Queensland Health

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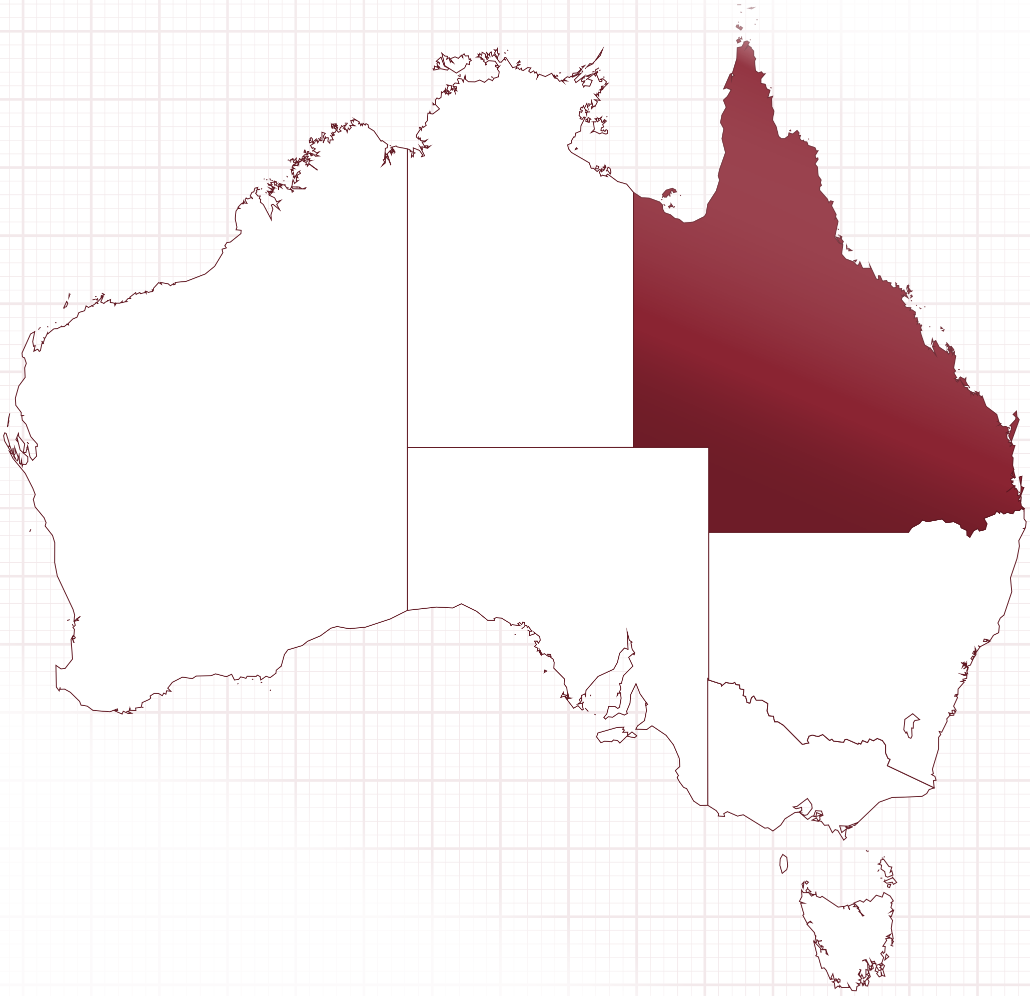
Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry
2018 Annual Report
Cardiothoracic Surgery Audit



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Queensland Cardiac Outcomes Registry
2018 Annual Report

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1 Foreword

As Director General of Queensland Health, I am pleased to present the ***Queensland Cardiac Outcomes Registry (QCOR) 2018 Annual Report***. The Annual Report provides detailed information on the performance of our clinical care for, and outcomes of, people with cardiac disorders.

The Annual Report examines a range of clinical areas including cardiac and thoracic surgery, cardiac rehabilitation, cardiac catheter interventions, electrophysiology and pacing, and heart failure support services. This year's Annual Report includes additional analysis of specific areas of interest to enable examination of clinical issues faced by practitioners at the face of patient care.

The Annual Report exemplifies how Queensland Health is meeting its objective to *enable safe, high quality services*. The results show that Queenslanders are receiving some of the best cardiac care in the country, and often the world. Queensland Health is committed to empowering our people to provide the best possible healthcare, to be transparent in our work and importantly use information to inform and improve the health outcomes of our patients.

The high level of clinical engagement extends beyond clinical practice to working collaboratively with Queensland Health administrators to improve the efficiency of our organisation. Recently, cardiac clinicians and administrators collaborated and used QCOR data to improve the purchasing process of clinical products resulting in savings of $5 million. These funds will now be available in the relevant Hospital and Health Services to reinvest into patient care.

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

I would like to acknowledge the ongoing effort of the Statewide Cardiac Clinical Network and its many clinicians and colleagues, who have collaborated to produce this Annual Report.

Dr John Wakefield PSM
Director-General
Queensland Health

2 Message from the SCCN Chair

It is my pleasure to introduce the 4th Queensland Cardiac Outcome Registry (QCOR) Annual Report. The activities of QCOR continue to mature, and this report gives us yet another opportunity to re-examine the reasons for continuing this work, as well as forming a stimulus to reinvigorate our efforts. The chance to ask, "Why are we doing this?" – a lot of effort, repeated committee meetings, some late nights, and occasional irritation with colleagues, as a counterpoise to the ingrained clinician desire to do the absolute best for every patient we care for and to have data to prove it. The ledger is strongly tilted in the affirmative.

Queensland is now acknowledged as having some of the most comprehensive cardiac data in the country, and the success of this program absolutely rests on the sustained clinician participation on which the programme is built. Every step from patient care, through recording of data, to submission, reverification and analysis is heavily invested by the clinicians. This intensive participation towards a common goal has certainly drawn the cardiac community together and we can be rightly proud of the cohesiveness of the efforts to improve care across the state.

The report this year further extends important elements of patient care – we have a strong collaboration with Queensland Ambulance Service (QAS), and now have access to quite comprehensive prehospital care including QAS administered thrombolysis and outcomes. In a state as large as Queensland it is critical that we track these important aspects of care. The documentation of post hospital cardiac rehabilitation and heart failure management continues to provide a more comprehensive picture extending the window of acute admission and without doubt adding to the safety of our acute interventions.

It is gratifying to see that procedural outcomes across all of the participating institutions remain stable and of high quality.

Finally, one of the important reasons which clinicians originally identified supporting participation in the program has come to fruition – the cardiac data derived from QCOR has now led to specific investment by the state government in the processes of cardiac care. In the coming year, in an initial investment roll out, hospitals in Cairns and Townsville will significantly expand their outreach into rural and remote centres in Torres and Cape and across to the North West Hospital and Health Service. QCOR data has clearly profiled both the need and the shortfall of cardiac services in these areas and has led to a recognition of our responsibilities for delivering safe and efficacious treatment both for patients who live close to major centres, but also especially for those far removed. This programme will extend to the remaining Hospital and Health Services in a multi-year investment.

Again, I give thanks to all of the clinicians who continue to participate in this important work. In the coming year, QCOR will have the capacity to invite private cardiac providers in the state to submit data to QCOR, so that we can obtain a more complete picture both public and private, of cardiac services across the state.

A special thanks is given to the Statewide Cardiac Clinical Informatics Unit technical and administrative staff who continue to supply superb assistance to the program and who are truly integral to the quality of the attached report.

Dr Paul Garrahy
Chair
Statewide Cardiac Clinical Network

3 Introduction

The Queensland Cardiac Outcomes Registry (QCOR) is an ever-evolving clinical information collection which enables clinicians and other key stakeholders access to quality, contextualised clinical and procedural data. On the background of significant investment and direction from the Statewide Cardiac Clinical Network (SCCN) and under the auspices of Clinical Excellence Queensland, QCOR provides analytics and overview for several clinical information systems and databases. By utilising extensive ancillary complementary administrative datasets, a sophisticated level of multi-purpose reporting and insight has been gained.

QCOR data collections are governed by bespoke clinical committees which provide oversight and direction to reporting content and analysis as well as informing decision-making for future endeavours. These committees are supported by Statewide Cardiac Clinical Informatics Unit (SCCIU) who form the business unit of QCOR. All processes and groups report to the SCCN, which is facilitated by Clinical Excellence Queensland.

The strength of the Registry would not be possible without significant clinician input. Assisting to maintain quality, relevance and context through QCOR committees, clinicians are continually developing and evolving the analysis and focus of each specific group. The SCCIU performs the role of coordinating these individual QCOR committees which each have their individual direction and unique requirements.

The SCCIU provide the reporting, analysis, and development of the many clinical cardiology and cardiothoracic surgical applications and systems in use across Queensland Health. The SCCIU also provides data quality and audit functions as well as expert technical and informatics resources for development, maintenance and continual improvement of specialised clinical applications and relevant secondary uses.

The SCCIU team consists of:

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

This 2018 QCOR report now includes a total of 6 clinical audits. The addition of the thoracic surgery audit report complements the existing cardiac surgery report to enable a clearer picture of the work undertaken by cardiac and thoracic surgeons in Queensland. This work reflects efforts in this space and the highlights the vast patient cohort that are encountered by clinicians working in this specialty. It is with this continual development and evolution of clinical reporting maturity that QCOR hopes to further support cardiothoracic clinical informatics into the future.

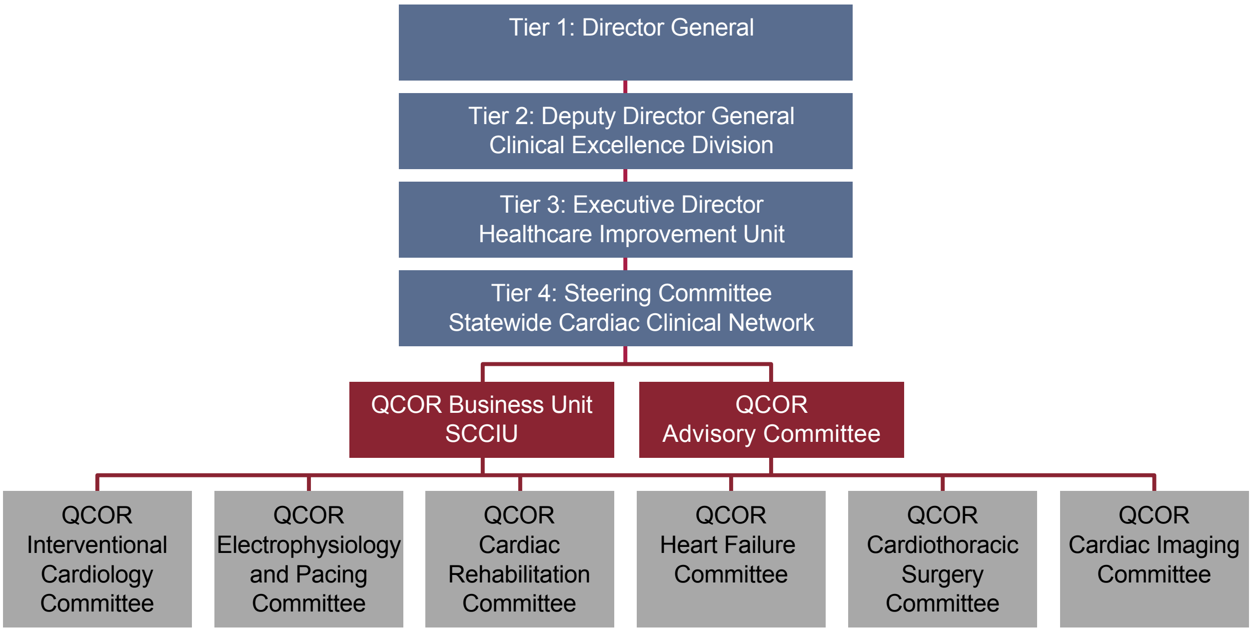

Figure A: Operational structure

Queensland Cardiac Outcomes Registry

The health of Queenslanders

>5 million
population*

1 in 5
admitted to hospital†

766,000
aged 65 years or older†

16%
Coronary heart disease is the leading cause of death

15%
of total disease burden is caused by cardiovascular disease†

11%
Hospital spending on cardiovascular disease

31%
have untreated high total cholesterol

11%
smoke daily†

23%
have untreated high blood pressure

2 in 3
are overweight or obese†

63%
are sufficiently active†

28%
of all deaths due to cardiovascular disease

4.6%
Aboriginal and Torres Strait Islander population‡

4.8%
have diabetes§

What's new?

- Thoracic Surgery Audit
- Electrophysiology and pacing clinical indicators
- Thrombolysis for STEMI analysis
- Interhospital transfer for coronary intervention review
- Cardiac rehabilitation patient outcome measures
- Body mass index in cardiac surgery investigation

Figure B: QCOR 2018 infographic

2018 Activity at a Glance

Case and patient volumes

4,867
percutaneous coronary interventions

401
structural heart disease interventions

148
transcatheter aortic valve replacement procedures

2,384
adult cardiac surgeries

850
adult thoracic surgeries

4,474
electrophysiology and pacing procedures

3,136
cardiac implantable electronic device procedures

4,878
new heart failure support services referrals

11,723
cardiac rehabilitation referrals

Clinical indicator progress

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

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

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

95%
of cardiac rehabilitation referrals within 3 days of discharge

0.3%
procedural tamponade rate for cardiac device and electrophysiology procedures

Continuing our work

- Data linkage opportunities
- National registry alignment
- Clinical indicator review
- Structural heart disease application
- Cardiac outreach application
- ECG Flash project

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* Australian Bureau of Statistics. Regional population growth, Australia, 2017-2018. Cat. no. 3218.0. ABS:Canberra; 2019

† Queensland Health (2018).The health of Queenslanders 2018. Report of the Chief Health Officer Queensland. Brisbane. Queensland Government

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

§ Diabetes Australia. State statistical snapshot: Queensland. As at 30 June 2018; 2018

4 Executive summary

This report encompasses procedures and cases for 8 cardiac catheterisation laboratories (CCL) and electrophysiology and pacing (EP) facilities and 5 cardiothoracic surgery units operating across Queensland public hospitals. It also includes referrals to clinical support and rehabilitation services for the management of heart disease including 22 heart failure support services and 55 cardiac rehabilitation outpatient facilities.

- 15,436 diagnostic or interventional cases were performed across the 8 public cardiac catheterisation laboratory facilities in Queensland hospitals. Of these, 4,867 involved percutaneous coronary intervention (PCI).
- Patient outcomes following PCI remain encouraging. The 30 day mortality rate following PCI was 1.9%, and of the 94 deaths observed, 74% were classed as either salvage or emergency PCI.
- In analysis for patients with STEMI, the median time from FdECG to reperfusion and arrival at PCI facility to reperfusion was observed at 85 minutes and 42 minutes. This compares favourably to results for previous years and internationally.
- Across the four sites with a cardiac surgery unit, a total of 2,384 cases were performed including 1,414 CABG and 1,005 valve procedures.
- As in previous years, observed rates for cardiac surgery mortality and morbidity are either within the expected range or better than expected, depending on the risk model used to evaluate these outcomes. Once again the exception was the rate of deep sternal wound infection.
- The Cardiac Surgery Audit includes a focused supplement on obesity in cardiac surgery. This report highlights the increased rate of post-operative morbidity and mortality for patients with a higher BMI (>30 kg/m^2).
- The five public hospitals providing thoracic surgery services in 2018 performed a total of 850 cases. Almost one-third (30%) of surgeries followed a preoperative diagnosis of primary lung cancer or pleural disease (33%). This is the first QCOR Annual Report to examine thoracic surgery, and this will be expanded in future years.
- At the 8 public EP sites, a total of 4,474 cases were performed, which included 3,136 cardiac device procedures and 1,061 electrophysiology procedures. This audit includes expanded reporting around clinical indicators for EP cases.
- This Electrophysiology and Pacing Audit identified a median wait time of 81 days for complex ablation procedures, and 33 days for elective ICD implants.
- There were a total of 11,723 referrals to one of the 55 public cardiac rehabilitation services in 2018. Most referrals (77%) followed an admission at a public hospital in Queensland.
- The vast majority of referrals to CR were created within three days of the patient being discharged from hospital (95%), while over half of patients went on to complete an initial assessment by CR within 28 days of discharge (59%).
- There were 4,878 new referrals to a heart failure support service in 2018. Clinical indicator benchmarks were achieved for timely follow-up of referrals, and prescription of angiotensin-converting-enzyme inhibitor (ACEI) or angiotensin II receptor blockers (ARB) and appropriate beta blockers as per clinical guidelines.

5 Acknowledgements and authors

This collaborative report was produced by the SCCIU, audit lead for QCOR for and on behalf of the Statewide Cardiac Clinical Network.

The work of QCOR would not be possible without the continued support and funding from Clinical Excellence Queensland. This publication draws on the expertise of many teams and individuals. In particular, the assistance of the Statistical Services Branch, Healthcare Improvement Unit and Queensland Ambulance Service each make significant contributions to ensure the success of the program. Metro North Hospital and Health Service are also recognised through their stake in supporting and hosting the SCCIU operational team.

Furthermore, the tireless work of clinicians who contribute and collate quality data, as part of providing quality patient care, ensures credible analysis and monitoring of the standard of cardiac services in Queensland. The following provided writing assistance with this year's report:

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Queensland Ambulance Service

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Statewide Cardiac Clinical Informatics Unit

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Dr Ian Smith, PhD
Mr William Vollbon

6 Future plans

Continual progress with expanded analyses and uses of clinical data has been a focus for QCOR in 2018. This is evident through new report elements encompassing thoracic surgery and extended examination of patients undergoing thrombolysis for myocardial infarction. Similarly, obesity and cardiac surgery have been examined and have unveiled key findings that are highly relevant given the increasing incidence of obesity within the general population. Intending to provide clinically relevant analysis, the future work of QCOR is exciting.

The utilisation of linkage data provided by administrative datasets continues to enable and assist QCOR data collections. These data enable information from different sources to be brought together to create a new, richer dataset. Examples of future opportunities for the use of supplementary datasets are medication detail from discharge summaries and pathology investigations undertaken within public Queensland facilities. With access to these expanded data collections, there are opportunities to be seized across many fronts including enhanced risk adjustment options, expanded clinical indicator programs and streamlined participation in national registry activities. Furthermore, this will enable efficiencies in data collections where elements are either not available or practical for collection at the point-of-care, and thereby reduce duplication of entry across clinical systems.

Opportunities exist to better integrate QCOR clinical applications with enterprise systems such as the acclaimed Queensland Health application, The Viewer. It is envisaged that cardiac rehabilitation referrals and assessment forms will be incorporated within the patient record, along with procedure reports generated by the upcoming QCOR structural heart disease application. These developments are set to complement the existing report sharing functionality present within the QCOR electrophysiology system. Further opportunities have been flagged across the heart failure support services and cardiothoracic surgery space to enhance these applications to meet the bespoke requirements of the clinical specialty areas. By embracing opportunities to share valuable clinical data kept in various QCOR systems, investment in QCOR applications will be further realised and valued.

