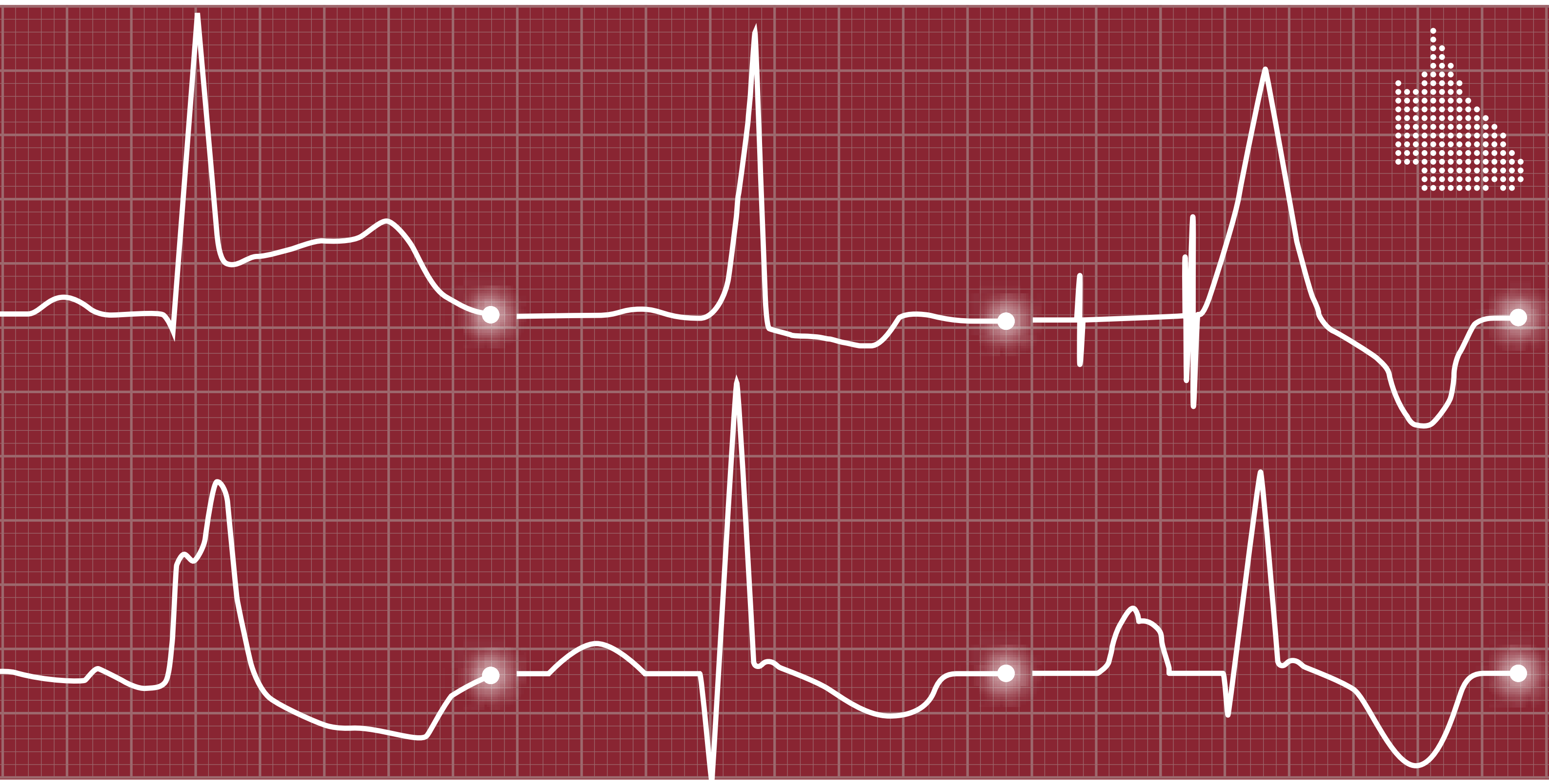
Clinical **Excellence** Queensland

Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry
2019 Annual Report
Cardiothoracic Surgery Audit



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Queensland Government

Queensland Cardiac Outcomes Registry
2019 Annual Report

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1 Message from the SCCN Chair

We are pleased to present the 2019 Queensland Cardiac Outcomes Registry (QCOR) Annual Report, which marks five years of publication. Yet again, the Report documents the world-class quality of care offered by practitioners within the Queensland public health system. The QCOR program is driven by the passion of Queensland's clinicians to not only report on the quality, performance and outcomes of cardiac services delivered to Queenslanders, but to enable and provide a comprehensive platform to directly support frontline cardiac services and be a driving force for continuous improvement. The result has been collaboration on a statewide scale, with QCOR directly supporting the efforts of hundreds of clinicians across often incredible distances.

The breadth of QCOR is highlighted by the development of a new module to support cardiac outreach services, starting with the Far North Queensland outreach unit in late 2019. Outreach services are an important part of delivering quality care to patients for whom cardiac care is less accessible, due to their remoteness from traditional facility-based services. This initial reporting will be expanded as additional units are established or come online over following years. This Report also shines a spotlight on the new partnership between QCOR and the Queensland Rheumatic Heart Disease (RHD) Registry. Despite being in its infancy, this collaboration has already led to the identification and development of specialised care plans for almost two hundred Queenslanders suffering from RHD. These are outcomes which are seldom linked to traditional research-focused registries and reflect a far greater vision at the core of this clinician-led initiative.

Clinical quality has again continued to be a focus of this report, with several new clinical indicators having been added to these audits for the new year to align with ever-changing international guidelines for the management and treatment of patients. As such, the registry continues to evolve and clinical indicators across all areas of interest will continue to be reviewed and expand accordingly over future years. It is yet again reassuring to see performance of Queensland services strong when compared to these often optimistic benchmarks and targets.

Investment in the collection of clinical data is now recognised as a valuable means of returning on investment and identifying areas of efficiency that subsequently enable cost savings and redirection of health funding to areas of need or emerging clinical technologies. QCOR data has underpinned bulk purchase arrangements and continues to demonstrate the ability to negotiate strongly with industry via commercial processes and ensure that each health funding dollar is spent wisely and carefully. Future processes now have the potential to increase in scope which will drive further financial realisation on investment that compound and grow over time.

The tireless work of Queensland cardiac clinicians and administrative staff must be recognised, not only for delivering high quality clinical outcomes but for their engagement, understanding and enthusiasm for quality clinical processes that are supported by quality data, and we look forward to future expansion that seeks to apply a similar scope and high standard of reporting to echocardiography and structural heart disease.

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

2 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 modules 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 Marcus Prior, Informatics Analyst
Dr Ian Smith, PhD, Biostatistician
Mr William Vollbon, Manager*
Mr Michael Mallouhi, Clinical Analyst
Ms Bianca Sexton, Project Manager
Mr Karl Wortmann, Application Developer

* Principal contact officer/QCOR program lead

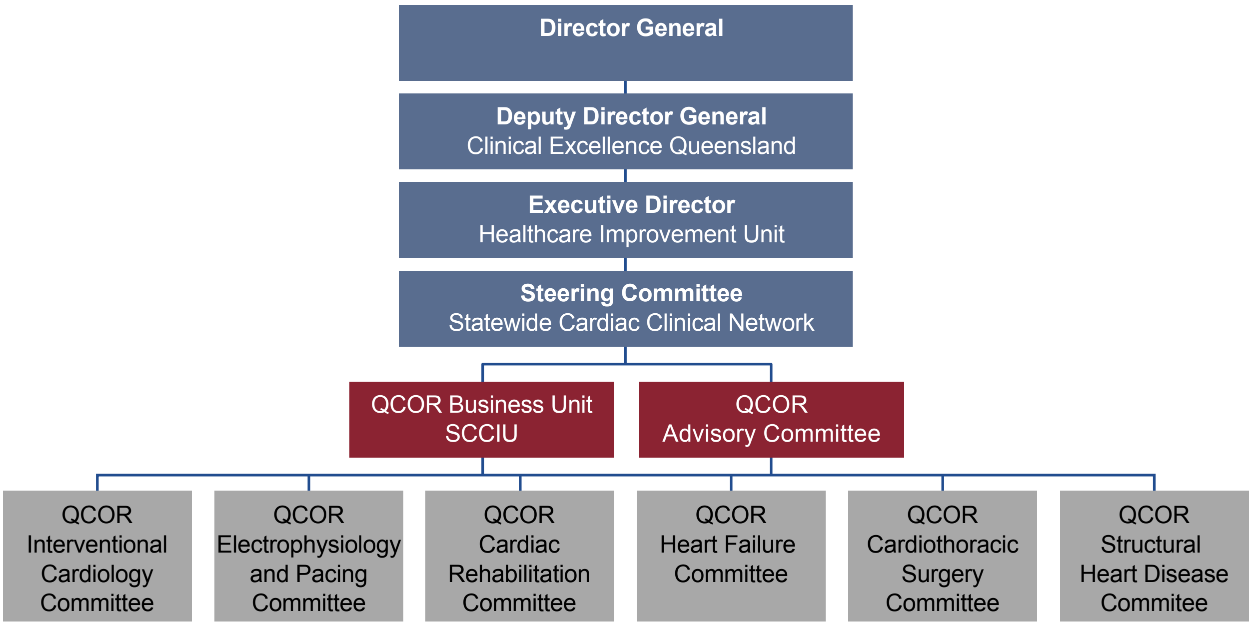


Figure 1: Governance structure

Queensland Cardiac Outcomes Registry

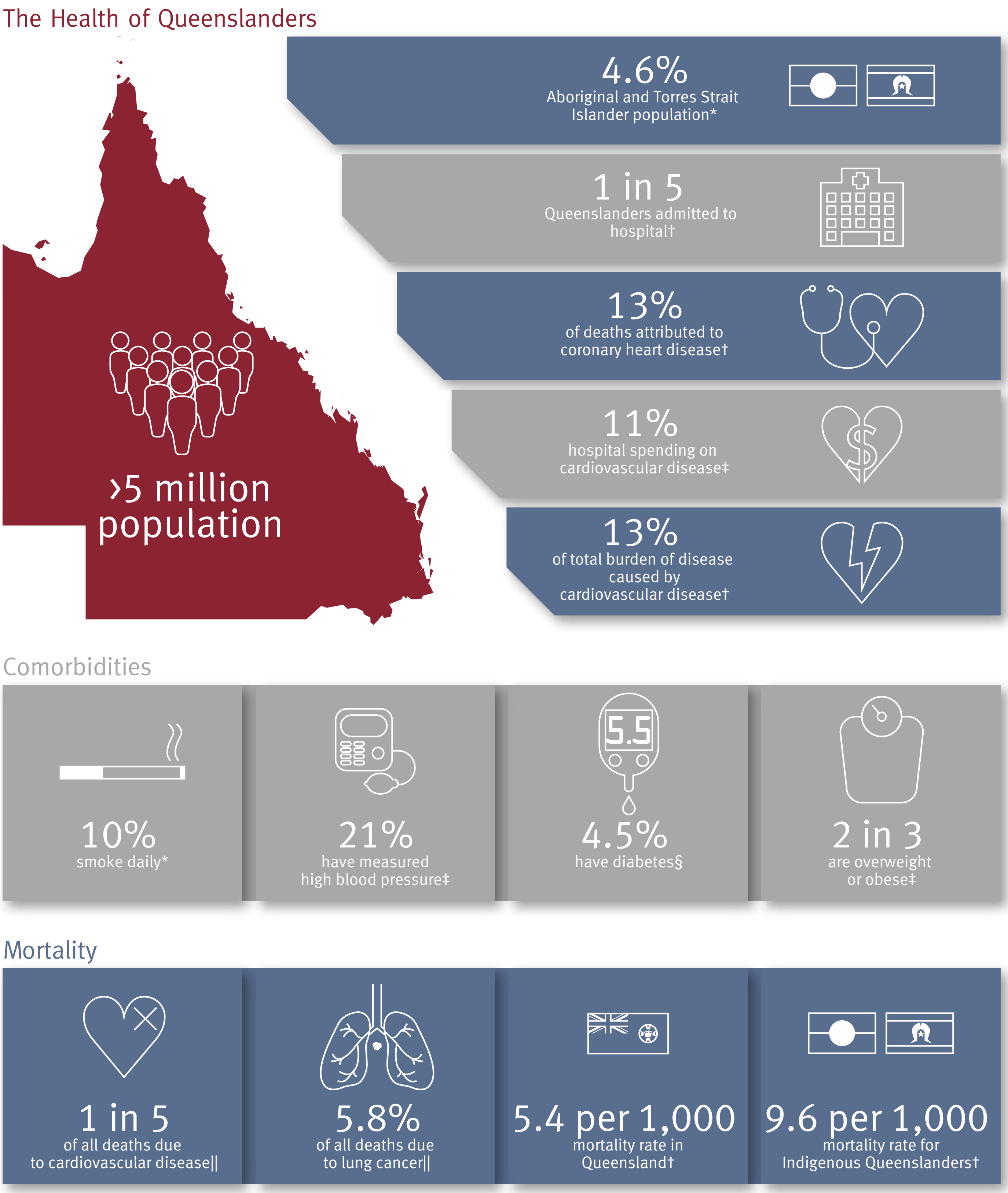


Figure 2: QCOR 2019 infographic

* 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 Bureau of Statistics. (2019). *Deaths, Australia, 2018*. Cat. no. 3302.0. ABS: Canberra.

2019 Activity at a Glance

What's New?

- Rheumatic heart disease, cardiac outreach and ECG Flash spotlights
- Expanded thrombolysis for STEMI analysis
- Cardiac surgery EuroSCORE II risk adjustment analysis
- Cardiac surgery remoteness investigation
- New timely non-acute assessments cardiac rehabilitation indicator
- New mineralocorticoid antagonist prescription heart failure indicator

Interventional Cardiology

5,002
percutaneous coronary interventions

477
structural heart disease interventions

249
transcatheter aortic valve replacements

15,615
all coronary procedures

Cardiothoracic Surgery

2,622
adult cardiac surgeries

1,042
adult thoracic surgeries

Electrophysiology & Pacing

4,654
electrophysiology and pacing procedures

3,189
cardiac implantable electronic device procedures

Heart Failure Support Services

5,304
heart failure support services referrals

Cardiac Rehabilitation

11,547
cardiac rehabilitation referrals

Rheumatic Heart Disease

179
unknown RHD patients identified

Clinical Indicator Progress

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

0.3%
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

94%
of cardiac rehabilitation referrals within 3 days of discharge

1.0%
mortality rate for coronary artery bypass surgery at 30 days

QCOR Yearly Trends

Interventional Cardiology

15,615
cases in 2019
– up from 15,293 in 2017

5,002
PCI cases in 2019
– up from 4,867 in 2018

3 minute
improvement in median time to reperfusion for STEMI PCI from 2017 to 2019

8%
increase in primary PCI cases meeting 90 minute target for timely reperfusion – 2017 to 2019

Cardiothoracic Surgery

11%
increase in cardiac surgery cases
– 2017 to 2019

23%
increase in thoracic surgery cases
– 2018 to 2019

Electrophysiology & Pacing

4,654
cases in 2019
– up from 4,474 in 2018

22%
increase in complex EP cases
– 2018 to 2019

Outpatient Support Services

23,000+
cardiac rehabilitation referrals
– 2018 and 2019

17%
increase in new heart failure support services referrals
– 2017 to 2019

3 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
- A/Prof Richard Lim, Princess Alexandra Hospital
- Dr Rohan Poulter, Sunshine Coast University Hospital
- A/Prof Atifur Rahman, Gold Coast University Hospital
- Dr Shantisagar Vaidya, Mackay Base Hospital
- Dr Gregory Starmer, 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
- Ms Bianca Sexton
- 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

4 Executive summary

This report comprises an account for cases performed in the eight cardiac catheterisation laboratories (CCL) and nine electrophysiology and pacing (EP) facilities, along with five cardiothoracic surgery units operating across Queensland public hospitals in 2019. Referrals to the 21 heart failure support and 57 cardiac rehabilitation services for the management of heart disease have also been included in this Audit.

- 15,615 diagnostic or interventional cases were performed across the eight public CCL facilities in Queensland hospitals. Percutaneous coronary intervention (PCI) was performed in 5,002 of these cases.
- Patient outcomes following PCI remain encouraging. The 30 day mortality rate following PCI was 2.2%, and of the 108 deaths observed, 77% 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 and arrival at PCI facility to reperfusion was observed at 83 minutes and 42 minutes.
- Across the four sites with a cardiac surgery unit, a total of 2,622 cases were performed including 1,567 coronary artery bypass grafting (CABG) and 1,104 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.
- Approximately 4% of all cardiac surgical patients resided in remote or very remote Australia.
- Patients in Outer Regional and Remote/Very Remote areas were two to four times more likely to have a postoperative length of stay >14 days (Outer Regional: OR 2.02, $p<0.01$), Remote/Very Remote: OR 4.05, $p <0.001$).
- Patients residing outside of a Major City of Australia had a higher likelihood of having a length of stay <6 days (Inner Regional: OR 1.61 $p=0.009$, Outer Regional: OR 1.45 $p=0.044$).
- A total of 1,042 thoracic surgery cases were performed across the five public hospitals providing thoracic surgery services in 2019. Almost a quarter (24%) of surgeries followed a preoperative diagnosis of primary lung cancer, whereas pleural disease accounted for nearly a third of all cases (32%).
- At the nine public Electrophysiology and Pacing (EP) sites, a total of 4,654 cases were performed, which included 3,189 cardiac device procedures and 1,058 electrophysiology procedures. This year's EP Audit sees the addition of Toowoomba Hospital, which began direct entry in November 2019.
- The EP clinical indicator audit identified a median wait time of 81 days for complex ablation procedures, and 32 days for elective implantable cardioverter defibrillator (ICD) implants. Meanwhile the median wait time for a standard ablation procedure was 117 days.
- There was a total of 11,547 referrals to one of the 57 public cardiac rehabilitation (CR) services in 2019. Almost three quarters of referrals (74%) followed an admission at a public hospital in Queensland.
- The vast majority of referrals to CR were created within three days of the patient being discharged from hospital (94%), while over half of patients went on to complete an initial assessment by CR within 28 days of discharge (56%). This performance measure is consistent with the data observed in 2018.
- There were 5,304 new referrals to a heart failure support service in 2019. Clinical indicator benchmarks were achieved for timely follow-up of referrals and appropriate medication prescriptions as per clinical guidelines for all medications except mineralocorticoid receptor antagonists.

5 Cardiac Outreach Spotlight

The development and implementation of the QCOR Cardiac Outreach module is an initiative of the Statewide Cardiac Clinical Network in partnership with the Healthcare Improvement Unit and the Health Minister's 'Rapid Results Program'.

People living in rural and remote locations (such as North Queensland) and Aboriginal and Torres Strait Islander people are admitted to hospital for cardiac related conditions at two to three times the rate of the broader Queensland population*. Equitable access to health care across Queensland can be a challenge due to its vast size and dispersed population, which can require patients to travel significant distances to access cardiac care. Furthermore, due to the vast distances this patient cohort need to travel to access tertiary care, their healthcare journey is often fragmented contributing to poorer access and health outcomes. The foundation of this model is based on a coordinated approach which supports the patient journey by linking to services. Through the outreach model, patients in a remote setting can access support from a team of practitioners much closer to home including a specialist cardiologist, cardiac scientists, nurses and health workers.

As well as seeing a cardiologist for initial consultation, review or follow-up, patients attending a cardiac outreach clinic can have specialised tests such as echocardiograms and stress tests, as well as the potential for referral to tertiary care for more complex procedures. Close links with other Queensland Health outpatient services such as cardiac rehabilitation programs or heart failure support services are also an advantage of this model of care. These services are further supplemented by telehealth and remote cardiac testing capabilities.

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

* Australian Commission on Safety and Quality in Health Care (ACSQHC) and Australian Institute of Health and Welfare. (2017). The second Australian atlas of healthcare variation. Sydney: ACSQHC.

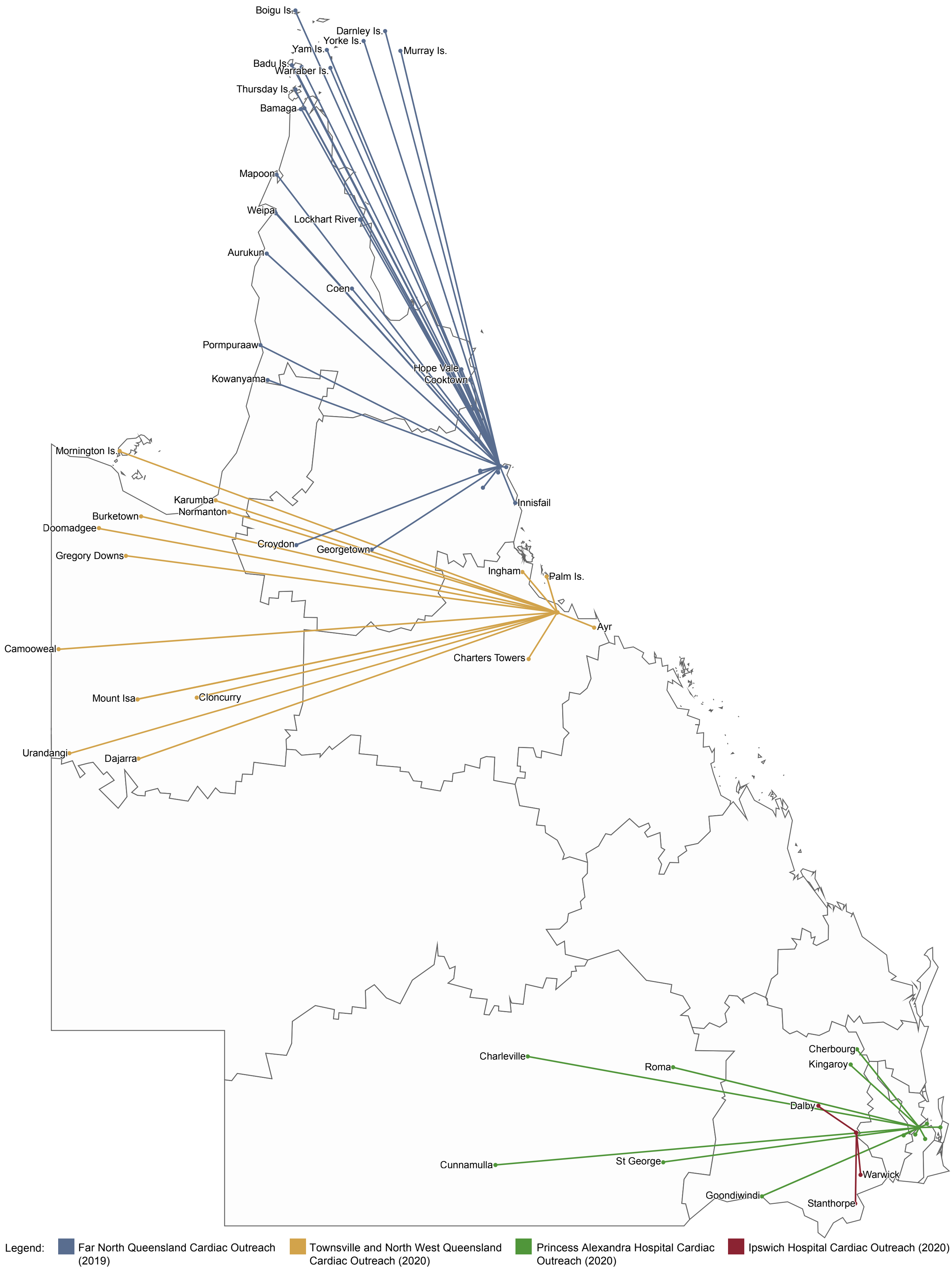


Figure 3: Cardiac outreach hub and spoke locations

6 ECG Flash Spotlight

ECG Flash, a Statewide Cardiac Clinical Network initiative, aims to give rural and remote clinicians 24/7 access to urgent specialist cardiology advice. When a patient presents at emergency and an ECG is taken, the system lets clinicians send time critical, 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 a hub and spoke model of care where larger facilities with specialist staff cardiologists act as the hub to smaller regional and remote centres.

Regional and remote sites (spoke sites) use a digitally enabled ECG cart which 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 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 2019, there were 30 rural sites utilising the ECG Flash solution and they sent 252 ECGs through to five receiving cardiology departments.

Implementation at an additional 51 rural sites and 3 hub sites is planned for 2020. Further use of ECG Flash data to complement existing QCOR data collections will be the focus for future work.

