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Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry

2020 Annual Report

Cardiac Surgery Audit

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Queensland Government

Queensland Cardiac Outcomes Registry
2020 Annual Report

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1 Foreword

Dr John Wakefield PSM
Director-General
Queensland Health

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

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

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

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

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

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

2 Message from the SCCN Chair

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

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

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

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

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

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

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

3 Introduction

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

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

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

The SCCIU team consists of:

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

* Principal contact officer/QCOR program lead

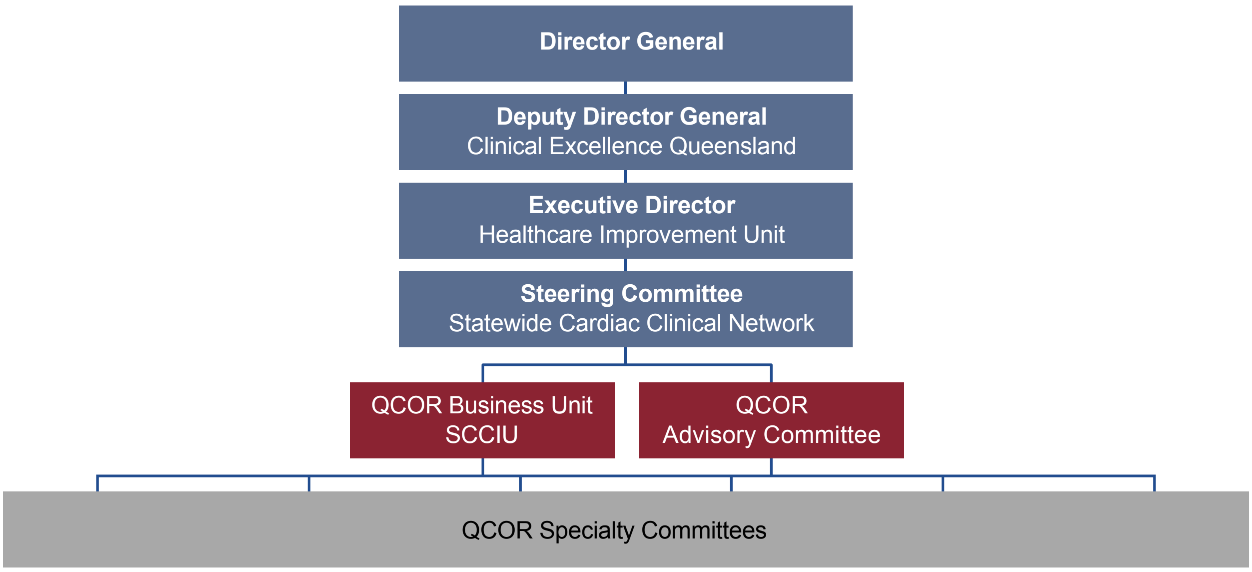


Figure 1: Governance structure

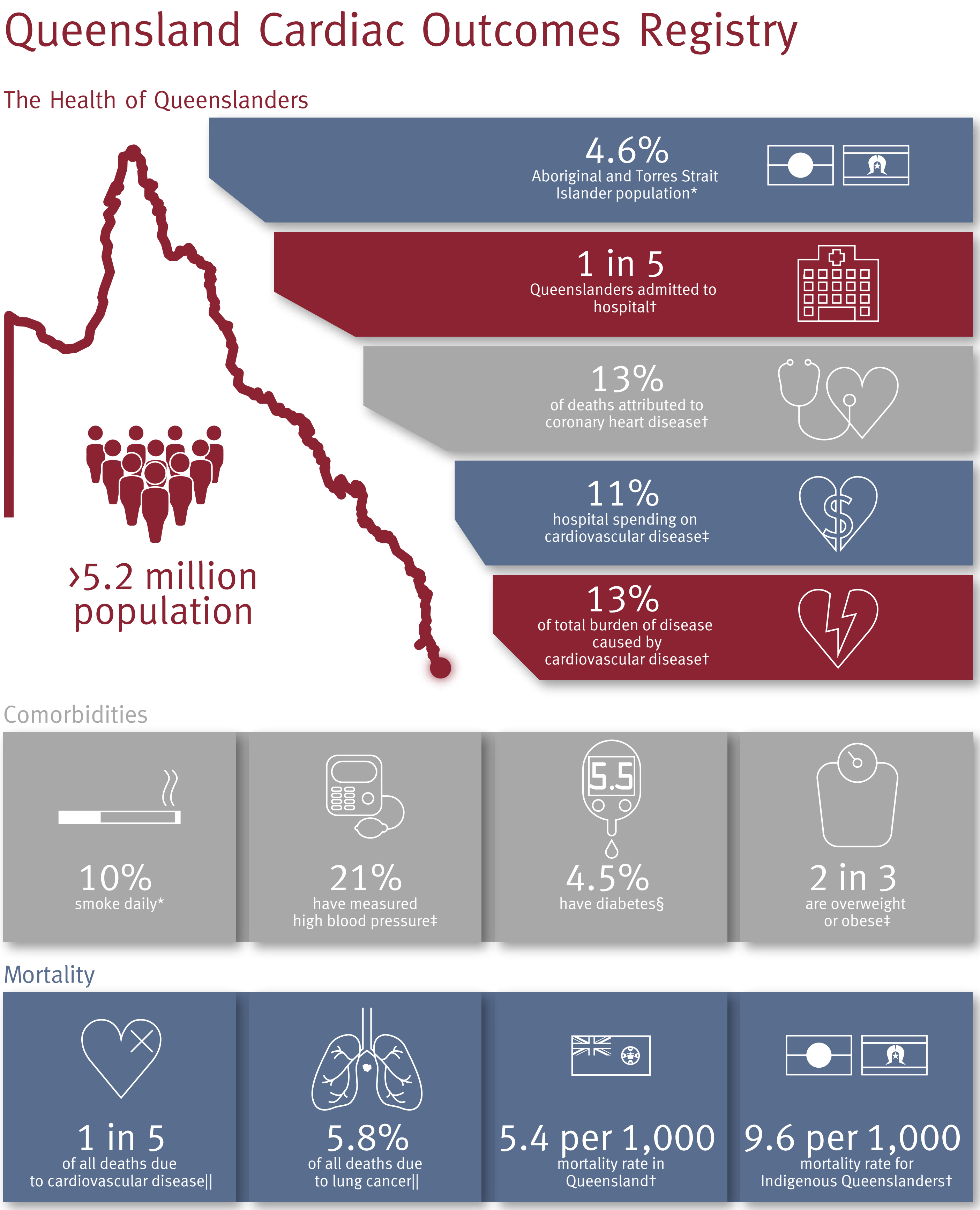


Figure 2: QCOR 2020 infographic

* 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

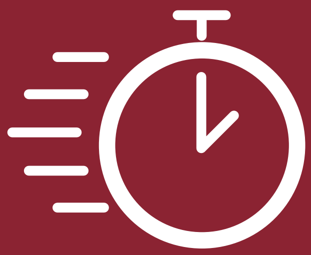
QCOR Yearly Trends

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

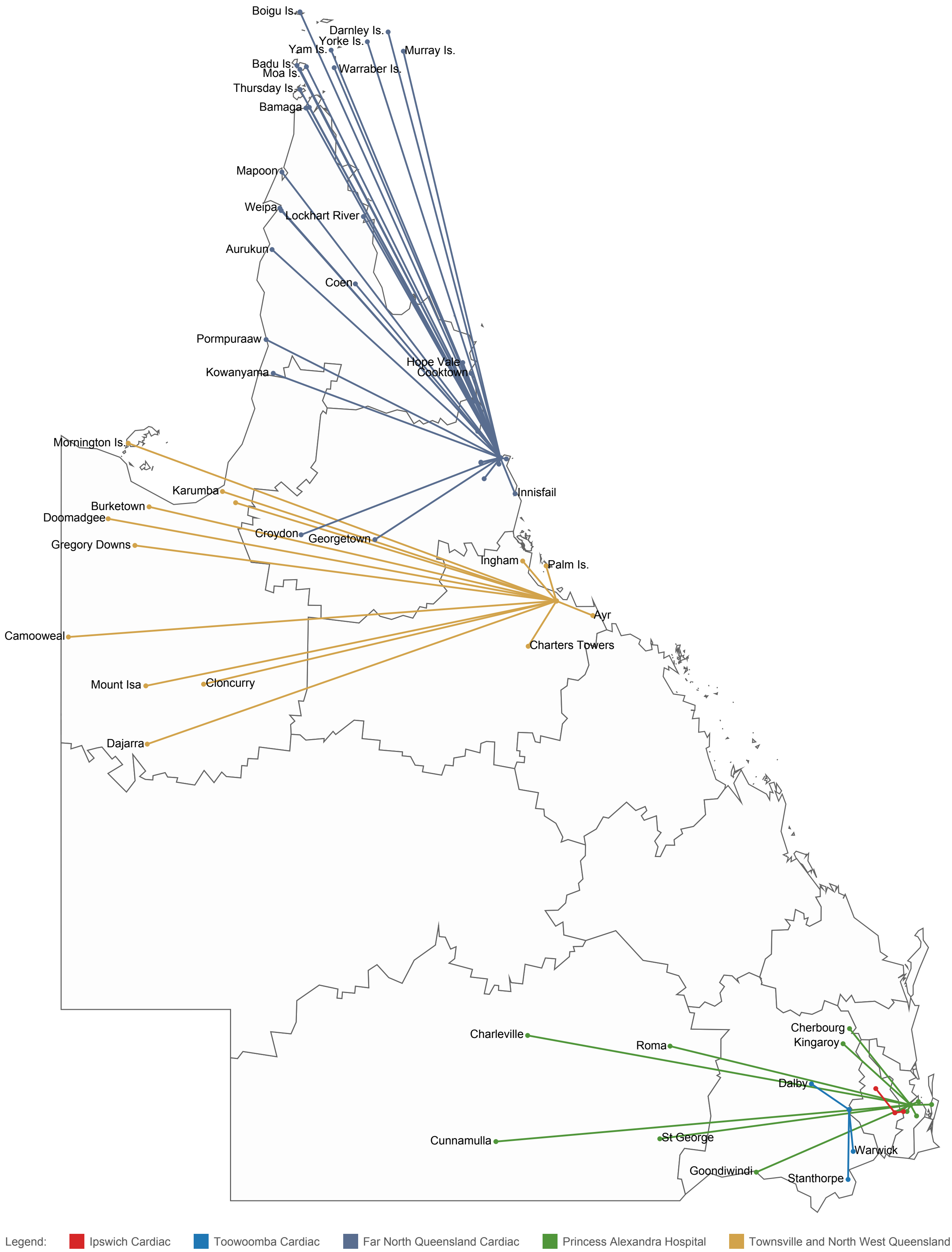


Figure 1: Cardiac outreach hub and spoke locations

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.

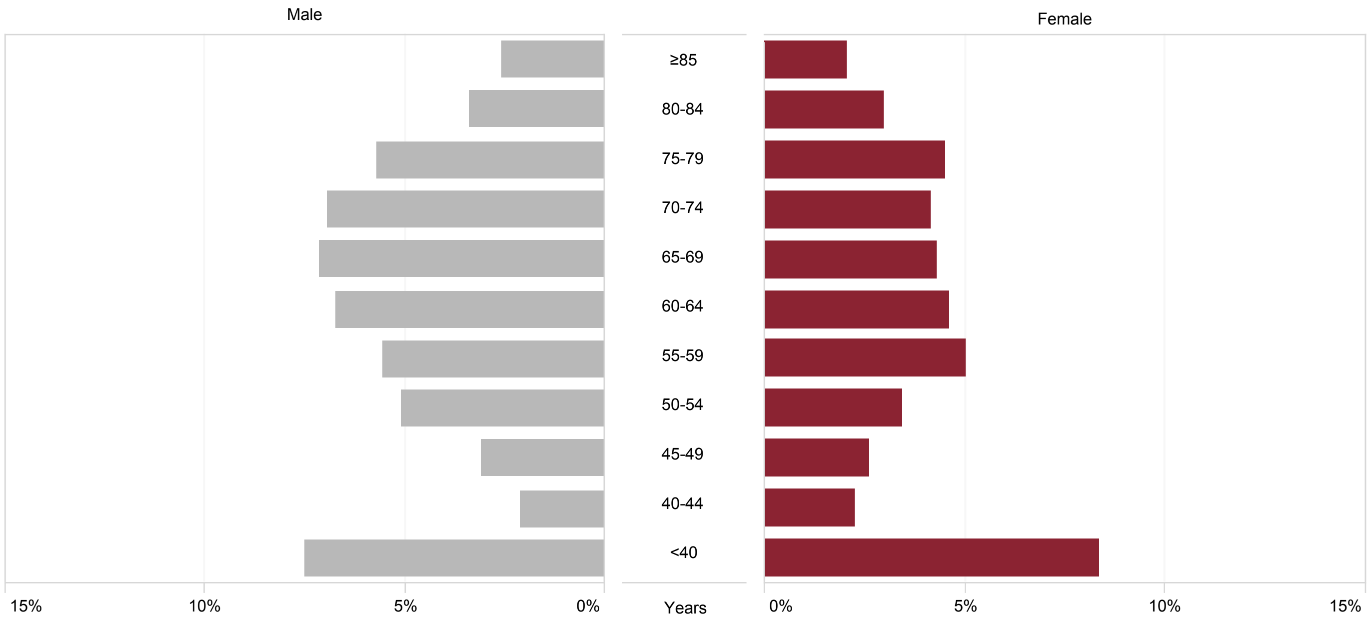


Figure 2: Proportion of outreach consults by age and gender

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%.

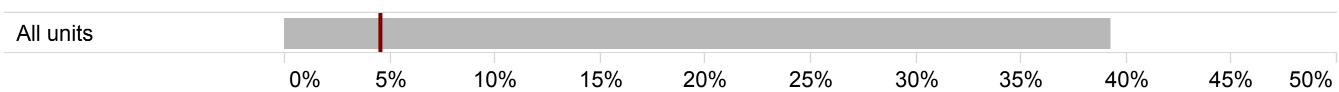


Figure 3: Proportion of Aboriginal and Torres Strait Islander patients seen in cardiac outreach

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.