Continual development, revision, and optimisation of clinical indicator programs is essential to the ongoing relevance of the Registry. QCOR will continue to collaborate with experts in all clinical domains to expand the scope of our existing analyses. This will be undertaken with a view to maintain and enhance the quality of reporting and improve the timeliness and relevance of the information provided for clinical leads. Such areas where reporting will be enhanced for next year's Annual Report include:

- Time to angiography for patients receiving thrombolysis
- Expanded radiation safety analyses for diagnostic and interventional cardiology
- Review of risk adjustment models for interventional cardiology
- EuroSCORE II risk adjustment for cardiac surgery patients
- MRA prescription rates for HFrEF patients
- CR referrals rates following cardiac intervention

QCOR is actively investigating opportunities within several areas including the implementation of new patient-reported outcomes and quality-of-life measures and realising further efficiencies concerning statewide procurement of medical devices. New areas of research and research partners and opportunities to contribute to works underway across Queensland Health, and at a national level, are continually being pursued and engaged.

7 Facility profiles

7.1 Cairns Hospital

- 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

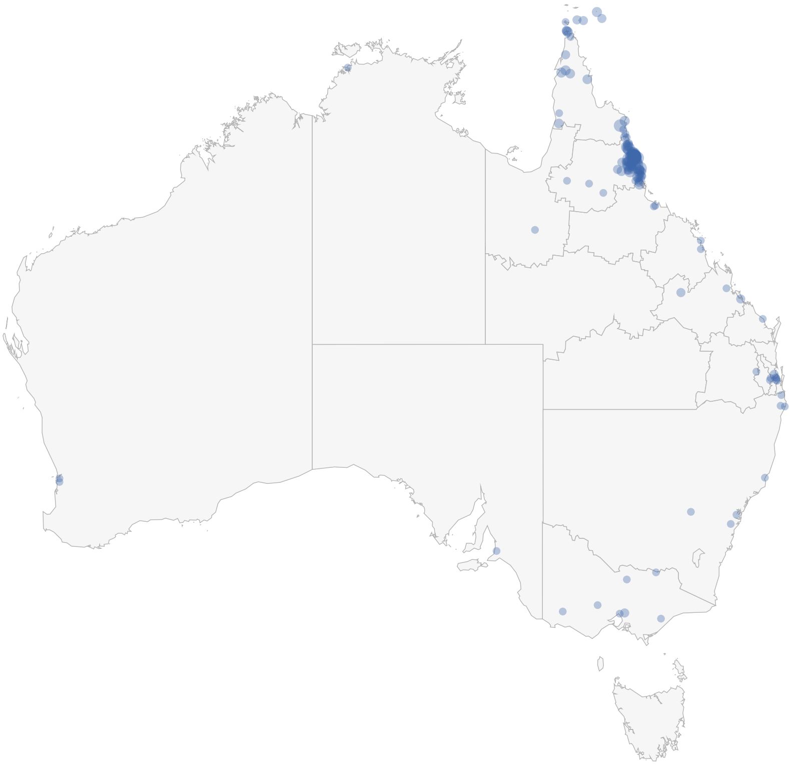


Figure 1: Cairns Hospital

7.2 The Townsville Hospital

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

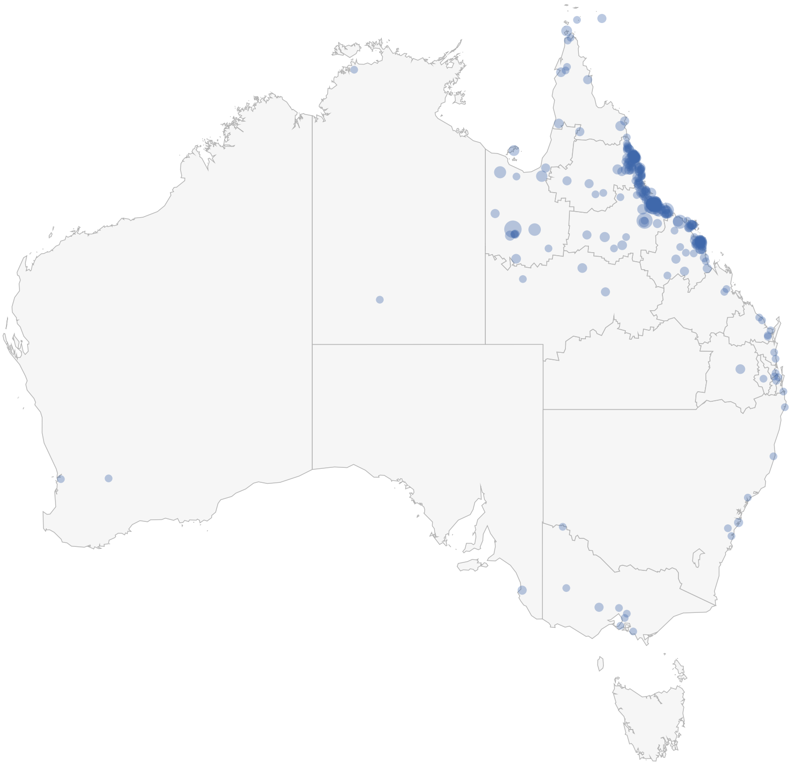


Figure 2: The Townsville Hospital

7.3 Mackay Base Hospital

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

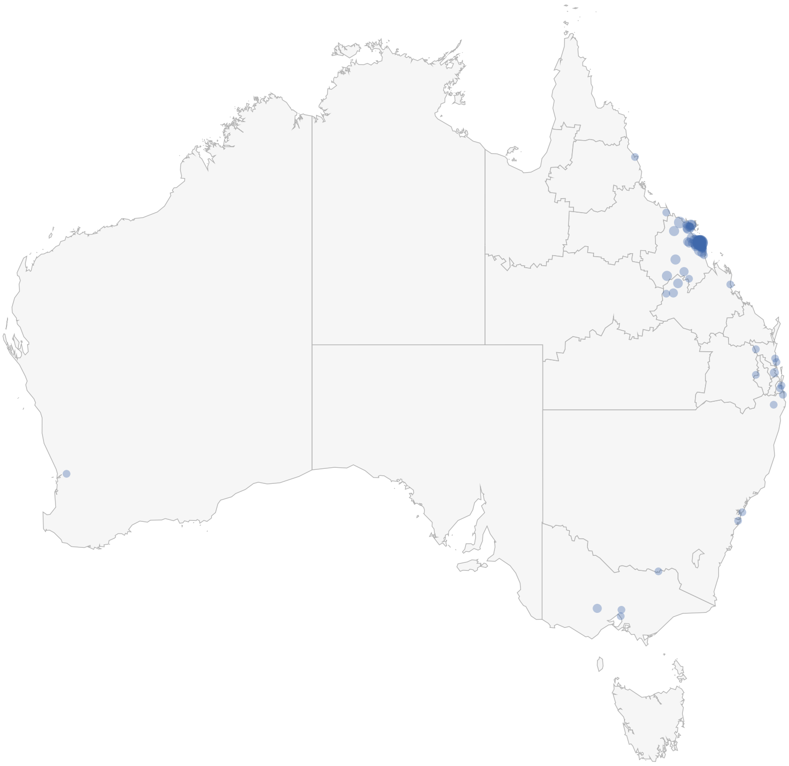


Figure 3: Mackay Base Hospital

7.4 Sunshine Coast University Hospital

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

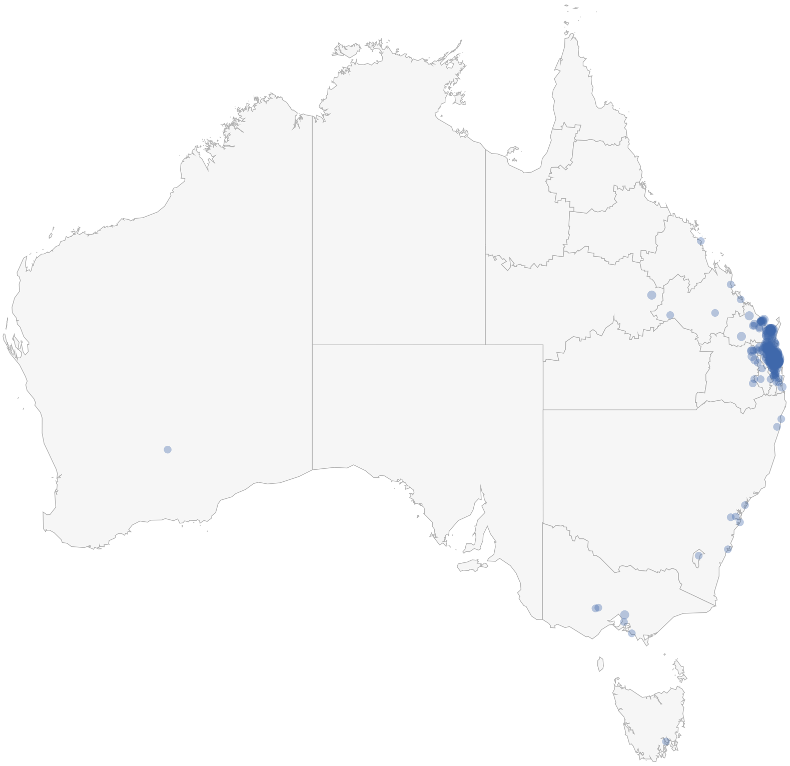


Figure 4: Sunshine Coast University Hospital

7.5 The Prince Charles Hospital

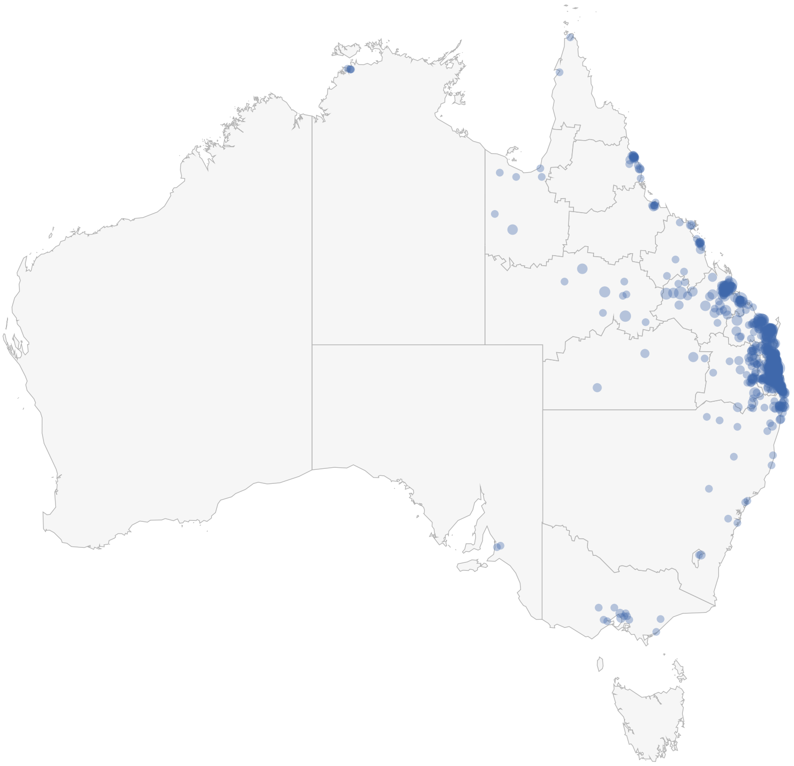


Figure 5: The Prince Charles Hospital

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

7.6 Royal Brisbane and Women's Hospital

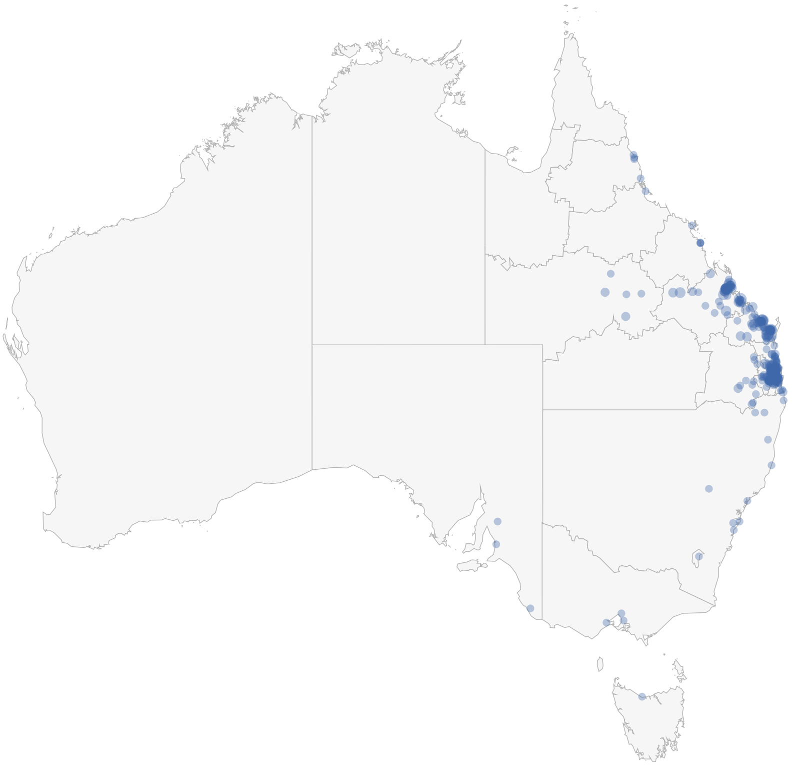


Figure 6: Royal Brisbane and Women's Hospital

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

7.7 Princess Alexandra Hospital

- 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

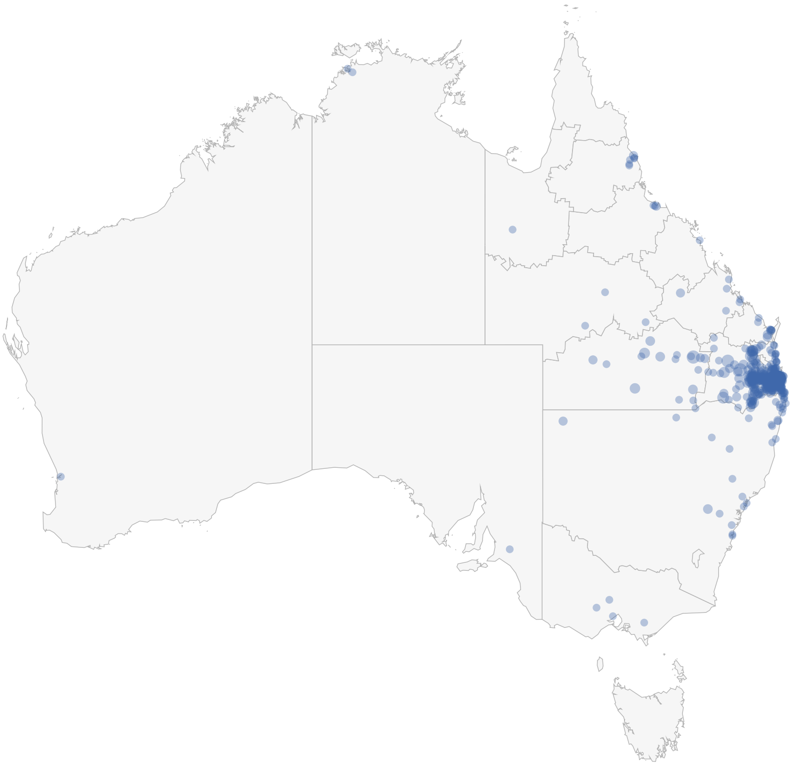


Figure 7: Princess Alexandra Hospital

7.8 Gold Coast University Hospital

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

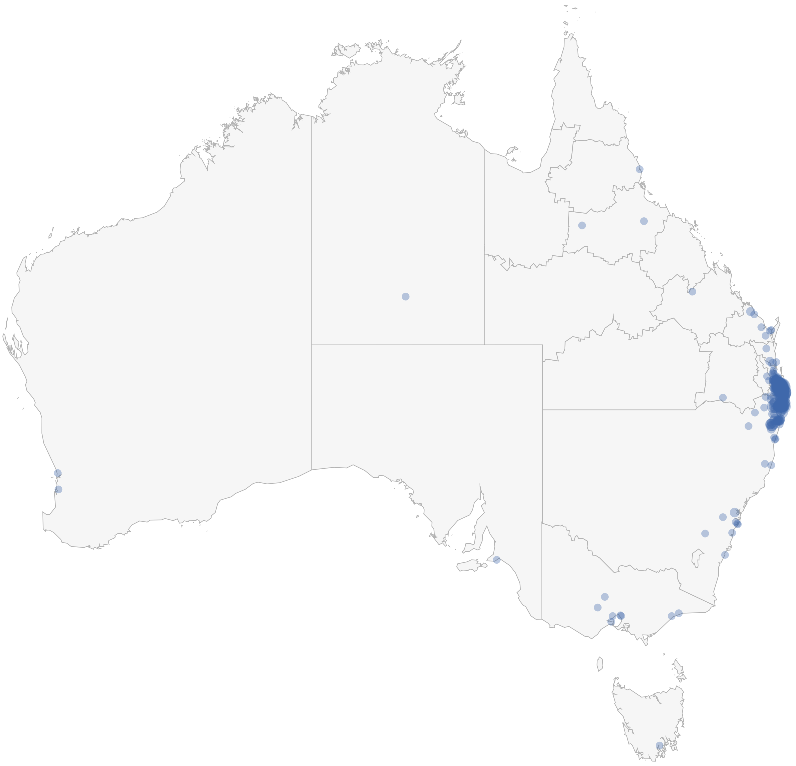


Figure 8: Gold Coast University Hospital

Cardiothoracic Surgery Audit

1 Message from the QCOR Cardiothoracic Committee Chair

Presented here is the 2018 QCOR Audit covering Cardiac Surgery.