Table 2: ECG Flash – participating hub sites

ECG Flash hub	Commenced date	Number of spoke sites 2019	Number of spoke sites 2020
Princess Alexandra Hospital	August 2018	9	9
Cairns Hospital	September 2018	10	19
Mackay Base Hospital	February 2019	7	7
Townsville University Hospital	June 2019	4	6
Bundaberg Hospital	February 2020	–	8

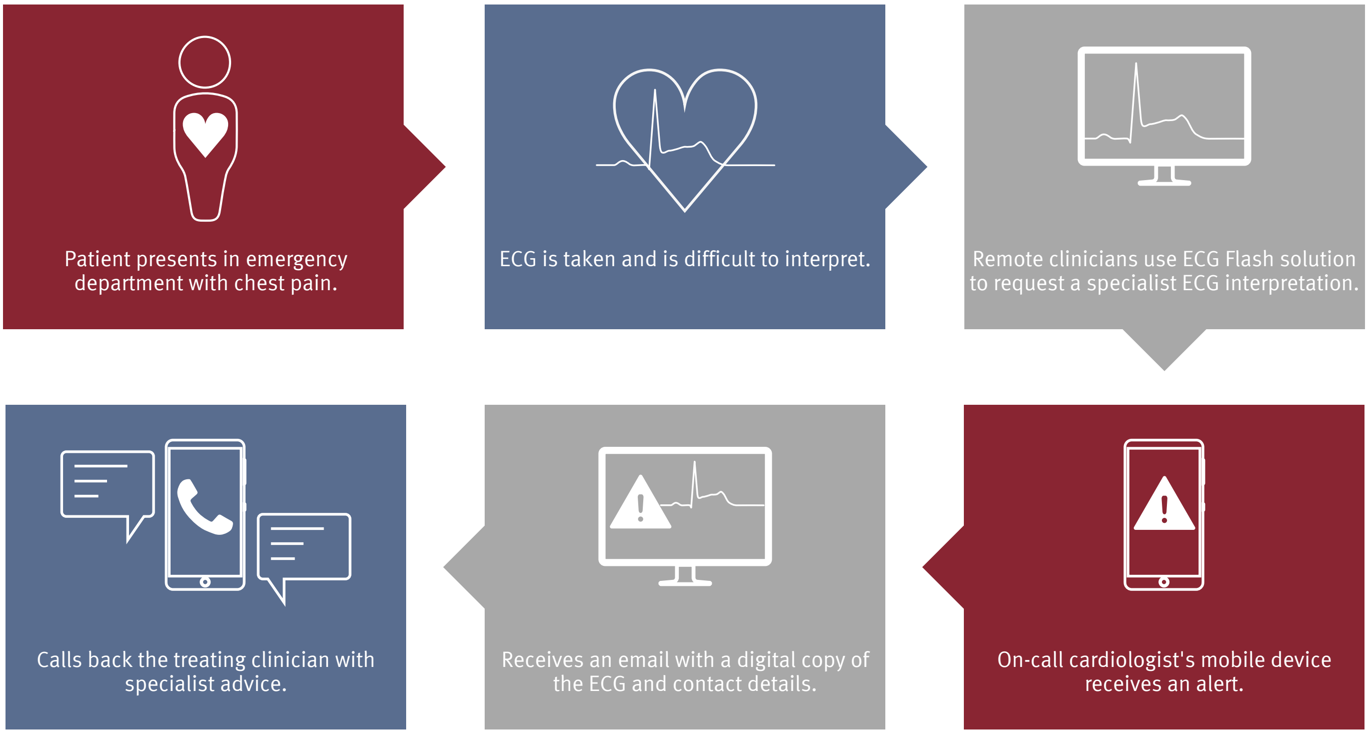


Figure 4: ECG Flash process flow

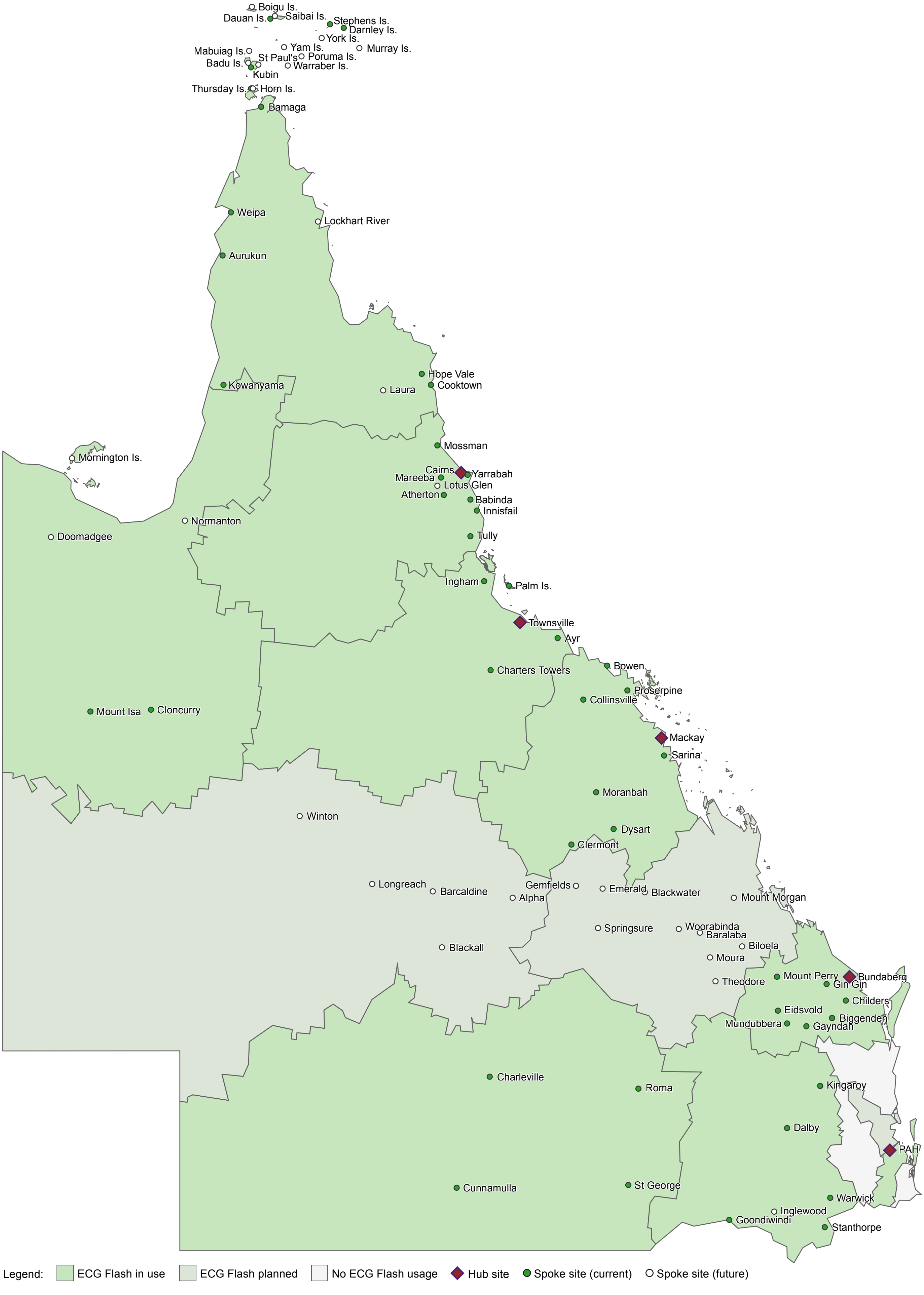


Figure 5: ECG Flash hub and spoke locations as at November 2020

7 RHD Spotlight

7.1 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 with client care 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 timely delivery of secondary prophylaxis.

The program further advocates for and supports activities aimed at preventing, identifying, managing and treating acute rheumatic fever (ARF) and RHD, and promotes primordial, primary and secondary prevention aimed at preventing initial episodes of ARF and development of RHD. This includes the development and distribution of ARF/RHD education and health promotion-focused resources such as client and family educational material to improve health literacy, and information on diversionary therapy aids and reward/incentive products.

Additional strategies are being undertaken to enhance the quality of support the program provides including, creation and distribution of reports for outreach clinics, HHS, service providers and health service planning managers. Individual client information and clinical advice is being provided to healthcare providers including, diagnostic criteria, notification process, treatment and follow-up requirements (point of care information).

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 (3rd edition)* 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.

7.2 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. Clients typically present with a history of a sore throat and/or infected skin sores, pain and swelling in one or more joints, fever, malaise, a skin rash, chorea (jerky, uncoordinated movements of the hands, feet, tongue and face) and sometimes chest pain. 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, any remaining damage to the brain can cause ongoing mental health and neurological issues. Similarly, anatomical changes occur affecting the heart valves with the ensuing clinical sequalae known as 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 modest as a sore throat or skin infection which can be easily treated with common antibiotics, however if left untreated, it can lead to stroke and valve disease requiring cardiac surgery, often in an adolescent population. 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.

7.3 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 2017, there was a rate of 111 ARF cases per 100,000 Aboriginal and Torres Strait Islander Australians whereas for Australians of other descent the rate was 1 per 100,000. (Australian Institute of Health and Welfare (AIHW) 2019).† Between the ages of 5 years to 24 years, Aboriginal and Torres Strait Islander peoples are three times more likely to die from RHD than Australians of other descent.

7.4 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.

ARF and RHD contribute to increased death and disability in Queensland. RHD accrues early in life, with 20% of people on the Queensland RHD Register under 18 years of age and 26% of all ARF and RHD clients having had or will require valvular surgery.

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

Table 3: 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

7.5 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.

* 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

† Australian Institute of Health and Welfare (2020). *Acute rheumatic fever and rheumatic heart disease in Australia, 2014–2018.* Retrieved from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/acute-rheumatic-fever/contents/summary

‡ 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

7.6 Queensland RHD Program and QCOR

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.

Through QCOR, reporting of positive RHD findings by echocardiography has resulted in 172 previously unknown clients with RHD being added to the Register.

Table 4: QCOR echocardiography module RHD notifications

	Positive RHD findings n	Unknown RHD clients identified n
Cairns	494	66
Townsville	150	62
Mackay	47	26
Rockhampton	28	18
Total	**719**	**172**

Through the QCOR cardiac surgery RHD notification reports, seven previously unknown clients requiring surgery for their RHD have been added to the RHD register since October 2019.

Table 5: QCOR cardiac surgery module RHD notifications

	Positive RHD findings n	Unknown RHD clients identified n
Statewide cardiac surgery	14	7

8 Facility profiles

8.1 Cairns Hospital

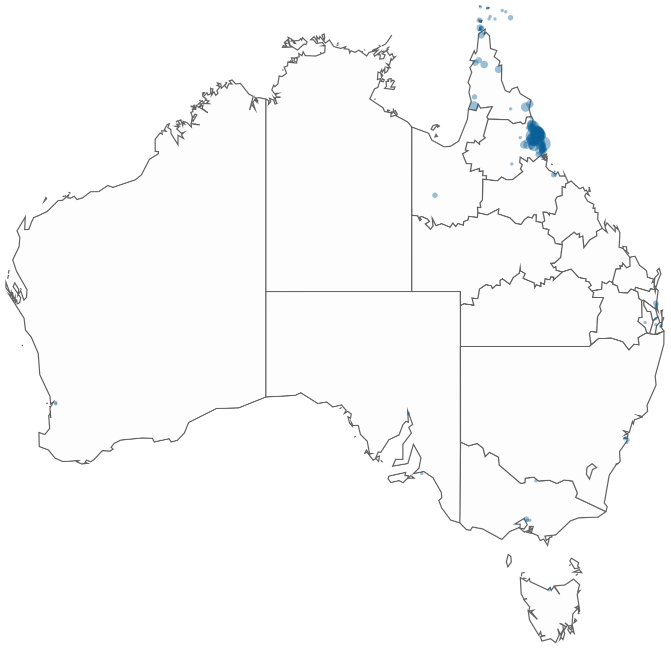


Figure 6: Cairns Hospital

- 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

8.2 Townsville University Hospital

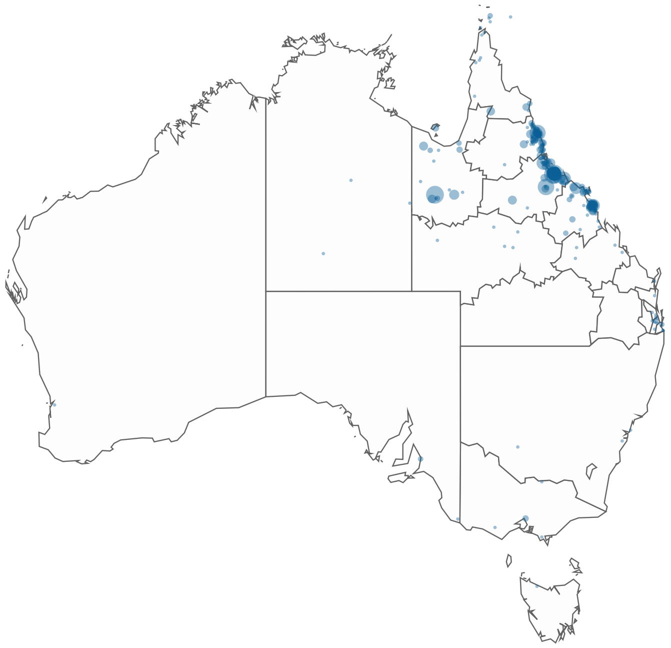


Figure 7: Townsville University Hospital

- 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

8.3 Mackay Base Hospital

Figure 8: 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

8.4 Sunshine Coast University Hospital

Figure 9: 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

8.5 The Prince Charles Hospital

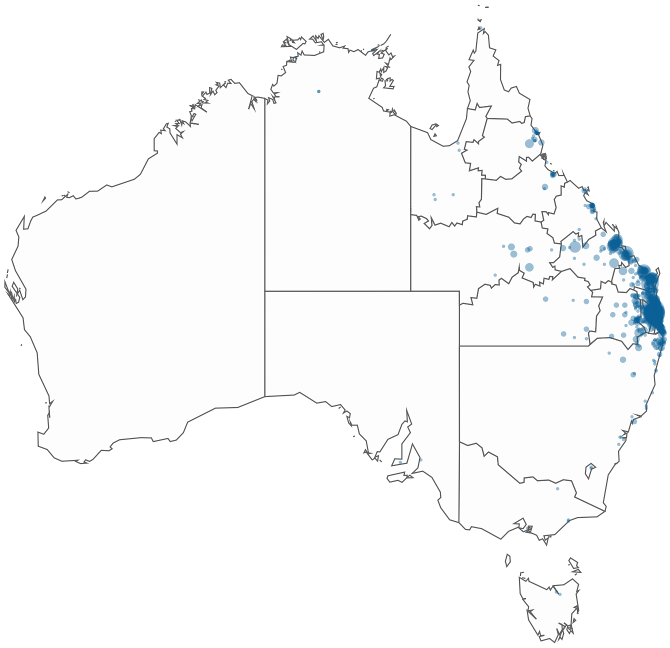


Figure 10: The Prince Charles Hospital

- 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 & 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

8.6 Royal Brisbane & Women's Hospital

Figure 11: 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 & Women's Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Thoracic surgery

8.7 Princess Alexandra Hospital

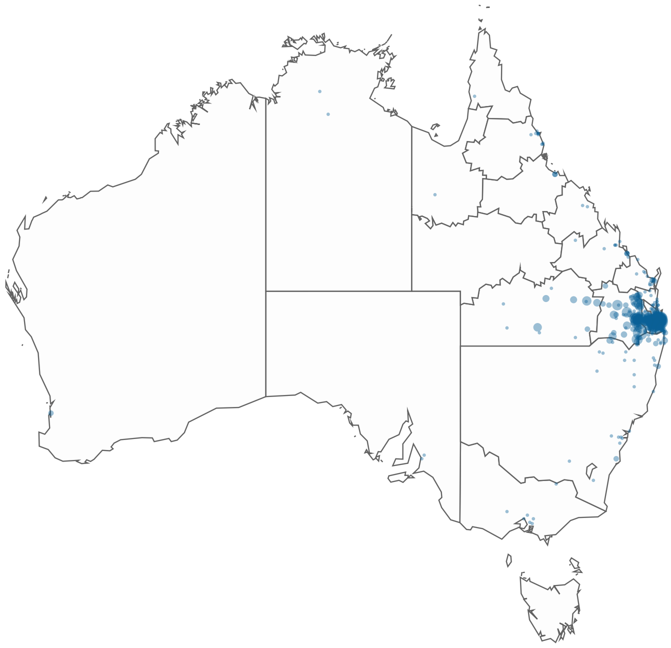


Figure 12: Princess Alexandra Hospital

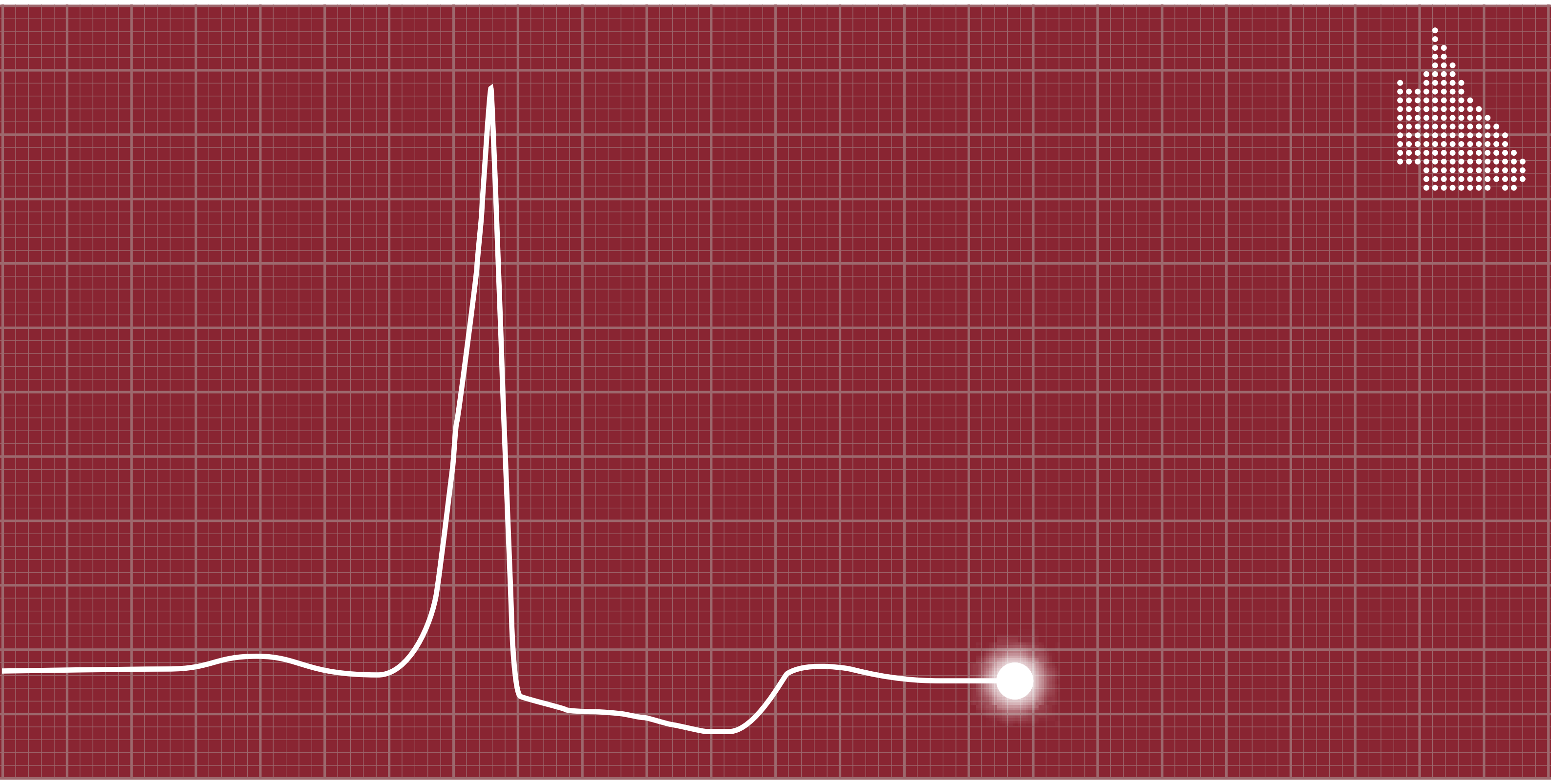
- Referral hospital for Metro South and South West Hospital and Health Services, serving a population of approximately 1,000,000
- Public tertiary level invasive cardiac services provided at the Princess Alexandra Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural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

8.8 Gold Coast University Hospital

Figure 13: Gold Coast University Hospital

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

Cardiothoracic Surgery Audit



1 Message from the QCOR Cardiothoracic Steering Committee Chair

Undergoing cardiac surgery can be the last stage of a long journey from health, to disease, to diagnosis, to catheter based treatment, and finally to major surgical treatment. Assessing the safety and quality of this final stage of treatment starts with stopping to back at the journey our patients have taken. A thoughtful reader of this audit will see how the journey unfolds for most patients. Most commonly patients are in their seventh decade of life, overweight and obese with the resulting diseases of hypertension and dyslipidaemia. The need for surgery is most often urgent, demonstrating that after decades of missed opportunity for prevention, patients suddenly develop a pattern of disease that if not treated with urgency results in a threat to their life. The significant rate of urgent and emergency surgery reflects the story of poorly controlled risk factors presenting in a sudden fashion requiring urgent intervention. This decades long public health disaster caused by the confluence of environmental and physiologic factors that results in obesity, metabolic syndromes, and the associated diseases is demonstrated in this audit, being that the surgical treatment of the end result of obesity related disease is clearly the bulk of the need for cardiac surgery. Primary prevention and public health failures result in highly invasive resource consuming treatments such as cardiac surgery.

The audit process is iterative and results in the addition of data points that clarify the conditions treated and the measurements of performance. The addition of data points for calculation of the EuroSCORE II and self-administered recreational intravenous drug use related to intracardiac infections are examples of the iterations in the data set that are changes in this report.

The safety and performance of cardiac surgery is again shown to be better than is predicted by risk calculators. Across Queensland, those who undergo cardiac surgery have a less than expected rate of complications and death. Surgery is being performed at a high level. Deep sternal wound infection continues at the same rate and hence has the same fixed relationship to the risk score as in previous years.

The length of stay analysis again shows that there are more patients who stay longer than two weeks than expected from risk scores. Comparison with an American risk score is probably the source of this finding given that geography and health system structure may influence this result. None of these factors differ markedly between Queensland and generalised United States data. The supplemental report was triggered by these observations. This finds that the length of stay greater than two weeks is explained by distance from hospitals, which is not unexpected. Interestingly, the length of stay for those not within major cities but in inner and outer regional areas was less than expected, perhaps a reflection that distances of several hundred kilometres are not particularly prohibitive to discharge for most Queenslanders. However, the analysis did show that Very Remote Australia and the Major Cities of Australia are very different places, the extremes of health system experiences for Queenslanders. Younger, mostly Aboriginal patients residing in Very Remote Australia requiring cardiac surgery have to travel distances equivalent to the entire length of the United Kingdom to undergo surgery, surgery that is usually urgent. The findings of low rates of salvage cases in Remote Australia reflects the inability to overcome distance in the most critical of emergencies, rather than the absence of conditions that require salvage in regional and remote areas. This is the very definition of the tyranny of distance to which some Queenslanders will become victims. However, pleasingly, overall, distance does not have a negative factor in patients' experience of their cardiac surgical journey.

I once again thank my fellow committee members whose participation reflects their ongoing concern in the quality of the care that we provide Queenslanders.

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

2 Key findings

This Queensland Cardiac Surgery Audit describes baseline demographics, risk factors, surgeries performed and surgery outcomes for 2019.

Key findings include:

- The number of surgeries performed across the four public adult cardiac surgery units in Queensland were 2,622.
- The majority of patients were aged between 61 years and 80 years of age (61%) with a median age of 66 years old.
- Approximately three quarters of patients were male (72%).
- The majority of all patients were overweight or obese (77%), with less than one quarter (22%) of patients having a body mass index within the normal range.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 6.9%, and had a wide variation between sites with 23% of patients in Townsville identifying as Aboriginal and Torres Strait Islander.
- The majority of patients had high blood pressure (66%) or a history of high cholesterol (61%). 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).
- Over a quarter (28%) of patients had an element of left ventricular systolic dysfunction.
- Over half (58%) of all cases were elective admissions with 14% of elective patients being admitted on the day of surgery.
- In 2019, 1,567 patients had a CABG procedure, the majority (92%) of patients had multi-vessel disease.
- There were 294 patients who underwent aortic surgery, with 78% undergoing ascending aorta replacement.
- Among the 1,104 patients undergoing valve surgery in 2019, the most common interventions performed were replacement of the aortic valve (68%) or mitral valve (17%).
- Degenerative valve disease (56%) was the primary pathology for patients undergoing valve intervention.
- Major morbidities were evaluated using Society of Thoracic Surgeons (STS) models with most results demonstrating that the observed rate of adverse events is within expectations. The 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

Queenslanders were served by four public cardiac surgery units that were spread across Metropolitan and regional locations. Each unit entered data directly into the QCOR cardiac surgery database application.

