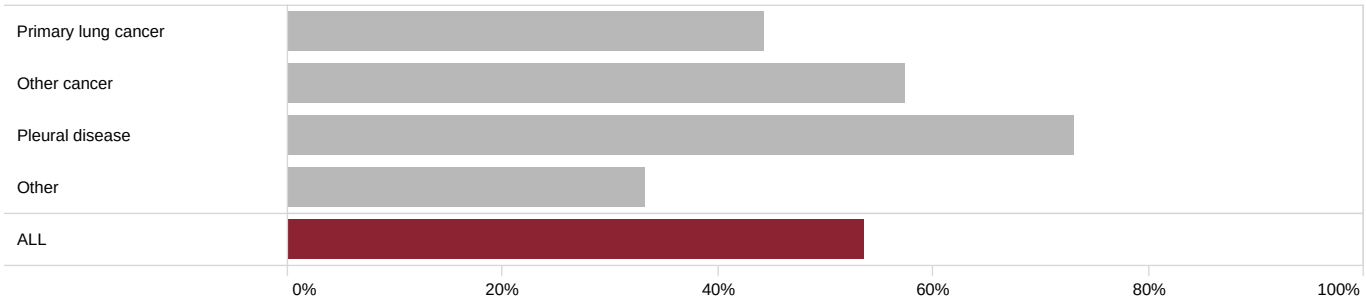
Indication	DOSA n (%)
Primary lung cancer	114 (44.0)
Other cancer	95 (42.4)
Pleural disease	42 (44.2)
Other	82 (58.2)
ALL	**333 (46.3)**

7.2 Surgical technique

7.2.1 Video-assisted thoracic surgery

Overall, 54% of cases utilised video-assisted thoracic surgery (VATS), including 73% of cases in the pleural disease category.

Of procedures undertaken through VATS, 43% utilised 3 ports for the operation.



Excludes missing data (3.0%)

Figure 11: Proportion of cases utilising VATS by indication category

Table 18: VATS cases by number of ports used and indication category

Indication	1 port n (%)	2 ports n (%)	3 ports n (%)	≥4 ports n (%)
Primary lung cancer	35 (33.0)	38 (35.8)	33 (31.1)	–
Other cancer	48 (34.5)	36 (25.9)	54 (38.8)	1 (0.7)
Pleural disease	56 (24.2)	69 (29.9)	105 (45.5)	1 (0.4)
Other	16 (22.2)	11 (15.3)	42 (58.3)	3 (4.2)
ALL	**155 (28.3)**	**154 (28.1)**	**234 (42.7)**	**5 (0.9)**

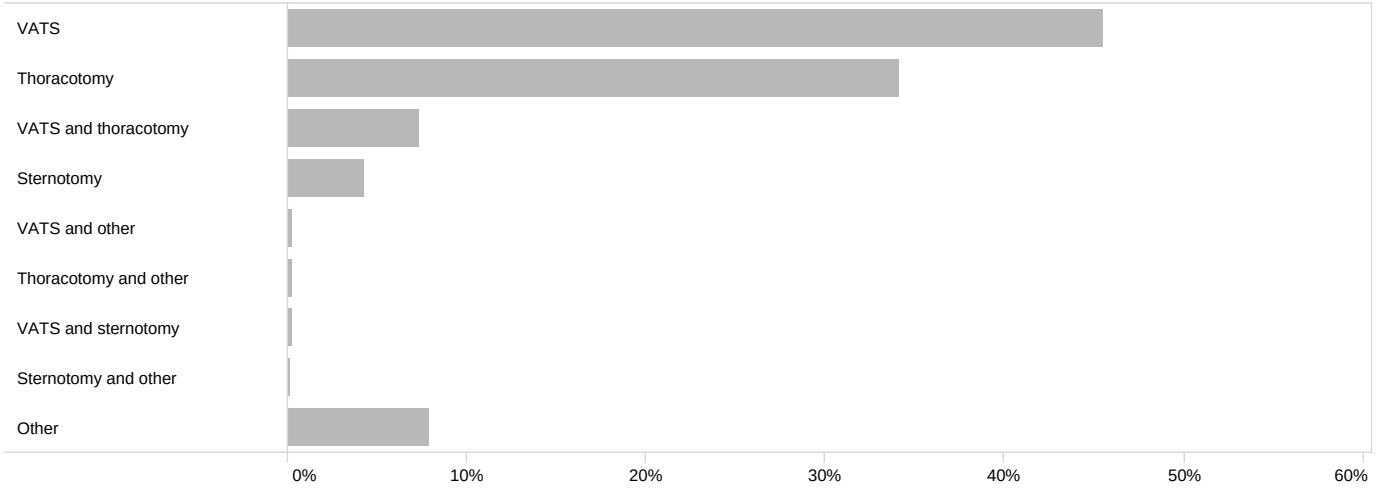
Excludes missing data (3.0%)

7.2.2 Incision type

Approximately 46% of all surgeries were solely video assisted, while 34% of the total surgeries were performed via thoracotomy.

Thoracotomy access was more likely for patients presenting with a cancer diagnosis, where the most common approaches were by thoracotomy only (43%), VATS only (38%), or VATS and thoracotomy (11%).

Use of sternotomy accounted for 5% of overall cases.



Excludes missing data (3.1%)

Figure 12: Proportion of all cases by incision type

Table 19: Incision type by indication category

Incision type	Primary lung cancer n (%)	Other cancer n (%)	Pleural disease n (%)	Other n (%)	All n (%)
VATS	78 (29.5)	117 (47.0)	219 (70.2)	68 (29.1)	482 (45.5)
Thoracotomy	153 (58.0)	71 (28.5)	73 (23.4)	64 (27.4)	361 (34.1)
VATS and thoracotomy	31 (11.7)	24 (9.6)	15 (4.8)	8 (3.4)	78 (7.4)
Sternotomy	–	25 (10.0)	1 (0.3)	20 (8.5)	46 (4.3)
VATS and sternotomy	1 (0.4)	1 (0.4)	–	1 (0.4)	3 (0.3)
Thoracotomy and other	1 (0.4)	–	–	1 (0.4)	2 (0.2)
VATS and other	–	–	–	2 (0.9)	2 (0.2)
Sternotomy and other	–	–	1 (0.3)	–	1 (0.1)
Other	–	11 (4.4)	3 (1.0)	70 (29.9)	84 (7.9)
Total	**264 (100.0)**	**249 (100.0)**	**312 (100.0)**	**234 (100.0)**	**1,059 (100.0)**

Excludes missing data (3.1%)

7.3 Surgery types

Thoracic surgery cases will often involve a number of procedures undertaken in combination. For patients with an indication of primary lung cancer, there was an average of 2.1 procedures per operation with a lobectomy being the most frequently performed procedure type (83%).

Wedge resection (30%) and lobectomy (29%) were the most common procedures performed in the other cancer cohort, while pleural disease was commonly treated with pleurodesis (46%).

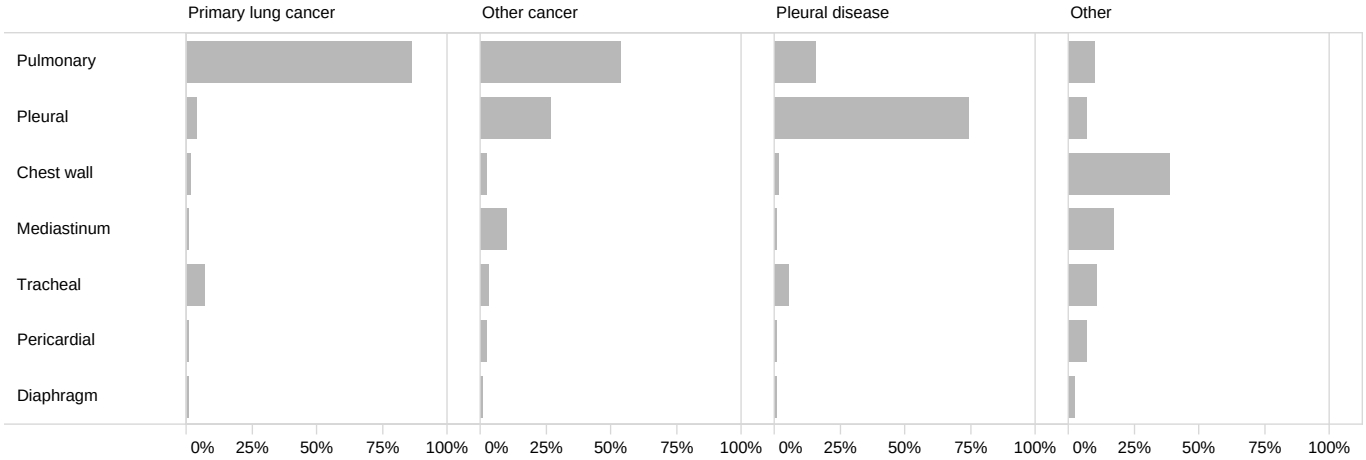


Figure 13: Proportion of procedure types by thoracic structure and indication category

Table 20: Surgical procedures for primary lung cancer

	n (%)
Lobectomy	222 (83.8)
Lymph node sampling	195 (73.6)
Bronchoscopy	34 (12.8)
Wedge resection	28 (10.6)
Lymph node dissection	19 (7.2)
Bilobectomy	9 (3.4)
Pneumonectomy	8 (3.0)
Segmentectomy	7 (2.6)
Pleural biopsy	6 (2.3)
Pleurodesis	5 (1.9)
Pleural drainage	3 (1.1)
Chest wall biopsy	3 (1.1)
Decortication	3 (1.1)
Rib resection	3 (1.1)
Bronchial repair	2 (0.8)
Sleeve resection	2 (0.8)
Air leak control	1 (0.4)
Bullectomy	1 (0.4)
Chest wall resection	1 (0.4)
ORIF* ribs	1 (0.4)
Other	6 (2.3)
Total	**265 (100.0)**

Table 21: Surgical procedures for other cancer

	n (%)
Wedge resection	81 (30.3)
Lobectomy	76 (28.5)
Lymph node sampling	65 (24.3)
Pleural biopsy	42 (15.7)
Pleural drainage	37 (13.9)
Pleurodesis	34 (12.7)
Thymectomy	23 (8.6)
Resection mediastinal mass	16 (6.0)
Segmentectomy	9 (3.4)
Lymph node dissection	7 (2.6)
Mediastinoscopy	7 (2.6)
Decortication	6 (2.2)
Chest wall biopsy	5 (1.9)
Pericardial window	4 (1.5)
Open biopsy	3 (1.1)
Bilobectomy	2 (0.7)
Chest wall reconstruction	2 (0.7)
Chest wall resection	2 (0.7)
Pneumonectomy	2 (0.7)
Rib resection	2 (0.7)
Other	15 (5.6)
Total	**254 (100.0)**

* Open reduction internal fixation

Table 22: Surgical procedures for pleural disease

	n (%)
Pleurodesis	148 (46.3)
Pleural drainage	119 (37.2)
Decortication	114 (35.6)
Pleural biopsy	85 (26.6)
Wedge resection	72 (22.5)
Clot evacuation	37 (11.6)
Flexible bronchoscopy	27 (8.4)
Bullectomy	18 (5.6)
Air leak control	9 (2.8)
Pericardial window	6 (1.9)
Rigid bronchoscopy	5 (1.6)
Muscle flap	4 (1.3)
Lobectomy	3 (0.9)
Bronchial repair	2 (0.6)
Chest wall reconstruction	2 (0.6)
Chyle leak control	2 (0.6)
Open biopsy	2 (0.6)
Pleural tent	2 (0.6)
Pneumonectomy	2 (0.6)
Rib resection	2 (0.6)
Lung volume reduction	1 (0.3)
Diaphragm plication	1 (0.3)
Resection mediastinal mass	1 (0.3)
Tracheal stent	1 (0.3)
Other	39 (12.2)
Total	**320 (100.0)**

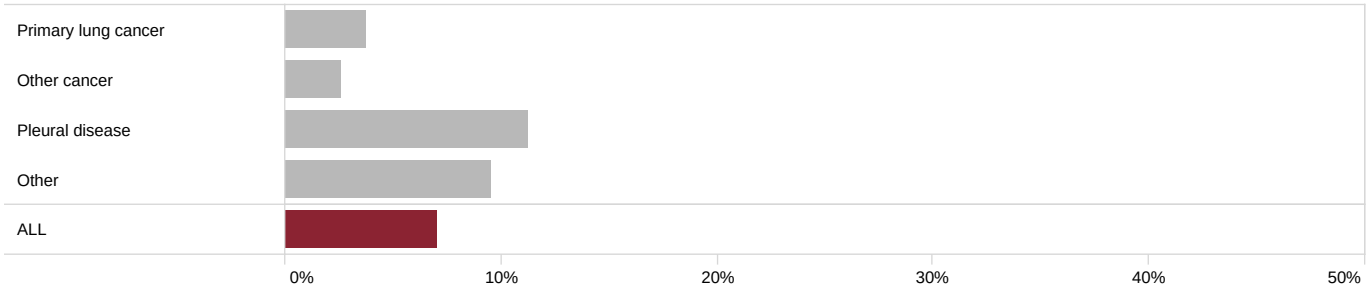
Table 23: Surgical procedures for all other surgeries

	n (%)
ORIF* ribs	59 (23.2)
Bronchoscopy	18 (7.1)
Sympathectomy	15 (5.9)
Rib resection	14 (5.5)
Pericardial window	13 (5.1)
Wedge resection	13 (5.1)
Mediastinoscopy	12 (4.7)
Thymectomy	12 (4.7)
Chest wall resection	10 (3.9)
Chest wall reconstruction	9 (3.5)
Lymph node sampling	8 (3.1)
Resection mediastinal mass	8 (3.1)
Decortication	7 (2.8)
Sternectomy	7 (2.8)
Sternal wire/plating procedure	7 (2.8)
Endobronchial ablation	6 (2.4)
Pericardial drainage	6 (2.4)
Diaphragm plication	6 (2.4)
Muscle flap	5 (2.0)
Pleural drainage	5 (2.0)
Bronchial repair	4 (1.6)
Chest wall biopsy	4 (1.6)
Clot evacuation	4 (1.6)
Open biopsy	4 (1.6)
Pericardial cyst resection	4 (1.6)
Lobectomy	3 (1.2)
Pleural washout	3 (1.2)
Tracheoesophageal fistula repair	3 (1.2)
Nuss bar procedure	2 (0.8)
Xiphoidectomy	2 (0.8)
Pectus repair	2 (0.8)
Pleural biopsy	2 (0.8)
Tracheal repair	2 (0.8)
Bullectomy	1 (0.4)
Chyle leak control	1 (0.4)
Hydatid cyst	1 (0.4)
Lung biopsy	1 (0.4)
Lung volume reduction	1 (0.4)
Lymph node dissection	1 (0.4)
Thyroidectomy	1 (0.4)
Tracheobronchoplasty	1 (0.4)
Removal of foreign body	1 (0.4)
Other	55 (21.7)
Total	**254 (100.0)**

* Open reduction internal fixation

7.4 Blood product usage

Approximately 7% of all thoracic surgical cases required blood product usage. Just under 2% of patients were transfused with both red blood cell (RBC) and non-red blood cell products (NRBC). Nearly 13% of patients diagnosed with pleural disease required some blood product transfusion.



Excludes missing data (10.0%)

Figure 14: Proportion of cases requiring blood product transfusion

Table 24: Blood product types used by indication category

Indication	RBC and NRBC n (%)	RBC only n (%)	NRBC only n (%)	No blood products used n (%)
Primary lung cancer	1 (0.4)	7 (2.9)	1 (0.4)	228 (96.2)
Other cancer	2 (0.9)	4 (1.7)	–	224 (97.4)
Pleural disease	7 (2.4)	25 (8.5)	1 (0.3)	262 (88.8)
Other	8 (3.6)	12 (5.5)	1 (0.5)	199 (90.5)
ALL	**18 (1.8)**	**48 (4.9)**	**3 (0.3)**	**913 (93.0)**

Excludes missing data (10.2%)

8 Clinical outcomes

8.1 Length of stay

The median postoperative length of stay for thoracic surgery patients was four days, which ranged from four days to five days across indication categories.

For primary lung cancer cases the median postoperative length of stay was five days which compares similarly to results published through the Queensland Lung Cancer Quality Index.[27]

Table 25: Postoperative length of stay by indication category

Indication	Median days	Interquartile range days
Primary lung cancer	5	4–7
Other cancer	4	3–6
Pleural disease	5	3–11
Other	4	2–11
ALL	**4**	**3–8**

8.2 Major morbidity

There were 121 cases (11%) having one or more new major morbidities recorded post procedure. The incidence rate of major morbidity ranged from 17% in the primary lung cancer group to 6% in the other indication category.

An air leak lasting three to seven days occurred postoperatively in 4% of thoracic surgeries.

Table 26: New major morbidity by diagnosis category

Indication	Yes n (%)	No n (%)
Primary lung cancer	46 (17.4)	219 (82.6)
Other cancer	24 (9.4)	230 (90.6)
Pleural disease	37 (11.6)	283 (88.4)
Other	14 (5.5)	240 (94.5)
ALL	**121 (11.1)**	**972 (88.9)**

Excludes missing data (9.9%)

Table 27: Type of major morbidity

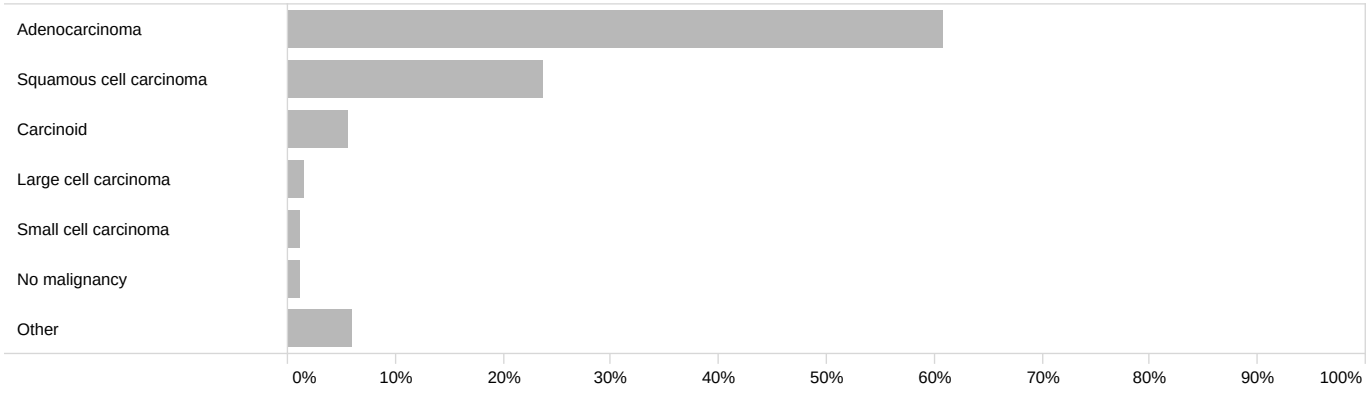
Major morbidity type	n (%)
Air leak 3–7 days	40 (3.7)
Air leak >7 days	20 (1.8)
Reoperation	15 (1.4)
Atrial fibrillation	15 (1.4)
Wound infection	11 (1.0)
Pneumonia	11 (1.0)
Cerebrovascular accident	1 (0.1)
Pulmonary embolism	1 (0.1)
Other major morbidity	35 (3.2)

Excludes missing data (9.9%)

8.3 Primary lung cancer outcomes

8.3.1 Final histopathology

In patients with a preoperative suspicion of primary lung malignancy, adenocarcinoma (61%) was the most common lung cancer according to final histopathology, followed by squamous cell carcinoma (24%).



Excludes missing data (4.9%)

Figure 15: Proportion of primary lung cancer cases by final histopathology

Table 28: Final histopathology results for primary lung malignancy

Histopathology	n (%)
Adenocarcinoma	153 (60.7)
Squamous cell carcinoma	60 (23.8)
Carcinoid	14 (5.6)
Large cell carcinoma	4 (1.6)
Small cell carcinoma	3 (1.2)
No malignancy	3 (1.2)
Other	15 (6.0)
ALL	**252 (100.0)**

Excludes missing data (4.9%)

8.3.2 Stage classification

The tumour-node-metastasis (TNM)[28] staging classification system has been used to categorise lung cancer cases into stages of severity. Primary lung malignancy patients are clinically staged in the preoperative period as well as pathologically staged postoperatively. Assessing cancer staging plays an important role in guiding treatment options for patients. It is important to note that these cases below are the cohort of primary lung cancer patients who proceeded to surgical intervention.

The most common postoperative pathological TNM classification for primary lung malignancy was a grade Ib tumour (22%), followed by IIb (20%). A preoperative diagnosed stage four cancers (3.9%) are the least likely malignancy to proceed to surgery when compared with other cancer stages.

Table 29: Primary lung malignancy by preoperative clinical classification

Clinical classification	n (%)
Tis	1 (0.4)
Ia1	7 (3.1)
Ia2	68 (30.1)
Ia3	35 (15.5)
Ib	37 (16.4)
IIa	10 (4.4)
IIb	41 (18.1)
IIIa	17 (7.5)
IIIb	1 (0.4)
IVa	8 (3.5)
IVb	1 (0.4)
Total	**226 (100.0)**

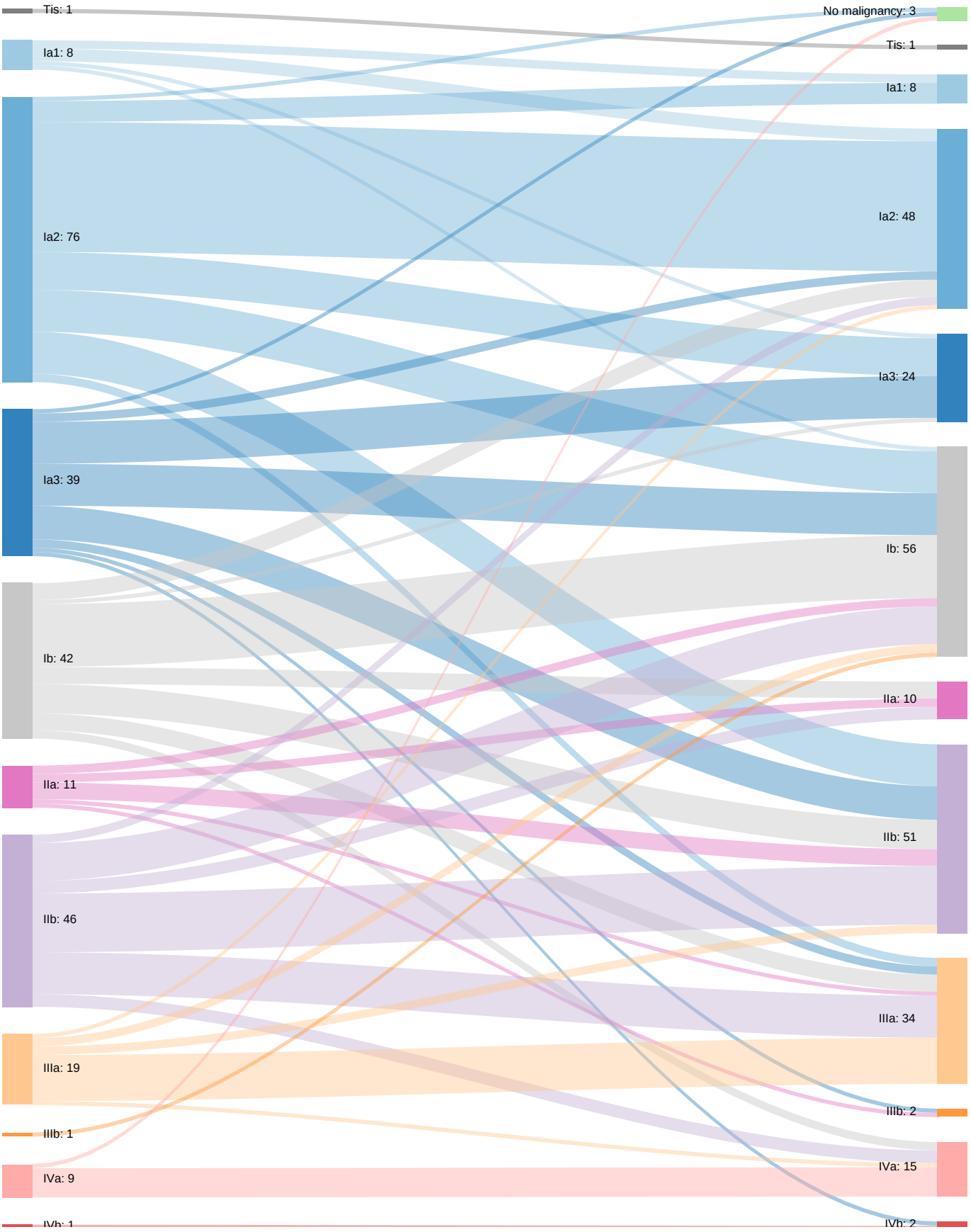
Excludes missing data (14.7%)

Table 30: Primary lung malignancy by postoperative pathological classification

Pathological classification	n (%)
Tis	1 (0.4)
Ia1	7 (3.1)
Ia2	43 (19.0)
Ia3	21 (9.3)
Ib	50 (22.1)
IIa	9 (4.0)
IIb	45 (19.9)
IIIa	30 (13.3)
IIIb	2 (0.9)
IVa	13 (5.8)
IVb	2 (0.9)
No malignancy	3 (1.3)
Total	**226 (100.0)**

Excludes missing data (14.7%)

Of the 226 primary lung cancer procedures with complete data, pathological upstaging occurred in 42% of cases while 16% were downstaged postoperatively and 42% had no change to the preoperative staging classification.



Excludes missing data (14.7%)

Figure 16: Primary lung cancer cases by clinical and pathological TNM classification

8.4 Unadjusted all-cause mortality

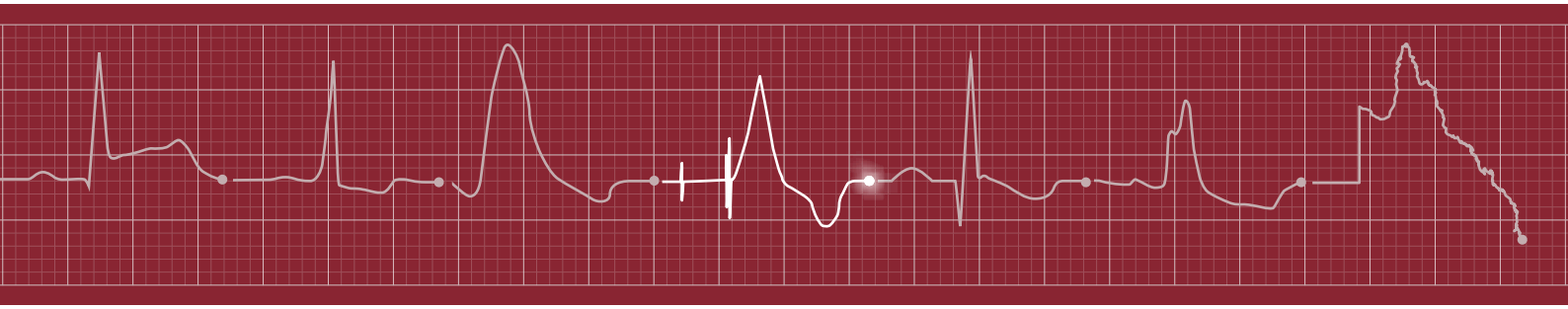
The unadjusted all-cause mortality rate within 30 days of all thoracic surgery was 0.7%, increasing to 1.9% at 90 days. Mortality rates at 90 days for malignancy related surgeries are higher than the overall group, though caution should be used when interpreting these results due to small patient volumes.

Survival following thoracic surgery is influenced by many factors which are not always directly related to the operation itself. Outcomes of thoracic surgery for cancer can be affected by how advanced the malignancy is. Within this cohort, approximately 7% of lung cancers are postoperatively classified as stage IV, which is associated with an inherently high short-term mortality rate.

Table 31: All-cause unadjusted mortality up to 90 days post surgery

Indication	Total cases n	Death in 30 days n (%)	Death in 90 days n (%)
Primary lung cancer	265	1 (0.4)	2 (0.8)
Other cancer	254	4 (1.6)	10 (3.9)
Pleural disease	320	1 (0.3)	0 (0.0)
Other	254	2 (0.8)	9 (3.5)
ALL	**1,093**	**8 (0.7)**	**21 (1.9)**

Electrophysiology and Pacing Audit



1 Message from the QCOR Electrophysiology and Pacing Committee

This 2020 Annual Report offers detailed insight into key aspects of electrophysiology and pacing (EP) procedures across the state of Queensland. This year's report includes a record 9 public sites contributing, with detailed information on patient demographics, procedures undertaken and their outcomes. With each year of additional data, the registry builds an increasingly detailed picture to guide improvements in EP service delivery around the state.

The COVID-19 global pandemic necessitated a halt to elective procedures for an extended duration – with a large effect observed in the EP and ablation domain. Reassuringly, overall procedural volumes remained steady over the year, an outcome which is likely owing to the resilience and tireless work of Queensland EP clinicians. In this way, COVID-19 has highlighted the flexibility and adaptability of EP services, allowing these characteristics to come to the forefront.

With access to longer term data, observations of trends in procedural complexity and case mix can be made. An incremental increase year-on-year in the proportion and volume of complex EP and ablation procedures highlights the existing demand on current systems. It is expected that this demand will only increase over time, given the ageing population.

Volumes of complex EP procedures, such as pulmonary vein isolation for atrial fibrillation, increased in 2020 despite the impacts of lockdowns and procedure cancellations as a result of COVID-19. This has however still come at a cost, with wait times for complex ablation increasing over previous years. This further underscores the demand and unmet need for these technically-challenging procedures.

QCOR data has once again informed a competitive market share arrangement for implantable cardiac devices, ensuring investment in the best possible care for Queensland EP patients. The ongoing work of QCOR continues to inform current and future initiatives of this kind. Through the QCOR registry, significant savings for the health system have already been realised, allowing these funds to be reinvested into further improvements to provision of patient care.

With a growing pool of data and analyses available to inform its stakeholders, it is hoped that the future of electrophysiology and pacing services can continue to expand and evolve to serve the needs of all Queenslanders.

On behalf of the
QCOR Electrophysiology and Pacing Committee

2 Key findings

This Electrophysiology and Pacing Audit describes baseline demographics, risk factors, procedures performed and outcomes for 2020.

Key findings include:

- Across Queensland, nine public sites contributed to the registry with all sites contributing a complete year of data.
- Of the 5,201 electrophysiology and pacing cases, 3,551 were device procedures and 1,286 were electrophysiology procedures.
- An increase of 416 device procedures was observed in 2020 over 2018 volumes and an additional 231 electrophysiology procedures were performed.
- Complex electrophysiology has increased as a proportion of all electrophysiology cases from 52% in 2018 to 72% in 2020.
- Pulmonary vein isolation for atrial fibrillation cases have increased from 295 in 2018 to 349 in 2020.
- Three quarters of patients were aged 60 years or over (75%) with a median age of 69 years.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 4.4%.
- The vast majority of patients (71%) were classed as having an unhealthy body mass index (BMI) of greater than 30 kg/m2.
- Complex electrophysiology procedures which utilise three-dimensional mapping technology, involve pulmonary vein isolation or ventricular arrhythmias accounted for 72% of this case cohort.
- Atrial flutter, pulmonary vein isolation for atrial fibrillation, and atrioventricular node re-entry tachycardia ablations accounted for 71% of all ablation cases.
- The reported complication rate for all device procedures was 1.0%, while electrophysiology procedures had a 1.7% complication rate.
- There was a 0.2% procedural tamponade rate reported for all cases.
- The statewide median wait time for complex ablation was 104 days with 73% of cases meeting the 180 day benchmark.
- The 12 month device system loss rate due to infection was 0.5%.

3 Participating sites

There were nine public electrophysiology and pacing units spread across metropolitan and regional Queensland. All of these entered data directly into the Queensland Cardiac Outcomes Registry (QCOR) electrophysiology and pacing application.

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

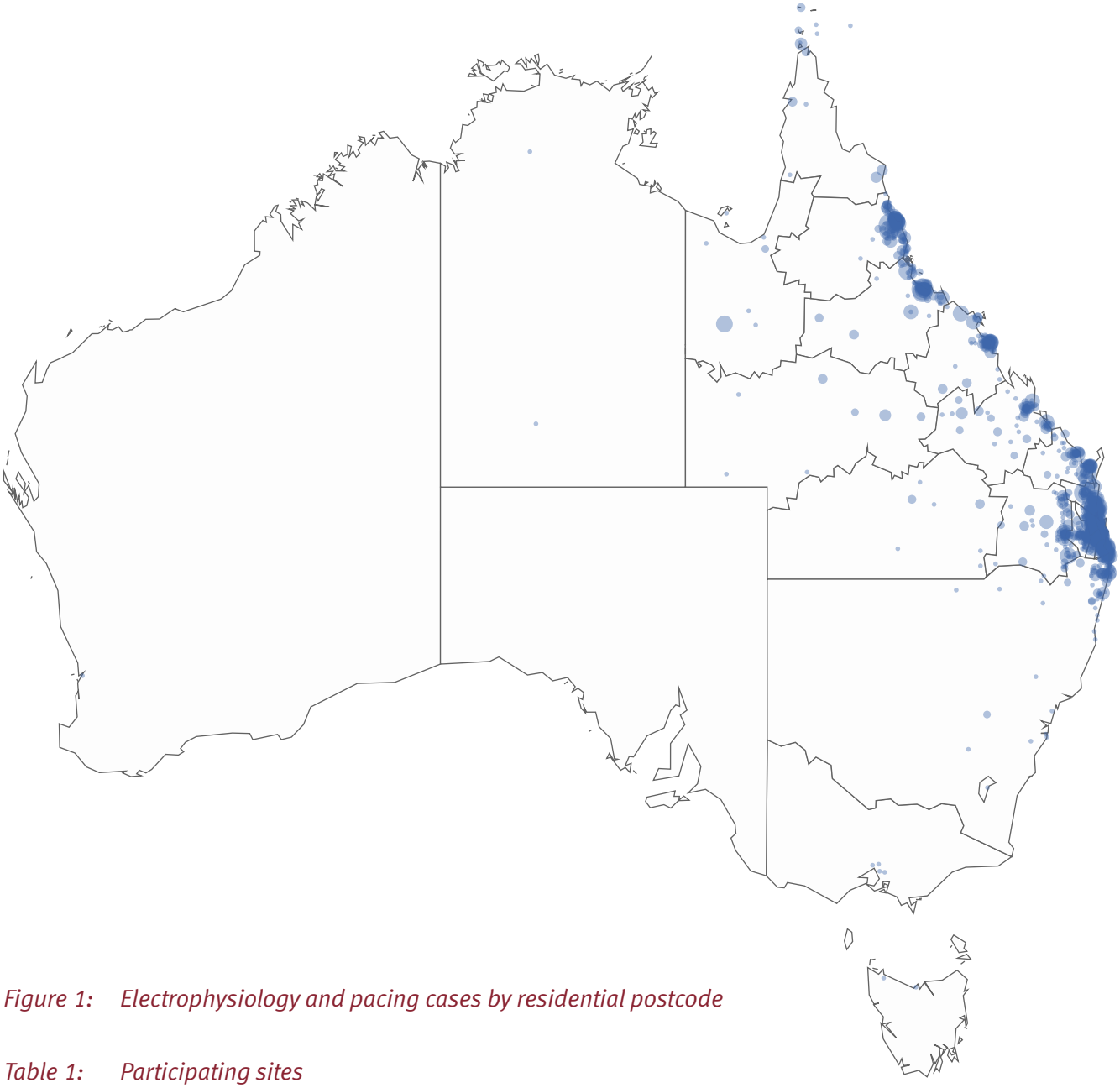


Figure 1: Electrophysiology and pacing cases by residential postcode

Table 1: Participating sites

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

4 Case totals

4.1 Case volume

There were 5,201 electrophysiology and pacing procedures documented using the QCOR electrophysiology and pacing application.

Table 2: Total cases by category

Procedure combination	Category	Total cases n (%)
Cardiac device procedure	Device	3,499 (67.3)
Cardiac device procedure + EP study		23 (0.4)
Cardiac device procedure + other procedure		14 (0.3)
Cardiac device procedure + EP study + ablation		5 (0.1)
Cardiac device procedure + EP study + drug challenge		4 (0.1)
Cardiac device procedure + cardioversion		2 (<0.1)
Cardiac device procedure + pericardiocentesis		2 (<0.1)
Cardiac device procedure + drug challenge		1 (<0.1)
Cardiac device procedure + EP study + cardioversion		1 (<0.1)
EP study + ablation	EP	861 (16.6)
EP study		192 (3.7)
Ablation		160 (3.1)
EP study + ablation + cardioversion		47 (0.9)
EP study + cardioversion		10 (0.2)
EP study + drug challenge		9 (0.2)
EP study + ablation + other procedure		2 (<0.1)
EP study + ablation + other procedure + pericardiocentesis		2 (<0.1)
Ablation + cardioversion		2 (<0.1)
EP study + ablation + pericardiocentesis		1 (<0.1)
Cardioversion	Other	297 (5.7)
Drug challenge		35 (0.7)
Other procedure		22 (0.4)
Pericardiocentesis		7 (0.1)
Cardioversion + other procedure		3 (0.1)
ALL		**5,201 (100.0)**

4.2 Cases by category

The majority of cases performed were cardiac device procedures accounting for over two thirds (68%) of documented procedures. The remainder of cases were electrophysiology and ablation procedures (25%), with the remainder categorised as 'other' procedures (7%).