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

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

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

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

2 Key findings

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

Key findings include:

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

3 Participating sites

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

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

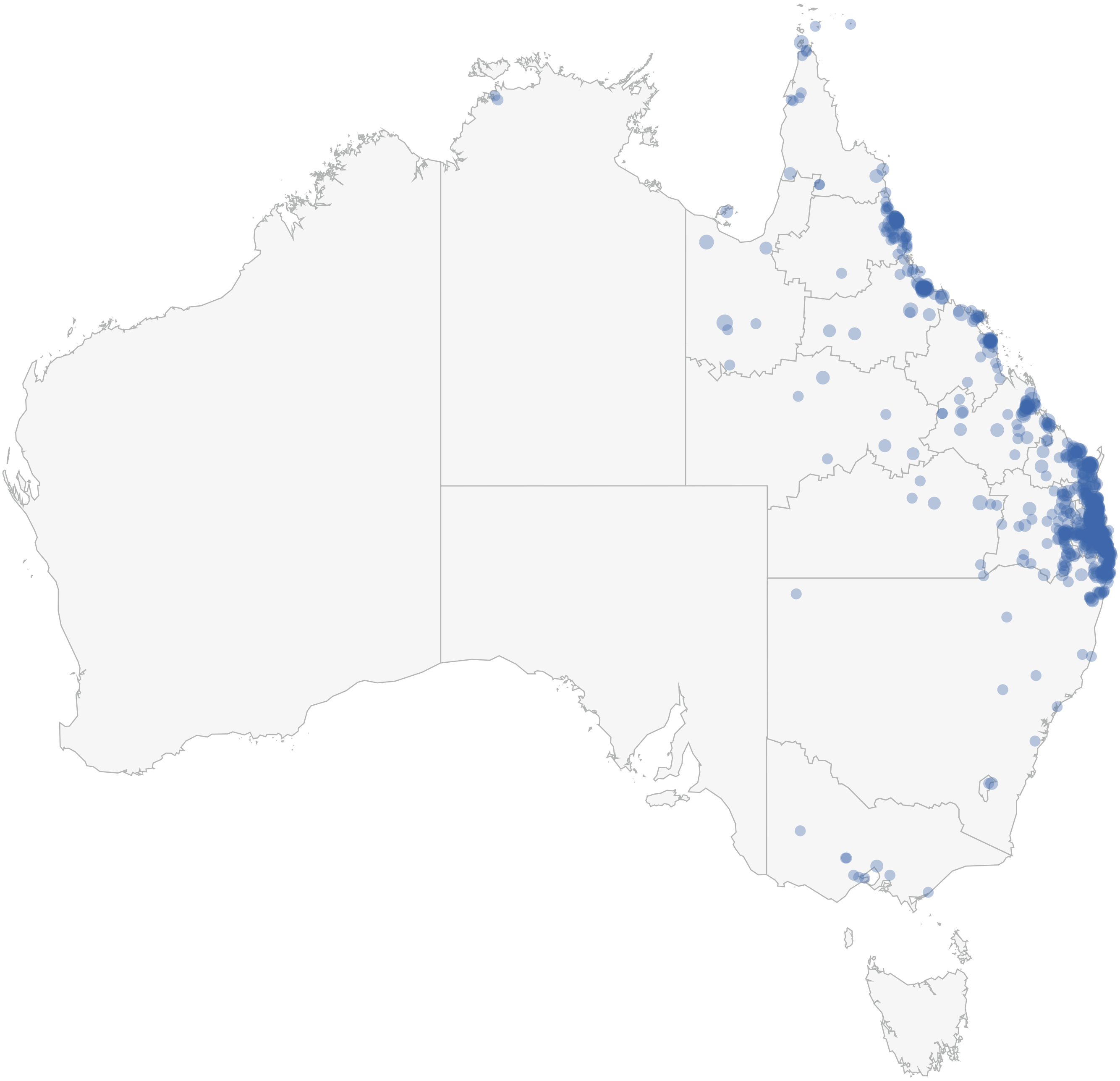


Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

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

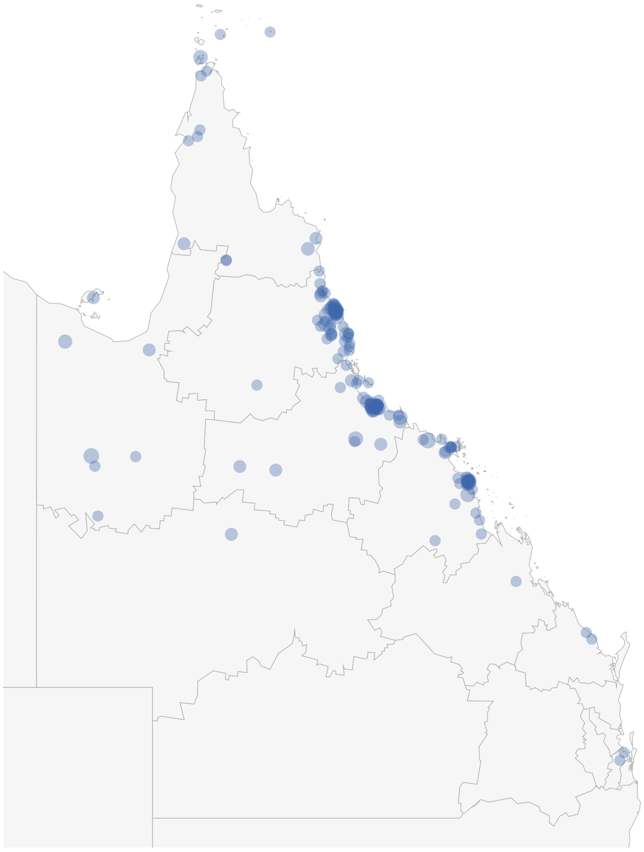


Figure 2: The Townsville Hospital

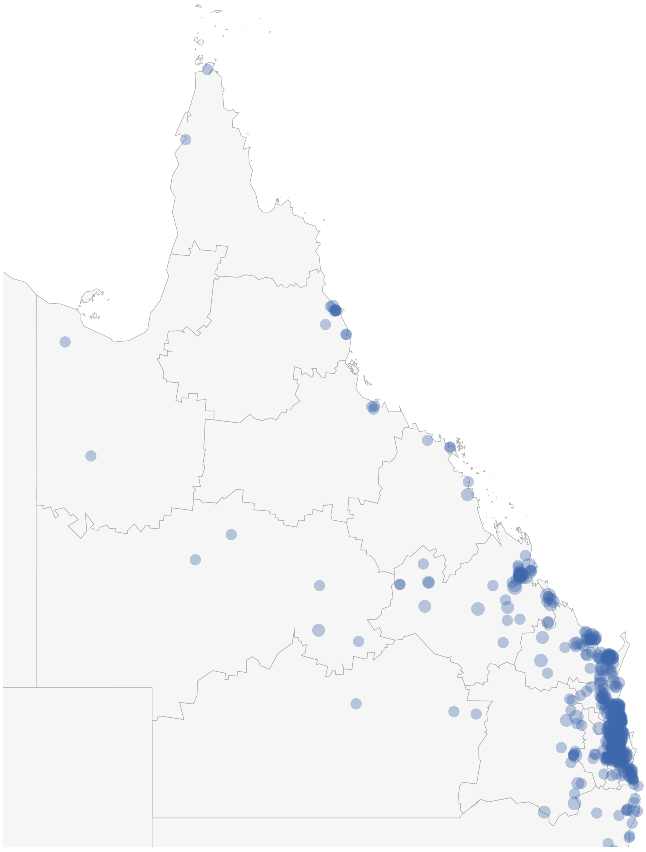


Figure 3: The Prince Charles Hospital

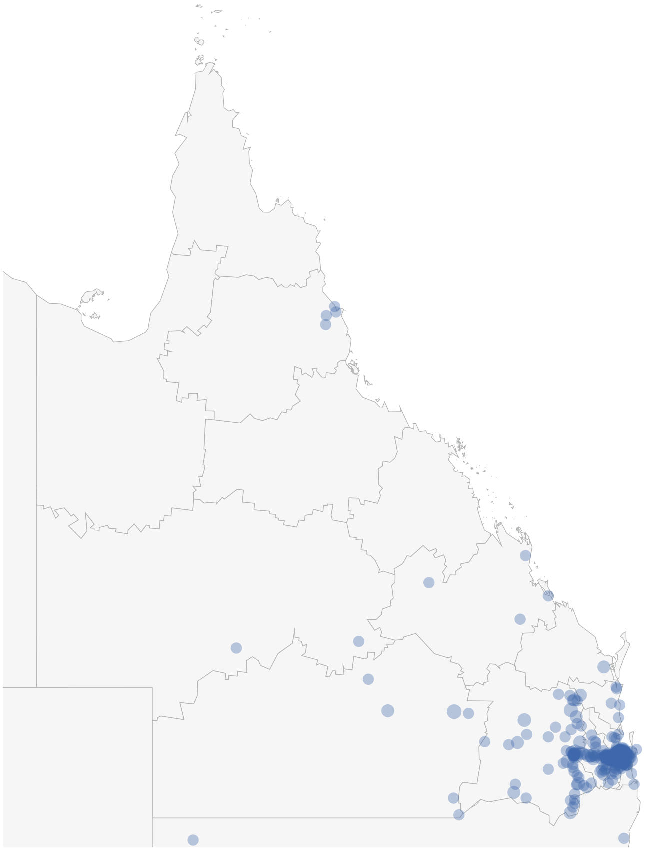


Figure 4: Princess Alexandra Hospital

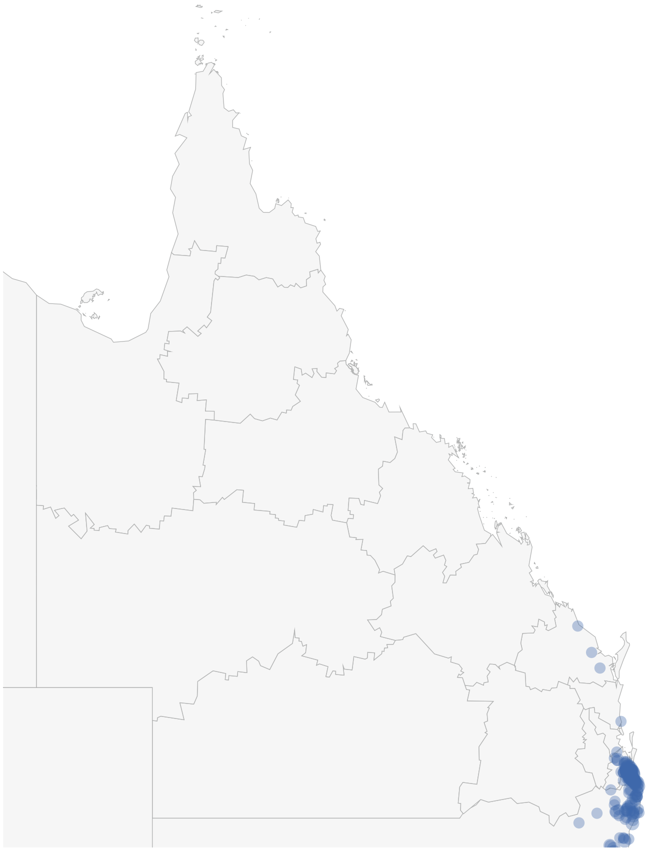


Figure 5: Gold Coast University Hospital

4 Case totals

4.1 Total surgeries

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

Table 2: Procedure counts and surgery category

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

* Category procedure combination allocated

† Includes TAVR procedures (n=76)

4.2 Cases by category

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

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

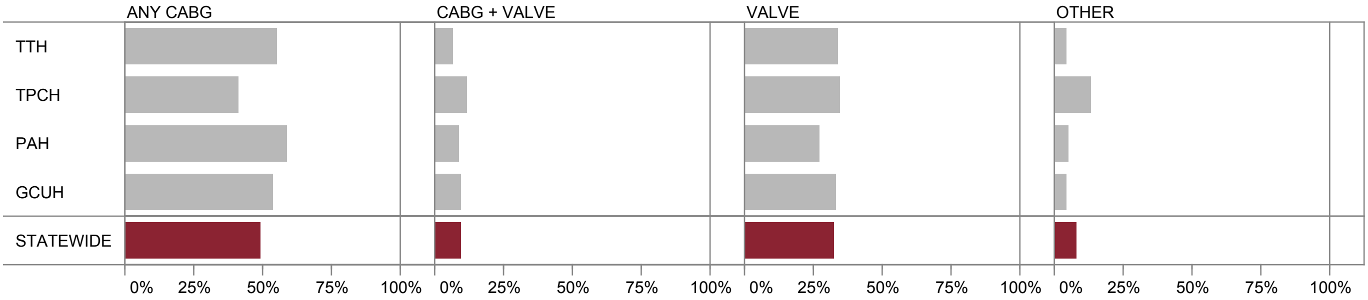


Figure 6: Proportion of cases by site and surgery category

Table 3: Cases by site and surgery category

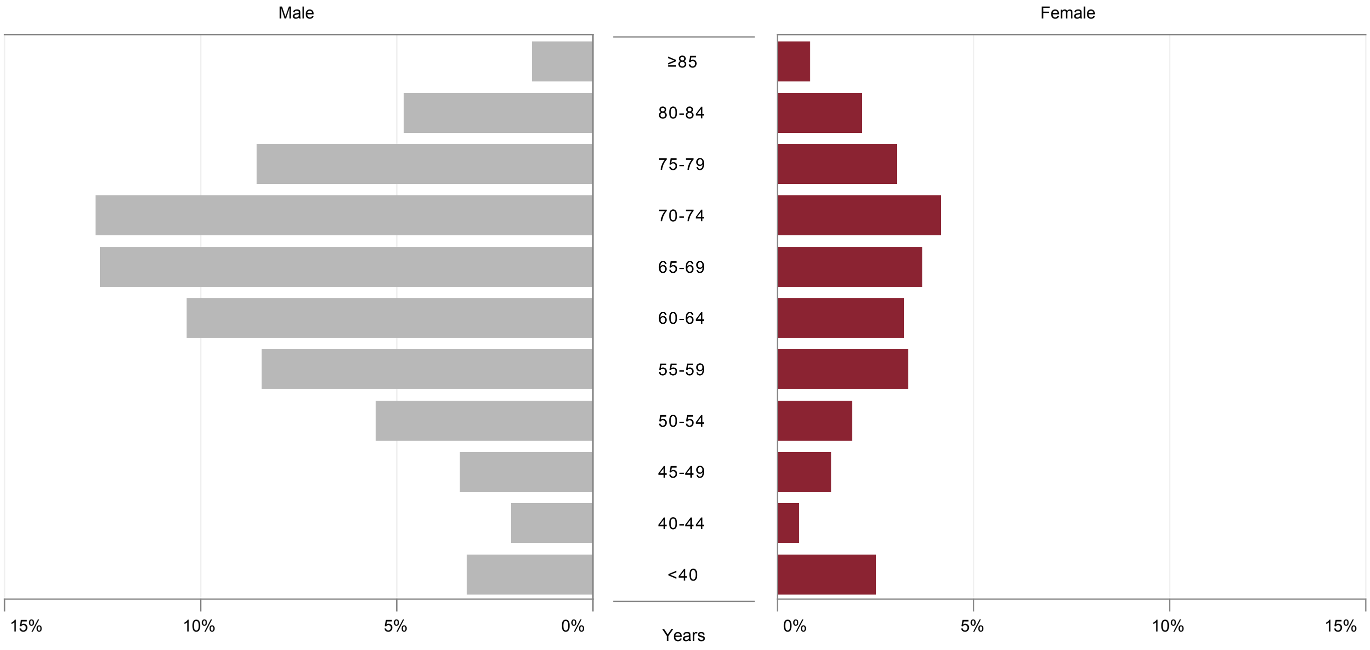
SITE	Total cases n	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)
TTH	359	197 (54.9)	24 (6.7)	122 (34.0)	16 (4.2)
TPCH	1,087	447 (41.1)	126 (11.6)	374 (34.4)	140 (12.9)
PAH	605	356 (58.8)	55 (9.1)	164 (27.1)	30 (5.0)
GCUH	333	178 (53.5)	31 (9.3)	109 (32.7)	15 (4.5)
STATEWIDE	**2,384**	**1,178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

5 Patient characteristics

5.1 Age and gender

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

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



% of total (n=2,384)

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

Table 4: Median age by gender and surgery category

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

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

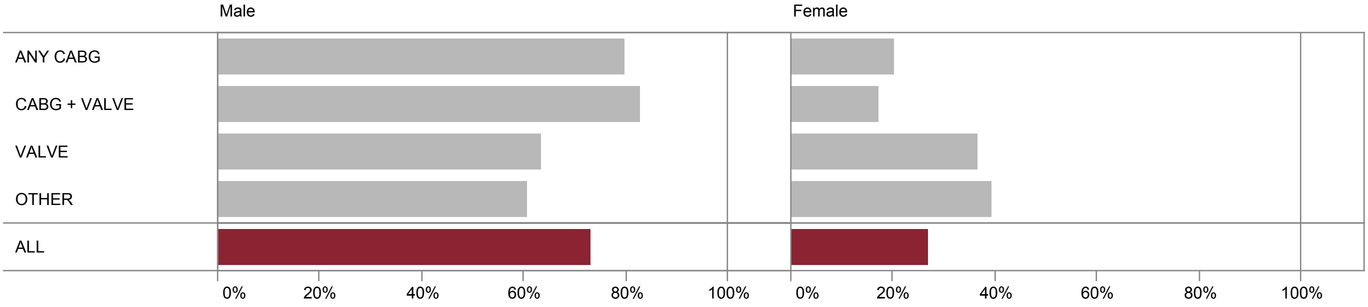
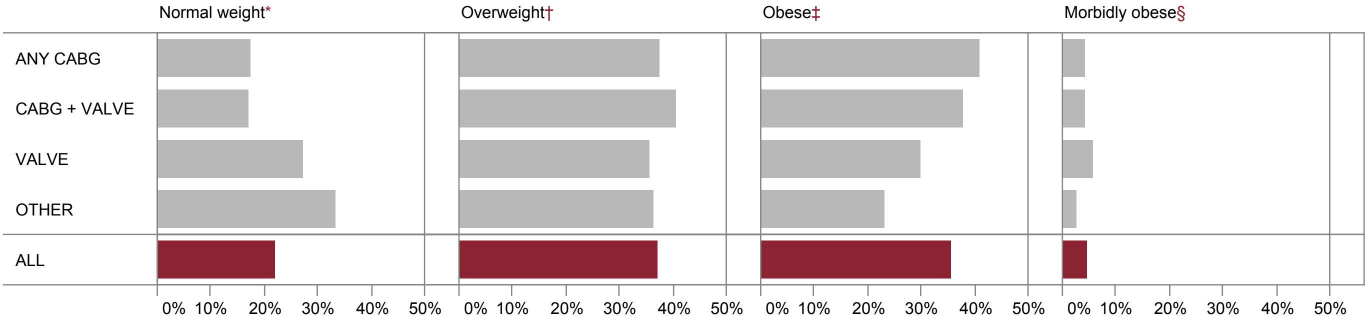


Figure 8: Proportion of cases by gender and surgery category

5.2 Body mass index

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

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



* BMI 18.5–24.9 kg/m^2

† BMI 25–29.9 kg/m^2

‡ BMI 30–39.9 kg/m^2

§ BMI ≥40 kg/m^2

Figure 9: Proportion of cases by BMI and surgery category

Table 5: Cases by BMI and surgery category

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

Missing data not displayed (0.1%)

5.3 Aboriginal and Torres Strait Islander status

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

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

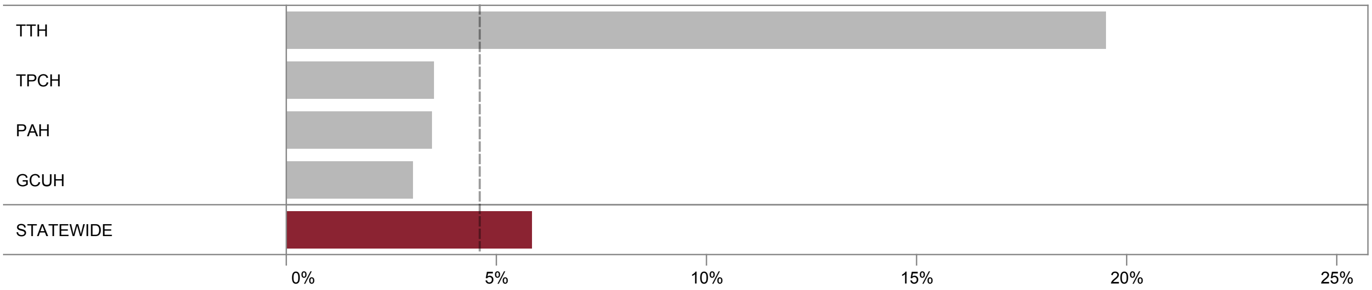


Figure 10: Proportion of all cardiac surgical cases by identified Aboriginal and Torres Strait Islander status and site

