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Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry
2017 Annual Report

Cardiac Surgery Audit

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

Queensland Government

Contents

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Cardiac Surgery Audit

Figures

Cardiac Surgery Audit Supplement

Upcoming initiatives

Tables

1 Message from the SCCN Chair

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

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

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

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

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

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

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

Dr Paul Garrahy
Chair
Statewide Cardiac Clinical Network

2 Introduction

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

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

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

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

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

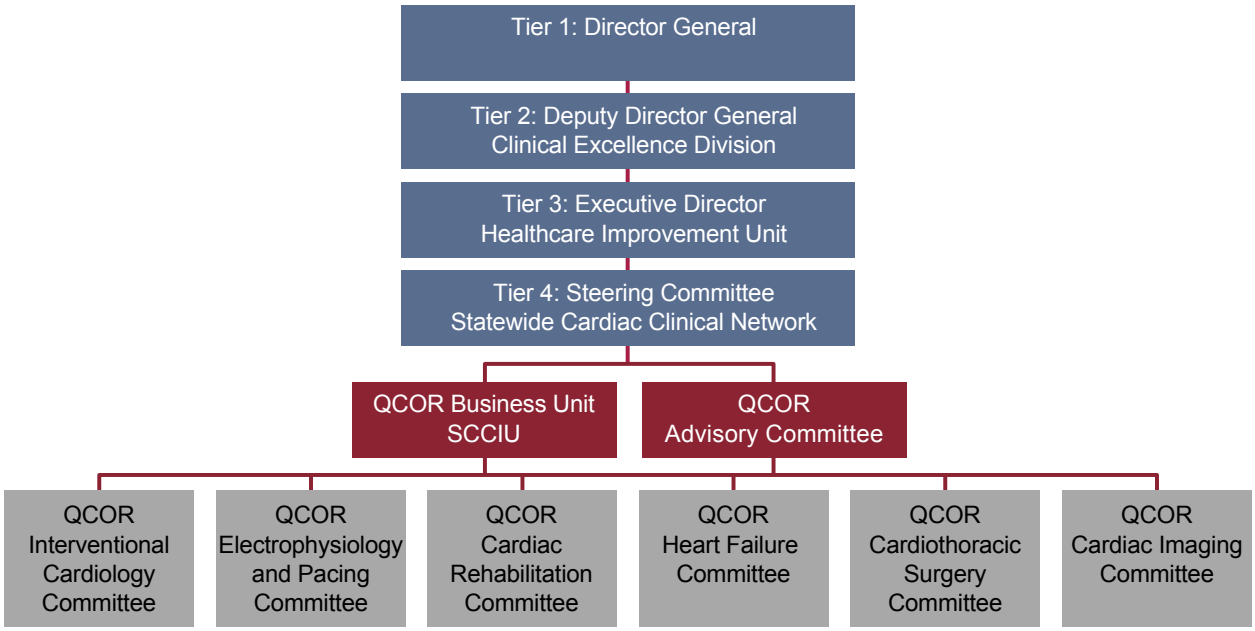

Figure A: Operational structure

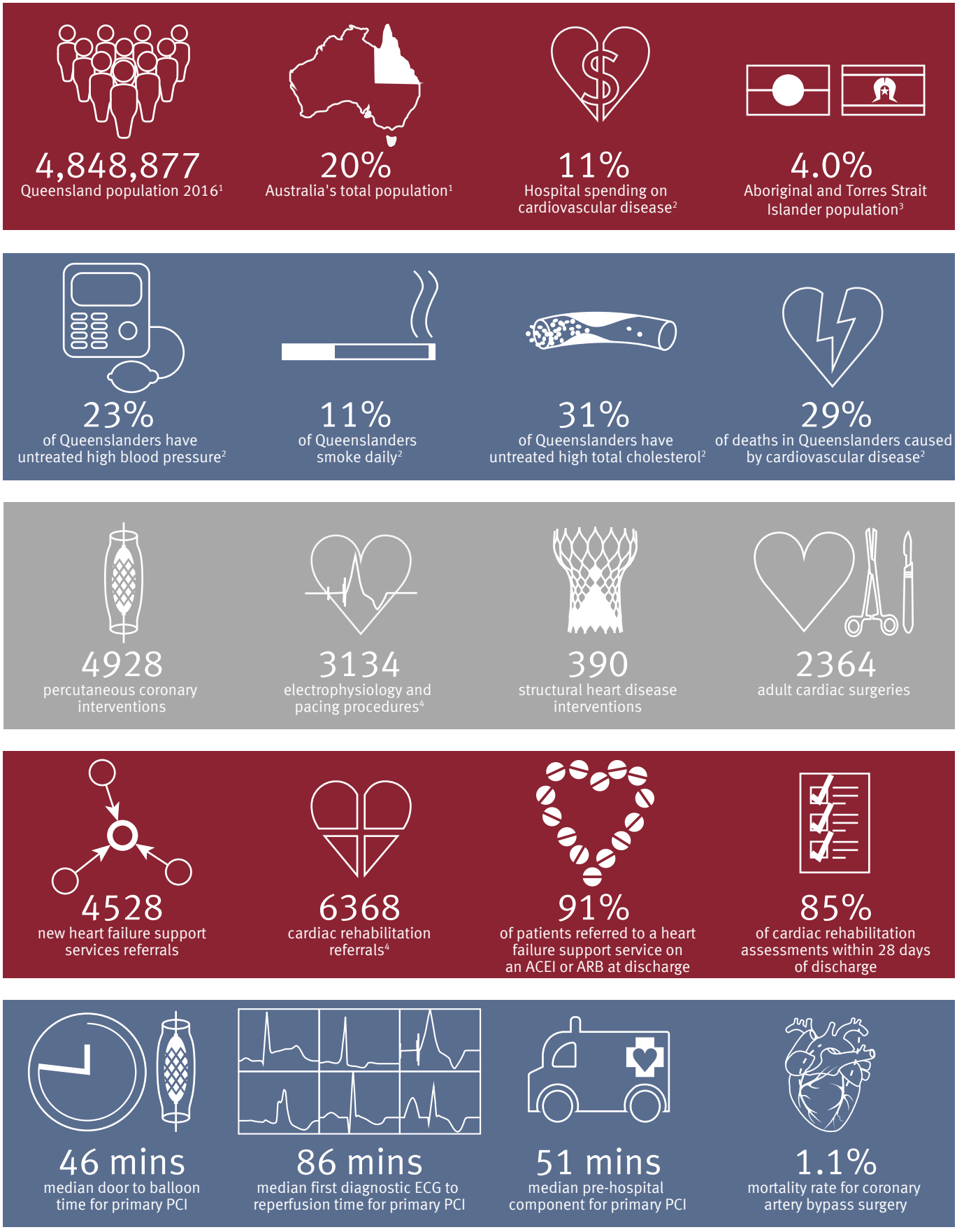

Figure B: QCOR 2017 infographic

3 Executive summary

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

4 Acknowledgements and authors

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

The work of the Queensland Cardiac Outcomes Registry would not be possible without the continued support and funding from the Clinical Excellence Division, Queensland Health. This publication draws on the expertise of many people. In particular, staff from the Statistical Services Branch the Healthcare Improvement Unit and the Queensland Ambulance Service within the Department of Health and Emergency Services each make significant contributions to ensure the success of the program. Furthermore, the tireless work of clinicians who contribute and collate quality data, as part of providing quality patient care, ensures credible analysis, and monitoring of the standard of cardiac services in Queensland.

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6 Future plans

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

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

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

Cardiac Surgery Audit

17 Message from the QCOR Cardiothoracic Committee Chair

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

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

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

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

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

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

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

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

18 Key findings

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

Key findings include:

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

19 Participating sites

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

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

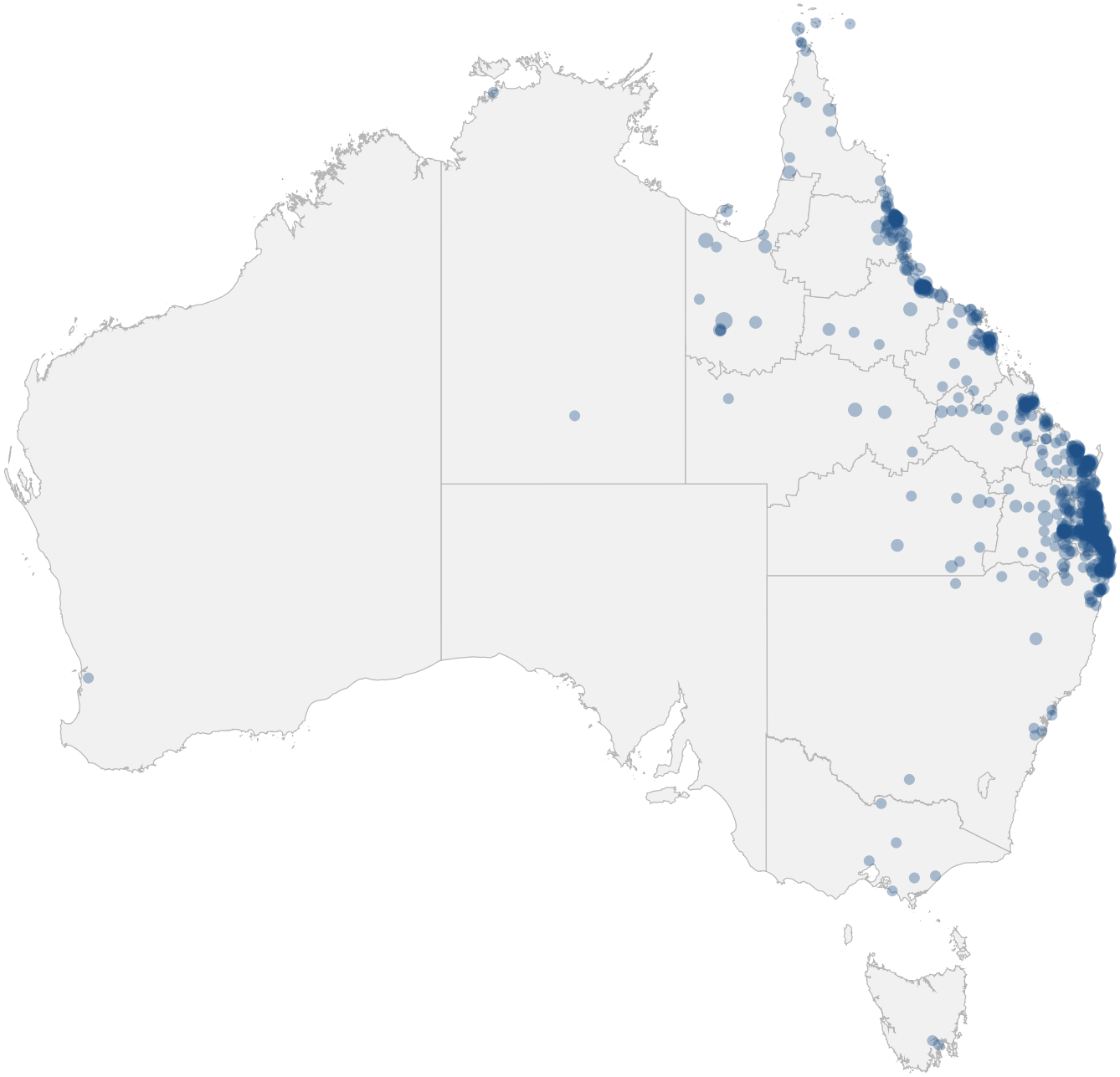


Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

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

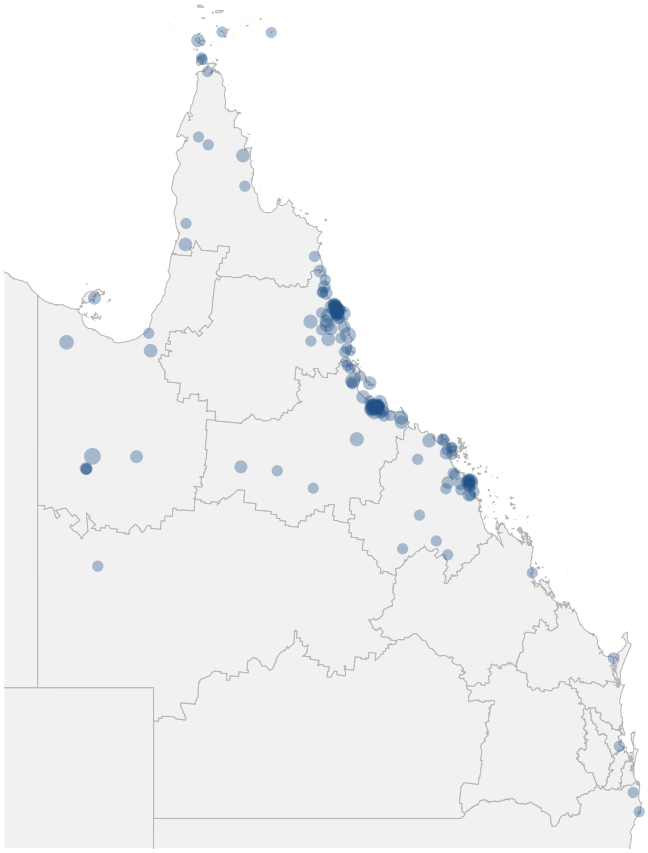


Figure 2: The Townsville Hospital

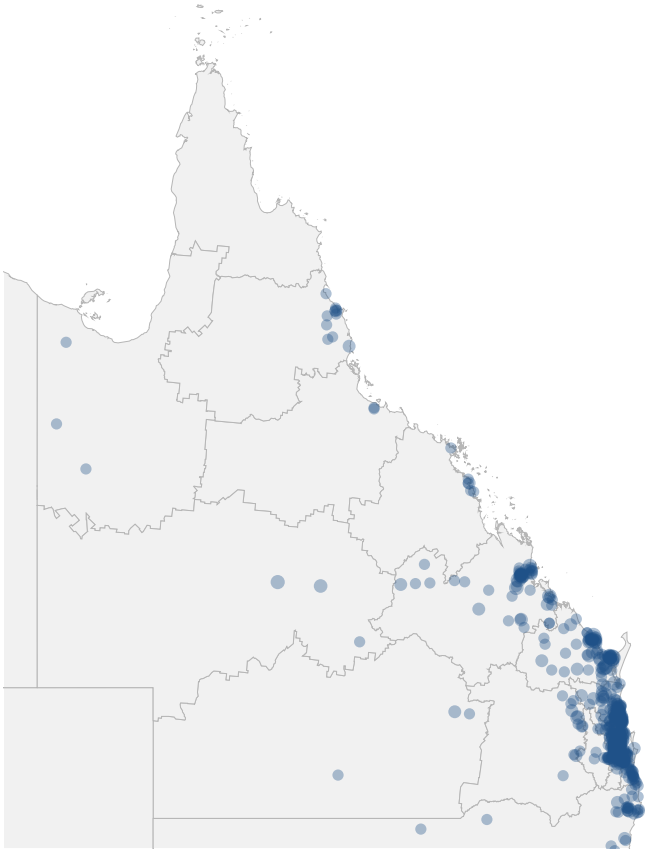


Figure 3: The Prince Charles Hospital

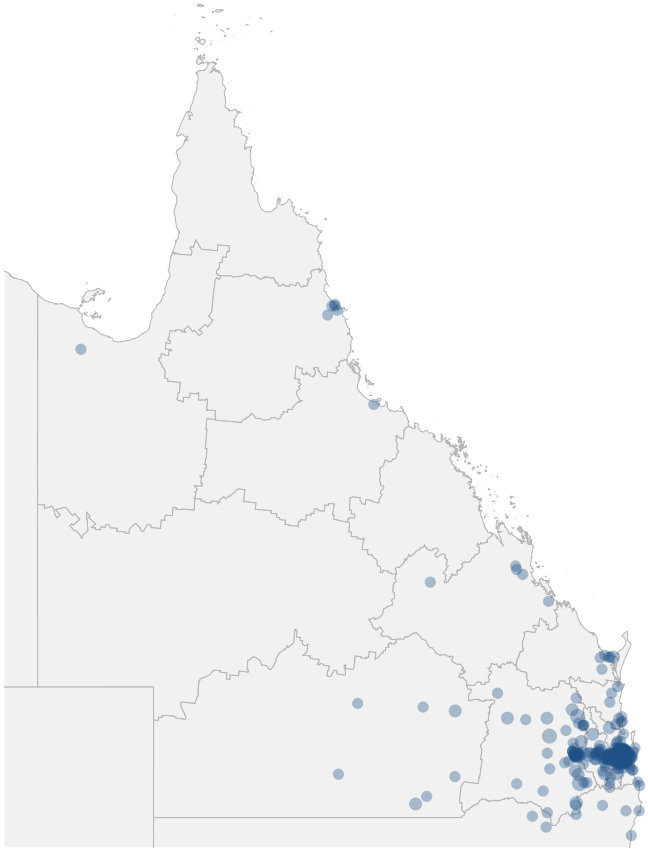