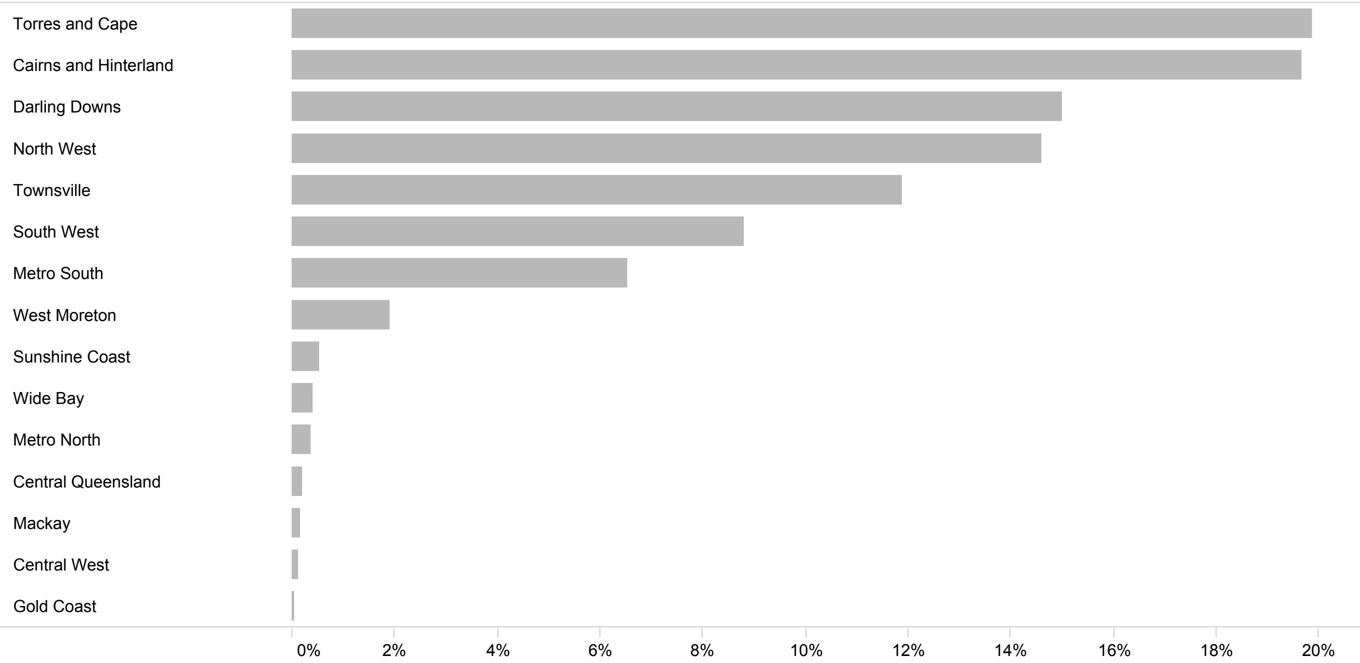


Figure 4: Proportion of patients by HHS of residence since commencement

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

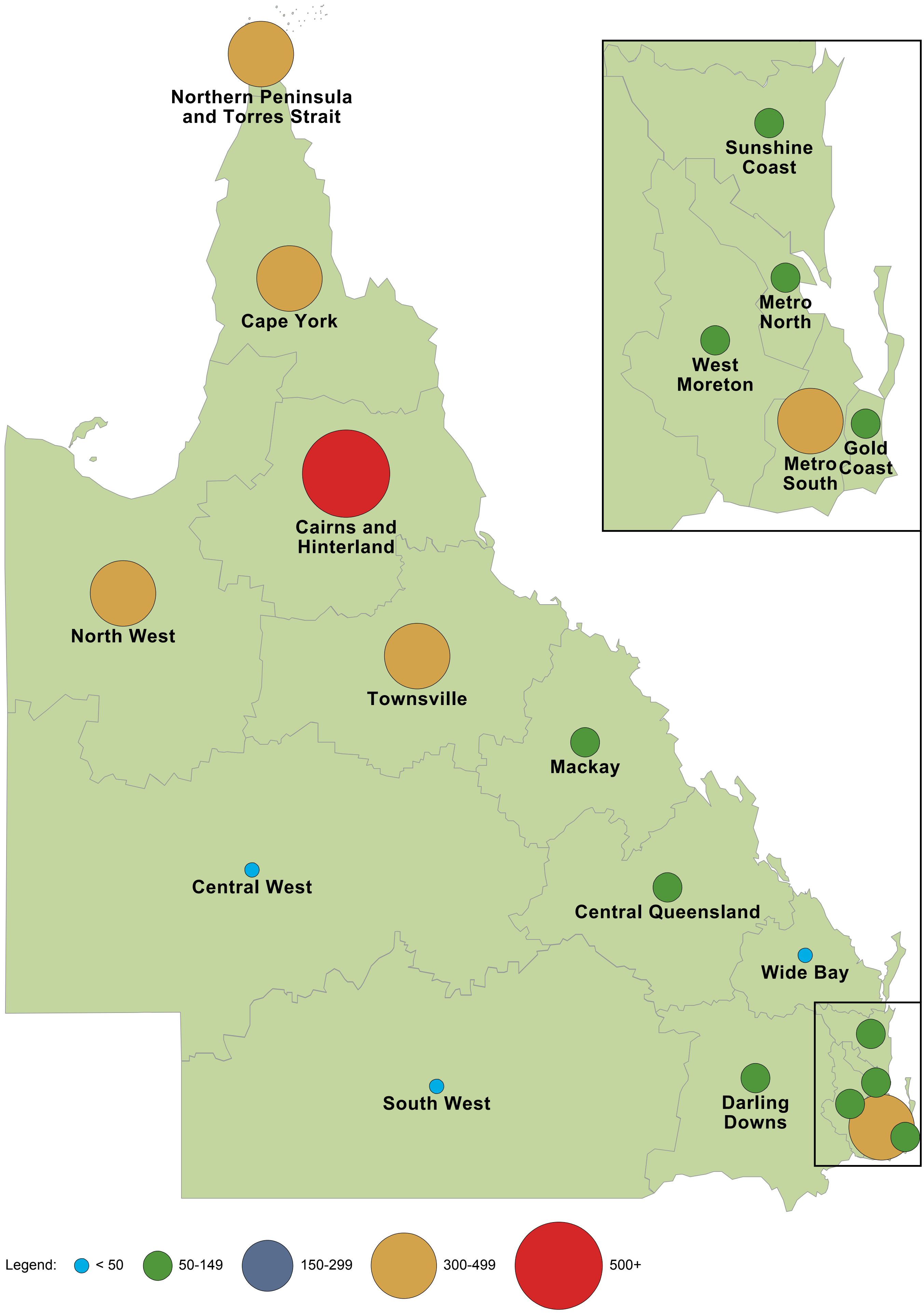


Figure 1: Rheumatic Heart Disease active clients by area of residence

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.

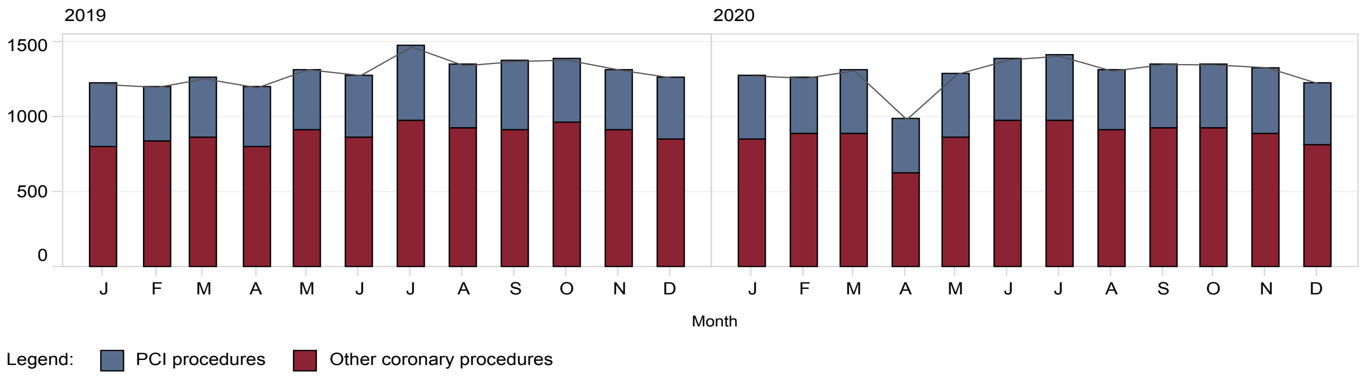


Figure 1: Proportion of all diagnostic and interventional cardiology cases by case category and month, 2019–2020

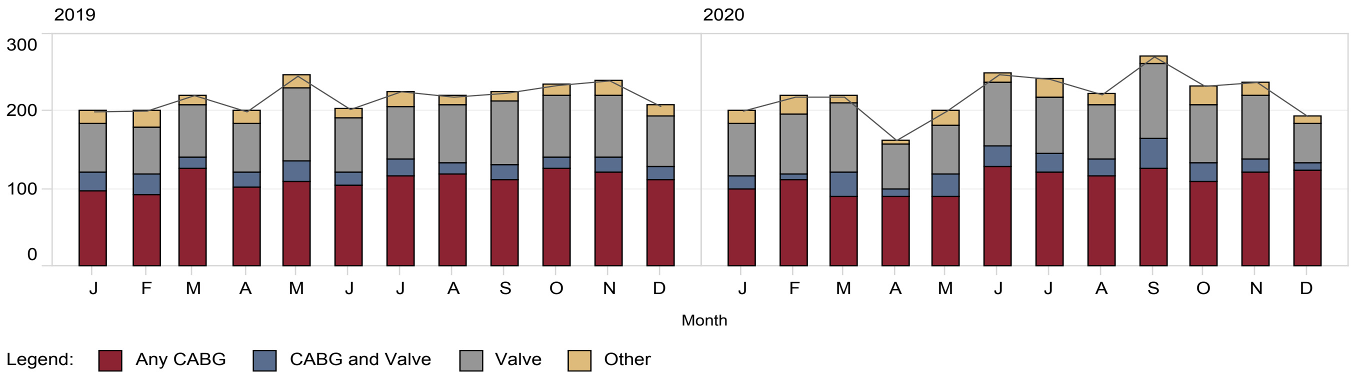


Figure 2: Proportion of all cardiac surgery cases by procedure category and month, 2019–2020

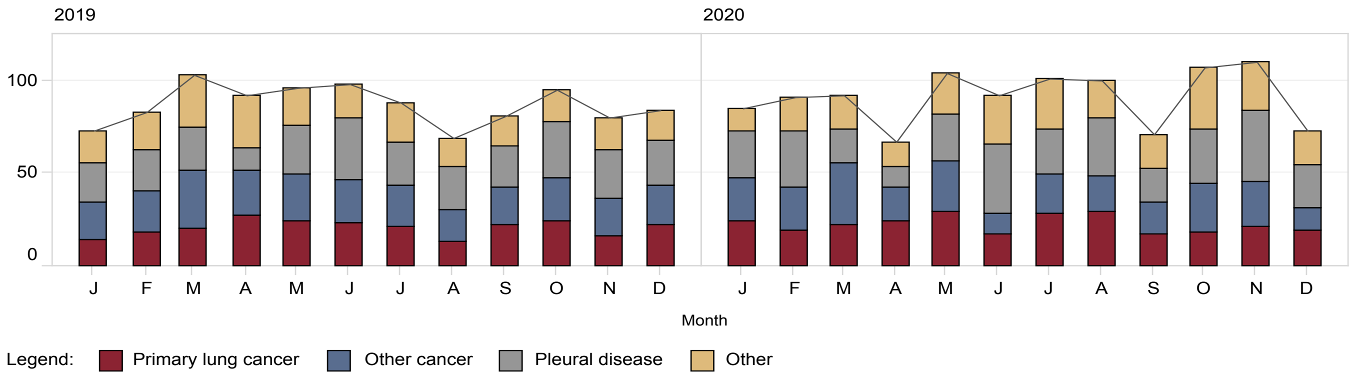


Figure 3: Proportion of all thoracic surgery cases by indication and month, 2019–2020

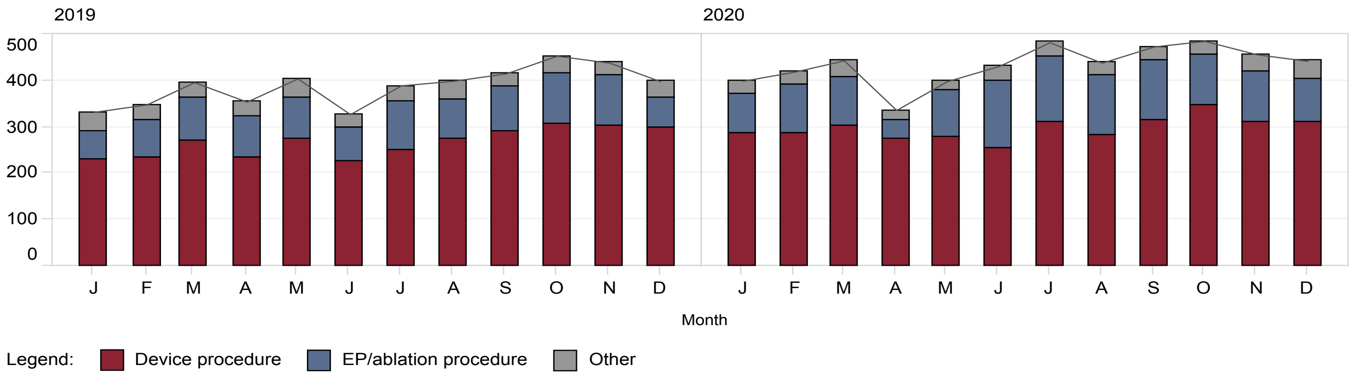


Figure 4: Proportion of all electrophysiology and pacing cases by procedure category and month, 2019–2020

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

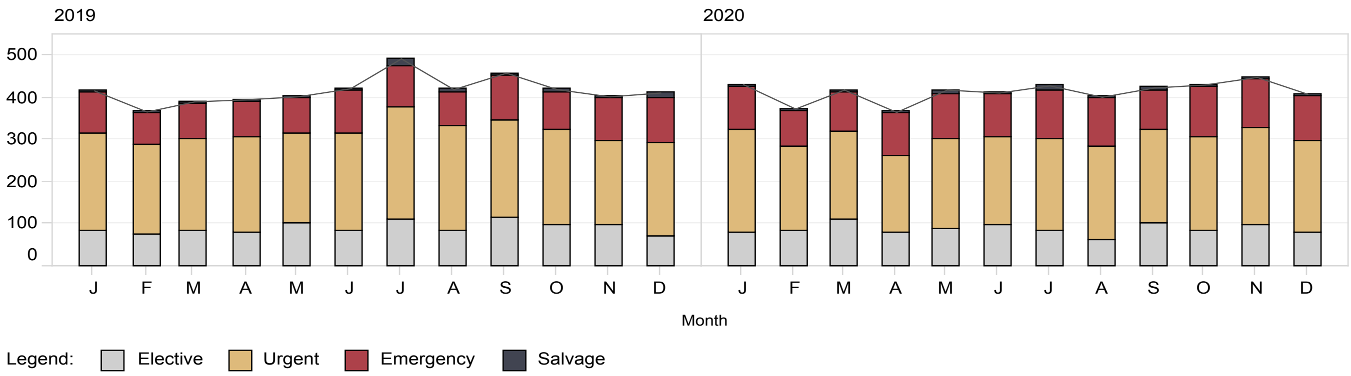


Figure 5: Proportion of all interventional cardiology cases by admission status and month, 2019–2020