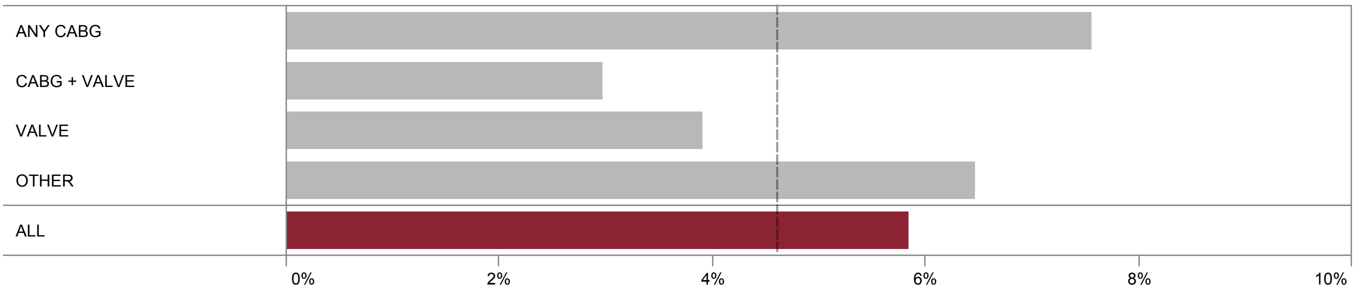
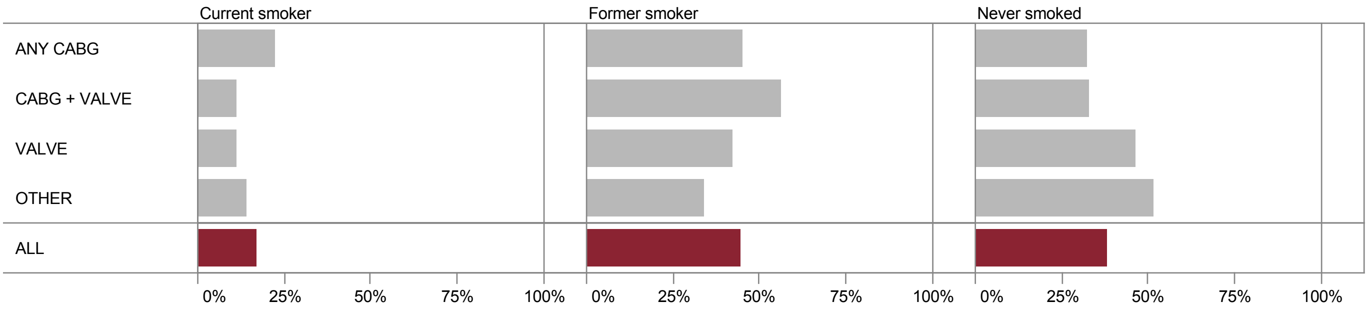


Figure 11: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

6 Risk factor profile

6.1 Smoking history

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



Unknown smoking status not displayed (4.6%)

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

6.2 Diabetes

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

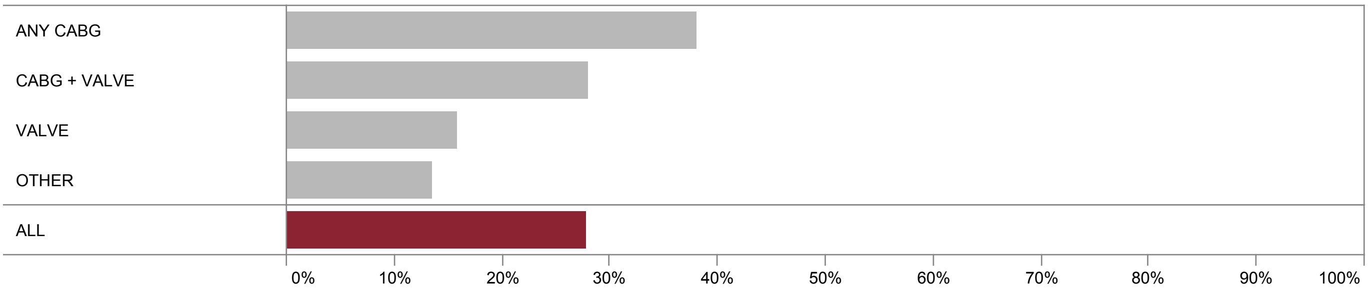


Figure 13: Proportion of cases by diabetes status and surgery category

6.3 Hypertension

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

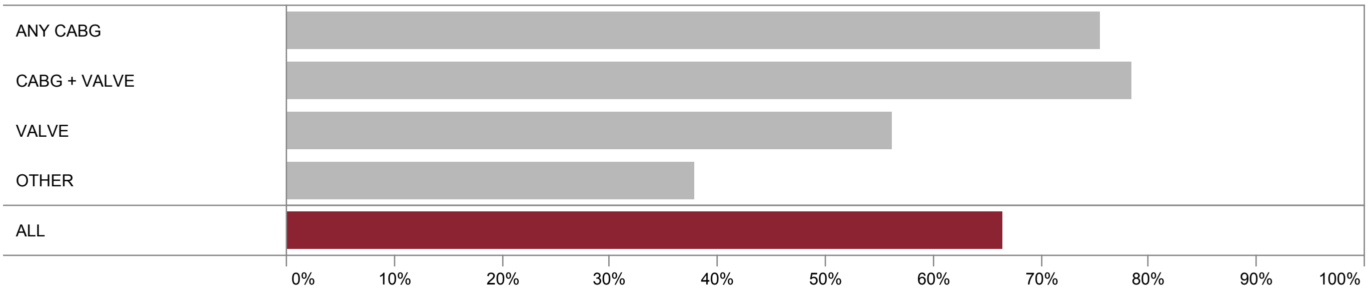


Figure 14: Proportion of cases by hypertension status and surgery category

6.4 Hypercholesterolaemia

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

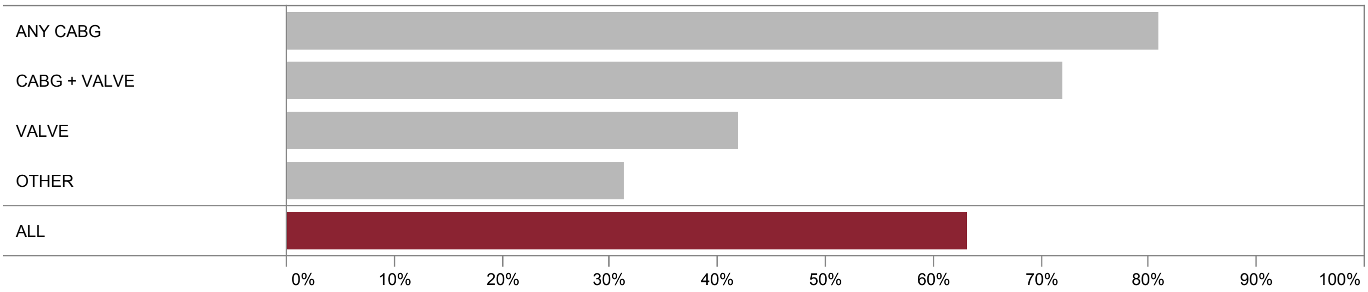
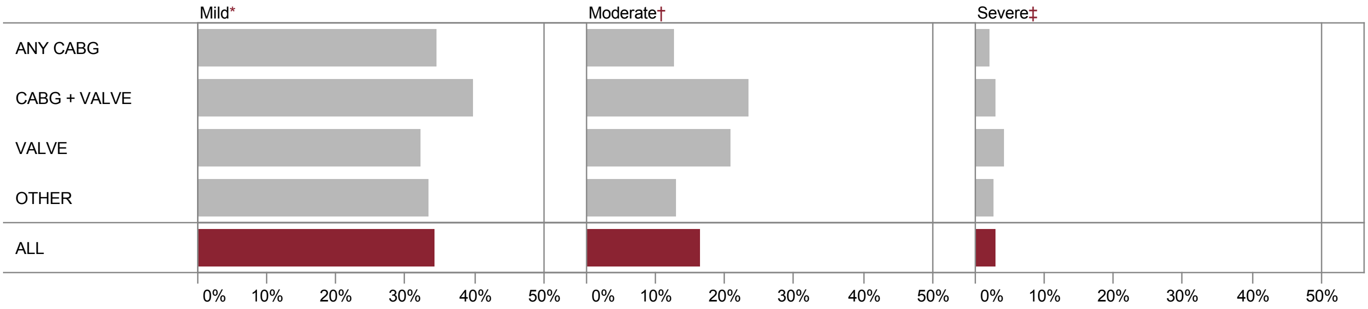


Figure 15: Proportion of cases by statin therapy status and surgery category

6.5 Renal impairment

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



* eGFR 60–89 mL/min/1.73 m^2

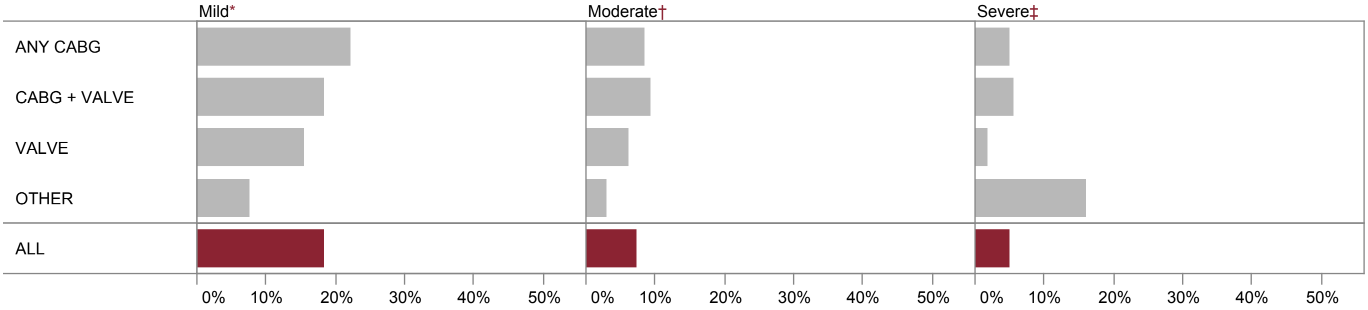
† eGFR 30–59 mL/min/1.73 m^2

‡ eGFR <30 mL/min/1.73 m^2

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

6.6 Left ventricular dysfunction

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



* LVEF 40–49%

† LVEF 30–39%

‡ LVEF <30%

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

6.7 Summary of risk factors

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

Table 6: Summary of risk factors by surgery category

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

Table 7: Summary of combined risk factors by surgery category

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

7 Care and treatment of patients

7.1 Admission status

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

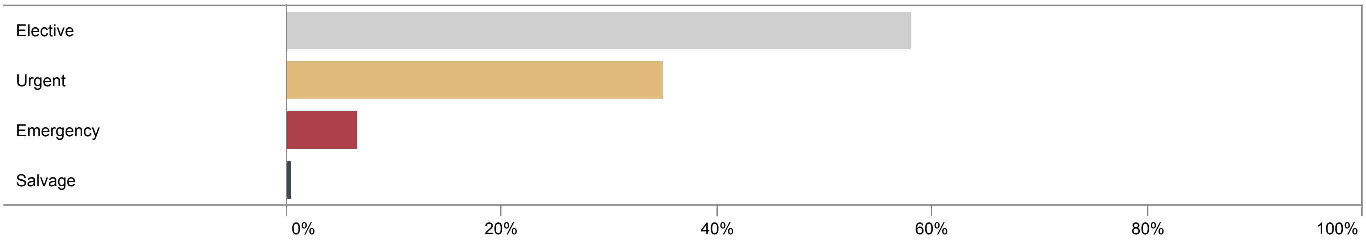


Figure 18: Proportion of cases by admission status

Table 8: Cases by admission status and surgery category

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

7.2 Day of surgery admission

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

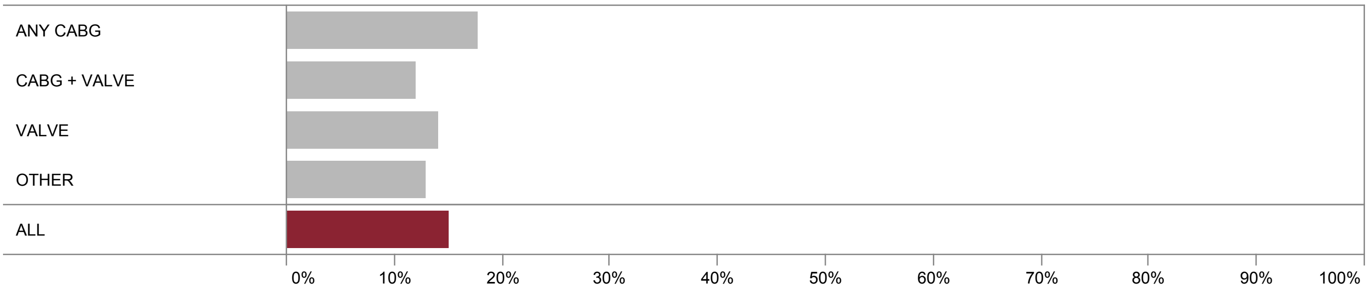


Figure 19: Proportion of elective cases for DOSA cases by surgery category

Table 9: DOSA cases by surgery category

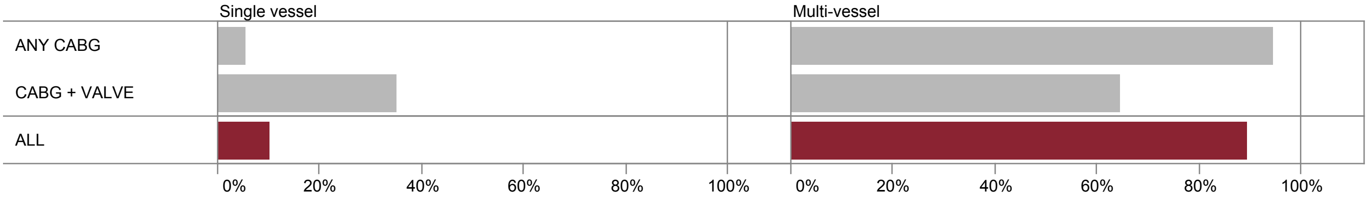
	Total elective cases n	DOSA cases n (%)
ANY CABG	520	92 (17.7)
CABG + VALVE	158	19 (12.0)
VALVE	627	88 (14.1)
OTHER	77	10 (13.0)
ALL	**1,382**	**209 (15.1)**

7.3 Coronary artery bypass grafting

7.3.1 Number of diseased vessels

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

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



Excludes missing data/not applicable (n=6)

Figure 20: Number of diseased vessels

Table 10: Number of diseased vessels

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

Excludes missing data/not applicable (n=6)

7.3.2 Number of grafts

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

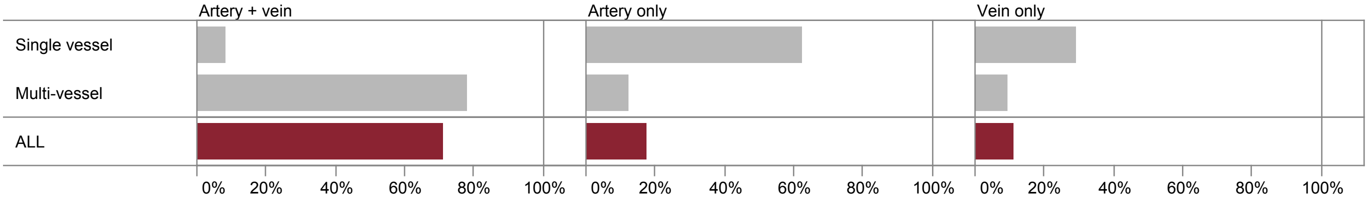
Table 11: Number of grafts by number of diseased vessels

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

Excludes missing data/not applicable (n=6)

7.3.3 Conduits used

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



Excludes missing data/not applicable (n=6)

Figure 21: Proportion of diseased vessels by conduits used

Table 12: Conduits used by number of diseased vessels

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

Excludes missing data/not applicable (n=6)