Figure 4: Princess Alexandra Hospital

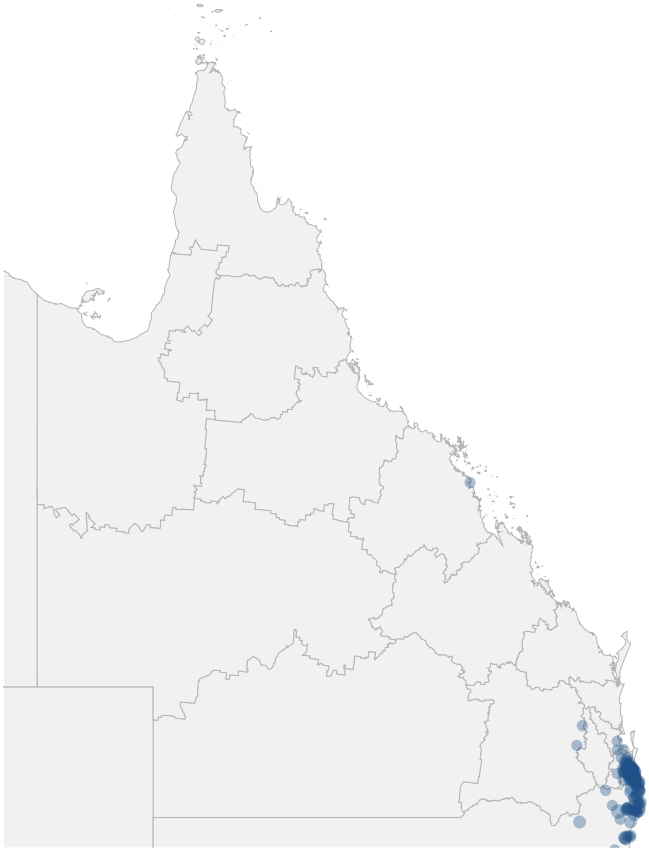


Figure 5: Gold Coast University Hospital

20 Case totals

20.1 Total cases

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

Table 2: Procedure counts and surgery category

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

Note, final column outlines allocation of procedures to surgery categories

* Category procedure combination allocated

† Includes TAVR procedures (n=40)

20.2 Cases by category

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