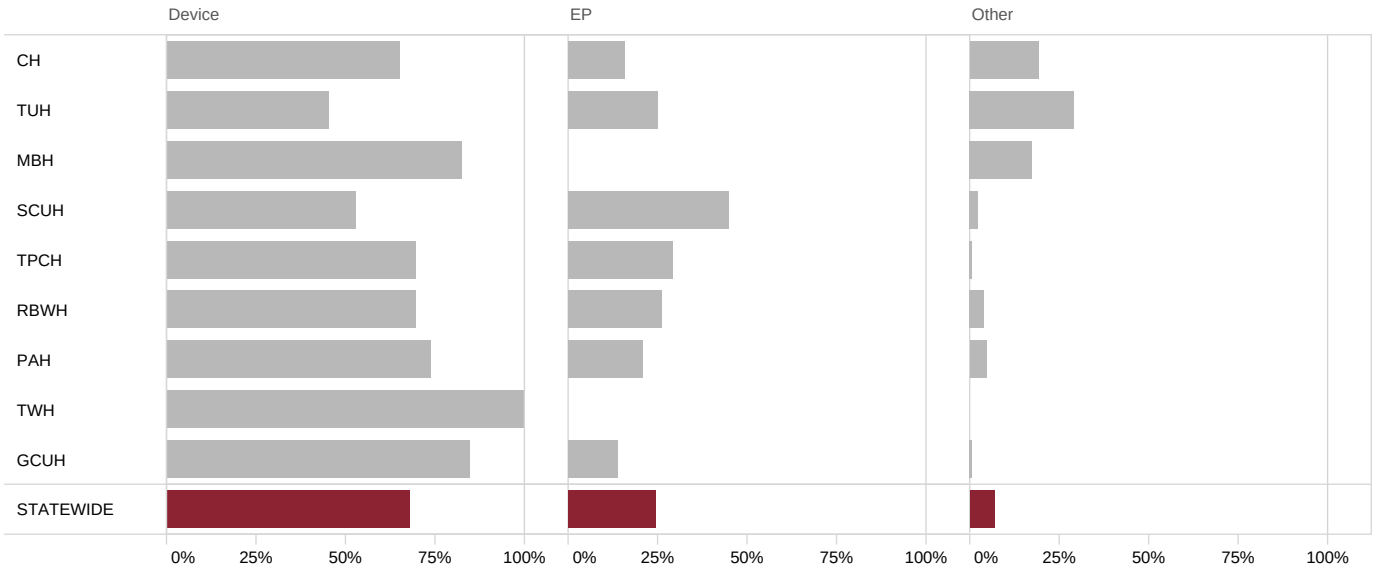


Figure 2: Proportion of cases by site and category

Table 3: Cases by case category

Site	Device n (%)	EP n (%)	Other n (%)	Total n (%)
CH	342 (9.6)	84 (6.5)	100 (27.5)	526 (10.1)
TUH	234 (6.6)	130 (10.1)	151 (41.5)	515 (9.9)
MBH	99 (2.8)	–	21 (5.8)	120 (2.3)
SCUH	340 (9.6)	290 (22.6)	14 (3.8)	644 (12.4)
TPCH	835 (23.5)	349 (27.1)	8 (2.2)	1,192 (22.9)
RBWH	394 (11.1)	148 (11.5)	22 (6.0)	564 (10.8)
PAH	688 (19.4)	196 (15.2)	45 (12.4)	929 (17.9)
TWH	86 (2.4)	–	–	86 (1.7)
GCUH	533 (15.0)	89 (6.9)	3 (0.8)	625 (12.0)
STATEWIDE	**3,551 (68.3)**	**1,286 (24.7)**	**364 (7.0)**	**5,201 (100.0)**

4.3 Yearly case distribution

Yearly growth has been noted over the years since QCOR reporting has begun and this can now be better understood with a larger dataset. It is evident that since 2018 that the volume of cardiac device procedures and electrophysiology procedures has increased. These reasons for these increases are likely multifactorial and include expansion of services at some sites and new services offered at others.

The complexity of electrophysiology procedures has a large bearing on the time taken and resources used to perform these procedures. A notable increase in the volume and proportion of complex electrophysiology procedures can be seen over time. Again, there are multiple underlying contributing factors to this increase and that this increase in ability to treat complex cases underlines the quality services in place.

An increase in the proportion and volume of pulmonary vein isolation/atrial fibrillation ablation has been observed over the past three years. It is recognised that there is a significant demand for these services as the prevalence of atrial fibrillation increases.

Wait times for procedure categories and urgency status has varied over the past three years. Of particular note is a decrease in wait time for elective permanent pacemaker and an increase for complex ablation procedures.

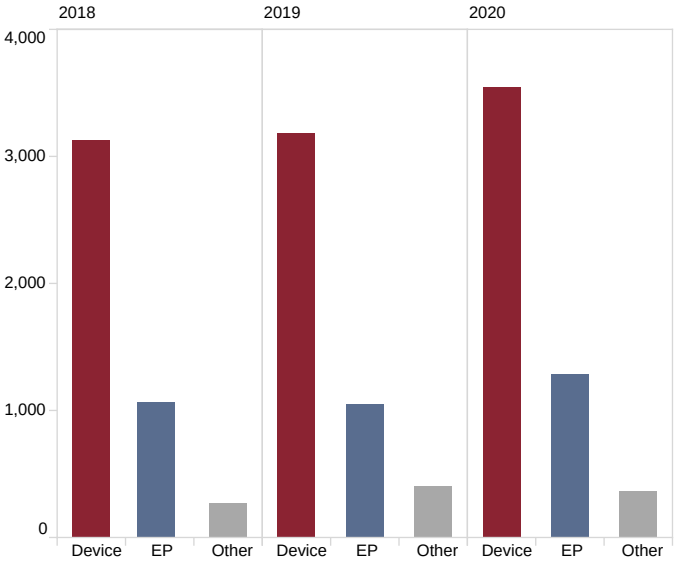


Figure 3: Yearly case volume by case category, 2018–2020

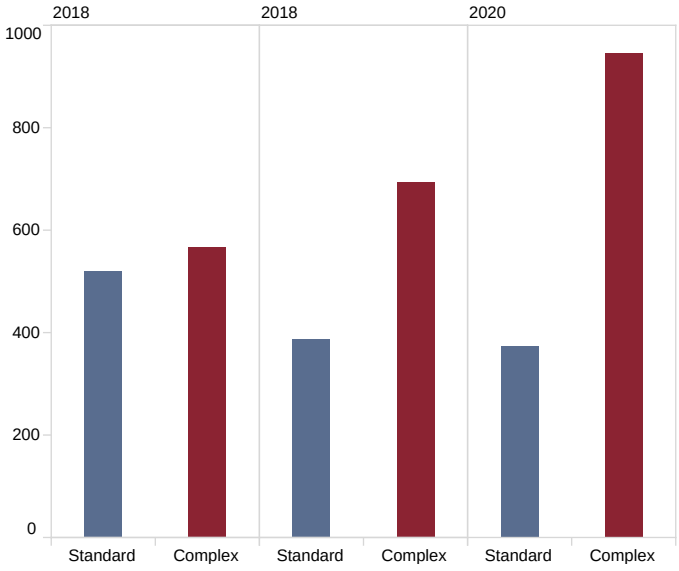


Figure 4: Yearly case volume by electrophysiology procedural complexity, 2018–2020

Table 4: Yearly case volume by case category, 2018–2020

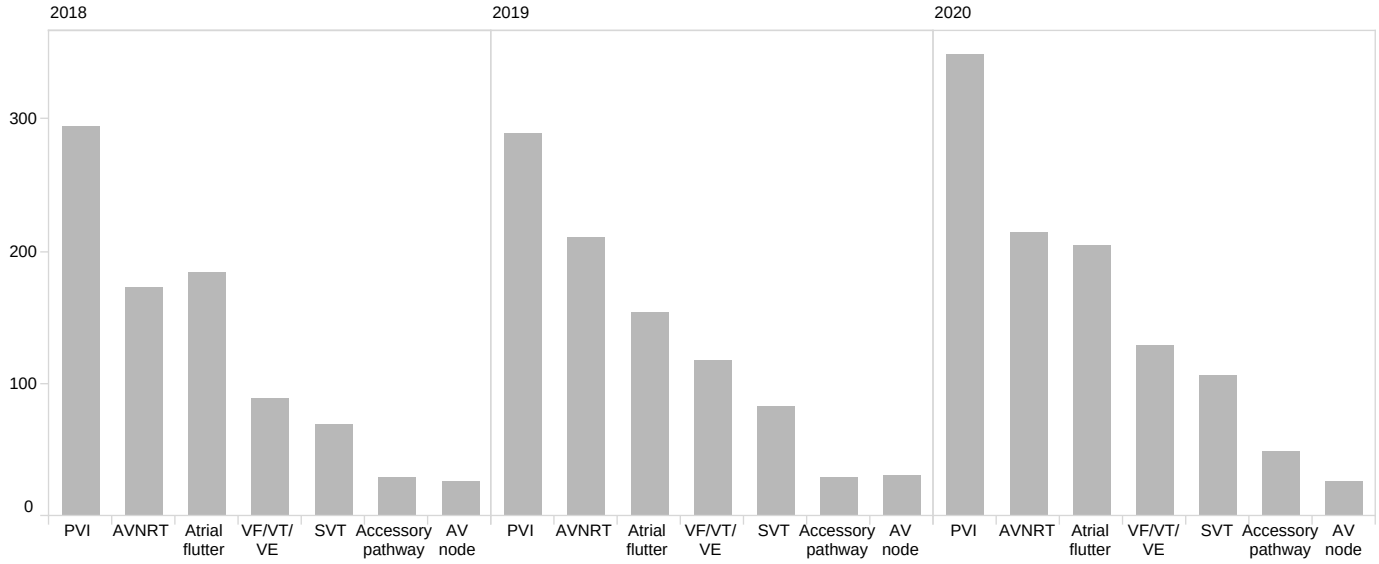
Case category	2018* n	2019 n	2020 n
Device	3,136	3,189	3,551
All EP	1,088	1,082	1,319
Other	277	407	364

* Case totals do not reflect all 2018 activity for GCUH

Table 5: Yearly case volume by electrophysiology procedural complexity, 2018–2020

Electrophysiology procedure complexity	2018* n (%)	2019 n (%)	2020 n (%)
Standard	520 (47.8)	389 (36.0)	374 (28.3)
Complex	568 (52.2)	693 (64.0)	946 (71.7)

* Case totals do not reflect all 2018 activity for GCUH



Case totals do not reflect all 2018 activity for GCUH

Figure 5: Number of yearly ablation cases by arrhythmia type, 2018–2020

Table 6: Yearly ablation cases by arrhythmia type, 2018–2020

Ablation type	2018* n	2019 n	2020 n
Pulmonary vein isolation	295	290	349
AVNRT	173	210	214
Atrial flutter	184	154	205
Ventricular arrhythmia / ectopy	88	118	129
Supraventricular tachycardia	69	83	107
Accessory pathway	29	29	49
AV node	26	30	27

* Case totals do not reflect all 2018 activity for GCUH

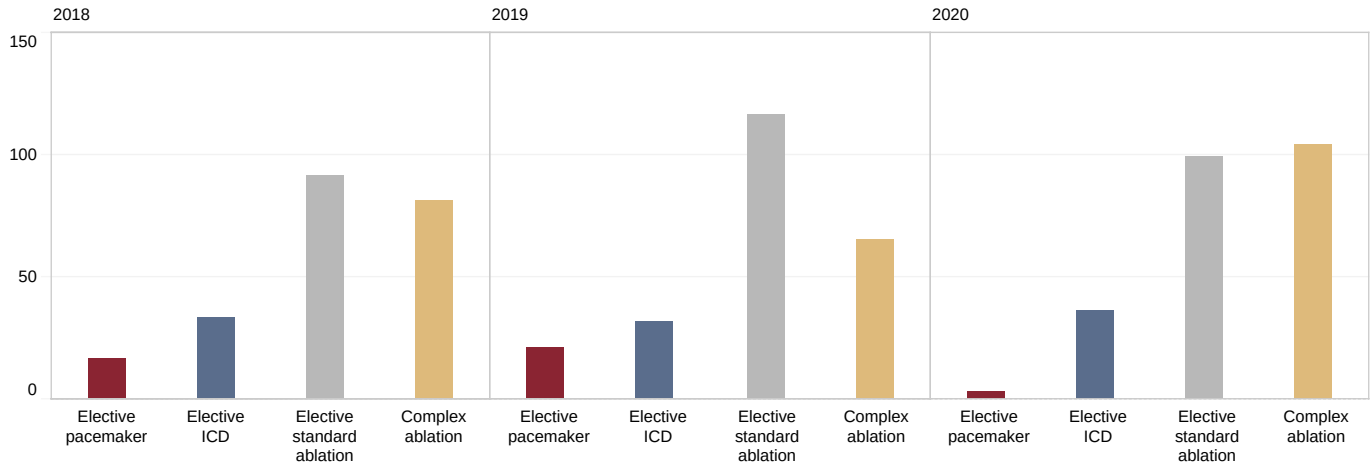


Figure 6: Median wait time analysis by procedure category, 2018–2020

Table 7: Median wait time analysis by procedure category, 2018–2020

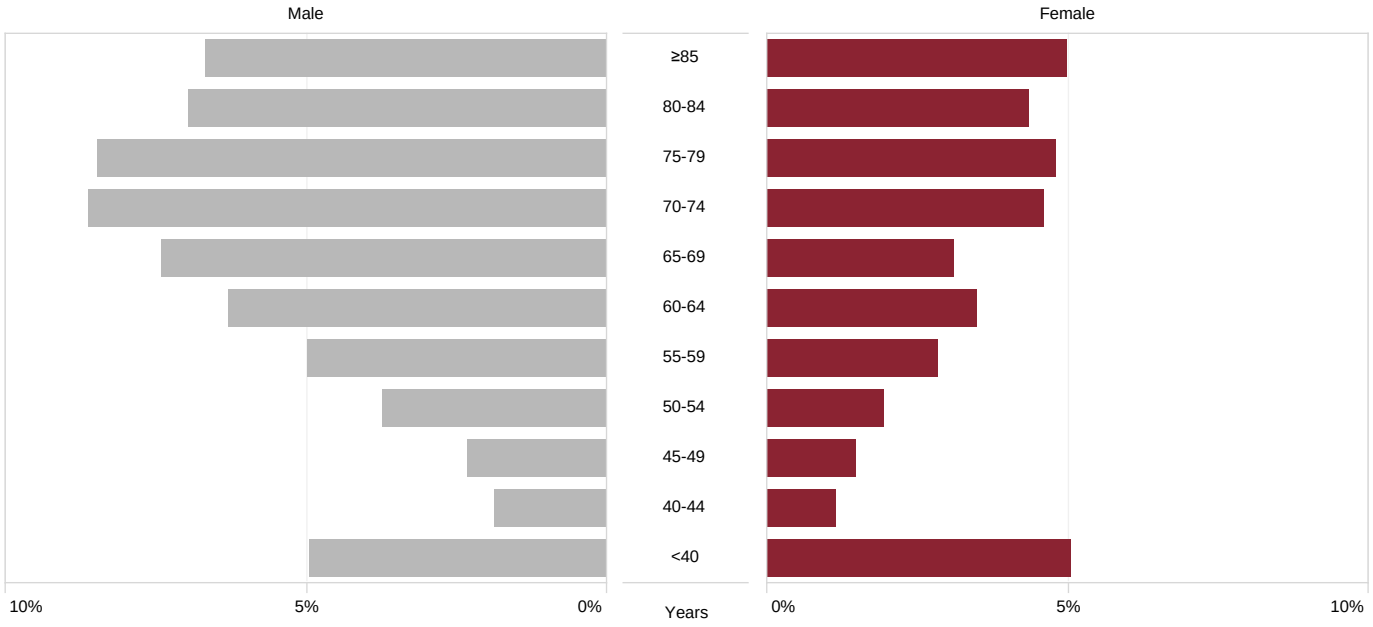
Procedure category	2018 days	2019 days	2020 days
Elective PPM	17	21	3
Elective ICD	33	32	36
Elective standard ablation	91	117	99
Complex ablation	81	65	104

5 Patient characteristics

5.1 Age and gender

Age is an important risk factor for developing cardiovascular disease with the majority of patients in this cohort aged 60 years and above (75%). The median age of the overall electrophysiology and pacing patient cohort was 69 years of age. Males between the age of 70 and 74 comprised the largest proportion by age and gender.

The median age of males and females was 69 years. Patient age differed considerably by procedure category with the median age of patients undergoing electrophysiology procedures being 58 years compared to 74 years for cardiac device procedures.



% of total (n=5,201)

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

Table 8: Median age by gender and case category

	Total cases n	Male years	Female years	All years
Device	3,551	73	74	74
EP	1,286	59	55	58
Other	364	62	64	62
Total	**5,201**	**69**	**69**	**69**

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

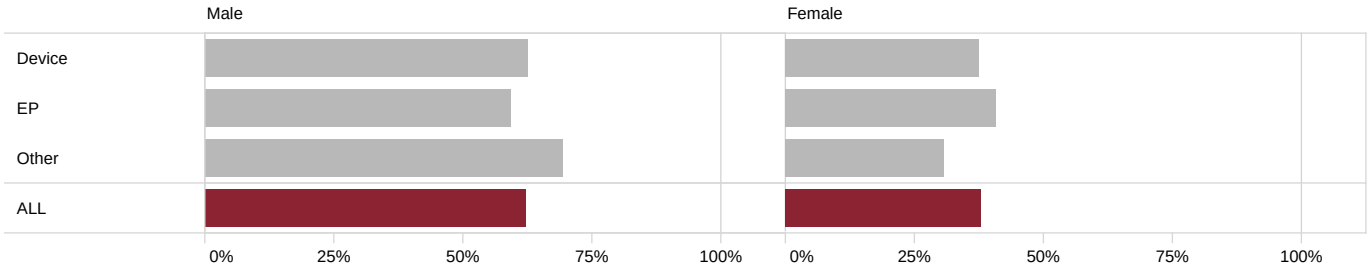


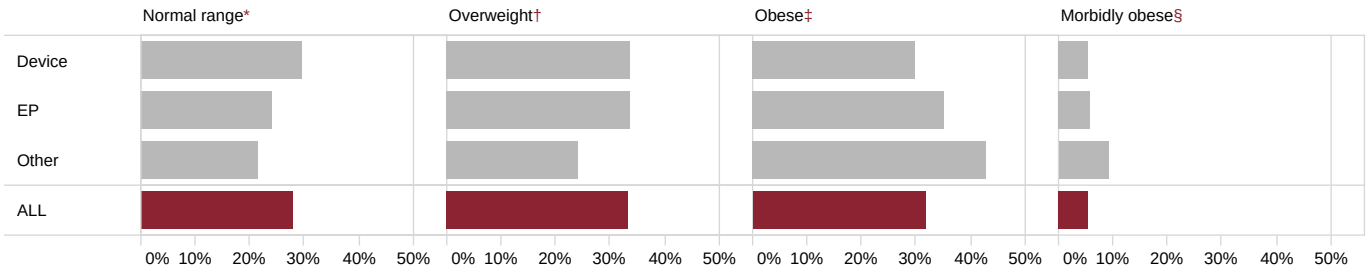
Figure 8: Proportion of cases by gender and category

Table 9: Proportion of cases by gender and category

	Total cases n	Male n (%)	Female n (%)
Device	3,551	2,226 (62.7)	1,325 (37.3)
EP	1,286	760 (59.1)	526 (40.9)
Other	364	252 (69.2)	112 (30.8)
ALL	**5,201**	**3,238 (62.3)**	**1,963 (37.7)**

5.2 Body mass index

Patients classed as having a body mass index (BMI) category of overweight (33%), obese (32%) or morbidly obese (6%) represented almost three quarters of all electrophysiology and pacing patients. Patients classed as underweight represented less than 2% of all cases.



* BMI 18.5–24.9 kg/m^2

† BMI 25.0–29.9 kg/m^2

‡ BMI 30.0–39.9 kg/m^2

§ BMI ≥40.0 kg/m^2

Figure 9: Proportion of cases by BMI and case category

5.3 Aboriginal and Torres Strait Islander status

Overall, the proportion of identified Aboriginal and Torres Strait Islander patients undergoing electrophysiology and pacing procedures was 4.4%. This correlates closely to the estimated proportion of Aboriginal and Torres Strait Islander peoples within Queensland (4.6%).[2] There was large variation between units, with the North Queensland sites seeing a larger proportion of Aboriginal and Torres Strait Islander patients.

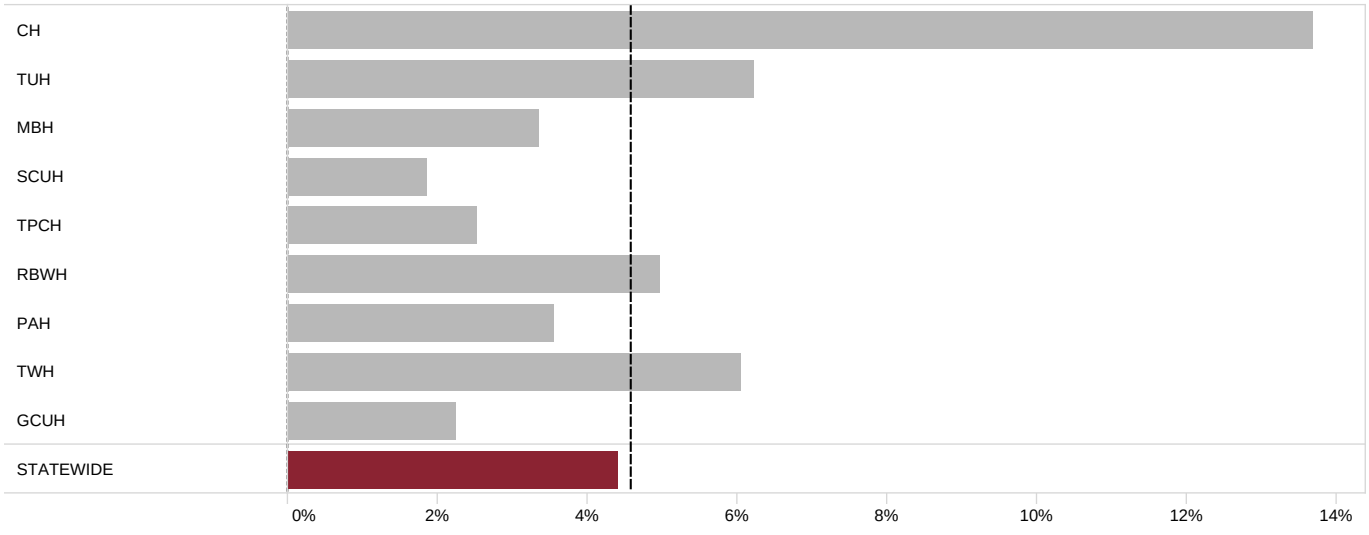


Figure 10: Proportion of cases by identified Aboriginal and Torres Strait Islander status and site

5.4 Device procedures

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

Table 10: Cardiac device case types by site

Procedure type	CH	TUH	MBH	SCUH	TPCH	RBWH	PAH	TWH	GCUH
	n	n	n	n	n	n	n	n	n
Pacemaker procedure*	168	131	39	214	386	134	437	67	297
ICD procedure*	40	33	–	43	138	74	94	7	99
Loop recorder implant/explant	90	19	54	24	91	131	56	–	56
BiV ICD procedure*	15	19	–	26	76	21	40	5	30
BiV pacemaker procedure*	6	15	–	18	36	13	9	3	11
Lead revision/replacement/pocket revision	9	2	2	10	21	14	27	2	24
Device explant	2	1	4	3	58	1	5	1	7
Leadless pacemaker implant	4	12	–	–	21	4	2	–	4
Temporary pacing system	8	1	–	2	5	2	15	1	4
Defibrillation threshold testing	–	1	–	–	1	–	3	–	1
Insertion of epicardial lead	–	–	–	–	1	–	–	–	–
Insertion of epicardial pacing system	–	–	–	–	1	–	–	–	–
ALL	**342**	**234**	**99**	**340**	**835**	**394**	**688**	**86**	**533**

* Implant/generator change/upgrade

5.5 Electrophysiology studies/ablations

Electrophysiology studies involving radiofrequency ablation were the most common individual procedure performed across all sites, ranging from 61% of case volume at SCUH to 82% at GCUH.

Table 11: Electrophysiology study/ablation types by site

Site	Procedure type	Complex EP n	Standard EP n	Case n (%)
CH	Radiofrequency ablation	10	38	48 (57.1)
	Cryotherapy ablation	19	–	19 (22.6)
	Electrophysiology study	3	13	16 (19.0)
	Radiofrequency and cryotherapy ablation	1	–	1 (1.2)
TUH	Radiofrequency ablation	82	23	105 (80.2)
	Electrophysiology study	8	8	16 (12.2)
	Cryotherapy ablation	8	–	8 (6.1)
	Electrophysiology study and drug challenge	1	–	1 (0.8)
	Radiofrequency and cryotherapy ablation	1	–	1 (0.8)
SCUH	Radiofrequency ablation	157	21	178 (60.8)
	Electrophysiology study	41	14	55 (18.8)
	Cryotherapy ablation	51	5	55 (18.8)
	Radiofrequency and cryotherapy ablation	3	1	4 (1.4)
	Electrophysiology study and drug challenge	–	1	1 (0.3)
TPCH	Radiofrequency ablation	173	79	252 (70.8)
	Electrophysiology study	31	24	55 (15.4)
	Cryotherapy ablation	41	–	41 (11.5)
	Electrophysiology study drug challenge	4	2	6 (1.7)
	Radiofrequency and cryotherapy ablation	2	–	2 (0.6)
RBWH	Radiofrequency ablation	112	2	114 (71.7)
	Electrophysiology study	20	11	30 (18.9)
	Cryotherapy ablation	12	–	12 (7.5)
	Radiofrequency and cryotherapy ablation	2	–	2 (1.3)
	Electrophysiology study and drug challenge	–	1	1 (0.6)
PAH	Radiofrequency ablation	109	51	160 (77.3)
	Electrophysiology study	18	24	42 (20.3)
	Cryotherapy ablation	–	3	3 (1.4)
	Electrophysiology study and drug challenge	–	2	2 (1.0)
GCUH	Radiofrequency ablation	34	39	73 (82.0)
	Electrophysiology study	2	12	14 (15.7)
	Cryotherapy ablation	1	1	2 (2.2)
STATEWIDE		**946**	**374**	**1,319 (100.0)**

5.5.1 Ablation type/arrhythmia

The most frequently ablated clinical arrhythmia was atrial fibrillation (pulmonary vein isolation), which accounted for 32% of ablations across all sites. This was followed by atrioventricular nodal re-entry tachycardias (AVNRT) (20%) and atrial flutter (19%).

Age and gender varied depending on the arrythmia ablated. Patients undergoing accessory pathway ablation had a lower median age than those who underwent pulmonary vein isolation or AV node ablation. Furthermore, two thirds of patients undergoing pulmonary vein isolation were male which contrasts with the AVNRT cohort which is predominately a female group.

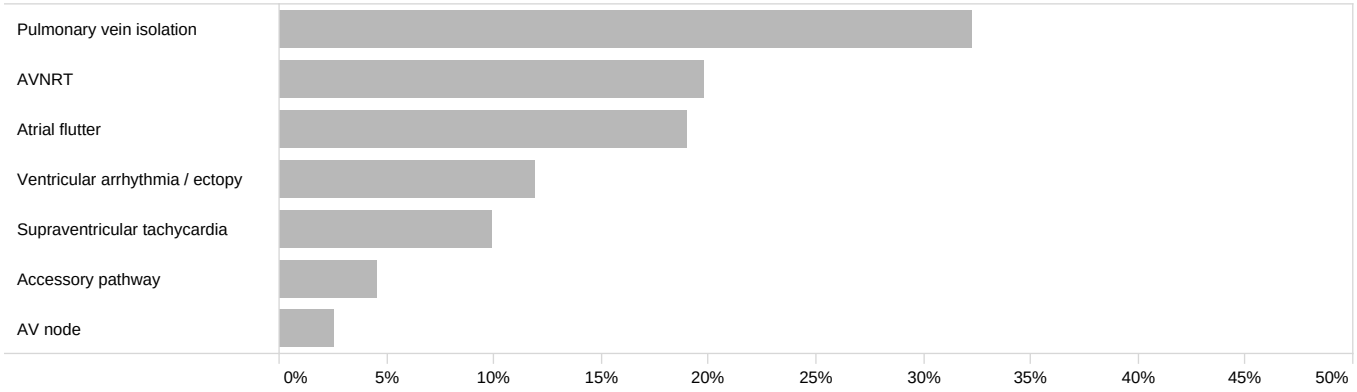


Figure 11: Proportion of arrhythmias ablated

Table 12: Median age and gender by ablation type

Ablation type	Gender	Total cases n (%)	Median age years
Pulmonary vein isolation	Male	240 (68.8)	59
	Female	109 (31.2)	66
AVNRT	Male	65 (30.4)	55
	Female	149 (69.6)	49
Atrial flutter	Male	155 (75.6)	66
	Female	50 (24.4)	71
Ventricular arrhythmia / ectopy	Male	86 (66.7)	65
	Female	43 (33.3)	47
Supraventricular tachycardia	Male	54 (50.5)	35
	Female	53 (49.5)	39
Accessory pathway	Male	34 (69.4)	30
	Female	15 (30.6)	23
AV node	Male	8 (29.6)	75
	Female	19 (70.4)	77
ALL		**1,080 (100.0)**	**59**

Table 13: Arrhythmia type by site

Site	Ablation type	Count n (%)
CH	Pulmonary vein isolation	24 (2.2)
	AVNRT	21 (1.9)
	Atrial flutter	7 (0.6)
	Supraventricular tachycardia	5 (0.5)
	Accessory pathway	4 (0.4)
	AV node	4 (0.4)
	Ventricular arrhythmia / ectopy	3 (0.3)
TUH	Pulmonary vein isolation	31 (2.9)
	Ventricular arrhythmia / ectopy	27 (2.5)
	AVNRT	26 (2.4)
	Atrial flutter	11 (1.0)
	Supraventricular tachycardia	8 (0.7)
	Accessory pathway	8 (0.7)
	AV node	3 (0.3)
SCUH	Pulmonary vein isolation	101 (9.4)
	Atrial flutter	65 (6.0)
	AVNRT	44 (4.1)
	Ventricular arrhythmia / ectopy	12 (1.1)
	Supraventricular tachycardia	9 (0.8)
	AV node	5 (0.5)
	Accessory pathway	1 (0.1)
TPCH	Pulmonary vein isolation	89 (8.2)
	AVNRT	54 (5.0)
	Ventricular arrhythmia / ectopy	49 (4.5)
	Atrial flutter	46 (4.3)
	Supraventricular tachycardia	39 (3.6)
	Accessory pathway	15 (1.4)
	AV node	3 (0.3)
RBWH	Pulmonary vein isolation	34 (3.1)
	Atrial flutter	30 (2.8)
	AVNRT	27 (2.5)
	Supraventricular tachycardia	19 (1.8)
	Ventricular arrhythmia / ectopy	10 (0.9)
	Accessory pathway	7 (0.6)
	AV node	1 (0.1)
PAH	Pulmonary vein isolation	55 (5.1)
	AVNRT	32 (3.0)
	Atrial flutter	26 (2.4)
	Ventricular arrhythmia / ectopy	17 (1.6)
	Supraventricular tachycardia	17 (1.6)
	Accessory pathway	8 (0.7)
	AV node	8 (0.7)
GCUH	Atrial flutter	20 (1.9)
	Pulmonary vein isolation	15 (1.4)
	Ventricular arrhythmia / ectopy	11 (1.0)
	AVNRT	10 (0.9)
	Supraventricular tachycardia	10 (0.9)
	Accessory pathway	6 (0.6)
	AV node	3 (0.3)
STATEWIDE		**1,080 (100.0)**

5.6 Other procedures

The most common other procedure was cardioversion (82%). Variations in clinical practice across sites can be observed here with not all cardioversions performed being carried out in the electrophysiology laboratory environment or documented using the QCOR module.

Table 14: Other procedures

	Total n	Cardioversion n (%)	Drug challenge n (%)	Other procedure n (%)	Pericardiocentesis n (%)
CH	100	84 (84.0)	10 (10.0)	5 (5.0)	1 (1.0)
TUH	151	144 (95.4)	3 (2.0)	3 (2.0)	1 (0.7)
MBH	21	21 (100.0)	–	–	–
SCUH	14	–	11 (78.6)	–	3 (21.4)
TPCH	8	–	1 (12.5)	5 (62.5)	2 (25.0)
RBWH	22	9 (40.9)	8 (36.4)	5 (22.7)	–
PAH	45	42 (93.3)	–	3 (6.7)	–
GCUH	3	–	2 (66.7)	1 (33.3)	–
STATEWIDE	**364**	**300 (82.4)**	**35 (9.6)**	**22 (6.0)**	**7 (1.9)**

6 Intraprocedural complications

Complications are a well-known, but rare outcome following any medical procedure or intervention. Some intraprocedural complications are more severe than others with a wide range of management options. The summary of complications below denotes events observed during and post procedure. The QCOR electrophysiology application is predominantly utilised for procedural detail reporting and as such, documentation of peri and post-procedural complications is the responsibility of site practitioners.

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

The overall device procedure complication rate was 1.0%, while electrophysiology procedures had a 1.7% complication rate.

Table 15: Cardiac device procedure complications

Procedure type	Complication	Total n (%)
Pacemaker implant/generator change	Conduction block	3 (0.2)
	Other	3 (0.2)
	Vascular injury including bleeding	3 (0.2)
	Drug reaction	2 (0.1)
	Lead complication	2 (0.1)
	Pericardial effusion without tamponade	2 (0.1)
	Haemodynamic instability	1 (0.1)
	Pneumothorax	1 (0.1)
ICD implant/generator change/upgrade	Coronary sinus dissection	1 (0.2)
	Lead complication	1 (0.2)
	Vascular injury	1 (0.2)
BIV ICD implant/generator change/upgrade	Coronary sinus dissection	2 (0.9)
	Pericardial effusion with tamponade	1 (0.4)
	Pericardial effusion without tamponade	1 (0.4)
	Other	1 (0.4)
BIV pacemaker implant/generator change/upgrade	Atrial arrhythmia	1 (0.9)
	Coronary sinus dissection	1 (0.9)
Lead revision/replacement/pocket revision	Lead complication	2 (1.8)
	Cardiac arrest	1 (0.9)
	Death	1 (0.9)
	Pericardial effusion with tamponade	1 (0.9)
Loop recorder implant/explant	Haemodynamic instability	1 (0.2)
	Other	1 (0.2)
Temporary pacing system	Acute pulmonary oedema	1 (2.6)
ALL		**35 (1.0)**

Table 16: Electrophysiology procedure complications by study type and complexity

Procedure type	Complexity	Complication	Total n (%)
Electrophysiology study	Standard EP	Conduction block	1 (0.9)
		Neurologic disturbance	1 (0.9)
	Complex EP	Cardiac arrest	1 (0.8)
		Bleeding	1 (0.8)
Cryotherapy ablation	Complex EP	Phrenic nerve injury	3 (2.3)
Radiofrequency ablation	Standard EP	Conduction block	3 (1.2)
		Vasovagal reaction	2 (0.8)
	Complex EP	Death	2 (0.3)
		Pacing lead dislodgement	1 (0.1)
		Atrial arrhythmia requiring DCCV	1 (0.1)
		Cardiac arrest	1 (0.1)
		Pericardial effusion with tamponade	1 (0.1)
		Pericardial effusion without tamponade	1 (0.1)
		Vascular injury	1 (0.1)
		Other	1 (0.1)
Radiofrequency and cryotherapy ablation	Complex EP	Phrenic nerve injury	1 (11.1)
ALL			**22 (1.7)**

7 Clinical indicators

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

The quality and safety indicators which have been nominated by the QCOR Electrophysiology and Pacing Committee are outlined below.

Table 17: Electrophysiology and pacing clinical indicators

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

7.1 Waiting time from referral date to procedure by case category

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

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

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

7.1.1 Elective pacemaker

Examination of the waiting time for elective pacemaker procedures is below. Of the 269 cases with complete data, the median wait time was 3 days. There were one quarter of patients waiting more than one month.

Table 18: Elective pacemaker wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days
STATEWIDE	427	269	3	0–31

7.1.2 Elective ICD wait time and proportion within 28 days

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

Table 19: Elective ICD wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days	Met target %
STATEWIDE	257	153	36	18–68	36.8

7.1.3 Standard ablation

Waiting times for standard ablation procedures are presented below. Of the 130 cases eligible for analysis, the median wait time was 99 days.

Table 20: Elective standard ablation wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days
STATEWIDE	205	130	99	50–168

7.1.4 Complex ablation with proportion within 180 days or less

Complex ablations are defined as cases using three-dimensional mapping technology or involving ventricular arrhythmia or pulmonary vein isolation. This indicator examines the waiting time for these procedures and the proportion adhering to the benchmark of 180 days or less.

A median wait time of 104 days was observed, with a large interquartile range demonstrating there are a number of patients with considerably long waits.

Table 21: Elective complex ablation wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days	Met target %
STATEWIDE	674	356	104	45–191	72.5

7.2 Procedural tamponade rates

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

Table 22: Procedural tamponade analysis

Procedure category	Total cases analysed n	Procedural tamponade observed n	Procedural tamponade rate %
Device	3,551	2	<0.1
EP	1,286	8	0.6
ALL	**4,837**	**10**	**0.2**

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

This indicator identifies the number of cases where lead dislodgement was observed within one year of lead insertion. The cases included in this indicator were all new device implants or upgrades where a new lead/s had been implanted and a lead revision or replacement was subsequently required due to dislodgement. Index implant procedures were cases performed within Queensland Health implanting facilities in the 2019 calendar year.

The analysis showed 40 cases (2.0%) where reintervention was required within 12 months of the index procedure.

These results compare favourably with international cohorts, where observed dislodgement rates for pacemaker system implants vary from 1.0 to 2.7%.[29]

Table 23: Reintervention due to lead dislodgement analysis

	Cases analysed n	12 month lead dislodgement n	12 month lead dislodgement rate %
Eligible 2019 device cases	2,082	40	2.0

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

One of the most serious long-term complications related to mortality and morbidity for patients with cardiac implantable electronic devices is infection. Complete removal of all hardware is the recommended treatment for patients with established device infection because infection relapse rates due to retained hardware are high. For this indicator, implant cases where new devices or leads were implanted form the cohort.