7.3.4 Off-pump CABG

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

Table 13: Off-pump CABG

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

7.3.5 Y or T grafts

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

Table 14: Y or T graft used by procedure category

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

7.4 Aortic surgery

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

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

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

Table 15: Aortic surgery by procedure type

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

7.4.1 Aortic pathology

Table 16: Aortic surgery cases by pathology type

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

7.5 Valve surgery

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

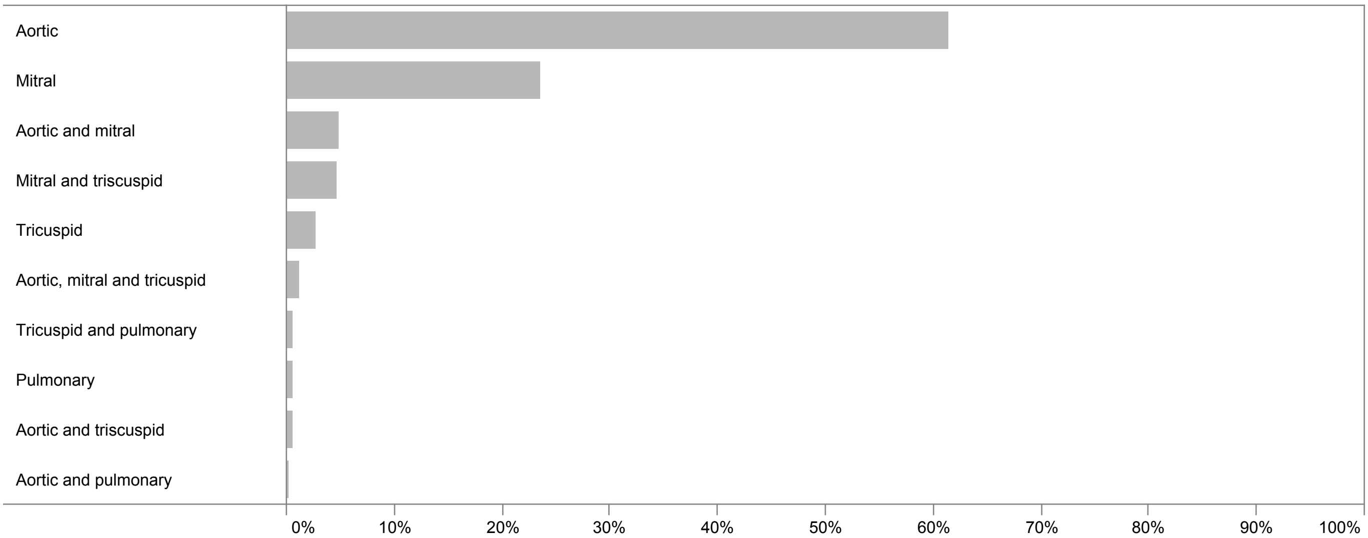


Figure 22: Proportion of valve surgery cases by valve

Table 17: Valve surgery cases by valve

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

7.5.1 Valve pathology

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

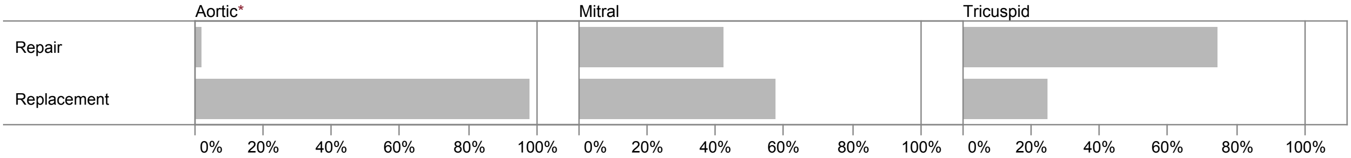
Table 18: Valve pathology by valve type

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

7.5.2 Types of valve surgery

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

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



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

Figure 23: Valve surgery category by valve

Table 19: Valve surgery category by valve

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

* Includes TAVR procedure (n=76) involving CTS

Transcatheter aortic valve replacement

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

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

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

Table 20: TAVR cases by site and CS involvement

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

7.5.3 Valve repair surgery

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

Table 21: Valve repair surgery by valve type

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

7.5.4 Valve replacement surgery

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

Table 22: Valve replacement surgery by valve type

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

Prosthesis type

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

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

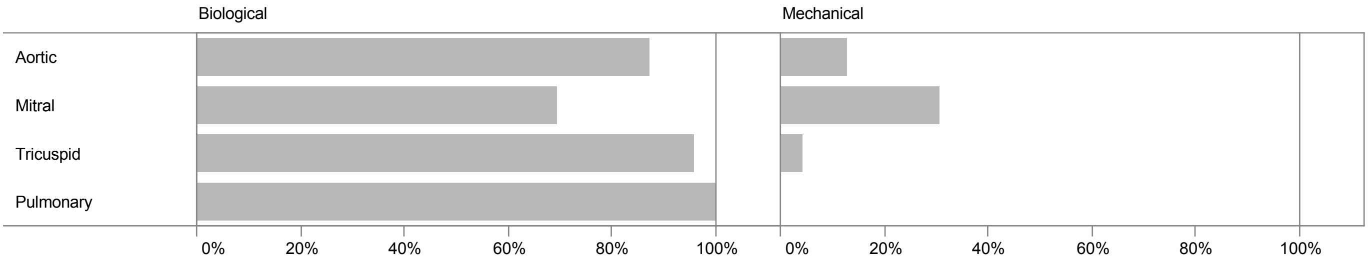


Figure 24: Proportion of valve replacements by valve prosthesis category and valve type

Table 23: Types of valve prosthesis by valve type

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

7.6 Other cardiac surgery

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

Table 24: Other cardiac procedures

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

* Bilateral sequential single lung transplant

† Left ventricular outflow tract

‡ Hypertrophic obstructive cardiomyopathy

§ Ventricular assist device

‖ Extracorporeal membrane oxygenation

Partial anomalous pulmonary venous drainage

7.7 Blood product usage

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

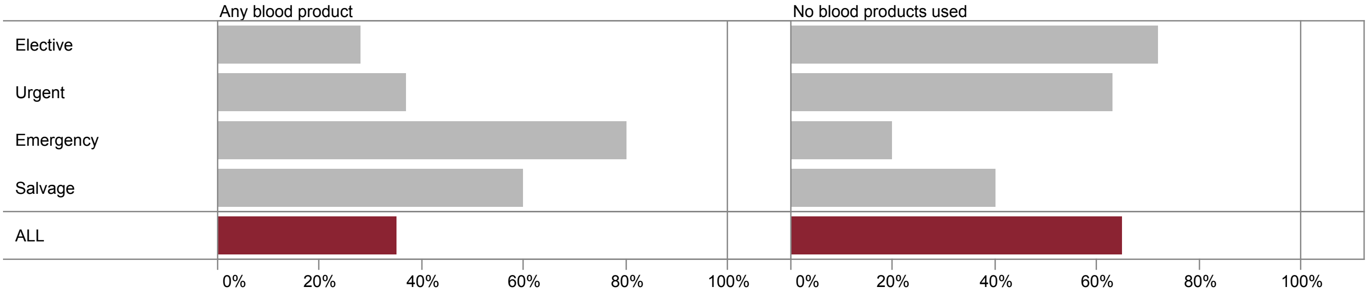


Figure 25: Blood products used by admission status

Table 25: Blood product type used by admission status

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

8 Clinical outcomes

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

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

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

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

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

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

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

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

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

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

8.1 Mortality

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

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

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

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

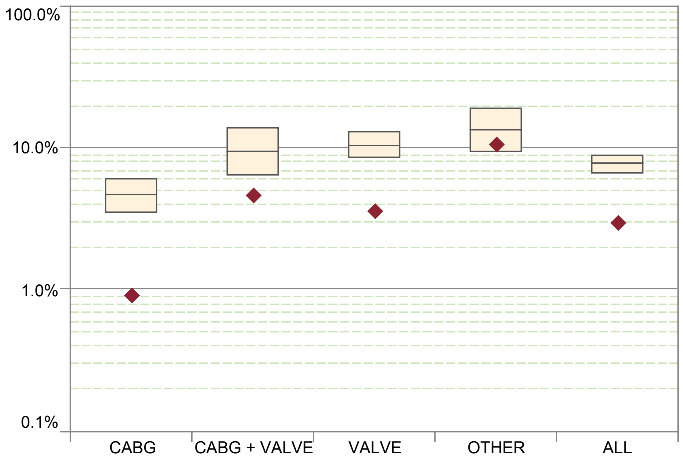


Figure 26: EuroSCORE

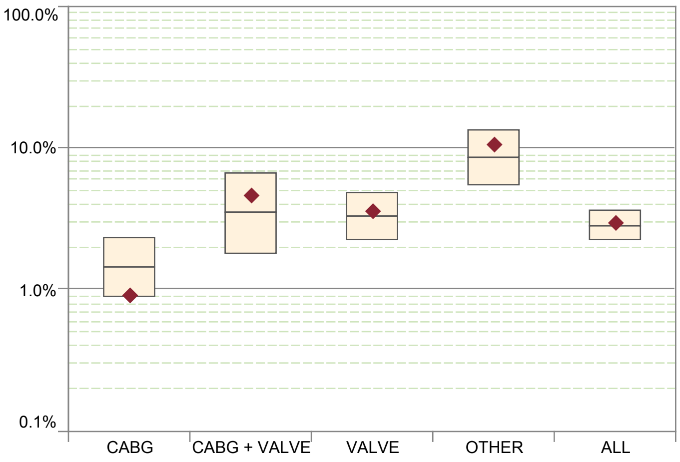


Figure 27: ANZSCTS General Score

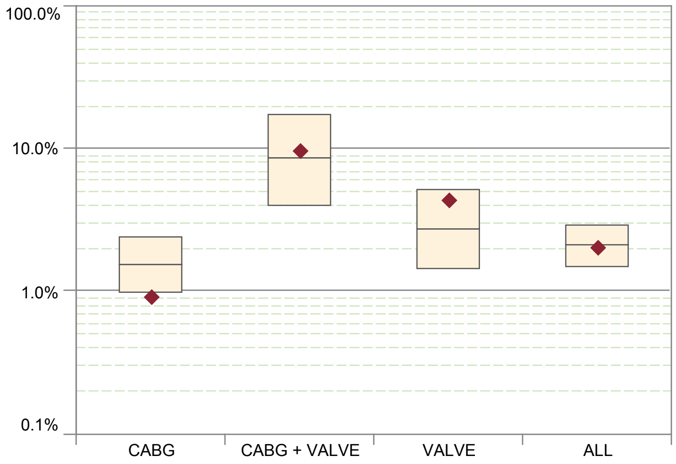


Figure 28: STS (Death)

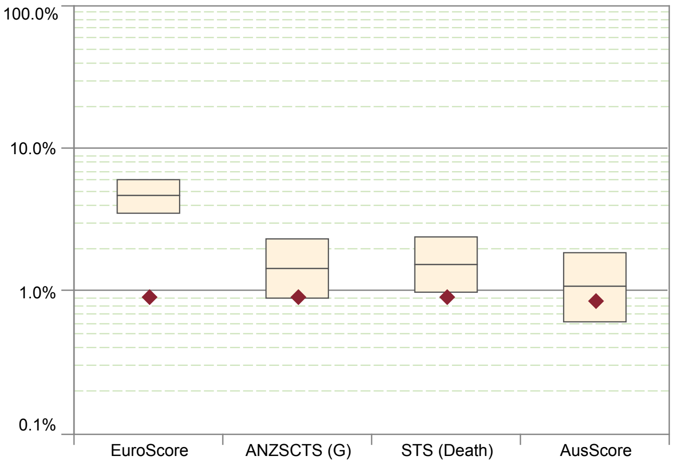


Figure 29: CABG

8.2 Morbidity

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

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

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

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

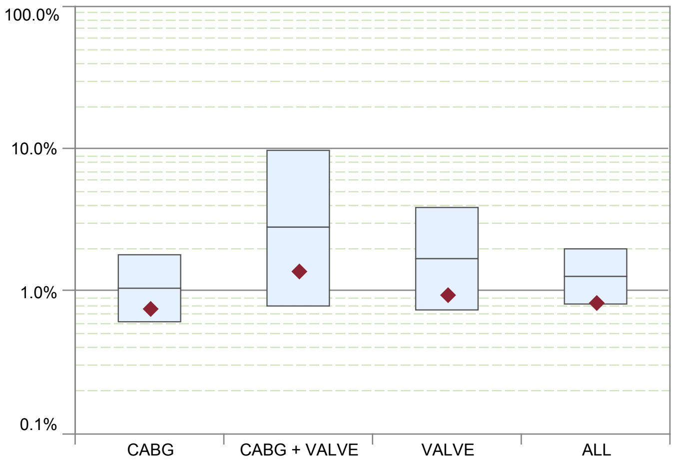


Figure 30: CVA

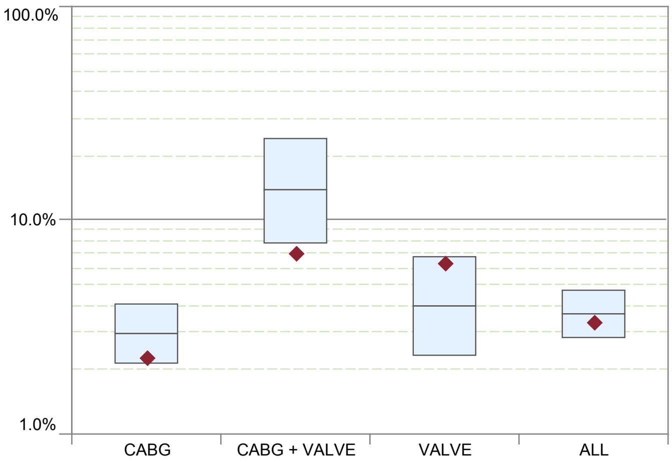


Figure 31: Renal failure

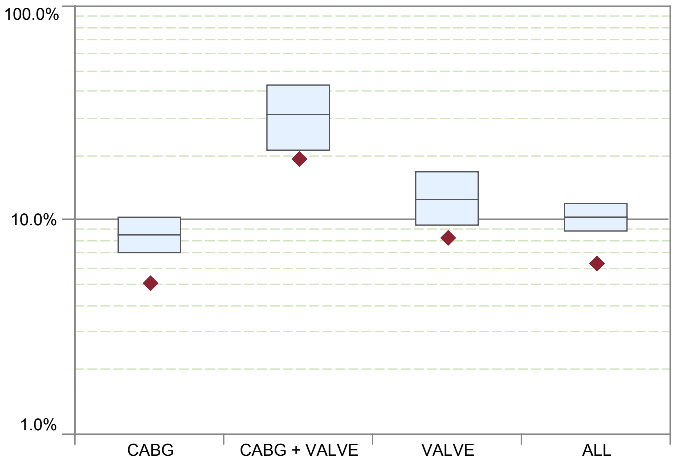


Figure 32: Ventilation >24 hours

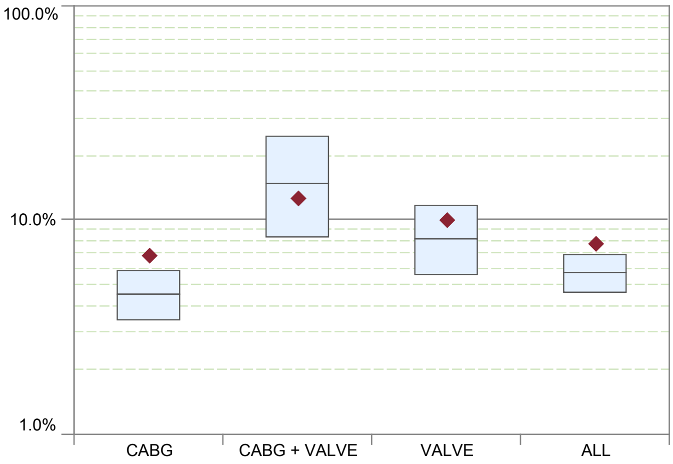


Figure 33: Reoperation

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

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

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

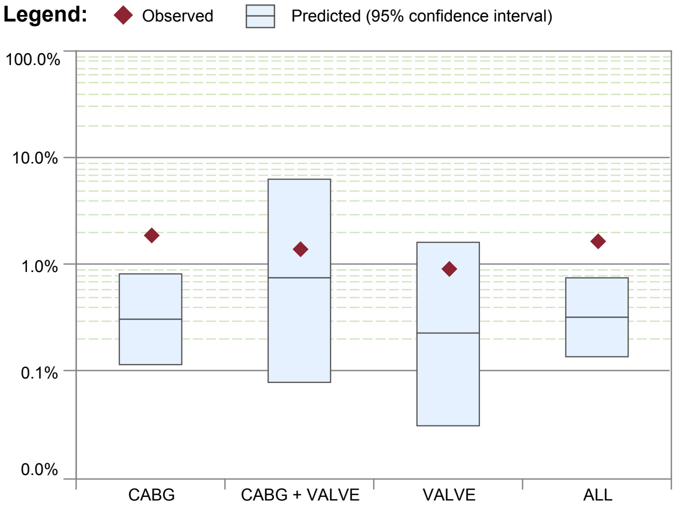


Figure 34: Deep sternal infection

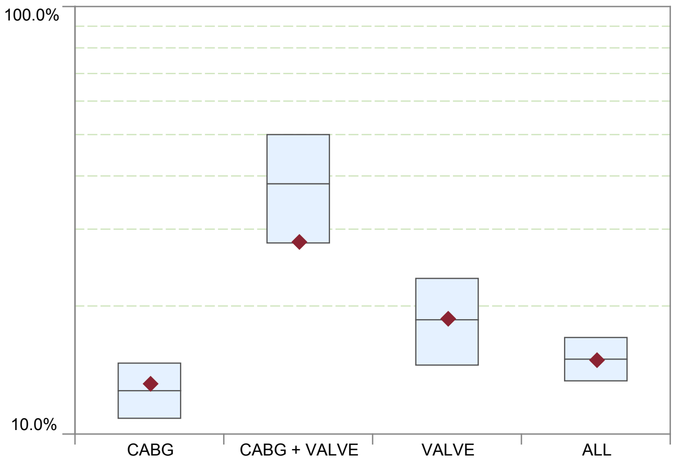


Figure 35: Major morbidity

8.3 Measures of process

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

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

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

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

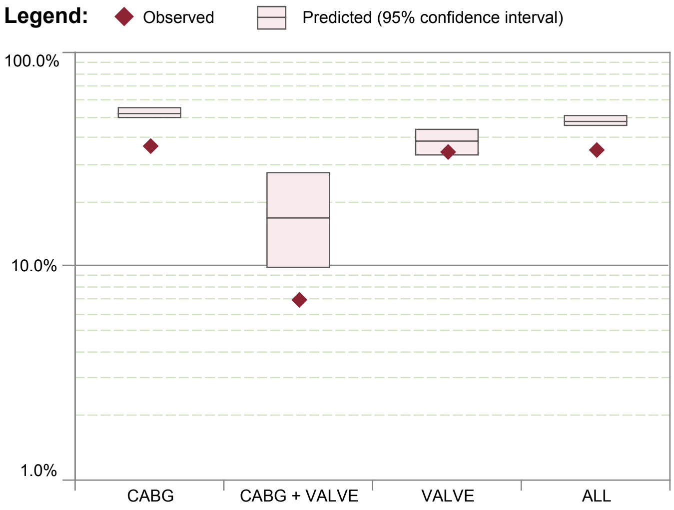


Figure 36: LOS ‹6 days

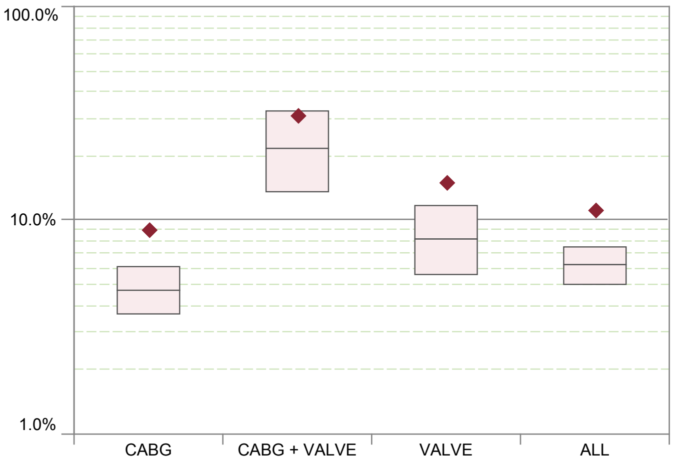


Figure 37: LOS ›14 days

8.4 Failure to rescue

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

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

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

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

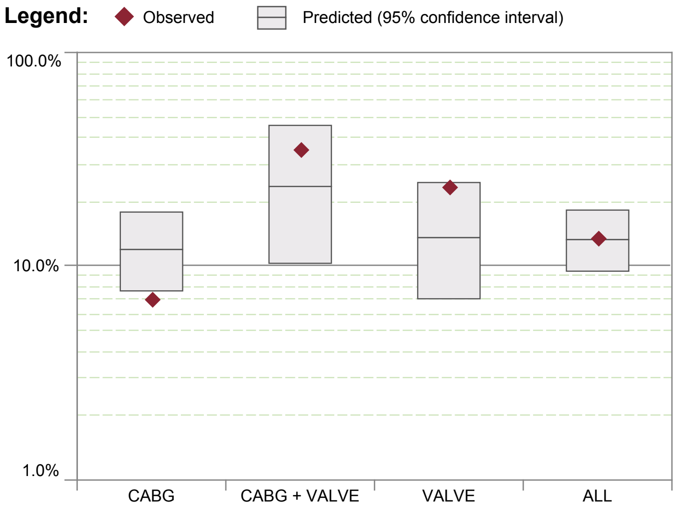


Figure 38: Failure to rescue

9 Conclusions

There are several points to draw from this report.