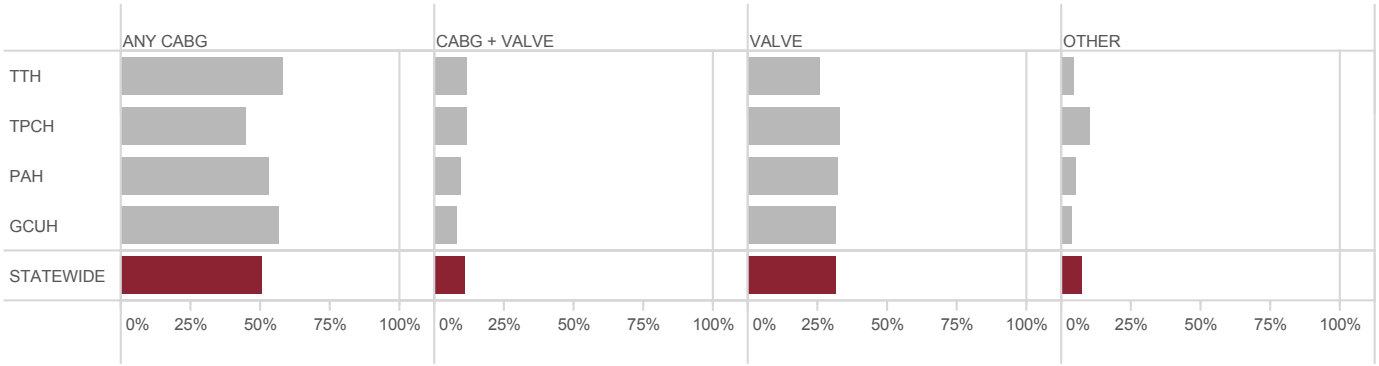


Figure 6: Proportion of cases by site and surgery category

Table 3: Proportion of cases by surgery category

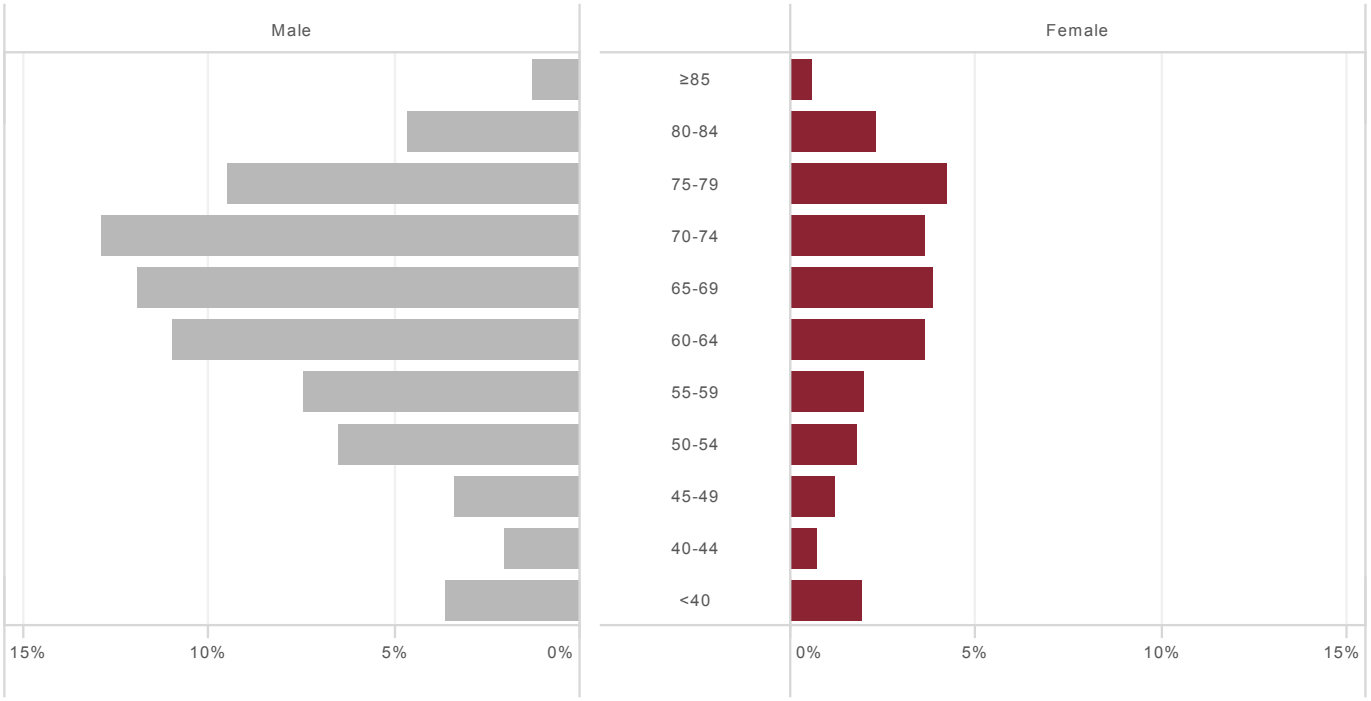
SITE	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	Total cases n (%)
TTH	206 (58.2)	41 (11.6)	91 (25.7)	16 (4.5)	354 (100.0)
TPCH	498 (44.8)	131 (11.8)	370 (33.3)	113 (10.2)	1,112 (100.0)
PAH	304 (53.1)	56 (9.8)	184 (32.1)	29 (5.1)	573 (100.0)
GCUH	183 (56.3)	27 (8.3)	103 (31.7)	12 (3.7)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