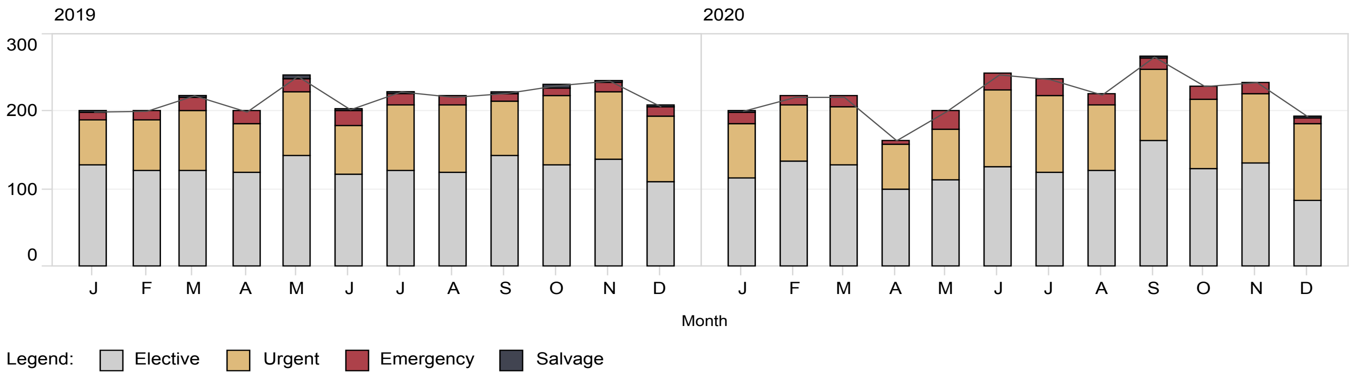


Figure 6: Proportion of all cardiac surgery cases by admission status and month, 2019–2020

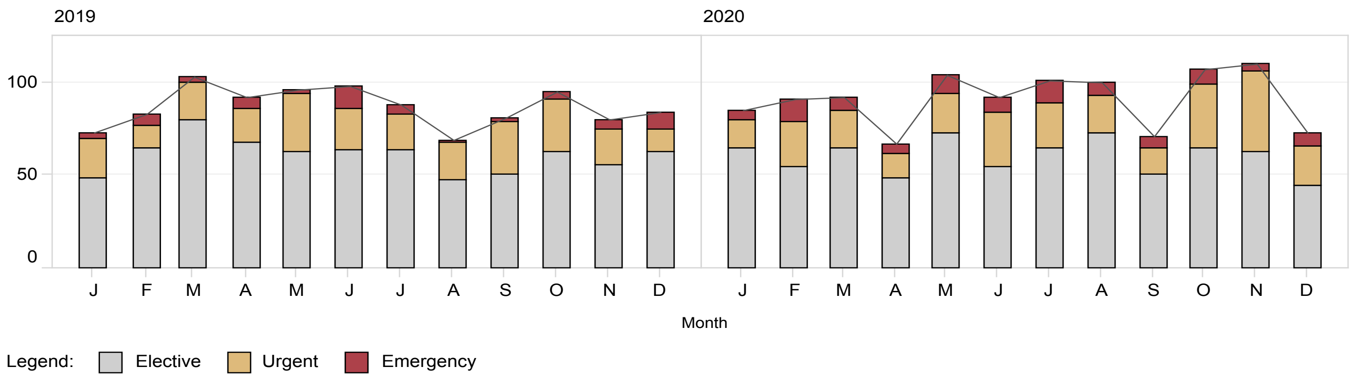
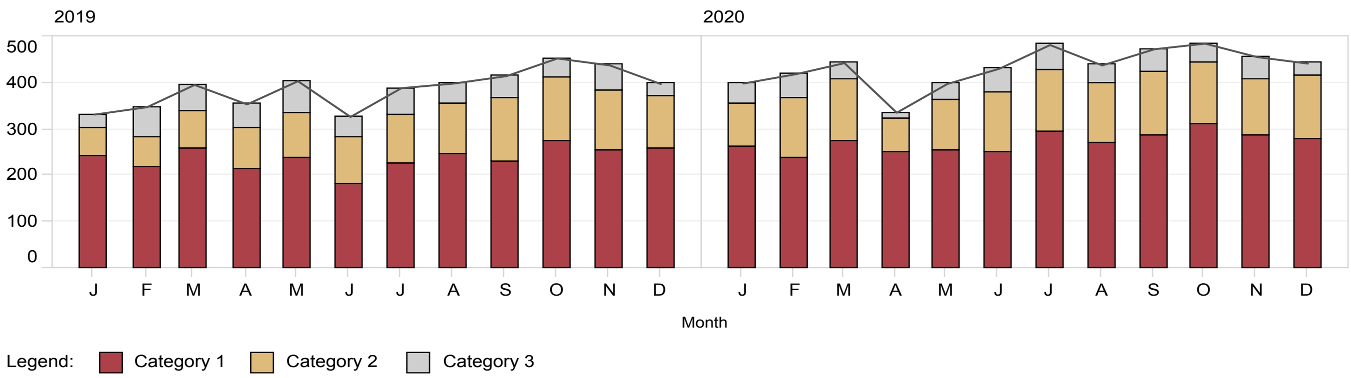


Figure 7: Proportion of all thoracic surgery cases by admission status and month, 2019–2020



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.

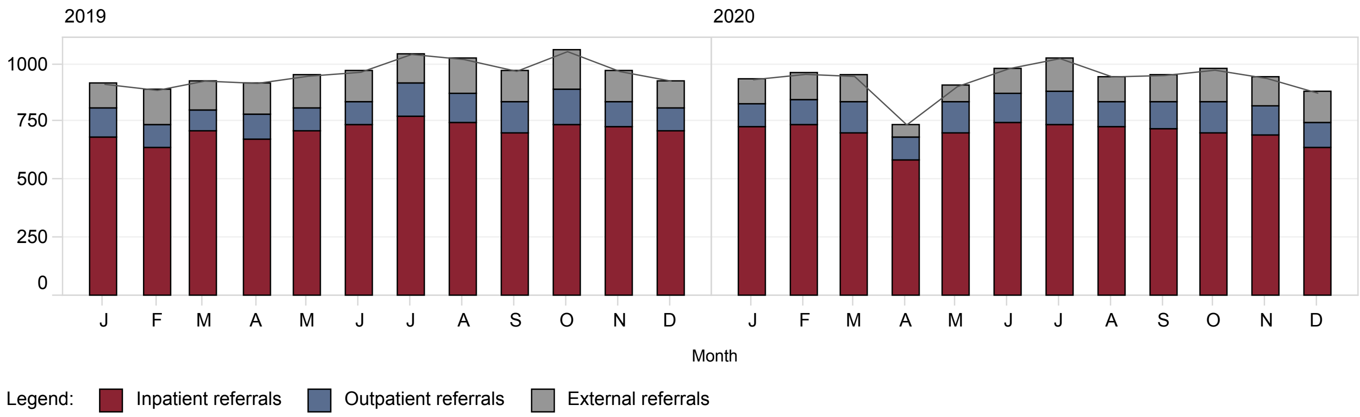


Figure 9: Cardiac rehabilitation referral source, 2019–2020

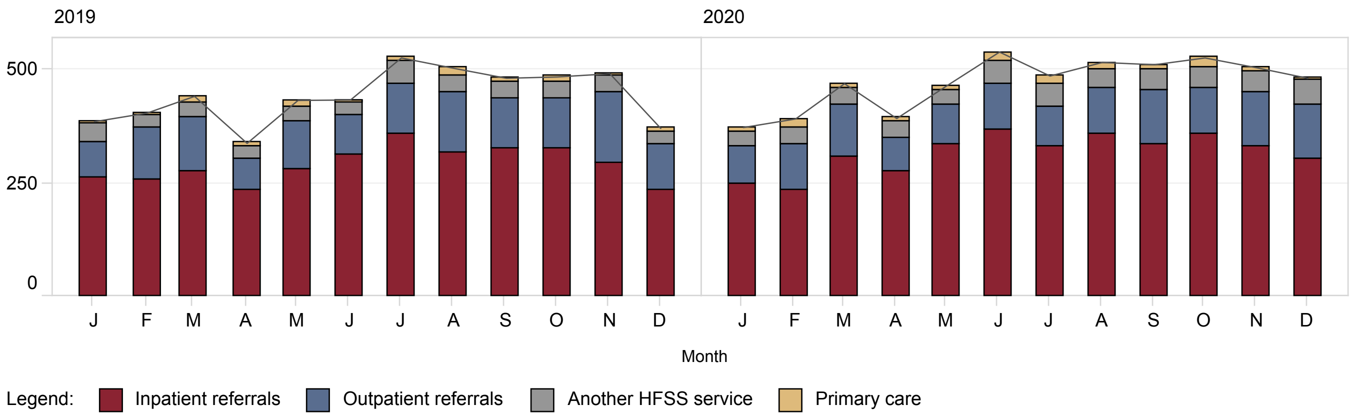


Figure 10: Heart failure support services referral source, 2019–2020

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.

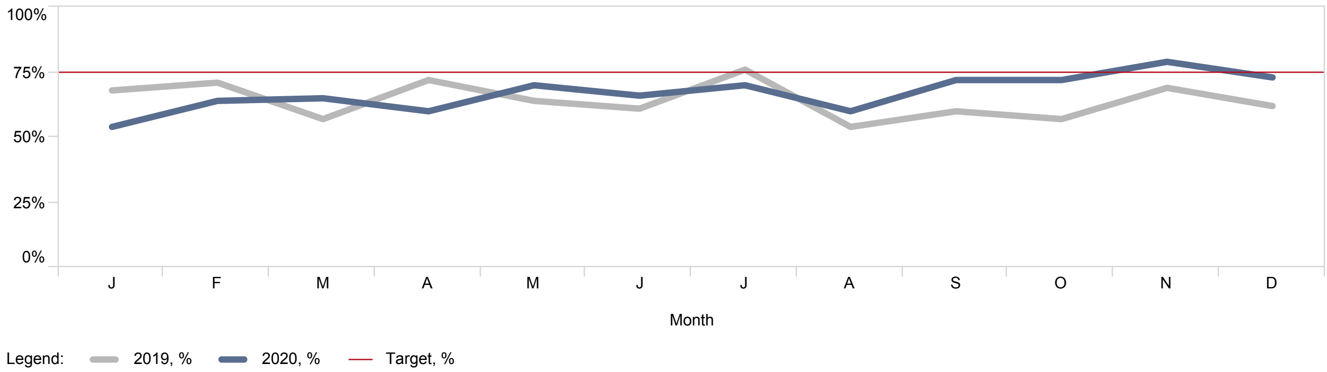


Figure 11: Proportion of ST-elevation myocardial infarction patients presenting within six hours of symptom onset who received an intervention within 90 minutes of first diagnostic electrocardiograph, 2019–2020

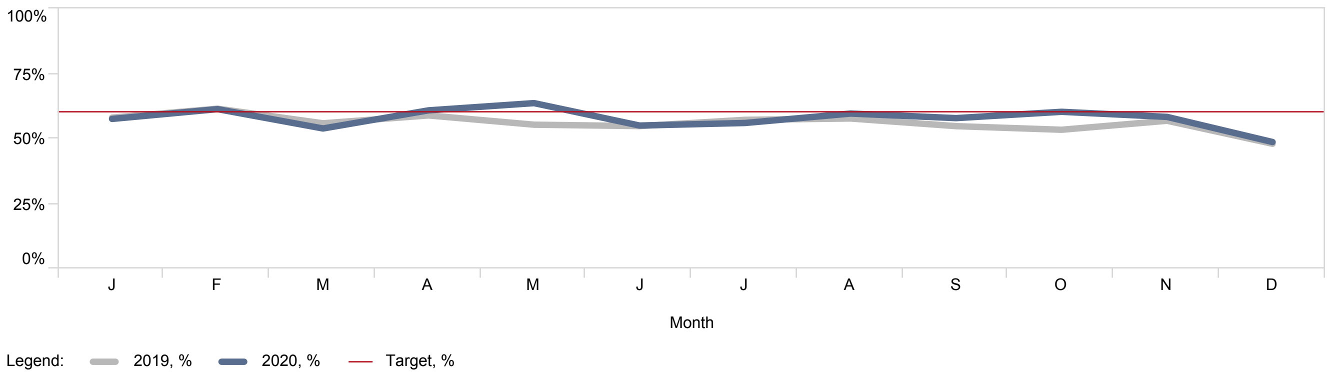


Figure 12: Cardiac rehabilitation performance measure, 2019–2020

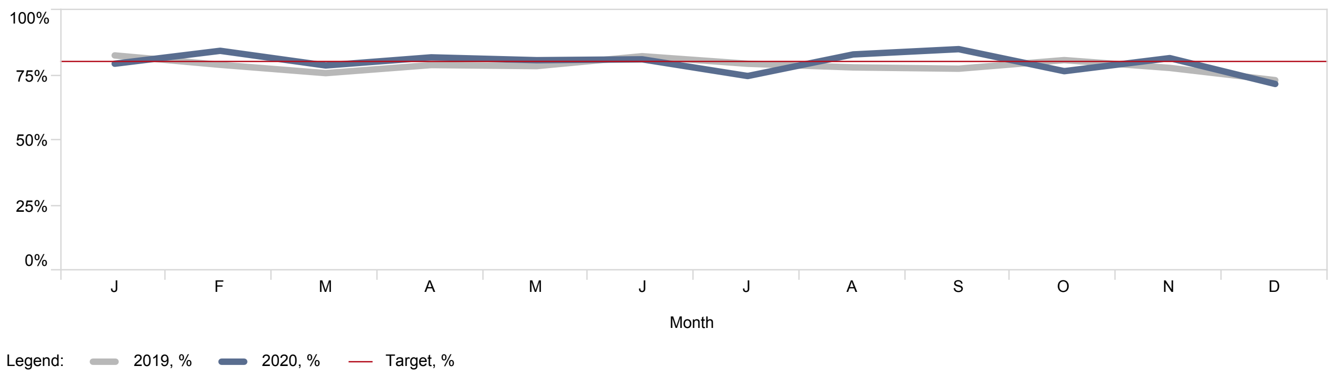


Figure 13: Heart failure support services clinical follow-up of acute patients within two weeks, 2019–2020

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

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

Cardiac Surgery

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.