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

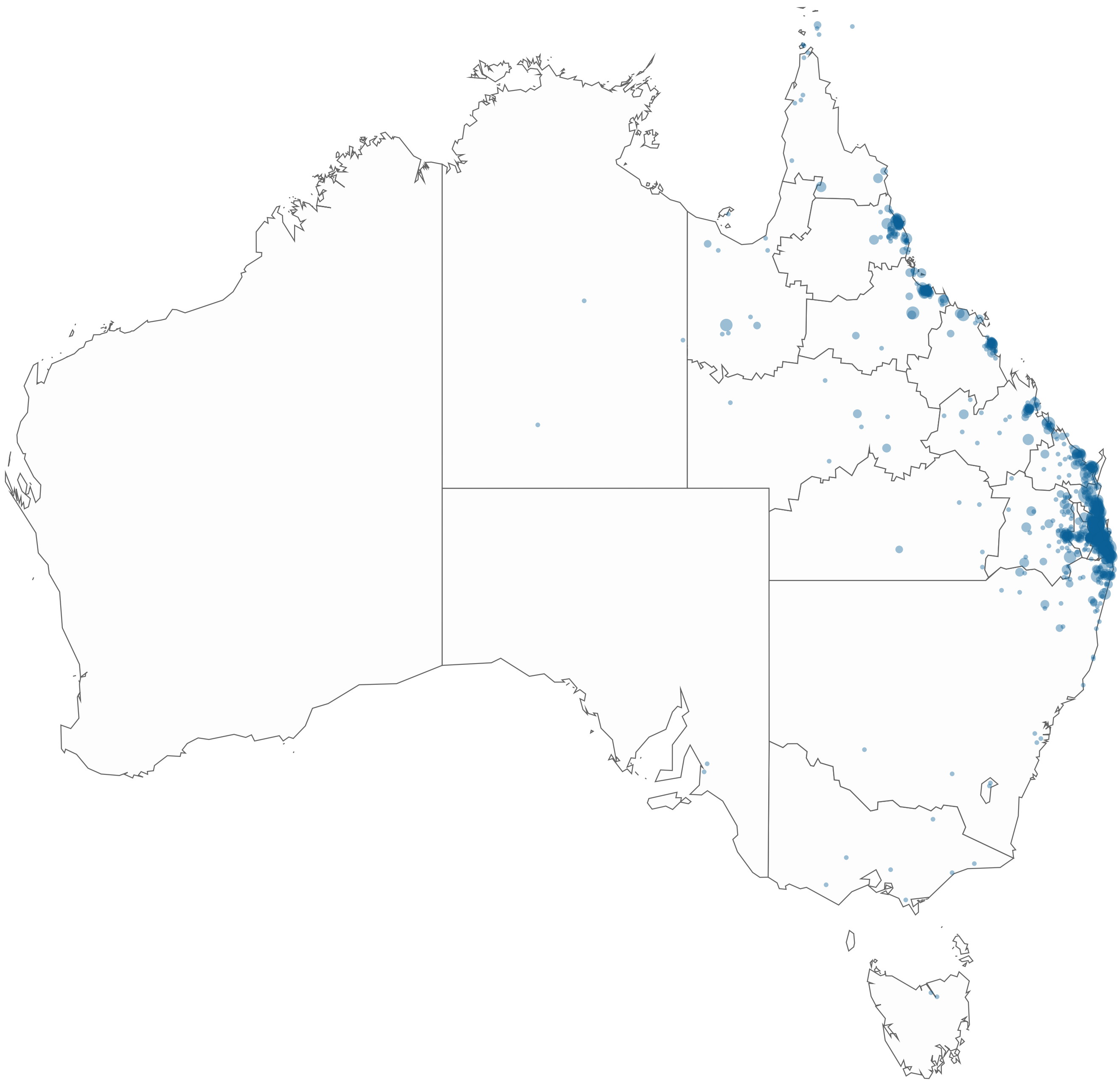


Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

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

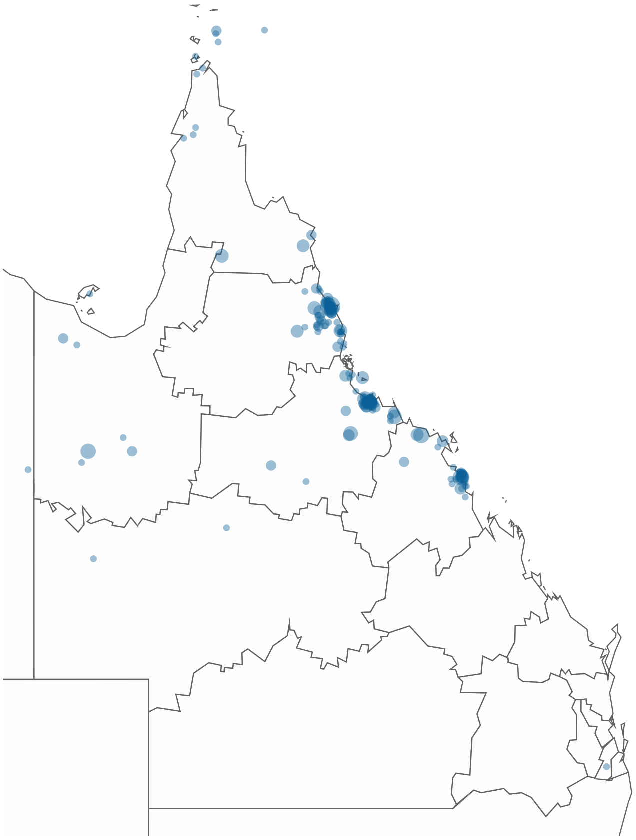


Figure 2: Townsville University Hospital

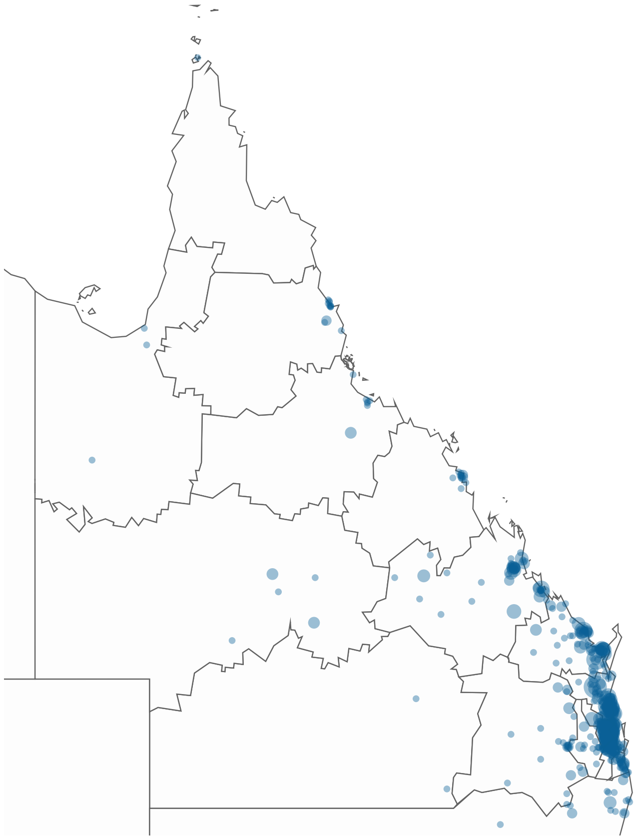


Figure 3: The Prince Charles Hospital

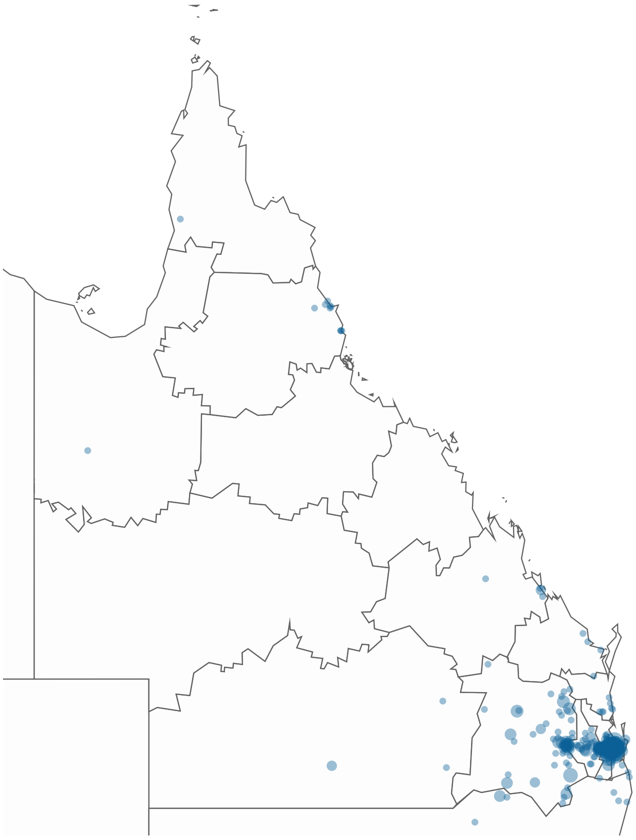


Figure 4: Princess Alexandra Hospital

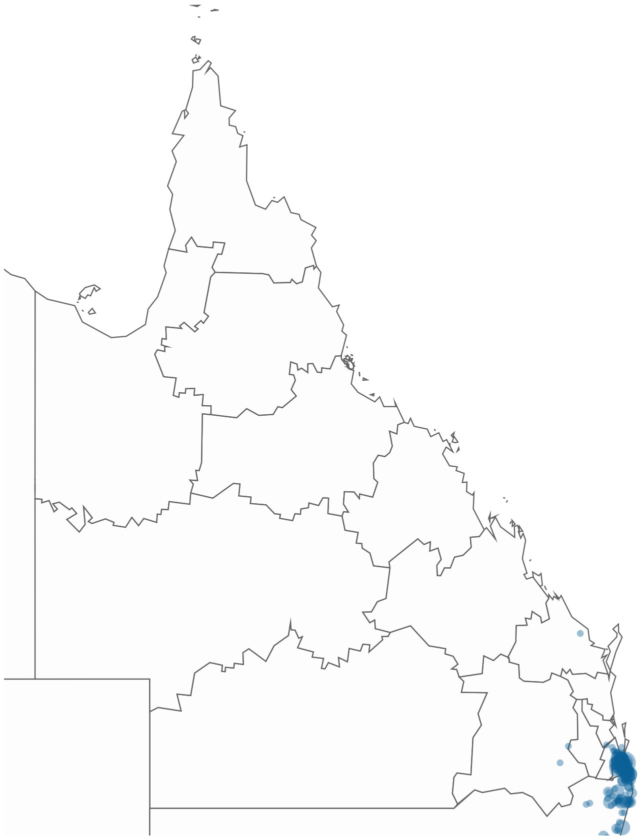


Figure 5: Gold Coast University Hospital

4 Case totals

4.1 Total surgeries

The total number of cardiac surgical procedures performed at the four public hospitals participating in the QCOR database was 2,622. Each of the procedure combinations included in those cases have been allocated to a cardiac surgery procedure category for the purpose of this report.

Table 2: Procedure counts and surgery category

Procedure combination	Count	Category*
CABG	1,284	ANY CABG
CABG + other cardiac procedure	29	
CABG + other non-cardiac procedure	9	
CABG + aortic procedure	8	
CABG + other cardiac procedure + other non-cardiac procedure	1	
CABG + valve	193	CABG + VALVE
CABG + valve + aortic procedure	27	
CABG + valve + other cardiac procedure	15	
CABG + valve + aortic procedure + other cardiac procedure	1	
Valve procedure†	586	VALVE
Valve + aortic procedure	194	
Valve + other cardiac procedure	72	
Valve + aortic procedure + other cardiac procedure	12	
Valve + other non-cardiac procedure	3	
Valve + aortic procedure + other non-cardiac procedure	1	
Other cardiac procedure	125	OTHER
Aortic procedure	45	
Other cardiac procedure + other non-cardiac procedure	11	
Aortic procedure + other non-cardiac procedure	3	
Aortic procedure + other cardiac procedure	3	
ALL	**2,622**	

* Category procedure combination allocated

† Includes TAVR procedures (n=134)

Cardiac Surgery

4.2 Cases by category

Nearly two thirds (60%) of all cardiac surgery procedures involved coronary artery bypass grafting (CABG). Of these, 9% involved a simultaneous CABG and valve procedure.

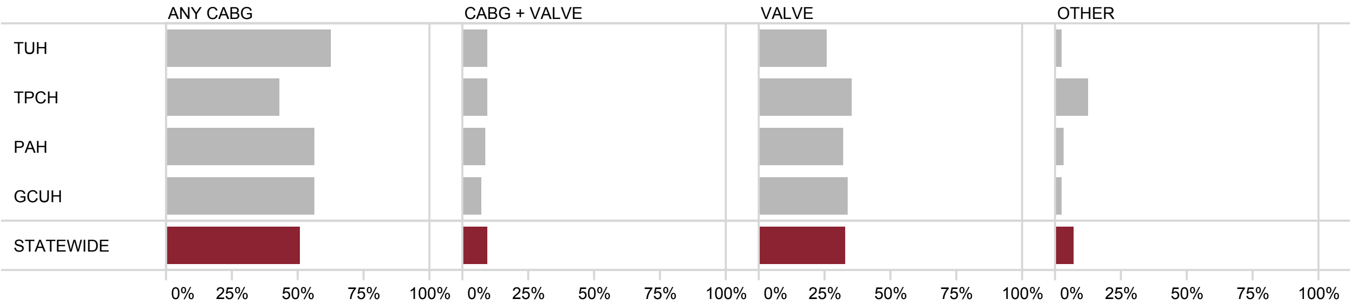


Figure 6: Proportion of cases by site and surgery category

Table 3: Proportion of cases by surgery category

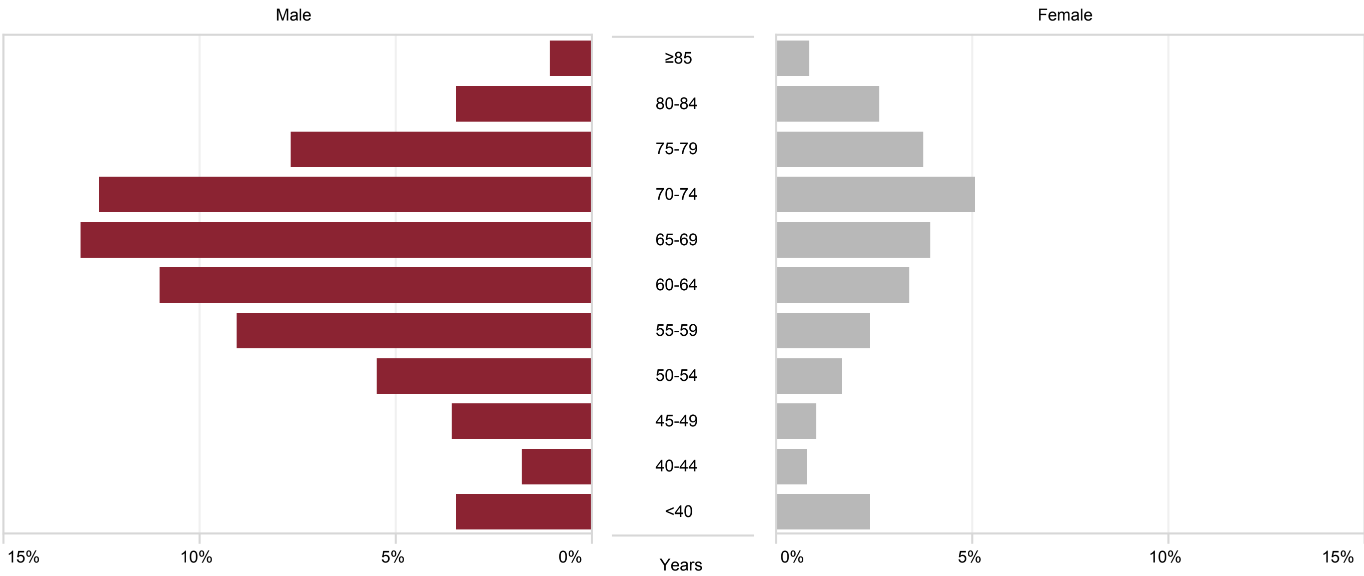
SITE	Total cases n	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)
TUH	363	226 (62.3)	34 (9.4)	95 (26.2)	8 (2.2)
TPCH	1,235	527 (42.7)	119 (9.6)	439 (35.5)	15 (12.1)
PAH	653	368 (56.4)	57 (8.7)	208 (31.9)	20 (3.1)
GCUH	371	210 (56.6)	26 (7.0)	126 (34.0)	9 (2.4)
STATEWIDE	**2,622**	**1,331 (50.8)**	**236 (9.0)**	**868 (33.1)**	**187 (7.1)**

5 Patient characteristics

5.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. Almost two thirds of patients were aged between 61 years and 80 years of age (61%). 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 8% of cases were performed on patients younger than 45 years of age.

The median age of all patients undergoing cardiac surgery was 66 years of age. The median age of both males and females undergoing cardiac surgery was 66 years and 68 years respectively.



% of total (n=2,622)

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	1,331	65	67	66
CABG + VALVE	236	70	72	70
VALVE	868	66	69	68
OTHER	187	52	52	52
ALL	**2,622**	**66**	**68**	**66**

Overall, around three quarters of patients were male (72%), with the largest proportion of females represented in the valve (38%) and other cardiac surgery (49%) categories. This reflects the increased risk of coronary artery disease in men.

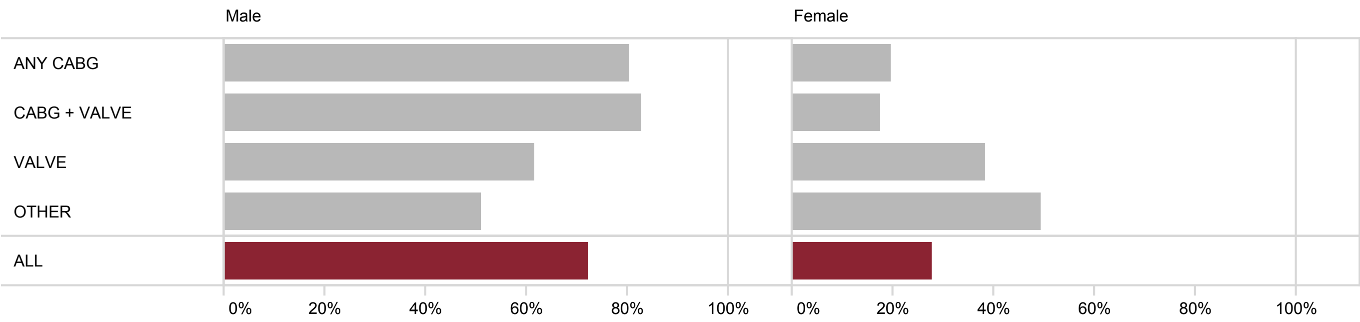


Figure 8: Proportion of cases by gender and surgery category

5.2 Body mass index

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

Just over one quarter (27%) 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	6 (0.5)	245 (18.4)	512 (38.5)	496 (37.3)	72 (5.4)
CABG + VALVE	2 (0.8)	44 (18.6)	90 (38.1)	86 (36.4)	14 (5.9)
VALVE	18 (2.1)	231 (26.6)	306 (35.3)	260 (30.0)	52 (6.0)
OTHER	7 (3.7)	57 (30.5)	67 (35.6)	46 (24.5)	10 (5.3)
ALL	**33 (1.3)**	**577 (22.0)**	**975 (37.2)**	**888 (33.9)**	**148 (5.6)**

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 the Aboriginal and Torres Strait Islander population 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 6.9%. This proportion is larger than the estimated 4.6% of the overall Queensland population that Aboriginal and Torres Strait Islander people account for.[2]

Almost one quarter (23%) of patients undergoing cardiac surgery at TUH identified as Aboriginal and Torres Strait Islander.

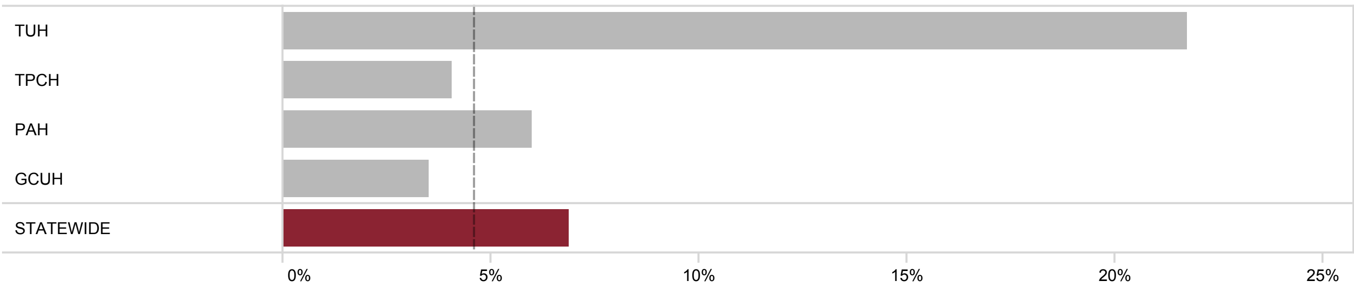


Figure 10: Proportion of all cardiac surgical cases by identified Aboriginal and Torres Strait Islander status and site

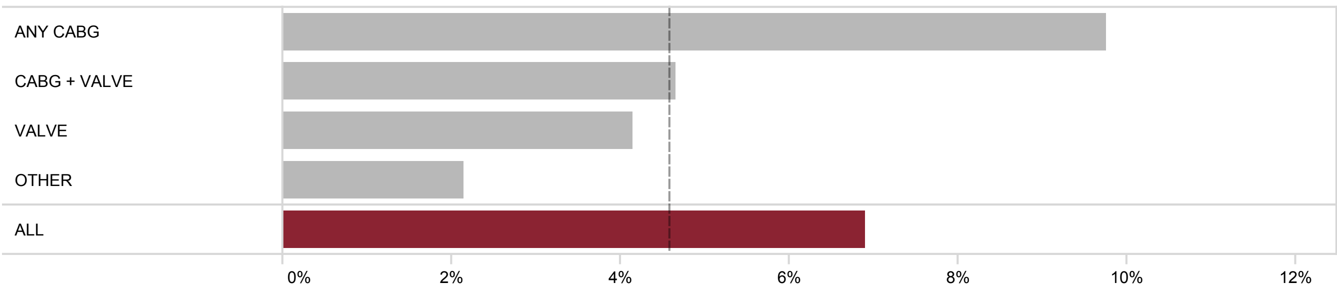
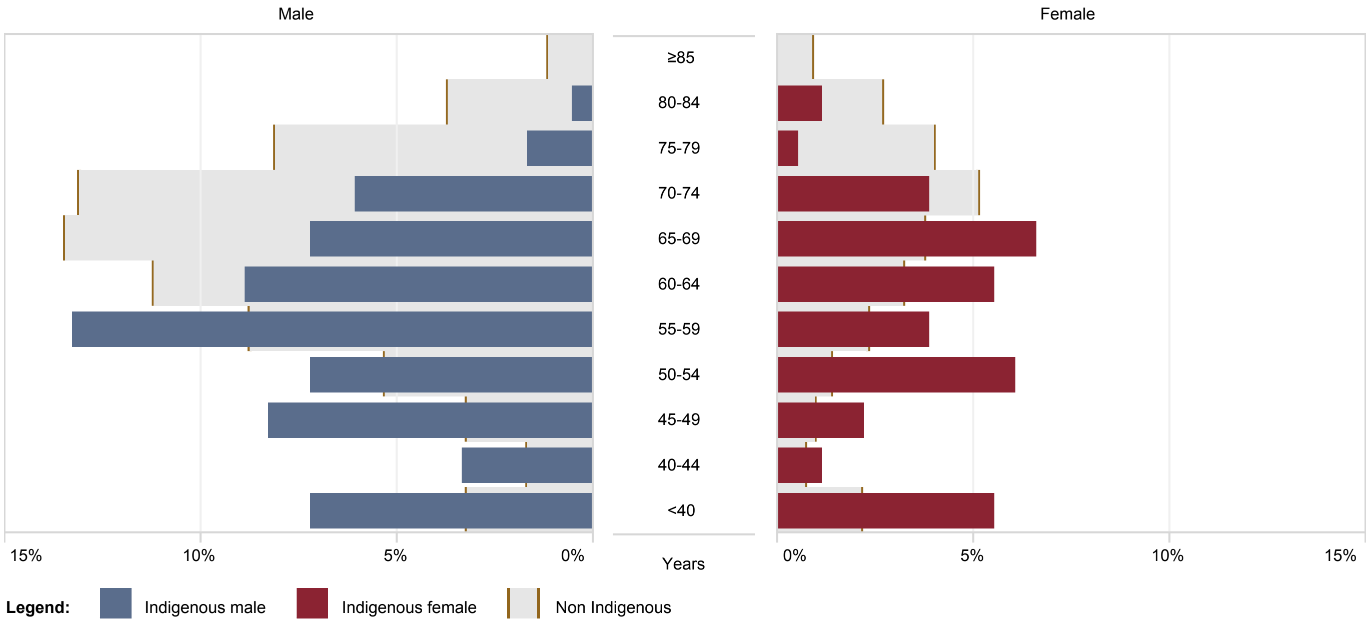


Figure 11: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

The median age for Aboriginal and Torres Strait Islander Queenslanders undergoing cardiac surgery was 58 years, whereas the median age of other patients was 67 years of age (Figure 12).



% of total Aboriginal and Torres Strait Islander (n=181) vs. total non-Indigenous (n=2,441)

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

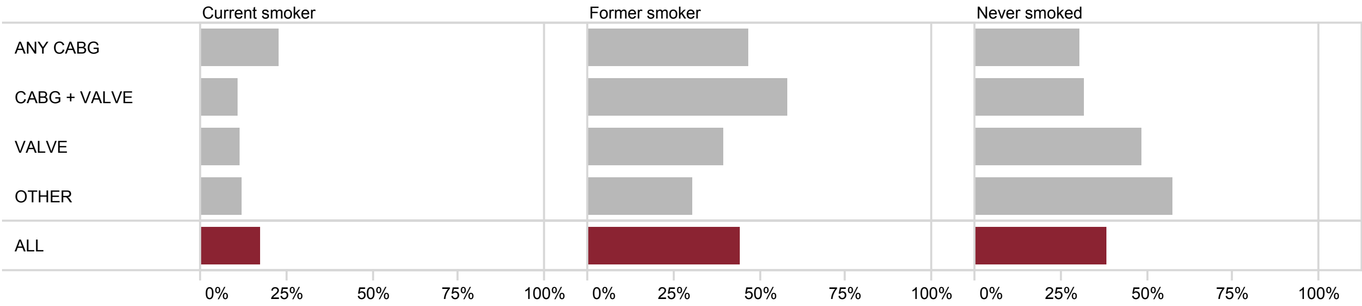
Table 6: Median patient age by gender and Indigenous status

	Male years	Female years	All years
Aboriginal and Torres Strait Islander	59	57	58
Non Aboriginal and Torres Strait Islander	69	66	67
ALL	**68**	**66**	**66**

6 Risk factor profile

6.1 Smoking history

Overall, 61% of patients had a history of tobacco use including 17% current smokers (defined as smoking within 30 days of the procedure) and 44% former smokers. Of the remaining patients, 39% reported never having smoked.



Unknown smoking status not displayed (<1.0%)

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%).

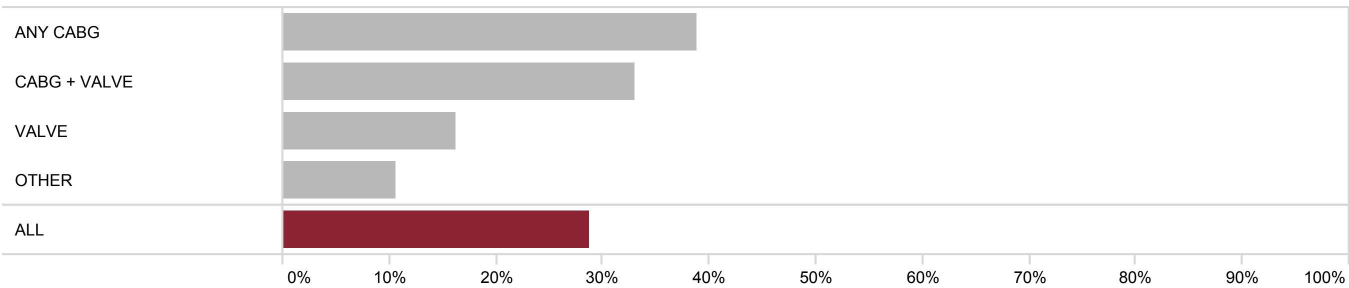


Figure 14: Proportion of cases by diabetes status and surgery category

Cardiac Surgery

6.3 Hypertension

Hypertension, defined as receiving antihypertensive medications at the time of surgery, was present in 66% of patients with considerable variation by surgery type (range 34% to 80%).

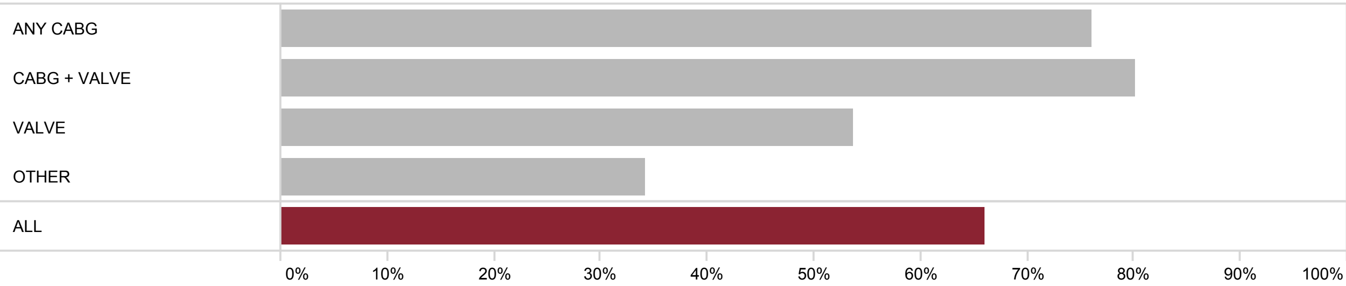


Figure 15: Proportion of cases by hypertension status and surgery category

6.4 Hypercholesterolaemia

Overall, 61% of patients had a documented history of hypercholesterolaemia, ranging from 78% in the CABG category to 23% in the other surgery category.