21 Patient characteristics

21.1 Age and gender

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

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



% of total (n=2,364)

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

Table 4: Median age by gender and surgery category

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

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

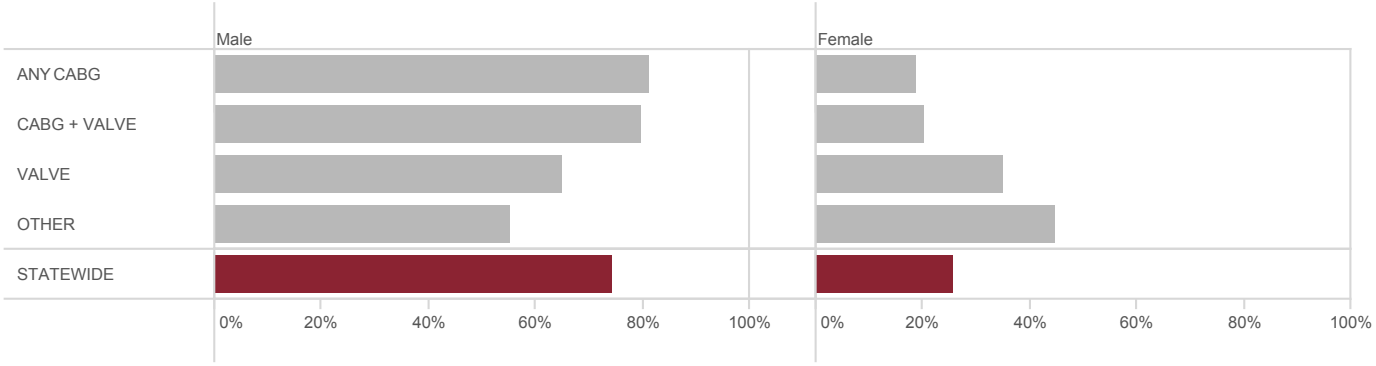
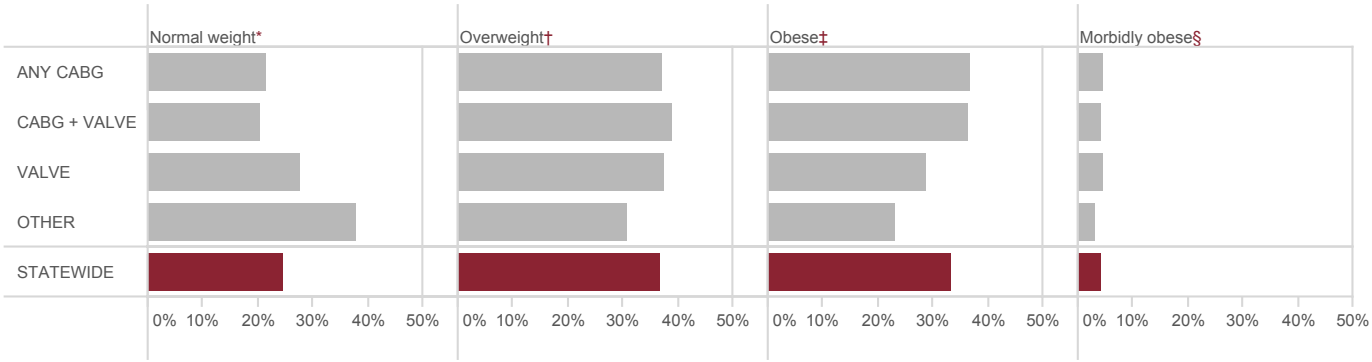


Figure 8: Proportion of cases by gender and surgery category

21.2 Body mass index

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

There were less obese patients in the valve only surgery category (29%) than other categories that include CABG surgery (37% and 36%). Patients classed as underweight (BMI<18.5kg/m²) represented approximately 1% of all cases.



* BMI 18.5–24.9 kg/m²

† BMI 25–29.9 kg/m²

‡ BMI 30–39.9 kg/m²

§ BMI ≥40 kg/m²

Figure 9: Proportion of cases by BMI and surgery category

Table 5: Proportion of cases by BMI and surgery category

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

21.3 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of health with a known impact on the development of cardiovascular disease. It is recognised that the Aboriginal and Torres Strait Islander population have a higher incidence and prevalence of coronary artery disease than other ethnicities.[11]