A system loss rate of 0.5% was observed at 12 months post procedure. This is reassuring when compared to international literature which suggests infection rates necessitating explant of approximately 2.4%.[30]

Table 24: Rehospitalisation with device loss analysis

	Cases analysed n	12 month system loss due to infection n	12 month system loss rate %
Eligible 2019 device cases	2,595	15	0.5

7.5 12 month all-cause mortality for cardiac device procedures

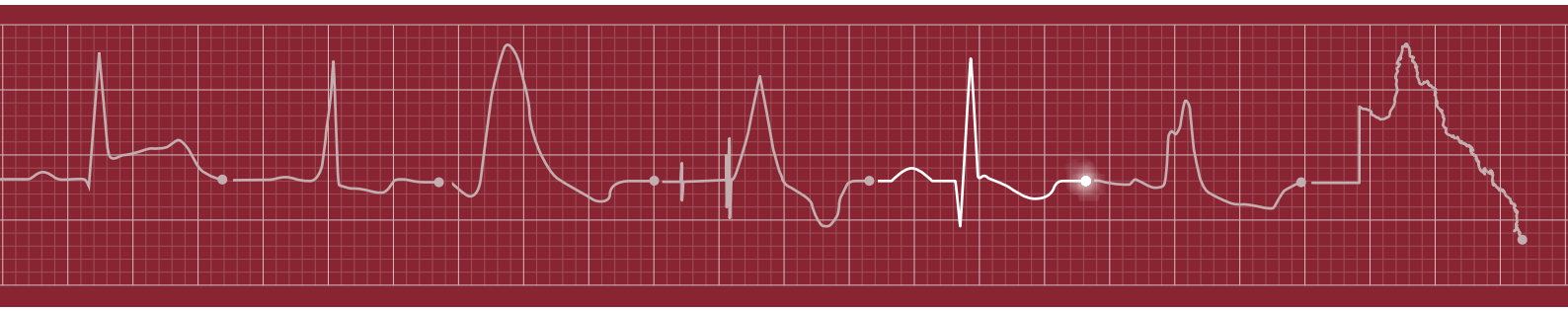
The all-cause unadjusted mortality rate following cardiac device procedure was 4.7%. To allow complete follow up over 12 months, these outcomes are reported for the previous 2019 patient cohort.

When interpreting this figure, it is important to note patients undergoing cardiac device procedures are often of advanced age (median age old 73 years). In addition, many patients have advanced symptomology such as advanced heart failure, or most likely suffering from multiple underlying risk factors or comorbidities.

Table 25: 12 month all-cause unadjusted mortality for cardiac device procedures

	Cases analysed n	12 month mortality observed n	12 month mortality rate %	Median age at procedure years	Interquartile range years
Any BiV procedure	294	14	4.8	69	59–75
ICD procedure	532	13	2.4	63	54–72
Pacemaker procedures	2,343	122	5.2	75	66–83
All 2019 device cases	**3,169**	**149**	**4.7**	**73**	**62–81**

Cardiac Rehabilitation Audit



1 Message from the QCOR Cardiac Rehabilitation Committee

This 2020 report for cardiac rehabilitation (CR) services in Queensland has seen a considerable shift in the offering and delivery of throughout Queensland due to unprecedented changes brought about by the COVID-19 global pandemic. The report shows that CR practitioners have worked with agility, fortitude and resilience to maintain consistently world-class levels of care. This report for CR services in 2020 exemplifies this, demonstrating how patient care was maintained and quality preserved in the face of such challenges.

COVID-19 temporarily closed some outpatient programs due to the redeployment of staff to other areas of healthcare, or the reclaiming of gym spaces to deliver pop up COVID-19 screening clinics and vaccination hubs. Public health directives also placed restrictions on outpatient programs by limiting the number of people per square metre and mandating the use of face masks. All outpatient programs responded well to these challenges, and many adapted their services to continue to deliver a form of CR to this vulnerable group of patients.

There were considerable changes to the mode of service delivery for many sites, such as a transition to increased use of telephone-based service delivery, or services trailing the use of video platforms for individual and group-based exercise. Where possible, all sites tended to retain face to face assessment before entry into these models of care. Much preparation has occurred in recent times to build clinician capability in delivering a video-based CR program, in the event clinicians are required to continue this delivery model. An incidental positive outcome of exploring these alternate models of care is that capacity has improved to deliver services to clients previously unable to attend due to geography.

This report further expands the analysis into patients who decline the opportunity to attend outpatient CR at both the time of referral and time of assessment or may be declined by their local CR program based on their own local service criteria. This report expands on the previous analysis around these patients to examine barriers to participation between males and females, by place of residence, diagnostic category and according to the patient's most recent procedure. As the CR registry continues to grow and encompass further data, we look forward to expanding insights into this cohort to better understand, predict and tailor CR programs to better serve all Queensland patients.

Further developments of the QCOR CR system will allow mapping and correlation of the various models of care that exist throughout the state, allowing further investigation of how these variations may impact on clinical outcomes. This is in addition to the outstanding service and quality offerings delivered via QCOR and the SCCIU initiatives. None of this would be possible without the tireless work of CR staff and clinicians and we sincerely thank you for the contribution to ensuring quality care.

On behalf of the
QCOR Cardiac Rehabilitation Committee

2 Key findings

This fourth Cardiac Rehabilitation (CR) Audit examines the characteristics and outcomes for patients referred to and assessed by public CR services in Queensland. It also outlines clinical indicator performance for participating services.

- There were 59 public cardiac rehabilitation (CR) sites that contributed data to QCOR.
- A total of 11,177 referrals were made to public CR programs across Queensland. A further 1,070 referrals were declined, unsuitable or referred outside of Queensland Health at the point of first contact.
- Approximately 75% of all referrals originated from an inpatient setting, while 12% of referrals originated from outside of Queensland Health.
- There were 7,175 of referrals (64%) which proceeded to a pre assessment by CR. The most common reasons that the pre assessment did not take place was that the patient declined, was medically unsuitable or inappropriate, had been uncontactable or failed to attend the appointment.
- Male patients accounted for 70% of all CR pre assessments.
- The median age of patients was 66 years, with three quarters of patients aged 57 years and above. There was considerable variation in median age between Aboriginal and Torres Strait Islander patients (56 years) and patients of other descent (66 years).
- The total proportion of Aboriginal and Torres Strait Islander patients was 7%. Large geographical variance was noted, with sites in North Queensland having a significantly higher proportion of Aboriginal and Torres Strait Islander patients.
- Overall, 66% of referrals had a pre assessment diagnosis of ischaemic heart disease.
- At pre assessment, 80% of patients were classed as having an unhealthy body mass index (BMI) including 36% classed as overweight, 37% obese and 7% morbidly obese.
- The most common procedure undergone by patients who attended a CR pre assessment was a percutaneous coronary intervention, which had been performed for 41% of patients. There were 18% of patients who had undergone coronary artery bypass grafting.
- Only 39% of patients were recorded as being sufficiently active at pre assessment.
- Completion of a timely referral for Queensland Health inpatients (within 3 days of discharge from hospital) was achieved in 93% of cases.
- A timely overall journey occurred in 58% of cases (Queensland Health inpatients referred within 3 days of discharge and assessed by CR program within 28 days of discharge).
- 41% of patients who completed a pre assessment continued CR to the completion of a post assessment.
- The majority of patients completing a post assessment reported an improved health status following completion of CR, regardless of which measure was used.

3 Participating sites

Table 1: Participating CR sites

Legend: ⊘ Engaged and contributing ◑ Partially contributing (‹50% of referrals) ○ Not contributing

HHS/Organisation	CR program	Locations	2017	2018	2019	2020
Cairns and Hinterland	Cairns Outpatient CR Program	Cairns	⊘	⊘	⊘	⊘
	Cassowary Area CR	Innisfail, Tully	⊘	⊘	⊘	⊘
	Tablelands CR	Atherton, Mareeba	⊘	⊘	⊘	⊘
	Mossman CR and Prevention Program	Mossman	⊘	⊘	⊘	⊘
Central Queensland	Community Health CR	Gladstone	⊘	⊘	⊘	⊘
	Biloela CR Program	Biloela	⊘	⊘	⊘	⊘
	CR Outpatient Program	Rockhampton, Capricorn Coast	⊘	⊘	⊘	⊘
	Mount Morgan CR	Mount Morgan†	–	–	⊘	⊘
Central West	Longreach and Central West CR Program	Longreach	⊘	⊘	⊘	⊘
		Blackall*	–	⊘	⊘	⊘
		Winton†	–	–	⊘	⊘
		Barcaldine‡	–	–	–	⊘
Darling Downs	Toowoomba Hospital Heart Care	Toowoomba	⊘	⊘	⊘	⊘
	Warwick CR Service	Warwick	⊘	⊘	⊘	⊘
	Chinchilla-Miles CR Service	Chinchilla, Miles	⊘	⊘	⊘	⊘
	Dalby-Tara CR Service	Dalby, Tara	⊘	⊘	⊘	⊘
	Kingaroy Hospital South Burnett CR	Kingaroy	⊘	⊘	⊘	⊘
	Goondiwindi CR	Goondiwindi	○	○	⊘	⊘
	Texas OPCR Program	Texas†	–	–	⊘	○
	Stanthorpe Health CR Program	Stanthorpe	○	○	○	○
Gold Coast	Gold Coast Heart Health Service	Robina	⊘	⊘	⊘	⊘
HCC§	SMoCC‖	Health Contact Centre	⊘	⊘	⊘	⊘
Mackay	Mackay Heart Health Service	Mackay	⊘	⊘	⊘	⊘
	Mackay Rural District CR	Proserpine, Bowen	⊘	◑	○	○
Metro North	Complex Chronic Disease	Caboolture, Chermside, North Lakes, Redcliffe	⊘	⊘	⊘	⊘
	TPCH Cardiac Rehabilitation Service‡	The Prince Charles Hospital#	–	–	–	⊘
Metro South	PAH Heart Recovery Program	Princess Alexandra Hospital	⊘	⊘	⊘	⊘
	Bayside CR Program	Redland	⊘	⊘	⊘	⊘
	Brisbane South CR Service	Eight Mile Plains, Inala	⊘	⊘	⊘	⊘
	Logan-Beaudesert CR Service	Browns Plains	⊘	⊘	⊘	⊘
North West	North West CR Program	Mount Isa	⊘	⊘	⊘	⊘
South West	South West HHS CR Services	Charleville, Roma	⊘	⊘	⊘	⊘
		St George*	–	⊘	⊘	⊘
Sunshine Coast	Sunshine Coast HHS Cardiac Rehab	Caloundra, Gympie, Maroochydore, Nambour, Noosa	⊘	⊘	⊘	⊘
Townsville	Townsville CR Outpatient Program	Townsville	⊘	⊘	⊘	⊘
	Ingham CR Outpatient Program	Ingham	⊘	◑	◑	○
	Charters Towers CR	Charters Towers	○	◑	◑	◑
	Ayr Health Service	Ayr	○	○	○	◑
West Moreton	Ipswich and West Moreton CR	Ipswich, Boonah, Esk, Gatton, Laidley	⊘	⊘	⊘	⊘
Wide Bay	Fraser Coast CR	Hervey Bay, Maryborough	⊘	⊘	⊘	⊘
	Wide Bay Rural and Allied Health*	Biggenden, Eidsvold, Gayndah, Mundubbera	–	⊘	⊘	⊘

* New service commencing in 2018
† New service commencing in 2019
‡ New service commencing in 2020
§ Health Contact Centre
‖ Self Management of Chronic Conditions (delivering the COACH program)
Temporary service as part Metro North HHS COVID-19 response

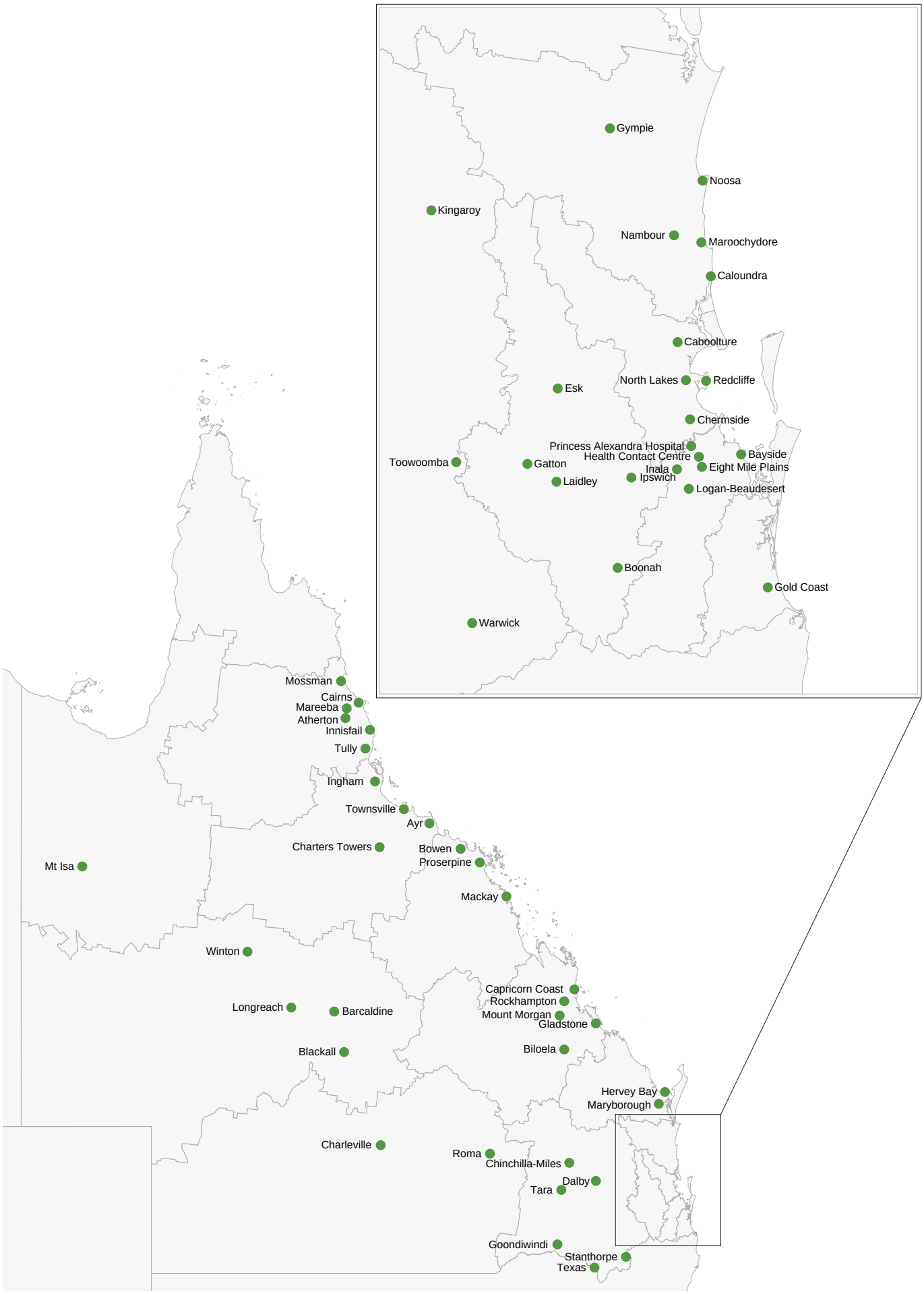


Figure 1: Map of Queensland public CR sites

4 Total referrals

4.1 Statewide

The volume of cardiac rehabilitation (CR) referrals entered into the QCOR clinical application expanded through 2020 to include an additional 11,177 new referrals for the calendar year. This brings the overall total to over 40,000 referrals since data collection commenced in July 2017.

Clinicians at 59 Queensland CR sites have incorporated data entry into their daily practices. A smaller number of sites deliver public outpatient CR but contribute to the database inconsistently or not at all. This can be a result of various factors such as resource availability. These sites remain a focus for engagement and involvement.

There is now an increased level of detail that can be recorded in the QCOR module in cases where the patient declined or was unsuitable to participate in CR. This has increased the availability of data, allowing these cases to be examined in more detail.

The majority of referrals (75%) originated from a public inpatient setting with smaller numbers originating from external and outpatient settings.

A major impact for the 2020 year has been the global COVID-19 pandemic, the effects of which are examined earlier in this publication.

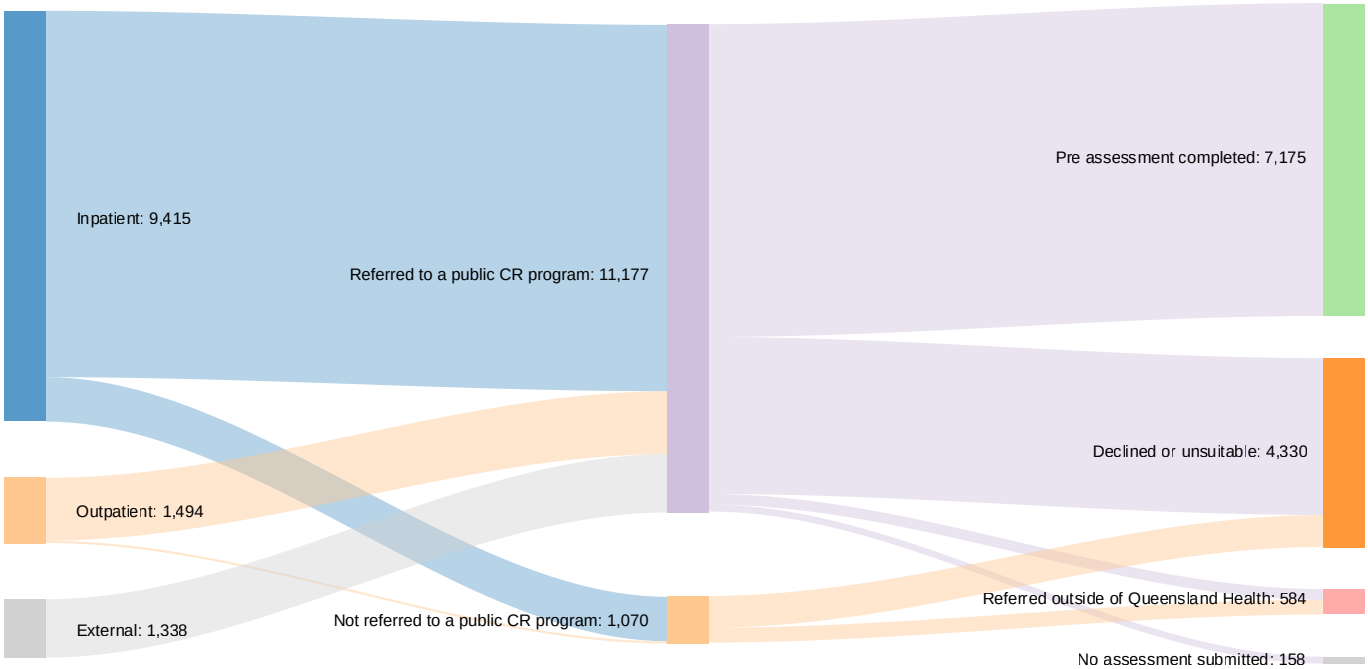


Figure 2: Statewide cardiac rehabilitation referrals flow

Patients were located across a wide geographical area with the majority residing in population centres along the Eastern Seaboard (Figure 3).

More than half of all patients were residing in major cities, and the remainder in regional and remote areas of Queensland. This is consistent with the decentralised distribution of the population within the state.

It is important to note that referrals for patients residing interstate or overseas are not generally accepted by Queensland public CR programs. The inclusion of these data is reflective of local site processes and may also vary based on available resources.

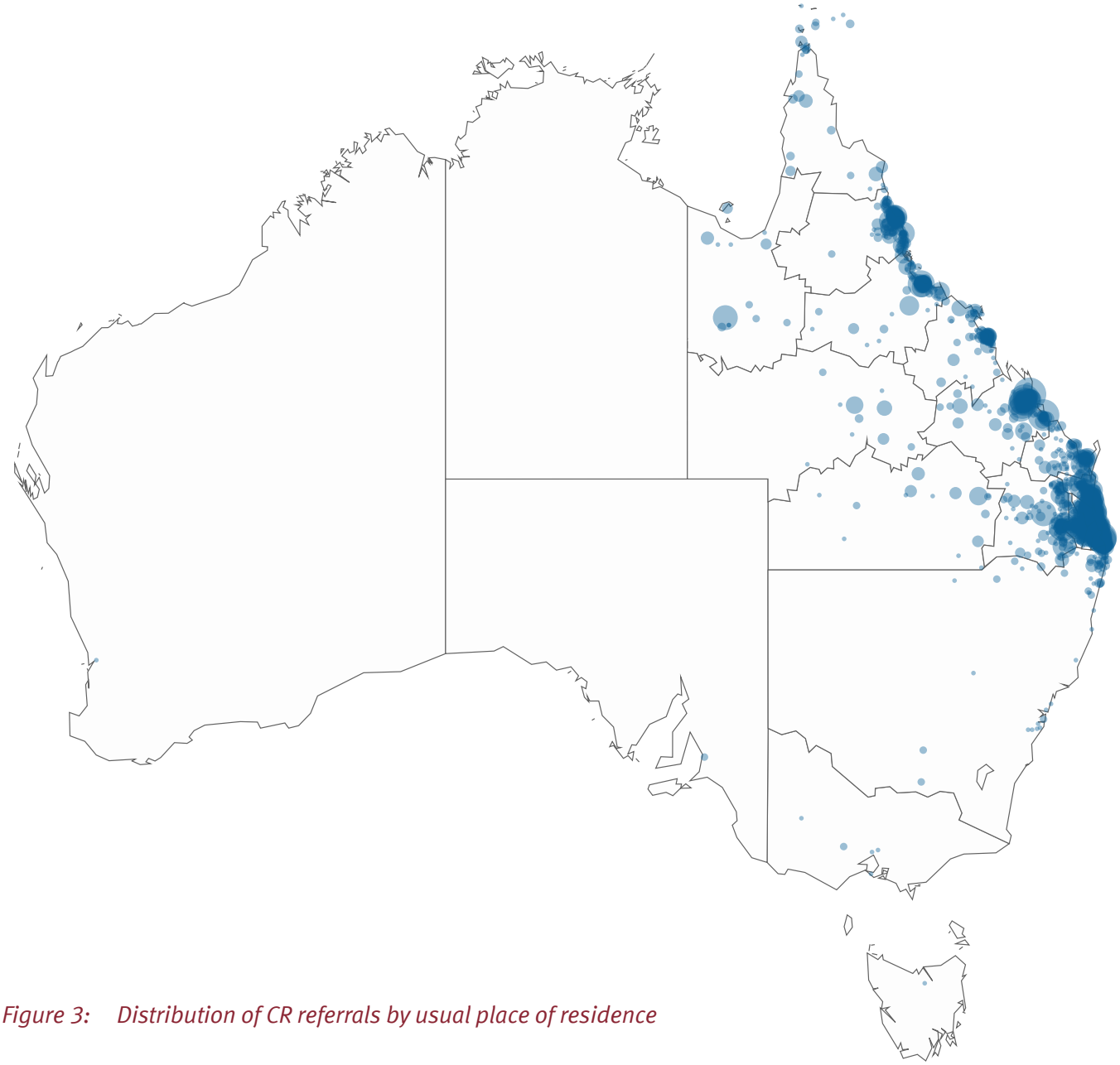


Figure 3: Distribution of CR referrals by usual place of residence

Table 2: CR referrals by remoteness classification

Remoteness area*	%
Major Cities of Australia	52.6
Inner Regional Australia	26.9
Outer Regional Australia	16.9
Remote Australia	1.4
Very Remote Australia	2.2
ALL	**100.0**

Excludes missing data (0.6%)

* Classified by Australian Statistical Geography Standard remoteness area

4.2 Origin of referrals

The majority of referrals (75%) originated from an inpatient setting, with smaller proportions of referrals flowing to CR from an outpatient setting (13%) and outside of Queensland Health (12%).

There was considerable variation across participating CR programs in the proportion of referrals from external sources, which ranged from <1% to 26%. It is possible that not all sites are entering referrals received from general practitioners, private hospitals or external specialists.

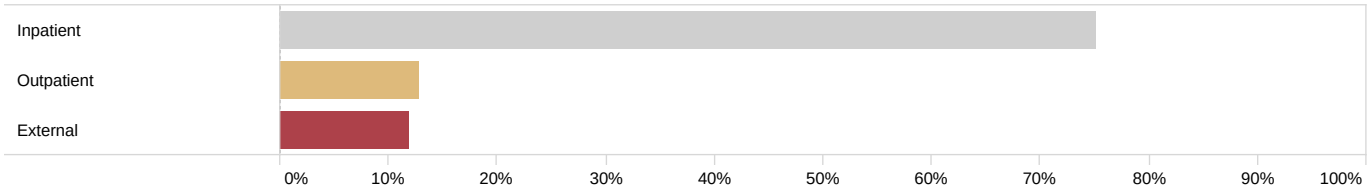


Figure 4: Proportion of referrals by referral source

Table 3: Referral sources by outpatient program HHS

HHS/division	Total referrals n	Inpatient* n (%)	Outpatient* n (%)	External n (%)
Cairns and Hinterland	753	686 (91.1)	32 (4.2)	35 (4.6)
Central Queensland	1,026	612 (59.6)	205 (20.0)	209 (20.4)
Central West	41	21 (51.2)	19 (46.3)	1 (2.4)
Darling Downs	497	346 (69.6)	64 (12.9)	87 (17.5)
Gold Coast	1,578	1,329 (84.2)	171 (10.8)	78 (4.9)
Health Contact Centre	1,253	1,042 (83.2)	162 (12.9)	49 (3.9)
Mackay	285	175 (61.4)	109 (38.2)	1 (0.4)
Metro North	1,421	1,008 (70.9)	161 (11.3)	252 (17.7)
Metro South	1,706	1,256 (73.6)	100 (5.9)	350 (20.5)
North West	64	44 (68.8)	17 (26.6)	3 (4.7)
South West	62	28 (45.2)	20 (32.3)	14 (22.6)
Sunshine Coast	956	860 (90.0)	43 (4.5)	53 (5.5)
Townsville	490	379 (77.3)	108 (22.0)	3 (0.6)
West Moreton	763	370 (48.5)	194 (25.4)	199 (26.1)
Wide Bay	282	241 (85.5)	37 (13.1)	4 (1.4)
Statewide	**11,177**	**8,397 (75.1)**	**1,442 (12.9)**	**1,338 (12.0)**

* Includes referrals from a Queensland Health public facility

4.3 Inpatient referrals

For referrals originating from an inpatient setting, the largest referrer was Metro North HHS which accounted for one quarter (25%) of these referrals. Gold Coast HHS and Metro South HHS received the largest volumes of inpatient referrals (16% and 15% respectively).

Table 4: CR inpatient referrals by source and destination HHS

HHS/organisation	Outgoing inpatient referrals n (%)	Incoming inpatient referrals n (%)
Cairns and Hinterland	705 (8.4)	686 (8.2)
Central Queensland	381 (4.5)	612 (7.3)
Central West	–	21 (0.3)
Darling Downs	131 (1.6)	346 (4.1)
Gold Coast	1,345 (16.0)	1,329 (15.8)
Health Contact Centre	–	1,042 (12.4)
Mackay	92 (1.1)	175 (2.1)
Mater Health Services	95 (1.1)	–
Metro North	2,093 (24.9)	1,008 (12.0)
Metro South	1,775 (21.1)	1,256 (15.0)
North West	–	44 (0.5)
South West	1 (<0.1)	28 (0.3)
Sunshine Coast	787 (9.4)	860 (10.2)
Townsville	791 (9.4)	379 (4.5)
West Moreton	134 (1.6)	370 (4.4)
Wide Bay	67 (0.8)	241 (2.9)
Statewide	**8,397 (100.0)**	**8,397 (100.0)**

The flow of inpatient referrals from the originating HHS or organisation (acute site) to the CR outpatient program HHS is illustrated in Figure 5. The majority of inpatient referrals remained within the originating HHS, though there was some variation noted.

It should be highlighted that there are no outpatient programs for Mater Health Services, and conversely the Health Contact Centre provides an outpatient (telephone based) service only.

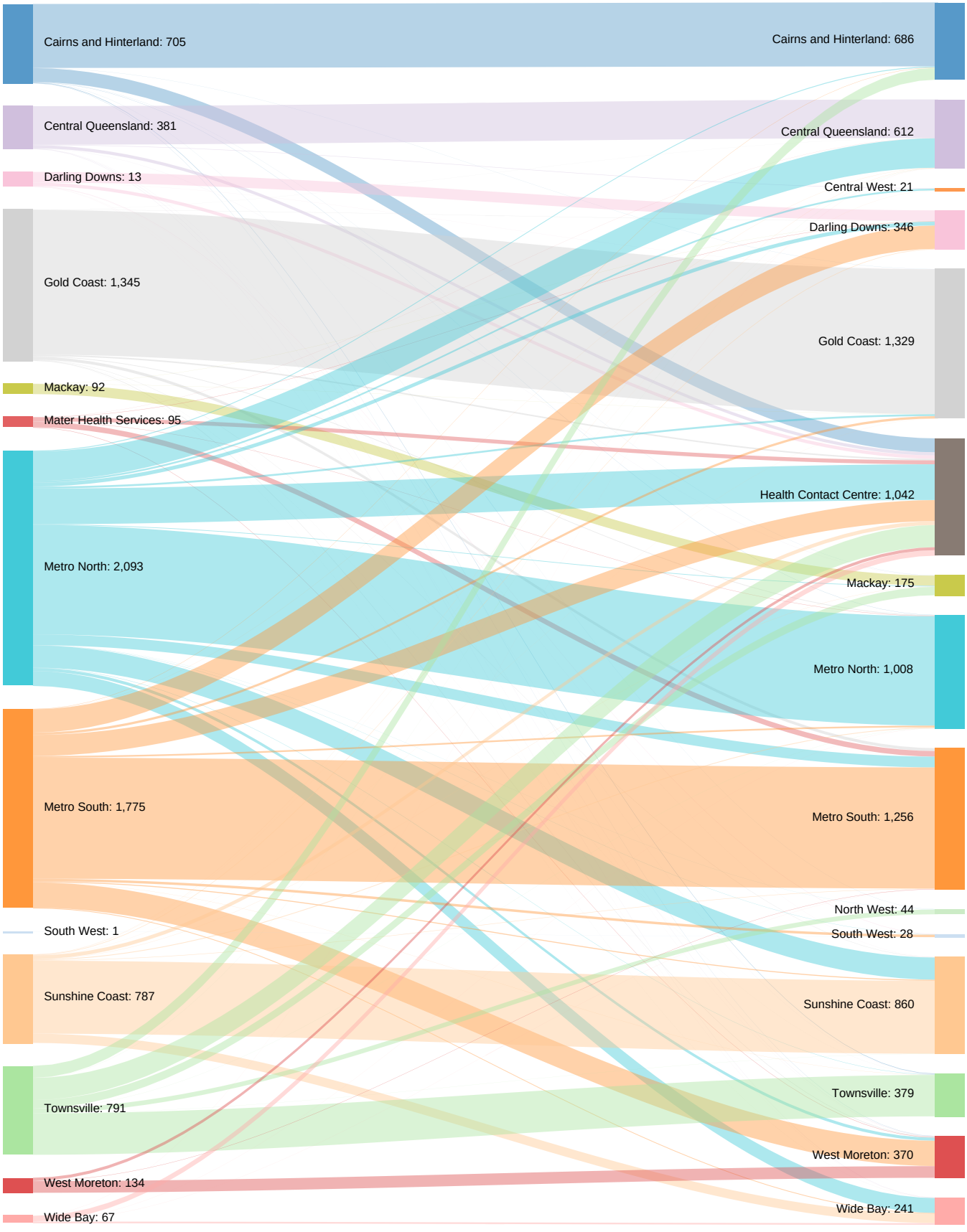


Figure 5: CR inpatient referrals by source and destination HHS

5 Program participation

5.1 Pre assessment stage

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

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

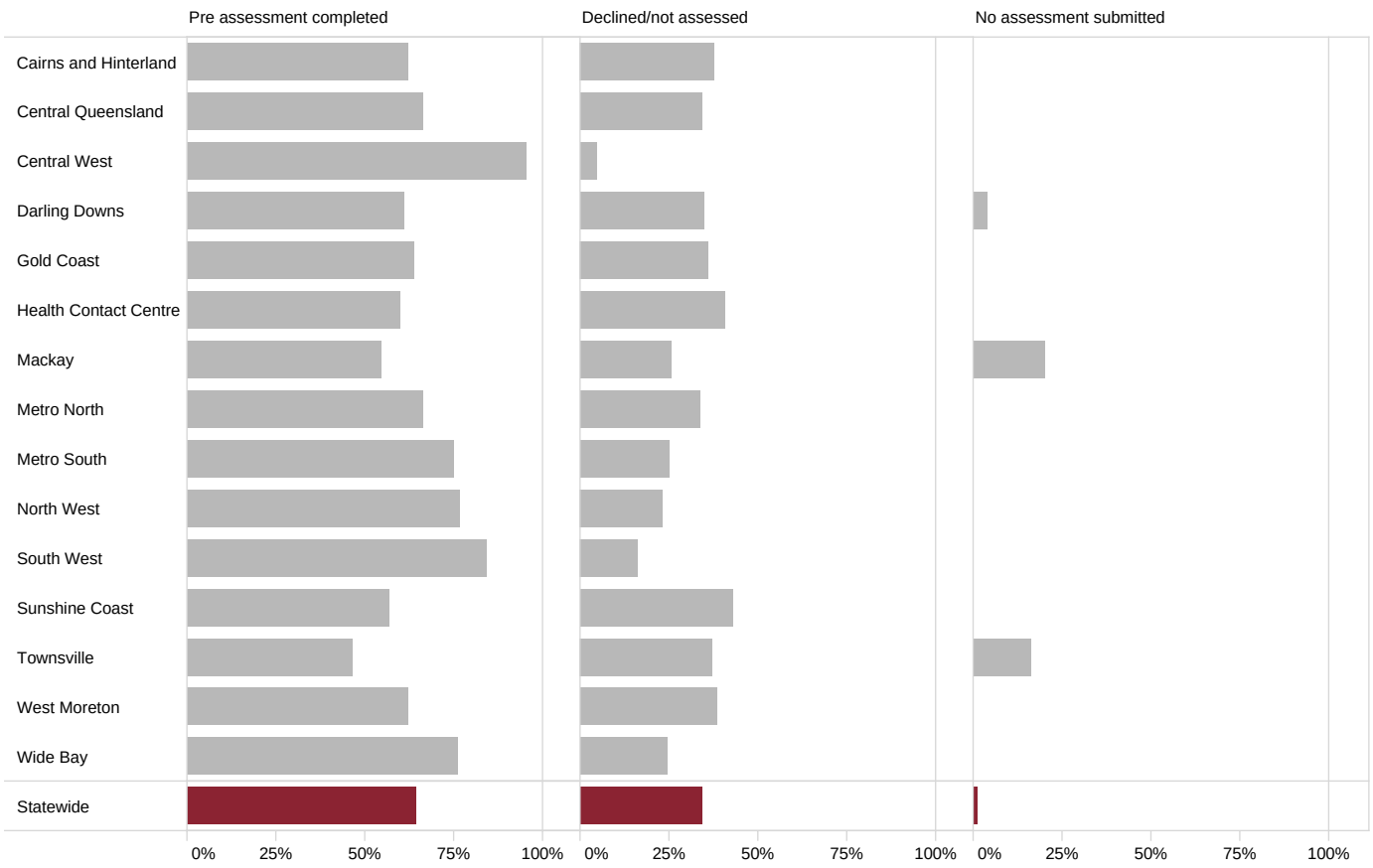
The proportion of total referrals which proceeded to a pre assessment within any timeframe was 64%. This is a limited metric which should be interpreted with caution due to varying processes across the state for patients refusing or not interested in attending CR, and for patients residing overseas and interstate.

Capacity for service delivery is also a contributing factor for referrals not proceeding to pre assessment, these issues are explored later in the report.

Table 5: Total pre assessments completed by outpatient HHS/division

Outpatient HHS/division	Pre assessment completed n (%)	Declined/not assessed n (%)	No assessment submitted n (%)
Cairns and Hinterland	467 (62.0)	286 (38.0)	–
Central Queensland	676 (65.8)	352 (34.2)	–
Central West	39 (95.1)	2 (4.9)	–
Darling Downs	303 (60.8)	175 (35.1)	20 (4.0)
Gold Coast*	1,007 (63.8)	571 (36.2)	–
Health Contact Centre	746 (59.5)	507 (40.5)	–
Mackay	155 (54.4)	72 (25.3)	58 (20.4)
Metro North	940 (66.2)	481 (33.8)	–
Metro South	1,281 (75.1)	425 (24.9)	–
North West	49 (76.6)	15 (23.4)	–
South West	52 (83.9)	10 (16.1)	–
Sunshine Coast	546 (57.1)	410 (42.9)	–
Townsville	228 (46.5)	182 (37.1)	80 (16.3)
West Moreton	472 (61.9)	291 (38.1)	–
Wide Bay	214 (75.9)	68 (24.1)	–
Statewide	**7,175 (64.2)**	**3,847 (34.4)**	**158 (1.4)**

* Referrals to Gold Coast HHS include 11% patients residing interstate, typically referred on for CR outside of Queensland Health



Total for Gold Coast HHS includes 11% referrals for patients residing interstate

Figure 6: Proportion of CR referrals proceeding to pre assessment by outpatient HHS/division

5.2 Post assessment stage

In most cases, the post assessment is representative of completion and graduation from the specialist CR outpatient program. This provides an opportunity for the patient and clinician to reflect upon the targets defined at the pre assessment and discuss the impact of the program. Of 7,175 completed pre assessments, 41% proceeded to post assessment which compares similarly to the previous year.