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

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

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

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

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

10 Supplement: Body mass index in cardiac surgery

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

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

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

Table 1: BMI category definitions

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

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

10.1 Patient characteristics

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

Over half (57%) of all patients analysed were males with a BMI greater than 30 kg/m², whereas the same female cohort accounted for only 18% of all surgeries. The overall median age of patients was 66 years old which was similar across gender and most BMI categories (Table 4). The exception was the smaller group of patients that classed as underweight, where the median age was considerably younger at 53 years.

Table 2: Total cases by body mass index category

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

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

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

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

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

10.2 Care and treatment of patients

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

Table 5: Treatment characteristics by body mass index category

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

10.3 Risk factors and comorbidities

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

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

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

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

* eGFR 60–89 mL/min/1.73m^2

† eGFR 30–59 mL/min/1.73m^2

‡ eGFR <30 mL/min/1.73m^2

10.4 Patient outcomes

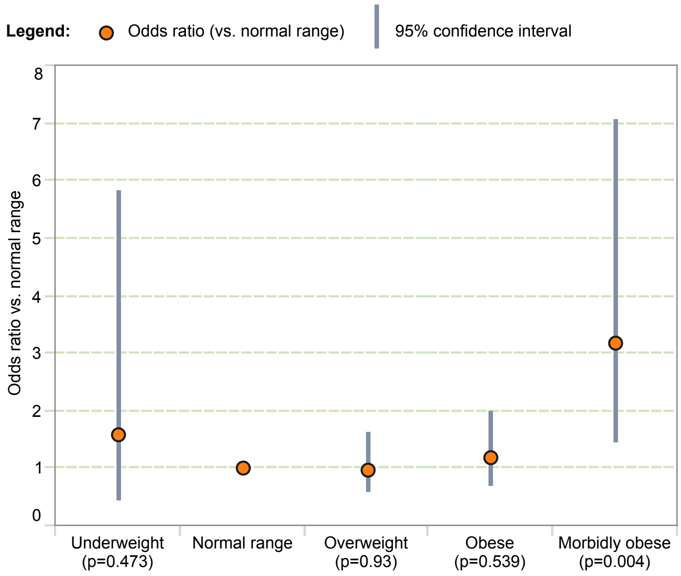
This section examines the effect of patient BMI category on the risk of procedural complications and key targets for surgical performance. For the purpose of this analysis, relative odds ratios (OR) have been derived to compare outcomes against the normal range BMI category while controlling for known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

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

10.4.1 Mortality

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

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



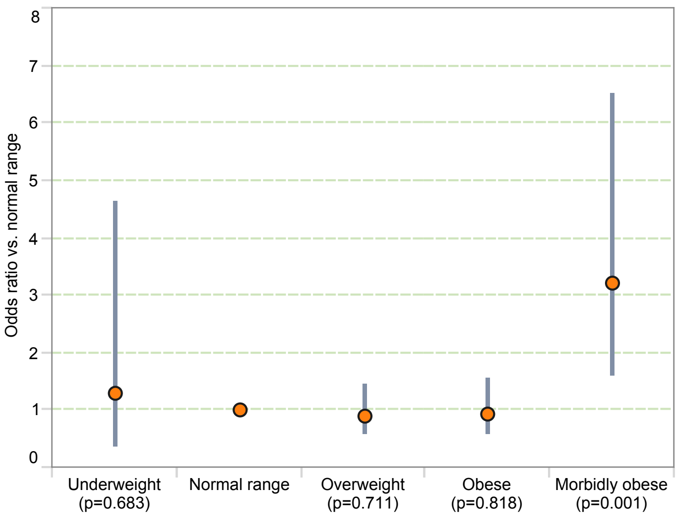


Figure 1: Standardised incidence of death within 30 days of procedure by BMI category

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

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

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

* Used as reference/baseline for comparison across categories

10.4.2 Morbidity

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

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

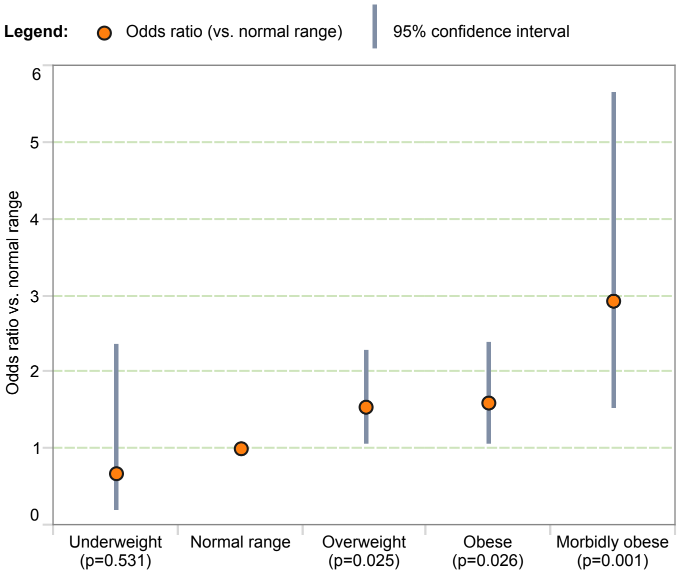


Figure 3: Standardised incidence of renal failure by BMI category

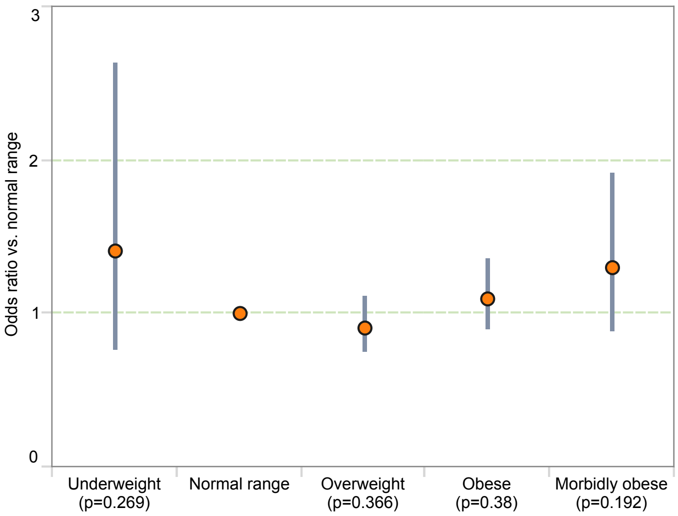


Figure 4: Standardised incidence of major morbidity by BMI category

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

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

* Used as reference/baseline for comparison across categories

† Ventilation ›24 hours

‡ Composite of all morbidities above

10.4.3 Measures of process

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

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

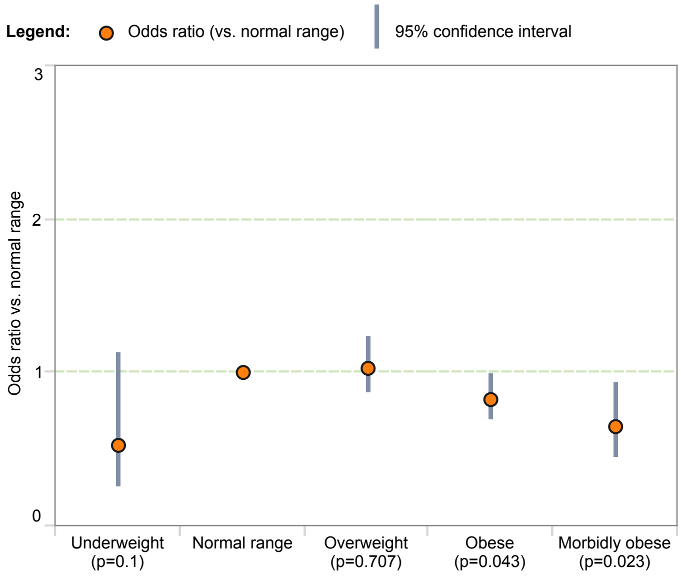


Figure 5: Standardised incidence of length of stay ‹6 days by BMI category

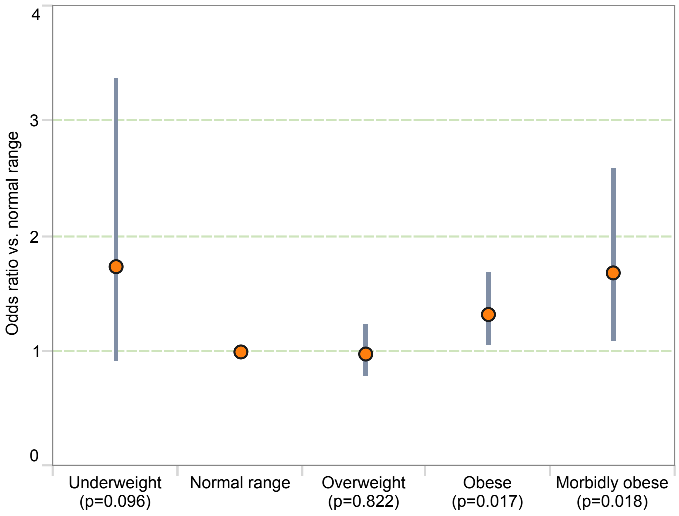


Figure 6: Standardised incidence of length of stay ›14 days by BMI category

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

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

* Used as reference/baseline for comparison across categories

10.4.4 Rehospitalisation

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

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

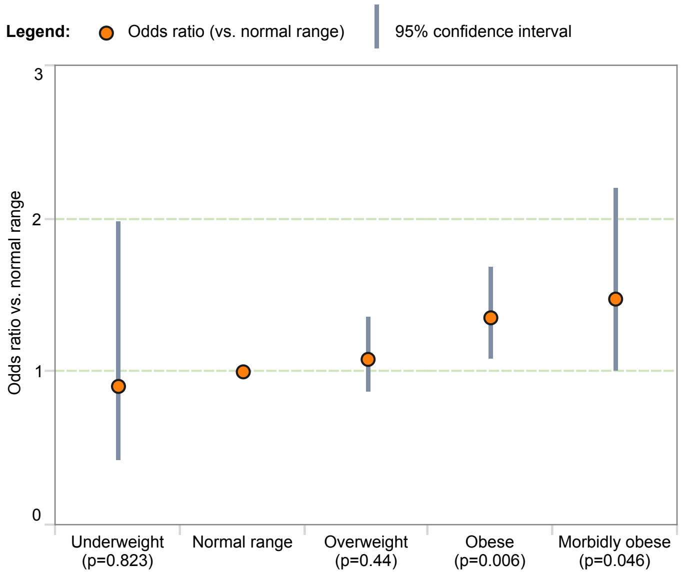


Figure 7: Standardised incidence of rehospitalisation within 30 days of surgery by BMI category

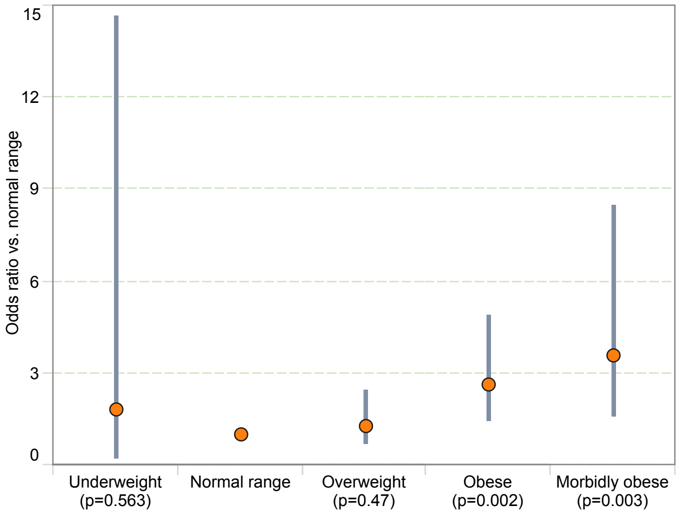


Figure 8: Standardised incidence of rehospitalisation for incisional complications within 30 days of surgery by BMI category

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

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

* Used as reference/baseline for comparison across categories

10.5 Discussion

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

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

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

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

Part B: Thoracic Surgery

11 Message from the QCOR Cardiothoracic Committee Chair

Welcome to the first Thoracic Surgery Audit from QCOR.

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

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

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

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

12 Key findings

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

Key findings include:

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

13 Participating sites

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

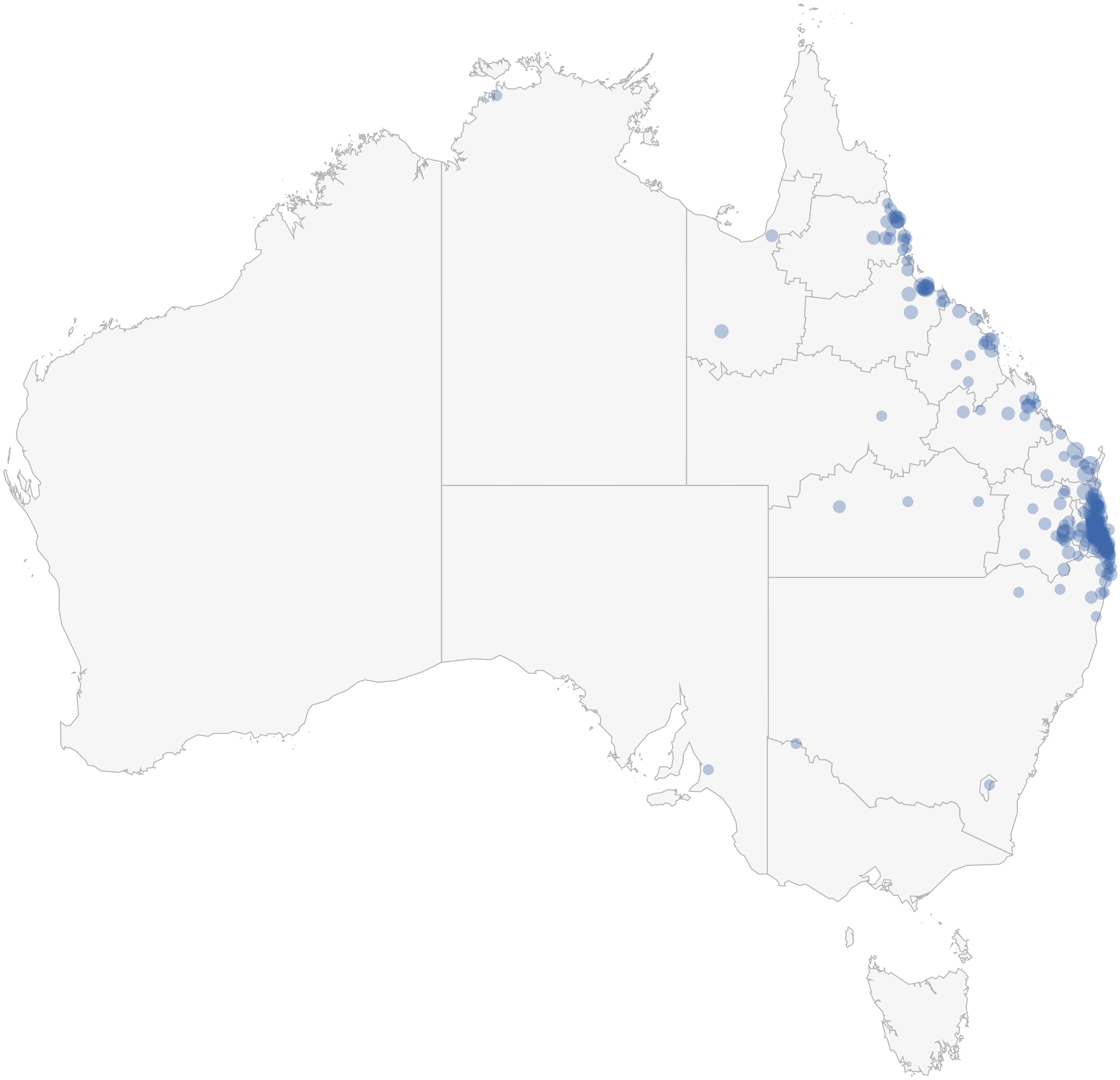


Figure 1: Thoracic surgery cases by residential postcode

Table 1: Participating sites

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

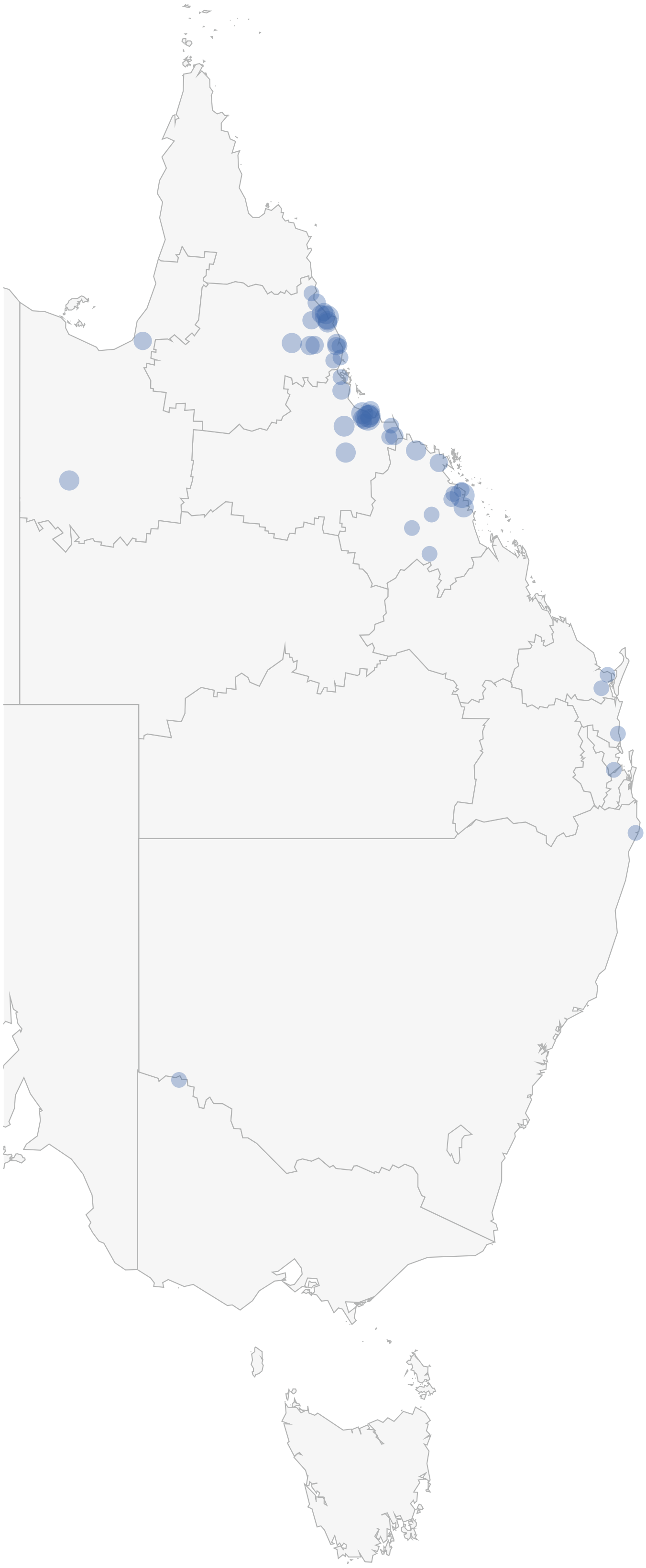


Figure 2: The Townsville Hospital

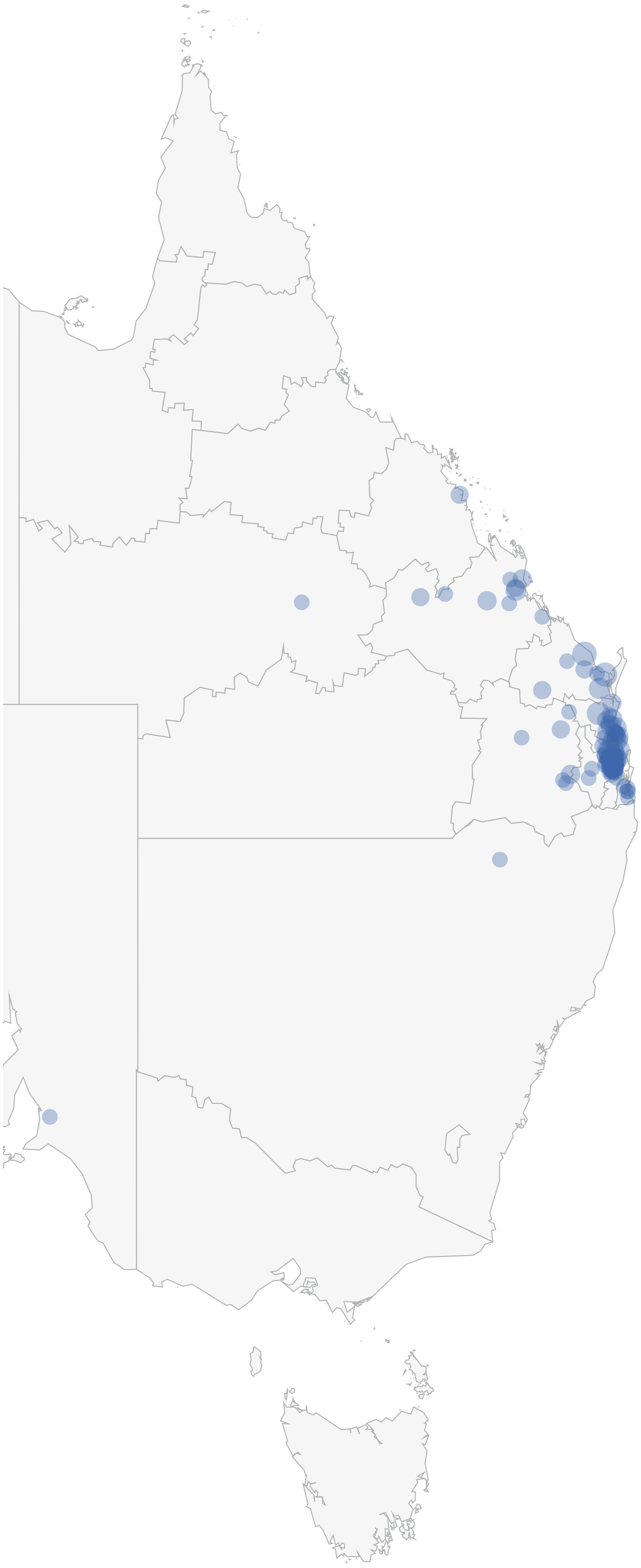


Figure 3: The Prince Charles Hospital

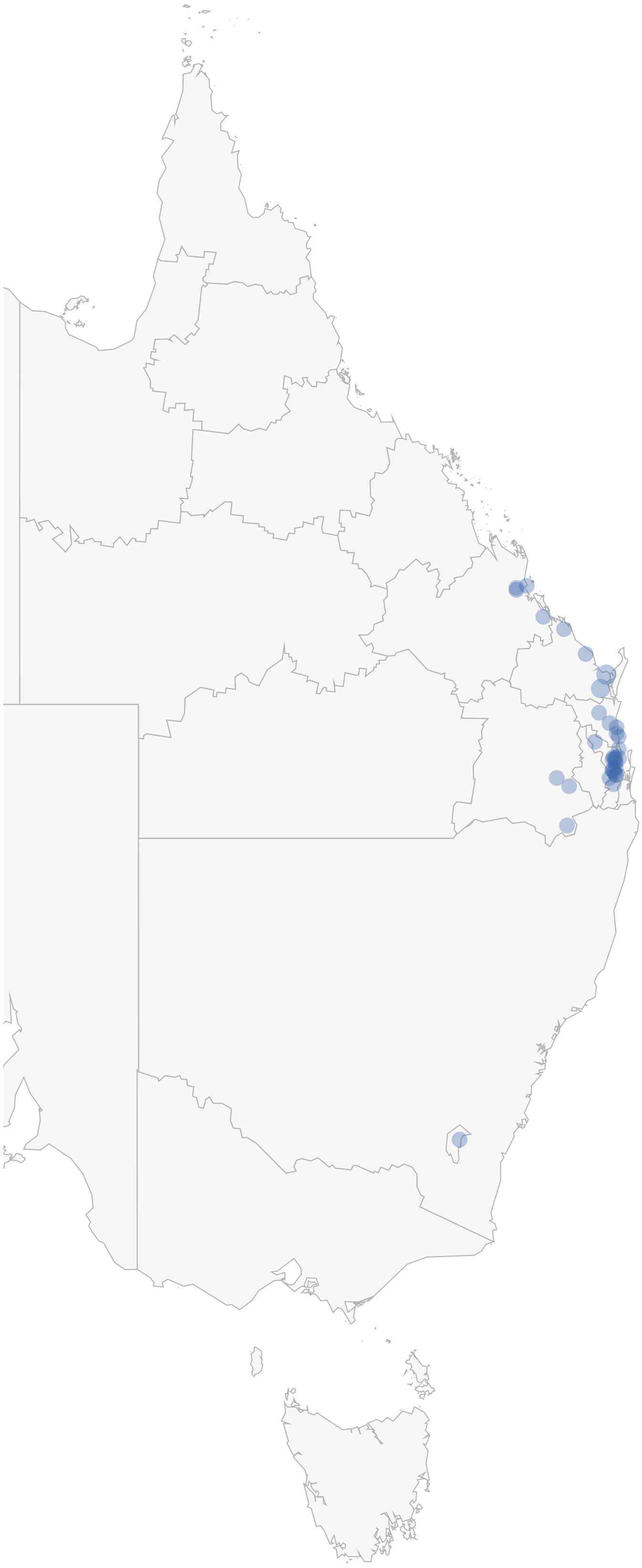


Figure 4: Royal Brisbane and Women's Hospital

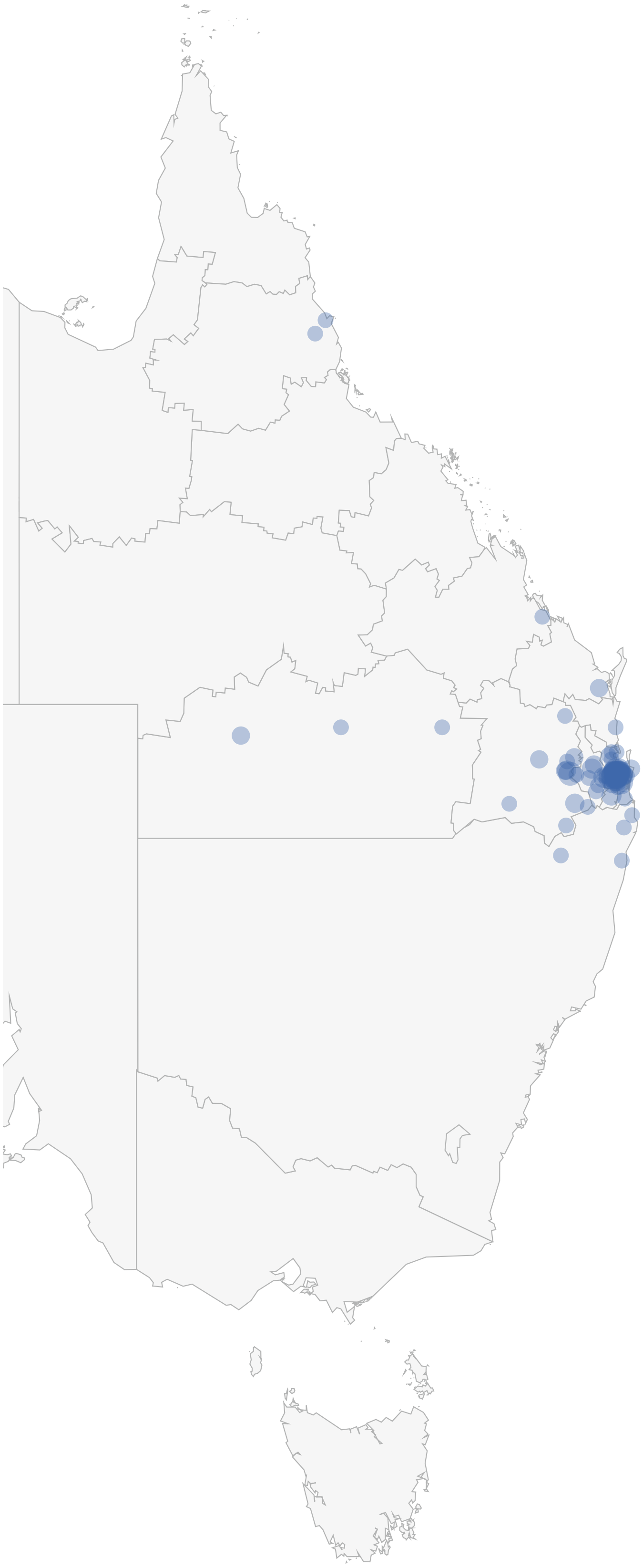


Figure 5: Princess Alexandra Hospital

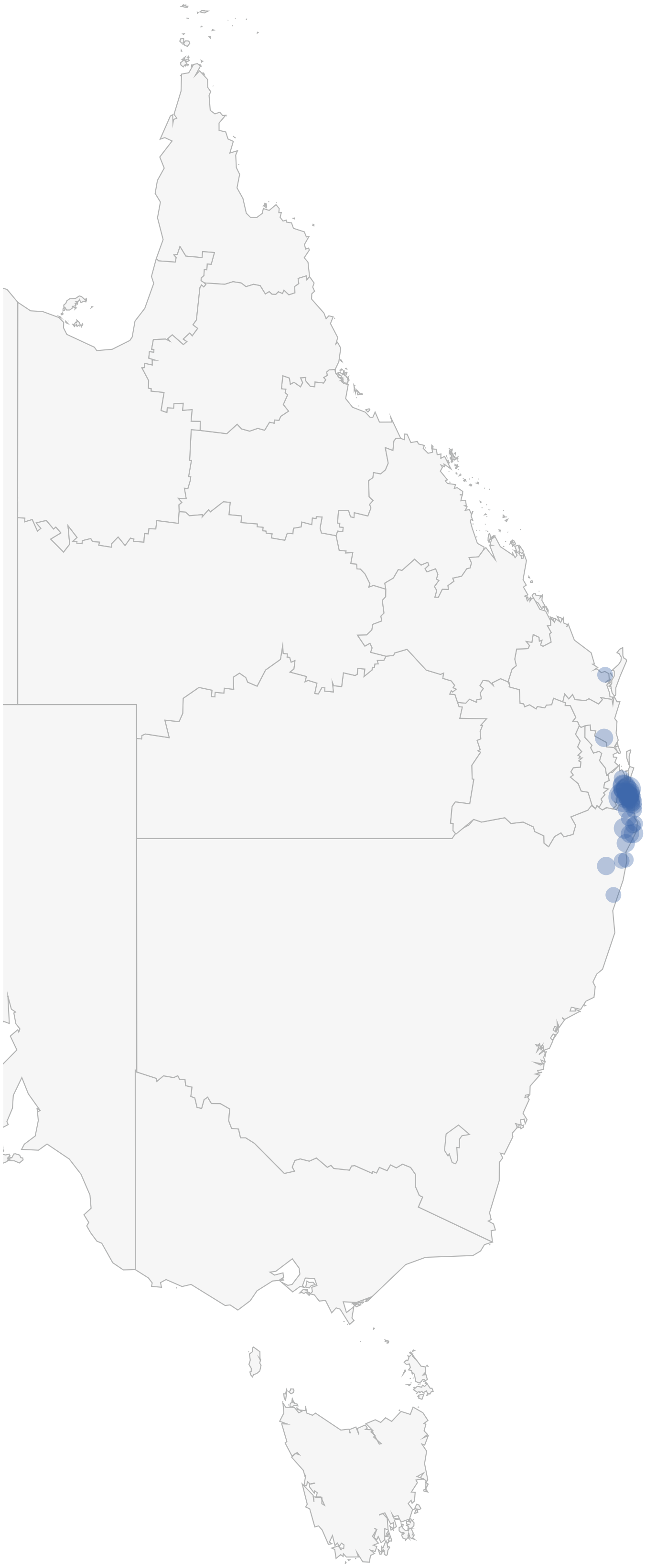


Figure 6: Gold Coast University Hospital

14 Case totals

14.1 Total surgeries

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

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

Table 2: Cases by site and preoperative diagnosis category

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

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

† Pneumothorax, haemothorax, empyema or pleural thickening/nodules

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

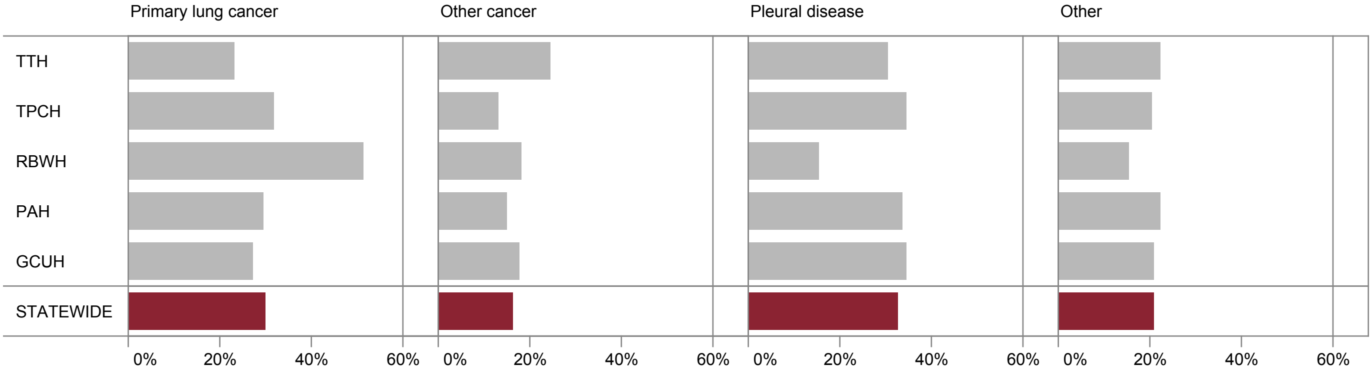


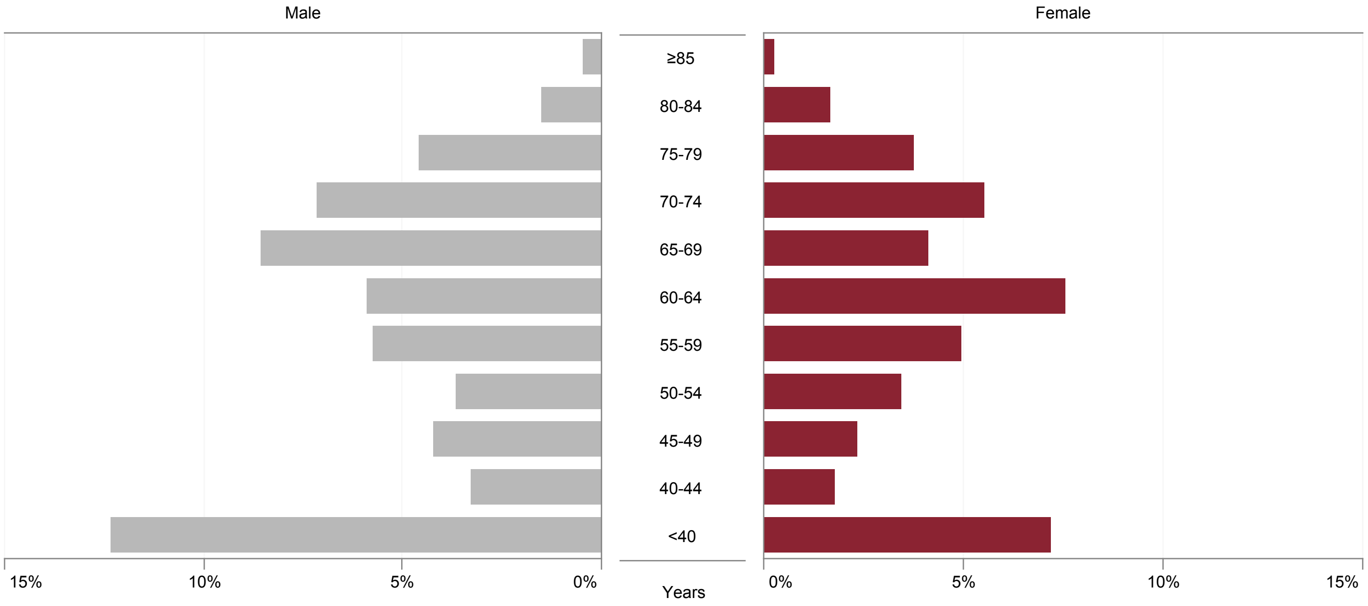
Figure 7: Proportion of cases by site and preoperative diagnosis category

15 Patient characteristics

15.1 Age and gender

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

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



% of total (n=850)