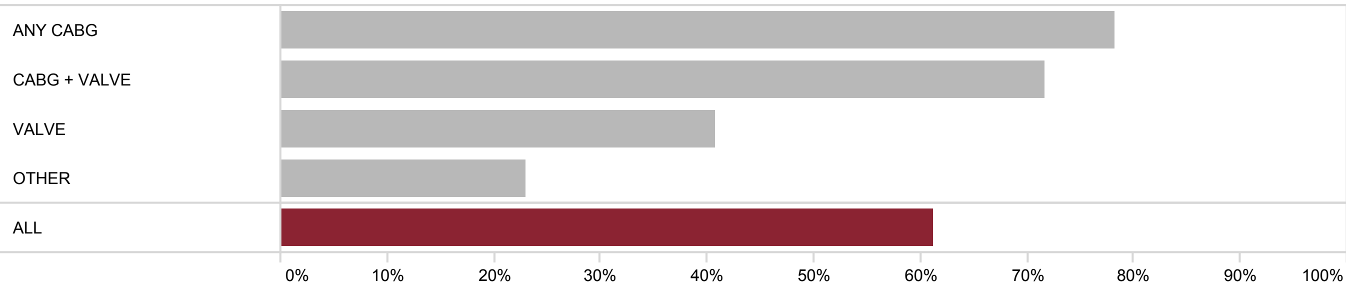
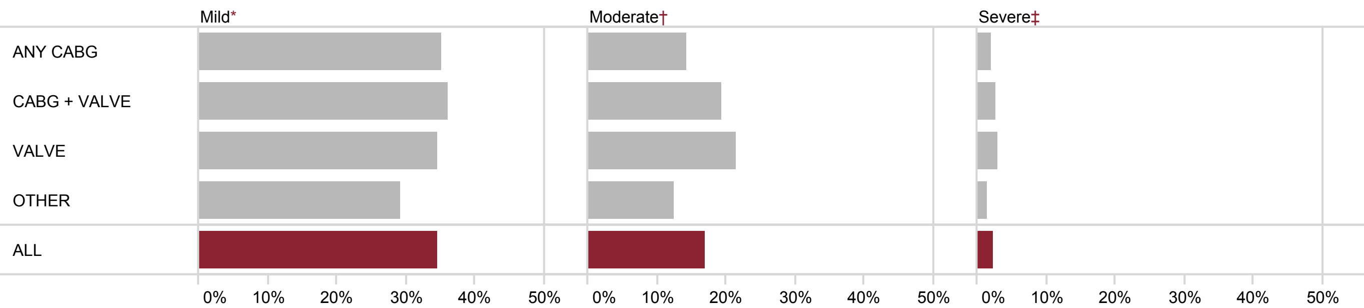


Figure 16: Proportion of cases by statin therapy status and surgery category

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 60% of patients undergoing CABG and valve surgery had documented renal impairment.



* eGFR 60–89 mL/min/1.73 m^2

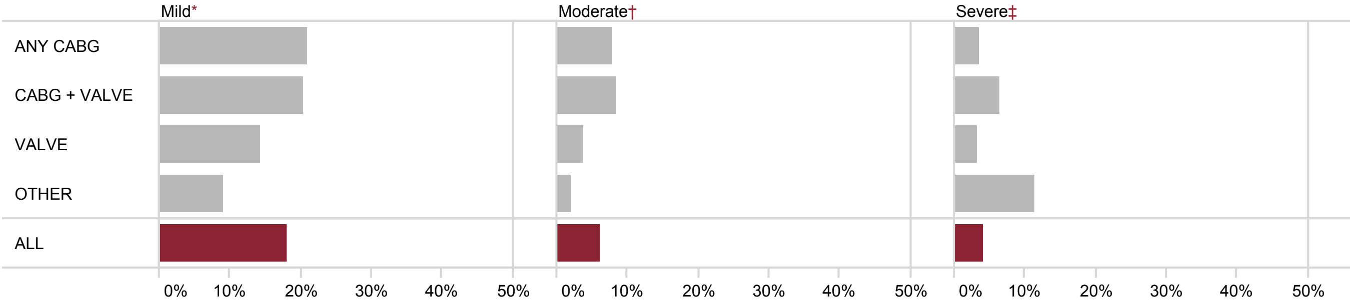
† eGFR 30–59 mL/min/1.73 m^2

‡ 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

Over a quarter (28%) of patients were classed as having an impaired left ventricular ejection fraction (LVEF), including 18% with mild LV dysfunction (LVEF between 40% to 50%), 6% with moderate LV dysfunction (LVEF between 30% to 39%) and 4% with severe LV dysfunction (LVEF less than 30%).



* LVEF 40–49%

† LVEF 30–39%

‡ LVEF <30%

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

6.7 Infective endocarditis

There were 105 cases of infective endocarditis (IE) that required cardiac surgical intervention. Of these, nearly three-quarters (n=74) were active infections at the time of surgery.

Native valve endocarditis was noted in 72% of active infections, with prosthetic valve involvement in 11%.

Table 7: Infective endocarditis status

Endocarditis status	n (%)
Active	74 (70.5)
Treated	31 (29.5)
Total	**105 (100.0)**

Table 8: Active infective endocarditis by site of infection

Active endocarditis site	n (%)
Native valve	53 (71.6)
Aortic root	13 (17.6)
Prosthetic valve	5 (6.8)
Prosthetic valve + pacemaker	2 (2.7)
Prosthetic valve + aortic root	1 (1.4)
Pacemaker	2 (2.6)
Total	**74 (100.0)**

6.7.1 Organism

Almost half (46%) of all active IE cases were identified as a methicillin susceptible Staphylococcus aureus (MSSA) infection, while the responsible organism was unidentified in 11% of cases.

Table 9: Identified organism in active IE cases

Active organism	n (%)
MSSA*	34 (45.9)
Streptococcus	11 (14.9)
Staphylococcus (other)	8 (10.8)
Enterococcus	3 (4.1)
Propionibacterium	3 (4.1)
Other	7 (9.5)
Unknown/unidentified	8 (10.8)
Total	**74 (100.0)**

* Methicillin susceptible Staphylococcus aureus

6.7.2 Intravenous drug use

Almost one in five (18%) of all active infective endocarditis cases were linked to a history of intravenous drug use (IVDU), of which over half were current intravenous drug users.

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

IVDU history	n (%)
Current IVDU (≤3 months)	7 (9.5)
Previous IVDU (>3 months)	6 (8.1)
No history of IVDU	54 (73.0)
Unknown	7 (9.5)
Total	**74 (100.0)**

6.8 Summary of risk factors

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

Table 11: Summary of risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
BMI ≥30 kg/m²	568 (42.7)	100 (42.4)	312 (36.0)	56 (29.8)	1,036 (39.5)
Current smoker	291 (21.9)	24 (10.2)	96 (11.1)	21 (11.2)	432 (16.5)
Diabetes	516 (38.8)	78 (33.1)	141 (16.3)	20 (10.6)	755 (28.8)
eGFR 60–89 mL/min/1.73 m²	466 (35.0)	85 (36.0)	299 (34.4)	54 (28.9)	904 (34.5)
eGFR 30–59 mL/min/1.73 m²	189 (14.2)	46 (19.5)	186 (21.5)	23 (12.3)	444 (16.9)
eGFR <30 mL/min/1.73 m²	29 (2.2)	6 (2.5)	26 (3.0)	3 (1.6)	64 (2.4)
Former smoker	604 (45.4)	132 (55.9)	330 (38.1)	54 (28.7)	1,120 (42.7)
Hypertension	1,013 (76.1)	189 (80.1)	465 (53.6)	64 (34.0)	1,731 (66.0)
Hypercholesterolaemia	1,040 (78.1)	169 (71.6)	353 (40.7)	43 (23.0)	1,605 (61.2)
Infective endocarditis	0 (0.0)	7 (3.0)	93 (10.7)	5 (2.7)	105 (4.0)
LVEF 40–50%	281 (21.1)	48 (20.3)	124 (14.3)	17 (9.0)	470 (17.9)
LVEF 30–39%	105 (7.9)	20 (8.5)	34 (3.9)	4 (2.1)	163 (6.2)
LVEF <30%	47 (3.5)	15 (6.4)	27 (3.4)	21 (11.2)	110 (4.2)

Table 12: Summary of combined risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
Hypertension + hypercholesterolaemia	867 (65.1)	142 (60.2)	262 (30.2)	31 (16.6)	1,302 (49.7)
Current/former smoker + hypertension	692 (52.0)	126 (53.4)	230 (26.5)	32 (17.1)	1,080 (41.2)
Current/former smoker + hypertension + hypercholesterolaemia	599 (45.0)	97 (41.1)	135 (15.6)	17 (910)	848 (32.3)
BMI ≥30 kg/m² + hypercholesterolaemia	463 (34.8)	70 (29.7)	149 (17.2)	16 (8.5)	698 (26.6)
Diabetes + hypertension + hypercholesterolaemia	387 (29.1)	54 (22.9)	77 (8.9)	7 (3.7)	525 (20.0)
Diabetes + eGFR ≤89 mL/min/1.73 kg/m²	248 (18.6)	40 (16.9)	93 (10.7)	9 (4.8)	390 (14.9)
Current/former smoker + BMI ≥30 kg/m² + diabetes	179 (13.4)	27 (11.4)	45 (5.2)	4 (2.1)	255 (9.7)
BMI ≥30 kg/m² + diabetes	276 (20.7)	42 (17.8)	81 (9.3)	9 (4.8)	408 (15.6)

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.

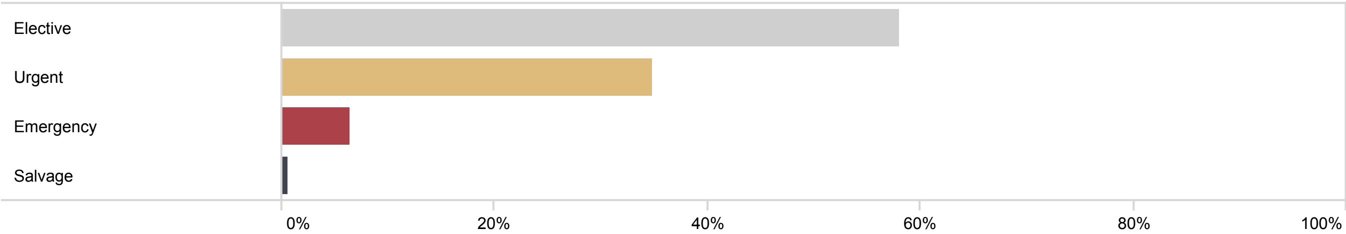


Figure 19: Proportion of cases by admission status

Table 13: Cases by admission status and surgery category

	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)
ANY CABG	568 (42.7)	696 (52.3)	57 (4.3)	10 (0.8)
CABG + VALVE	156 (66.1)	73 (30.9)	7 (3.0)	–
VALVE	702 (80.9)	127 (14.6)	37 (4.3)	2 (0.2)
OTHER	97 (51.9)	17 (9.1)	68 (36.4)	5 (2.7)
ALL	**1,523 (58.1)**	**913 (34.8)**	**169 (6.4)**	**17 (0.6)**

7.2 Day of surgery admission

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

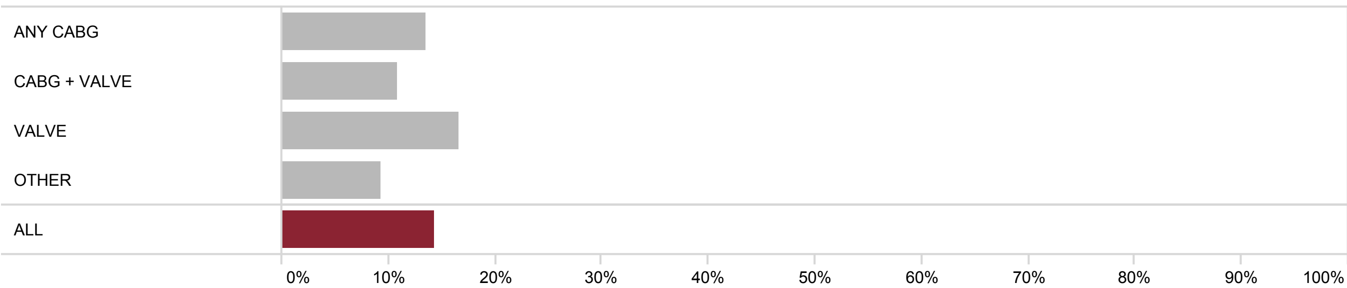


Figure 20: Proportion of elective cases for DOSA cases by surgery category

Table 14: DOSA cases by surgery category

	Total elective cases n	DOSA cases n (%)
ANY CABG	568	77 (13.6)
CABG + VALVE	156	17 (10.9)
VALVE	702	116 (16.5)
OTHER	97	9 (9.3)
ALL	**1,523**	**219 (14.4)**

7.3 Coronary artery bypass grafting

7.3.1 Number of diseased vessels

There were 1,567 CABG procedures performed across all sites. The majority (92%) had multi-vessel disease.

When CABG was performed in conjunction with a valve procedure, 67% of patients had multi-vessel disease compared to 96% when CABG surgery was performed without a valve intervention.

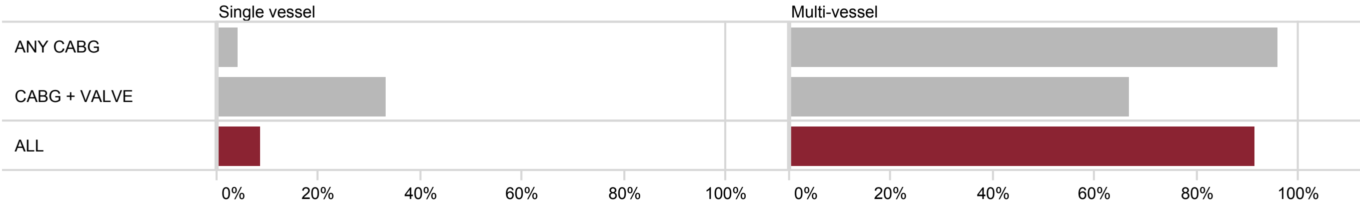


Figure 21: Number of diseased vessels

Table 15: Number of diseased vessels

	Single vessel n (%)	Multi-vessel n (%)	Total n (%)
ANY CABG	54 (4.1)	1,277 (95.9)	1,331 (100.0)
CABG + VALVE	78 (33.2)	158 (66.9)	236 (100.0)
ALL	**132 (8.4)**	**1,435 (91.6)**	**1,567 (100.0)**

Excludes missing data/not applicable (n=6)

7.3.2 Number of grafts

Overall, the average CABG procedure required 2.7 grafts. In multi vessel CABG, the mean number of grafts utilised was 2.9.

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	2.9
CABG + VALVE	1.1	2.3	2	1.9
ALL	**1.2**	**2.9**	**3**	**2.7**

7.3.3 Conduits used

In CABG, including surgeries involving valvular intervention, the most common form of revascularisation required the use of a combination of an arterial and vein graft (72%). Total arterial revascularisation occurred in 18% of cases.

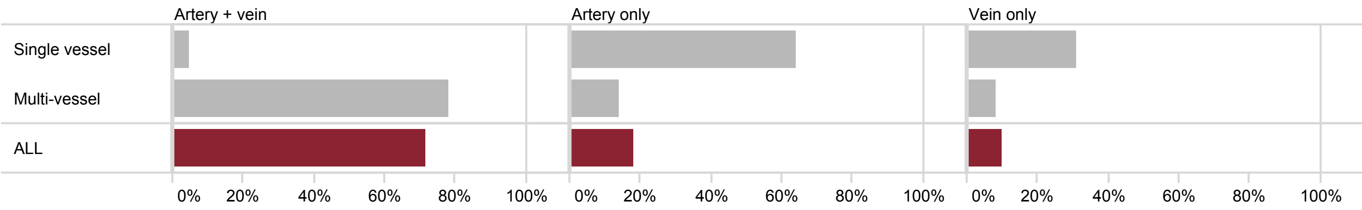


Figure 22: Proportion of diseased vessels by conduits used

Table 17: Conduits used by number of diseased vessels

	Artery + vein n (%)	Artery only n (%)	Vein only n (%)
Single vessel	6 (4.5)	85 (64.4)	41 (31.1)
Multi-vessel	1,121 (78.1)	198 (13.8)	116 (8.1)
ALL	**1,127 (71.9)**	**283 (18.1)**	**157 (10.0)**

7.3.4 Off-pump CABG

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

Table 18: Off-pump CABG

	Total cases n	Off-pump n (%)
Isolated CABG	1,284	26 (2.0)

7.3.5 Y or T grafts

Approximately 6% of all CABG surgeries included 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	1,331	80 (6.0)
CABG + VALVE	236	7 (3.0)
ALL	**1,567**	**87 (5.6)**

7.4 Aortic surgery

There were a total of 294 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 (53%).

Most aortic surgery procedures included replacement of the ascending aorta in isolation (60%), while surgery to replace both the ascending aorta and aortic arch accounted for 11% of cases.

Aortoplasty involving patch repair was performed in approximately 18% of aortic surgery cases.

Table 20: Aortic surgery by procedure type

Aortic surgery type	n (%)
Replacement	225 (76.5)
Ascending aorta	176 (59.9)
Ascending + aortic arch	32 (10.9)
Ascending aorta + aortic arch + descending aorta	8 (2.7)
Descending aorta	5 (1.7)
Aortic arch	4 (1.4)
Aortoplasty	56 (19.0)
Patch repair	43 (14.6)
Direct aortoplasty	13 (4.4)
Aortoplasty and replacement	12 (4.1)
Patch repair + ascending aorta	7 (2.4)
Patch repair + ascending aorta + aortic arch	3 (1.0)
Direct aortoplasty + ascending aorta	2 (0.7)
Direct aortoplasty + ascending aorta + aortic arch	1 (0.3)
ALL	**294 (100.0)**

7.4.1 Aortic pathology

Table 21: Aortic surgery cases by pathology type

Aortic pathology type	n (%)
Aortic aneurysm	156 (53.1)
Aortic dissection (≤2 weeks)	50 (17.0)
Calcification	28 (9.5)
Aortic abscess	10 (3.4)
Aortic dissection (>2 weeks)	5 (1.7)
Other	45 (15.3)
ALL	**294 (100.0)**

7.5 Valve surgery

There were 1,104 valve surgery procedures performed at the participating sites during 2019.

The aortic valve was the most commonly operated on valve either with or without other valves (69%). Isolated mitral valve surgery was the next most common valvular surgery (23%).

Overall, 11% of valve operations performed comprised of intervention to multiple valves.

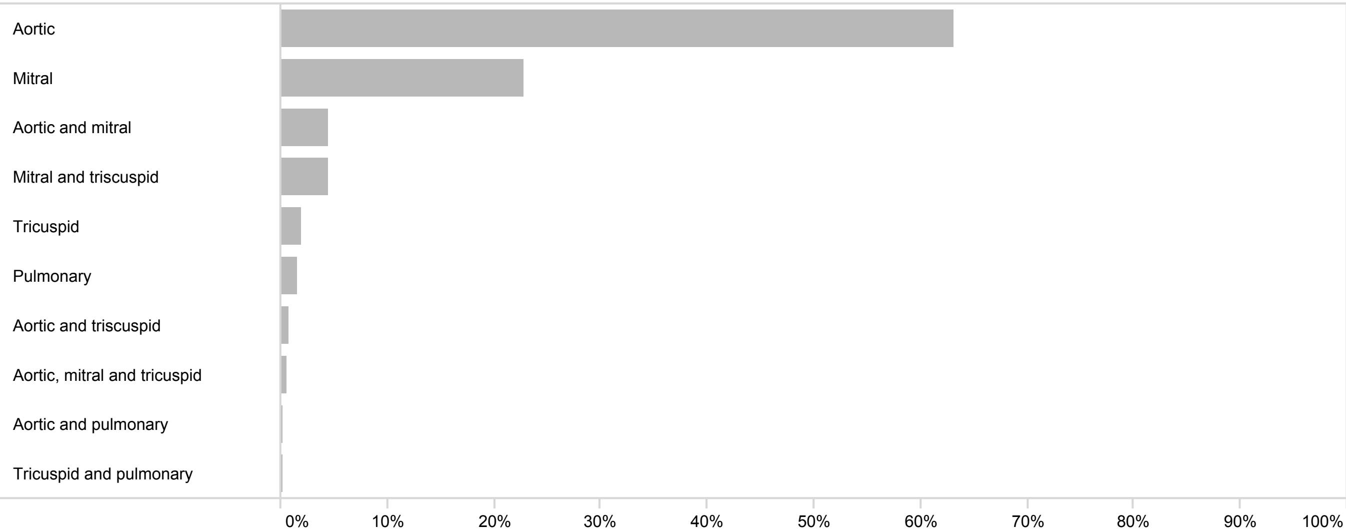


Figure 23: Proportion of valve surgery cases by valve

Table 22: Valve surgery cases by valve

Type of valve surgery	n (%)
Aortic	697 (63.1)
Mitral	251 (22.7)
Aortic and mitral	50 (4.5)
Mitral and tricuspid	48 (4.3)
Tricuspid	22 (2.0)
Pulmonary	16 (1.4)
Aortic and tricuspid	9 (0.8)
Aortic, mitral and tricuspid	7 (0.6)
Aortic and pulmonary	2 (0.2)
Tricuspid and pulmonary	2 (0.2)
ALL	**1,104 (100.0)**

7.5.1 Valve pathology

The most common valve pathology across all valve types was a degenerative cause (56%) and accounted for more than half of all aortic (61%) and mitral (52%) valve procedures.

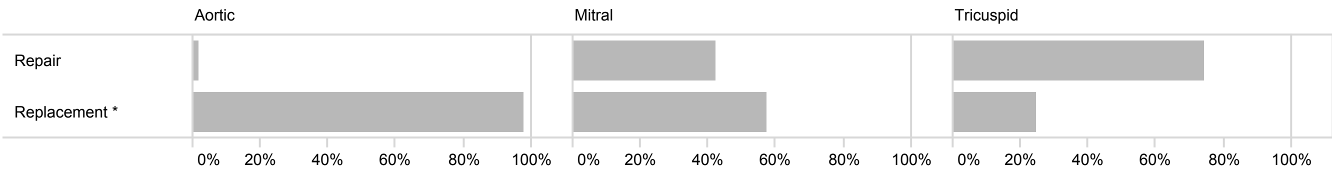
Table 23: Valve pathology by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Degenerative	464 (60.7)	186 (52.2)	38 (43.2)	–	688 (56.0)
Congenital	121 (15.8)	6 (1.7)	6 (6.8)	14 (70.0)	147 (12.0)
Infection	42 (5.5)	42 (11.8)	9 (10.2)	2 (10.0)	95 (7.7)
Rheumatic	18 (2.4)	37 (10.4)	8 (9.1)	–	63 (5.1)
Prosthesis failure	28 (3.7)	22 (6.2)	–	2 (10.0)	52 (4.2)
Dissection	34 (4.5)	–	–	–	34 (2.8)
Ischaemic	–	21 (5.9)	–	–	21 (1.7)
Annuloaortic ectasia	16 (2.1)	–	–	–	16 (1.3)
Functional	–	–	13 (14.8)	–	13 (1.1)
Peri-prosthetic leak	3 (0.4)	–	–	1 (5.0)	4 (0.3)
Failed prior repair	–	–	3 (3.4)	–	3 (0.2)
Iatrogenic	1 (0.1)	–	–	–	1 (0.1)
Other	38 (5.0)	42 (11.8)	11 (12.5)	1 (5.0)	92 (7.5)
ALL	**765 (100.0)**	**356 (100.0)**	**88 (100.0)**	**20 (100.0)**	**1,229 (100.0)**

7.5.2 Types of valve surgery

The majority of valve surgery cases involved aortic valve intervention (62%).

The most common aortic valve procedure was replacement surgery (98%), with the remainder involving valve repair. Similarly, for the mitral valve, replacement was more frequent than repair (54% vs. 46%).



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

Figure 24: 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	14 (1.8)	164 (46.1)	72 (81.8)	1 (5.0)	251 (20.4)
Replacement	751 (98.2)*	192 (53.9)	16 (18.2)	19 (95.0)	978 (79.6)
Inspection only	–	–	–	–	–
ALL	**765 (100.0)**	**356 (100.0)**	**88 (100.0)**	**20 (100.0)**	**1,229 (100.0)**

* Includes TAVR procedure involving CTS (n=134)

Transcatheter aortic valve replacement (TAVR)

A TAVR procedure is often a combined effort of a multidisciplinary heart team involving both interventional cardiologists and cardiac surgeons, among other specialties. Despite the varied role of the surgeon in the heart team, over half (54%) of all TAVR were performed with a cardiac surgeon involved in the procedure.

It should be noted that the reported number of TAVR cases within this Audit reflects those where a cardiothoracic surgeon was present during the procedure. As such, it does not represent the total number of these surgeries performed in Queensland public hospitals in 2019.

Further detail regarding all TAVR procedures performed in a Queensland public hospital are included in the structural heart disease supplement to the interventional cardiology chapter of this Annual Report.

Table 25: TAVR cases by site and CS involvement

Site	All TAVR n	Combined CS and cardiologist TAVR n (%)
TUH	13	13 (100.0)
TPCH	156	41 (26.3)
PAH	54	54 (100.0)
GCUH	26	26 (100.0)
STATEWIDE	**249**	**134 (54.0)**

7.5.3 Valve repair surgery

The most common form of valve repair surgery was repair/reconstruction with annuloplasty (80%) followed by annuloplasty only (10%). Mitral valve repair/reconstruction with annuloplasty was the most common individual valve repair surgery comprising 57% of overall valve repair surgery.

Table 26: Valve repair surgery by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Repair/reconstruction with annuloplasty	–	142 (86.6)	57 (79.2)	–	199 (79.3)
Annuloplasty only	–	14 (8.5)	12 (16.7)	–	26 (10.4)
Repair/reconstruction without annuloplasty	–	5 (3.0)	3 (4.2)	–	8 (3.2)
Root reconstruction with valve sparing	7 (50.0)	–	–	–	7 (2.7)
Resuspension of aortic valve	6 (42.9)	–	–	–	6 (2.4)
Repair paravalvular leak	–	1 (0.6)	–	1 (100.0)	2 (0.8)
Tumour tissue removal	1 (7.1)	1 (0.6)	–	–	2 (0.8)
Alfieri suture	–	1 (0.6)	–	–	1 (0.4)
ALL	**14 (100.0)**	**164 (100.0)**	**72 (100.0)**	**1 (100.0)**	**251 (100.0)**

7.5.4 Valve replacement surgery

Aortic valve replacement accounted for the majority of valve replacement surgeries (76%), which included 134 TAVR procedures and 120 aortic root reconstruction surgeries utilising a valved conduit.

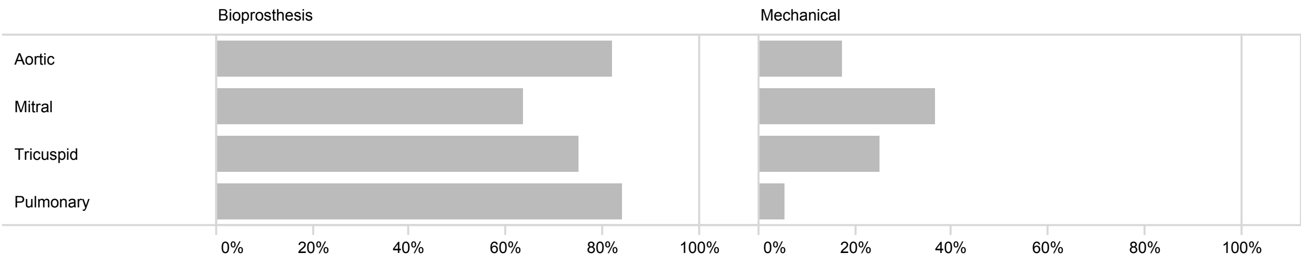
Table 27: Valve replacement surgery by valve type

Surgery type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Replacement	497 (66.2)	192 (100.0)	16 (100.0)	19 (100.0)	724 (74.0)
TAVR	134 (15.7)	–	–	–	134 (13.7)
Root reconstruction with valve conduit	120 (16.0)	–	–	–	120 (12.3)
ALL	**751 (100.0)**	**192 (100.0)**	**16 (100.0)**	**19 (100.0)**	**978 (100.0)**

Prosthesis type

The most common form of valve prostheses used across all valve types were biological (78%). Mechanical prostheses were used in 21% of cases with a greater proportion represented in mitral valve replacement surgeries.