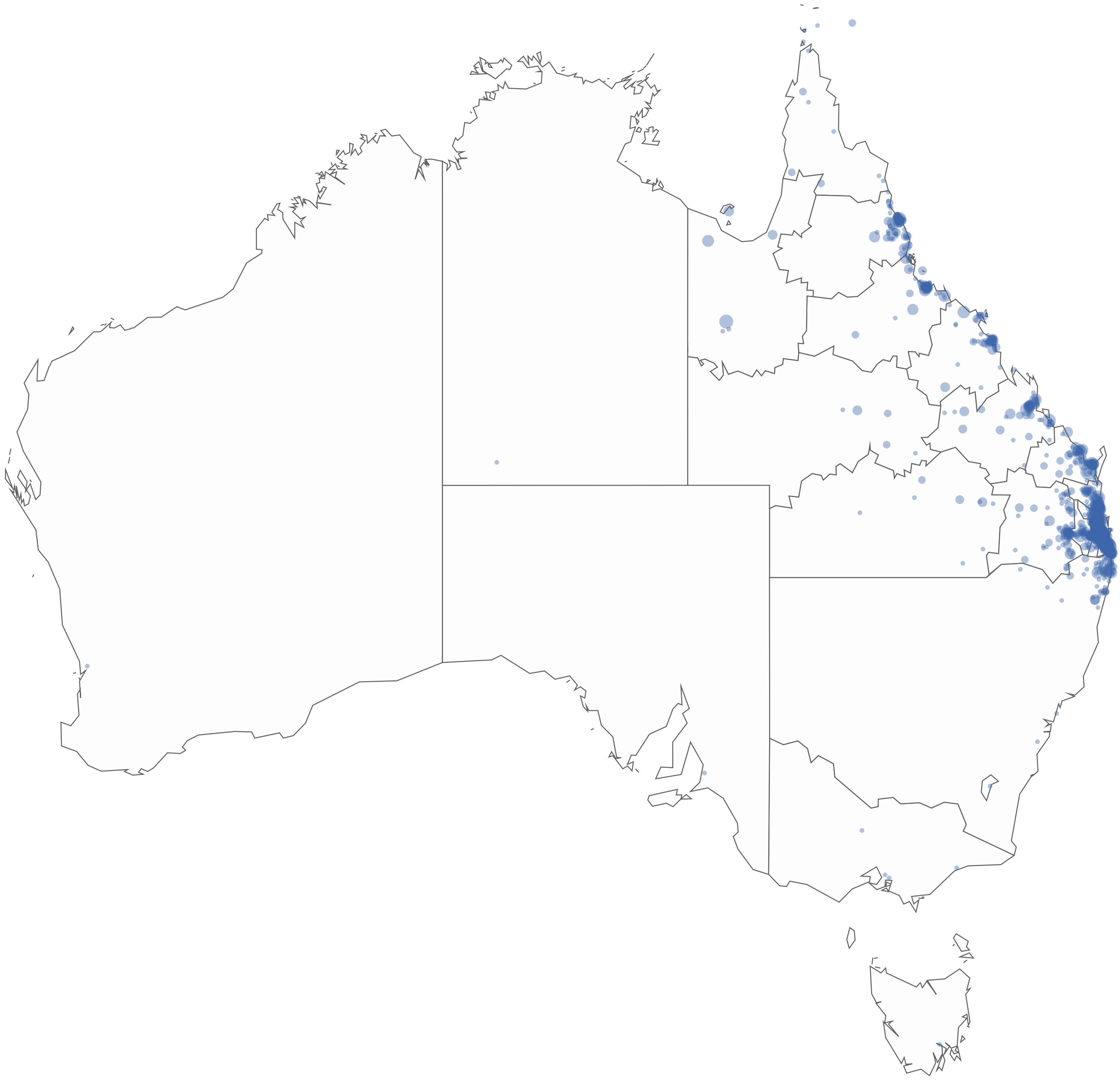


Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

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

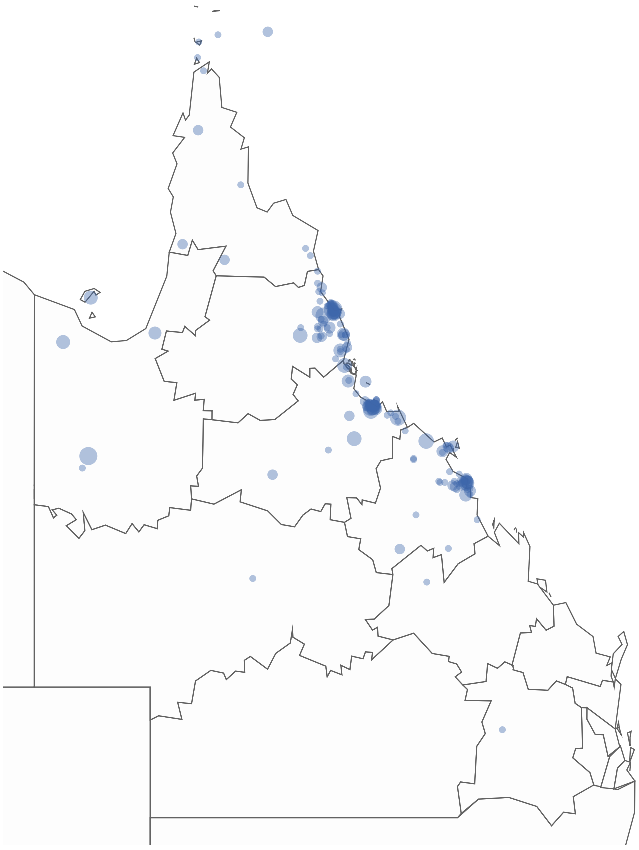


Figure 2: Townsville University Hospital

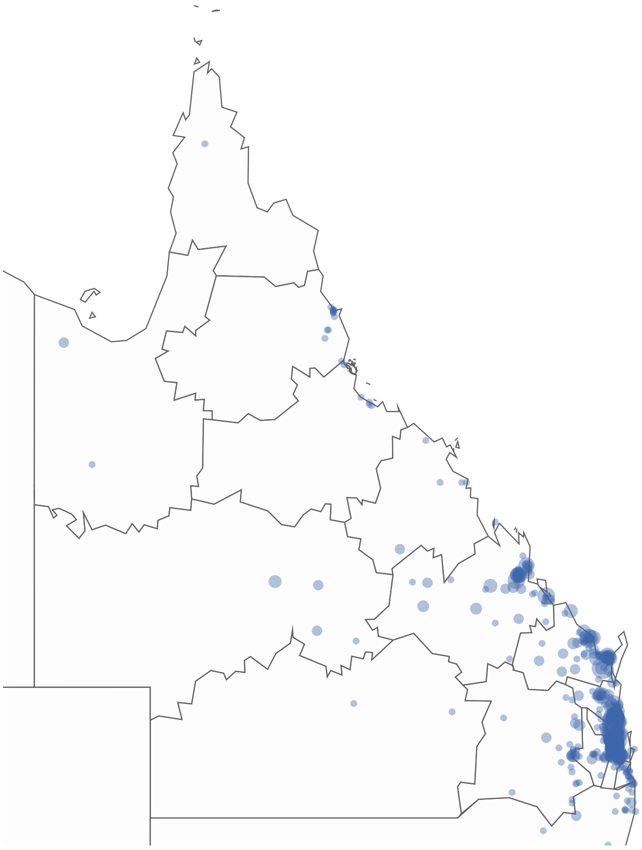


Figure 3: The Prince Charles Hospital

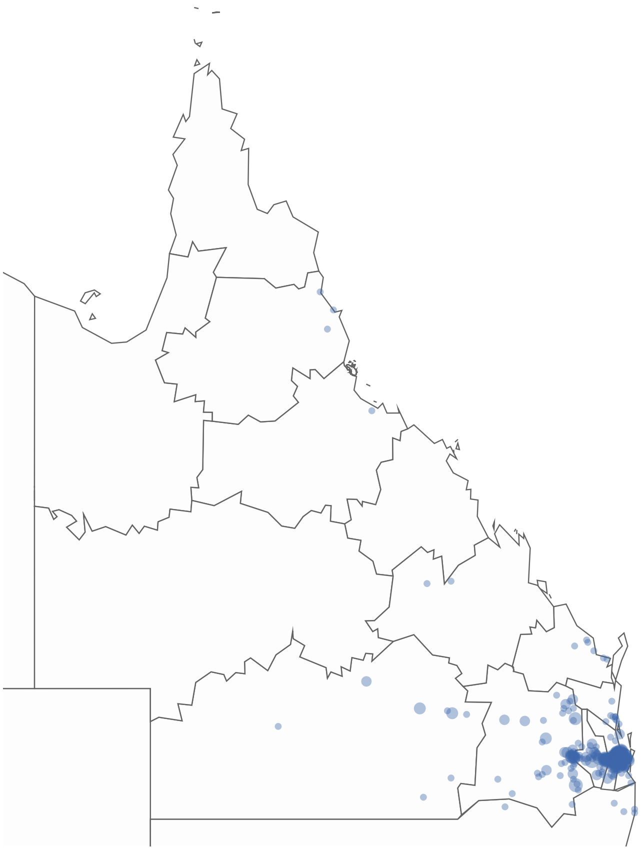


Figure 4: Princess Alexandra Hospital

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)

Cardiac Surgery

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.

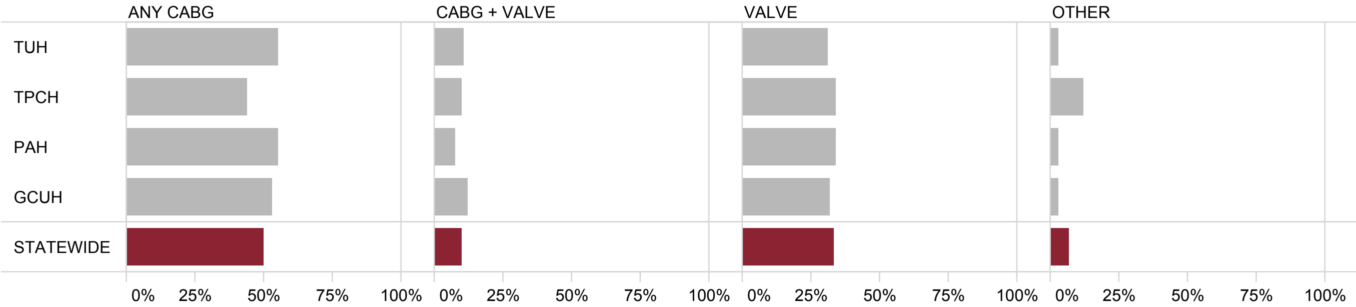


Figure 6: Proportion of cases by site and surgery category

Table 3: Proportion of cases by surgery category

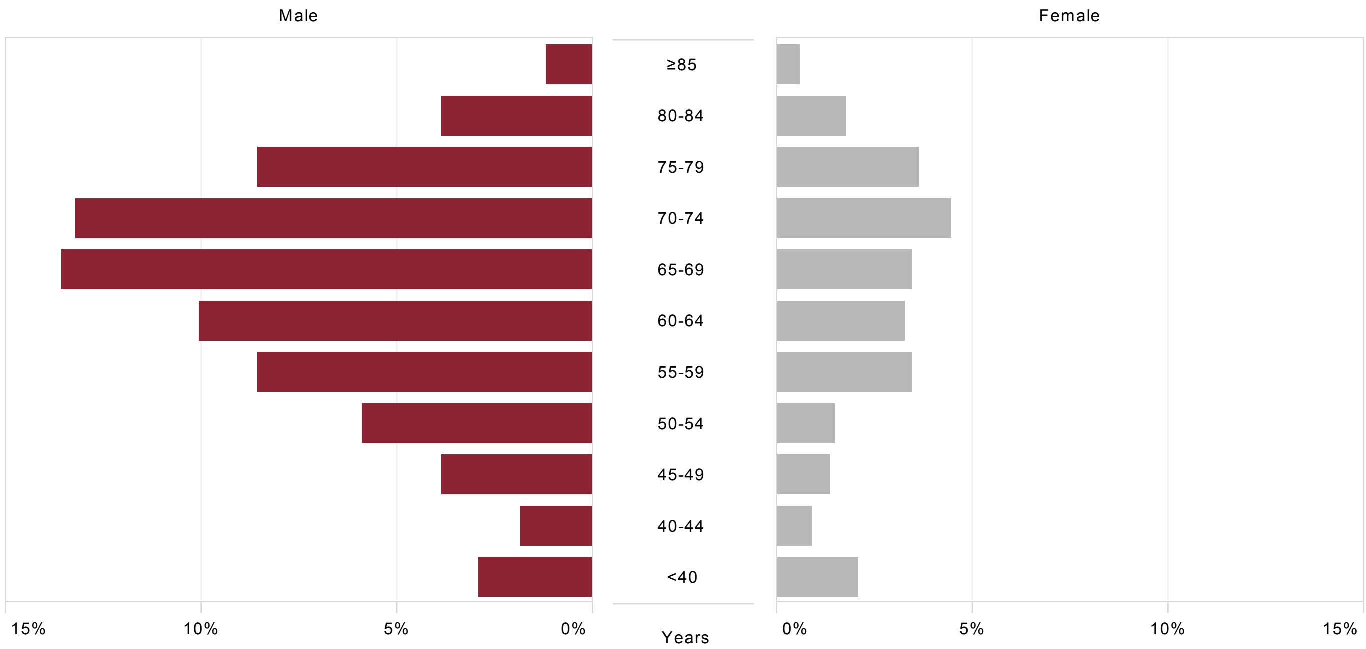
SITE	All cases n	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)
TUH	386	214 (55.4)	41 (10.6)	120 (31.1)	11 (2.8)
TPCH	1,191	526 (44.2)	114 (9.6)	409 (34.3)	142 (11.9)
PAH	643	357 (55.4)	48 (7.5)	220 (34.3)	18 (2.8)
GCUH	431	229 (53.3)	52 (12.1)	138 (31.9)	12 (2.8)
STATEWIDE	**2,651**	**1,326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

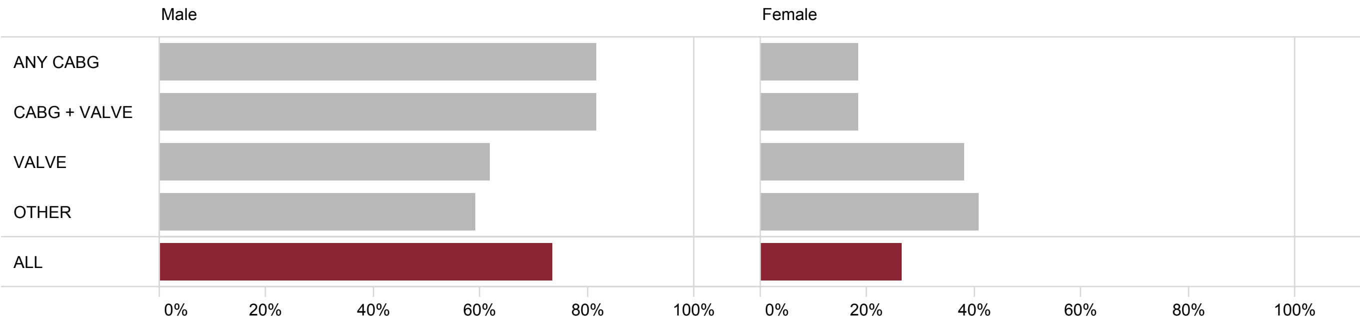


Figure 8: Proportion of cases by gender and surgery category

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.