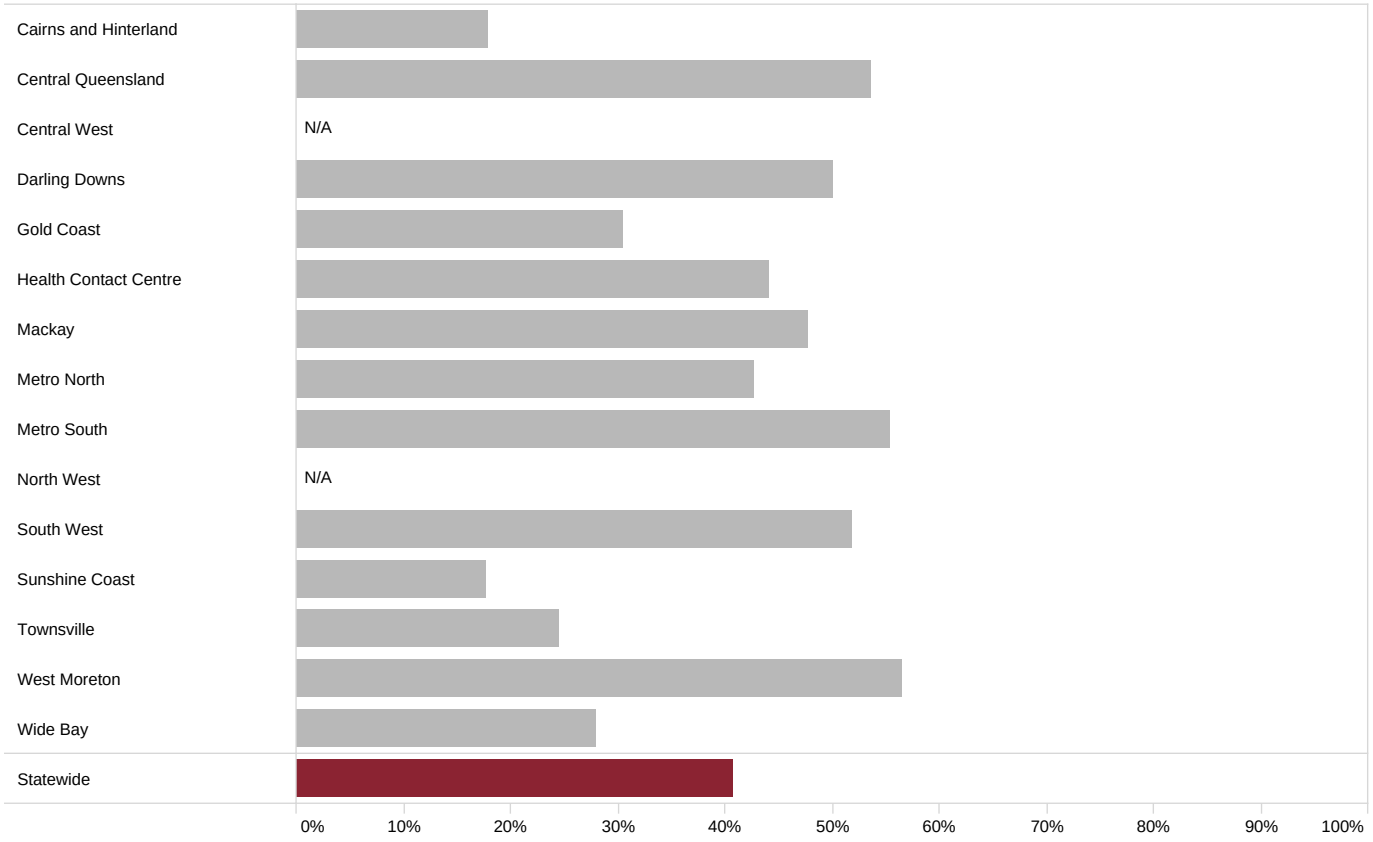
Completion rates and median time interval from pre assessment to post assessment varied considerably by HHS. The median time from pre assessment to post assessment was 80 days, with a range of 50 days to 259 days across outpatient HHS. There was considerable variation in the proportion of cases where a post assessment was completed, suggesting the model of care and data entry vary at a local level. A range of issues can contribute to completion of the post assessment which may include timing, patient availability or other factors outside the control of the program. Reasons for non-participation in the post assessment presents an opportunity for investigation in the future.

Data reported in this section uses a six month cut-off period for post assessment completion.

Table 6: Total post assessments completed by HHS

Outpatient HHS/division	Post assessment completed n (%)	Median time to post assessment days
Cairns and Hinterland	83 (17.8)	78
Central Queensland	362 (53.6)	76
Central West	1 (2.6)	N/A
Darling Downs	152 (50.2)	56
Gold Coast	307 (30.5)	50
Health Contact Centre	329 (44.1)	155
Mackay	74 (47.7)	83
Metro North	401 (42.7)	105
Metro South	709 (55.3)	66
North West	5 (10.2)	N/A
South West	27 (51.9)	98
Sunshine Coast	96 (17.6)	107
Townsville	56 (24.6)	259
West Moreton	267 (56.6)	74
Wide Bay	60 (28.0)	57
Statewide	**2,929 (40.8)**	**80**

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



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

Figure 7: Proportion of CR assessments proceeding to post assessment

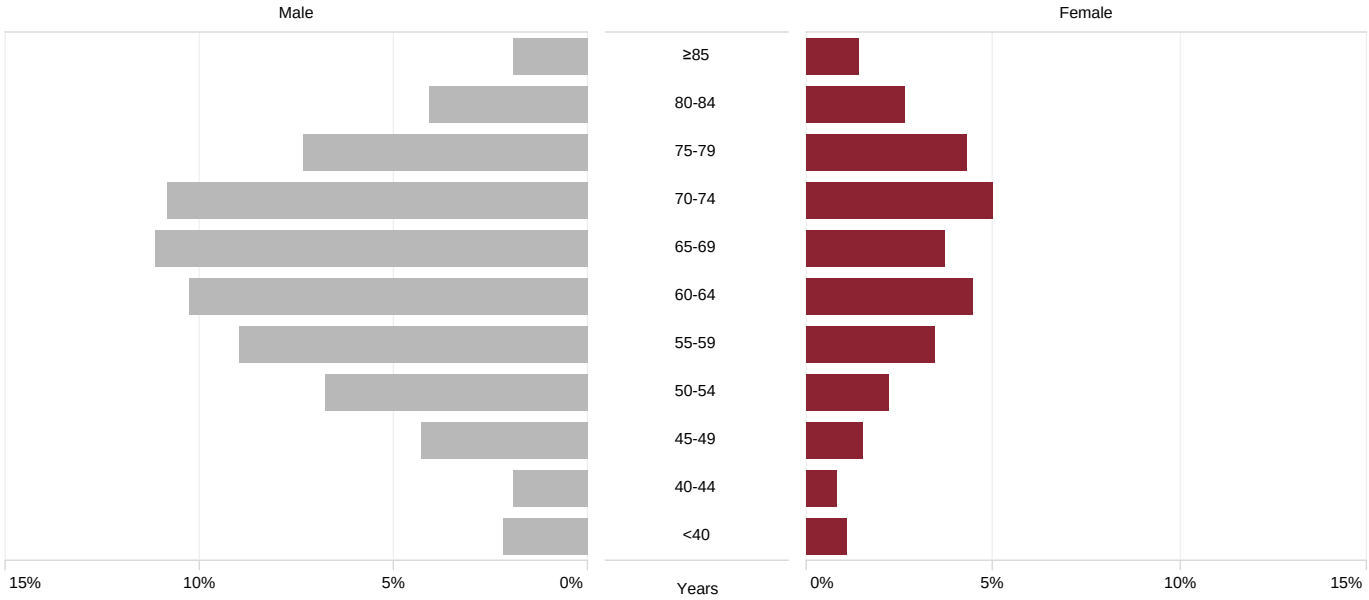
6 Patient characteristics

The following analysis examines the characteristics of the 7,175 patients who completed an initial CR pre assessment. Largely these characteristics are similar to those reported over previous years.

6.1 Age and gender

Development of cardiovascular disease is related to age. Overall, 70% of patients were male and 30% female. The age distribution of referrals was similar for genders, though the median age for males was slightly lower than for females (65 years vs. 68 years).

Overall, three quarters of patients were 57 years of age or older (interquartile range 57 years to 74 years).



% of total referrals (n=11,177)

Figure 8: Referrals by patient gender and age group

Table 7: Median patient age by gender and HHS

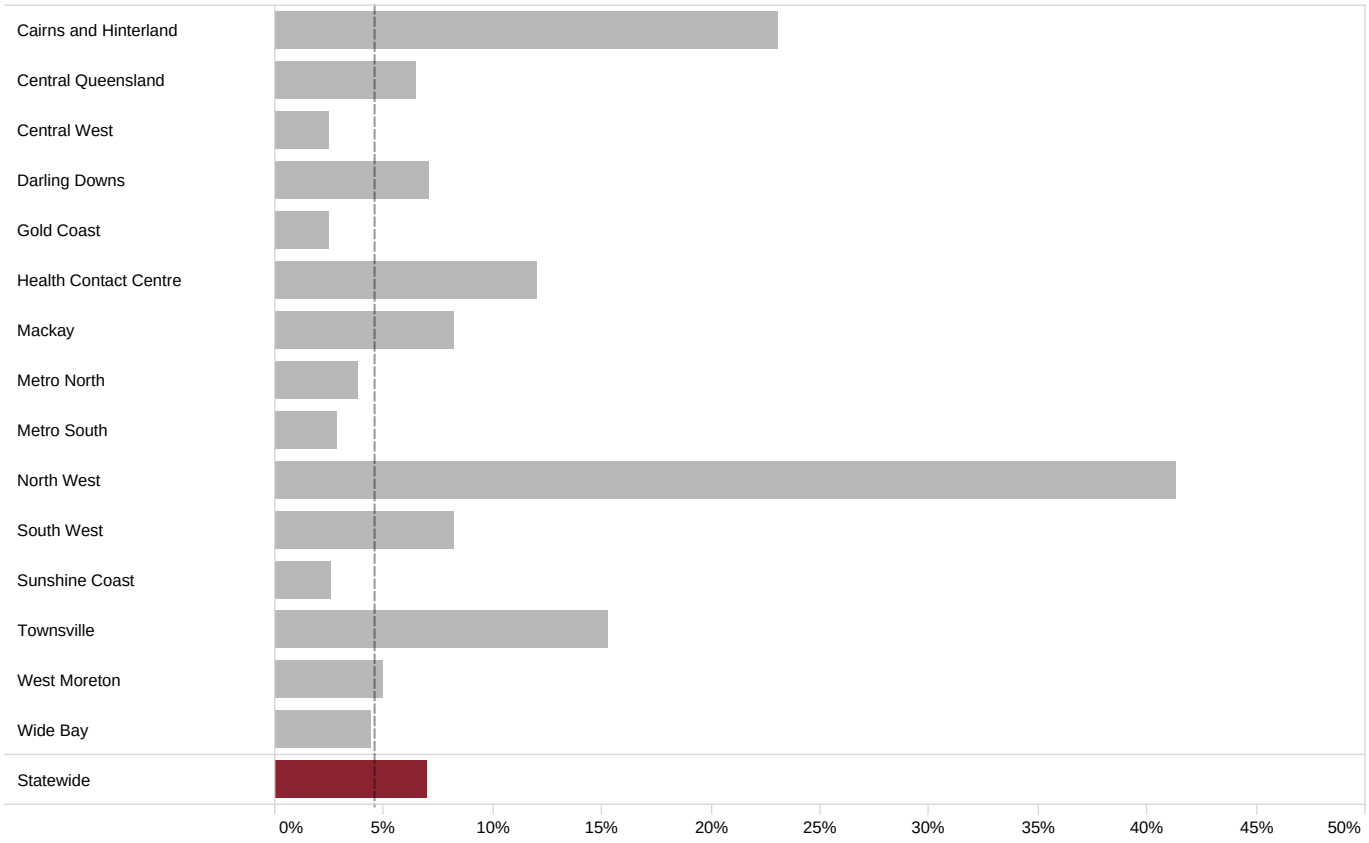
Outpatient HHS/division	Male years	Female years	All years
Cairns and Hinterland	65	63	64
Central Queensland	67	69	68
Central West	64	67	66
Darling Downs	65	64	65
Gold Coast	66	70	67
Health Contact Centre	64	67	65
Mackay	66	63	65
Metro North	67	69	67
Metro South	63	67	64
North West	53	59	55
South West	71	71	71
Sunshine Coast	66	69	67
Townsville	63	62	63
West Moreton	65	68	66
Wide Bay	68	69	68
Statewide	**65**	**68**	**66**

6.2 Aboriginal and Torres Strait Islander status

It is recognised that the Aboriginal and Torres Strait Islander population has a higher incidence and prevalence of coronary artery disease with ischaemic heart disease identified as the leading cause of death among Indigenous Australians in 2020.[31]

In this cohort, Aboriginal and Torres Strait Islander patients represent 7% of all statewide referrals with considerable variation observed across CR programs. By comparison, the estimated overall proportion of the Aboriginal and Torres Strait Islander population in Queensland is 4.6%.[2]

Larger proportions of Aboriginal and Torres Strait Islander patients were referred to CR programs in northern HHSs. Cairns and Hinterland, Townsville and North West HHSs all reported more than 12% of patients identifying as Aboriginal and Torres Strait Islander.

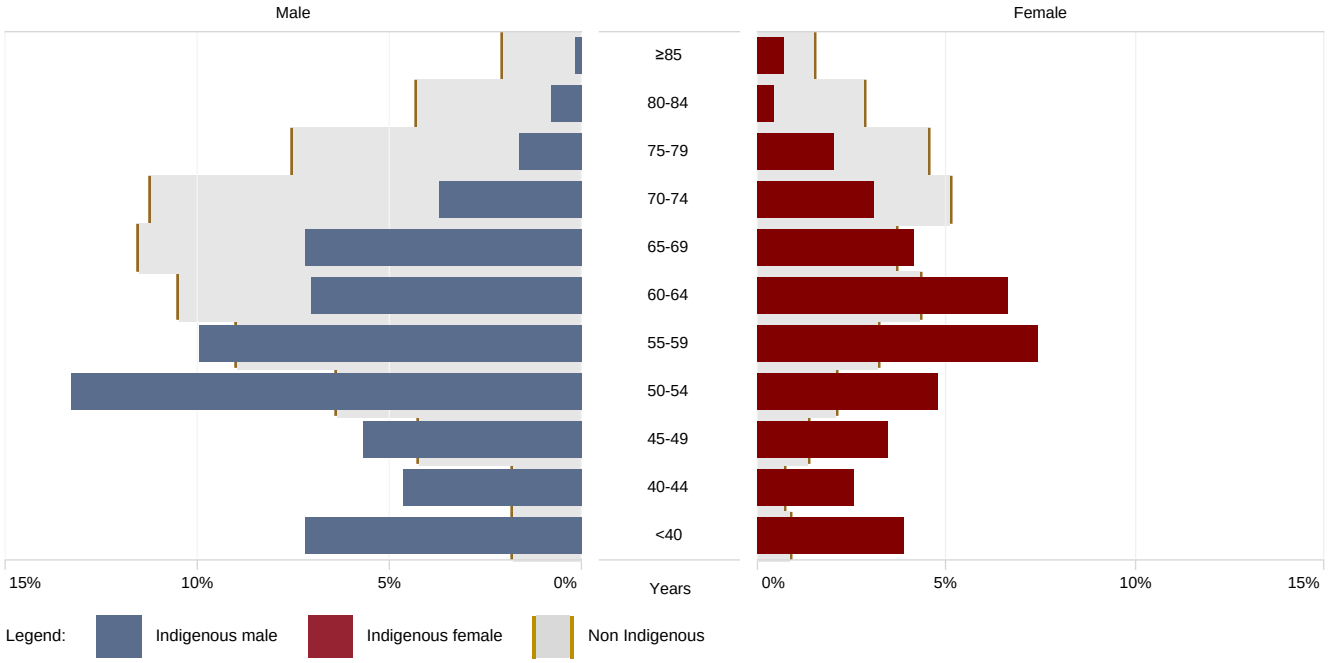


Excludes missing data (3.3%)

Figure 9: Proportion of identified Aboriginal and Torres Strait Islander patients by outpatient HHS

The proportion of Aboriginal and Torres Strait Islander patients referred to CR had a median age considerably lower than other patients (56 years vs. 66 years respectively).

The rate of cardiovascular disease among Aboriginal and Torres Strait Islander patients is largely different to that seen among other Australians. The disparity in median age and proportionate numbers of Aboriginal and Torres Strait Islander patients undertaking CR is consistent with chronic diseases occurring more often and at a younger age compared to non-Indigenous Australians.



Excludes missing data (3.3%)

Figure 10: Proportion of all CR referrals by age group and Indigenous status

Table 8: Median patient age by gender and Indigenous status

	Male years	Female years	All years
Aboriginal and Torres Strait Islander	55	58	56
Non Aboriginal and Torres Strait Islander	66	69	66
Total	**65**	**68**	**66**

Excludes missing data 3.3%

7 Clinical presentation

7.1 Diagnosis

For the following analysis, patients attending a CR pre assessment have been grouped into a diagnosis category based on clinical patient information obtained through the course of referral and pre assessment.

The majority of pre assessments (66%) followed a previous diagnosis of ischaemic heart disease (IHD).

Table 9: Pre assessments by diagnosis category

Diagnosis category	n	%
Ischaemic heart disease*	4,725	65.9
Valvular disease	626	8.7
Other†	1,824	25.4
ALL	**7,175**	**100.0**

* STEMI, NSTEMI and angina

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

7.2 Most recent procedure

The most common procedure preceding a referral to CR was PCI. This was documented for 41% of all referrals and 56% of referrals for patients with IHD.

There were 12% of cases where the most recent procedure had not been identified. These cases can be attributed to missing data, or to patients being conservatively managed and thus having no previous invasive cardiac procedure at the time of program commencement.

Table 10: Most recent procedure noted at pre assessment by diagnosis category

Most recent procedure	Ischaemic heart disease n (%)	Valvular disease n (%)	Other n (%)	All n (%)
PCI	2,663 (56.4)	2 (0.3)	297 (16.3)	2,962 (41.3)
Coronary angiogram	723 (15.3)	12 (1.9)	345 (18.9)	1,080 (15.1)
CABG	814 (17.2)	9 (1.4)	325 (17.8)	1,148 (16.0)
Valve procedure	9 (0.2)	523 (83.5)	133 (7.3)	665 (9.3)
Device procedure	8 (0.2)	2 (0.3)	125 (6.9)	135 (1.9)
CABG + valve procedure	58 (1.2)	52 (8.3)	35 (1.9)	145 (2.0)
Other	40 (0.8)	8 (1.3)	160 (8.8)	208 (2.9)
Not specified	410 (8.7)	18 (2.9)	404 (22.1)	832 (11.6)

7.3 Risk factors and comorbidities

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

At the time of the pre assessment:

- The majority of patients (90%) had a history of abnormal cholesterol levels or had been prescribed lipid lowering therapy at the time of assessment. This ranged from 64% to 97% across diagnosis categories.
- Only 39% of patients met the physical activity guidelines for their age and were sufficiently active. Furthermore, 18% of patients were classed as inactive, which is defined as only undertaking activities associated with daily living.
- The majority of patients were identified as having an unhealthy body mass index (BMI) with less than one quarter (20%) of patients having a BMI within the normal range.
- Overall, 28% of patients had diabetes as a comorbidity with some variation observed between diagnosis categories.
- Almost half (47%) of patients had a family history of cardiovascular disease.
- Overall, there were 16% of patients assessed by outpatient CR who were documented as having heart failure.
- Of the patients documented to have heart failure, 87% were classed as having a reduced ejection fraction (LVEF <50%).
- Over one quarter (28%) of patients had a documented history of depression.
- More than half of patients (60%) were identified as having a history of hypertension.
- There were 13% of patients identified as current smokers (defined as smoking within 30 days), while 50% were classed as former smokers.

Table 11: Summary of risk factors by diagnosis category

Risk factor	Ischaemic heart disease %	Valvular disease %	Other %	All %
Abnormal cholesterol*	97.0	64.2	82.1	90.3
Activity level				
Sufficiently active	39.9	39.9	35.5	38.8
Insufficiently active	42.6	42.8	44.4	43.1
Inactive	17.5	17.3	20.0	18.2
Body mass index				
Normal range†	19.7	23.7	19.9	20.1
Overweight‡	37.0	31.7	33.7	35.8
Obese§	36.3	38.3	36.6	36.6
Morbidly obese‖	6.3	4.6	8.3	6.7
Diabetes	28.5	19.7	27.8	27.6
Family history of CVD#	48.7	34.9	46.4	46.9
Heart failure	12.9	13.4	24.5	15.9
Heart failure, LVEF**				
≥50%	5.6	35.0	18.1	12.5
40–49%	44.4	30.0	27.0	36.8
30–39%	37.0	23.8	27.0	32.3
‹30%	13.0	11.3	27.8	18.4
History of depression	28.9	22.2	28.2	28.1
Hypertension	59.4	53.5	62.3	59.6
Smoking status				
Current smoker††	15.6	6.9	9.6	13.3
Former smoker	50.4	45.2	48.6	49.5
Never smoked	34.0	47.9	41.8	37.2

% from total complete data per case category

* Total cholesterol ›4.0 mmol/L, HDL ‹1.0 mmol/L, LDL ›2.0 mmol/L or triglycerides ›2.0 mmol/L

† BMI 18.5–24.9 kg/m²

‡ BMI 25.0–29.9 kg/m²

§ BMI 30.0–39.9 kg/m²

‖ BMI ≥40.0 kg/m²

\# Cardiovascular disease

** Left ventricular ejection fraction

†† Within 30 days

7.4 Current medications

Over three quarters of patients were being treated with aspirin (84%) and lipid lowering medications (85%). As expected, there was variation in medication across diagnosis categories. Patients with IHD tended to use antiplatelet and sublingual nitrate medications more than patients with valvular disease. This is consistent with the different disease processes and respective treatment regimes.

Table 12: Current medications by diagnosis category

Medications	IHD %	Valvular disease %	Other %	All %
Aspirin	92.2	64.4	67.9	83.6
ACEI/ARB*	65.4	41.7	54.3	60.5
Antiplatelet	70.5	11.4	31.1	55.3
Anticoagulant	14.8	47.9	28.2	21.1
Beta blocker	68.9	56.6	62.2	66.1
Diabetic medications	23.8	16.5	23.7	23.2
Dual antiplatelet	66.3	7.4	24.5	50.5
Lipid lowering	92.9	53.2	75.5	85.1
Sublingual nitrate	63.4	7.2	26.7	49.2
Other	67.0	84.6	74.9	70.5

* Angiotensin converting enzyme inhibitor/angiotensin receptor blocker

8 Program outcomes

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

A limiting factor for this analysis is availability of data for the post assessment stage. Specifically, the availability of updated pathology and other investigations as well as the model of care employed by the CR program. This may result in limited data from which conclusions can be drawn and is a focus for future reporting and enhancements to data collection.

Table 13: Summary of program outcome measures

Program outcome	Category	Measure
1	Pathology	Lipid profile
2	Functional	Six minute walk test
3	PROMS	Patient Health Questionnaire
4	PROMS	Assessment of Quality of Life
5	PROMS	Other patient reported outcomes

8.1 Lipid profile

Data for lipid values such as total cholesterol was available for a smaller proportion of patients completing CR. A barrier to reporting this outcome is that updated pathology results are not always available for the post assessment stage. It is hoped that this limitation may be reduced with increased availability of data and linkage with other Queensland Health data collections.

Overall a reduction in the mean total cholesterol was observed as was a reduction in triglycerides and LDL-C levels. This may be attributable to the impact of CR and adherence with pharmacotherapy.

Table 14: Summary of lipid values

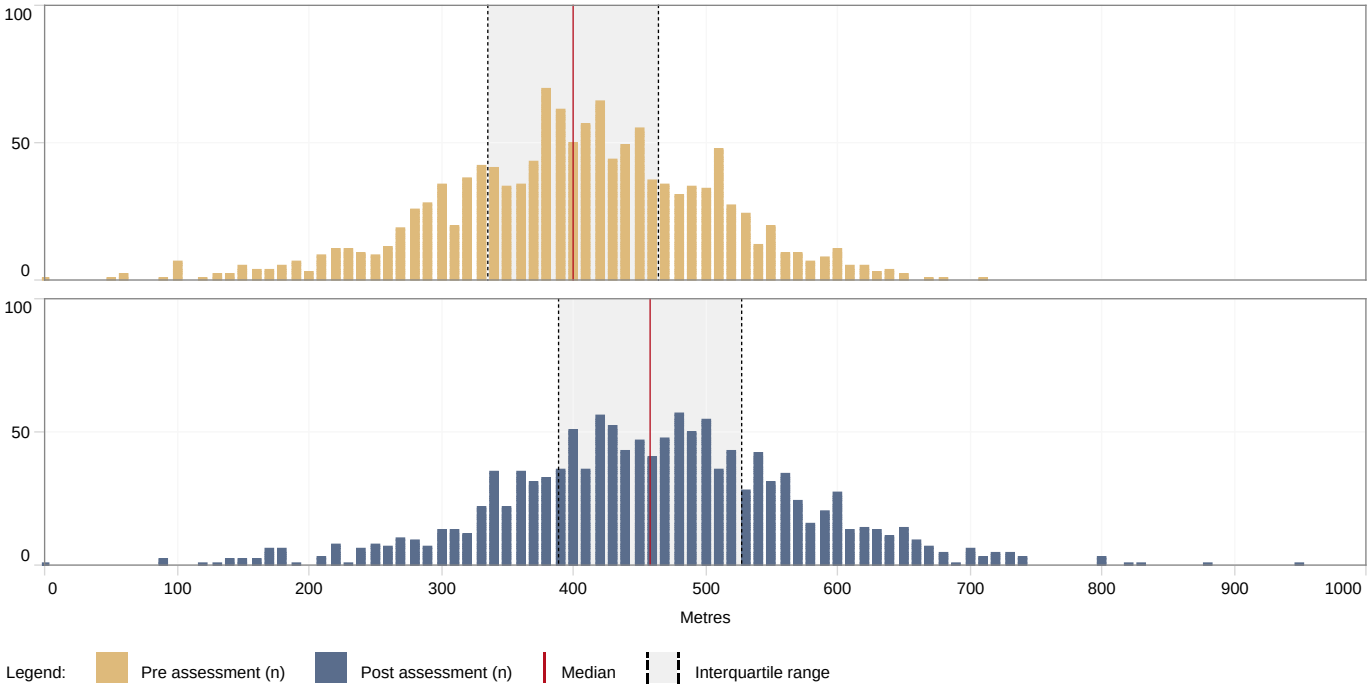
	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Total cholesterol (mmol/L)	392	4.8 ± 1.4	3.7 ± 0.9	-1.1 ± 1.4
Triglycerides (mmol/L)	358	1.9 ± 1.6	1.5 ± 1.1	-0.4 ± 1.3
HDL-C (mmol/L)	315	1.1 ± 0.3	1.1 ± 0.4	0.0 ± 0.3
LDL-C (mmol/L)	310	2.9 ± 1.2	1.8 ± 0.8	-1.1 ± 1.2

8.2 Six minute walk test

A functional measure is commonly utilised prior to implementing an exercise program in order to determine exercise prescription and enable changes to be measured. The six minute walk test (6MWT) is a standardised investigation of submaximal exercise capacity that is often used in patients with cardiopulmonary disease. Changes in the six minute walk distance are useful in assessing functional capacity and the efficacy of therapeutic interventions such as pharmacotherapy and CR.[32]

There were 1,288 cases where the patient completed a 6MWT at the pre assessment and post assessment stages. The 6MWT is not always feasible due to the different models of care that exist, with some programs not offering an exercise component. In the majority of instances (72%) patients demonstrated an improvement in 6MWT, with 53% recording an increase of greater than 50 metres (Table 16).

Throughout 2020, there was a 39% reduction in the data available for 6MWT outcomes. It is likely this is attributable to the interruption of CR gym programs due to the global COVID-19 pandemic.



Results rounded to 10 metres

Figure 11: Comparison of pre assessment and post assessment six minute walk test results

Table 15: Summary of six minute walk test results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Distance travelled (metres)	1,288	397.3 ± 101.4	456.7 ± 112.9	59.5 ± 62.0

Table 16: Change in six minute walk test results

	n (%)
Improved ≥50 metres	680 (52.8)
Improved 26–49 metres	243 (18.9)
No change (≤25 metres)	306 (23.8)
Worsened >25 metres	59 (4.6)
ALL	**1,288 (100.0)**

8.3 Patient reported outcome measures

Patient Health Questionnaire

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

The Patient Health Questionnaire-4 (PHQ-4) is a validated tool for screening anxiety and depressive disorders.[33] This instrument is a four item composite measure derived from the Generalized Anxiety Disorder-7 scale (GAD-7) and the Patient Health Questionnaire-9 (PHQ-9). Each of the four items on the PHQ-4 is scored using a four point scale:

- high psychological distress being scored 9–12 points
- mild psychological distress scoring between 3–5 points
- minimal depression and anxiety scoring between 0–2 points.

A total of 2,584 paired data were available for analysis. Over one quarter of patients (28%) demonstrated an improved PHQ-4 score at post assessment and 57% recorded no change to their PHQ-4 score. Given a large proportion of patients reported minimal depression and anxiety at the pre assessment there is often no scope for improvement via this metric.

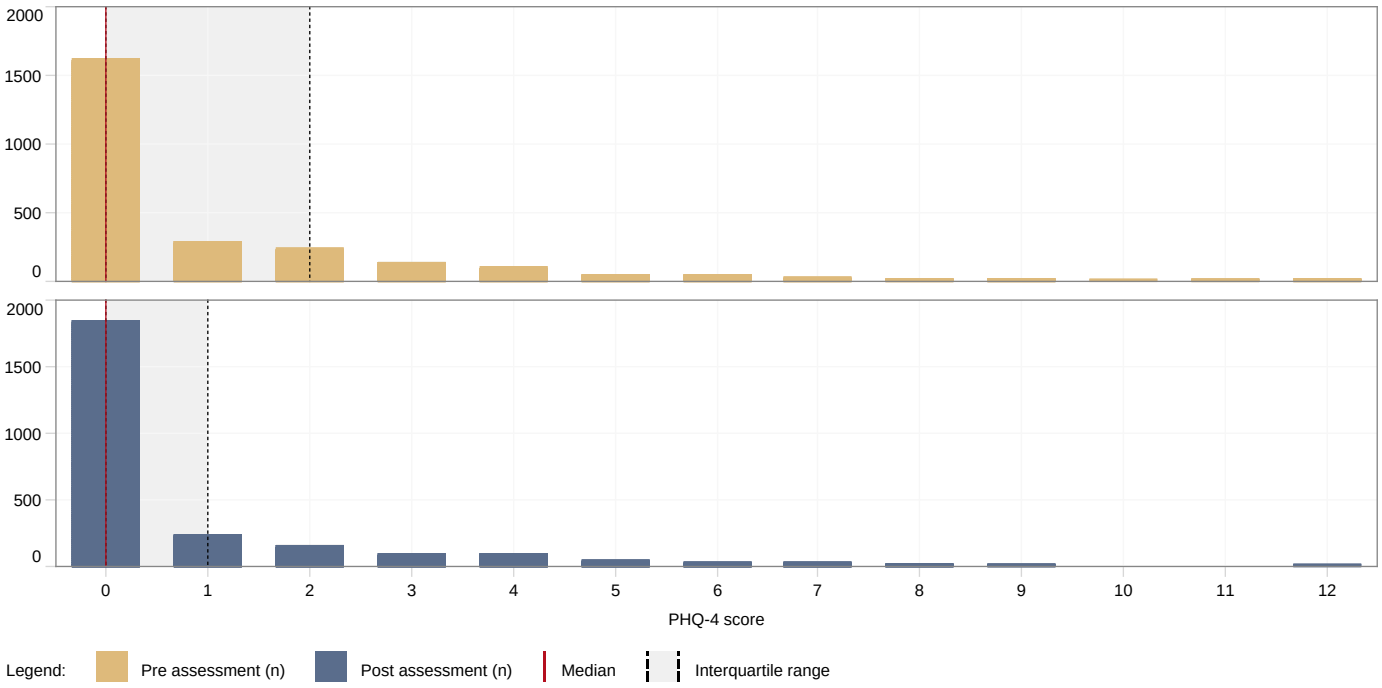


Figure 12: Comparison of pre assessment and post assessment PHQ-4 results

Table 17: Summary of PHQ-4 results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Depression score (PHQ-2)	2,584	0.5 ± 1.2	0.4 ± 1.0	-0.1 ± 1.2
Anxiety score (GAD-2)	2,584	0.7 ± 1.3	0.5 ± 1.1	-0.2 ± 1.2
Overall score	**2,584**	**1.2 ± 2.2**	**0.9 ± 1.9**	**-0.3 ± 2.1**

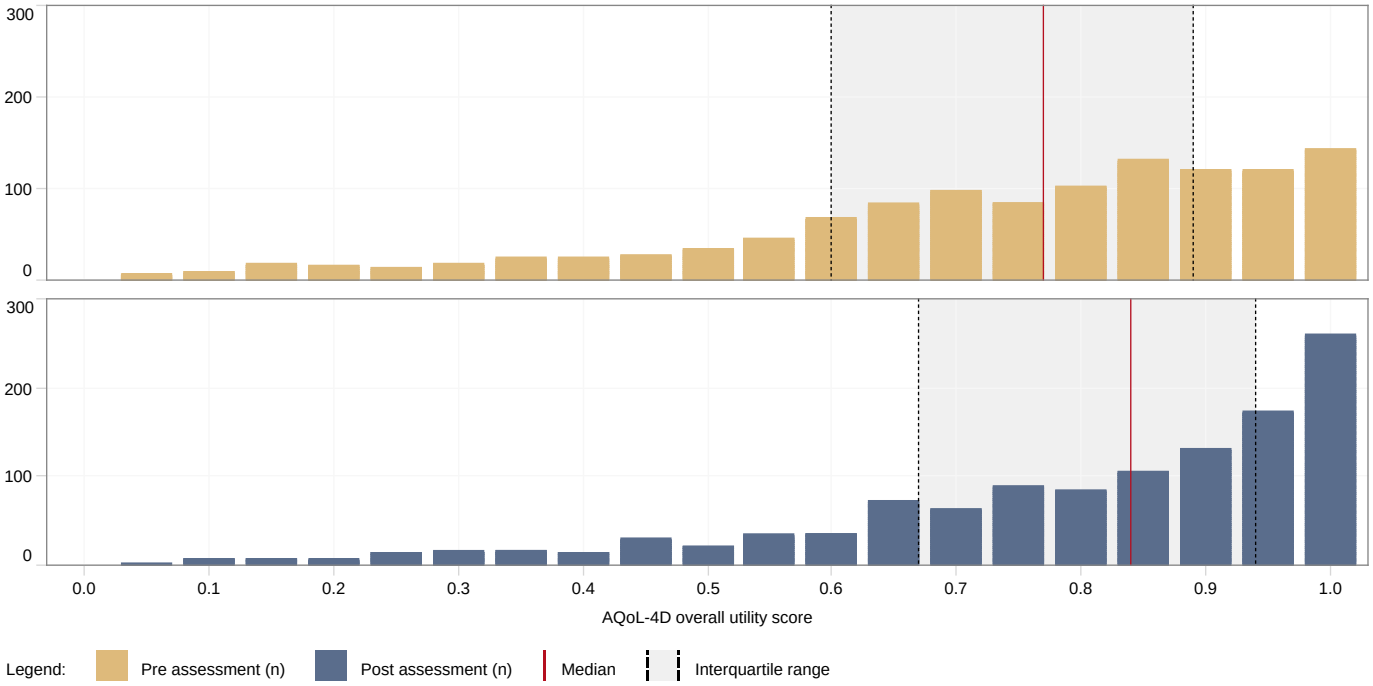
Table 18: Change in PHQ-4 results

	n (%)
Any improvement	717 (27.7)
No change	1,467 (56.8)
Any worse result	400 (15.5)
ALL	**2,584 (100.0)**

Assessment of Quality of Life

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

For the 1,192 records available at the pre and post CR timeframes, the mean overall pre assessment AQoL-4D utility score was 0.72 which compares similarly to expected results for patients with a cardiovascular diagnosis.[34] This utility score improved to 0.78 at the post assessment stage, where 60% of patients demonstrated an improved overall utility score after CR intervention (Table 19 and Table 20).



Results rounded to 0.05 utility score

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

Table 19: Summary of AQoL-4D results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Independent living	1,192	0.90 ± 0.16	0.95 ± 0.12	0.04 ± 0.14
Relationships	1,192	0.91 ± 0.15	0.92 ± 0.15	0.01 ± 0.15
Senses	1,192	0.94 ± 0.08	0.94 ± 0.08	0.01 ± 0.08
Mental health	1,192	0.89 ± 0.12	0.91 ± 0.11	0.02 ± 0.11
Overall score	**1,192**	**0.72 ± 0.23**	**0.78 ± 0.22**	**0.06 ± 0.20**

Table 20: Change in AQoL-4D results

	n (%)
Any improvement	713 (59.8)
No change	142 (11.9)
Any worse result	337 (28.3)
ALL	**1,192 (100.0)**

Other patient reported outcomes

Any assessment by a CR clinician includes a component assessing for quality of life (QOL). However, the use of a long-form questionnaire (such as AQoL-4D) is often impractical or unwarranted. The assessment of patient reported QOL takes the form of an abbreviated questionnaire allowing patients to self-report their health-related status across three domains.

The questions asked include:

- In general, how would you describe your health at present?
- In general, how would you describe your mood at present?
- How fit are you now compared with 6 months ago?

The abbreviated questionnaire often provides a gauge to whether the CR practitioner may need to apply a more detailed QOL assessment to better understand the status and needs of the individual patient.

Paired data on the condensed QOL survey were available for 1,368 assessments.

Self reported health

There were 44% of patients reporting a health status of very good or excellent at post assessment, compared with 17% at the pre assessment phase. Overall, half of patients (51%) reported a feeling of improved health. Reductions in the numbers of patients reporting fair or poor health were observed with only 2% of patients reporting poor health at post assessment.

Decreases in self reported health status were reported by 11% of patients, however caution should be exercised when interpreting this result as there are many confounding factors which may affect the health status of a patient with what is often a newly diagnosed complex chronic disease.

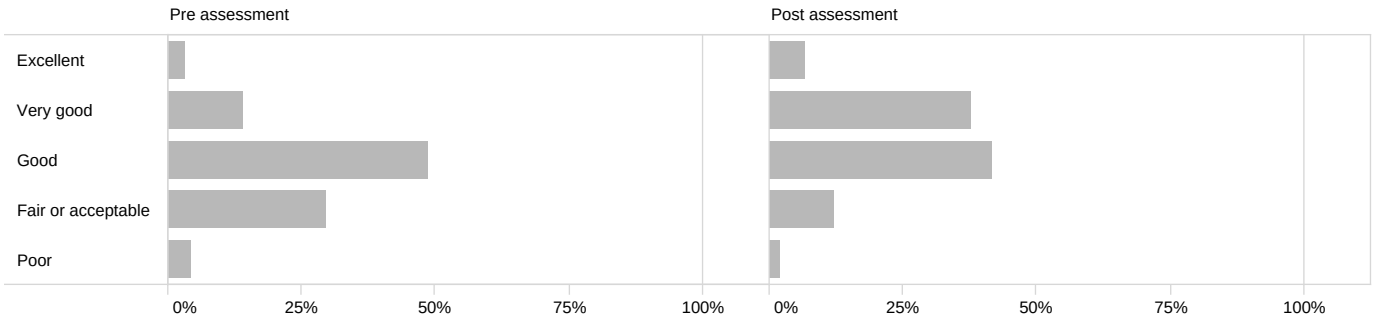


Figure 14: Comparison of patient reported health status at pre and post assessment

Table 21: Change in patient reported health status at pre and post assessment

	n (%)
Any improvement	694 (50.7)
No change	528 (38.6)
Any worse result	146 (10.7)
ALL	**1,368 (100.0)**

Self reported mood

Almost half of patients (45%) reported an improved mood compared to the pre assessment stage. The proportion of patients reporting excellent mood scores at post assessment increased from 4% to 10%, while those with very good mood scores increased from 19% to 36%.