Porcine-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 (0.6%)

Figure 25: 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	349 (46.5)	17 (8.9)	0 (0.0)	2 (10.5)	368 (37.6)
Biological – porcine	267 (35.6)	105 (54.7)	12 (75.0)	14 (73.7)	398 (40.7)
Mechanical	131 (17.4)	70 (36.5)	4 (25.0)	1 (5.3)	206 (21.1)
Homograft/allograft	3 (0.4)	0 (0.0)	0 (0.0)	2 (10.5)	5 (0.5)
Autograft	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
ALL	**751 (100.0)**	**192 (100.0)**	**16 (100.0)**	**19 (100.0)**	**978 (100.0)**

7.6 Other cardiac surgery

The most common forms of other cardiac surgery were atrial septal defect repair (10%), followed by left atrial appendage closure (9%). Approximately 8% of other surgeries were classified as various other cardiac surgery.

Table 29: Other cardiac procedures

Procedure	n (%)
Atrial septal defect repair	37 (10.8)
Left atrial appendage closure	31 (9.1)
Atrial arrhythmia surgery	29 (8.5)
Other congenital	28 (8.2)
LVOT† myectomy for HOCM‡	26 (7.6)
BSSLTx*	23 (6.7)
Cardiac tumour	20 (5.8)
Ventricular septal defect repair	15 (4.4)
Cardiac transplant	14 (4.1)
ECMO‖ procedure	11 (3.2)
VAD§ procedure	10 (2.9)
Permanent LV epicardial lead	9 (2.6)
PPM procedure	8 (2.3)
LV aneurysm repair	7 (2.0)
Lung resection	6 (1.8)
Patent foramen ovale repair	5 (1.5)
Single lung transplant	5 (1.5)
Septal myectomy	5 (1.5)
Other myectomy	5 (1.5)
Cardiac trauma	4 (1.2)
Pulmonary thrombo-endarterectomy	4 (1.2)
Pericardiectomy	3 (0.9)
PAPVD# repair	3 (0.9)
Coronary artery endarterectomy	2 (0.6)
Cardiopulmonary transplant	2 (0.6)
Pericardial effusion drainage	2 (0.6)
Other cardiac	28 (8.2)
ALL	**342 (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). Three quarters (75%) of all emergency cases utilised at least one blood product.

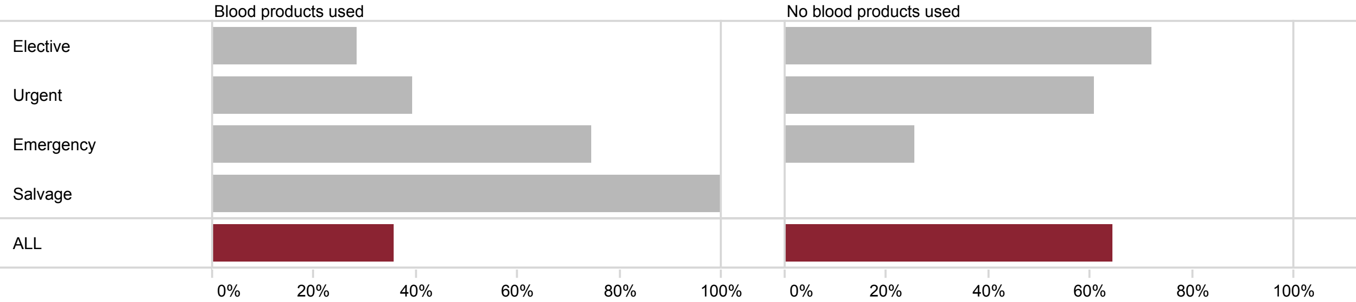


Figure 26: Blood products used by admission status

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	149 (9.8)	161 (10.6)	119 (7.8)	1,094 (71.8)
Urgent	137 (15.0)	146 (16.0)	76 (8.3)	554 (60.7)
Emergency	78 (46.2)	24 (14.2)	24 (14.2)	43 (25.4)
Salvage	13 (76.5)	4 (23.5)	0 (0.0)	0 (0.0)
ALL	**377 (14.4)**	**335 (12.8)**	**219 (8.4)**	**1,691 (64.5)**

8 Outcomes

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

8.1 Risk prediction models

Risk adjustment models are a commonly employed method of estimating patient outcomes based on patient-specific comorbidities and clinical factors known at the time of surgery. This statistical analysis enables the adjustment of risk for individual patients, attempting to correct for patients who may be undergoing surgery in a critical pre-operative state e.g. 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. In this 2019 cohort, EuroSCORE II is reported for the first time.

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 postoperative risk of complications (morbidity).

The risk prediction models used in evaluating the 2019 clinical outcomes for cardiac surgical cases are:

- EuroSCORE[14]
- EuroSCORE II[15]
- ANZSCTS General Score[16]
- AusSCORE[17]
- STS Score (mortality and morbidity)[18, 19, 20]

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[14], EuroSCORE II[15], and ANZSCTS General Score[16] can be applied to evaluate deaths for all types of cardiac surgical cases, whereas the AusSCORE model[17] 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.

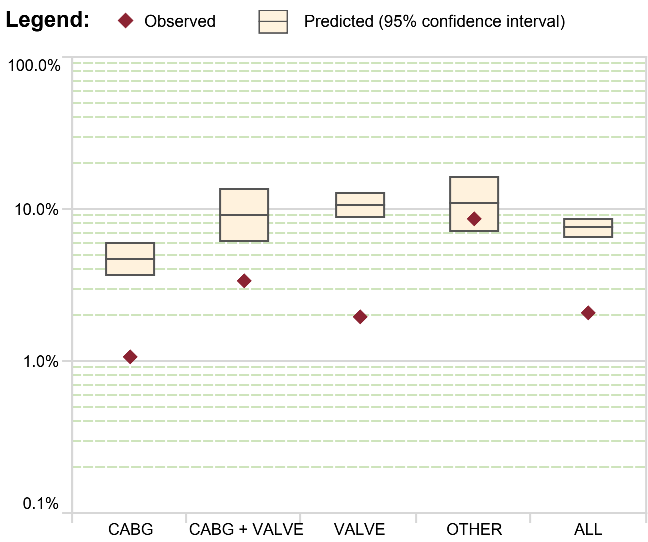


Figure 27: EuroSCORE

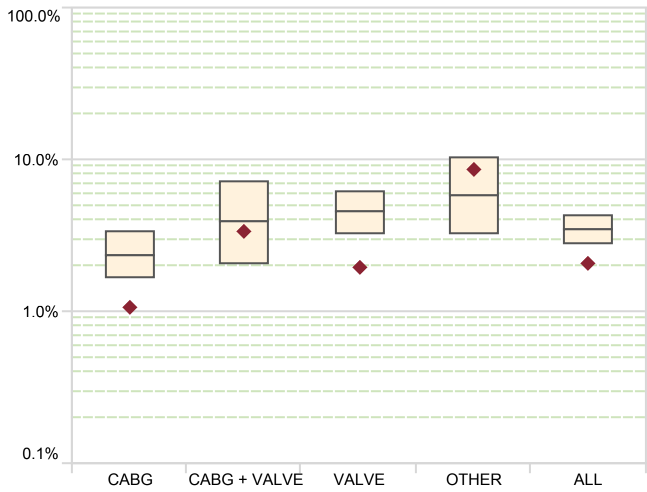


Figure 28: EuroSCORE II

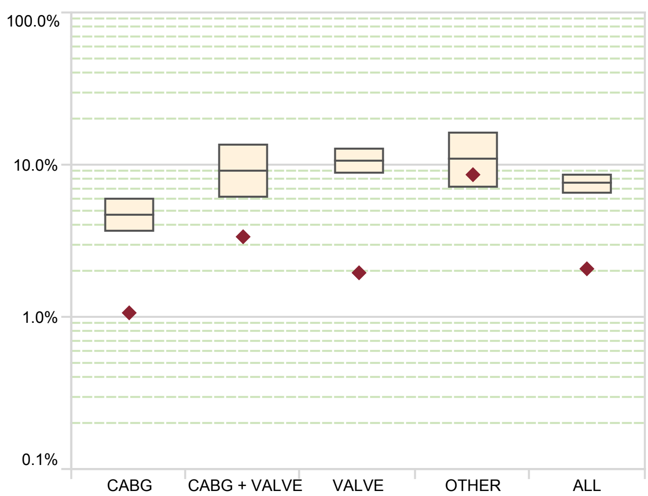


Figure 29: ANZSCTS (General Score)

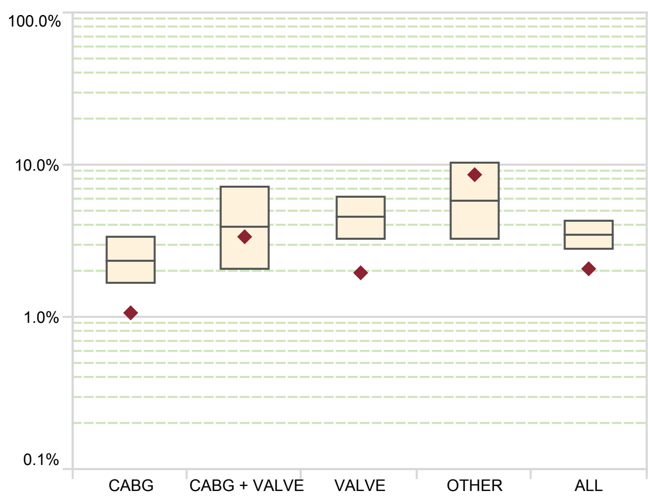


Figure 30: STS (death)

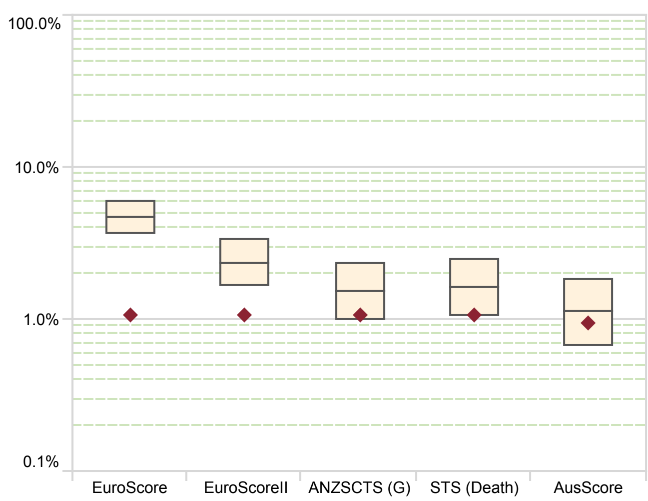


Figure 31: CABG

8.1.2 Morbidity

Patients undergoing cardiac surgery are at risk of experiencing a range of significant morbidities in the postoperative 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 37) 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 exception continues to be deep sternal wound infection (DSWI) in CABG cases and the All category, where the rate appears be higher than predicted.

As the definition of DSWI includes reopening and debridement of the wound site, a flow-on consequence of this event is the higher than expected rate of reoperations in CABG cases.

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

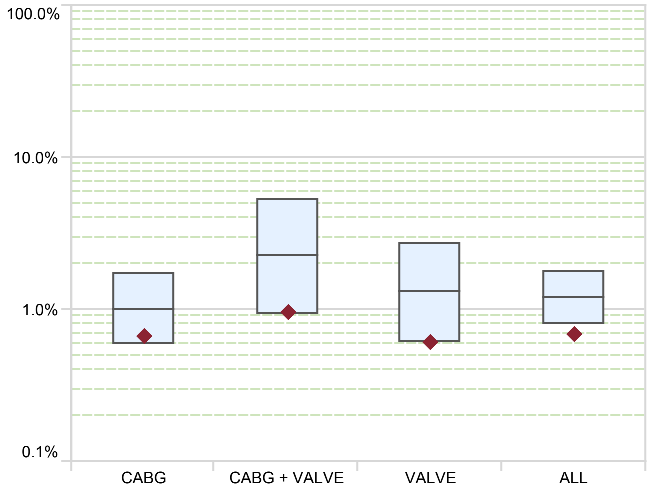


Figure 32: Cerebrovascular accident

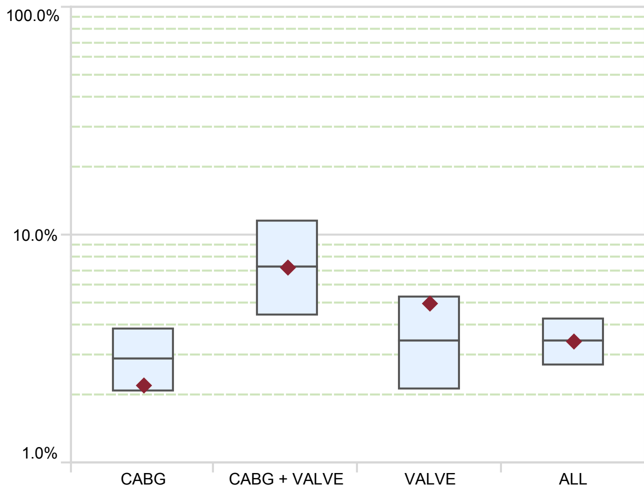


Figure 33: Renal failure

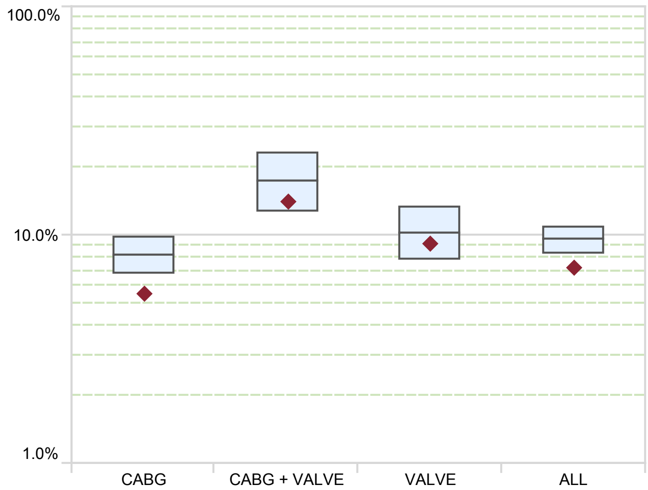


Figure 34: Ventilation >24 hours

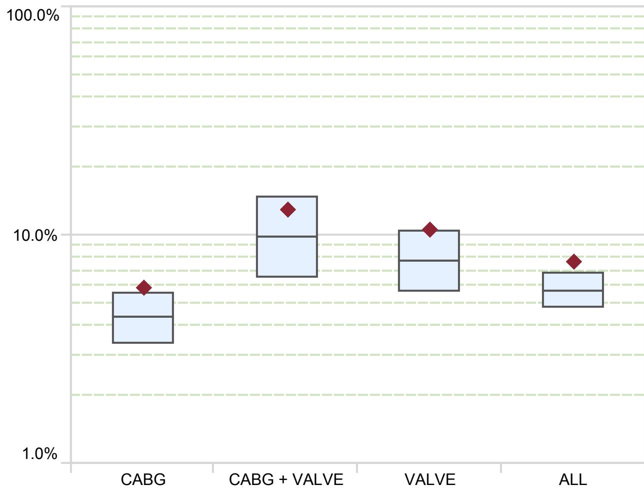


Figure 35: Reoperation

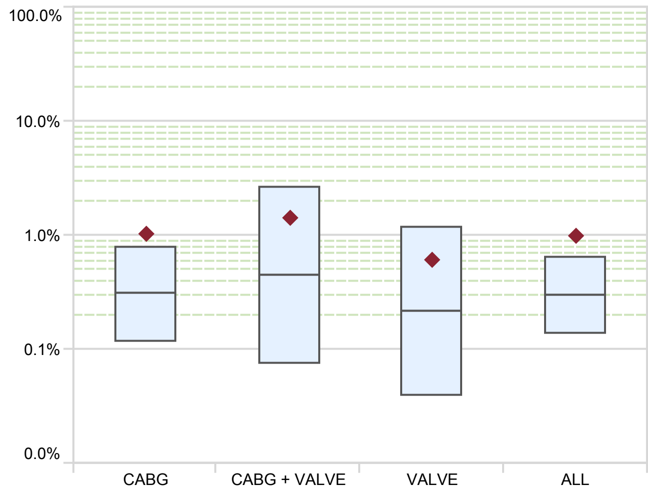


Figure 36: Deep sternal infection

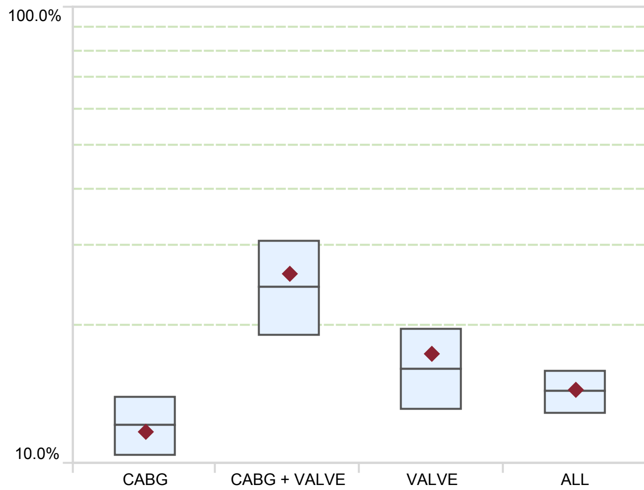


Figure 37: Major morbidity

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 lower 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.

Legend: Observed   Predicted (95% confidence interval)

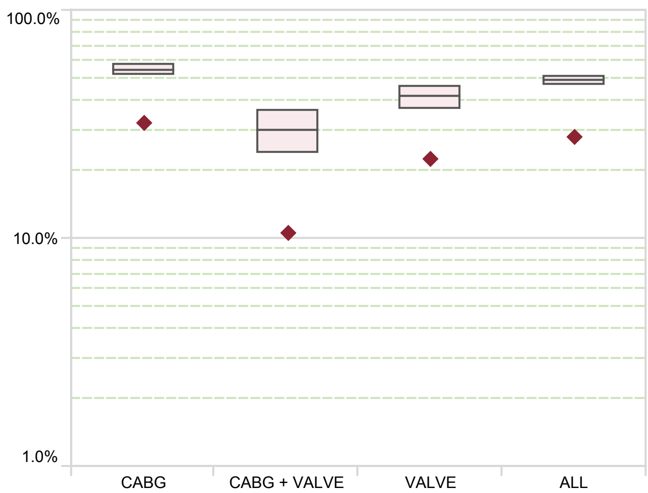


Figure 38: LOS ‹6 days

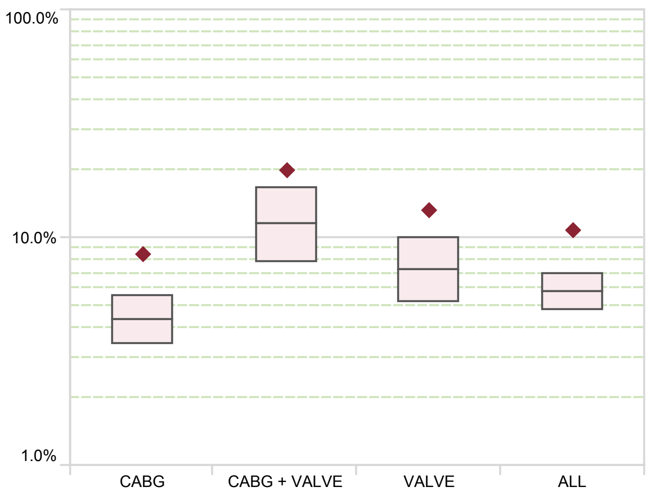


Figure 39: LOS ›14 days

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 postoperative 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 CABG cases is statistically better than predicted and the rate for valve, and combined CABG and valve cases is within the expected range.

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

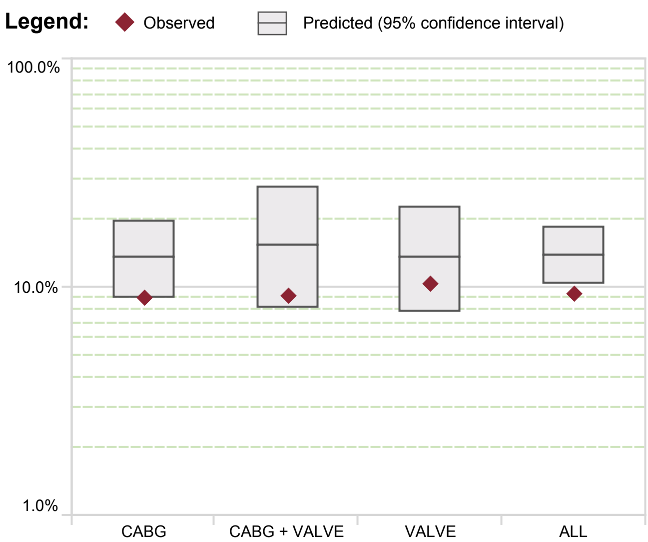


Figure 40: Failure to rescue

9 Conclusions

This is the fourth report to examine cardiac surgery outcomes for Queensland and once again highlights that cardiac surgery is being performed in Queensland to high levels of safety, with better than expected results when compared to American, European and Australian risk scores. While the bulk of surgery is acute coronary surgery, the remaining surgeries involve a wide array of procedures. The teams and systems that perform cardiac surgery are functioning well for Queenslanders.

Deep sternal wound infection for isolated CABG continues to be encountered at a higher than expected rate based on risk scores. This in turn is reflected in results for the overall cohort. As discussed in previous reports, this appears to be a persistent finding. Further work to investigate what elements may predict DSWI and whether any form of risk factor modification is possible prior to surgery to alleviate this elevated rate is clearly warranted.

Surgical aortic valve replacement case volume has reduced over the past three years however there has been a commensurate increase in the numbers of transcatheter valvular procedures. Evolving clinical guidelines for utilisation of transcatheter replacement as opposed to traditional surgical approach as well as an increasing appreciation of the operational benefits in terms of length of stay will continue to see increasing volumes of these procedures.

The addition of the EuroSCORE II risk prediction model and expanded examination of infective endocarditis in this year's report reflects the advantages and responsiveness of QCOR as a bespoke registry guided by the specific needs of Queensland clinicians. We look forward to further opportunities to expand on these analyses in future reports.

Expansion of the data analysis project in Queensland cardiac surgery will, in future, seek to include the publication of data from the Queensland Children's Hospital. Our paediatric cardiac surgical colleagues are leading the drive across Australia and New Zealand to establish a registry in which performance in paediatric cardiac surgery can be assessed. This project has been undertaken so far without direct involvement from QCOR. Preliminary collaboration reflects willingness for open disclosure and accountability for their results. Our aim is to support their efforts to establish Australia and New Zealand wide benchmarking for paediatric cardiac surgery.

10 Supplement: Cardiac surgery and geography

This report seeks to identify any relationship between the amount of time spent in hospital after cardiac surgery and the geographic remoteness of the patient's place of usual residence. The focus is on patients who have undergone cardiac surgery at one of the four public cardiothoracic surgery units located in Queensland between the years of 2017 and 2019.

With a land area of 1.7 million square kilometres, Queensland is Australia's second-largest state and home to a widely-dispersed population of approximately five million people. Queensland is the most decentralised of all mainland Australian states, with (36%) of Queenslanders residing in regional or remote areas. The population is most heavily concentrated along the Eastern Seaboard and 7,000 kilometre stretch of Queensland Pacific coastline.

For the outcomes analysis, the two primary outcomes of interest had been postoperative length of stay (LOS) less than six days and LOS greater than 14 days. The secondary outcome of interest was to examine any effect of geographic remoteness on subsequent rehospitalisation within 30 days of surgery. The six and 14 day cut-offs had been selected to align with the STS measures which have been used elsewhere in the document.

Patients were classed into a remoteness area based on the Australian Statistical Geography Standard[21], using their postcode and suburb combination. The estimated distance travelled for surgery was based on the direct, point-to-point distance (excluding driving time). Data linkage with Queensland Hospital Admitted Patient Data Collection was used to identify additional time spent in a public hospital postoperatively outside of the participating cardiac surgery unit.

Table 1: Queensland and Australian total estimated resident population by remoteness area

Remoteness area	Queensland n (%)	Australia n (%)
Major Cities of Australia	3,282,614 (64.4)	18,320,373 (72.2)
Inner Regional Australia	991,155 (19.5)	4,499,741 (17.7)
Outer Regional Australia	694,038 (13.6)	2,054,693 (8.1)
Remote Australia	71,900 (1.4)	290,431 (1.1)
Very Remote Australia	54,803 (1.1)	200,333 (0.8)
Total	**5,094,510 (100.0)**	**25,365,571 (100.0)**

Australian Bureau of Statistics. Regional Population Growth 2018-19, March 2020. Cat No 3218.0. Accessed November 2020

The majority of Queensland's population reside in areas classed as Major Cities of Australia (64%) with approximately one-fifth (20%) residing in Inner Regional areas. As expected, the proportion residing in Regional, Remote and Very Remote areas of Queensland demonstrates a stepwise decrease as distance to the Metropolitan area increases (Table 1).