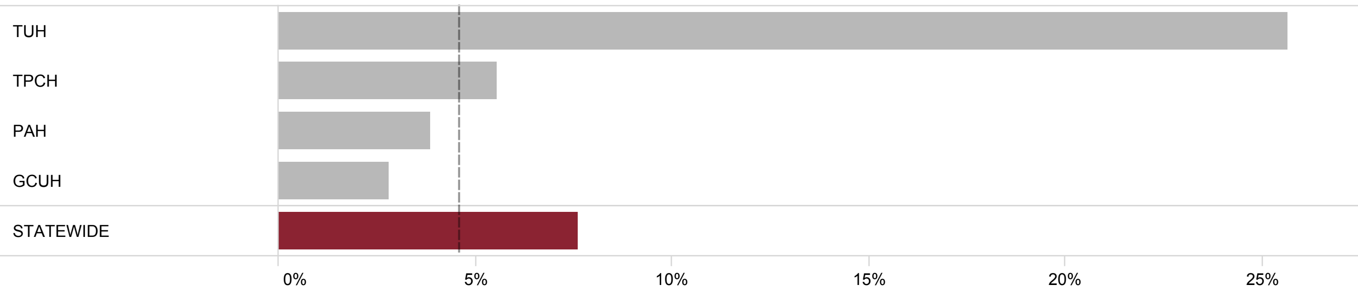


Figure 10: Proportion of all cardiac surgical cases by identified Aboriginal and Torres Strait Islander status and site

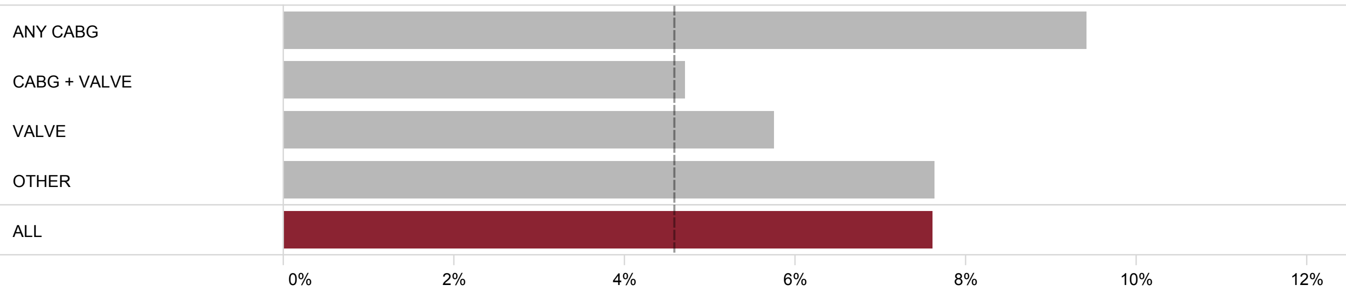
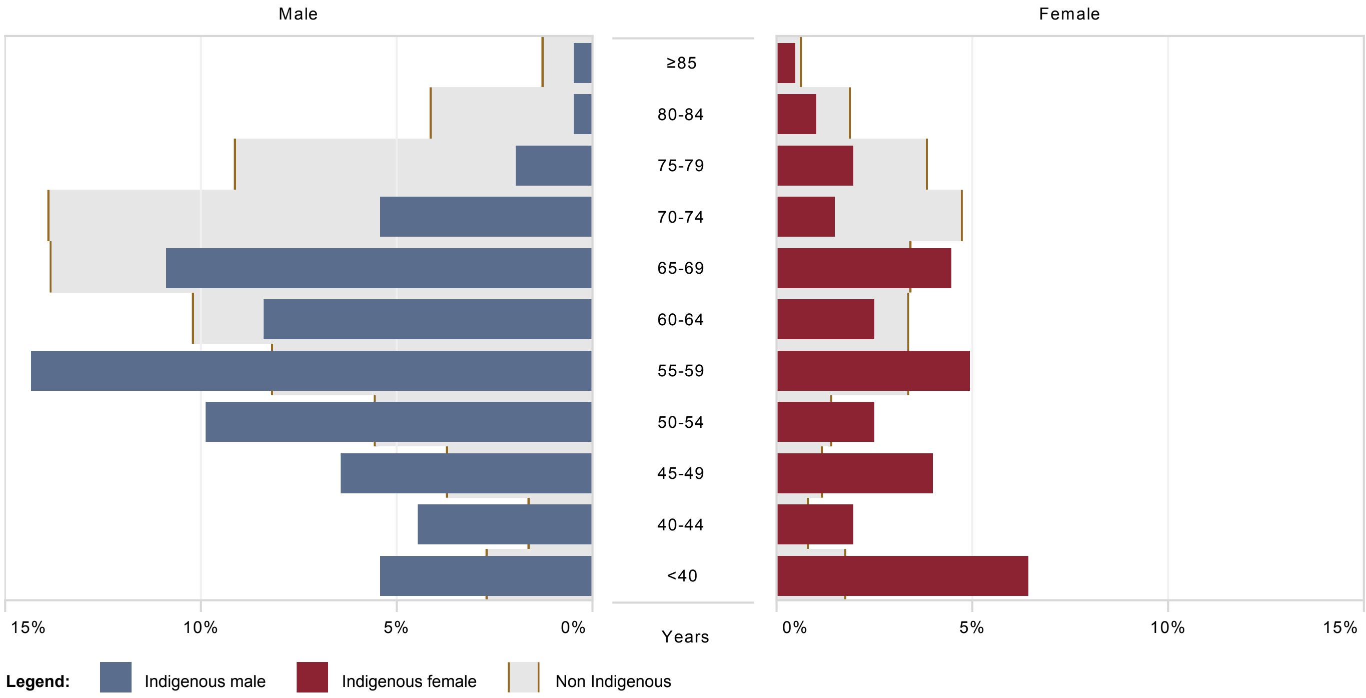


Figure 11: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

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

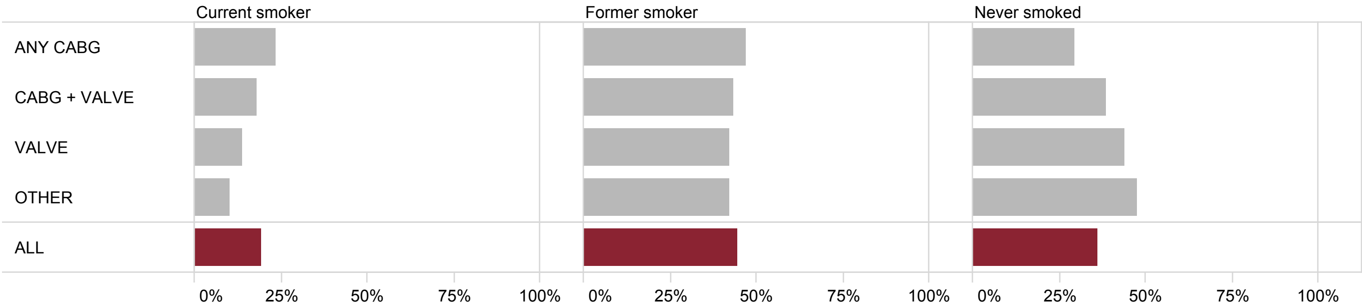
Table 6: Median patient age by gender and Aboriginal and Torres Strait Islander status

	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%).

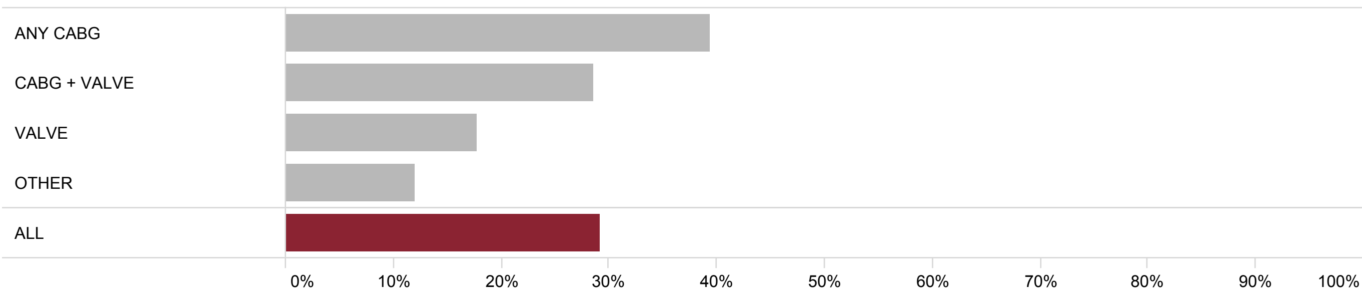


Figure 14: Proportion of cases by diabetes status and surgery category

Cardiac Surgery

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%).

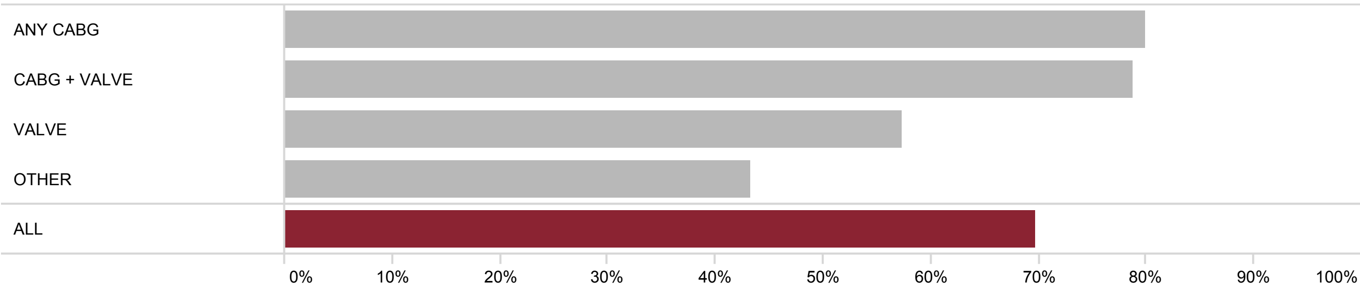


Figure 15: Proportion of cases by hypertension status and surgery category

6.4 Hypercholesterolaemia

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

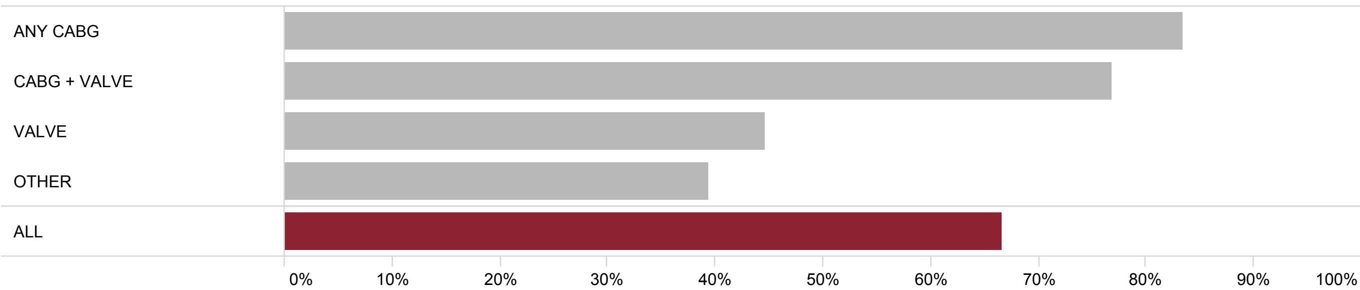
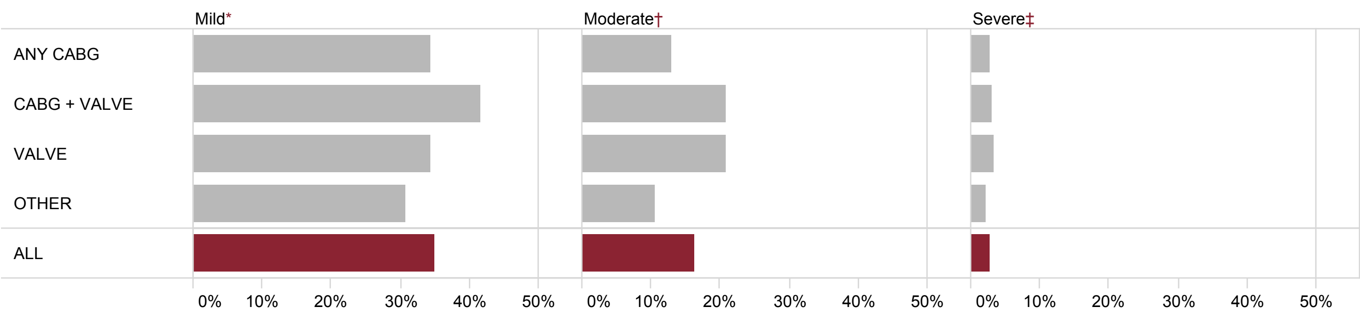