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

Table 3: Median age by gender and preoperative diagnosis category

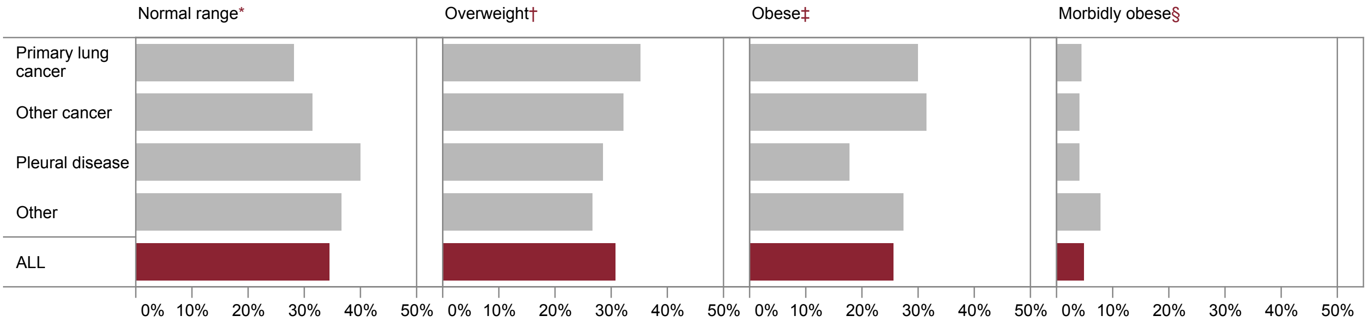
Preoperative diagnosis	**Male years**	**Female years**	**ALL years**
Primary lung cancer	65	65	65
Other cancer	68	61	64
Pleural disease	47	54	49
Other	54	49	53
ALL	**59**	**61**	**60**

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

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

15.2 Body mass index

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



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

Excludes missing data (7.6%)

* BMI 18.5–24.9 kg/m^2

† BMI 25–29.9 kg/m^2

‡ BMI 30–39.9 kg/m^2

§ BMI ≥40 kg/m^2

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

Table 5: BMI category by preoperative diagnosis category

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

Excludes missing data (7.6%)

15.3 Aboriginal and Torres Strait Islander status

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

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

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

Excludes missing data (2.5%)

16 Risk factors and comorbidities

16.1 Smoking history

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

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

Table 7: Smoking history by preoperative diagnosis category

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

Excludes missing data (2.2%)

16.2 Respiratory disease

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

Table 8: Respiratory disease according to preoperative diagnosis category

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

Excludes missing data (5.6%)

* Patient is on chronic inhaled or oral bronchodilator therapy

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

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

16.3 Diabetes

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

Table 9: Diabetes status by preoperative diagnosis category

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

Excludes missing data (2.2%)

16.4 Coronary artery disease

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

Table 10: Coronary artery disease status by preoperative diagnosis category

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

Excludes missing data (2.9%)

16.5 Renal function

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

Table 11: Renal function by preoperative diagnosis category

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

Excludes missing data (6.9%)

* eGFR ≥90 mL/min/1.73 m^2

† eGFR 60–89 mL/min/1.73 m^2

‡ eGFR 30–59 mL/min/1.73 m^2

§ eGFR <30 mL/min/1.73 m^2

16.6 Cerebrovascular disease

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

Table 12: Cerebrovascular disease type by preoperative diagnosis category

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

Excludes missing data (2.2%)

* Typically includes transient ischaemic attack

† Typically includes cerebrovascular accident

16.7 Peripheral vascular disease

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

Table 13: Peripheral vascular disease status by preoperative diagnosis category

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

Excludes missing data (2.2%)

16.8 Previous interventions

16.8.1 Previous thoracic surgery

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

Table 14: Previous thoracic surgery by preoperative diagnosis category

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

Excludes missing data (5.3%)

16.8.2 Previous pulmonary resection

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

Table 15: Previous pulmonary resection surgery by preoperative diagnosis category

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

Excludes missing data (3.2%)

17 Care and treatment of patients

17.1 Admission status

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

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

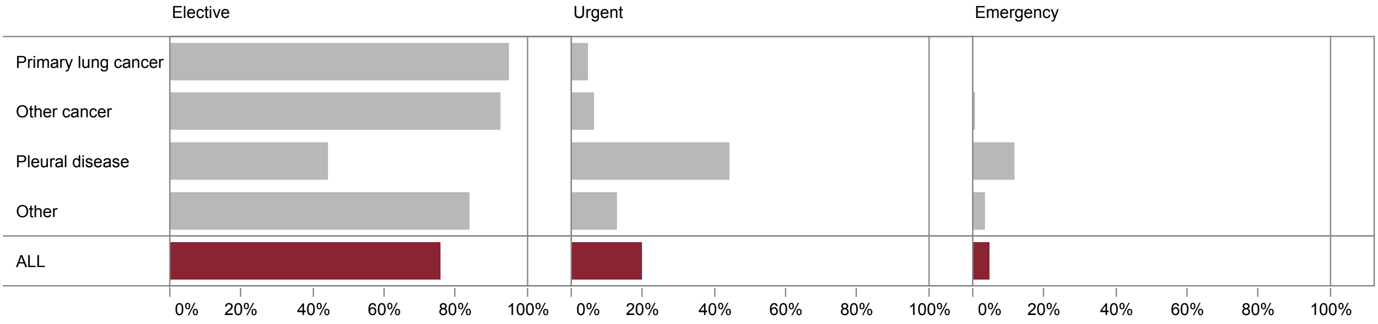


Figure 10: Admission status by preoperative diagnosis category

17.1.1 Elective day of surgery admissions

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

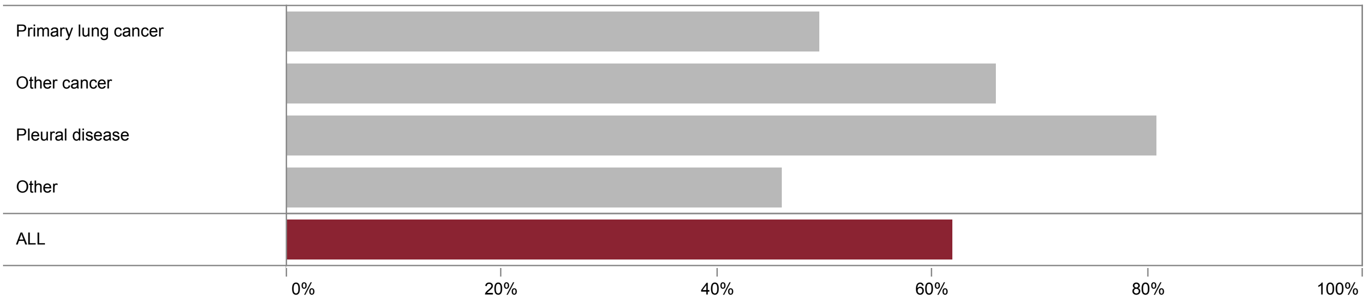
Table 16: Day of surgery admissions by preoperative diagnosis category

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

17.2 Surgical technique

17.2.1 Video-assisted thoracic surgery

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



Excludes missing data (1.3%)

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

Number of ports

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

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

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

Excludes missing data (1.5%)

17.2.2 Incision type

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

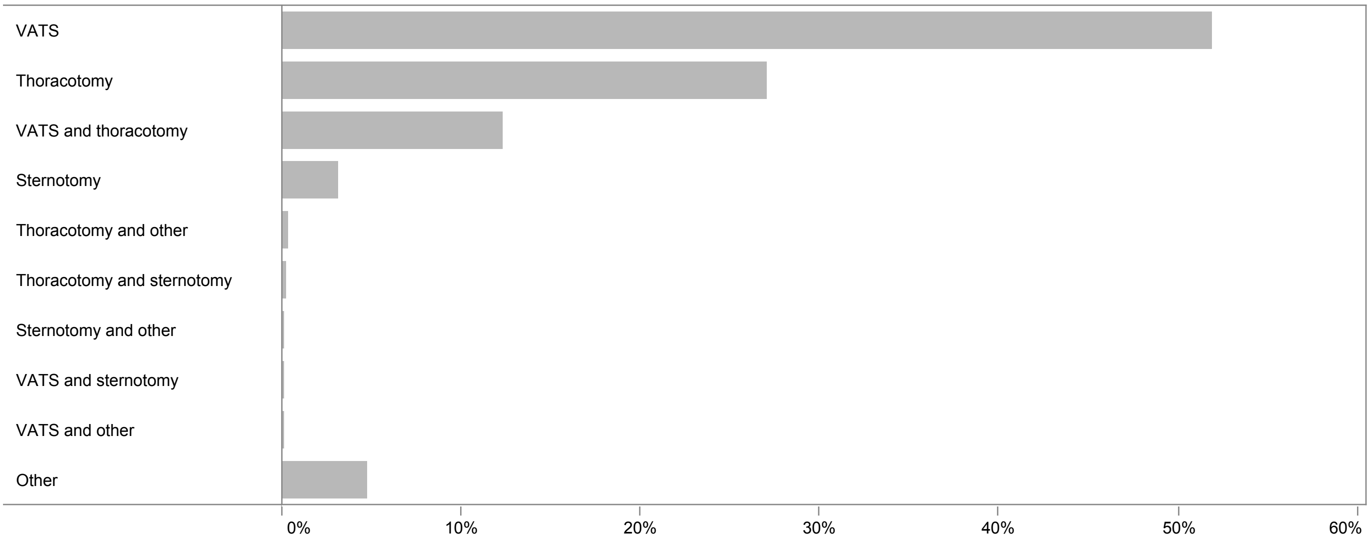


Figure 12: Proportion of all cases by incision type

Table 18: Incision type by preoperative diagnosis category

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

Excludes missing data (5.2%)

17.3 Surgery types

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

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

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

Table 19: Surgical procedures for primary lung cancer

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

Table 20: Surgical procedures for other cancer

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

Table 21: *Surgical procedures for pleural disease*

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

Table 22: *Surgical procedures for all other surgeries*

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

17.4 Blood product usage

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

Excludes missing data (2.7%)

Figure 13: Proportion of cases requiring blood product transfusion

Table 23: Blood product types used by preoperative diagnosis category

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

Excludes missing data (2.7%)

18 Clinical outcomes

18.1 Length of stay

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

Table 24: Length of stay by preoperative diagnosis category

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

18.2 Major morbidity

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

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

Table 25: New major morbidity by diagnosis category

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

Excludes missing data (2.4%)

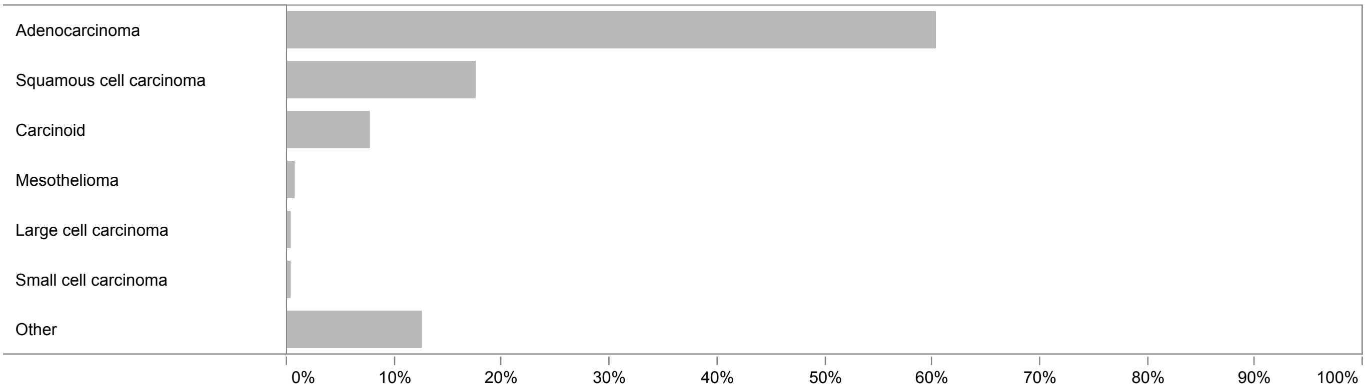
Table 26: Type of major morbidity

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

18.3 Primary lung cancer outcomes

18.3.1 Final histopathology

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



Excludes missing data (3.2%)

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

Table 27: Final histopathology results for primary lung malignancy

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

18.3.2 Stage classification

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

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

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

Excludes missing data/not applicable (15.8%)

18.4 Unadjusted all-cause mortality

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

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

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

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

19 Conclusions

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

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

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

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Cardiac Surgery Audit

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Glossary

6MWT	Six Minute Walk Test
ACC	American College of Cardiology
ACEI	Angiotensin Converting Enzyme Inhibitor
ACOR	Australasian Cardiac Outcomes Registry
ACS	Acute Coronary Syndromes
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
AQoL	Assessment of Quality of Life
ARB	Angiotensin II Receptor Blocker
ARNI	Angiotensin Receptor-Neprilysin Inhibitors
ASD	Atrial Septal Defect
ATSI	Aboriginal and Torres Strait
AV	Atrioventricular
AVNRT	Atrioventricular Nodal Re-entry Tachycardia
BCIS	British Cardiovascular Intervention Society
BiV	Biventricular
BMI	Body Mass Index
BMS	Bare Metal Stent
BNH	Bundaberg Hospital
BSSLTX	Bilateral Sequential Single Lung Transplant
BVS	Bioresorbable Vascular Scaffold
CABG	Coronary Artery Bypass Graft
CAD	Coronary Artery Disease
CBH	Caboolture Hospital
CCL	Cardiac Catheter Laboratory
CH	Cairns Hospital
CHF	Congestive Heart Failure
CI	Clinical Indicator
CR	Cardiac Rehabilitation
CRT	Cardiac Resynchronisation Therapy
CS	Cardiac Surgery
CV	Cardiovascular
CVA	Cerebrovascular Accident
DAOH	Days Alive and Out of Hospital
DES	Drug Eluting Stent
DOSA	Day Of Surgery Admission
DSWI	Deep Sternal Wound Infection
ECG	12 lead Electrocardiograph
ECMO	Extracorporeal Membrane Oxygenation
ED	Emergency Department
eGFR	Estimated Glomerular Filtration Rate
EP	Electrophysiology
FdECG	First Diagnostic Electrocardiograph
FTR	Failure To Rescue
GAD	Generalized Anxiety Disorder
GCCH	Gold Coast Community Health
GCUH	Gold Coast University Hospital
GLH	Gladstone Hospital
GP	General Practitioner
GYH	Gympie Hospital
HBH	Hervey Bay Hospital (includes Maryborough)
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HFSS	Heart Failure Support Service
HHS	Hospital and Health Service
HOCM	Hypertrophic Obstructive Cardiomyopathy
HSQ	Health Support Queensland
IC	Interventional Cardiology
ICD	Implantable Cardioverter Defibrillator
IHT	Inter-hospital Transfer
IPCH	Ipswich Community Health
LAA	Left Atrial Appendage
LAD	Left Anterior Descending Artery
LCX	Circumflex Artery
LGH	Logan Hospital
LOS	Length Of Stay
LV	Left Ventricle
LVEF	Left Ventricular Ejection Fraction
LVOT	Left Ventricular Outflow Tract
MBH	Mackay Base Hospital
MI	Myocardial Infarction
MIH	Mt Isa Hospital
MRA	Mineralocorticoid Receptor Antagonists
MTHB	Mater Adult Hospital, Brisbane
NCDR	The National Cardiovascular Data Registry
NOAC	Non-Vitamin K Antagonist Oral Anticoagulants
NP	Nurse Practitioner
NRBC	Non-Red Blood Cells
NSTEMI	Non ST-Elevation Myocardial Infarction
OR	Odds Ratio
PAH	Princess Alexandra Hospital
PAPVD	Partial Anomalous Pulmonary Venous Drainage
PCI	Percutaneous Coronary Intervention
PDA	Patent Ductus Arteriosus
PFO	Patent Foramen Ovale
PHQ	Patient Health Questionairre
QAS	Queensland Ambulance Service
QCOR	Queensland Cardiac Outcomes Registry
QEII	Queen Elizabeth II Hospital
QH	Queensland Health
QHAPDC	Queensland Hospital Admitted Patient Data Collection
RBC	Red Blood Cells
RBWH	Royal Brisbane and Women's Hospital
RCA	Right Coronary Artery
RDH	Redcliffe Hospital
RHD	Rheumatic Heart Disease
RKH	Rockhampton Hospital
RLH	Redland Hospital
SCCIU	Statewide Cardiac Clinical Informatics Unit
SCCN	Statewide Cardiac Clinical Network
SCUH	Sunshine Coast University Hospital
SHD	Structural Heart Disease
STEMI	ST-Elevation Myocardial Infarction
STS	Society of Thoracic Surgery
TAVR	Transcatheter Aortic Valve Replacement
TMVR	Transcatheter Mitral Valve Replacement
TNM	Tumour, Lymph Node, Metastases
TPCH	The Prince Charles Hospital
TPVR	Transcatheter Pulmonary Valve Replacement
TTH	The Townsville Hospital
TWH	Toowoomba Hospital
VAD	Ventricular Assist Device
VATS	Video-Assisted Thoracic Surgery
VCOR	Victorian Cardiac Outcomes Registry
VF	Ventricular Fibrillation
VSD	Ventricular Septal Defect

Ongoing initiatives

Whilst continually refining and improving data collection and reporting practices for the benefit of public facilities, QCOR is also beginning the investigation of a method to collect and analyse clinical data for private healthcare facilities. Following interest from various private providers, QCOR is looking to extend its quality and safety focus to accommodate the requirements of these facilities. It is anticipated that QCOR will provide a role in the delivery of reports and benchmarking activities whilst also acting as a conduit to the various national registries in existence and development.

Cardiac outreach continues to expand in Queensland with formalised and newly funded services having commenced between Cairns and Hinterland and Torres and Cape Hospital and Health Service intending to provide cardiac care in many of these communities for the first time. Services will commence in January 2020 between Townsville and North West. The forward plan for the rollout of this model across the state has been developed in partnership with consumers and clinicians. A new system, the QCOR Outreach application has been developed to track activity, service provision and patient outcomes. This ground-up development specifically for cardiac outreach finished testing and goes live for use in late 2019.

The QCOR Structural Heart Disease module is currently in advanced stages of development with wider deployment expected in 2020. This QCOR module has been developed to provide superior procedure reporting capabilities for structural heart disease interventions, device closure, and percutaneous valve replacement and repair procedures. It will enable participation in national quality and safety activities for transcatheter aortic valve replacement as well as allow clinicians to utilise the application for collecting pre and post-procedural data in unprecedented detail. The application has been through rigorous testing with user training and further enhancements planned for the near future.

The ECG Flash initiative of the SCCN has continued to be implemented at several sites throughout 2018 and 2019. Deployment of hardware to spoke sites has been via a staged approach with uptake being varied based on local site workload and workforce. Integration of ECG Flash with workflow within hub sites continues to evolve with sites now taking the initiative to embrace and feedback to sites regarding the appropriate use of the system. Analysis of the utility of the system is beginning to take place with a focus on clinical efficacy and benefit. It is anticipated that QCOR will be able to support this new initiative through procedural linkage and outcome monitoring for the subset of patients whose clinical path utilised ECG Flash and went on to subsequent investigation or management.

Opportunities for participation in the formative stages of national registries and initiatives have been embraced by Queensland clinicians. These important initiatives which are in various stage of development will be critical to the future of clinical registries in Australia. It is anticipated that with further involvement from local stakeholders that these entities will evolve into relevant and useful tools for patient-centred reporting and outcomes.

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