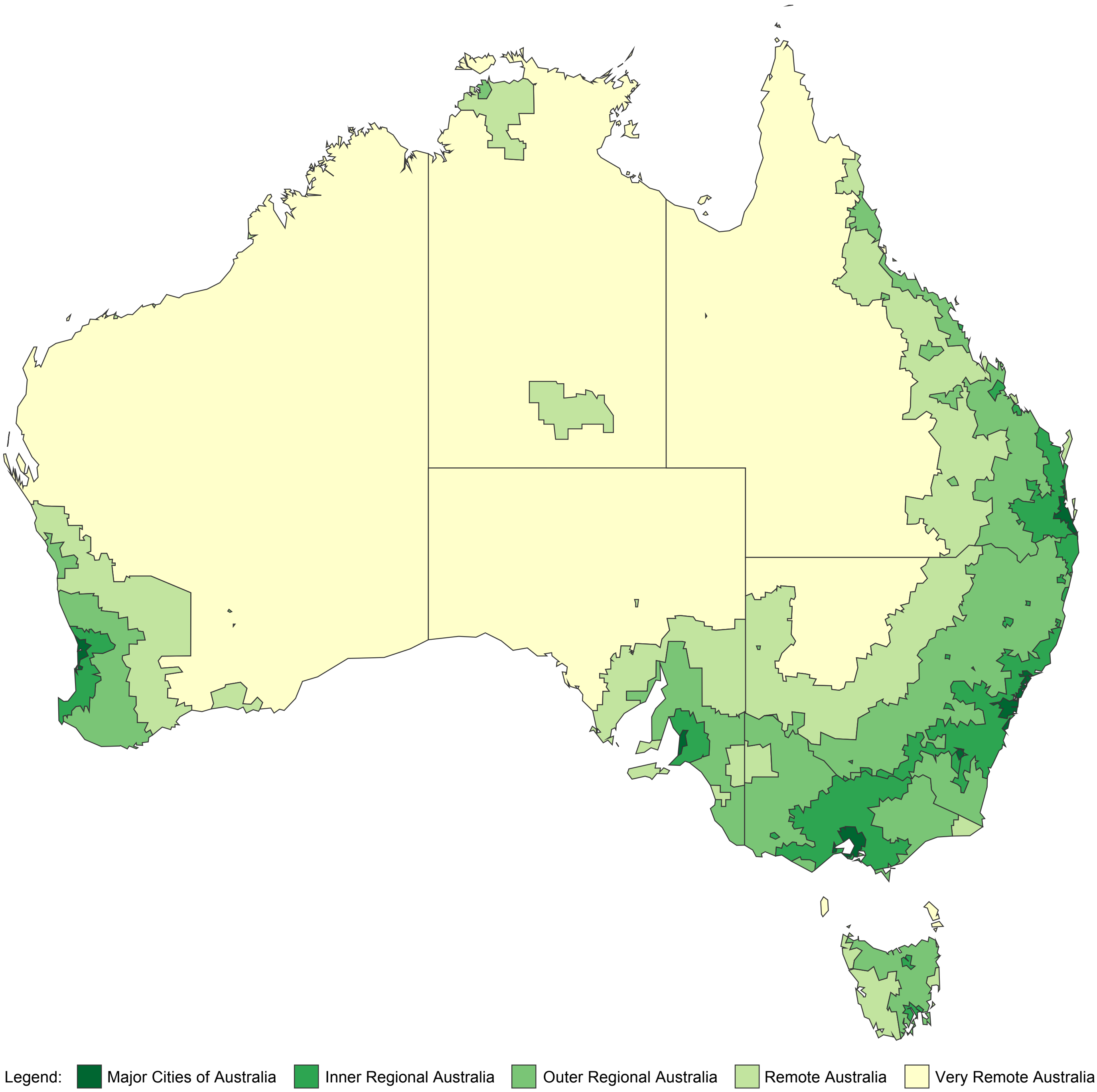


Figure 1: Australian Statistical Geography Standard remoteness areas

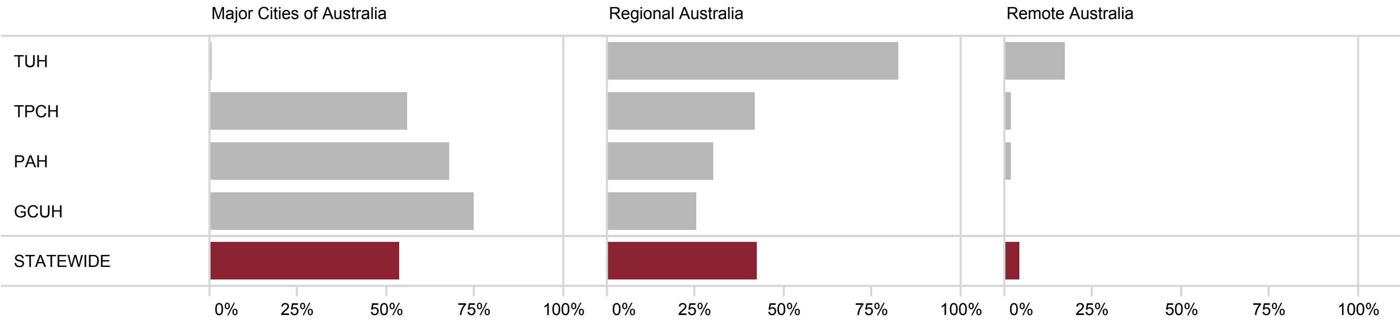
TUH treated the largest proportion of patients residing in Remote and Very Remote parts of Queensland (6% and 12% respectively). This contrasts with GCUH whose patient cohort resided predominantly (75%) within the Major Cities area. Of the overall patient cohort, 54% of patients lived in a Major City with 2.5% from a Very Remote location. This finding is consistent with an overall trend where patients undergoing cardiac surgery who reside in a Regional or Remote location are overrepresented when compared to their background population proportion.

As expected, median distances travelled by patients increased as their remoteness area moved further from Major Cities. The median estimated travel distance for those Queenslanders residing in Very Remote areas (787 km) is in stark contrast to those living in a Major City (18 km).

Table 2: Cardiac surgery cases by remoteness area and treating facility (2017–2019)

	Total cases n	Major Cities of Australia n (%)	Inner Regional Australia n (%)	Outer Regional Australia n (%)	Remote Australia n (%)	Very Remote Australia n (%)
TUH	1,063	5 (0.5)	114 (10.7)	761 (71.6)	58 (5.5)	125 (11.8)
TPCH	3,413	1,913 (56.1)	1,233 (36.1)	200 (5.9)	29 (0.8)	38 (1.1)
PAH	1,820	1,232 (67.7)	423 (23.2)	129 (7.1)	19 (1.0)	17 (0.9)
GCUH	1,019	762 (74.8)	231 (22.7)	26 (2.6)	–	–
STATEWIDE	**7,315**	**3,912 (53.5)**	**2,001 (27.4)**	**1,116 (15.3)**	**106 (1.4)**	**180 (2.5)**

Excludes missing postcode, no fixed abode, and overseas patients (0.5%)



Excludes missing postcode, no fixed abode, and overseas patients (0.5%)

Figure 2: Cardiac surgery cases by remoteness area and treating facility (2017–2019)

Table 3: Estimated distance travelled by remoteness area (2017–2019)

Remoteness area	Total cases n	Median kilometres	Interquartile range kilometres
Major Cities of Australia	3,912	18	9–30
Inner Regional Australia	2,001	156	95–287
Outer Regional Australia	1,116	252	73–298
Remote Australia	106	390	132–491
Very Remote Australia	180	787	690–959
Total	**7,315**	**37**	**15–182**

Excludes missing postcode, no fixed abode, and overseas patients (0.5%)

10.1 Patient characteristics

There were minimal differences in gender proportions observed when examined by remoteness area. Males were more likely to undergo cardiac surgery in all remoteness areas with the highest proportion of females represented in the Remote Australia area. As the remoteness of the area increased, there was a stepwise increase in the proportion of identified Aboriginal and Torres Strait Islander patients. There was a nine-year difference in median age observed between patients residing in Major Cities compared to those in Very Remote areas (66 years vs. 57 years).

Table 4: Patient characteristics by remoteness area (2017–2019)

	Major Cities of Australia n (%)	Inner Regional Australia n (%)	Outer Regional Australia n (%)	Remote Australia n (%)	Very Remote Australia n (%)	ALL n (%)
Gender						
Male	2,865 (73.2)	1,486 (74.3)	800 (71.7)	70 (66.0)	130 (72.2)	5,351 (73.2)
Female	1,047 (26.8)	515 (25.7)	316 (28.3)	36 (34.0)	50 (27.8)	1,964 (26.8)
Age group (years)						
<40	245 (6.3)	85 (4.2)	56 (5.0)	9 (8.5)	26 (14.4)	421 (5.8)
40–49	323 (8.3)	111 (5.5)	89 (8.0)	8 (7.5)	29 (16.1)	560 (7.7)
50–59	726 (18.6)	353 (17.6)	235 (21.1)	25 (23.6)	49 (27.2)	1,388 (19.0)
60–69	1,197 (30.6)	649 (32.4)	326 (29.2)	36 (34.0)	44 (24.4)	2,252 (30.8)
70–79	1,112 (28.4)	612 (30.6)	319 (28.6)	25 (23.6)	27 (15.0)	2,095 (28.6)
≥80	309 (7.9)	191 (9.5)	91 (8.2)	3 (2.8)	5 (2.8)	599 (8.2)
Aboriginal and Torres Strait Islander status						
Indigenous	110 (2.8)	108 (5.4)	145 (13.0)	36 (34.0)	99 (55.0)	498 (6.8)
Non-Indigenous	3,802 (97.2)	1,893 (94.6)	971 (87.0)	70 (66.0)	81 (45.0)	6,817 (93.2)
Total	**61 (100.0)**	**1,098 (100.0)**	**1,750 (100.0)**	**1,630 (100.0)**	**206 (100.0)**	**4,745 (100.0)**

Excludes missing postcode, no fixed abode, and overseas patients (0.5%)

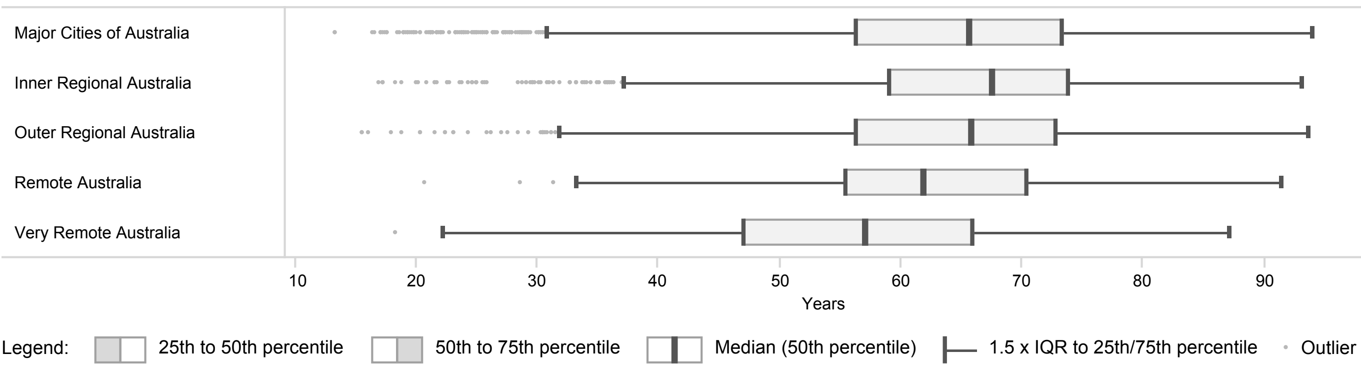


Figure 3: Patient age distribution by remoteness area (2017–2019 cohort)

Table 5: Median age by gender and remoteness area (2017–2019 cohort)

Remoteness area	Male years	Female years	ALL years
Major Cities of Australia	67	66	66
Inner Regional Australia	68	68	68
Outer Regional Australia	66	66	66
Remote Australia	62	62	62
Very Remote Australia	57	57	57
Total	**67**	**66**	**66**

Excludes missing postcode, no fixed abode, and overseas patients (0.5%)

10.2 Risk factors and comorbidities

As residential remoteness area progresses to becoming more remote, so too does the incidence of risk factors and comorbidities. There was an appreciable difference in the proportions of patients with higher BMI, current smoking status, diabetes, hypertension and statin usage between the Major Cities and Very Remote areas.

Table 6: Risk factors and comorbidities by remoteness area (2017–2019)

	Major Cities of Australia n (%)	Inner Regional Australia n (%)	Outer Regional Australia n (%)	Remote Australia n (%)	Very Remote Australia n (%)	ALL n (%)
BMI ≥30 kg/m²	1,498 (38.3)	793 (39.6)	441 (39.5)	44 (41.5)	80 (44.4)	2,856 (39.0)
Current smoker	603 (15.4)	314 (15.7)	223 (20.0)	24 (22.6)	65 (36.1)	1,229 (16.8)
Former smoker	1,590 (40.6)	932 (46.6)	481 (43.1)	43 (40.6)	59 (32.8)	3,105 (42.4)
Diabetes	1,021 (26.1)	560 (28.0)	332 (29.7)	34 (32.1)	89 (49.4)	2,036 (27.8)
Hypertension	2,560 (65.4)	1,365 (68.2)	778 (69.7)	74 (69.8)	131 (72.8)	4,908 (67.1)
Statin therapy	2,390 (61.1)	1,295 (64.7)	700 (62.7)	70 (66.0)	125 (69.4)	4,580 (62.6)
Infective endocarditis	172 (4.4)	83 (4.1)	46 (4.1)	4 (3.8)	6 (3.3)	311 (4.3)
Mild renal dysfunction*	1,313 (33.6)	717 (35.8)	369 (33.1)	37 (34.9)	35 (19.4)	2,471 (33.8)
Moderate renal dysfunction†	696 (17.8)	355 (17.7)	178 (15.9)	11 (10.4)	26 (14.4)	1,266 (17.3)
Severe renal dysfunction‡	91 (2.3)	47 (2.3)	37 (3.3)	6 (5.7)	9 (5.0)	190 (2.6)
LVEF 40–50%	723 (18.5)	354 (17.7)	212 (19.0)	21 (19.8)	33 (18.3)	1,343 (18.4)
LVEF 30–39%	258 (6.6)	127 (6.3)	72 (6.5)	17 (16.0)	20 (11.1)	494 (6.8)
LVEF <30%	185 (4.7)	83 (4.1)	43 (3.9)	5 (4.7)	7 (3.9)	323 (4.4)

* eGFR 60–89 mL/min/1.73m²

† eGFR 30–59 mL/min/1.73m²

‡ eGFR <30 mL/min/1.73m²

Cardiac Surgery

10.3 Care and treatment of patients

There was a greater proportion of patients undergoing CABG in the Very Remote Australia area when compared to others, which suggests a higher rate of coronary artery disease as a specific medical pathology in this cohort. Salvage cases were more often encountered in patients residing in the Major Cities area, which likely owes to the high-risk nature of this presentation category. Elective day of surgery admission rates were also markedly different across remoteness areas (Table 7).

Table 7: Treatment characteristics by remoteness area (2017–2019)

	Major Cities of Australia n (%)	Inner Regional Australia n (%)	Outer Regional Australia n (%)	Remote Australia n (%)	Very Remote Australia n (%)	ALL n (%)
Surgery category						
ANY CABG	1,950 (49.8)	989 (49.4)	567 (50.8)	53 (50.0)	108 (60.0)	3,667 (50.1)
CABG + VALVE	357 (9.1)	216 (10.8)	112 (10.0)	14 (13.2)	21 (11.7)	720 (9.8)
VALVE	1,268 (32.4)	661 (33.0)	372 (33.3)	32 (30.2)	43 (23.9)	2,376 (32.5)
OTHER	337 (8.6)	135 (6.7)	65 (5.8)	7 (6.6)	8 (4.4)	552 (7.5)
Isolated CABG						
	1,880 (48.1)	955 (47.7)	540 (48.4)	51 (48.1)	103 (57.2)	3,529 (48.2)
Admission status						
Elective	2,225 (56.9)	1,100 (55.0)	624 (55.9)	62 (58.5)	107 (59.4)	4,118 (56.3)
Urgent	1,338 (34.2)	781 (39.0)	445 (39.9)	39 (36.8)	67 (37.2)	2,670 (36.5)
Emergency	325 (8.3)	118 (5.9)	43 (3.9)	4 (3.8)	6 (3.3)	496 (6.8)
Salvage	24 (0.6)	2 (0.1)	4 (0.4)	1 (0.9)	0 (0.0)	31 (0.4)
Elective day of surgery admission						
	453 (20.4)	49 (4.5)	78 (12.5)	5 (8.1)	10 (9.3)	595 (14.4)
Discharge method						
Home/usual residence	3,703 (94.7)	1,852 (92.6)	1,038 (93.0)	98 (92.5)	168 (93.3)	6,859 (93.8)
Other*	209 (5.3)	149 (7.4)	78 (7.0)	8 (7.5)	12 (6.7)	456 (6.2)
Total	**3,912 (100.0)**	**2,001 (100.0)**	**1,116 (100.0)**	**106 (100.0)**	**180 (100.0)**	**7,315 (100.0)**

Excludes missing postcode, no fixed abode, and overseas patients (0.5%)

* Includes transfer to a private/interstate hospital, in-hospital mortality, nursing home or other health care accommodation

10.4 Patient outcomes

This section examines the association of patient remoteness on postoperative length of stay and rehospitalisation within 30 days. For the purpose of this analysis, relative odds ratios (OR) have been derived to compare outcomes across categories while controlling for clinical risk factors and in hospital complications/major morbidities.

Cases were excluded from the outcomes analysis where the postcode data were missing, for patients with no fixed place of residence or residing overseas, or where the patient had died during their hospital visit.

10.4.1 Postoperative length of stay

After adjusting for clinical characteristics and other procedural factors, the analysis found a positive correlation between the remoteness of the patient's place of residence and the likelihood the patient would remain in hospital >14 days postoperatively. Patients in Outer Regional and Remote/Very Remote areas were two to four times more likely to spend additional time in hospital. (Outer Regional: OR 2.02, p<0.01, Remote/Very Remote: OR 4.05, p <0.001).

Paradoxically, it was also found that when adjusted for clinical characteristics and procedural factors, patients residing in an Inner Regional and Outer Regional area had a higher likelihood of having a length of stay <6 days (Inner Regional: OR 1.61 p=0.009, Outer Regional: OR 1.45 p=0.044). Though it may seem likely that patients who reside further from their centre of treatment would be discharged to other care arrangements to ensure access to appropriate support, review of postoperative discharge destinations (Table 6) shows only a small proportion of patients within each geographic area who were not discharged to their usual place of residence. Further investigation may identify differences in practice with respect to these patients.

Legend: Odds ratio (vs. Major Cities) | 95% confidence interval

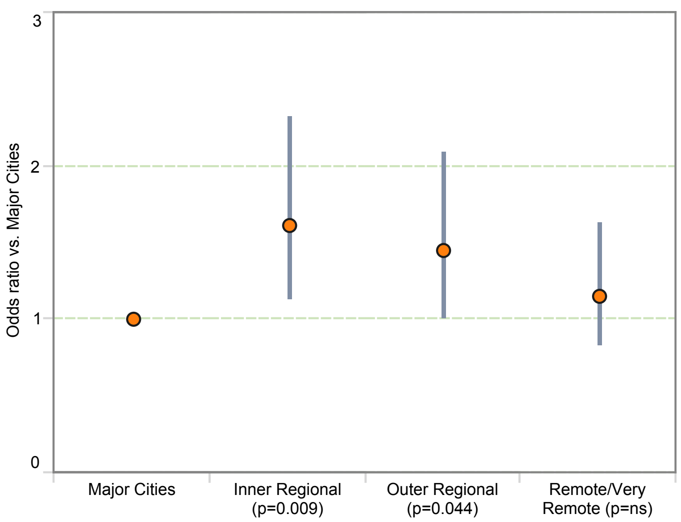


Figure 4: Standardised incidence of postoperative LOS less than six days by remoteness area (2017–2019)

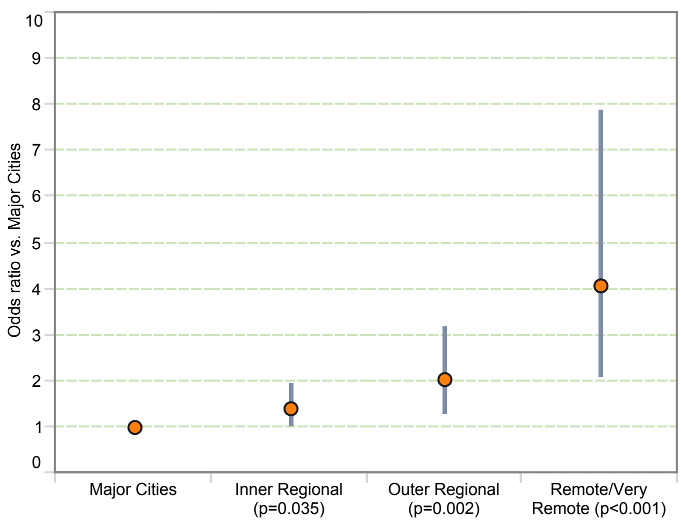


Figure 5: Standardised incidence of postoperative LOS greater than 14 days by remoteness area (2017–2019)

Table 8: Standardised incidence of overall LOS less than six days and greater than 14 days by remoteness area (2017–2019)

	Major Cities of Australia*	Inner Regional OR (p value)	Outer Regional OR (p value)	Remote/Very Remote OR (p value)
Post operative LOS <6 days	1.00	1.61 (p=0.009)	1.45(p=0.044)	1.16 (p>0.05)
Post operative LOS >14 days	1.00	1.40 (p=0.035)	2.02 (p=0.002)	4.05 (p<0.001)

* Used as reference/baseline for comparison across categories

10.4.2 Rehospitalisation within 30 days of surgery

In examining all-cause rehospitalisation within 30 days of surgery, there was minor variation observed when the patient remoteness areas were individually compared against the Major Cities area. Patients in Inner Regional and Outer Regional areas had a slightly lower overall 30 day rehospitalisation rate compared to patients located more closely towards the Greater Brisbane area (Inner Regional: OR 0.75, p<0.001, Outer Regional: OR 0.73, p=0.026).

This lower rate of 30 day rehospitalisation for patients in Inner Regional and Outer Regional areas may be associated with the increased rate of LOS>14 days for these patients. This could be attributable to patients who had required staged or subsequent procedures being retained in hospital for longer in the first instance, thereby leading to a reduced incidence of subsequent rehospitalisation.

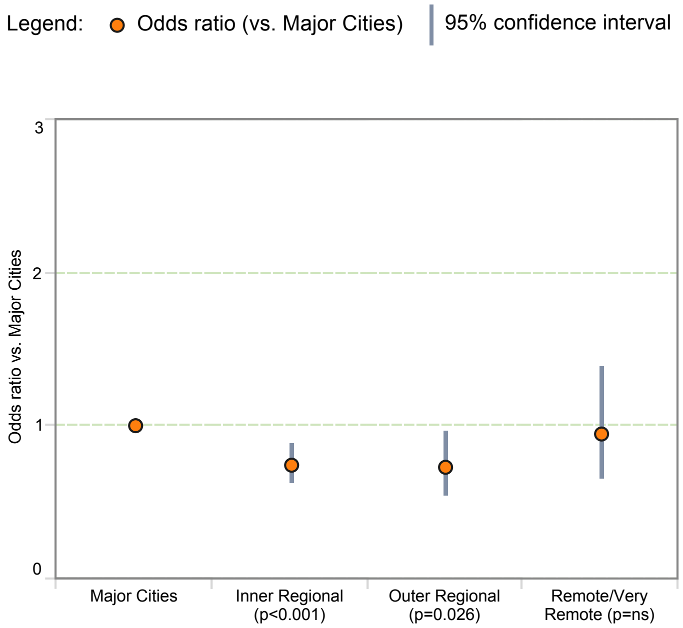


Figure 6: Standardised incidence of rehospitalisation within 30 days of surgery by remoteness area (2017–2019)

Table 9: Standardised incidence of rehospitalisation within 30 days of surgery by remoteness area (2017–2019)

	Major Cities of Australia*	Inner Regional OR (p value)	Outer Regional OR (p value)	Remote/Very Remote OR (p value)
Rehospitalisation within 30 days of surgery	1.00	0.75 (p<0.001)	0.73 (p=0.026)	0.95 (p>0.05)

* Used as reference/baseline for comparison across categories

10.5 Discussion

For patients attending surgery from a remote setting, it is clear that great distances may be involved in travelling to the nearest cardiac surgery unit for treatment. While these patients were in the minority, there are some clearly appreciable variations relating to patient risk profile and outcomes concerning time spent in hospital post-surgery.

Patients presenting from Remote and Very Remote areas (62 years and 57 years respectively) had a median age which was considerably younger than the median age of patients residing in the Major Cities area (66 years), which is suggestive of earlier onset of disease. As the residential remoteness area increased, so too did the incidence of preventable, lifestyle-related risk factors such as current smoking and obesity, which suggests poorer health literacy. From the Very Remote area, there was also a greater proportion of patients undergoing CABG (60% of patients, compared to 50% of overall patients) suggesting a higher rate of coronary artery disease as a specific pathology for this cohort.

Detailed analysis of patient outcomes identified that those patients residing in Outer Regional and Remote/Very Remote settings are two to four times more likely to spend greater than 14 days in hospital postoperatively. A lower incidence of 30 day rehospitalisation for patients residing in Inner Regional and Outer Regional areas was also noted. This may be reflective of care planning for patients residing in close proximity to the surgical hospital versus patients with a more distant place of residence. Counterintuitively, the analysis also showed that patients from Outer Regional and Remote areas were more likely to stay less than 6 days postoperatively. As this is not reflected in a higher rate of rehospitalisation for these areas, it is reassuring that this suggests Queensland practitioners are correctly selecting those patients eligible for discharge within 6 days. Further analysis may be needed to be able to better predict when a short stay is more likely based on risk factors, comorbidities and clinical status at presentation.

Access to tertiary care for all Queenslanders continues to be a focus for the public health system and these findings reflect the sometimes dichotomous scenarios that are frequently encountered by treating clinicians. Given that most cardiac surgical sites are often limited by intensive care and bed capacity, these findings are important to note for health system, operational and scheduling considerations as well as for the tailoring of treatment for individuals to ensure the best possible care for each patient. The increased proportion of Aboriginal and Torres Strait Islander patients presenting from regional and remote areas is likely reflective of the resident population within these areas and worth highlighting in terms of health service planning and provision.

Part B: Thoracic Surgery

1 Message from the Chair

This is the second annual audit of Thoracic Surgery in Queensland and is part of a wider Australia and New Zealand push to establish data registries, risk scores, and key performance indicators for Thoracic Surgery. Queensland leads the way in publishing statewide data for Thoracic Surgery.

Again reading the report, one sees the focus is on lung cancer, and its most modifiable risk factor, cigarette smoking. The rate of current smoking in the thoracic surgery cohort is nearly twice that of the general population, indicating once again the contribution of cigarette smoking to cancer. The outcomes for patients who can receive surgery for their lung cancer are dramatically better than those who are inoperable. The prevention of lung cancer, and after that, the discovery of cancers at a resectable stage are the two most important factors in improving the survival from lung cancer. This disease pattern means that thoracic surgery has a more elective pattern than cardiac surgery.

The analysis of performance in thoracic surgery is not as mature as in cardiac surgery. The mortality rate in the entire cohort was exceptionally low at 0.7%, meaning that mortality itself is not a reliable performance indicator. This mortality rate is exceptional when compared to published data, and needs further investigation and discussion. Whether this is a reflection of high quality performance or a conservative ethos is not an immediate conclusion, and needs to be taken in the context of the alternative treatments for lung cancer. This discussion is held elsewhere in the analysis of lung cancer care performance overall by different reporting groups. The morbidity rate is perhaps falsely high, in that it includes air leak between three and seven days, which is the most common scenario labelled as a morbidity but is not universally considered a marker in thoracic surgery. What is to be considered a morbidity that reflects quality in surgery in thoracic surgery is still for significant discussion and refinement by the committee.

The rate of previous thoracic surgery is of interest and is perhaps a future supplemental report. Patterns in the repeat intervention may give insights into how the approach to treatment can be changed.

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

2 Key findings

This Thoracic Surgery Audit describes baseline demographics, risk factors, surgeries performed, outcomes and subsequent investigations for 2019.