Figure 16: Proportion of cases by hypercholesterolaemia and surgery category

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

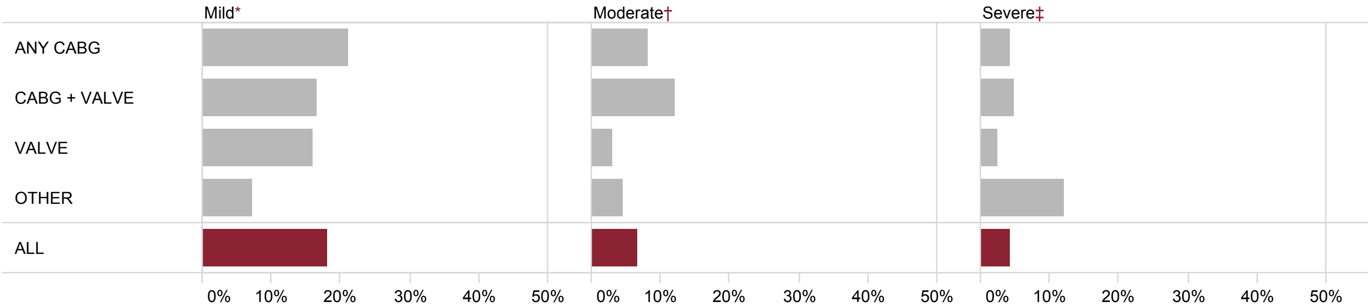
† eGFR 30–59 mL/min/1.73 m^2

‡ 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

Cardiac Surgery

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 m^2	456 (34.4)	106 (41.6)	304 (34.2)	56 (30.6)	922 (34.8)
eGFR 30–59 mL/min/1.73 m^2	172 (13.0)	53 (20.8)	186 (20.9)	19 (10.4)	430 (16.2)
eGFR <30 mL/min/1.73 m^2	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/m^2	531 (40.0)	97 (38.0)	332 (37.4)	70 (38.3)	1,030 (38.8)

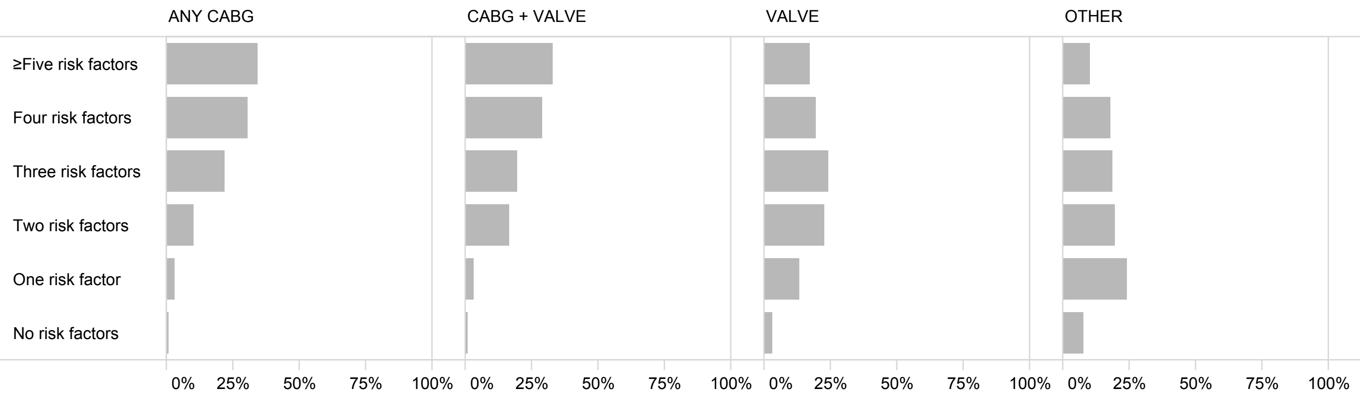


Figure 19: Number of patient risk factors by surgery category

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.

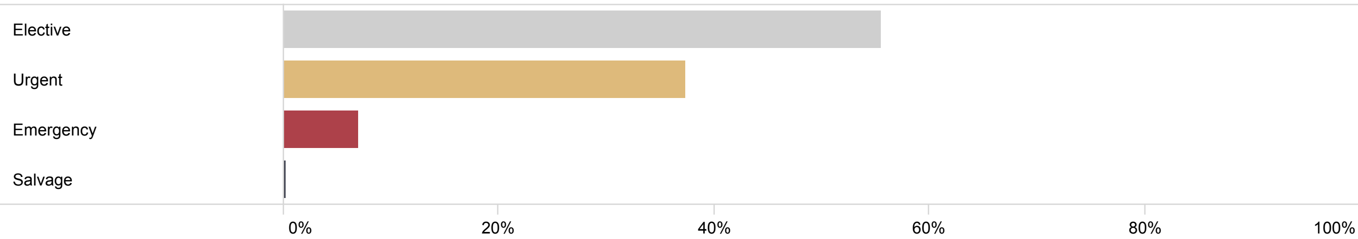


Figure 20: Proportion of cases by admission status

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.

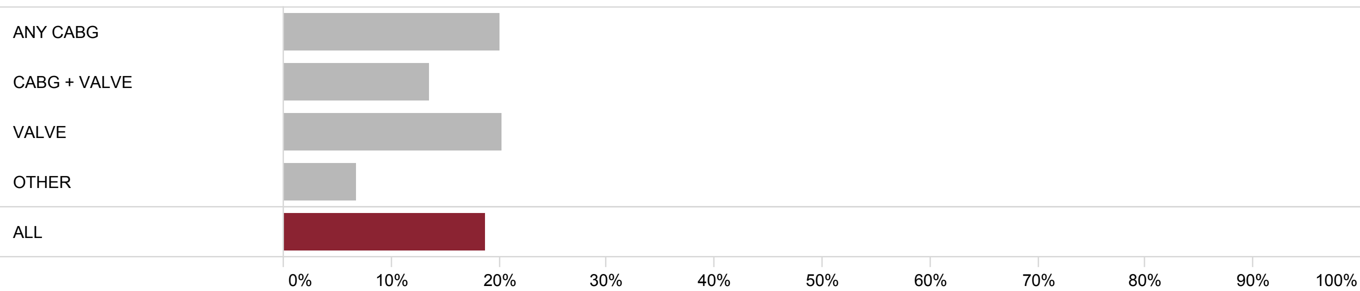


Figure 21: Proportion of elective cases for DOSA cases by surgery category

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.

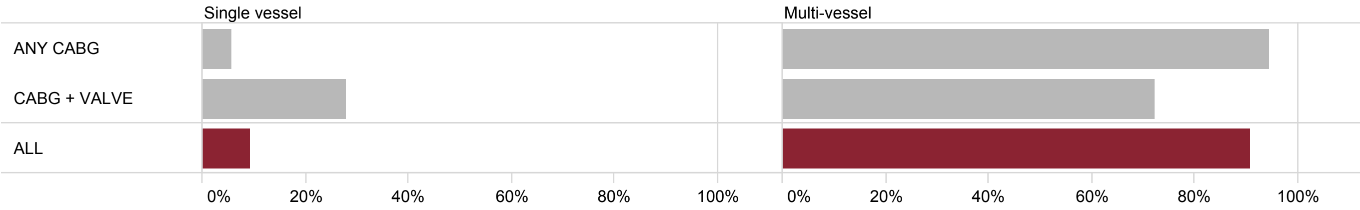


Figure 22: Number of diseased vessels by surgery category

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)**

Missing data not displayed (n=3)

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.

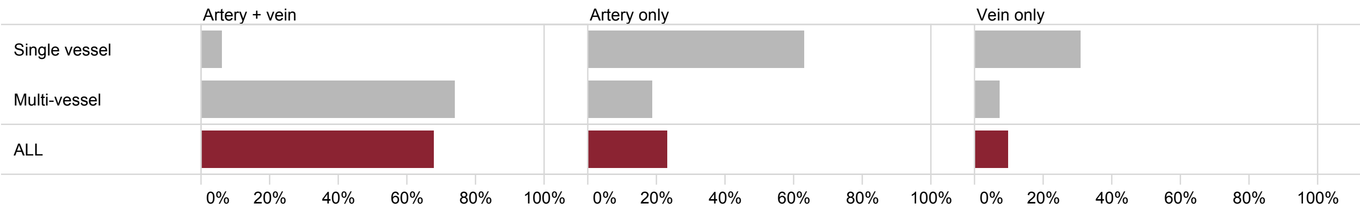


Figure 23: Proportion of diseased vessels by conduits used

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.

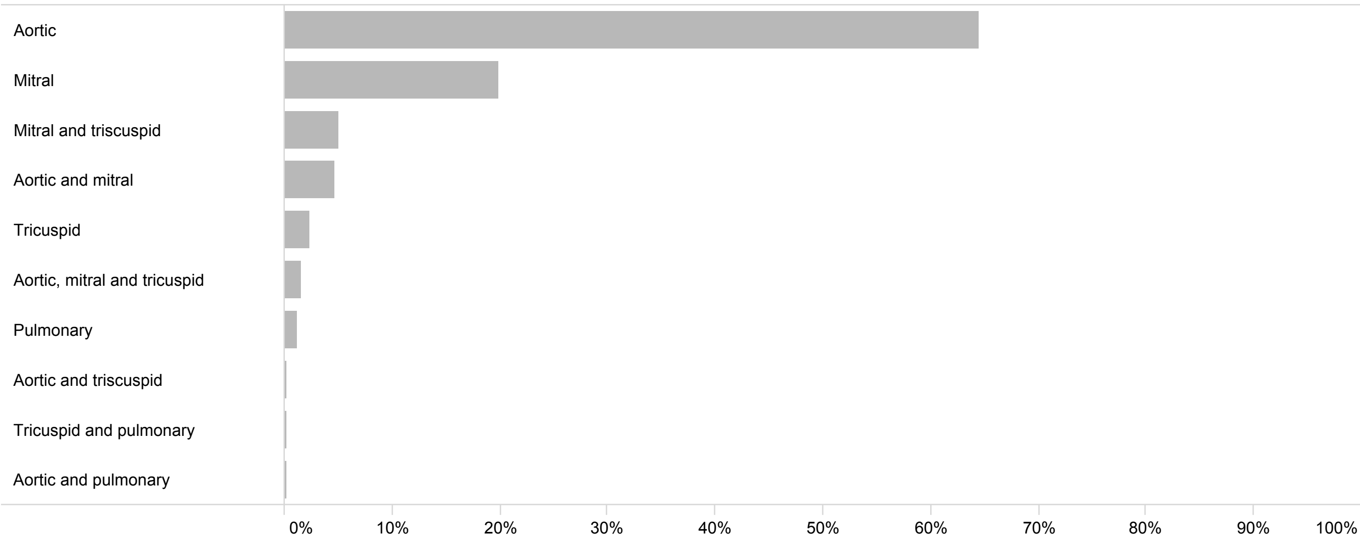


Figure 24: Proportion of valve surgery cases by valve

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

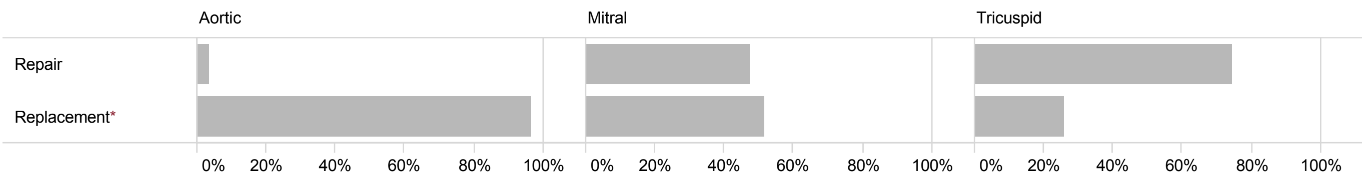
The most common valve pathology across all valve types was a degenerative cause (51%) which accounted for more than half of all aortic (54%) and mitral (52%) valve procedures.

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)**

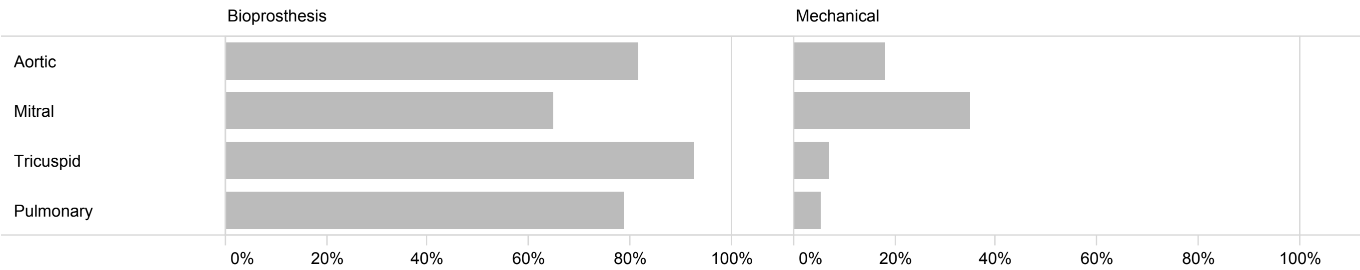
* Includes TAVR procedure involving CTS

† 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.

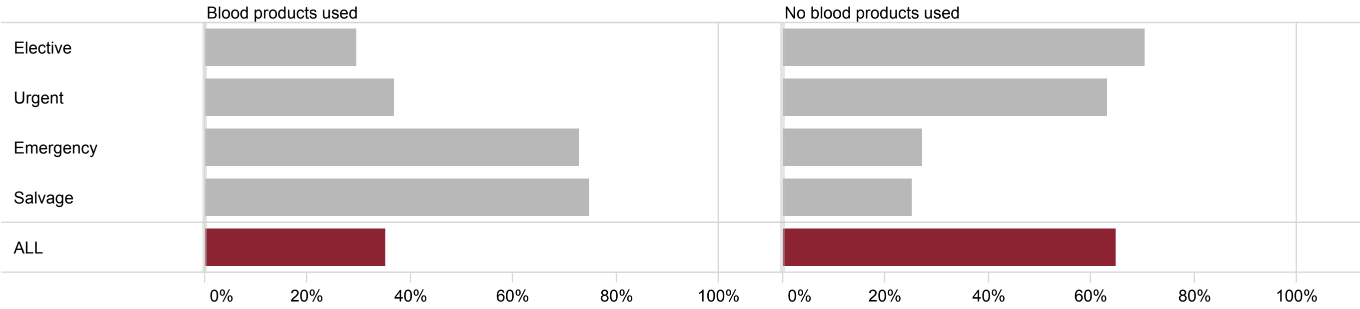


Figure 27: Blood products used by admission status

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)**

Cardiac Surgery

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

Cardiac Surgery

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.