There were 12% of patients who reported a decrease in mood, however it is reassuring to note an overall decrease in the proportion of patients reporting fair or poor mood.

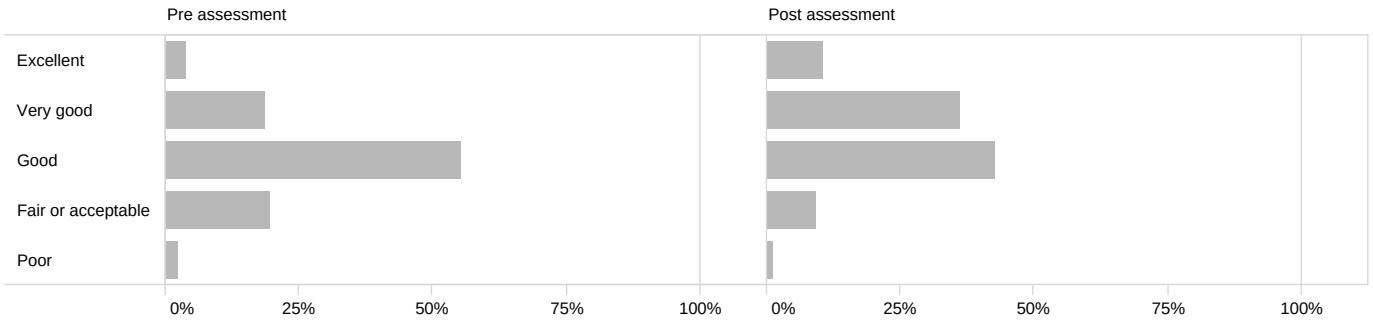


Figure 15: Comparison of patient reported mood at pre and post assessment

Table 22: Change in patient reported mood at pre and post assessment

	n (%)
Any improvement	610 (44.6)
No change	593 (43.3)
Any worse result	165 (12.1)
ALL	**1,368 (100.0)**

Self reported fitness

When asked to compare fitness level to the period six months prior to completing a CR program, over 46% of patients reported that their fitness had improved. Decreases in fitness were reported by 21% of patients. This finding may warrant further investigation as there may be various factors contributing to their reported decrease in fitness level.

Issues such as the development of significant cardiac dysfunction as a result of myocardial infarction may explain a decline in fitness. Given the result is compared to a baseline six months prior to completing CR, the patient's index cardiac event may also have occurred in this time and therefore regression may not be unexpected.

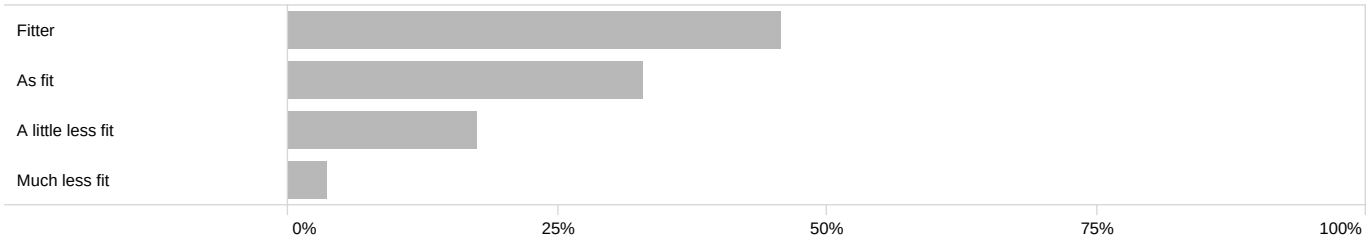


Figure 16: Patient reported change in fitness at post assessment

Table 23: Patient reported change in fitness at post assessment

	n (%)
Fitter	626 (45.8)
As fit	451 (32.9)
A little less fit	241 (17.6)
Much less fit	50 (3.7)
ALL	**1,368 (100.0)**

8.4 Failure to participate

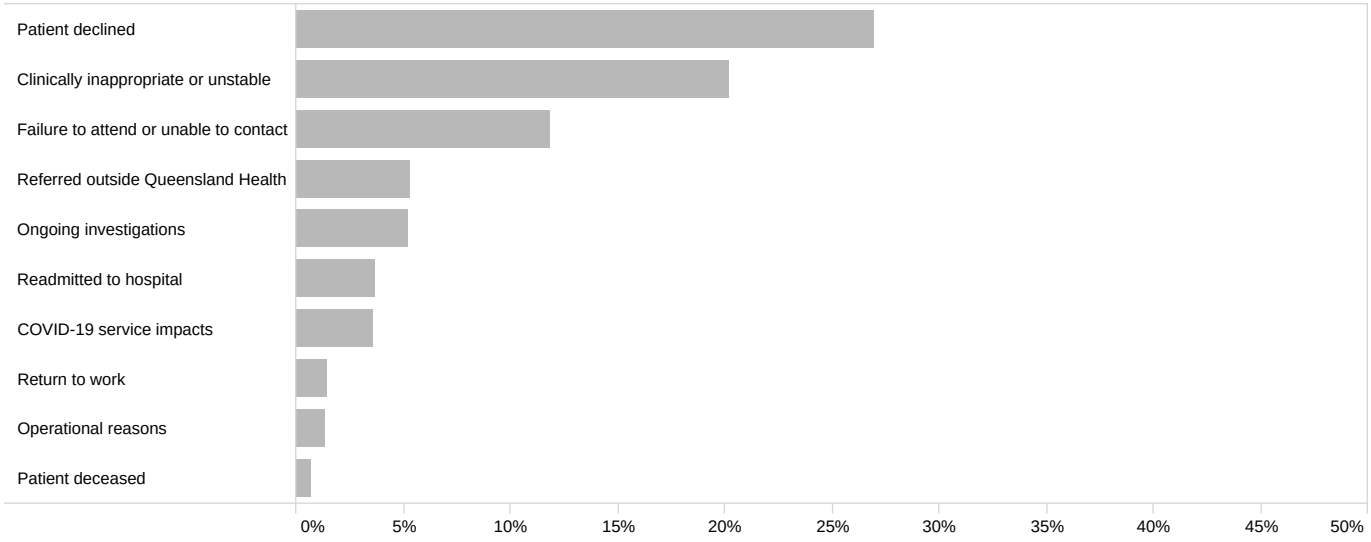
There are many reasons a patient may not participate in a CR program. In this cohort, which includes patients who declined or were unsuitable during phase 1 and phase 2, the most common reason for not participating in a CR program was that the patient had declined (27%). Twenty percent were medically inappropriate to participate or had been uncontactable or failed to attend (12%).

For 2020 referrals, 3.6% were declined due to impacts of the global COVID-19 pandemic such as compulsory service closures, staff redeployment and patient unwillingness to proceed.

An ongoing initiative has been to further define the subset of patients who did not participate in CR. The aim is to increase the level of detail available to describe the barriers to participation, identify common themes and opportunities to improve patient participation rates.

In some of these instances, the clinician may still provide opportunistic education and advice to these patients, however this is difficult to incorporate into reporting.

A limiting factor for this analysis is the amount of data available to describe this cohort, as this is limited to the information included on the initial referral only.



Not displaying other reasons (20%)

Figure 17: Reasons for no pre assessment being conducted

8.4.1 Age and gender

There is considerable variation in patient age when comparing patients who participated in CR as opposed to patients who declined or were not interested and patients who were medically unsuitable. Patients who participated in CR had a median age of 65 years, whilst patients who declined or were medically unsuitable had a median age four years older.

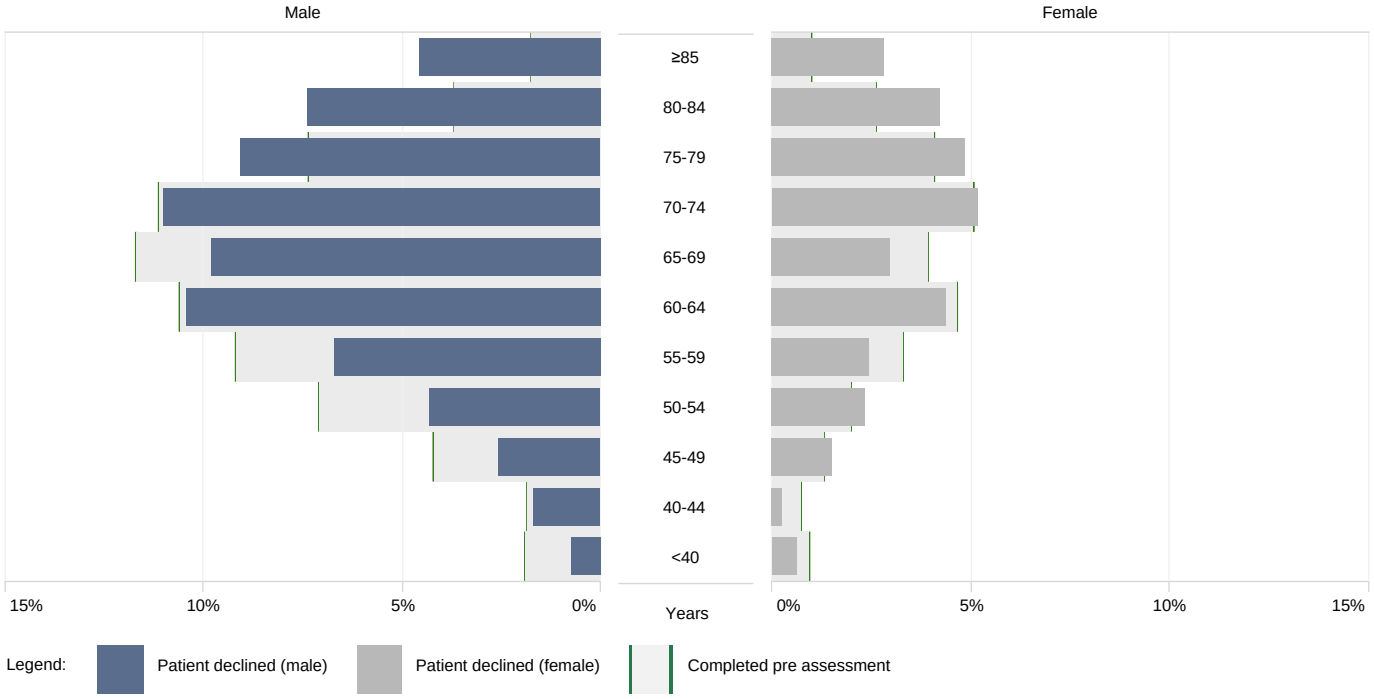


Figure 18: Patient age group and gender, patient declined vs. completed pre assessment

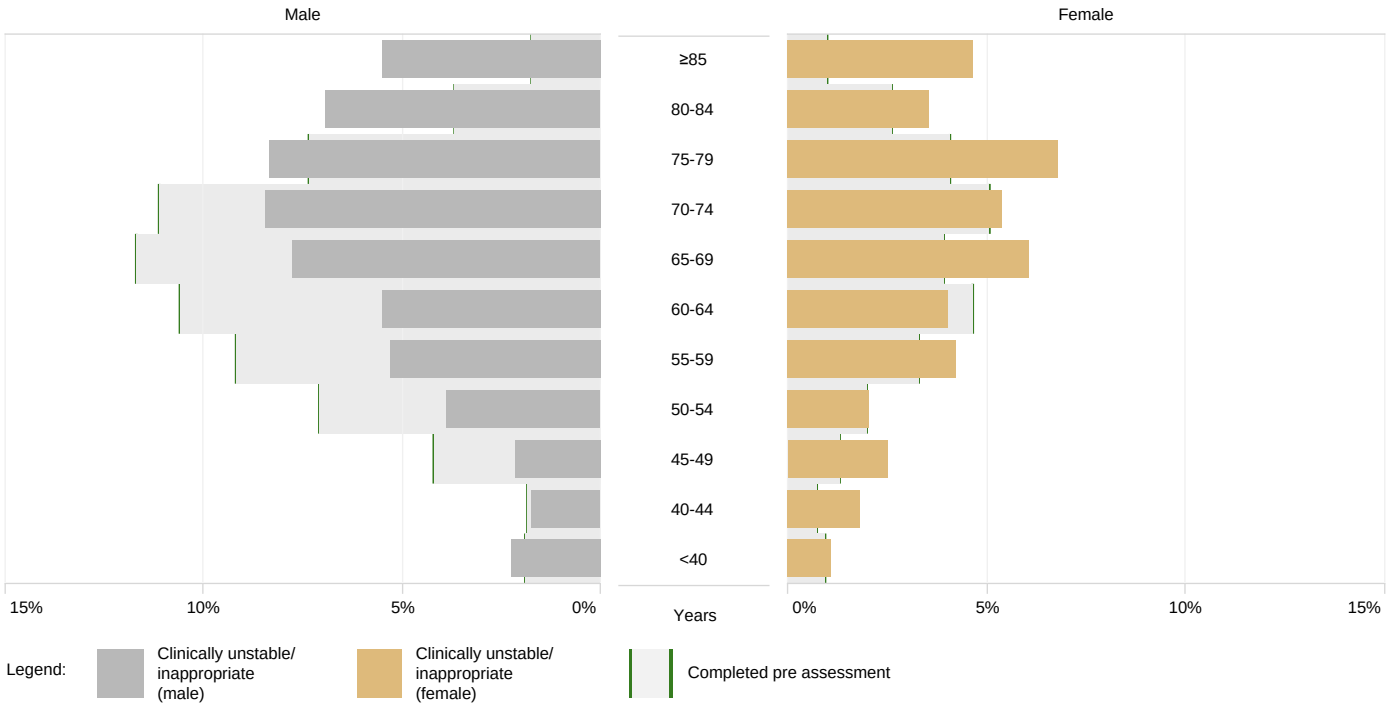


Figure 19: Patient age group and gender, clinically unstable/inappropriate vs. completed pre assessment

Table 24: Patient age (years) by program participation status

	Male Median (IQR)	Female Median (IQR)	ALL Median (IQR)
Pre assessment completed	65 (56–72)	67 (58–75)	65 (57–73)
Patient declined	69 (60–76)	71 (60–78)	69 (60–77)
Clinically unstable or inappropriate	70 (59–78)	69 (58–78)	69 (58–78)
Other reason not assessed	64 (55–73)	66 (57–77)	65 (55–74)

Table 25: Patient gender by program participation status

Gender	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
Female	2,127 (59.6)	391 (11.0)	390 (10.9)	662 (18.5)
Male	5,048 (63.6)	843 (10.6)	535 (6.7)	1,511 (19.0)
ALL	**7,175 (62.4)**	**1,234 (10.7)**	**925 (8.0)**	**2,173 (18.9)**

8.4.2 Diagnosis category

Of the patients who declined, 41% had a diagnosis of ischaemic heart disease and 4% had valvular disease. The majority (55%) had an other diagnosis.

By comparison, patients who had completed an initial assessment via CR were more likely to have a diagnosis of ischaemic heart disease or valvular heart disease (66% and 9% respectively).

Patients with no IHD or valvular disease were unlikely to commence a CR program, with 58% of these referrals declined by either the patient or the service. This may provide opportunities for services to review program offerings for these patients.

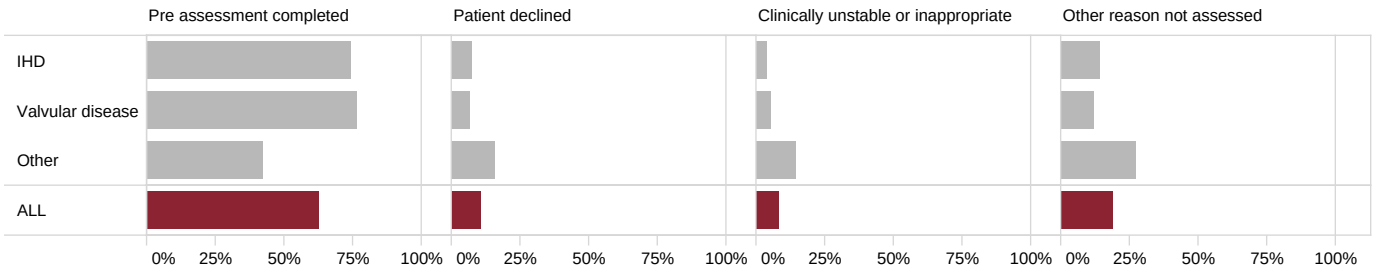


Figure 20: Proportion of cases by diagnosis category and program participation status

Table 26: Diagnosis category by program participation status

Gender	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
IHD	4,725 (74.1)	497 (7.8)	255 (4.0)	898 (14.1)
Valvular disease	626 (76.4)	54 (6.6)	43 (5.3)	96 (11.7)
Other	1,824 (42.3)	682 (15.8)	627 (14.5)	1,179 (27.3)
ALL	**7,175 (62.4)**	**1,233 (10.7)**	**925 (8.0)**	**2,173 (18.9)**

8.4.3 Most recent procedure

For the cohort that proceeded to assessment, their most recent procedure was closely related to their participation status. Eighty percent of patients who had a PCI procedure and 86% of patients who underwent CABG completed a pre assessment. This suggests that patients who have undergone an invasive cardiac procedure are more likely to have participated in a CR program.

Almost half of patients (47%) who declined CR had no recent procedure specified. Furthermore, 22% of patients that elected not to participate in CR were recorded as having undergone PCI, while approximately 8% had undergone CABG (with or without a concomitant valve procedure).

Care should be taken when interpreting these findings as this data element is not always completed at the time of referral. Therefore, it may not fully reflect the patient's medical history.

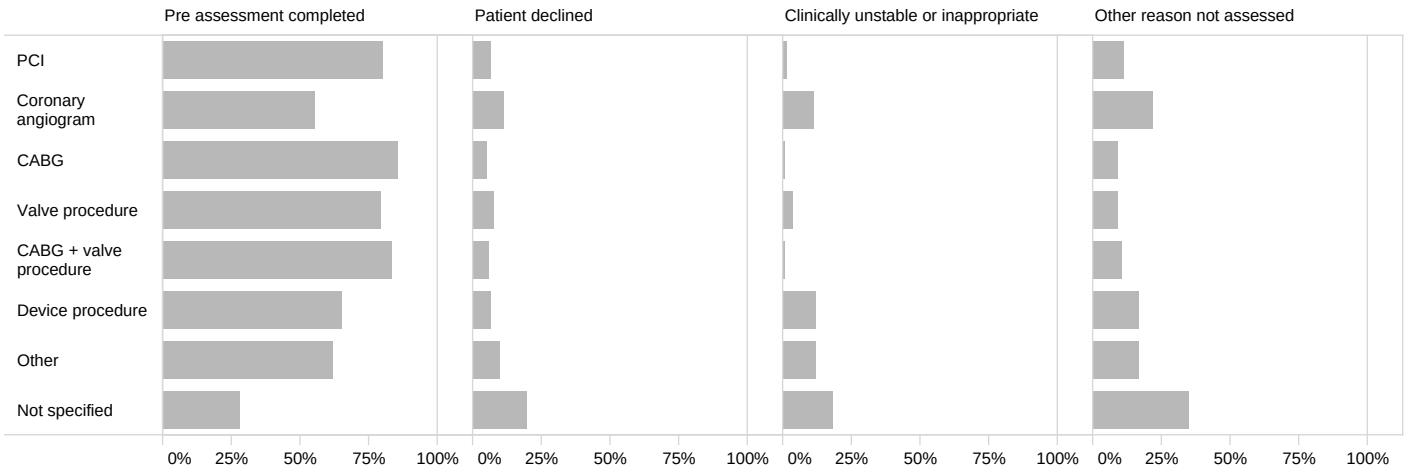


Figure 21: Proportion of referrals by most recent procedure and program participation status

Table 27: Most recent procedure by program participation status

Most recent procedure	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
PCI	2,962 (80.3)	254 (6.9)	51 (1.4)	420 (11.4)
Coronary angiogram	1,080 (55.4)	214 (11.0)	224 (11.5)	431 (22.1)
CABG	1,148 (85.5)	66 (4.9)	11 (0.8)	118 (8.8)
Valve procedure	665 (79.5)	66 (7.9)	30 (3.6)	76 (9.1)
CABG + valve procedure	145 (82.9)	11 (6.3)	1 (0.6)	18 (10.3)
Device procedure	135 (64.6)	14 (6.7)	26 (12.4)	34 (16.3)
Other	208 (61.7)	32 (9.5)	41 (12.2)	56 (16.6)
Not specified	832 (28.0)	576 (19.4)	541 (18.2)	1,020 (34.4)
ALL	**7,175 (62.4)**	**1,233 (10.7)**	**925 (8.0)**	**2,173 (18.9)**

8.4.4 Place of residence

Compared to patients who had taken up CR, a higher proportion of patients who elected not to participate resided in regional and remote areas of Queensland.

While there are many reasons a patient may wish not to participate in CR, this trend toward lower participation rates for patients in regional areas should be noted for service planning and model of care selection. These figures should be interpreted with caution due to the small numbers residing in the remote areas.

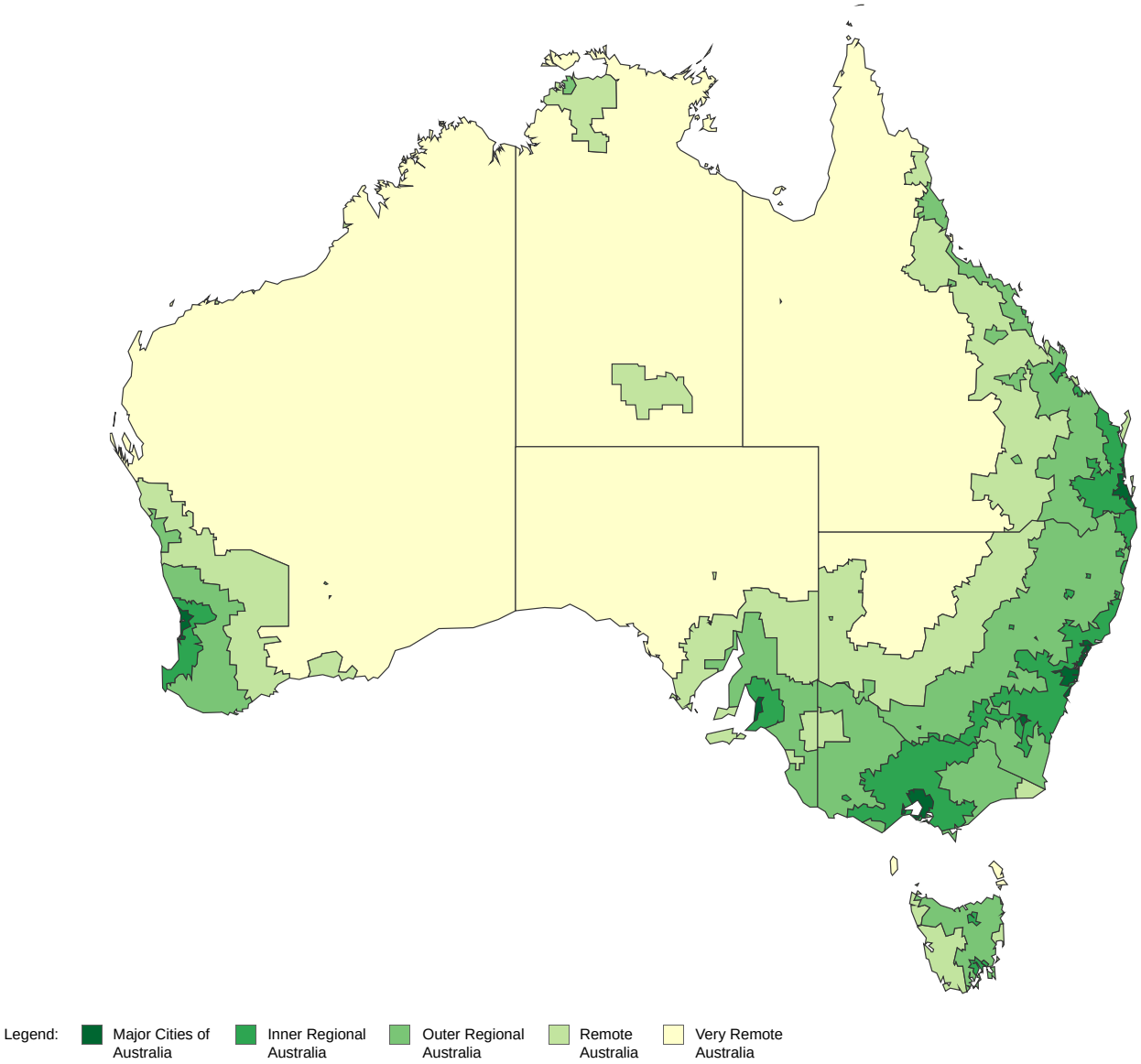


Figure 22: Australian Statistical Geography Standard remoteness areas

Table 28: Remoteness classification by program participation status

Remoteness area*	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
Major cities	3,936 (66.6)	592 (10.0)	384 (6.5)	994 (16.8)
Inner regional	1,872 (62.4)	351 (11.7)	168 (5.6)	611 (20.4)
Outer regional	1,094 (52.6)	249 (12.0)	302 (14.5)	436 (21.0)
Remote	67 (38.7)	23 (13.3)	39 (22.5)	44 (25.4)
Very remote	171 (62.4)	9 (3.3)	26 (9.5)	68 (24.8)
ALL	**7,140 (62.4)**	**1,224 (10.7)**	**919 (8.0)**	**2,153 (18.8)**

Excludes missing data (0.6%)

* Classified by Australian Statistical Geography Standard remoteness area

9 Clinical indicators

The CR clinical indicator program has been focused towards the timely provision of CR to admitted patients discharged from public hospitals. This requires collaboration between the acute and outpatient services, with each having their own targets (clinical indicators 1 and 2a respectively).

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

Table 29: Cardiac rehabilitation clinical indicators

#	Clinical indicator	Description
1	Timely referral – inpatients	Documented referral to CR within three days of discharge
2a	Timely assessment – inpatients	Initial CR pre assessment completed within 28 days of discharge
2b	Timely assessment – non acute patients	Initial CR pre assessment completed within 28 days of referral date
3	Timely journey – inpatients	Composite of timely referral and assessment

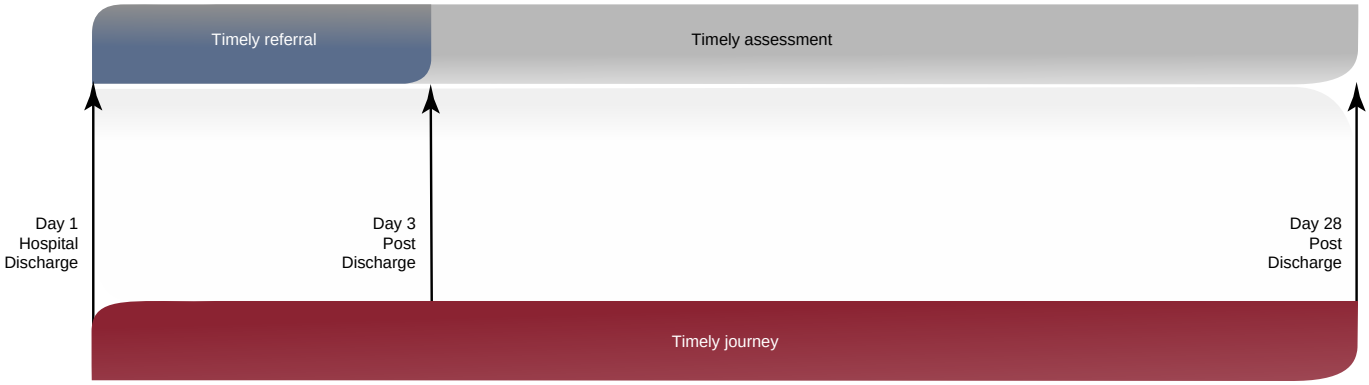


Figure 23: Timely referral, assessment and overall journey for inpatient referrals

9.1 Timely referral

This indicator examines the proportion of inpatient referrals to CR originating from a public hospital which had been provided to the CR program in a timely manner (within 3 days of referral). This requires the referral to be submitted to the outpatient program within three days of the patient being discharged from hospital.

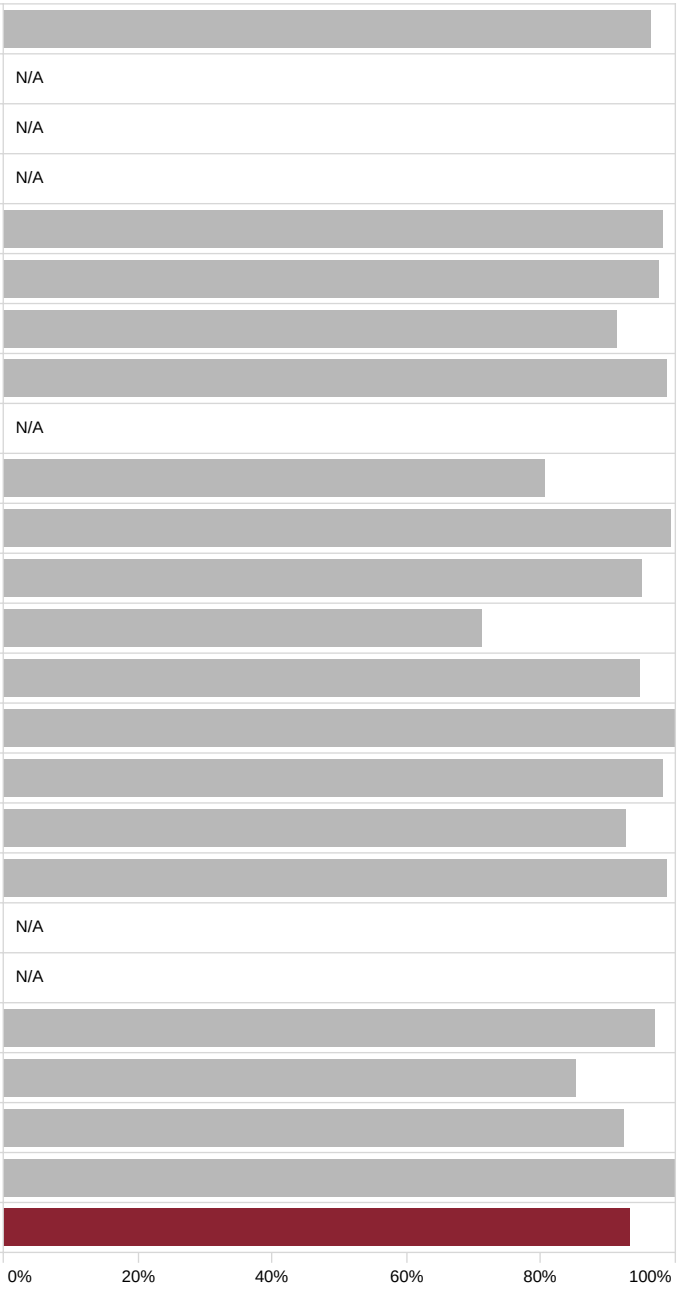
Overall, performance is high with 93% of referrals contributed to QCOR being submitted within three days of discharge.

Table 30: Timely referrals by referring HHS

Referring HHS/organisation	Total inpatient referrals n	Total eligible for analysis n	Target met n (%)
Cairns and Hinterland	705	697	671 (96.3)
Central Queensland	381	338	328 (97.0)
Darling Downs	131	128	125 (97.7)
Gold Coast	1,345	1,316	1,201 (91.3)
Mackay	92	92	91 (98.9)
Mater Health Services	95	87	70 (80.5)
Metro North	2,093	2,077	1,878 (90.4)
Metro South	1,775	1,772	1,738 (98.1)
South West	1	1	N/A
Sunshine Coast	787	753	730 (96.9)
Townsville	791	780	664 (85.1)
West Moreton	134	131	121 (92.4)
Wide Bay	67	67	67 (100.0)
Statewide	**8,397**	**8,239**	**7,685 (93.3)**

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

Referring HHS	Referred by hospital	Total analysed, n
Cairns and Hinterland	Cairns Hospital	696
	Mossman Hospital	1
Central Queensland	Gladstone Hospital	12
	Mount Morgan Hospital	1
	Rockhampton Hospital	325
Darling Downs	Toowoomba Hospital	128
Gold Coast	Gold Cost University Hospital	1,316
Mackay	Mackay Base Hospital	91
	Proserpine Hospital	1
Mater Health Services	Mater Hospital Brisbane	87
Metro North	Caboolture Hospital	137
	Redcliffe Hospital	40
	Royal Brisbane & Women's Hospital	416
	The Prince Charles Hospital	1,484
Metro South	Logan Hospital	83
	Princess Alexandra Hospital	1,547
	Queen Elizabeth II Jubilee Hospital	66
	Redland Hospital	76
South West	Charleville Hospital	1
Sunshine Coast	Nambour General Hospital	1
	Sunshine Coast University Hospital	752
Townsville	Townsville University Hospital	780
West Moreton	Ipswich Hospital	131
Wide Bay	Bundaberg Base Hospital	67
Statewide		



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

Figure 24: Timely referrals by referring hospital

9.2 Timely assessment – inpatients

This indicator examines the proportion of referrals to CR which proceed to an assessment within 28 days of discharge. In order to retain focus on the performance of the outpatient CR program, referrals which are not provided in a timely manner (<3 days from discharge) have been excluded from the analysis. Further to this, other ineligibility criteria are outlined in Table 31. The exclusions are applied where information is available and has been documented in the application.

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

Table 31: Summary of referrals ineligible for timely assessment clinical indicator – inpatients

Summary	n
Not referred within 3 days of discharge	519
Referred outside of Queensland Health	185
Clinically unstable/inappropriate	162
Same day admission	155
Patient readmitted to hospital	148
Patient accepted onto existing program	58
Patient deceased	29
ALL	**1,256**

Table 32: Timely assessment indicator by outpatient HHS – inpatients

Outpatient HHS/division	Total inpatient referrals n	Total eligible for analysis n	Target met n (%)
Cairns and Hinterland	686	568	358 (63.0)
Central Queensland	612	494	251 (50.8)
Central West	21	20	15 (75.0)
Darling Downs	346	326	109 (33.4)
Gold Coast	1,329	1,027	731 (71.2)
Health Contact Centre	1,042	816	501 (61.4)
Mackay	175	169	27 (16.0)
Metro North	1,008	889	536 (60.3)
Metro South	1,256	1,174	901 (76.7)
North West	44	31	24 (77.4)
South West	28	27	12 (44.4)
Sunshine Coast	860	728	450 (61.8)
Townsville	379	313	148 (47.3)
West Moreton	370	349	248 (71.1)
Wide Bay	241	210	116 (55.2)
Statewide	**8,397**	**7,141**	**4,427 (62.0)**

Outpatient HHS/division	Outpatient program	Total analysed, n
Cairns and Hinterland	Atherton	59
	Cairns	479
	Innisfail	58
	Mareeba	31
	Tully	34
Central Queensland	Biloela	23
	Capricorn Coast	82
	Gladstone	88
	Mount Morgan	31
	Rockhampton	346
Darling Downs	Dalby-Tara	28
	Kingaroy	72
	Toowoomba	168
	Warwick	37
Gold Coast	Gold Coast	1,303
Health Contact Centre	SMoCC	1,018
Mackay	Mackay	136
	Proserpine	29
Metro North	Caboolture	295
	Chermside	301
	North Lakes	267
	Redcliffe	112
	The Prince Charles Hospital	24
Metro South	Bayside	323
	Eight Mile Plains	127
	Inala	96
	Logan-Beaudesert	484
	Princess Alexandra Hospital	217
North West	Mt Isa	44
Sunshine Coast	Caloundra	225
	Gympie	144
	Maroochydore	175
	Nambour	137
	Noosa	153
Townsville	Ayr	31
	Ingham	32
	Townsville	294
West Moreton	Ipswich	368
Wide Bay	Hervey Bay	156
	Maryborough	63
Statewide		

Sites with <20 referrals for analysis not displayed

Figure 25: Timely assessment by outpatient program – inpatients

9.3 Timely assessment – non acute patients

This indicator examines the proportion of referrals from the non acute setting which proceed to an assessment within 28 days of referral. The majority of non acute patients (57%) are being assessed in a timely manner, with some notable variation between health services.