Key findings include:

- There were 1,042 thoracic surgical cases entered for 2019 across the five public thoracic surgery units in Queensland.
- The median age of patients undergoing thoracic surgery was 61 years of age, with 21% of patients aged under 40 years of age.
- Almost one third of patients (32%) were within the normal body mass index (BMI) range, while patients classed as overweight or obese made up more than half of the patient cohort (62%), including 4% classed as morbidly obese.
- The proportion of Aboriginal and Torres Strait Islander patients undergoing thoracic surgery was 4.7% of the total cohort.
- Most operations were performed for preoperative diagnoses of primary lung cancer (24%) or pleural disease (32%), while some other cancer or non-cancer diagnosis had been recorded in 18% and 26% of cases respectively.
- Two thirds of patients had some smoking history, including 23% who were current smokers at the time of surgery.
- Elective procedures accounted for 70% of the total surgeries performed, while 6% of cases were emergency operations. Of elective cases, 52% were performed on a day of surgery admission pathway.
- Lobectomy (84%) and lymph node sampling (65%) were the most common procedures performed on patients with a preoperative diagnosis of primary lung cancer.
- Approximately 7% of all cases required a blood product transfusion.
- The median length of stay (LOS) for thoracic surgery patients was 7 days. Patients with a preoperative diagnosis of pleural disease tended to stay longer with a median LOS of 11 days.
- There were 155 cases having one or more new major morbidities recorded post procedure. Prolonged air leak between three and seven days (18%) and reoperation (17%) were the most common reasons for major morbidity.
- Unadjusted all-cause mortality at 30 days was 0.7%, increasing to 1.5% at 90 days.

3 Participating sites

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

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

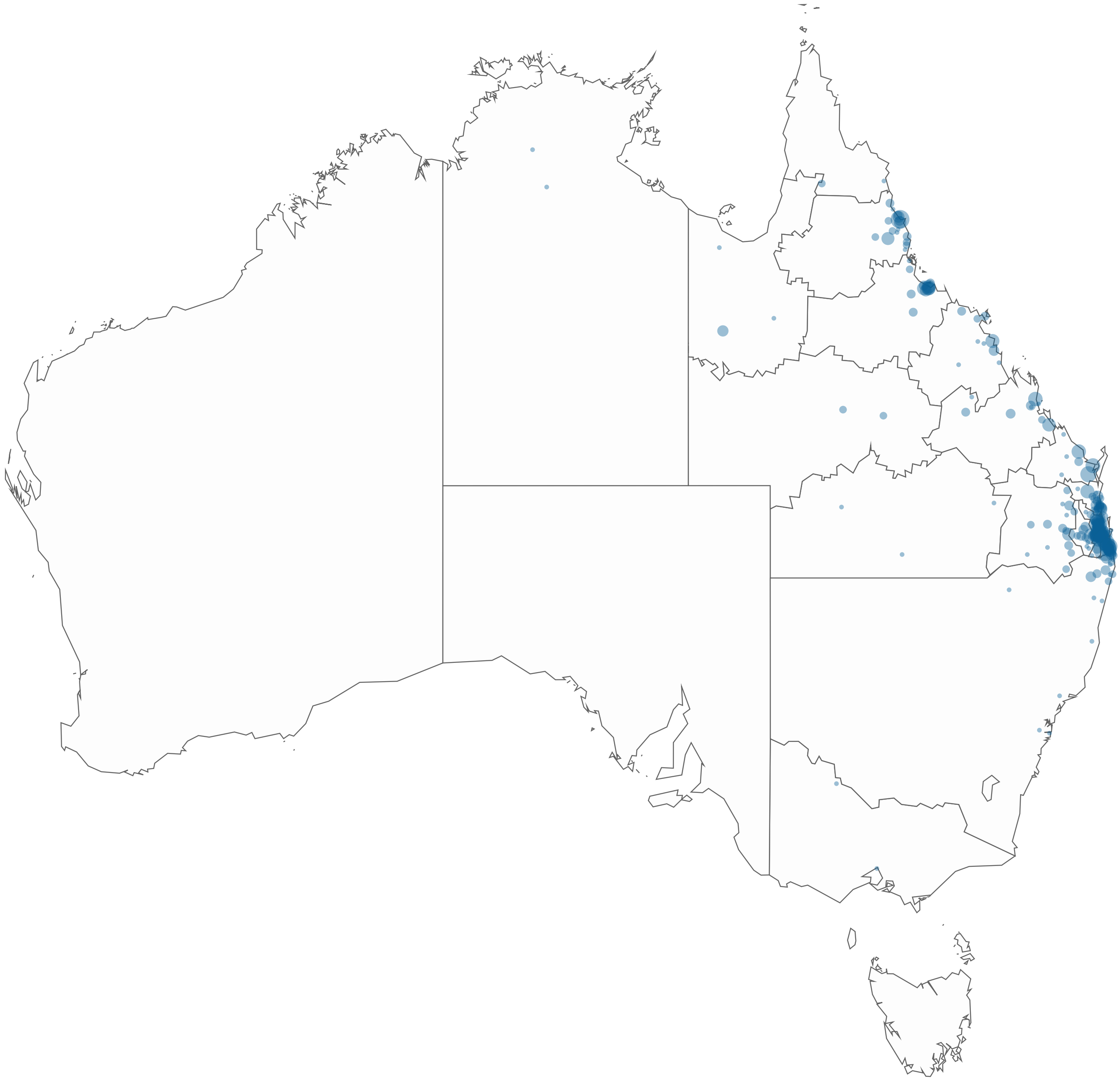


Figure 1: Thoracic surgery cases by residential postcode

Table 1: Participating sites

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

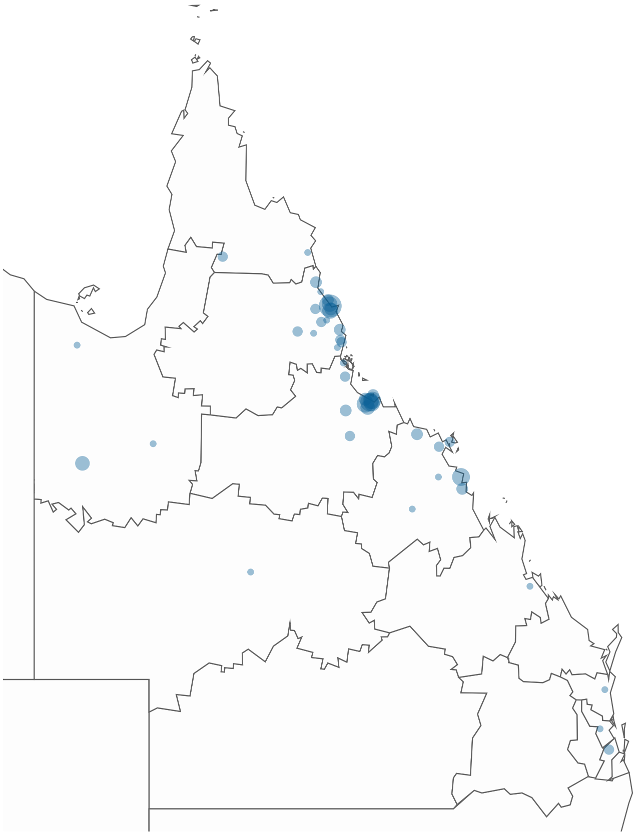


Figure 2: Townsville University Hospital

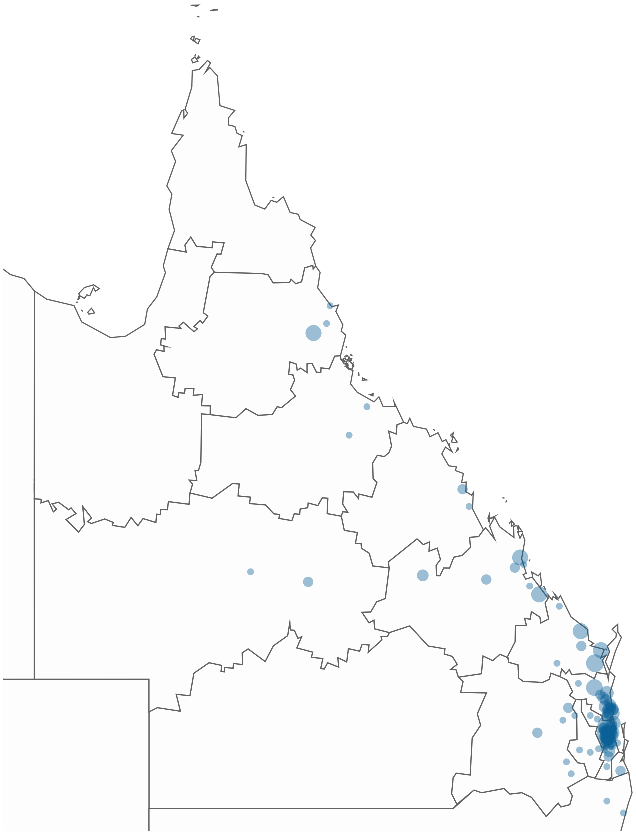


Figure 3: The Prince Charles Hospital

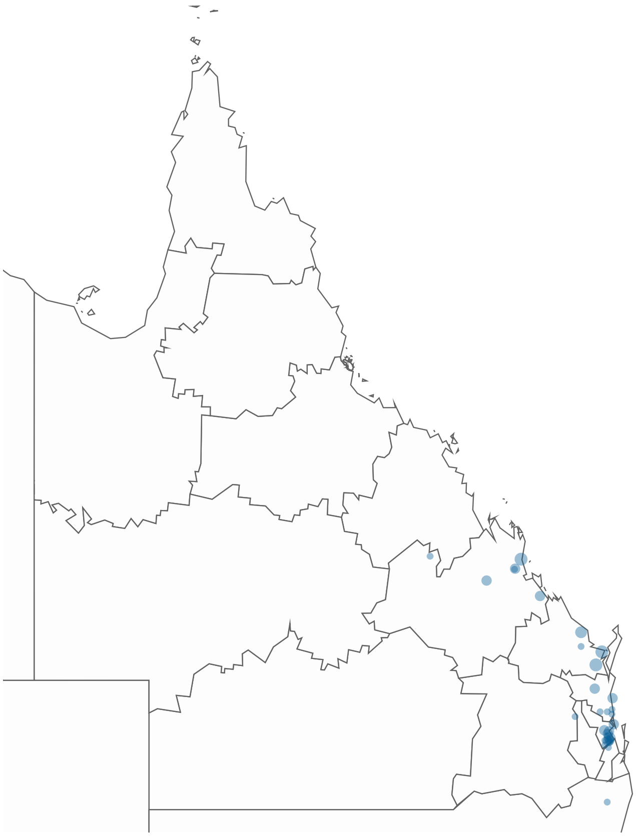


Figure 4: Royal Brisbane & Women's Hospital

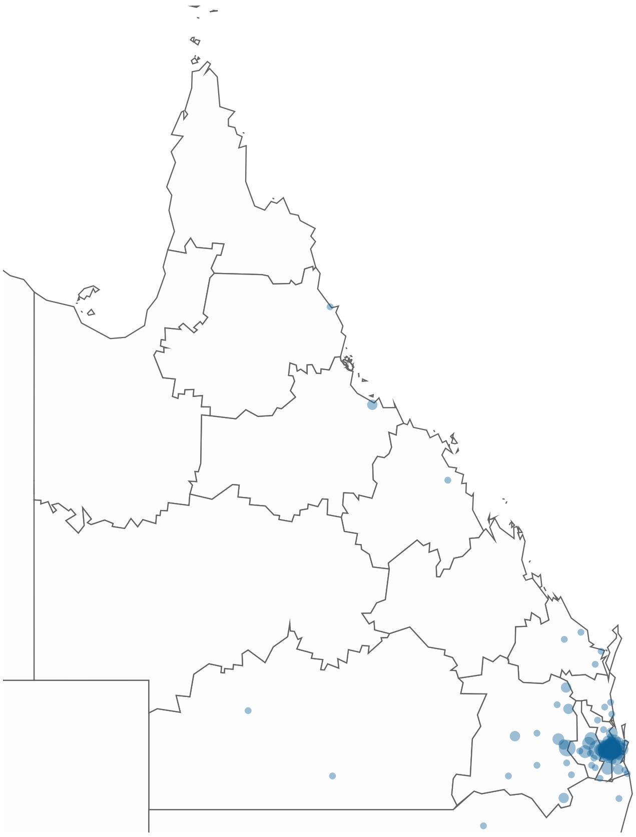


Figure 5: Princess Alexandra Hospital

Figure 6: Gold Coast University Hospital

4 Case totals

4.1 Total surgeries

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

Of the 1,042 cases performed across the five public thoracic surgery units in Queensland, many patients (42%) presented with a preoperative diagnosis including some form of cancer. Diagnosis of primary lung cancer accounted for 24% and 18% had another cancer diagnosis.

Non-cancer diagnoses accounted for 58% of the overall cases, including pleural disease (32%) or other non-cancer indication (26%).

Table 2: Cases by site and preoperative diagnosis category

SITE	Total n	Primary lung cancer n (%)	Other cancer* n (%)	Pleural disease† n (%)	Other‡ n (%)
TUH	175	34 (19.4)	65 (37.1)	35 (20.0)	41 (23.4)
TPCH	302	75 (24.8)	25 (8.3)	112 (37.1)	90 (29.8)
RBWH	57	20 (35.1)	13 (22.8)	11 (19.3)	13 (22.8)
PAH	306	72 (23.5)	50 (16.3)	107 (35.0)	77 (25.2)
GCUH	202	44 (21.8)	39 (19.3)	68 (33.7)	51 (25.2)
STATEWIDE	**1,042**	**245 (23.5)**	**192 (18.4)**	**333 (32.0)**	**272 (26.1)**

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

† Pneumothorax, haemothorax, empyema or pleural thickening/nodules

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

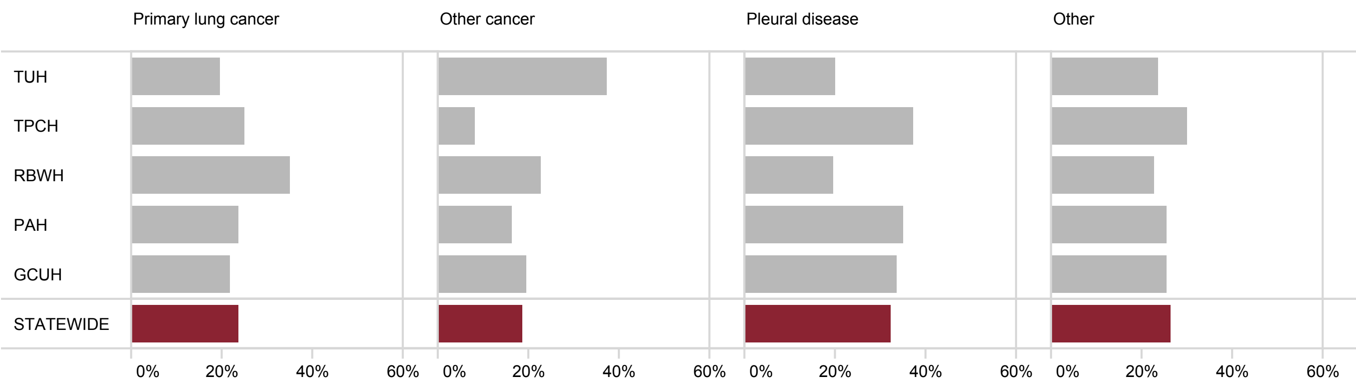


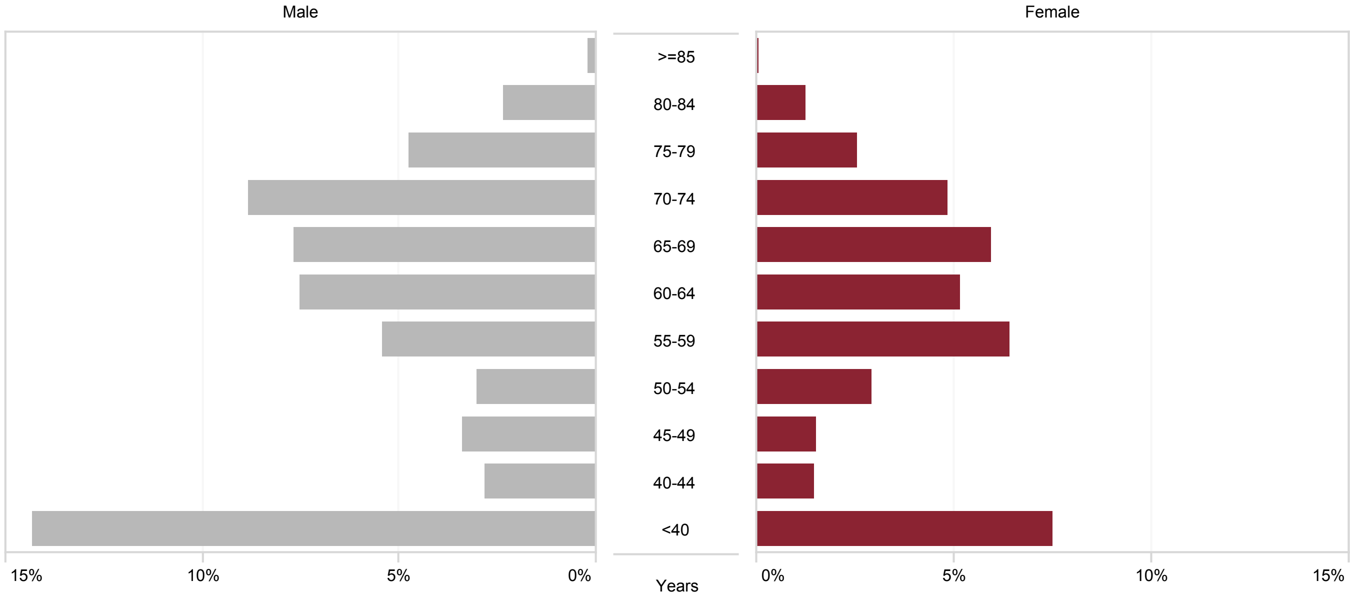
Figure 7: Proportion of cases by site and preoperative diagnosis category

5 Patient characteristics

5.1 Age and gender

The median age for thoracic surgical patients was 61 years, while more than one in five (21%) patients were less than 40 years of age.

Whilst the majority of patients were male (60%), distribution of cases between genders were similar among patients with a preoperative cancer diagnosis (53% and 47% for males and females respectively). Patients with pleural disease were more commonly male (72%).



% of total (n=1,042)

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

Table 3: Median age by gender and preoperative diagnosis category

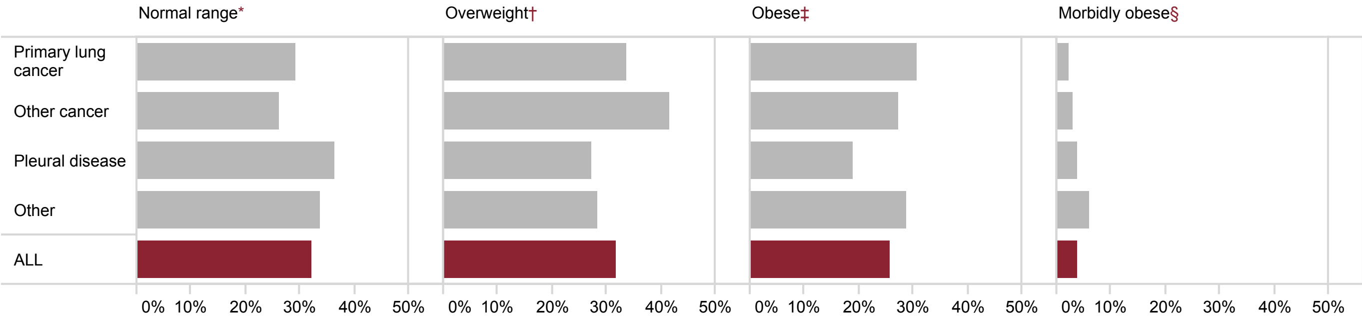
Preoperative diagnosis	Male	Female years	ALL years
Primary lung cancer	68	68	68
Other cancer	66	59	63
Pleural disease	47	45	47
Other	58	59	59
ALL	**61**	**60**	**61**

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

Preoperative diagnosis	Male n (%)	Female n (%)
Primary lung cancer	131 (53.5)	114 (46.5)
Other cancer	104 (54.2)	88 (45.8)
Pleural disease	239 (71.8)	94 (28.2)
Other	154 (56.6)	118 (43.4)
ALL	**628 (60.3)**	**414 (39.7)**

5.2 Body mass index

The majority of thoracic surgery patients (62%) were classed as overweight or obese, while 32% of patients had a body mass index (BMI) classed within the normal range. Approximately 6% of patients were classed as underweight.



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

Excludes missing data (0.6%)

* BMI 18.5–24.9 kg/m²

† BMI 25.0–29.9 kg/m²

‡ BMI 30.0–39.9 kg/m²

§ BMI ≥40.0 kg/m²

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

Table 5: BMI category by preoperative diagnosis category

Preoperative diagnosis	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
Primary lung cancer	8 (3.3)	71 (29.3)	82 (33.9)	75 (31.0)	6 (2.5)
Other cancer	4 (2.1)	50 (26.0)	80 (41.7)	52 (27.1)	6 (3.1)
Pleural disease	42 (12.7)	121 (36.7)	91 (27.6)	63 (19.1)	13 (3.9)
Other	10 (3.7)	91 (33.5)	77 (28.3)	78 (28.7)	16 (5.9)
ALL	**64 (6.2)**	**333 (32.1)**	**330 (31.9)**	**268 (25.9)**	**41 (4.0)**

Excludes missing data (0.6%)

5.3 Aboriginal and Torres Strait Islander status

The overall proportion of identified Aboriginal and Torres Strait Islander patients undergoing thoracic surgery was 4.7%.

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

Preoperative diagnosis	Indigenous n (%)	Non-Indigenous n (%)
Primary lung cancer	7 (2.9)	238 (97.1)
Other cancer	12 (6.3)	179 (93.7)
Pleural disease	23 (6.9)	310 (93.1)
Other	7 (2.6)	265 (97.4)
ALL	**49 (4.7)**	**992 (95.3)**

Excludes missing data (0.1%)

6 Risk factors and comorbidities

6.1 Smoking history

Nearly a quarter of patients (23%) were current smokers (defined as smoking within 30 days prior to surgery), while 43% of patients had a smoking history recorded. Only 26% of patients were identified as having never smoked. In 8% of cases, smoking status was unknown.

There was considerable variation for patients in the primary lung cancer category, where the majority (84%) were recorded as either current or former smokers.

Table 7: Smoking history by preoperative diagnosis category

Preoperative diagnosis	Current smoker n (%)	Former smoker n (%)	Never smoked n (%)	Unknown n (%)
Primary lung cancer	52 (21.2)	153 (62.4)	37 (15.1)	3 (1.2)
Other cancer	41 (21.4)	88 (45.8)	59 (30.7)	4 (2.1)
Pleural disease	105 (31.5)	103 (30.9)	83 (24.9)	42 (12.6)
Other	46 (16.9)	101 (37.1)	89 (32.7)	36 (13.2)
ALL	**244 (23.4)**	**445 (42.7)**	**268 (25.7)**	**85 (8.2)**

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6.2 Respiratory disease

The majority of patients (72%) did not have respiratory disease, while over one quarter (27%) were recorded as having mild or moderate respiratory disease.

Table 8: Respiratory disease according to preoperative diagnosis category

Preoperative diagnosis	Mild* n (%)	Moderate† n (%)	Severe‡ n (%)
Primary lung cancer	38 (16.1)	48 (20.3)	1 (0.4)
Other cancer	23 (12.6)	14 (7.7)	3 (1.6)
Pleural disease	35 (10.8)	43 (13.2)	4 (1.2)
Other	32 (12.2)	49 (18.6)	2 (0.8)
ALL	**128 (12.7)**	**154 (15.3)**	**10 (1.0)**

Excludes missing data (3.4%)

* Patient is on chronic inhaled or oral bronchodilator therapy

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

‡ Mechanical ventilation for chronic lung disease, or pO_2 on room air ‹60 mmHg or pCO2 on room air ›50 mmHg

6.3 Diabetes

There were 12% of thoracic surgery patients recorded as having diabetes. The incidence of diabetes was similar across preoperative diagnosis categories, ranging from 11% in the other category to 15% in the primary lung cancer cohort.

Table 9: Diabetes status by preoperative diagnosis category

Preoperative diagnosis	Diabetes n (%)	No diabetes n (%)
Primary lung cancer	36 (14.7)	209 (85.3)
Other cancer	25 (13.0)	167 (87.0)
Pleural disease	38 (11.4)	295 (88.6)
Other	30 (11.0)	242 (89.0)
ALL	**129 (12.4)**	**913 (87.6)**

6.4 Coronary artery disease

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Overall, 9% of thoracic surgery patients were identified as having a prior diagnosis of coronary artery disease (CAD), while 2.2% of the cohort had an unknown CAD history.

Table 10: Coronary artery disease status by preoperative diagnosis category

Preoperative diagnosis	CAD n (%)	No CAD n (%)	Unknown n (%)
Primary lung cancer	29 (12.1)	202 (84.2)	9 (3.8)
Other cancer	17 (9.0)	166 (88.3)	5 (2.7)
Pleural disease	24 (7.3)	296 (90.2)	8 (2.4)
Other	23 (8.6)	243 (91.0)	1 (0.4)
ALL	**93 (9.1)**	**907 (88.7)**	**23 (2.2)**

Excludes missing data (1.8%)

6.5 Renal function

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

Table 11: Renal function by preoperative diagnosis category

Preoperative diagnosis	Normal* n (%)	Mild† n (%)	Moderate‡ n (%)	Severe§ n (%)
Primary lung cancer	99 (41.8)	104 (43.9)	33 (13.9)	1 (0.4)
Other cancer	99 (52.9)	68 (36.4)	17 (9.1)	3 (1.6)
Pleural disease	234 (72.4)	49 (15.2)	35 (10.8)	5 (1.5)
Other	164 (64.8)	57 (22.5)	28 (11.1)	4 (1.6)
ALL	**596 (59.6)**	**278 (27.8)**	**113 (11.3)**	**13 (1.3)**

Excludes missing data (4.0%)

* eGFR ≥90 mL/min/1.73 m^2

† eGFR 60–89 mL/min/1.73 m^2

‡ eGFR 30–59 mL/min/1.73 m^2

§ eGFR <30 mL/min/1.73 m^2

6.6 Cerebrovascular disease

Approximately 4% of patients were described as having cerebrovascular disease. Of these patients, 3% were characterised by a reversible neurological deficit with a complete return of function within 72 hours. Less than 1% exhibited residual symptoms greater than 72 hours post onset.

Table 12: Cerebrovascular disease type by preoperative diagnosis category

Preoperative diagnosis	Reversible* n (%)	Irreversible† n (%)	No n (%)
Primary lung cancer	9 (3.7)	–	236 (96.3)
Other cancer	5 (2.6)	3 (1.6)	184 (95.8)
Pleural disease	8 (2.4)	3 (0.9)	322 (96.7)
Other	6 (2.2)	3 (1.1)	263 (96.7)
ALL	**28 (2.7)**	**9 (0.9)**	**1,005 (96.4)**

* Typically includes transient ischaemic attack

† Typically includes cerebrovascular accident

6.7 Peripheral vascular disease

The prevalence of peripheral vascular disease was 4% in patients undergoing thoracic surgery.

Table 13: Peripheral vascular disease status by preoperative diagnosis category

Preoperative diagnosis	Yes n (%)	No n (%)
Primary lung cancer	6 (2.5)	236 (97.5)
Other cancer	9 (5.1)	167 (94.9)
Pleural disease	14 (4.2)	317 (95.8)
Other	11 (3.8)	282 (96.2)
ALL	**40 (3.8)**	**1,002 (96.2)**

6.8 Previous interventions

6.8.1 Previous thoracic surgery

There were 12% of patients who underwent prior thoracic surgery, ranging from 6% in the primary lung cancer group to 16% in the pleural disease category.