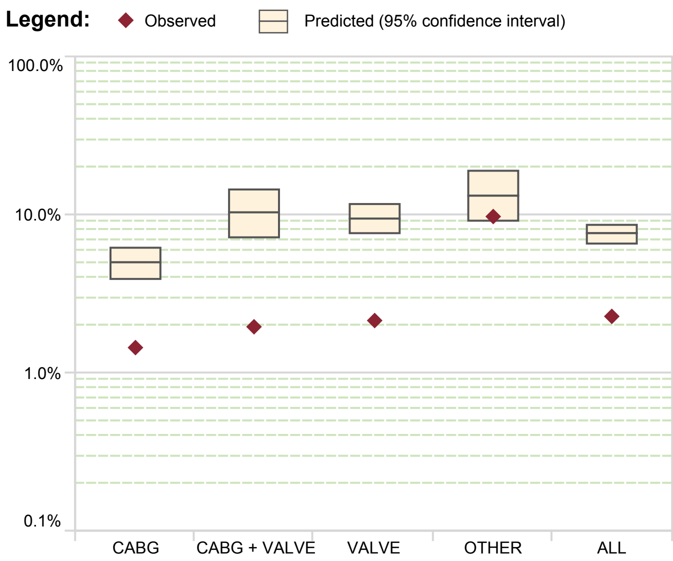


Figure 28: EuroSCORE

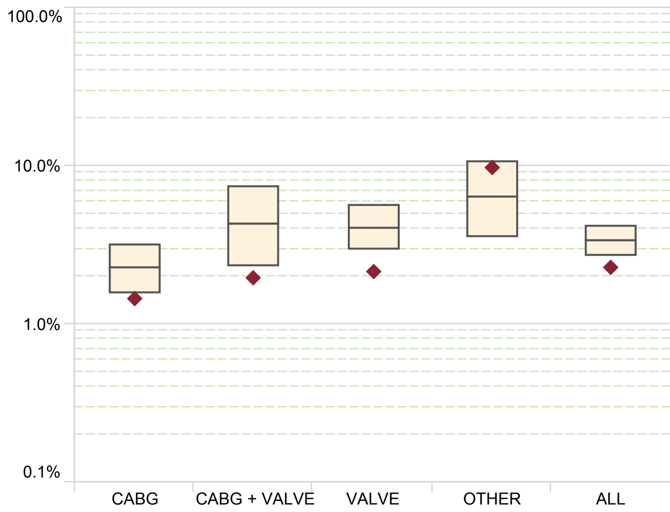


Figure 29: EuroSCORE II

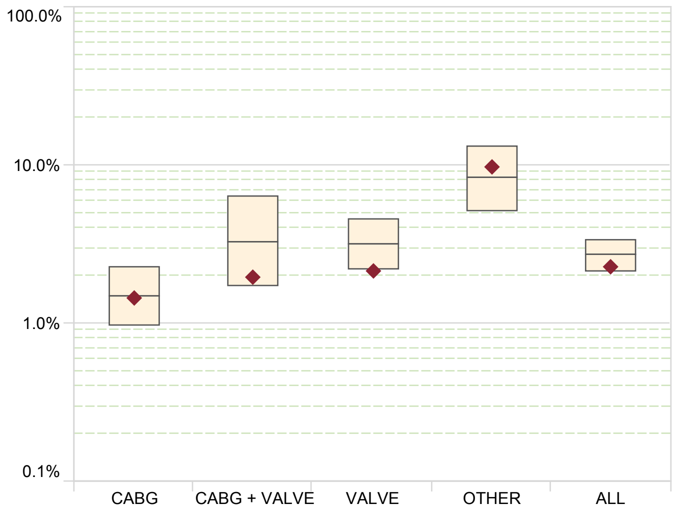


Figure 30: ANZSCTS (General Score)

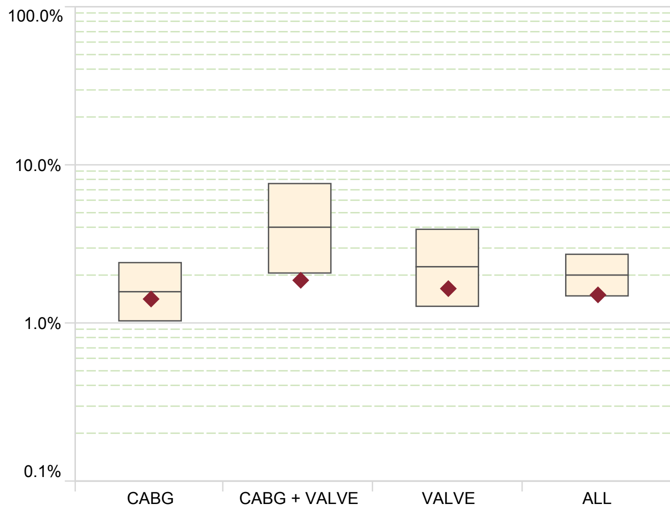


Figure 31: STS (death)

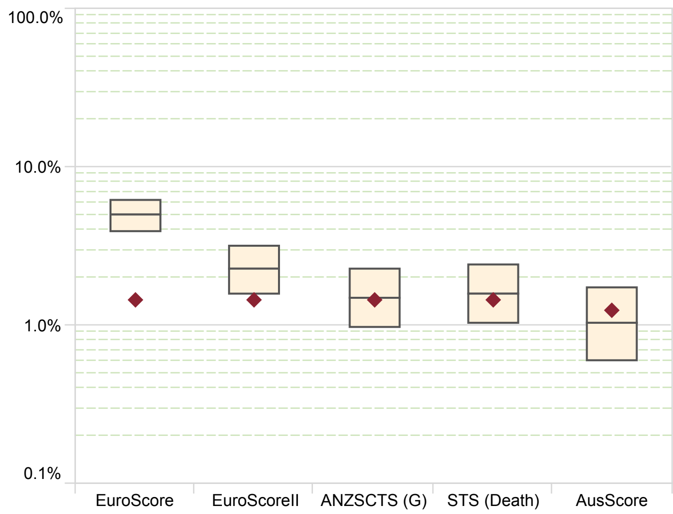


Figure 32: CABG

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]

Legend: ◆ Observed ▭ Predicted (95% confidence interval)

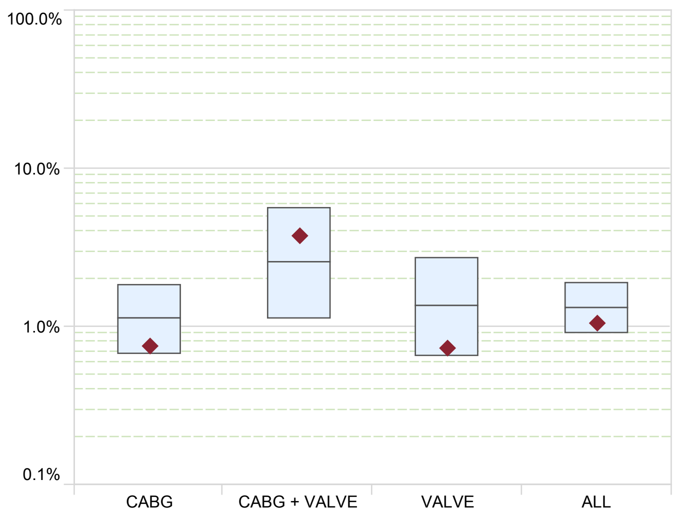


Figure 33: Cerebrovascular accident

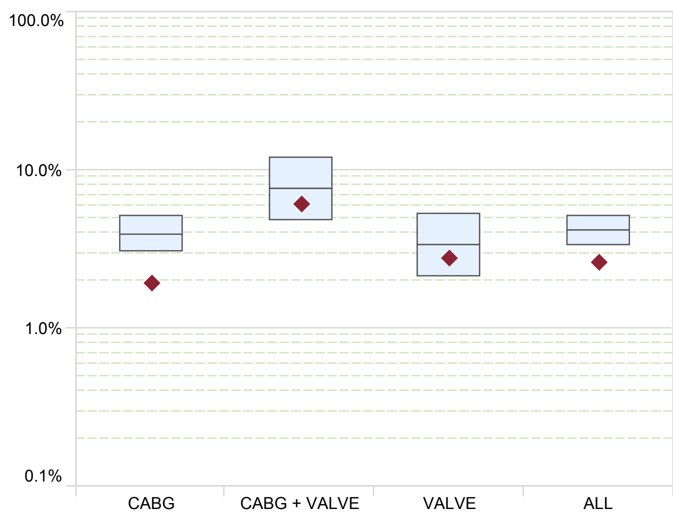


Figure 34: Renal failure

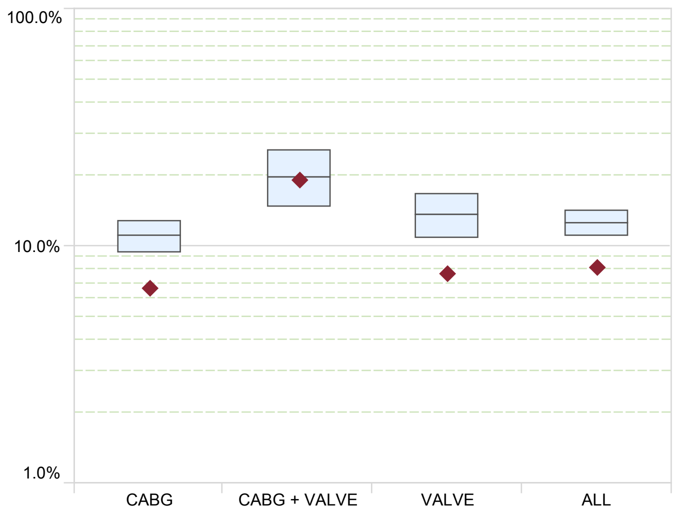


Figure 35: Ventilation >24 hours

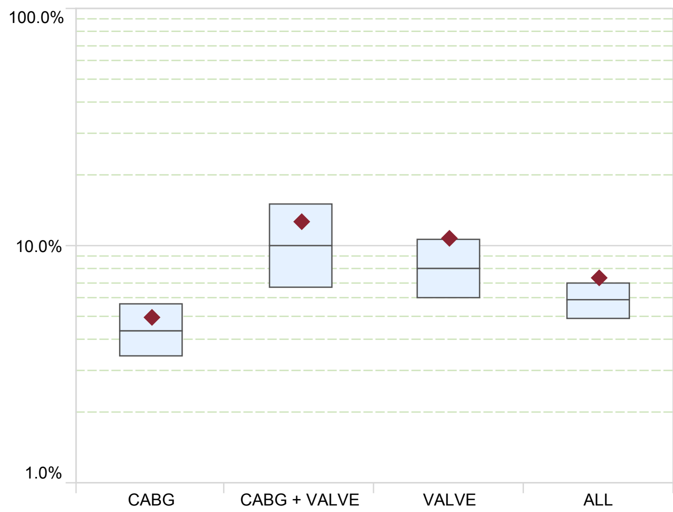


Figure 36: Reoperation

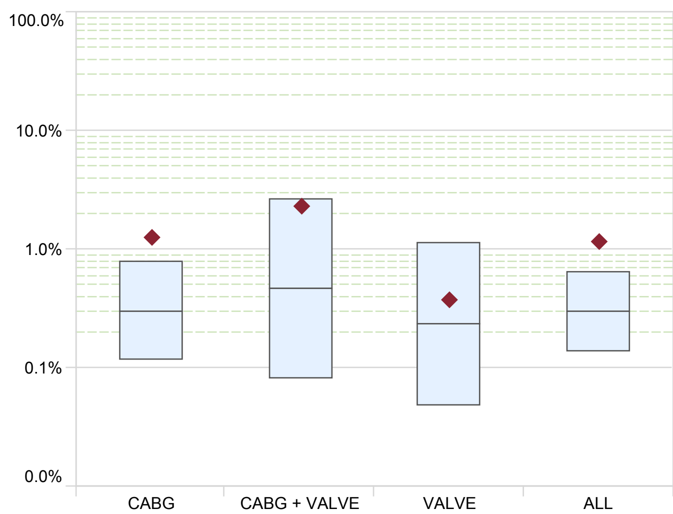


Figure 37: Deep sternal infection

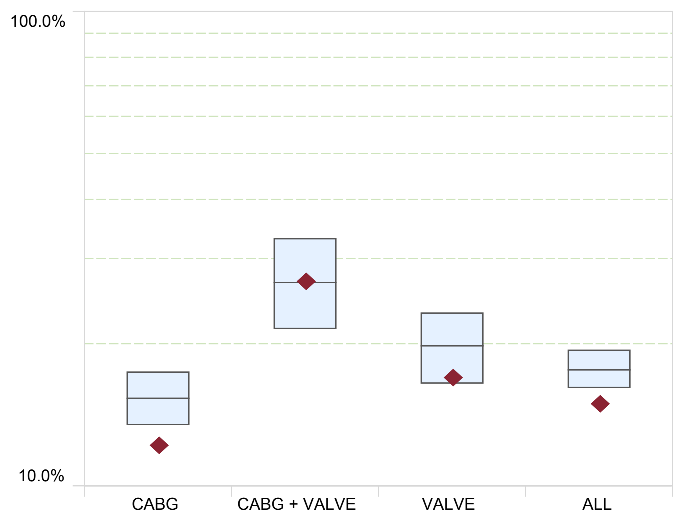


Figure 38: Major morbidity

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.

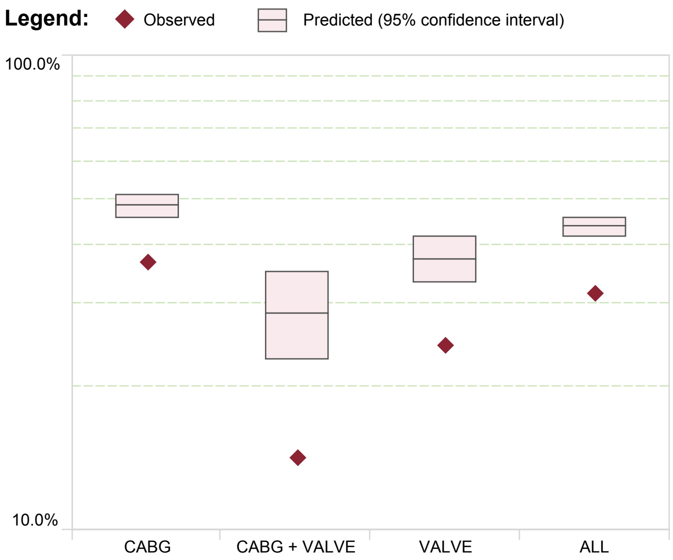


Figure 39: LOS ‹6 days

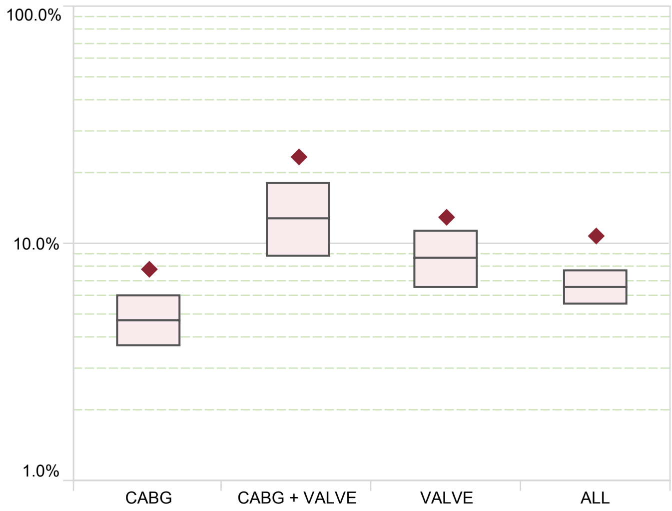


Figure 40: LOS ›14 days

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.