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

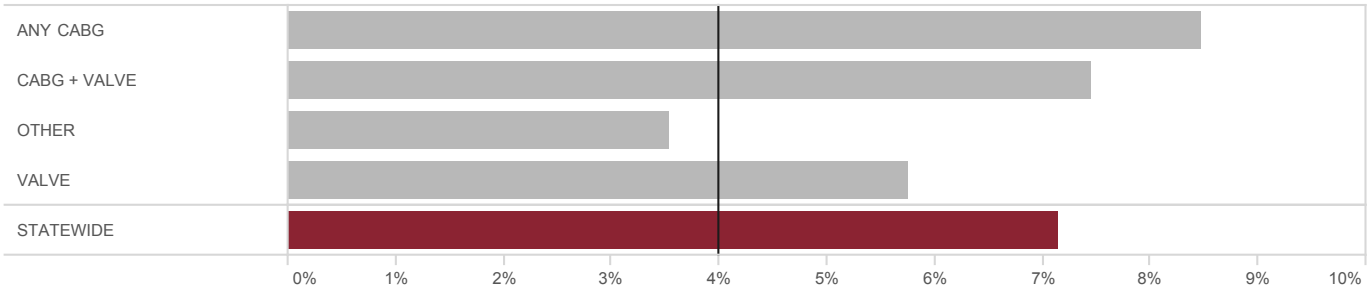


Figure 10: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

22 Risk factor profile

22.1 Smoking history

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

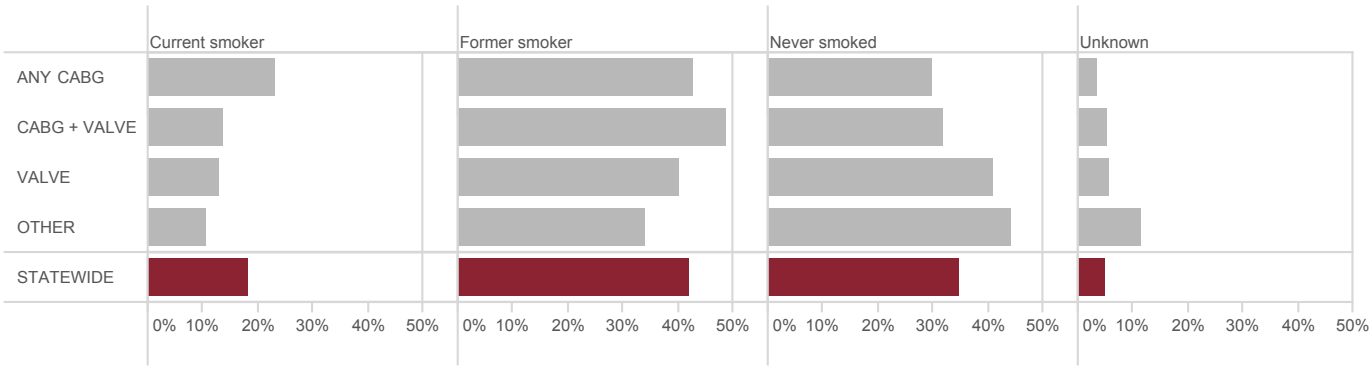


Figure 11: Proportion of cases by smoking status and surgery category

22.2 Diabetes

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

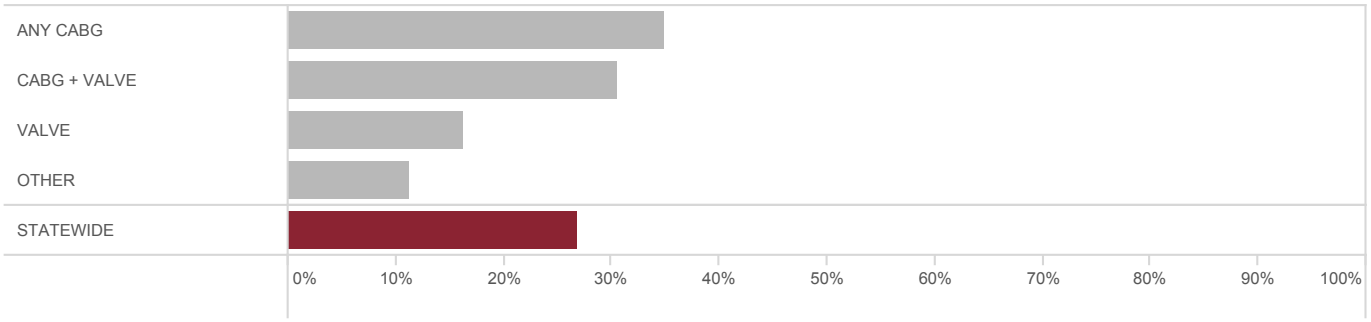


Figure 12: Proportion of cases by diabetes status and surgery category

22.3 Hypertension

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

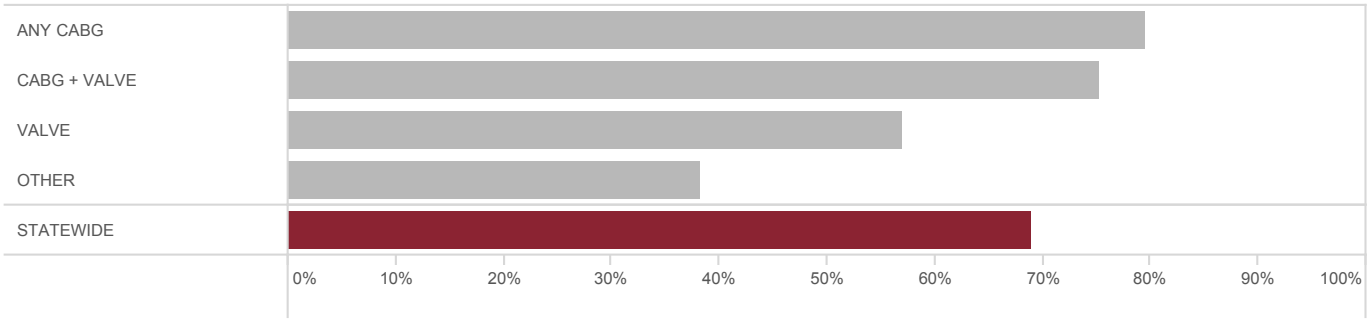


Figure 13: Proportion of cases by hypertension status and surgery category

22.4 Statin therapy