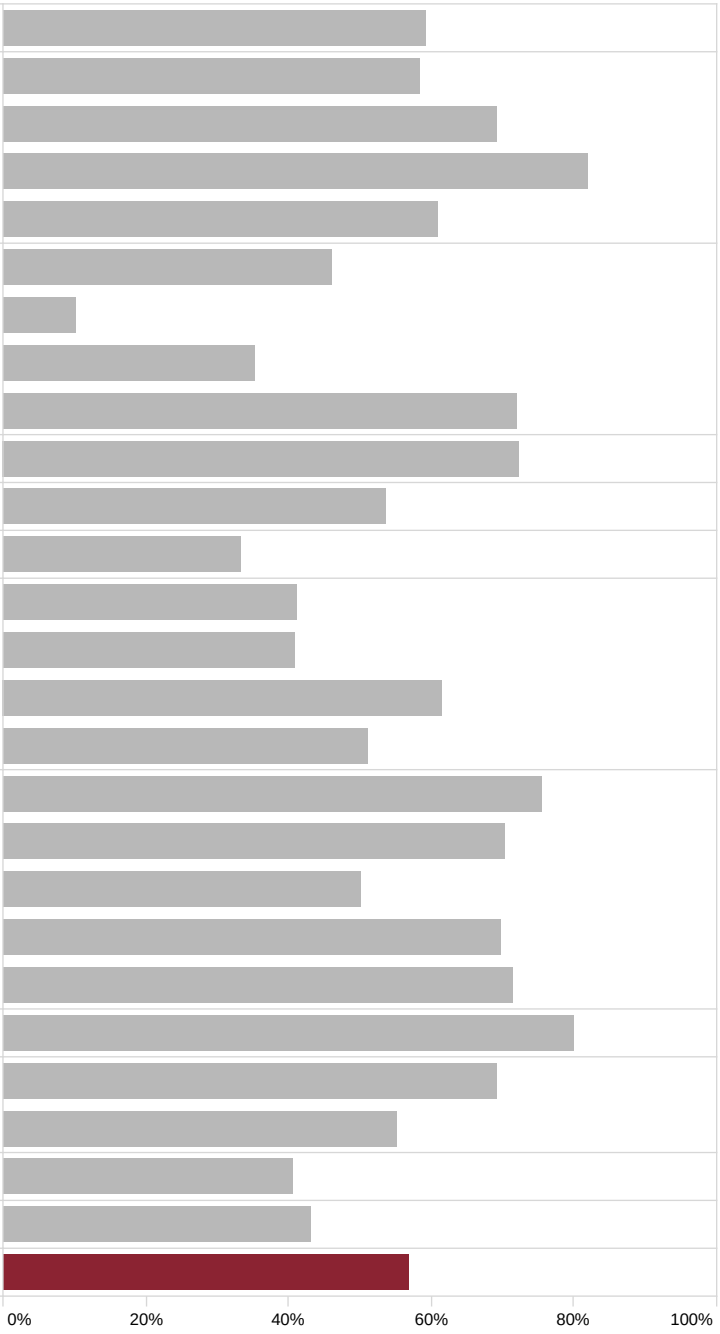
Table 33: Summary of referrals ineligible for timely assessment clinical indicator – non acute patients

Summary	n
Referred outside of Queensland Health	57
Clinically unstable/inappropriate	37
Patient accepted onto an existing program	23
Patient admitted to hospital	10
Patient deceased	4
ALL	**131**

Table 34: Timely assessment indicator by outpatient HHS – non acute patients

Outpatient HHS/division	Total non acute referrals n	Total eligible for analysis n	Target met n (%)
Cairns and Hinterland	67	62	37 (59.7)
Central Queensland	414	403	260 (64.5)
Central West	20	20	16 (80.0)
Darling Downs	151	148	66 (44.6)
Gold Coast	249	210	152 (72.4)
Health Contact Centre	211	194	104 (53.6)
Mackay	110	102	28 (27.5)
Metro North	413	401	198 (49.4)
Metro South	450	436	311 (71.3)
North West	20	20	16 (80.0)
South West	34	34	21 (61.8)
Sunshine Coast	96	90	61 (67.8)
Townsville	111	108	38 (35.2)
West Moreton	393	380	164 (43.2)
Wide Bay	41	41	36 (87.8)
Statewide	**2,780**	**2,649**	**1,508 (56.9)**

Outpatient HHS/division	Outpatient program	Total analysed, n
Cairns and Hinterland	Cairns	27
Central Queensland	Capricorn Coast	67
	Gladstone	87
	Mount Morgan	39
	Rockhampton	202
Darling Downs	Dalby-Tara	39
	Kingaroy	29
	Toowoomba	37
	Warwick	32
Gold Coast	Gold Coast	210
Health Contact Centre	SMoCC	194
Mackay	Mackay	84
Metro North	Caboolture	146
	Chermside	44
	North Lakes	122
	Redcliffe	88
Metro South	Bayside	176
	Eight Mile Plains	74
	Inala	20
	Logan-Beaudesert	138
	Princess Alexandra Hospital	28
North West	Mt Isa	20
Sunshine Coast	Caloundra	29
	Maroochydore	20
Townsville	Townsville	91
West Moreton	Ipswich	380
Statewide		



Sites with <20 referrals for analysis not displayed

Figure 26: Timely assessment by outpatient program – non acute patients

9.4 Timely journey

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

Referrals are excluded from the analysis for the reasons outlined in Table 35. The exclusions are applied where information is available and has been documented in the application.

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

Table 35: Summary of referrals ineligible for timely journey clinical indicator – inpatients

Summary	n
Referred outside of Queensland Health	185
Clinically unstable/inappropriate	162
Same day admission	155
Patient readmitted to hospital	148
Patient accepted onto existing program	58
Patient deceased	29
ALL	**737**

Table 36: Timely journey indicator by participating HHS – inpatients

Participating HHS/ organisation	Total inpatient referrals* n	Total eligible for analysis* n	Target met n (%)
Cairns and Hinterland	822	723	440 (60.9)
Central Queensland	650	567	261 (46.0)
Central West	21	21	15 (71.4)
Darling Downs	383	360	115 (31.9)
Gold Coast	1,387	1,178	760 (64.5)
Health Contact Centre	1,042	918	501 (54.6)
Mackay	177	174	27 (15.5)
Mater Health Services	95	85	52 (61.2)
Metro North	2,128	2,025	1,186 (58.6)
Metro South	1,954	1,891	1,287 (68.1)
North West	44	41	24 (58.5)
South West	28	27	12 (44.4)
Sunshine Coast	998	865	503 (58.2)
Townsville	802	757	330 (43.6)
West Moreton	400	385	257 (66.8)
Wide Bay	293	271	142 (52.4)
Statewide	**8,397**	**7,660**	**4,427 (57.8)**

* Includes both incoming and outgoing referrals

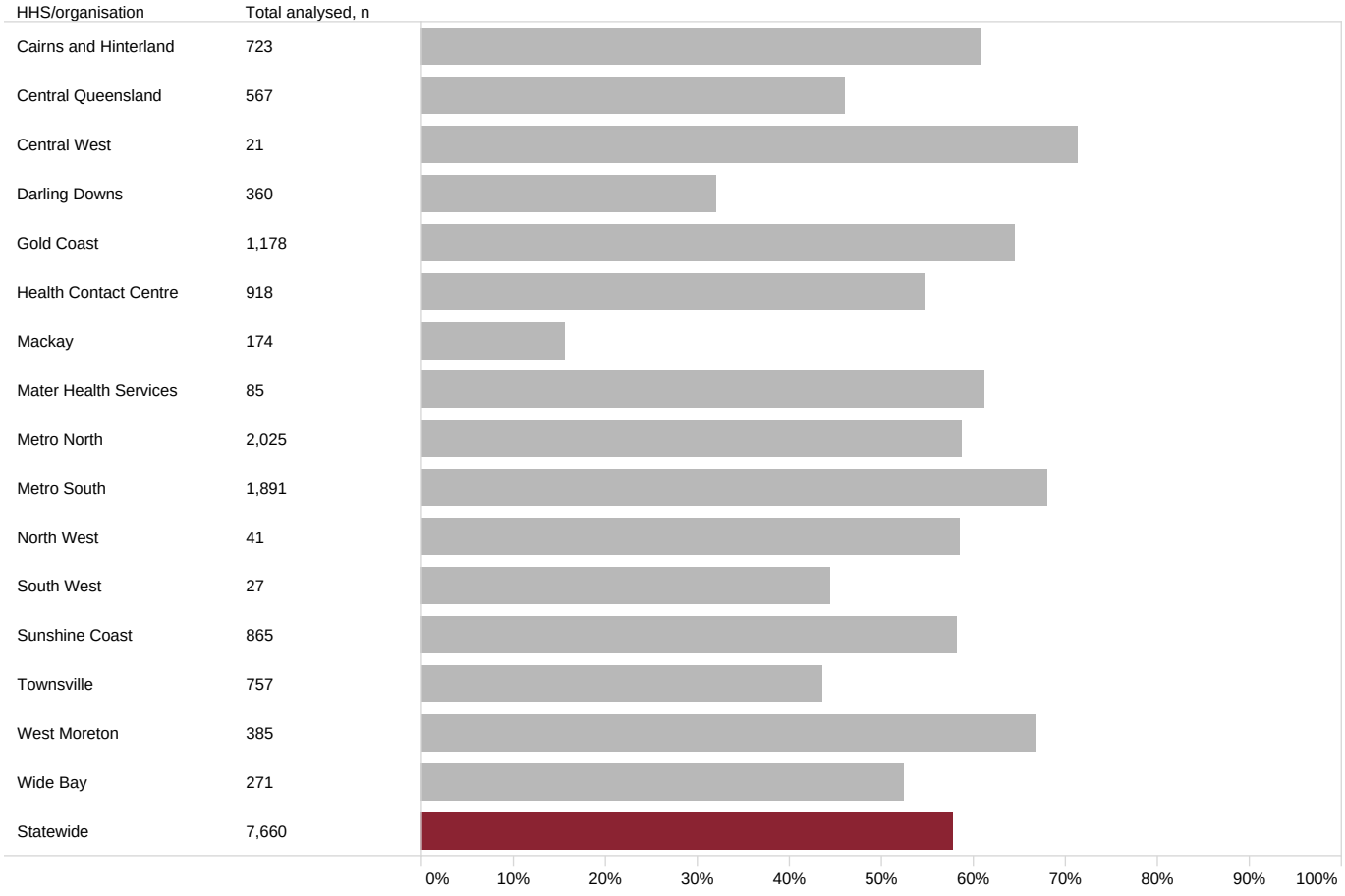
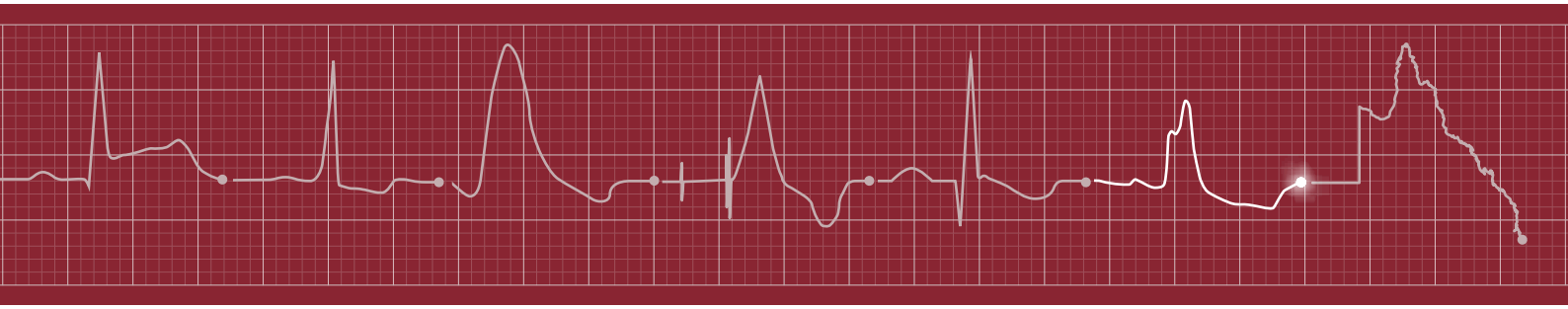


Figure 27: Timely journey indicator by participating HHS – inpatients

Heart Failure Support Services Audit



1 Message from the Heart Failure Steering Committee Chair

Patients living with symptomatic chronic heart failure have the opportunity to be supported by heart failure services until their condition is stabilised and therapy is optimised. Every new referral is audited, and outcomes are followed for 12 months. Between 2016 and 2020 there have been 24,395 audits of 19,000 unique patients.

Clinical indicators measure the timeliness of follow-up of referrals, evaluation of ejection fraction, and the prescription and titration of key heart failure medications. The performance on clinical indicators is accompanied by a coordinated program of education and quality improvement activities to address systems of care. Outcome measures include rehospitalisations, survival and time alive and out of hospital.

The Statewide Cardiac Clinical Informatics Unit (SCCIU) work closely with clinical leads to develop the registry including the introduction of new indicators and patient management tools. Next year an indicator will be introduced on the prescription of sodium-glucose co-transporter-2 (SGLT2) inhibitor as the evidence supporting their use has changed rapidly in the last two years.

I would like to thank the heart failure service nurses who collects the data as part of everyday clinical practice, demonstrating an ongoing commitment to quality improvement and dedication to patient care.

Finally, I wish to acknowledge those living with chronic heart failure. This registry will inform care to improve or maintain quality of life (which includes good symptom control, endurance, emotional support, and less time hospitalised) and prevent disease progression.

Associate Professor John Atherton
Chair
QCOR Heart Failure Committee

2 Key findings

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

The majority of the 5,664 referrals were male (68%), non-Indigenous (95.1%), referred to South East Queensland HFSS (82%), from an inpatient setting (67%) and diagnosed with HFrEF (80.9%).

The median age of referrals was 69 years old with male patients presenting younger than females (68 years vs. 71 years respectively). Aboriginal and Torres Strait Islander peoples represented a younger cohort compared with non-Indigenous patients (56 years vs. 70 years respectively), while HFrEF patients were younger than HFpEF patients (67 years vs. 76 years respectively). Patients aged 80 years or older represented over 21% of total cases.

Clinical indicator performance

Most indicators met benchmarks at a statewide level except for prescription of mineralocorticoid receptor antagonists for HFrEF (clinical indicator 5a and 5b) and the review and titration of beta blockers (clinical indicator 6a, 6b and 6c).

There is variation in practice with many of the 21 HFSS below benchmarks for clinical indicators 1a (follow-up of inpatient referrals in two weeks) and 6a, 6b and 6c (beta blocker review and titration).

Prescribing of guideline directed medications met benchmarks for all sites except for MRA (clinical indicator 5) which was uniformly below benchmarks.

Table 1: Summary of statewide clinical indicator performance

#	Clinical indicator	% referrals
1a	Follow-up of acute patients within 2 weeks	80.0*
1b	Follow-up of non acute patients within 4 weeks	84.0*
2	Assessment of left ventricular ejection fraction within 2 years	96.3*
3a	ACEI/ARB or ARNI† prescription at hospital discharge	91.7*
3b	ACEI/ARB or ARNI† at first clinical review	92.0*
4a	Beta blocker‡ prescription at hospital discharge	91.6*
4b	Beta blocker‡ prescription at first clinical review	91.7*
5a	Prescription of MRA§ for HFrEF at time of hospital discharge	46.3
5b	Prescription of MRA§ for HFREF at time of first HFSS clinical review	46.3
6a	Beta blocker‡ titration status review at six months post referral	74.9
6b	Beta blocker‡ achievement of guideline recommended target	32.0
6c	Beta blocker‡ achievement of guideline recommended target dose or maximum tolerated dose	77.2

* Benchmark met (benchmark is 80% achievement except for 6b which is 50%)

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

‡ Bisoprolol, carvedilol, metoprolol sustained release or nebivolol

§ Mineralocorticoid receptor antagonists

Patient outcomes

Patient outcomes are based on inpatient referrals from the previous year to allow for 12 month follow-up from the index hospitalisation. Key findings are summarised in Table 2.

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

#	Measures post index hospitalisation*	30 days	1 year
1	All-cause mortality	1.4%	13.4%
2	a) All-cause rehospitalisation	18.1%	53.9%
	b) Heart failure rehospitalisation	5.7%	22.0%
3	Composite all-cause hospitalisation or all-cause mortality	18.5%	55.0%
4	Days alive and out of hospital†	N/A	364 median days

* Commences from date of discharge for index admission

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

3 Participating sites

Heart Failure Support Services (HFSS) consists of teams of specialised nurses, with medical support and allied health services. There are 21 services which contributed data to this year's annual report and the locations and services offered are shown in Figure 1 and Table 4 respectively.

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

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

Figure 1: Heart Failure Support Service (HFSS) locations

Table 4: Components of Queensland Heart Failure Support Services (HFSS)

		HFSS disciplines				Modes of service (telephone + ...)				
HHS	**Facility**	**Nurse**	**NP***	**Pharm†**	**Physio or AEP‡**	**In-patient**	**Nurse or MD clinics**	**Home visits**	**Rehab programs**	**Medical mentor§**
Cairns and Hinterland	CH	Y	Y	–	Y	Y	Y	Y	Y	Y
Central Queensland	GLH	Y	–	–	Y	–	–	–	Y	Video clinic
	RKH	Y	Y	Y	Y	Y	Y	–	Y	Y
Darling Downs	TWH	Y	–	Y	R	–	Y	Y		Y
Gold Coast	GCCH	Y	–	Y	Y	Y	Y	Y	Y	Y
Mackay	MKH	Y	–	–	Y	Y	Y	–	Y	Y
Metro North	CBH	Y	–	Y	–	–	Y	–	–	Y
	RDH	Y	Y	Y	–	–	–	Y	–	Y
	RBWH	Y	–	Y	Y	Y	Y	–	Y	Y
	TPCH	Y	Y	Y	Y	Y	Y	–	Y	Y
Metro South	LGH	Y	Y	Y	Y	Y	Y	Y	Y	Y
	PAH	Y	Y	Y	Y	Y	Y	Y	Y	Y
	QEII	Y	Y	Y	R	Y	Y	Y	–	Y
	RLH	Y	Y	–	Y	Y	Y	Y	Y	Y
North West	MIH	Y	Y	Y	R	Y	Y	Y	–	Outreach
Sunshine Coast	GYH	Y	–	–	–	Y	Y	Y	–	Y
	SCUH	Y	Y	–	R	Y	Y	Y	–	Y
Townsville	TTH	Y	Y	Y	R	Y	Y	Y	–	Y
West Moreton	IPCH	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wide Bay	BNH	Y	–	–	R	–	Y	–	–	Y
	HBH	Y	Y	–	Y	Y	Y	Y	Y	Video clinic
Statewide		100%	62%	62%	86%	76%	90%	62%	57%	100%

* Nurse practitioner who can prescribe medications

† Pharmacist

‡ Physiotherapist or accredited exercise physiologist

§ The HFSS has a cardiologist or general physician mentor

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

4 New referrals

There were 5,664 new referrals reported by the 21 participating HFSS, with Metropolitan sites comprising 51% of all referrals. Five year trends in referral to HFSS can be seen in the figure below. Between 2016 and 2020 referral volumes increased by 41%.

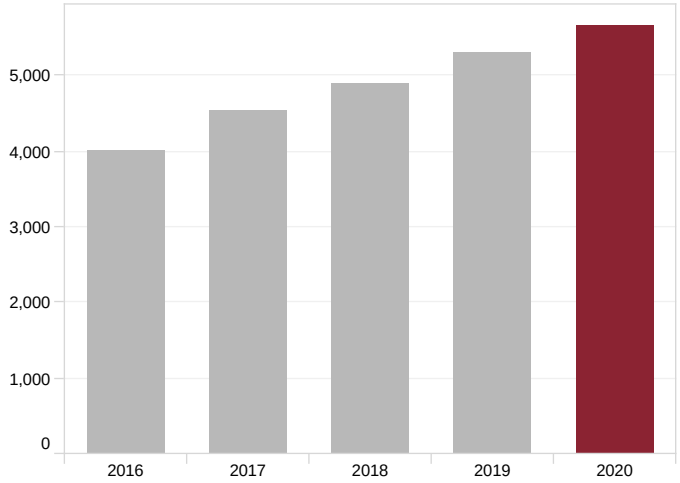


Figure 2: Total yearly HF referrals, 2016–2020

Table 5: Yearly HF referral volume, 2016–2020

	2016 n	2017 n	2018 n	2019 n	2020 n
Yearly referrals	4,021	4,528	4,878	5,304	5,664

4.1 Location of referrals

Table 6: Distribution of new referrals by HFSS location

Referrals per HHS	n (%)	Referrals per facility	n (%)
Cairns and Hinterland	150 (2.6)	Cairns Hospital	150 (2.6)
Central Queensland	234 (4.1)	Gladstone Hospital	15 (0.3)
		Rockhampton Hospital	219 (3.9)
Darling Downs	50 (0.9)	Toowoomba Hospital	50 (0.9)
Gold Coast	550 (9.7)	Gold Coast Community Health	550 (9.7)
Mackay	105 (1.9)	Mackay Base Hospital	105 (1.9)
Metro North	1,764 (31.1)	Caboolture Hospital	194 (3.4)
		Redcliffe Hospital	158 (2.8)
		Royal Brisbane & Women's Hospital	454 (8.0)
		The Prince Charles Hospital HFS	958 (16.9)
Metro South	1,416 (25.0)	Logan Hospital	432 (7.6)
		Princess Alexandra Hospital	618 (10.9)
		Queen Elizabeth II Hospital	162 (2.9)
		Redland Hospital	204 (3.6)
North West	47 (0.8)	Mt Isa Hospital	47 (0.8)
Sunshine Coast	522 (9.2)	Gympie	82 (1.4)
		Sunshine Coast University Hospital	440 (7.8)
Townsville	260 (4.6)	Townsville Hospital	260 (4.6)
West Moreton	397 (7.0)	Ipswich Community Health	397 (7.0)
Wide Bay	169 (3.0)	Bundaberg Hospital	105 (1.9)
		Hervey Bay/Maryborough Hospitals	64 (1.1)
Statewide			**5,664 (100.0)**

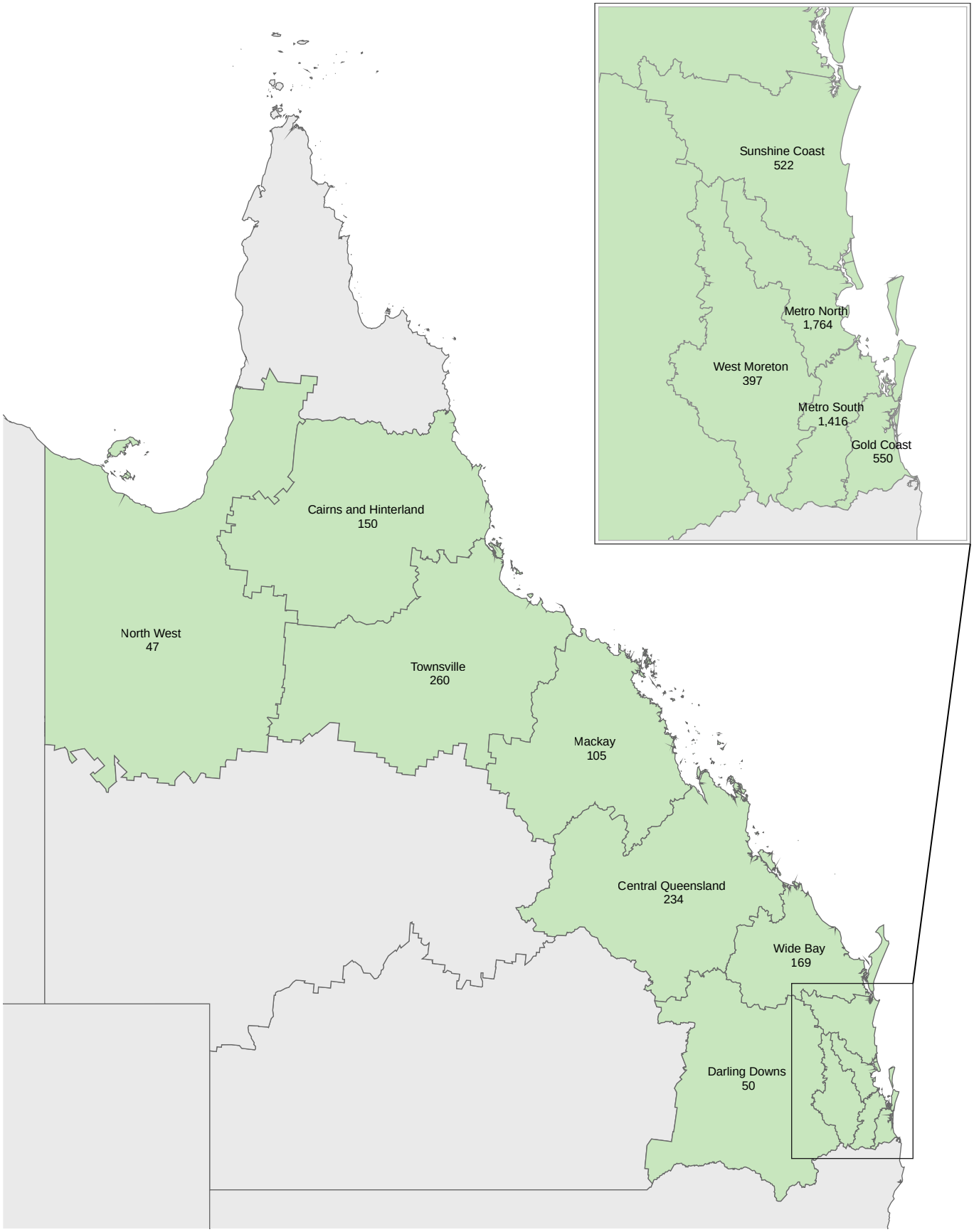


Figure 3: Regional distribution of new referrals

4.2 Referral source

Most referrals originated from an inpatient setting (67%), with smaller proportions originating from an outpatient setting (21%) or as a transfer from another service (9%).

Few referrals came directly from primary care (3%), which is expected as most referrals flow to specialty outpatient clinics for diagnosis and treatment optimisation prior to referral to an HFSS.

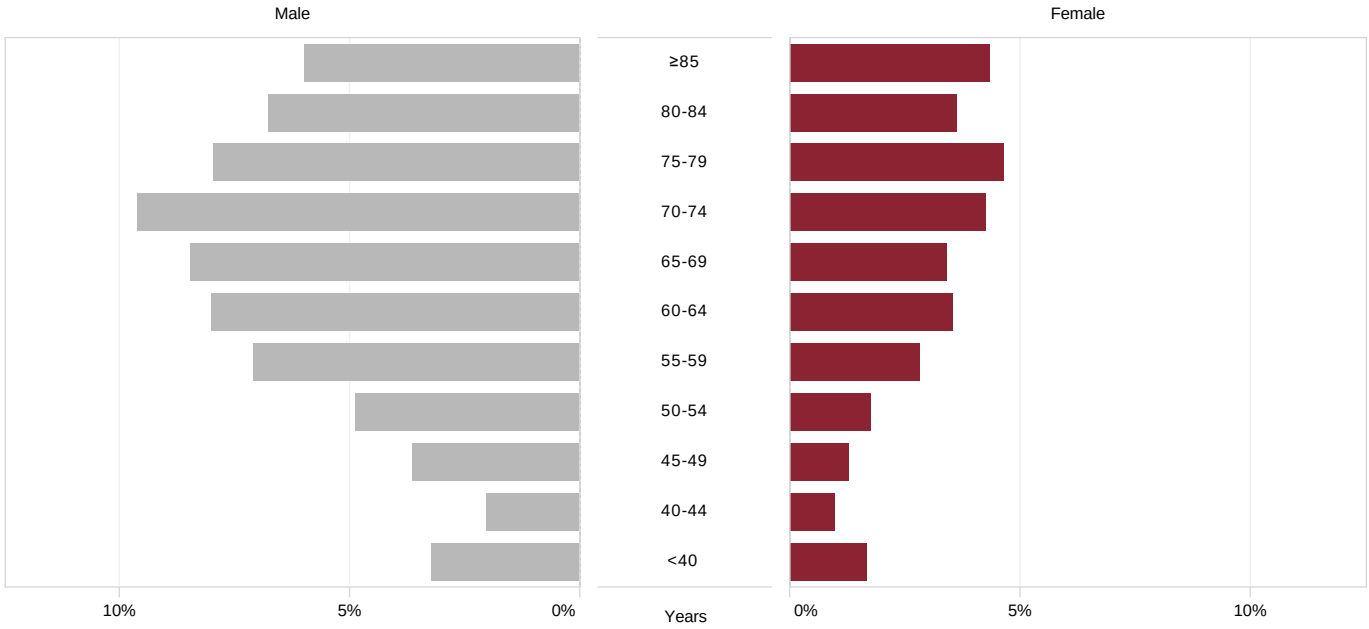
Table 7: Source of HFSS referral

HHS	HFSS	Inpatient n (%)	Outpatient n (%)	Another HFSS n (%)	Primary care n (%)
Cairns and Hinterland	Cairns Hospital	93 (62.0)	54 (36.0)	1 (0.7)	2 (1.3)
Central Queensland	Gladstone Hospital	7 (46.7)	4 (26.7)	4 (26.7)	–
	Rockhampton Hospital	147 (67.1)	40 (18.3)	4 (1.8)	28 (12.8)
Darling Downs	Toowoomba Hospital	6 (12.0)	44 (88.0)	–	–
Gold Coast	Gold Coast Community Health	389 (70.7)	118 (21.5)	25 (4.5)	18 (3.3)
Mackay	Mackay Base Hospital	51 (48.6)	51 (48.6)	3 (2.9)	–
Metro North	Caboolture Hospital	35 (18.0)	51 (26.3)	33 (17.0)	75 (38.7)
	Redcliffe Hospital	24 (15.2)	84 (53.2)	50 (31.6)	–
	Royal Brisbane & Women's Hospital	351 (77.3)	96 (21.1)	7 (1.5)	–
	The Prince Charles Hospital	870 (90.8)	81 (8.5)	6 (0.6)	1 (0.1)
Metro South	Logan Hospital	271 (62.7)	28 (6.5)	125 (28.9)	8 (1.9)
	Princess Alexandra Hospital	558 (90.3)	51 (8.3)	9 (1.5)	–
	Queen Elizabeth II Hospital	109 (67.3)	33 (20.4)	19 (11.7)	1 (0.6)
	Redland Hospital	61 (29.9)	65 (31.9)	77 (37.7)	1 (0.5)
North West	Mt Isa Hospital	9 (19.1)	30 (63.8)	–	8 (17.0)
Sunshine Coast	Gympie Hospital	34 (41.5)	11 (13.4)	35 (42.7)	2 (2.4)
	Sunshine Coast University Hospital	332 (75.5)	93 (21.1)	15 (3.4)	–
Townsville	Townsville Hospital	153 (58.8)	105 (40.4)	1 (0.4)	1 (0.4)
West Moreton	Ipswich Community Health	206 (51.9)	124 (31.2)	60 (15.1)	7 (1.8)
Wide Bay	Bundaberg Hospital	62 (59.0)	25 (23.8)	15 (14.3)	3 (2.9)
	Hervey Bay Hospital	14 (21.9)	16 (25.0)	30 (46.9)	4 (6.3)
Statewide		**3,782 (66.8)**	**1,204 (21.3)**	**519 (9.2)**	**159 (2.8)**

5 Patient characteristics

5.1 Age and gender

The statewide median age of patients managed by an HFSS was 69 years. The median age of women (71 years) was three years older than men. One third of patients (33%) were 75 years of age and older.



% of total (n=5,664)

Figure 4: Proportion of all referrals by gender and age group

Table 8: Median age in years by gender and HFSS

HHS	HFSS	Male years	Female years	All years
Cairns and Hinterland	Cairns Hospital	65	70	66
Central Queensland	Gladstone Hospital	72	65	68
	Rockhampton Hospital	68	68	68
Darling Downs	Toowoomba Hospital	62	63	62
Gold Coast	Gold Coast Community Health	70	74	71
Mackay	Mackay Base Hospital	70	68	69
Metro North	Caboolture Hospital	70	71	70
	Redcliffe Hospital	72	75	74
	Royal Brisbane & Women's Hospital	71	73	71
	The Prince Charles Hospital	69	74	70
Metro South	Logan Hospital	66	69	67
	Princess Alexandra Hospital	66	68	66
	Queen Elizabeth II Hospital	69	69	69
	Redland Hospital	68	73	70
North West	Mt Isa Hospital	57	59	58
Sunshine Coast	Gympie Hospital	76	74	76
	Sunshine Coast University Hospital	69	71	69
Townsville	Townsville Hospital	63	61	63
West Moreton	Ipswich Community Health	70	69	70
Wide Bay	Bundaberg Hospital	68	73	69
	Hervey Bay Hospital	72	79	74
Statewide		**68**	**71**	**69**

5.2 Gender

The majority of patients were male (68%), ranging from 51% to 78% across participating sites.

Table 9: Referrals by gender and HFSS

HHS	HFSS	Male n (%)	Female n (%)
Cairns and Hinterland	Cairns Hospital	117 (78.0)	33 (22.0)
Central Queensland	Gladstone Hospital	11 (73.3)	4 (26.7)
	Rockhampton Hospital	145 (66.2)	74 (33.8)
Darling Downs	Toowoomba Hospital	37 (74.0)	13 (26.0)
Gold Coast	Gold Coast Community Health	370 (67.3)	180 (32.7)
Mackay	Mackay Base Hospital	74 (70.5)	31 (29.5)
Metro North	Caboolture Hospital	143 (73.7)	51 (26.3)
	Redcliffe Hospital	101 (63.9)	57 (36.1)
	Royal Brisbane & Women's Hospital	292 (64.3)	162 (35.7)
	The Prince Charles Hospital	617 (64.4)	341 (35.6)
Metro South	Logan Hospital	297 (68.8)	135 (31.3)
	Princess Alexandra Hospital	452 (73.1)	166 (26.9)
	Queen Elizabeth II Hospital	103 (63.6)	59 (36.4)
	Redland Hospital	135 (66.2)	69 (33.8)
North West	Mt Isa Hospital	24 (51.1)	23 (48.9)
Sunshine Coast	Gympie Hospital	53 (64.6)	29 (35.4)
	Sunshine Coast University Hospital	313 (71.1)	127 (28.9)
Townsville	Townsville Hospital	184 (70.8)	76 (29.2)
West Moreton	Ipswich Community Health	247 (62.2)	150 (37.8)
Wide Bay	Bundaberg Hospital	78 (74.3)	27 (25.7)
	Hervey Bay Hospital	45 (70.3)	19 (29.7)
Statewide		**3,838 (67.8)**	**1,826 (32.2)**

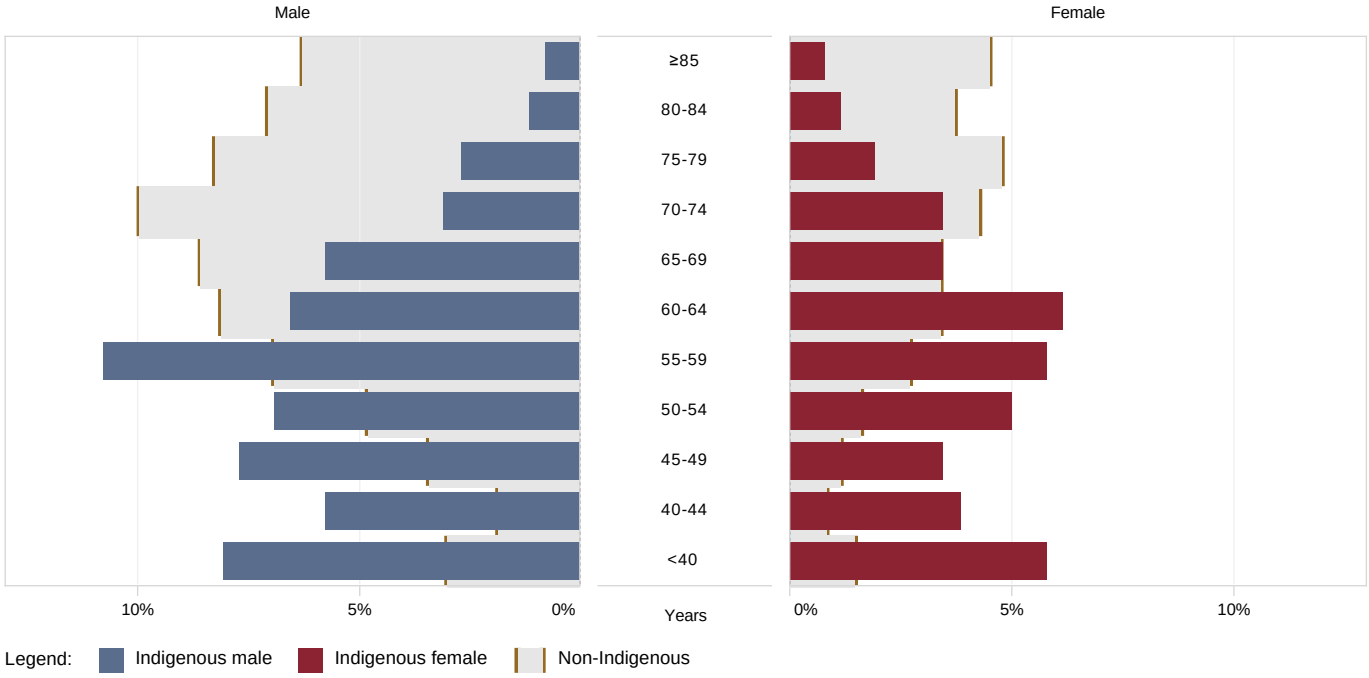
5.3 Aboriginal and Torres Strait Islander status

Patients of identified Aboriginal and Torres Strait Islander status made up 4.6% of all referrals. The number of referrals (260) was consistent with the previous year (243). Aboriginal and Torres Strait Islander patients were significantly younger than other Queenslanders. The proportion of caseload of Aboriginal and Torres Strait Islander patients was highest in Mount Isa (43% of all referrals), followed by Cairns (19%) and Townsville (16%).

The number of Aboriginal and Torres Strait Islander referrals in the Greater Brisbane area (Metro North and Metro South HHS) was 110 (42% of referrals statewide for Indigenous Australians).