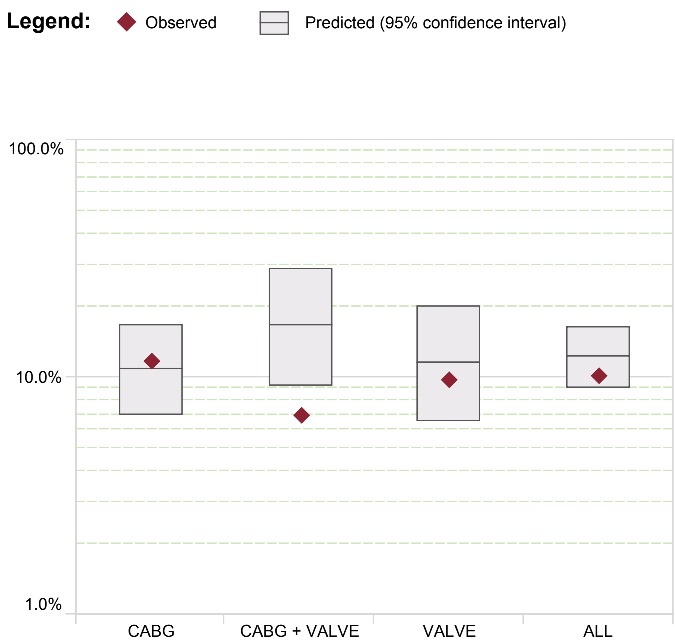


Figure 41: Failure to rescue

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.

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Chair, Australia and New Zealand Congenital Outcomes Registry for Surgery (ANZCORS) Steering Committee

9.2 Acknowledgements

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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.

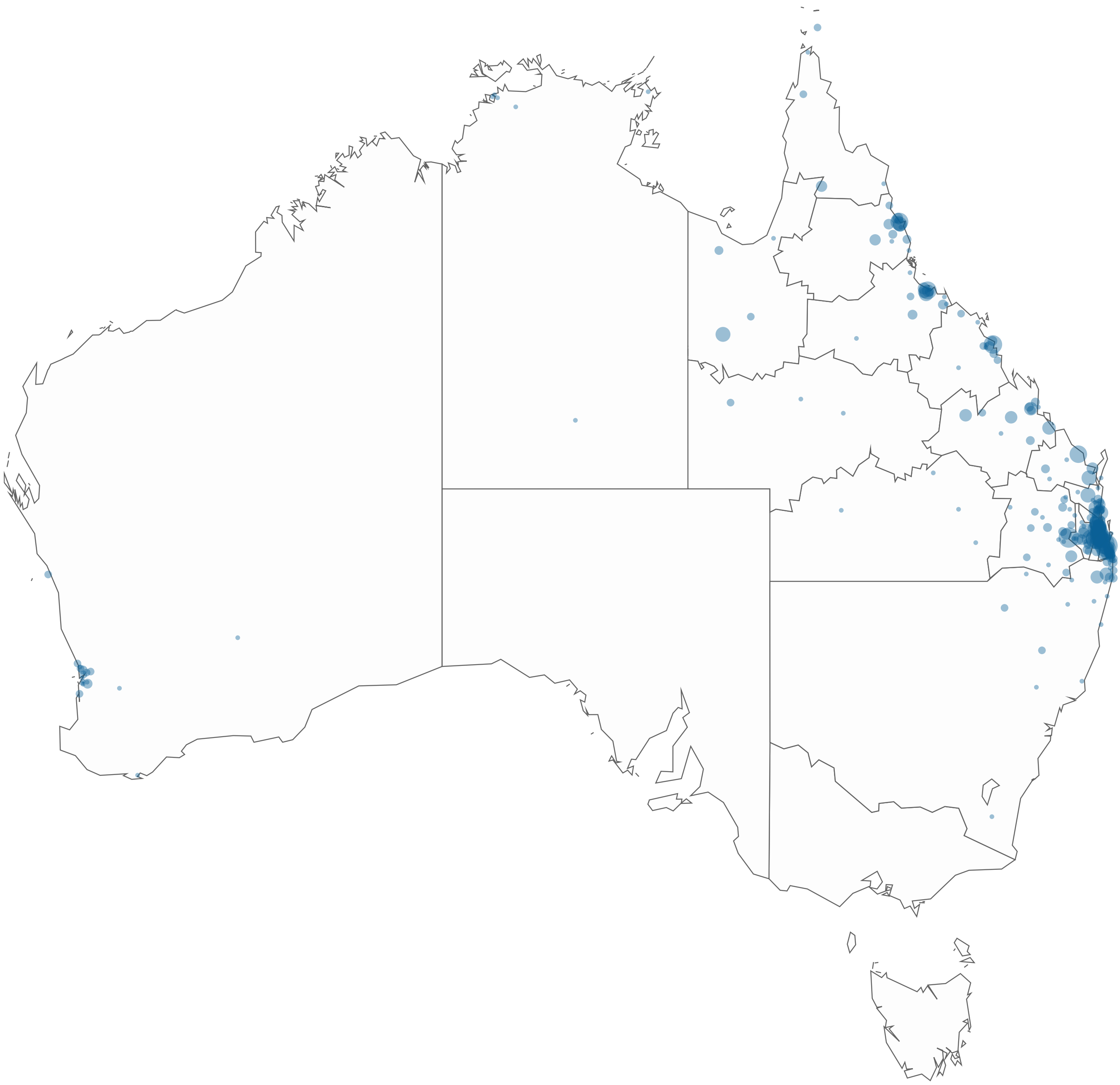

Figure 1: Cardiac patients treated by the Queensland Paediatric Cardiac Service between 2016–2020, by patient place of usual residence (residential postcode)

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

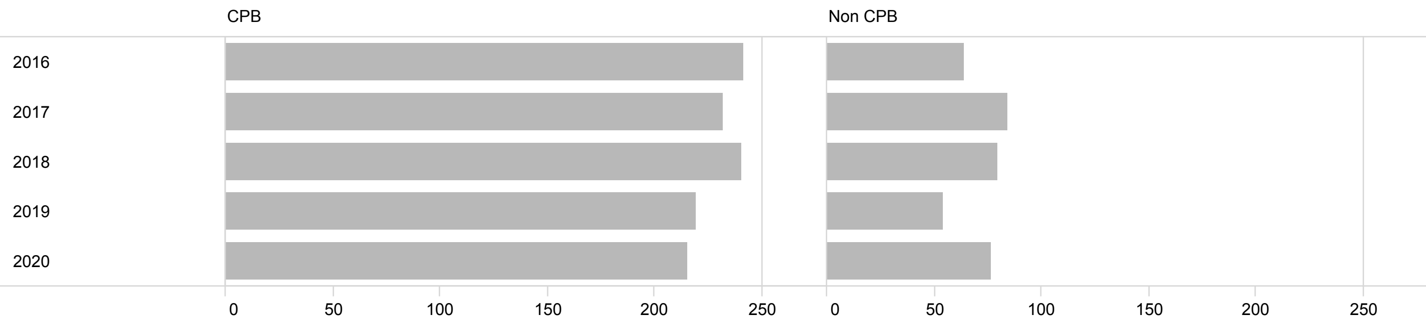

Figure 2: Number of cardiac patients by cardiopulmonary bypass utilisation, 2016–2020

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.

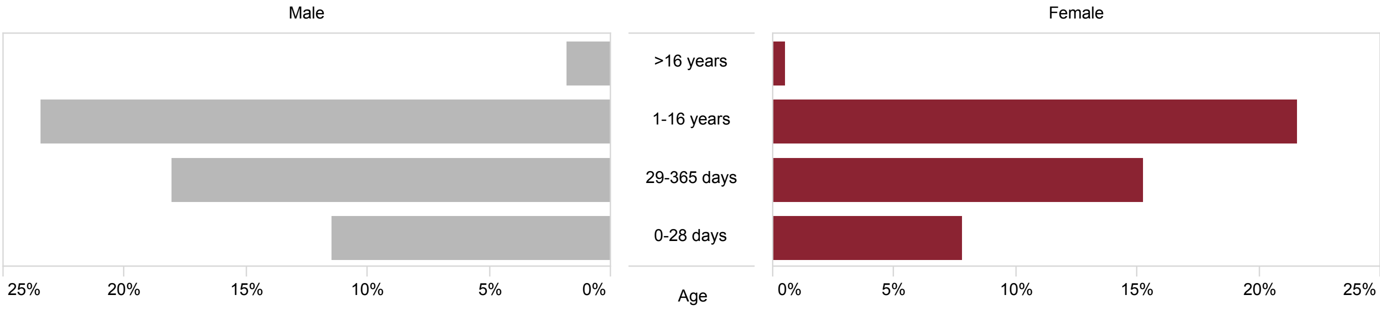

Figure 3: Proportion of all cardiac cases by age group and gender

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%

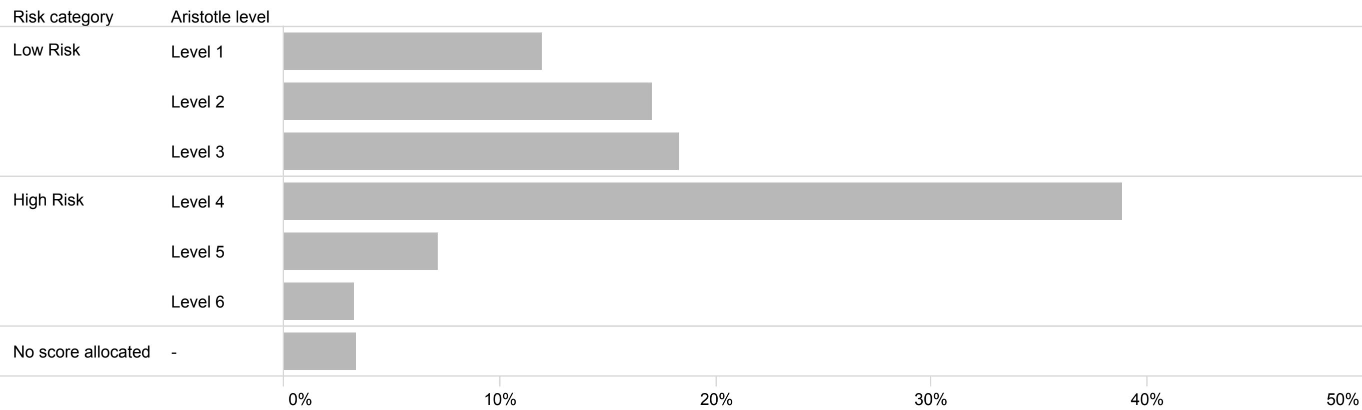

Figure 4: Proportion of all cardiac cases stratified by Aristotle Comprehensive Complexity score and risk category

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.

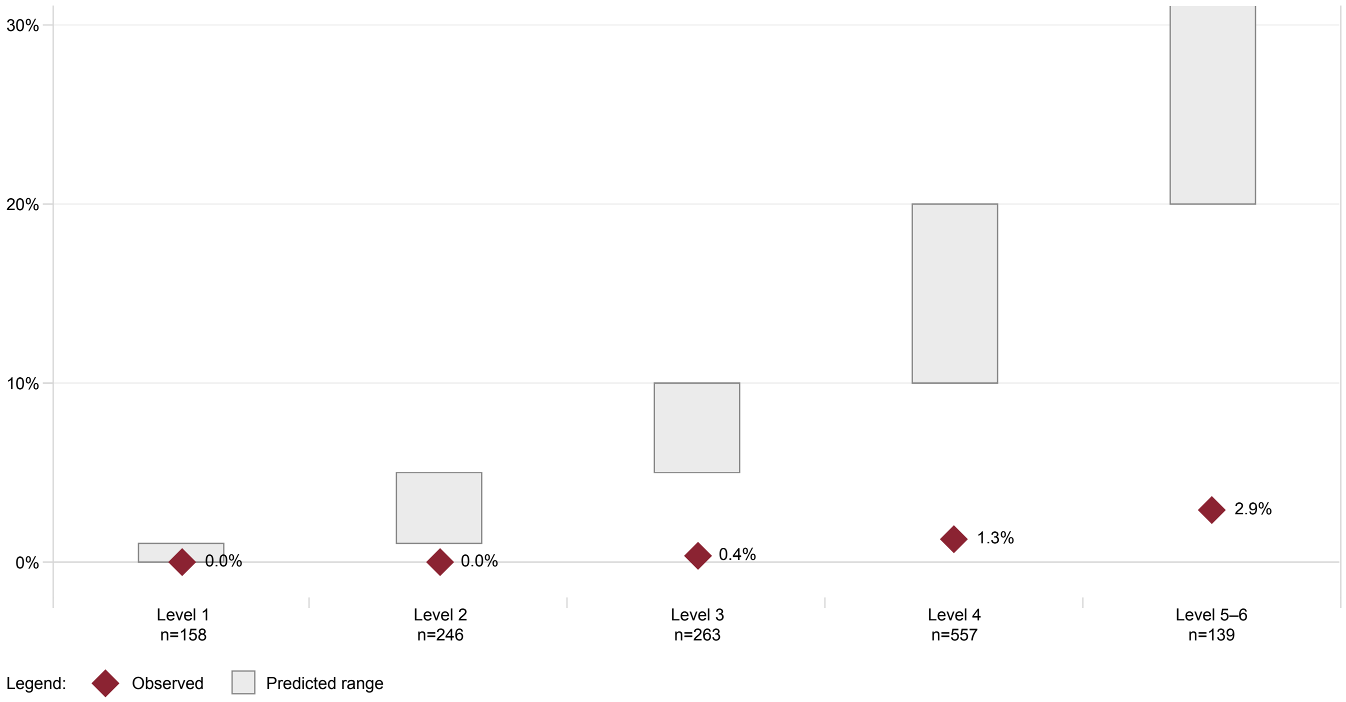

Figure 5: Cardiac patients 30 day mortality by Aristotle Comprehensive Complexity score, 2016–2020

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

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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