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

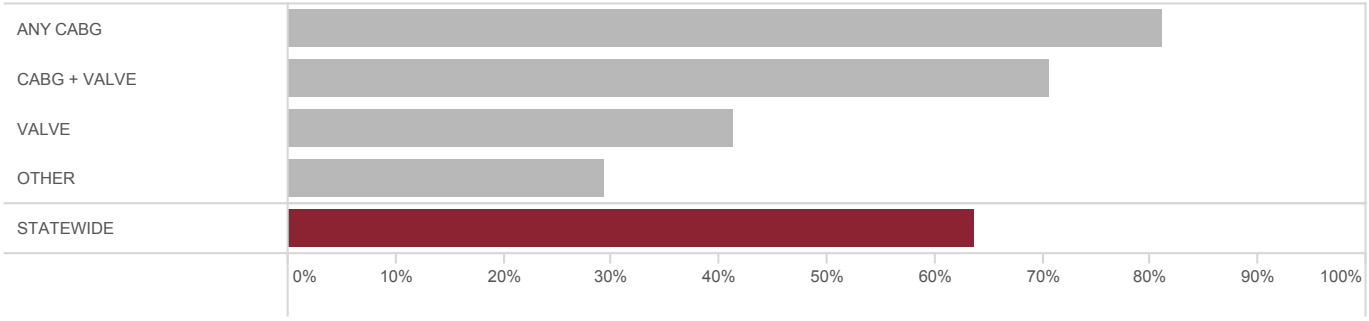


Figure 14: Proportion of cases by statin therapy status and surgery category

22.5 Renal impairment

54% of all patients were identified as having impaired renal function (eGFR ≤89 mL/min/1.73 m²) at the time of their surgery. Of these patients, the CABG and valve group had the highest incidence of renal impairment (68%).

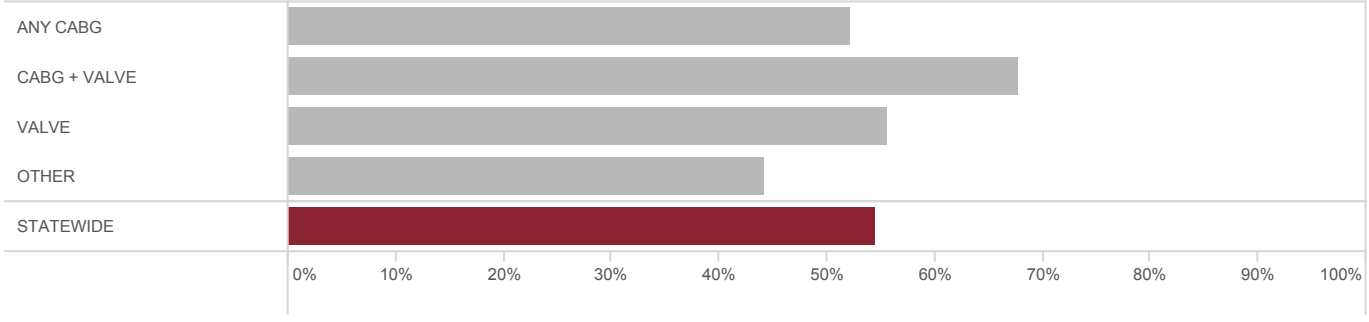


Figure 15: Proportion of cases by renal impairment status and surgery category

22.6 Severe renal dysfunction

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

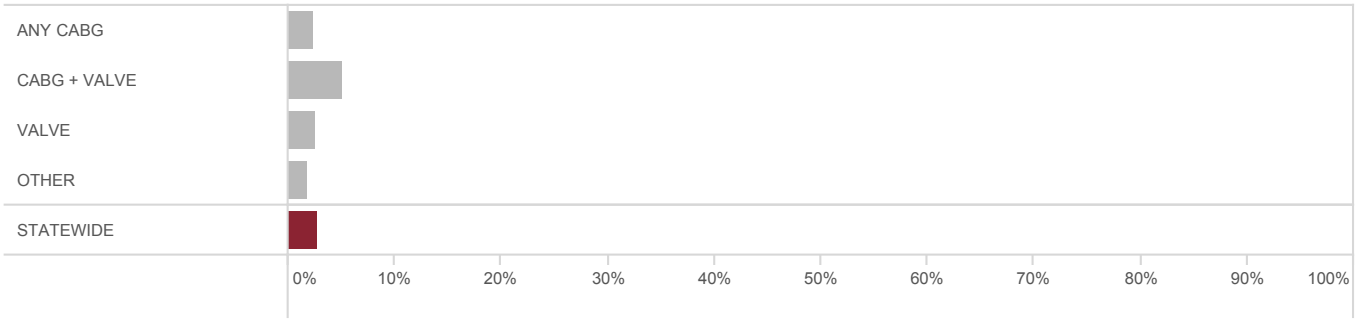


Figure 16: Proportion of cases by severe renal dysfunction status and surgery category