Table 10: Aboriginal and Torres Strait Islander HFSS referrals as a proportion of caseload

HHS	HFSS	Indigenous n (%)	Non-Indigenous n (%)	Not stated / unknown n (%)
Cairns and Hinterland	Cairns Hospital	29 (19.3)	121 (80.7)	–
Central Queensland	Gladstone Hospital	–	15 (100.0)	–
	Rockhampton Hospital	23 (10.5)	196 (89.5)	–
Darling Downs	Toowoomba Hospital	2 (4.0)	47 (94.0)	1 (2.0)
Gold Coast	Gold Coast Community Health	6 (1.1)	541 (98.4)	3 (0.5)
Mackay	Mackay Base Hospital	5 (4.8)	100 (95.2)	–
Metro North	Caboolture Hospital	4 (2.1)	190 (97.9)	–
	Redcliffe Hospital	6 (3.8)	152 (96.2)	–
	Royal Brisbane & Women's Hospital	16 (3.5)	437 (96.3)	1 (0.2)
	The Prince Charles Hospital	34 (3.5)	920 (96.0)	4 (0.4)
Metro South	Logan Hospital	13 (3.0)	419 (97.0)	–
	Princess Alexandra Hospital	29 (4.7)	589 (95.3)	–
	Queen Elizabeth II Hospital	4 (2.5)	158 (97.5)	–
	Redland Hospital	4 (2.0)	200 (98.0)	–
North West	Mt Isa Hospital	20 (42.6)	27 (57.4)	–
Sunshine Coast	Gympie Hospital	–	82 (100.0)	–
	Sunshine Coast University Hospital	5 (1.1)	435 (98.9)	–
Townsville	Townsville Hospital	41 (15.8)	214 (82.3)	5 (1.9)
West Moreton	Ipswich Community Health	17 (4.3)	379 (95.5)	1 (0.3)
Wide Bay	Bundaberg Hospital	2 (1.9)	103 (98.1)	–
	Hervey Bay Hospital	–	64 (100.0)	–
Statewide		**260 (4.6)**	**5,389 (95.1)**	**15 (0.3)**



% of total Indigenous (n=260) vs. total non-Indigenous (n=5,389). Excludes missing data (0.3%)

Figure 5: Proportion of all referrals by age group and identified Aboriginal and Torres Strait Islander status

Table 11: Median patient age by gender and Indigenous status

	Total referrals n	Male years	Female years	All years
Aboriginal and Torres Strait Islander	260	56	57	56
Non Aboriginal and Torres Strait Islander	5,389	69	72	70
Total	**5,649**	**68**	**71**	**69**

Excludes missing data (0.3%)

5.4 Phenotype of heart failure

The table below shows rates of different HF phenotypes referred to each HFSS, these include:

- HFrEF: heart failure with reduced ejection fraction, where the left ventricular ejection fraction is less than 50% at time of diagnosis,
- HFpEF: heart failure with preserved ejection fraction, where the left ventricular ejection fraction is 50% or greater at time of diagnosis,
- Primary right heart failure e.g. cor pulmonale.

The most common referral to a HFSS was for HFrEF (81%). The median age for HFrEF was nine years younger than for patients with HFpEF (67 vs. 76 years respectively). More men had HFrEF than women (72% male), whereas HFpEF did not have a significant gender difference (48% male and 52% female).

Table 12: Proportion of patients by heart failure phenotype

HHS	HFSS	HFrEF* n (%)	HFpEF† n (%)	Primary right HF n (%)	Unsure/ unknown n (%)
Cairns and Hinterland	Cairns Hospital	141 (94.0)	6 (4.0)	1 (0.7)	2 (1.3)
Central Queensland	Gladstone Hospital	13 (86.7)	1 (6.7)	–	1 (6.7)
	Rockhampton Hospital	179 (81.7)	31 (14.2)	6 (2.7)	3 (1.4)
Darling Downs	Toowoomba Hospital	31 (62.0)	6 (12.0)	–	13 (26.0)
Gold Coast	Gold Coast Community Health	450 (81.8)	77 (14.0)	10 (1.8)	13 (2.4)
Mackay	Mackay Base Hospital	100 (95.2)	4 (3.8)	–	1 (1.0)
Metro North	Caboolture Hospital	165 (85.1)	25 (12.9)	–	4 (2.1)
	Redcliffe Hospital	118 (74.7)	28 (17.7)	5 (3.2)	7 (4.4)
	Royal Brisbane & Women's Hospital	372 (81.9)	74 (16.3)	2 (0.4)	6 (1.3)
Metro South	The Prince Charles Hospital	666 (69.5)	224 (23.4)	29 (3.0)	39 (4.1)
	Logan Hospital	363 (84.0)	55 (12.7)	8 (1.9)	6 (1.4)
	Princess Alexandra Hospital	548 (88.7)	54 (8.7)	13 (2.1)	3 (0.5)
	Queen Elizabeth II Hospital	131 (80.9)	25 (15.4)	2 (1.2)	4 (2.5)
	Redland Hospital	158 (77.5)	33 (16.2)	8 (3.9)	5 (2.5)
North West	Mt Isa Hospital	23 (48.9)	6 (12.8)	2 (4.3)	16 (34.0)
Sunshine Coast	Gympie Hospital	57 (69.5)	21 (25.6)	4 (4.9)	–
	Sunshine Coast University Hospital	403 (91.6)	27 (6.1)	5 (1.1)	5 (1.1)
Townsville	Townsville Hospital	238 (91.5)	13 (5.0)	5 (1.9)	4 (1.5)
West Moreton	Ipswich Community Health	288 (72.5)	80 (20.2)	22 (5.5)	7 (1.8)
Wide Bay	Bundaberg Hospital	91 (86.7)	9 (8.6)	5 (4.8)	–
	Hervey Bay Hospital	50 (78.1)	10 (15.6)	4 (6.3)	–
Statewide		**4,585 (80.9)**	**809 (14.3)**	**131 (2.3)**	**139 (2.5)**

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

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

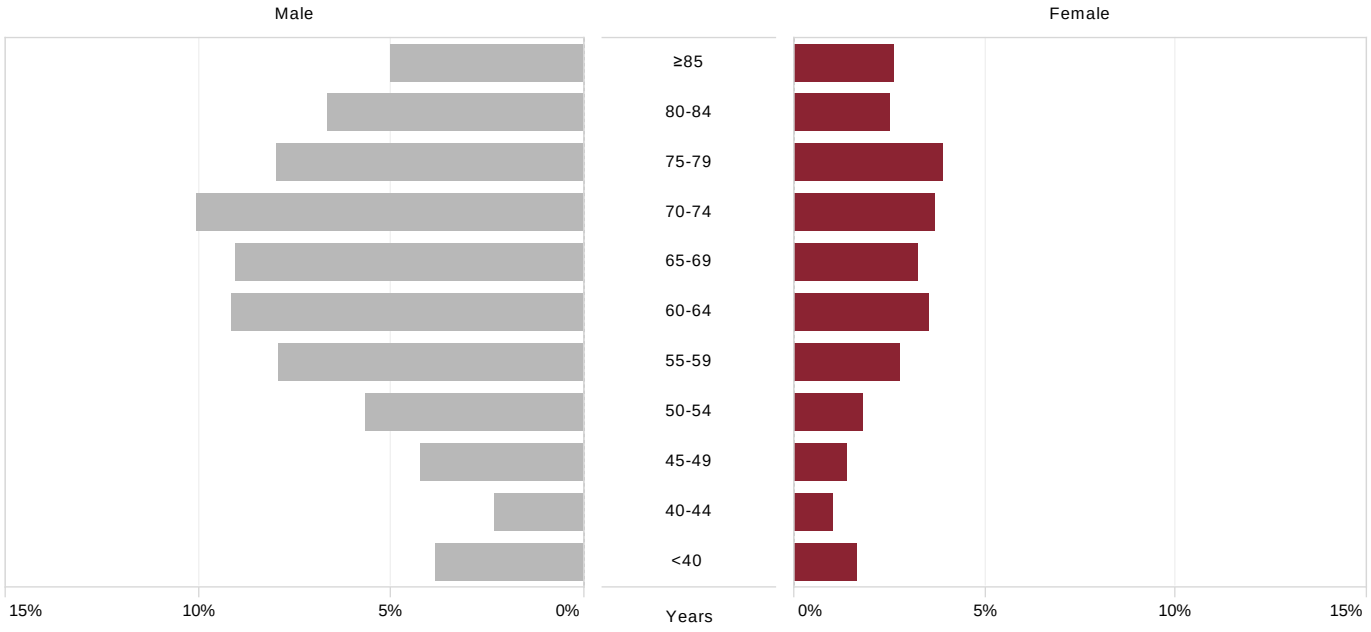
Table 13: Summary of patient age, gender and Indigenous status by heart failure phenotype

	HFrEF* n	HFpEF† n	Primary right HF n
Number	4,585	809	131
Age (median years)	67	76	76
% male	71.8	48.3	53.4
% Aboriginal and Torres Strait Islander	4.8	2.7	3.8

Excludes unsure/unknown HF phenotype (2.5%)

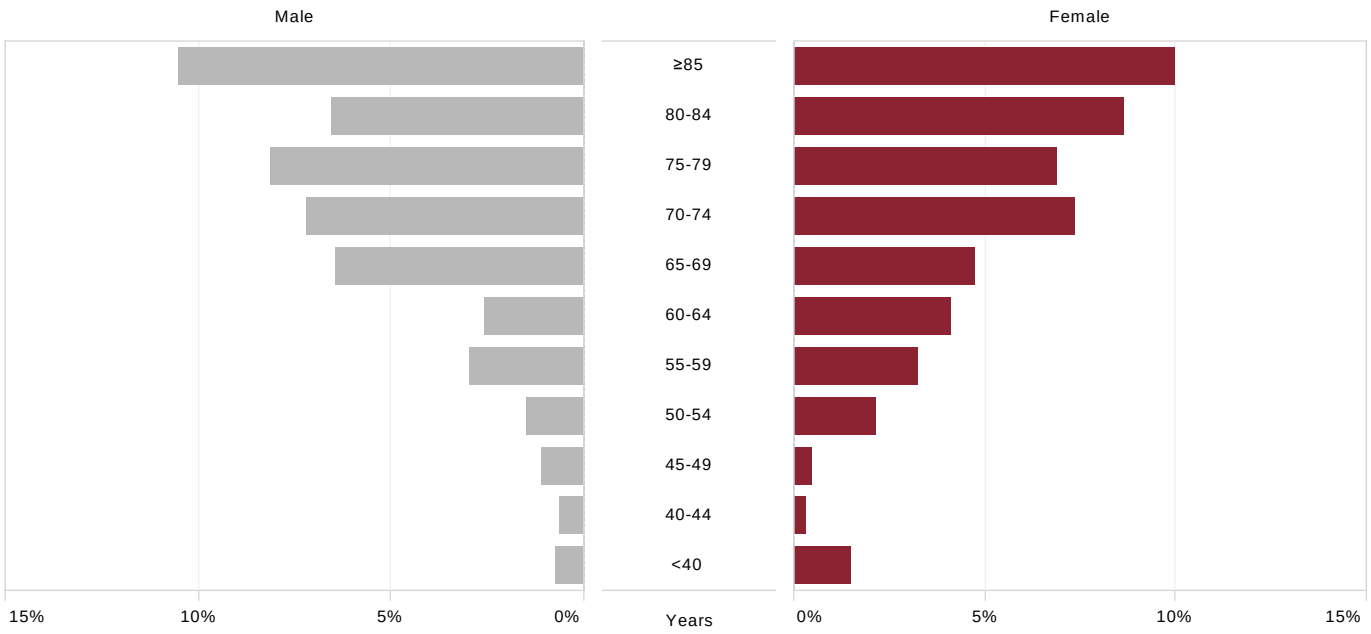
* Heart failure with reduced ejection fraction (LVEF ‹50%)

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



% of total with HFrEF (n=4,585)

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



% of total with HFpEF (n=809)

Figure 7: Proportion of HFpEF referrals by gender and age group

5.5 Summary of patient characteristics

A summary of patient characteristics from all referrals to an HFSS are shown below.

Table 14: Summary of patient characteristics

Characteristic	Summary
Participating HFSS	21
New referrals	5,664
Referrals from South East Queensland	82.0%
Referral source:	
Inpatient	66.8%
Outpatient	21.3%
Another HFSS	9.2%
Primary care	2.8%
Age (median years):	
All (median, range by service)	69 (58–76) years
Male vs. Female	68 vs. 71 years
Indigenous vs. non-Indigenous	56 vs. 69 years
HFrEF* vs. HFpEF†	67 vs. 76 years
Age group:	
80 years and over	20.7%
Males	67.8%
Aboriginal and Torres Strait Islander patients	4.6%
Heart failure phenotype:	
HFrEF*	80.9%
HFpEF†	14.3%
Primary right HF	2.3%
Unsure/unknown	2.5%

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

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

6 Clinical indicators

The number of clinical indicators is limited so that data entry is sustainable and part of routine clinical practice. The six clinical indicators selected are shown in Table 15.

The target benchmark for all indicators was set at 80%, except for 6b (beta blocker titration to clinical guideline target dose at six months) where the benchmark was set at 50%. The lower benchmark of 50% acknowledges that target doses derived from clinical trials may be inappropriate in clinical practice where patients are often older with greater disease severity and associated comorbidities compared to patients recruited to large drug trials.[37]

Table 15: Clinical process indicators

Indicator #	Process measures
1	**Timely follow-up and first clinical review** 1a) First clinical review within two weeks for inpatient referrals 1b) First clinical review within four 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), angiotensin II receptor blockers (ARB) or angiotensin receptor neprilysin inhibitor (ARNI) for HFrEF** 3a) Prescription at time of hospital discharge (inpatient referrals) 3b) Prescription at time of first clinical review (all referrals)
4	**Prescription of guideline recommended beta blockers (bisoprolol, carvedilol, metoprolol sustained release or nebivolol) for HFrEF** 4a) Prescription at time of hospital discharge (inpatient referrals) 4b) Prescription at time of first clinical review (all referrals)
5	**Prescription of mineralocorticoid receptor antagonists (MRA) for patients with HFrEF** 5a) Prescription at time of hospital discharge (inpatient referrals) 5b) Prescription at time of first clinical review (all referrals)
6	**Beta blocker review and titration** 6a) Titration review conducted within 6 months of first clinical review 6b) Guideline target dose achieved at time of titration review 6c) Either target or maximum dose achieved at time of titration review

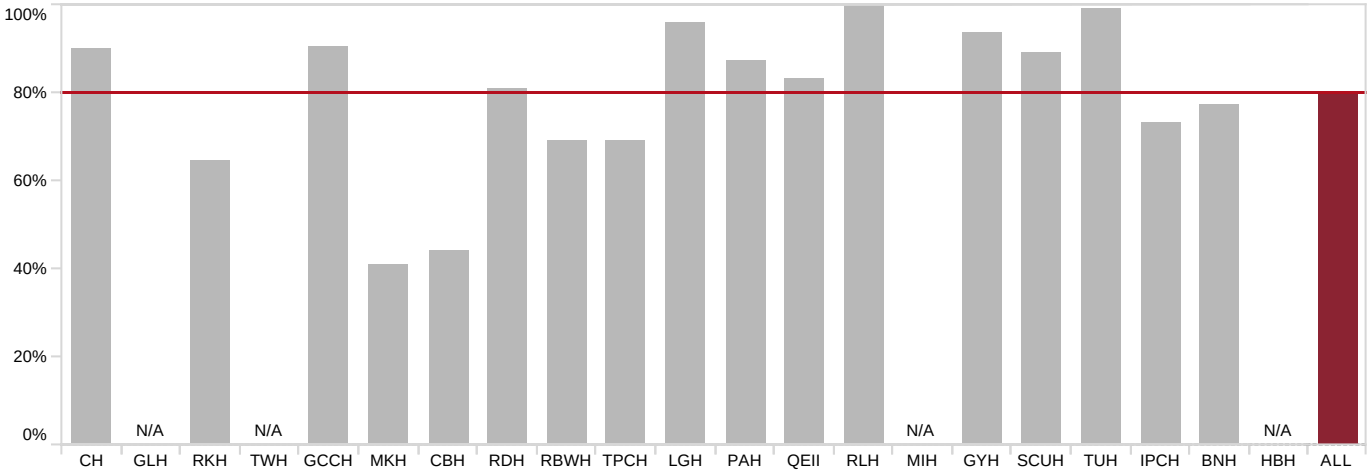
6.1 First clinical review

The HFSS review is defined as a clinical (rather than administrative) intervention and can be conducted face to face (clinic, gym or home visit) or virtually (phone, videoconference). 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 two 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 review timeframe chosen for this intervention was within two weeks of hospital discharge or date of referral after recent hospitalisation.

Of the 3,782 patients referred from an acute setting, 80% received a clinical review by an HFSS within two weeks of hospital discharge. Variation in performance was observed between services and is demonstrated in the figure below.



N/A: Eligible referrals <20

Figure 8: Inpatients who received first HFSS clinical review within two weeks of hospital discharge

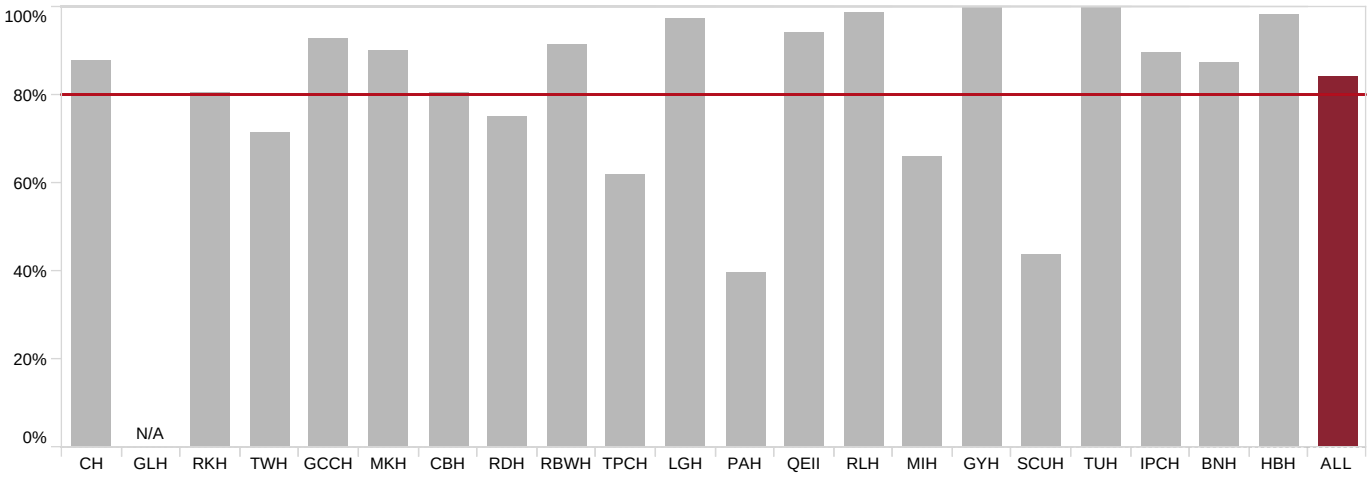
Table 16: Inclusion details for clinical indicator 1a: Inpatients receiving first HFSS clinical review within two weeks of hospital discharge

	n	%
Eligible for analysis	2,629	
Achieved benchmark	2,104	80.0
Benchmark not achieved	525	20.0
Ineligible	1,152	
Referred to another HFSS	636	
Referred to another service (e.g. cardiac rehabilitation or community nursing)	146	
Patient declined service	131	
Patient could not be contacted, lives out of area or repeated failure to attend	108	
HF no longer prime issue (palliative care, high care nursing home etc.)	73	
Patient deceased	44	
Other reason	14	
Missing data	1	
Total inpatient referrals	**3,782**	

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

For non acute referrals, clinical follow-up should be within four weeks of the referral date.

Referrals for 1,882 patients came from non acute services, of which 84% of the cases eligible for analysis received a clinical review within four weeks of referral. Variation in performance amongst services was observed and is outlined below.



N/A: Eligible referrals <20

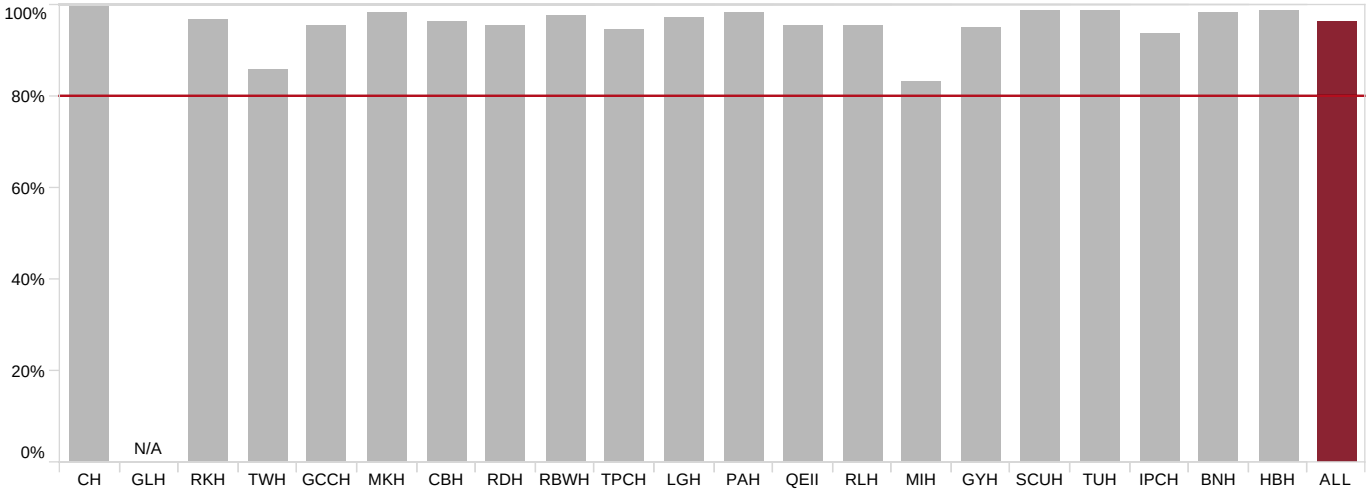
Figure 9: Proportion of non acute patients who received first HFSS clinical review within four weeks of referral

Table 17: Inclusion details for clinical indicator 1b: Non acute patients receiving first HFSS clinical review within four weeks of referral

	n	%
Eligible for analysis	1,705	
Achieved benchmark	1,433	84.0
Benchmark not achieved	272	16.0
Ineligible	165	
Patient declined service	50	
Referred to another HFSS	37	
Patient could not be contacted, lives out of area or repeated failure to attend	34	
HF no longer prime issue (palliative care, high care nursing home etc.)	16	
Referred to another service (e.g. cardiac rehabilitation or community nursing)	10	
Patient deceased	7	
Other reason	11	
Missing data	12	
Total non acute patients	**1,882**	

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

Australian clinical guidelines recommend that all patients with heart failure should have an assessment of left ventricular function.[36] In 96% of cases, LVEF was assessed within two years of referral to an HFSS. Little variation in performance was observed and is demonstrated in the analysis below.



N/A: Eligible referrals <20

Figure 10: Proportion of all patients who had LVEF assessed within two years of referral to HFSS

Table 18: Inclusion details for clinical indicator 2: Patients who had LVEF assessed within two years of referral

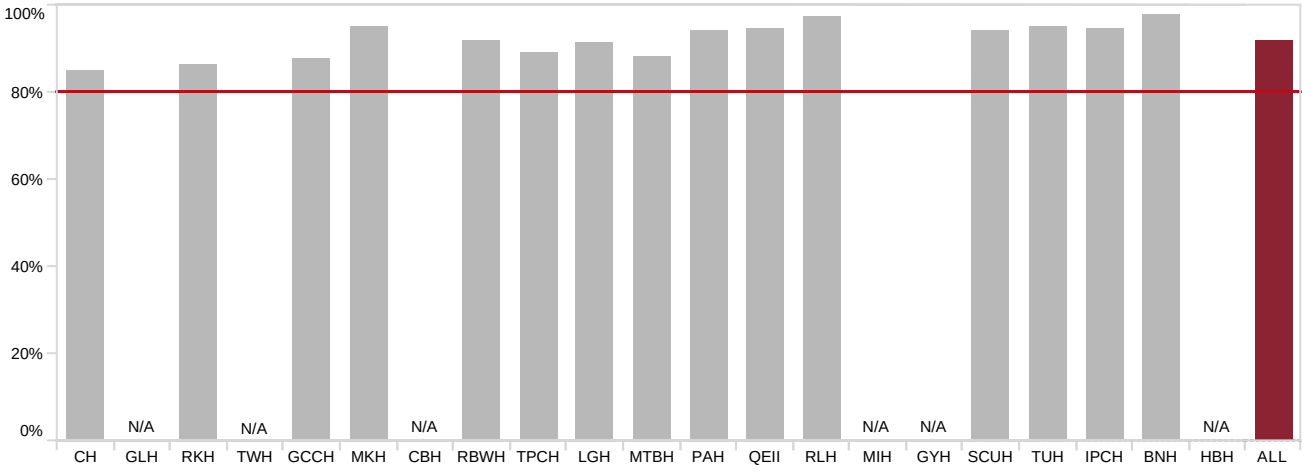
	n	%
Eligible for analysis	5,664	
Achieved benchmark	5,661	96.3
Benchmark not achieved	208	3.7
Ineligible	N/A	
Missing data	3	
Total referrals	**5,304**	

6.3 Prescription of ACEI, ARB or ARNI for patients with HFrEF

Angiotensin-converting-enzyme inhibitor (ACEI), angiotensin II receptor blockers (ARB) or angiotensin receptor neprilysin inhibitor (ARNI) have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all patients unless contraindicated or not tolerated.[36]

3a ACEI, ARB or ARNI prescription for HFrEF at hospital discharge

Prescription benchmarks for ACEI, ARB or ARNI therapy on hospital discharge was met for 92% of eligible patients.



N/A: Eligible referrals <20

Figure 11: Proportion of patients who were on ACEI, ARB or ARNI at time of hospital discharge

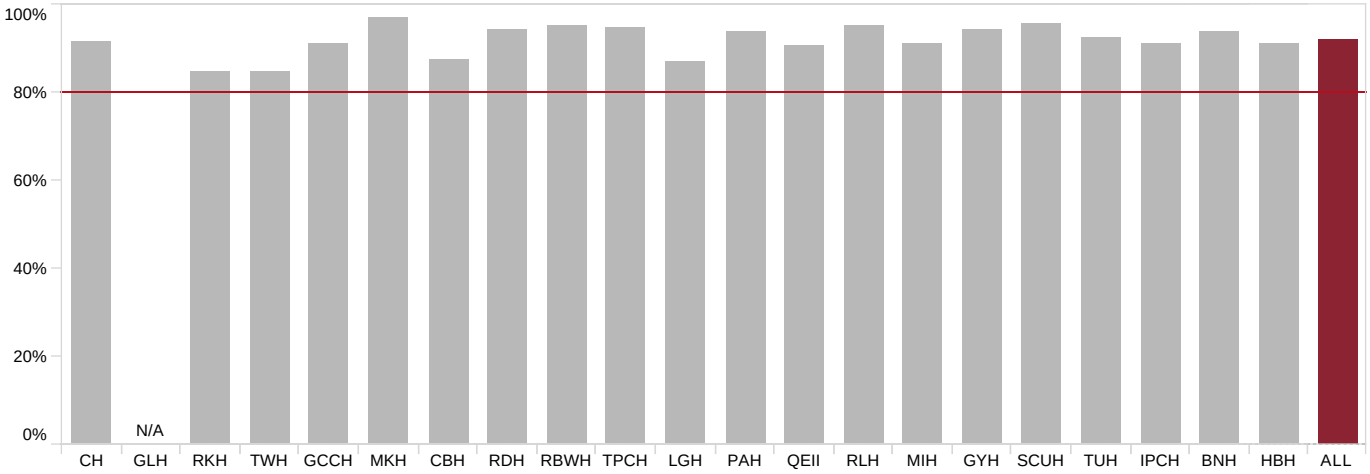
Table 19: Inclusion details for clinical indicator 3a: Inpatients on ACEI, ARB or ARNI at time of hospital discharge

	n	%
Eligible for analysis	2,820	
Achieved benchmark	2,585	91.7
Benchmark not achieved	235	8.3
Ineligible		
Documented contraindication*	166	
Incomplete data	2	
Total inpatient referrals analysed	**2,988**	

* Adverse reaction to ACEI/ARB or ARNI, palliative intent to treatment, pregnancy, eGFR <30mL/min/1.73m², severe aortic stenosis, renal artery stenosis, serum potassium >5.5 mmol/L, symptomatic hypotension

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

At the time of first clinical review, the target for prescription of ACEI, ARB or ARNI was met for 92% of eligible patients.



N/A: Eligible referrals <20

Figure 12: Proportion of patients on ACEI, ARB or ARNI at time of first clinical review by site

Table 20: Inclusion details for clinical indicator 3b: Patients on ACEI, ARB or ARNI at first clinical review

	n	%
Eligible for analysis	3,359	
Achieved benchmark	3,089	92.0
Benchmark not achieved	270	8.0
Ineligible		
Documented contraindication*	149	
Incomplete data	13	
Total referrals analysed	**3,521**	

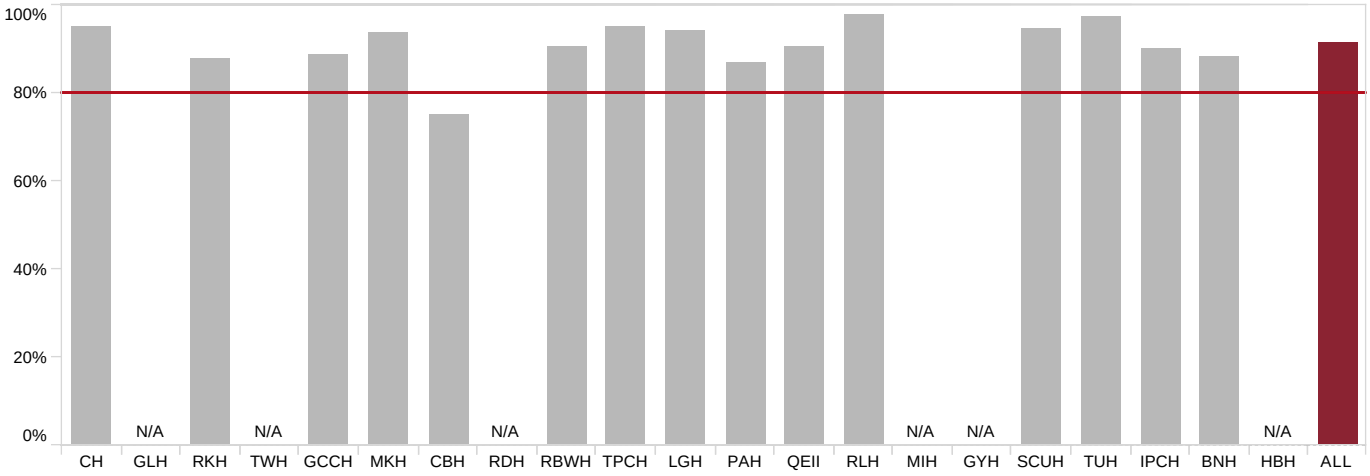
* Adverse reaction to ACEI/ARB or ARNI, palliative intent to treatment, pregnancy, eGFR <30mL/min/1.73m², severe aortic stenosis, renal artery stenosis, serum potassium >5.5 mmol/L, symptomatic hypotension

6.4 Prescription of guideline recommended beta blockers for HFrEF

Guideline recommended beta blockers have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all patients unless contraindicated or not tolerated.[35,36] 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

At hospital discharge, 92% of eligible patients were prescribed guideline recommended beta blockers.



N/A: Eligible referrals <20

Figure 13: Proportion of patients on guideline recommended beta blocker at hospital discharge by site

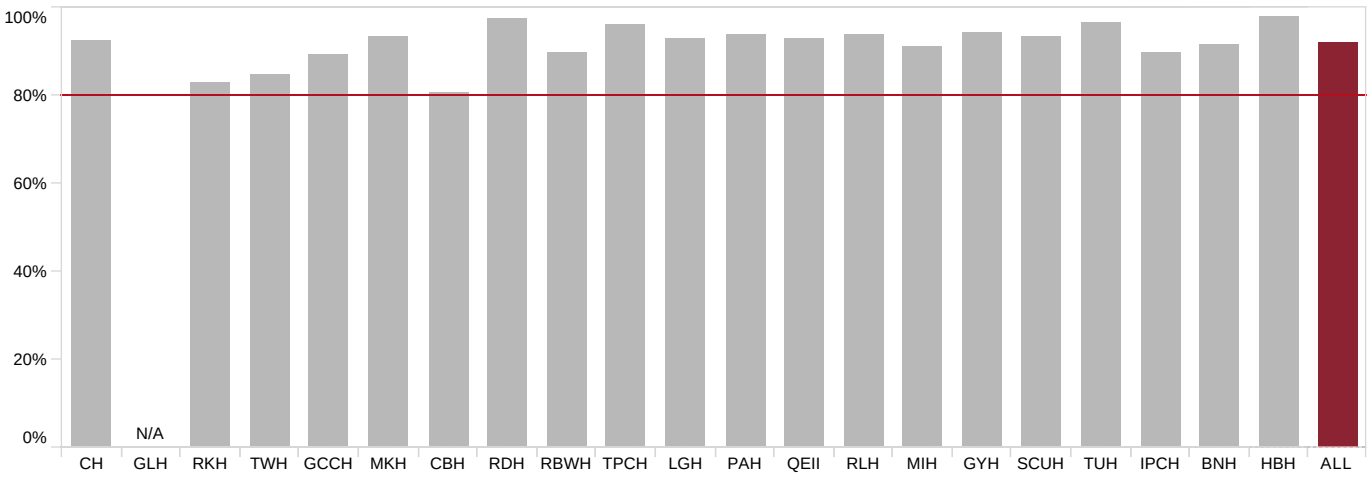
Table 21: Inclusion details for clinical indicator 4a: Patients on guideline recommended beta blocker at hospital discharge

	n	%
Eligible for analysis	2,912	
Achieved benchmark	2,667	91.6
Benchmark not achieved	245	8.4
Ineligible		
Documented contraindication*	74	
Incomplete data	2	
Total inpatient referrals analysed	**2,988**	

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

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

At the first clinical review, 92% of eligible referrals to HFSS were reported to be on a guideline recommended beta blocker.



N/A: Eligible referrals <20

Figure 14: Proportion of patients on guideline recommended beta blocker therapy at first clinical review by site

Table 22: Inclusion details for clinical indicator 4b: Patients on guideline recommended beta blocker at first clinical review

	n	%
Eligible for analysis	3,440	
Achieved benchmark	3,156	91.7
Benchmark not achieved	284	8.3
Ineligible		
Documented contraindication*	68	
Incomplete data	13	
Total referrals analysed	**3,521**	

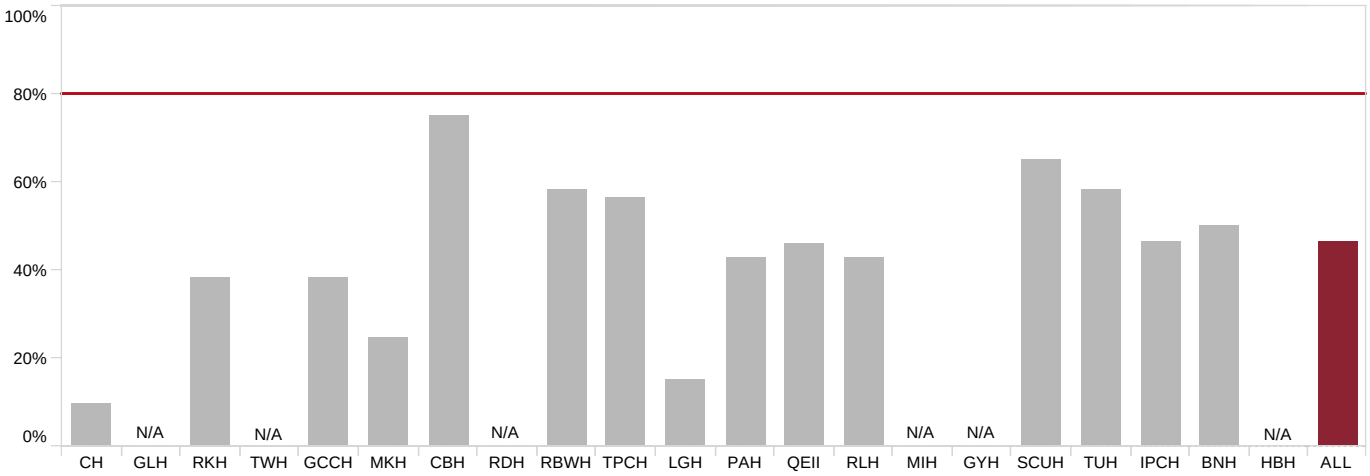
* Adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR <50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

6.5 Prescription of mineralocorticoid receptor antagonists (MRA) for patients with HFrEF

Guideline recommended mineralocorticoid receptor antagonists have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all patients unless contraindicated or not tolerated.[35, 36] Guideline recommended MRAs include eplerenone and spironolactone. All sites were below the benchmark.

5a Prescription of MRA for HFrEF at time of hospital discharge

At the time of discharge from hospital, 46% of eligible patients referred to an HFSS were prescribed an MRA.



N/A: Eligible referrals <20

Figure 15: Proportion of patients on guideline recommended MRA at hospital discharge by site

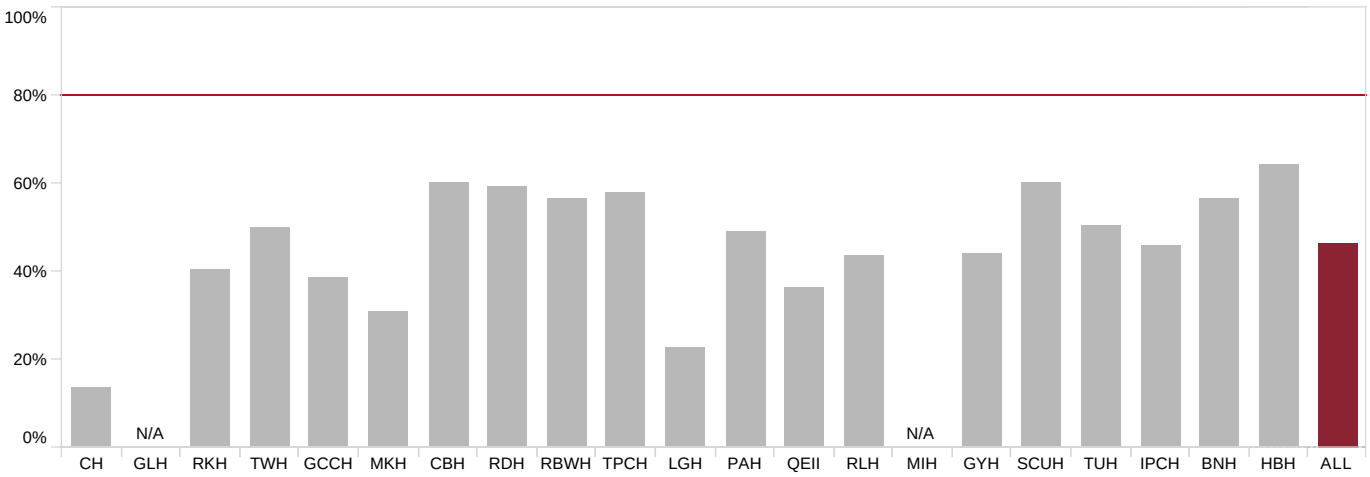
Table 23: Inclusion details for clinical indicator 5a: Patients on guideline recommended MRA at hospital discharge

	n	%
Eligible for analysis	2,664	
Achieved benchmark	1,234	46.3
Benchmark not achieved	1,430	53.7
Ineligible		
Documented contraindication*	322	
Missing data	2	
Total inpatient referrals analysed	**2,988**	

* Adverse reaction to MRA, palliative intent to treatment, serum potassium >5 mmol/L, pregnancy, eGFR <30mL/min/1.73m², previous gynaecomastia, Addison's disease, symptomatic hypotension or LVEF returned to >50%

5b Prescription of MRA for HFREF at time of first HFSS clinical review

At the time of first clinical review, 46% of eligible referrals to an HFSS were reported to be on a guideline recommended MRA. All sites were below the benchmark.