Table 14: Previous thoracic surgery by preoperative diagnosis category

Preoperative diagnosis	Yes n (%)	No n (%)
Primary lung cancer	26 (10.7)	218 (89.3)
Other cancer	10 (5.4)	176 (94.6)
Pleural disease	53 (16.1)	277 (83.9)
Other	29 (10.9)	237 (89.1)
ALL	**118 (11.5)**	**908 (88.5)**

Excludes missing data (1.5%)

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6.8.2 Previous pulmonary resection

Overall, 6% of patients had undergone a previous pulmonary resection operation.

Table 15: Previous pulmonary resection surgery by preoperative diagnosis category

Preoperative diagnosis	Yes n (%)	No n (%)
Primary lung cancer	13 (5.3)	230 (94.7)
Other cancer	7 (3.7)	184 (96.3)
Pleural disease	27 (8.2)	304 (91.8)
Other	13 (4.9)	253 (95.1)
ALL	**60 (5.8)**	**971 (94.2)**

Excludes missing data (1.1%)

7 Care and treatment of patients

7.1 Admission status

Approximately three quarters of all cases (70%) were classed as elective, while emergency admissions accounted for only 6% of cases.

A preoperative diagnosis of pleural disease was noted in 73% of all emergency cases and 74% of all urgent cases.

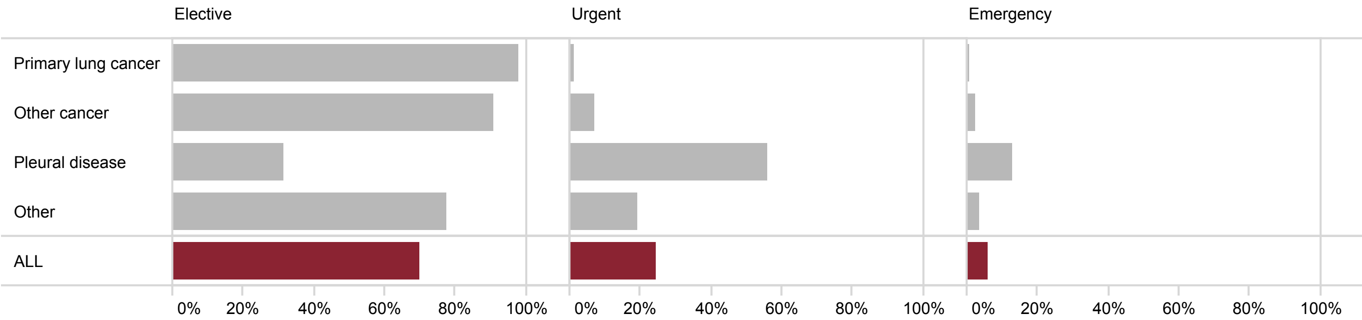


Figure 10: Admission status by preoperative diagnosis category

Table 16: Admission status by preoperative diagnosis category

	Elective n (%)	Urgent n (%)	Emergency n (%)	All n
Primary lung cancer	240 (98.0)	3 (1.2)	2 (0.8)	245
Other cancer	175 (91.1)	13 (6.8)	4 (2.1)	192
Pleural disease	104 (31.2)	186 (55.9)	43 (12.9)	333
Other	211 (77.6)	52 (19.1)	9 (3.3)	272
STATEWIDE	**730 (70.1)**	**254 (24.4)**	**58 (5.6)**	**1,042**

7.1.1 Elective day of surgery admissions

Of the 730 elective cases, 52% were recorded as day of surgery admissions (DOSA).

Table 17: Day of surgery admissions by preoperative diagnosis category

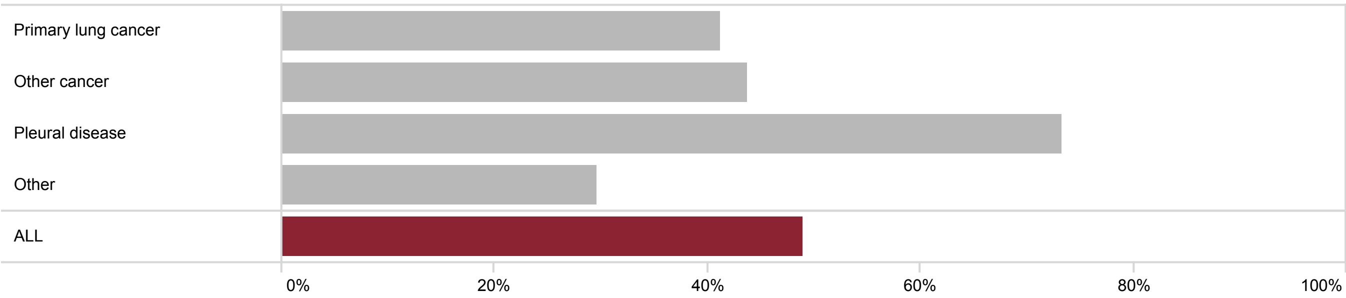
Preoperative diagnosis	DOSA n (%)
Primary lung cancer	118 (49.2)
Other cancer	106 (60.6)
Pleural disease	43 (41.3)
Other	110 (52.1)
ALL	**377 (51.6)**

Thoracic Surgery

7.2 Surgical technique

7.2.1 Video-assisted thoracic surgery

Overall, 49% of cases utilised video-assisted thoracic surgery (VATS), including 73% of cases in the pleural disease category. Of procedures undertaken through VATS, 38% utilised 3 ports for the operation.



Excludes missing data (1.2%)

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

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

Preoperative diagnosis	1 port n (%)	2 ports n (%)	3 ports n (%)	≥4 ports n (%)
Primary lung cancer	33 (33.7)	33 (33.7)	32 (32.7)	–
Other cancer	38 (46.3)	22 (26.8)	22 (26.8)	–
Pleural disease	58 (23.8)	82 (33.6)	102 (41.8)	2 (0.8)
Other	15 (18.8)	26 (32.5)	33 (41.3)	6 (7.5)
ALL	**144 (28.6)**	**163 (32.3)**	**189 (37.5)**	**8 (1.6)**

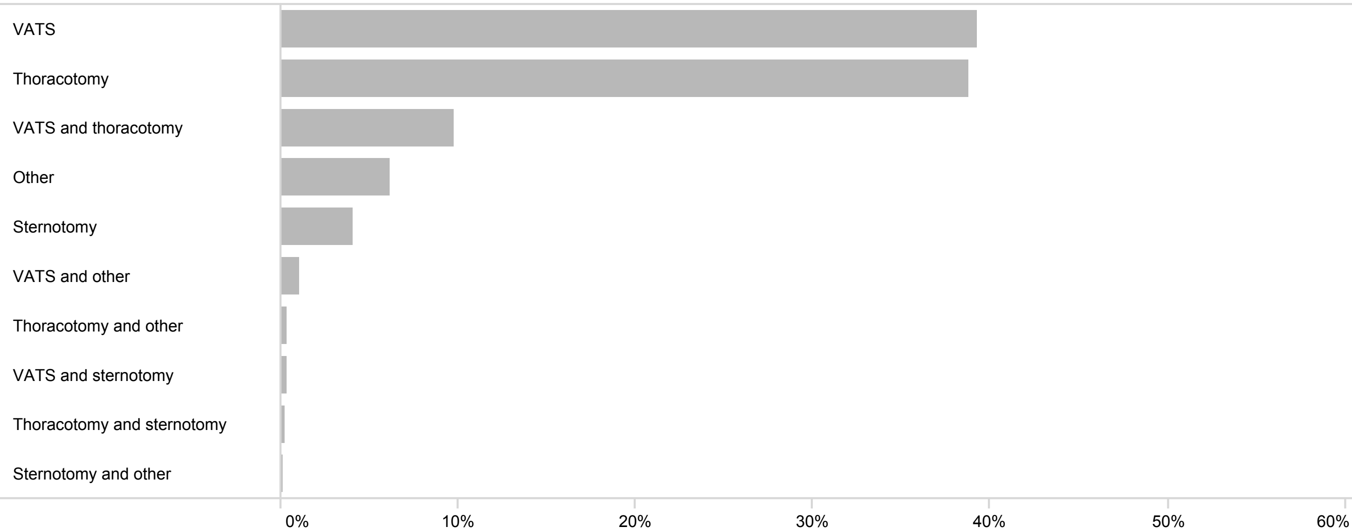
Excludes missing data (1.2%)

7.2.2 Incision type

Approximately 40% of all surgeries were solely video assisted, while 39% of the total surgeries were performed via thoracotomy.

Thoracotomy access was more likely for patients presenting with a cancer diagnosis, where the most common approaches were by thoracotomy only (54%), VATS only (28%), or VATS and thoracotomy (13%).

Use of sternotomy accounted for 5% of overall cases.



Excludes missing data (4.0%)

Figure 12: Proportion of all cases by incision type

Table 19: Incision type by preoperative diagnosis category

Incision type	Primary lung cancer n (%)	Other cancer n (%)	Pleural disease n (%)	Other n (%)	All n (%)
VATS	57 (23.7)	67 (35.8)	212 (64.0)	57 (23.7)	393 (39.3)
Thoracotomy	138 (57.3)	94 (50.3)	78 (23.6)	78 (32.4)	388 (38.8)
VATS and thoracotomy	40 (16.6)	14 (7.5)	26 (7.9)	18 (7.5)	98 (9.8)
Other	3 (1.2)	5 (2.7)	5 (1.5)	48 (19.9)	61 (6.1)
Sternotomy	2 (0.8)	3 (1.6)	2 (0.6)	34 (14.1)	41 (4.1)
VATS and other	1 (0.4)	1 (0.5)	4 (1.2)	4 (1.7)	10 (1.0)
Thoracotomy and other	–	2 (1.1)	1 (0.3)	–	3 (0.3)
VATS and sternotomy	–	–	2 (0.6)	1 (0.4)	3 (0.3)
Thoracotomy and sternotomy	–	1 (0.5)	1 (0.3)	–	2 (0.2)
Sternotomy and other	–	–	–	1 (0.4)	1 (0.1)
ALL	**241 (100.0)**	**187 (100.0)**	**331 (100.0)**	**241 (100.0)**	**1,000 (100.0)**

Excludes missing data (4.0%)

7.3 Surgery types

The most common procedure performed on patients with a preoperative diagnosis of primary lung cancer was a lobectomy (84%).

Wedge resection (37%) and lobectomy (35%) were the most common procedures in the other cancer cohort, while pleural disease was most commonly treated with pleurodesis (38%).

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

Table 20: Surgical procedures for primary lung cancer

	n (%)
Lobectomy	206 (84.1)
Lymph node sampling	158 (64.5)
Bronchoscopy	48 (19.6)
Wedge resection	28 (11.4)
Lymph node dissection	26 (10.6)
Pneumonectomy	10 (4.1)
Pleural biopsy	10 (4.1)
Pleurodesis	7 (2.9)
Bilobectomy	7 (2.9)
Segmentectomy	4 (1.6)
Pleural drainage	4 (1.6)
Stent – trachea	2 (0.8)
Decortication	2 (0.8)
Chest wall resection	2 (0.8)
Chest wall biopsy	2 (0.8)
Rib resection	1 (0.4)
Diaphragm resection/reconstruction	1 (0.4)
ORIF* ribs	1 (0.4)
Open biopsy	1 (0.4)
Chest wall reconstruction	1 (0.4)
Other	6 (2.4)
Total	**245 (100.0)**

* Open reduction internal fixation

Table 21: Surgical procedures for other cancer

	n (%)
Wedge resection	71 (37.0)
Lobectomy	67 (34.9)
Lymph node sampling	51 (26.6)
Pleural biopsy	26 (13.5)
Pleurodesis	25 (13.0)
Bronchoscopy	21 (10.9)
Pleural drainage	18 (9.4)
Lymph node dissection	11 (5.7)
Decortication	9 (4.7)
Mediastinoscopy	5 (2.6)
Chest wall resection	4 (2.1)
Mediastinal biopsy	4 (2.1)
Resection mediastinal mass	4 (2.1)
Segmentectomy	4 (2.1)
Chest wall reconstruction	3 (1.6)
Lung biopsy	3 (1.6)
Pericardial window	3 (1.6)
Open biopsy	2 (1.0)
Pneumonectomy	2 (1.0)
Diaphragm resection/reconstruction	2 (1.0)
Bilobectomy	1 (0.5)
Other	8 (4.2)
Total	**192 (100.0)**

Table 22: Surgical procedures for pleural disease

	n (%)
Pleurodesis	126 (37.8)
Decortication	112 (33.6)
Pleural drainage	93 (27.9)
Wedge resection	85 (25.5)
Pleural biopsy	62 (18.6)
Bronchoscopy	35 (10.5)
ORIF* ribs	27 (8.1)
Bullectomy	21 (6.3)
Clot evacuation	19 (5.7)
Washout	19 (5.7)
Lobectomy	4 (1.2)
Lymph node sampling	3 (0.9)
Pericardial window	3 (0.9)
Air leak control	2 (0.6)
Diaphragm plication	2 (0.6)
Rib resection	2 (0.6)
Chyle leak control	1 (0.3)
Lung biopsy	1 (0.3)
Lung volume reduction	1 (0.3)
Nuss bar	1 (0.3)
Open biopsy	1 (0.3)
Blebectomy	1 (0.3)
Pneumonectomy	1 (0.3)
Diaphragm resection/reconstruction	1 (0.3)
Segmentectomy	1 (0.3)
Other	36 (10.8)
Total	**333 (100.0)**

* Open reduction internal fixation

Table 23: Surgical procedures for all other surgeries

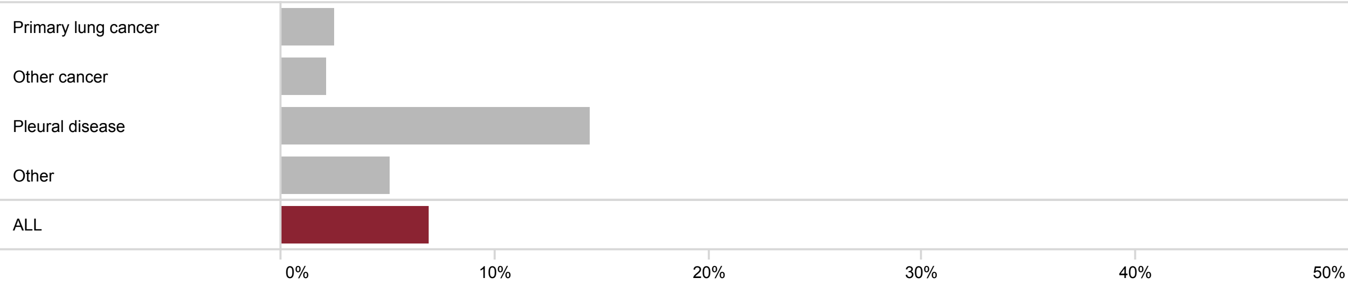
	n (%)
Lobectomy	42 (15.4)
Bronchoscopy	36 (13.2)
Wedge resection	29 (10.7)
Lymph node sampling	25 (9.2)
ORIF* ribs	21 (7.7)
Mediastinoscopy	20 (7.4)
Thymectomy	20 (7.4)
Chest wall reconstruction	15 (5.5)
Resection mediastinal mass	11 (4.0)
Rib resection	11 (4.0)
Nuss bar	10 (3.7)
Mediastinal biopsy	9 (3.3)
Chest wall resection	8 (2.9)
Sympathectomy	8 (2.9)
Open biopsy	7 (2.6)
Other – xiphoid excision	6 (2.2)
Pericardial window	6 (2.2)
Diaphragm plication	5 (1.8)
APC† laser procedure	4 (1.5)
Hernia repair	4 (1.5)
Muscle flap	4 (1.5)
Pacing procedure	4 (1.5)
Removal of foreign body	4 (1.5)
Removal of sternal wires	4 (1.5)
Bullectomy	3 (1.1)
Chest wall debridement	3 (1.1)
Lung biopsy	3 (1.1)
Bilobectomy	2 (0.7)
Bronchial repair	2 (0.7)
Chest wall biopsy	2 (0.7)
Decortication	2 (0.7)
Lung volume reduction	2 (0.7)
Lymph node dissection	2 (0.7)
Mediastinotomy	2 (0.7)
Pectus repair	2 (0.7)
Tracheal repair	2 (0.7)
Tracheal resection	2 (0.7)
Other	44 (16.2)
Total	**270 (100.0)**

* Open reduction internal fixation

† Argon plasma coagulation

7.4 Blood product usage

Approximately 7% of all thoracic surgical cases required blood product usage. Just under 2% of patients were transfused with both red blood cell (RBC) and non-red blood cell products (NRBC). Nearly 15% of patients diagnosed with pleural disease required some blood product transfusion.



Excludes missing data (0.1%)

Figure 13: Proportion of cases requiring blood product transfusion

Table 24: Blood product types used by preoperative diagnosis category

Preoperative diagnosis	RBC and NRBC n (%)	RBC only n (%)	NRBC only n (%)	No blood products used n (%)
Primary lung cancer	2 (0.8)	3 (1.2)	1 (0.4)	238 (97.5)
Other cancer	–	4 (2.1)	–	188 (97.9)
Pleural disease	14 (4.2)	33 (9.9)	1 (0.3)	285 (85.6)
Other	4 (1.5)	8 (2.9)	2 (0.7)	258 (94.9)
ALL	**20 (1.9)**	**48 (4.6)**	**4 (0.4)**	**969 (93.1)**

Excludes missing data (0.1%)

8 Clinical outcomes

8.1 Length of stay

The median length of stay for thoracic surgery patients was seven days, ranging from five days to twelve days across preoperative diagnosis categories.

Table 25: Length of stay by preoperative diagnosis category

Preoperative diagnosis	Median days	Interquartile range days
Primary lung cancer	6	4–8
Other cancer	5	3–9
Pleural disease	11	7–18
Other	5	3–10
ALL	**7**	**4–12**

8.2 Major morbidity

There were 155 cases (15%) having one or more new major morbidities recorded post procedure. The incidence rate of major morbidity ranged from 22% in the primary lung cancer group to 7% in the other cancer category.

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

Table 26: New major morbidity by diagnosis category

Preoperative diagnosis	Yes n (%)	No n (%)
Primary lung cancer	54 (22.0)	191 (78.0)
Other cancer	13 (6.8)	179 (93.2)
Pleural disease	60 (18.0)	273 (82.0)
Other	28 (10.3)	244 (89.7)
ALL	**155 (14.9)**	**887 (85.1)**

Excludes missing data (2.4%)

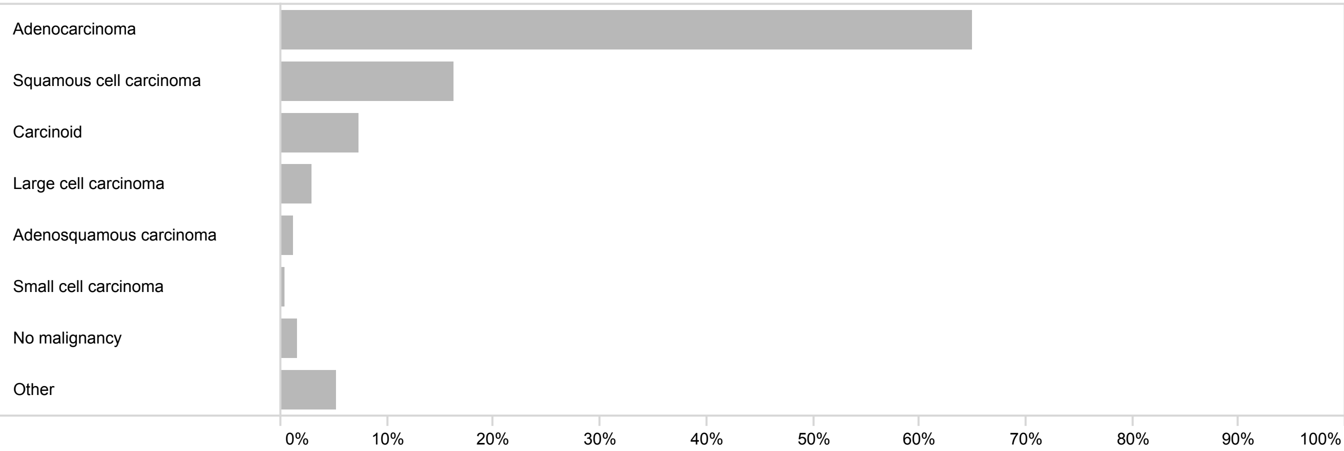
Table 27: Type of major morbidity

Major morbidity type	n (%)
Air leak (3–7 days)	41 (18.2)
Reoperation	39 (17.3)
Atrial fibrillation	32 (14.2)
Air leak (>7 days)	21 (9.3)
Wound infection	19 (8.4)
Pneumonia	15 (6.7)
Bronchopleural fistula	5 (2.2)
Pulmonary embolism	2 (0.9)
Cerebrovascular accident – reversible	1 (0.4)
Other major morbidity	50 (22.2)
ALL	**225 (100.0)**

8.3 Primary lung cancer outcomes

8.3.1 Final histopathology

In patients with a preoperative suspicion of primary lung malignancy, adenocarcinoma (65%) was the most common lung cancer according to final histopathology, followed by squamous cell carcinoma (16%).



Excludes missing data (3.2%)

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

Table 28: Final histopathology results for primary lung malignancy

Histopathology	n (%)
Adenocarcinoma	159 (64.9)
Squamous cell carcinoma	40 (16.3)
Carcinoid	18 (7.3)
Large cell carcinoma	7 (2.9)
Adenosquamous carcinoma	3 (1.2)
Small cell carcinoma	1 (0.4)
No malignancy	4 (1.6)
Other	13 (5.3)
ALL	**245 (100.0)**

Thoracic Surgery

8.3.2 Stage classification

The tumour-node-metastasis (TNM)[22] staging classification system has been used to categorise lung cancer cases into stages of severity. Primary lung malignancy patients are clinically staged in the preoperative period as well as pathologically staged postoperatively. Assessing cancer staging plays an important role in guiding treatment options for patients. It is important to note that these cases below are the cohort of primary lung cancer patients who proceeded to surgical intervention.

The most common postoperative pathological TNM classification for primary lung malignancy was a grade Ib tumour (23%), followed by Ia2 (22%). A stage IV cancer (1.6%) is the least likely malignancy to proceed to surgery when compared with other cancer stages.

Table 29: Primary lung malignancy by preoperative clinical classification

Clinical staging classification	n (%)
Ia1	9 (3.7)
Ia2	55 (22.4)
Ia3	35 (14.3)
Ib	34 (13.9)
IIa	12 (4.9)
IIb	36 (14.7)
IIIa	16 (6.5)
IIIb	2 (0.8)
IVa	3 (1.2)
IVb	1 (0.4)
Missing data	42 (17.1)
Total	**245 (100.0)**

Table 30: Primary lung malignancy by postoperative pathological classification

Pathological classification	n (%)
Ia1	5 (2.0)
Ia2	52 (21.2)
Ia3	26 (10.6)
Ib	55 (22.4)
IIa	12 (4.9)
IIb	36 (14.7)
IIIa	28 (11.4)
IIIb	6 (2.4)
IVa	11 (4.5)
IVb	1 (0.4)
No malignancy	4 (1.6)
Missing data	9 (3.7)
Total	**245 (100.0)**

8.4 Unadjusted all-cause mortality

Survival following thoracic surgery is influenced by many factors which are not always directly related to the operation itself. Outcomes of thoracic surgery for cancer can be affected by how advanced the malignancy is. Within this cohort, approximately 5% of lung cancers are postoperatively classified as stage IV, which is associated with an inherently high short-term mortality rate. The unadjusted all-cause mortality rate within 30 days of all thoracic surgery was 0.7%, increasing to 1.5% at 90 days. Mortality rates at 90 days for malignancy related surgeries are higher than the overall group, though caution should be used when interpreting these results due to a small patient numbers.

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

Category	Total cases n	Death in 30 days n (%)	Death in 90 days n (%)
Primary lung cancer	245	0 (0.0)	4 (1.6)
Other cancer	192	1 (0.5)	5 (2.6)
Pleural disease	333	5 (1.5)	6 (1.8)
Other	272	1 (0.4)	1 (0.4)
ALL	**1,042**	**7 (0.7)**	**16 (1.5)**

9 Conclusions

This is the second report to provide a detailed examination of procedures performed and the characteristics of patients treated by the five Queensland public thoracic surgical units. Within thoracic surgery, the committee has continued to encourage data quality and completeness which is reflected in a considerable reduction in missing data as well as an increase in the overall number of reported cases. This is now a more comprehensive overview of the often-varied role of thoracic surgeons working within Queensland public facilities.

Thoracic surgery is being performed at very safe levels with regards to patient survival in the immediate postoperative period. There is a wide spectrum of conditions and treatments with a marked variation in resource consumption as measured by the length of stay and morbidity dependent on condition. Further development of what is to be targeted with regards to performance is the future work of the committee.

Through the expanded analysis within this Report, we are now able to include quality data for pre-operative clinical staging of primary lung cancer. This will be an area for future expansion of reporting as investigation of clinical vs. pathological staging advances. All surgical units should be commended on their efforts in ensuring this increased level of data quality and are encouraged to sustain these efforts.

The future for the reporting of patient outcomes for patients undergoing thoracic surgery is encouraging and Queensland clinicians look forward to initiatives that seek to establish a comprehensive quality and safety program for all thoracic surgeries in Australia.

Discussions are also underway to expand the scope of the QCOR Thoracic Surgery module and tailor the data collection towards the specific requirements of paediatric patients. Though the differences for these patients compared to the adult population are well known, the advantage of QCOR as distinct from other registries is that it provides the ability to cater towards emerging requirements such as these.

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Glossary

6MWT	Six Minute Walk Test
ACC	American College of Cardiology
ACEI	Angiotensin Converting Enzyme Inhibitor
ACP	Advanced Care Paramedic
ACS	Acute Coronary Syndromes
AEP	Accredited Exercise Physiologist
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
APC	Argon Plasma Coagulation
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
CI	Clinical Indicator
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
FTR	Failure to Rescue
GAD	Generalized Anxiety Disorder
GCCH	Gold Coast Community Health
GCUH	Gold Coast University Hospital
GLH	Gladstone Hospital
GP	General Practitioner
GYH	Gympie Hospital
HBH	Hervey Bay Hospital (includes Maryborough)
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HFSS	Heart Failure Support Service
HHS	Hospital and Health Service
HOCM	Hypertrophic Obstructive Cardiomyopathy
HSQ	Health Support Queensland
IC	Interventional Cardiology
ICD	Implantable Cardioverter Defibrillator
IE	Infective Endocarditis
IHT	Inter-hospital Transfer
IPCH	Ipswich Community Health
LAA	Left Atrial Appendage
LAD	Left Anterior Descending Artery
LCX	Circumflex Artery
LGH	Logan Hospital
LOS	Length of Stay
LV	Left Ventricle
LVEF	Left Ventricular Ejection Fraction
LVOT	Left Ventricular Outflow Tract
MBH	Mackay Base Hospital
MI	Myocardial Infarction
MIH	Mt Isa Hospital
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
NOAC	Non Vitamin K Antagonist Oral Anticoagulants
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
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
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