N/A: Eligible referrals <20

Figure 16: Proportion of patients on guideline recommended MRA at first clinical review site

Table 24: Inclusion details for clinical indicator 5b: Patients on guideline recommended MRA at first clinical review

	n	%
Eligible for analysis	3,138	
Achieved benchmark	1,452	46.3
Benchmark not achieved	1,686	53.7
Ineligible		
Documented contraindication*	370	
Missing data	13	
Total referrals analysed	**3,521**	

* Adverse reaction to MRA, palliative intent to treatment, serum potassium >5 mmol/L, pregnancy, eGFR <30mL/min/1.73m², previous gynaecomastia, Addison's disease, symptomatic hypotension or LVEF returned to >50%

6.6 Beta blocker titration

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

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

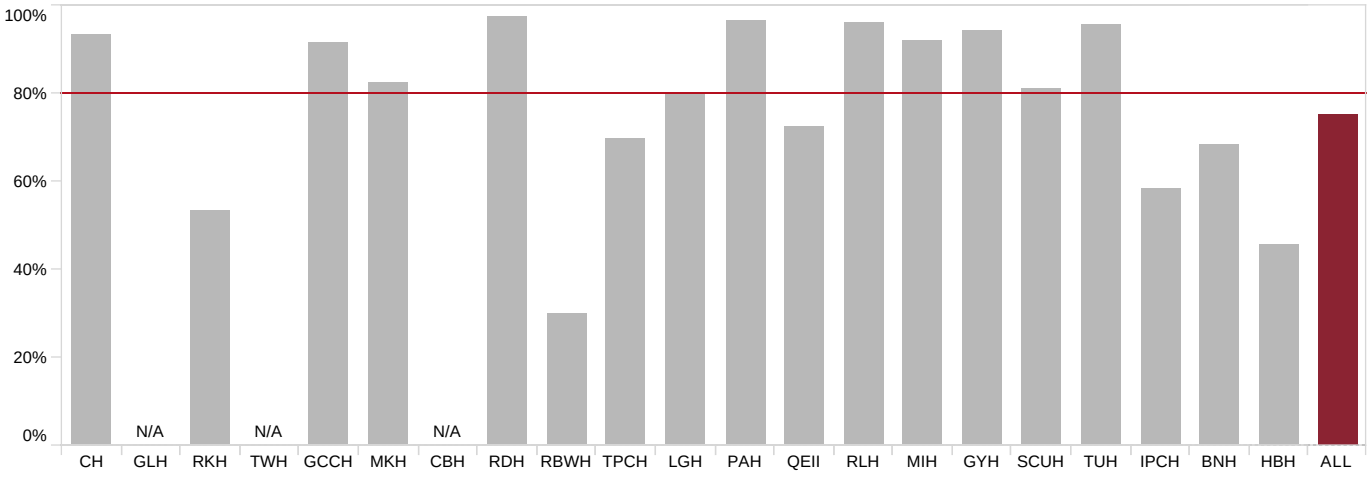
a) Review of titration status undertaken,

b) Achievement of target dose, and

c) Achievement of target or maximum tolerated dose.

6a Beta blocker titration review conducted within six months of first HFSS clinical review

At six months from referral or at the time of deactivation from the HFSS (whichever was sooner), 75% of patients received a beta blocker titration review which is below the benchmark. Variation in performance amongst services was observed and is demonstrated in the figure below.



N/A: Eligible referrals <20

Figure 17: Proportion of patients who had a beta blocker titration review conducted within six months by site

Table 25: Inclusion details for clinical indicator 6a: Patients who had a beta blocker titration review within six months

	n	%
Eligible for analysis	1,783	
Achieved benchmark	1,336	74.9
Benchmark not achieved	447	25.1
Ineligible	1,515	
Patient on target dose at the time of referral	784	
Patient could not be contacted, lives out of area or repeated failure to attend	139	
Patient declined service	115	
Referred to another HFSS	94	
HF no longer prime issue (palliative care, high care nursing home etc.)	70	
Patient deceased	59	
Medical follow-up only (GP, private or public physician)	48	
Referred to another service (e.g. cardiac rehabilitation or community nursing)	30	
Documented contraindication*	26	
Patient on max tolerated dose	7	
Other reason	143	
Missing data	14	
Total analysed	**3,312**	

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

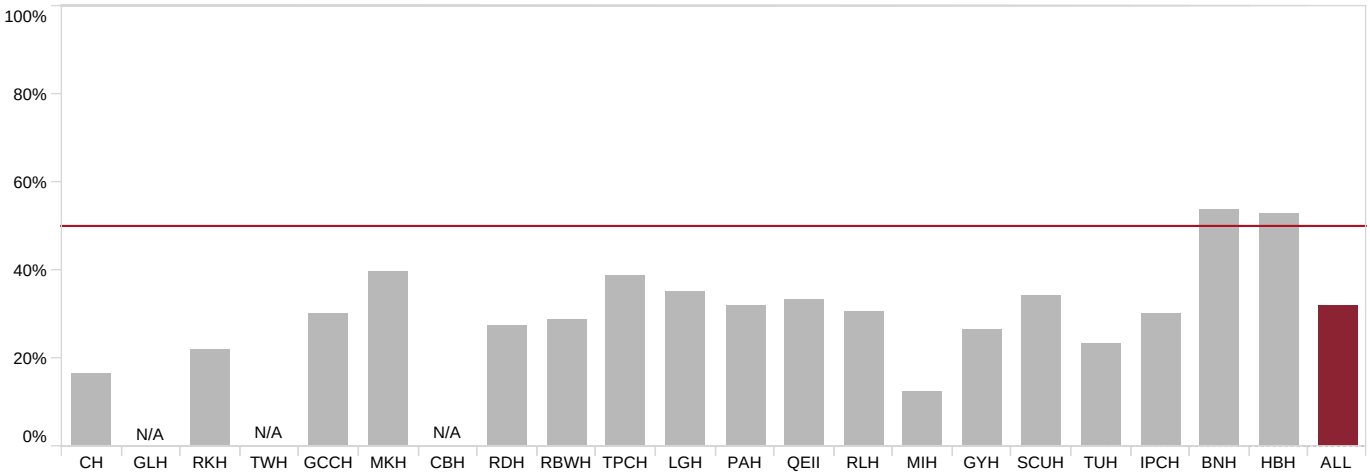
6b Beta blocker clinical guideline target dose achieved at time of titration review

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

Guideline recommended target dose was achieved for 32% of referrals within six months or at deactivation, with only two sites exceeding the benchmark (see Figure 18).

Daily target doses are:

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



N/A: Eligible referrals <20

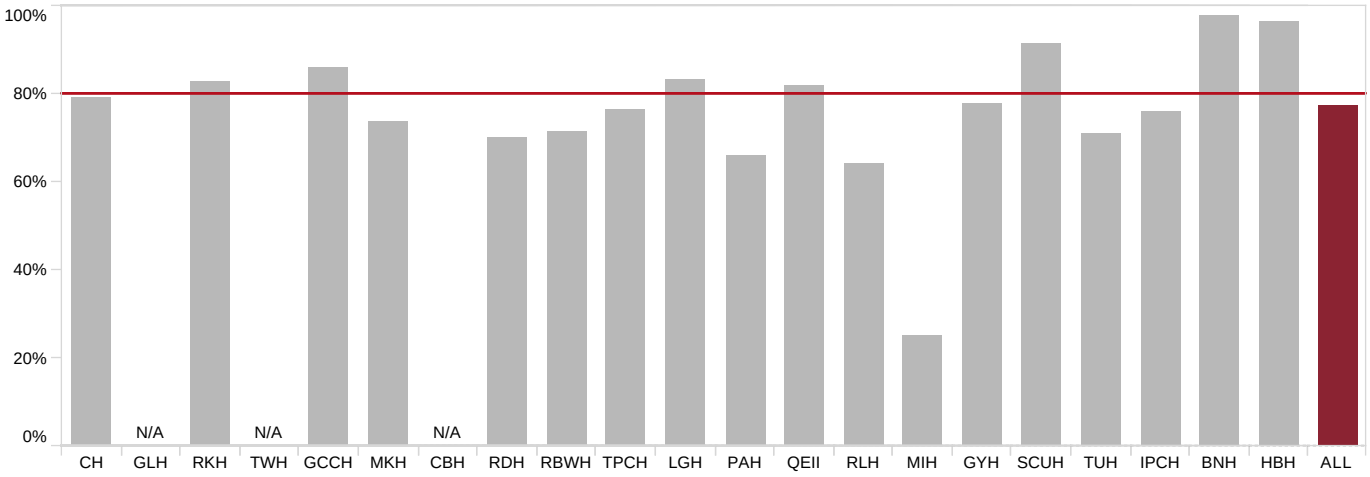
Figure 18: Proportion of patients who achieved target beta blocker dose at time of titration review by site

Table 26: Inclusion details for clinical indicator 6b: Patients who achieved target beta blocker dose at time of titration review

	n	%
Eligible for analysis	1,783	
Achieved benchmark	571	32.0
Benchmark not achieved	1,212	68.0
Ineligible	N/A	
Total titration reviews conducted	**1,783**	

6c Beta blocker titration clinical guideline target or maximum tolerated dose achieved at time of titration review

Maximum tolerated dose of beta blockers is based on a clinical judgement balancing the harm and benefit of up-titration. The number of patients reaching the target dose or maximum tolerated dose of guideline recommended beta blocker medication by the time of the titration review was 77% (below the 80% benchmark).



N/A: Eligible referrals <20

Figure 19: Proportion of patients who achieved target beta blocker dose or maximum tolerated dose at time of titration review

Table 27: Inclusion details for clinical indicator 6c: Patients who achieved target or maximum tolerated beta blocker dose at time of titration review

	n	%
Eligible for analysis	1,783	
Achieved benchmark	1,376	77.2
Benchmark not achieved	407	22.8
Ineligible	N/A	
Total titration reviews conducted	**1,783**	

6.7 Summary of clinical indicators

Table 28: Summary of clinical process indicator performance by site

	Clinical indicator achievement (%)											
HFSS	**1a**	**1b**	**2**	**3a**	**3b**	**4a**	**4b**	**5a**	**5b**	**6a**	**6b**	**6c**
Cairns Hospital	90	88	99	93	91	95	92	10	14	93	16	79
Gladstone Hospital	–	–	–	–	–	–	–	–	–	–	–	–
Rockhampton Hospital	65	81	97	84	85	88	83	38	41	53	22	83
Toowoomba Hospital	–	71	86	–	85	–	85	–	50	–	–	–
Gold Coast Community Health	91	93	95	89	91	89	89	38	39	91	30	86
Mackay Base Hospital	41	90	98	98	97	94	93	24	31	82	40	74
Caboolture Hospital	44	81	96	100	87	75	81	75	60	–	–	–
Redcliffe Hospital	81	75	96	–	94	–	97	–	59	98	28	70
Royal Brisbane & Women's Hospital	69	91	98	95	95	91	90	58	56	30	29	72
The Prince Charles Hospital	69	62	95	93	94	95	96	56	58	70	39	77
Logan Hospital	96	97	97	83	87	94	93	15	23	80	35	83
Princess Alexandra Hospital	88	40	98	94	94	87	94	43	49	96	32	66
Queen Elizabeth II Hospital	83	94	96	90	91	90	93	46	37	72	33	82
Redland Hospital	100	99	96	97	95	98	93	43	44	96	31	64
Mt Isa Hospital	–	66	83	–	91	–	91	–	–	92	13	25
Gympie Hospital	94	100	95	–	94	–	94	–	44	94	27	78
Sunshine Coast University Hospital	89	44	99	95	96	95	93	65	60	81	34	91
Townsville Hospital	99	100	99	91	92	97	96	58	50	96	23	71
Ipswich Community Health	73	90	94	88	91	90	90	46	46	58	30	76
Bundaberg Hospital	77	87	98	92	94	88	91	50	56	68	54	98
Hervey Bay Hospital	–	98	98	–	91	–	98	–	64	46	53	96
Statewide	**80**	**84**	**96**	**92**	**92**	**92**	**92**	**46**	**46**	**75**	**32**	**77**

Legend:

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

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

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

3a ACEI, ARB or ARNI prescription at hospital discharge (Benchmark: 80%)

3b ACEI, ARB or ARNI prescription at first clinical review (Benchmark: 80%)

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

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

5a Guideline recommended MRA prescription at hospital discharge (Benchmark: 80%)

5b Guideline recommended MRA prescription at first clinical review (Benchmark: 80%)

6a Beta blocker titration status review at six months post referral (Benchmark: 80%)

6b Beta blockers achievement of guideline recommended target dose (Benchmark: 50%)

6c Beta blockers achievement of guideline recommended target dose or maximum tolerated dose (Benchmark: 80%)

7 Patient outcomes

Chronic heart failure is associated with recurrent hospitalisation and increased mortality. Support from multidisciplinary HF disease management programmes (such as an HFSS) and adherence to recommended therapies are associated with improved outcomes.

7.1 Methods

This analysis used the previously reported 2019 patient cohort to examine the early (30 day) and one year clinical outcomes (rehospitalisation and mortality) among patients referred to HFSS. This was performed using data linkage with the Queensland Hospital Admitted Patient Data Collection (QHAPDC) and Queensland Registry of Births, Deaths and Marriages.

For this report, only HFSS referrals initiated during an inpatient encounter for 2019 were included. The earliest admission of the calendar year was considered the index admission (which may not be the first time that a patient has been hospitalised with heart failure).

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

The patient outcome indicators of interest are summarised in Table 28. Survival curves were constructed using the Kaplan–Meier method and cumulative incidence function was used to estimate the risk of all-cause and HF-related rehospitalisation 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, interquartile range, and mean values. Categorical variables were summarised as frequencies and percentages.

Table 29: Patient outcome indicators

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

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

7.2 Findings

There were 3,490 inpatient referrals of which 96% were successfully linked with the QHAPDC data. There were 339 patients who were ineligible for readmission and mortality analysis for the reasons shown in Table 30. A further 37 patients (1%) did not have complete follow up over one year to allow DAOH to be calculated.

Table 30: Eligibility criteria for patient outcome indicators

	n	%
Total 2019 inpatient referrals	**3,490**	**100.0**
Ineligible at index admission		
Duplicate patient record	155	4.4
Died during index admission	29	0.8
Not a Queensland resident	81	2.3
Transferred to private hospital	31	0.9
Index admission is not overnight	21	0.6
No linkage data available	125	3.6
Included in readmission and mortality analysis	**3,048**	**87.3**
Ineligible at subsequent admission over 1 year		
Transferred to private hospital	35	1.0
Moved outside of Queensland	2	<0.1
Included in days alive and out of hospital analysis	**3,011**	**86.3**

7.2.1 All-cause mortality

Among patients referred to HFSS during an inpatient encounter, the 30 day and one year unadjusted all-cause mortality rates were 1.4% and 13.4%. The Kaplan-Meier survival analyses below (Figures 20 to 22) suggest that older age was associated with increased mortality rates at all time points and particularly at 12 months.

Table 31: Cumulative all-cause unadjusted mortality rate from 30 to 365 days after discharge

	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Total deaths identified	44 (1.4)	130 (4.3)	223 (7.3)	408 (13.4)
Died during subsequent admission*	26 (0.9)	85 (2.8)	140 (4.6)	244 (8.0)
All other deaths	18 (0.6)	45 (1.5)	83 (2.7)	164 (5.4)
Total at risk	**3,004 (98.6)**	**2,918 (95.7)**	**2,825 (92.7)**	**2,640 (86.6)**

* Data available for Queensland public hospitals only

Table 32: Cumulative all-cause unadjusted mortality by patient characteristic

Characteristic	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	2,047	31 (1.5)	85 (4.2)	138 (6.7)	276 (13.5)
Female	1,001	13 (1.3)	45 (4.5)	85 (8.5)	132 (13.2)
Age group					
<65 years	1,129	9 (0.8)	25 (2.2)	43 (3.8)	74 (6.6)
65–74 years	776	13 (1.7)	28 (3.6)	42 (5.4)	89 (11.5)
≥75 years	1,143	22 (1.9)	77 (6.7)	138 (12.1)	245 (21.4)
Heart failure phenotype					
HFrEF	2,425	34 (1.4)	87 (3.6)	150 (6.2)	279 (11.5)
HFpEF	569	9 (1.6)	37 (6.5)	64 (11.2)	113 (19.9)
Missing/unsure	54	1 (1.9)	6 (11.1)	9 (16.7)	16 (29.6)
ALL	**3,048**	**44 (1.4)**	**130 (4.3)**	**223 (7.3)**	**408 (13.4)**

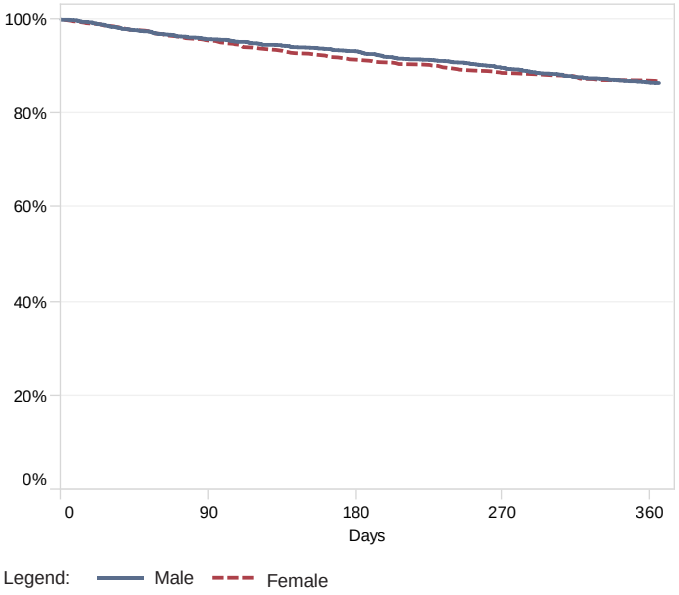


Figure 20: Heart failure survival by gender

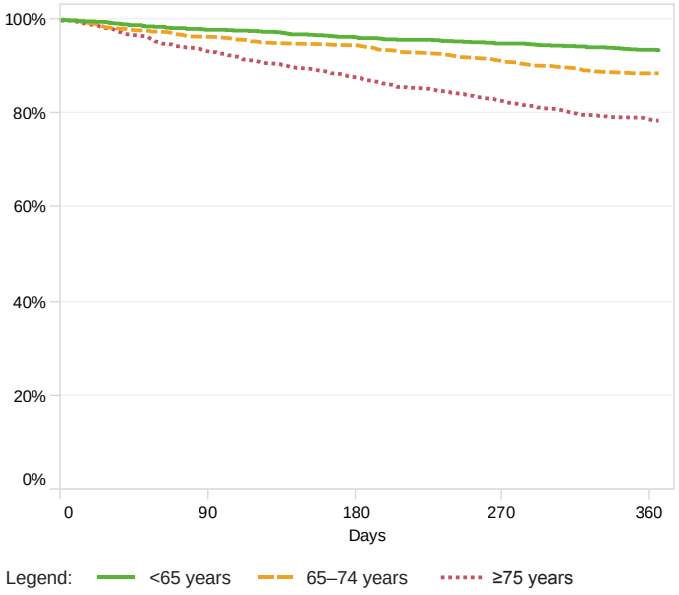


Figure 21: Heart failure survival by age group

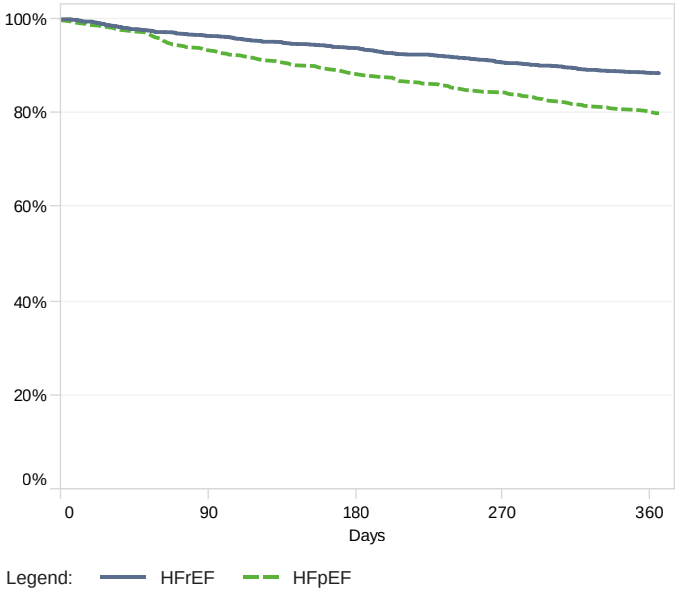


Figure 22: Heart failure survival by phenotype

7.2.2 All-cause and heart failure rehospitalisation

Cumulative incidence curves for all-cause and HF hospitalisation are shown in Figures 23 and 24. Of the 3,490 eligible patients referred to HFSS during 2019, the unadjusted rate of all-cause hospitalisation was 18.1% at 30 days, increasing to 53.9% at one year. Hospitalisations relating to HF (as identified by discharge diagnosis coding) were 5.7% and 22.0% at 30 days and one year respectively.

The overall risk of hospitalisation or death within 12 months post the index admission was 55.0% (Figure 25). Almost a third of patients referred to an HFSS were rehospitalised at least twice in the subsequent 12 months (Table 33).

Table 33: Number of rehospitalisations per patient in the year post initial discharge

Total in one year	All-cause n (%)	Heart failure n (%)
0	1,443 (47.3)	2,429 (79.7)
1	727 (23.9)	404 (13.3)
2	385 (12.6)	127 (4.2)
3	212 (7.0)	53 (1.7)
4	103 (3.4)	16 (0.5)
≥5	178 (5.8)	19 (0.6)

Table 34: Cumulative incidence of all-cause rehospitalisation from 30 to 365 days post discharge

Characteristic	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	2,047	367 (18.0)	629 (31.0)	823 (40.7)	1,035 (51.8)
Female	1,001	182 (18.3)	329 (33.2)	443 (45.1)	570 (58.2)
Age group					
<65 years	1,129	182 (16.2)	304 (27.1)	391 (34.9)	487 (43.8)
65–74 years	776	138 (17.9)	237 (30.9)	310 (40.5)	392 (51.6)
≥75 years	1,143	229 (20.1)	417 (36.9)	565 (50.5)	726 (65.7)
Heart failure phenotype					
HFrEF	2,425	415 (17.2)	709 (29.5)	935 (39.0)	1,176 (49.5)
HFpEF	569	121 (21.4)	225 (40.0)	302 (54.1)	391 (70.7)
Missing/unsure	54	13 (24.1)	24 (46.2)	29 (56.9)	38 (76.0)
ALL	**3,048**	**549 (18.1)**	**958 (31.7)**	**1,266 (42.1)**	**1,605 (53.9)**

Table 35: Cumulative incidence of heart failure rehospitalisation from 30 to 365 days post discharge

Characteristic	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	2,047	117 (5.8)	218 (10.9)	300 (15.3)	405 (21.4)
Female	1,001	54 (5.5)	105 (10.8)	156 (16.5)	214 (23.2)
Age group					
<65 years	1,129	48 (4.3)	93 (8.3)	127 (11.5)	173 (16.0)
65–74 years	776	42 (5.5)	79 (10.4)	116 (15.4)	155 (21.3)
≥75 years	1,143	81 (7.2)	151 (13.8)	213 (20.1)	291 (28.9)
Heart failure phenotype					
HFrEF	2,425	132 (5.5)	240 (10.1)	329 (14.1)	438 (19.3)
HFpEF	569	36 (6.4)	78 (14.3)	121 (22.7)	172 (33.9)
Missing/unsure	54	3 (5.6)	5 (10.2)	6 (13.0)	9 (23.1)
ALL	**3,048**	**171 (5.7)**	**323 (10.9)**	**456 (15.6)**	**619 (22.0)**

Table 36: Cumulative incidence of all-cause rehospitalisation or death from 30 to 365 days post discharge

Characteristic	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	2,047	377 (18.4)	646 (31.6)	848 (41.4)	1,084 (53.0)
Female	1,001	188 (18.8)	340 (34.0)	461 (46.1)	592 (59.1)
Age group					
<65 years	1,129	186 (16.5)	310 (27.5)	400 (35.4)	503 (44.6)
65–74 years	776	144 (18.6)	245 (31.6)	320 (41.2)	409 (52.7)
≥75 years	1,143	235 (20.6)	431 (37.7)	589 (51.5)	764 (66.8)
Heart failure phenotype					
HFrEF	2,425	428 (17.6)	728 (30.0)	964 (39.8)	1,227 (50.6)
HFpEF	569	124 (21.8)	232 (40.8)	313 (55.0)	407 (71.5)
Missing/unsure	54	13 (24.1)	26 (48.1)	32 (59.3)	42 (77.8)
ALL	**3,048**	**565 (18.5)**	**986 (32.3)**	**1,309 (42.9)**	**1,676 (55.0)**

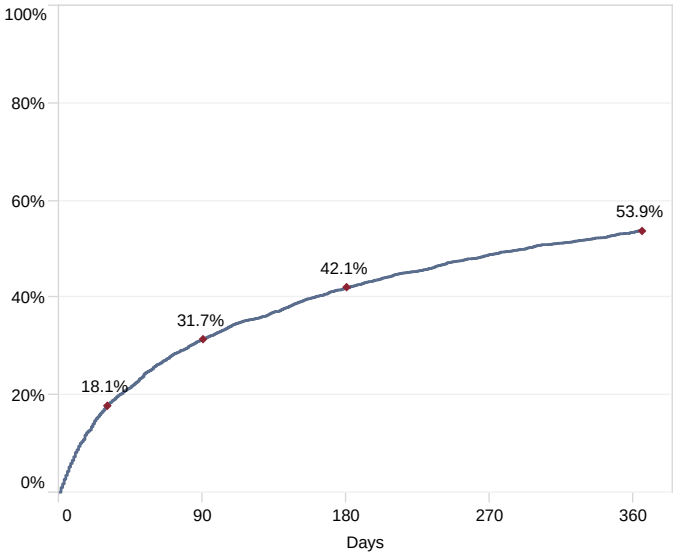


Figure 23: Cumulative incidence of all-cause rehospitalisation

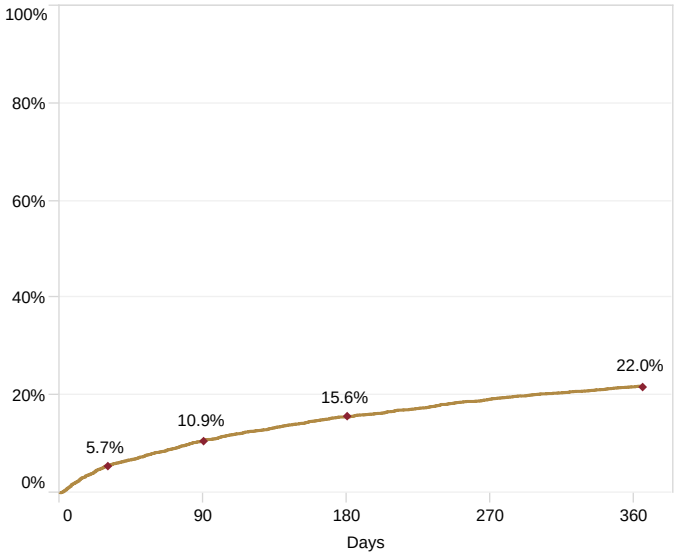


Figure 24: Cumulative incidence of heart failure rehospitalisation

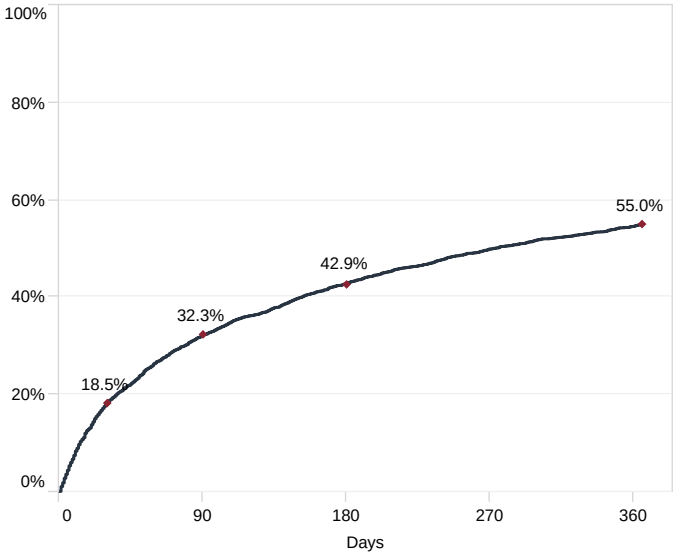


Figure 25: Cumulative incidence of all-cause rehospitalisation or death

7.2.3 Days alive and out of hospital

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

Almost 46% of patients survived more than a year without rehospitalisation, with a median of 364 days for the whole group. The mean days alive and out of hospital was 329.7, which equates to over 105,000 days lost due to death or hospitalisation over 12 months in 3,011 patients.

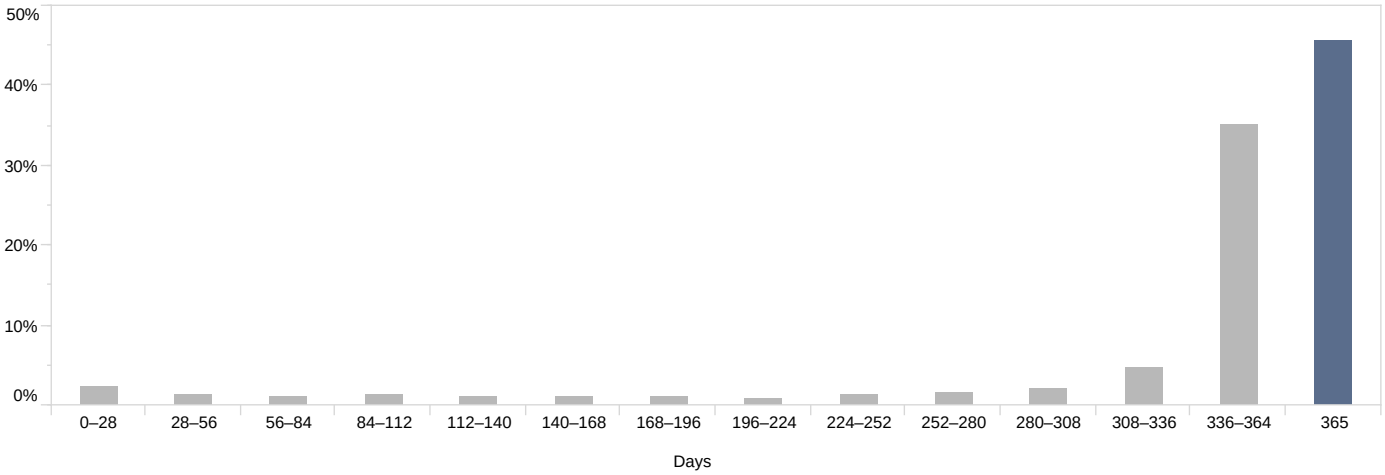
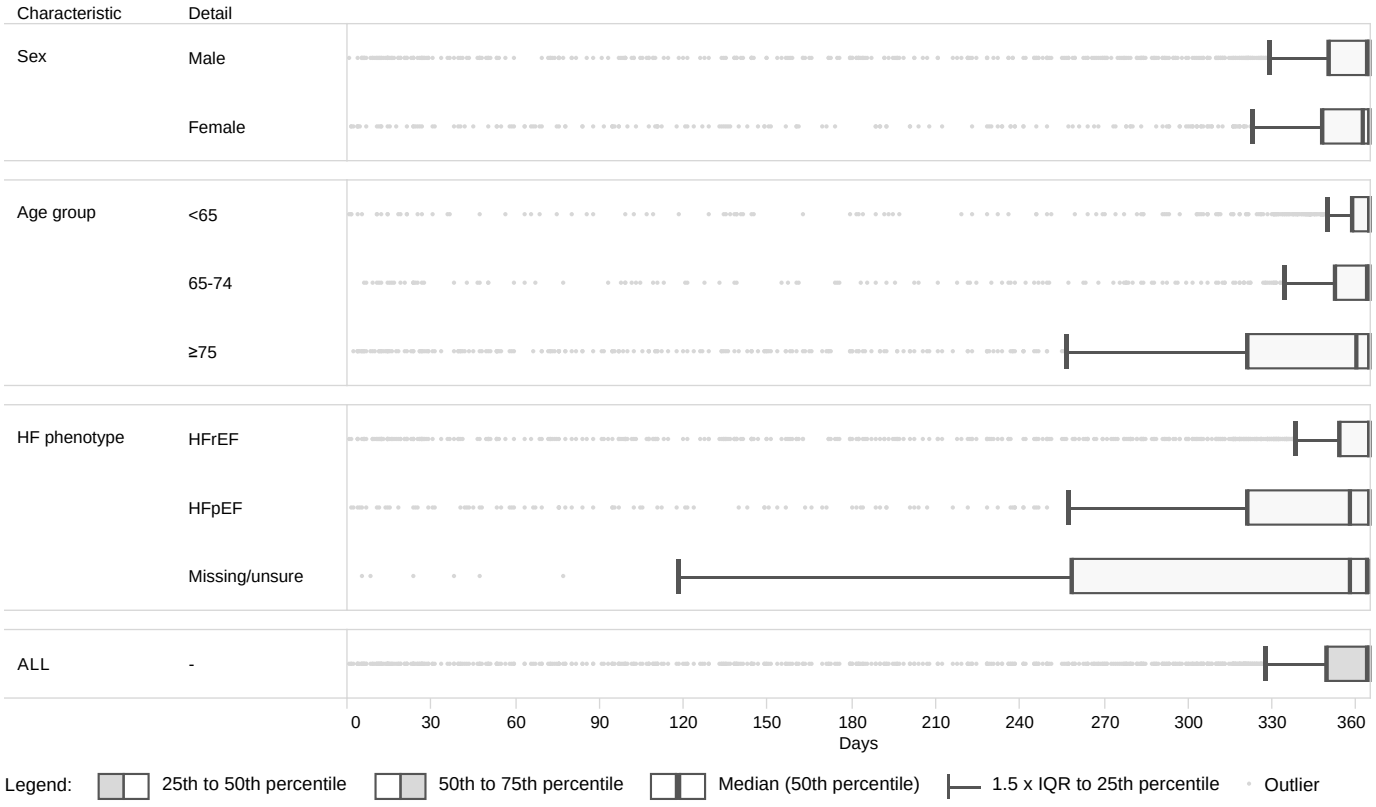


Figure 26: Days alive and out of hospital within one year after hospital discharge.

Table 37: Days alive and out of hospital within one year of discharge by patient characteristic

Characteristic	Detail	n	Mean	Median (IQR)
Sex	Male	2,027	330.9	364 (350–365)
	Female	984	327.2	363 (348–365)
Age group	<65	1,119	345.3	365 (359–365)
	65–74	767	334.0	364 (352–365)
	≥75	1,125	311.2	360 (321–365)
HF phenotype	HFrEF	2,403	334.5	365 (354–365)
	HFpEF	555	312.3	358 (322–365)
	Missing/unsure	53	291.5	358 (259–364)
ALL		**3,011**	**329.7**	**364 (350–365)**

The box and whisker plots in Figure 27 illustrate the distribution of DAOH for different characteristics. The median DAOH is close to 365 days for most categories (the box shows the middle 50% of scores). The whiskers stretching to the left illustrate that many patients spent subsequent time in hospital or died. The DAOH was much lower for patients who were over 75 years old.



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

Figure 27: Days alive and out of hospital within one year of discharge by patient characteristic

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Glossary

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

NCR	National Cardiac Registry
NCS	Networked Cardiac Services
NP	Nurse Practitioner
NRBC	Non-Red Blood Cells
NSTEMI	Non-ST Elevation Myocardial Infarction
OR	Odds Ratio
OOHCA	Out of Hospital Cardiac Arrest
ORIF	Open Reduction Internal Fixation
PAH	Princess Alexandra Hospital
PAPVD	Partial Anomalous Pulmonary Venous Drainage
PCI	Percutaneous Coronary Intervention
PDA	Patent Ductus Arteriosus
PFO	Patent Foramen Ovale
PHQ	Patient Health Questionnaire
PICU	Paediatric intensive care unit
PROMS	Patient Reported Outcome Measures
QAS	Queensland Ambulance Service
QCOR	Queensland Cardiac Outcomes Registry
QEII	Queen Elizabeth II Jubilee Hospital
QHAPDC	Queensland Hospital Admitted Patient Data Collection
RBC	Red Blood Cells
RBWH	Royal Brisbane & Women's Hospital
RCA	Right Coronary Artery
RDH	Redcliffe Hospital
RHD	Rheumatic Heart Disease
RKH	Rockhampton Hospital
RLH	Redland Hospital
SCCIU	Statewide Cardiac Clinical Informatics Unit
SCCN	Statewide Cardiac Clinical Network
SCUH	Sunshine Coast University Hospital
SHD	Structural Heart Disease
SMoCC	Self Management of Chronic Conditions
STEMI	ST-Elevation Myocardial Infarction
STS	Society of Thoracic Surgery
TAVR	Transcatheter Aortic Valve Replacement
TMVR	Transcatheter Mitral Valve Replacement
TNM	Tumour, Lymph Node, Metastases
TPCH	The Prince Charles Hospital
TPVR	Transcatheter Pulmonary Valve Replacement
TUH	Townsville University Hospital
TWH	Toowoomba Hospital
VAD	Ventricular Assist Device
VATS	Video Assisted Thoracic Surgery
VCOR	Victorian Cardiac Outcomes Registry
VF	Ventricular Fibrillation
VSD	Ventricular Septal Defect

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