22.7 Left ventricular function

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

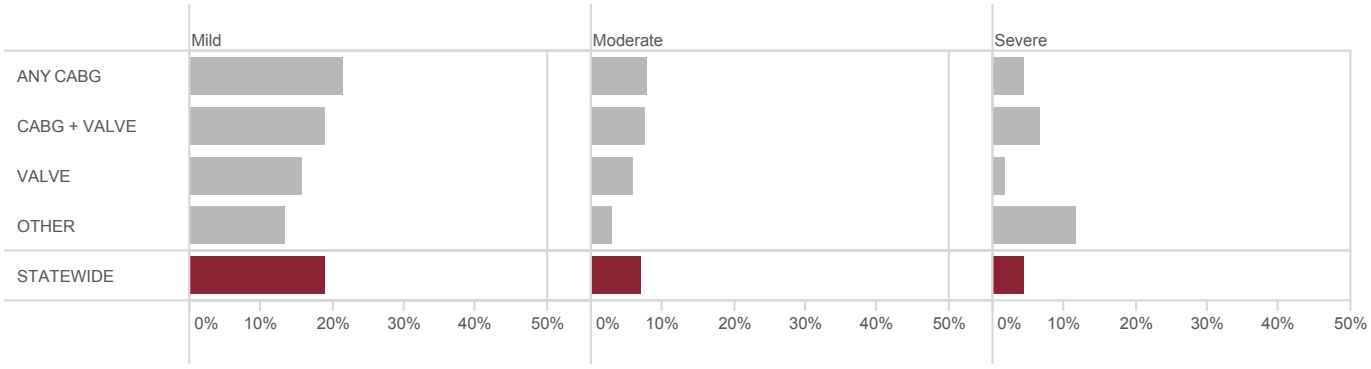


Figure 17: Proportion of cases by LV dysfunction category and surgery category

22.8 Summary of risk factors

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

Table 6: Summary of risk factors by surgery category

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

Table 7: Summary of combined risk factors by surgery category

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

23 Care and treatment of patients

23.1 Admission status

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

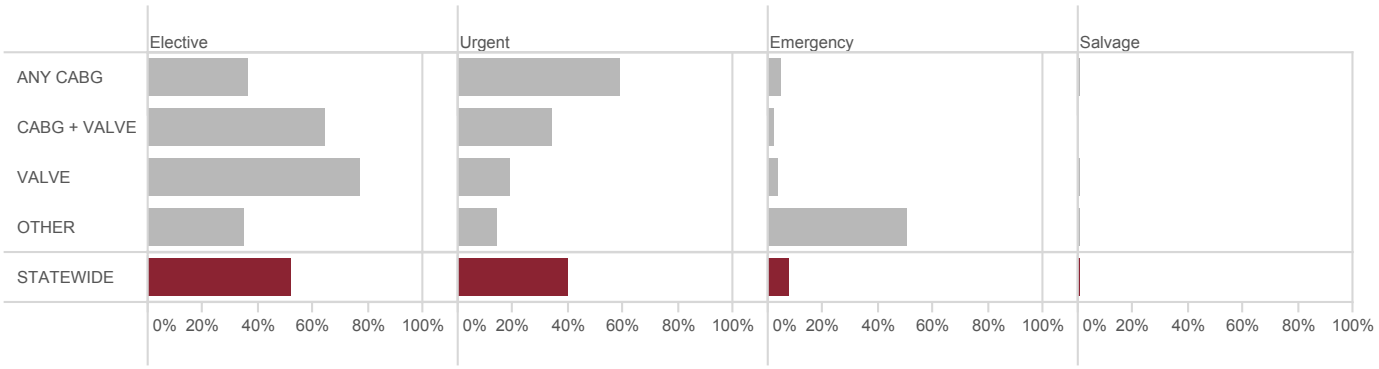


Figure 18: Proportion of cases by admission status and surgery category

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

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

23.2 Day of surgery admission

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

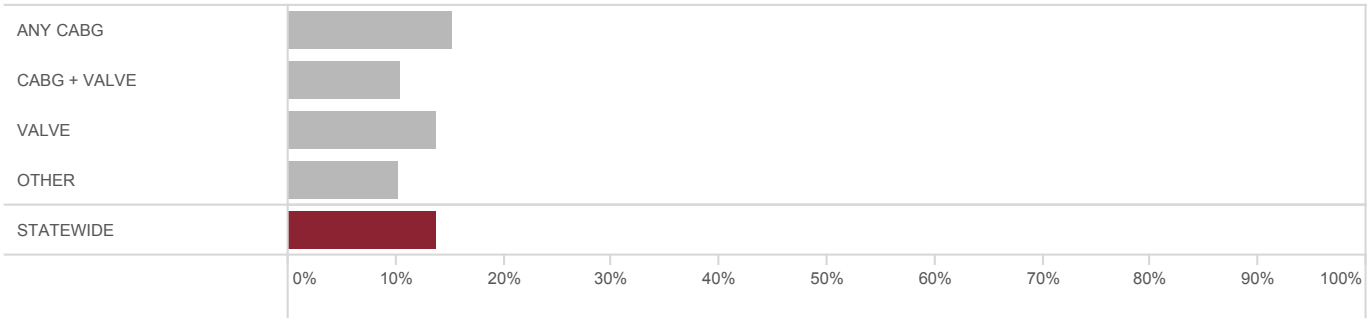


Figure 19: Proportion of elective cases for DOSA by surgery category

Table 9: Proportion of DOSA cases by surgery category

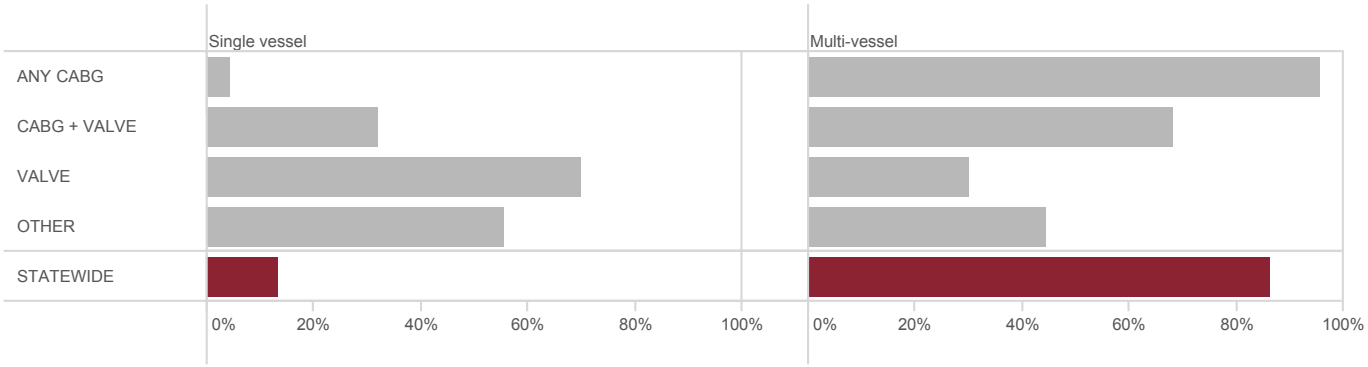
	Total elective cases n	DOSA cases n (%)
ANY CABG	433	66 (15.2)
CABG + VALVE	163	17 (10.4)
VALVE	577	79 (13.7)
OTHER	59	6 (10.2)
STATEWIDE	**1,232**	**168 (13.6)**

23.3 Coronary artery bypass grafts

23.3.1 Number of diseased vessels

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

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



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

Figure 20: Number of diseased vessels

Table 10: Number of diseased vessels

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

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

23.3.2 Mean number of grafts

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

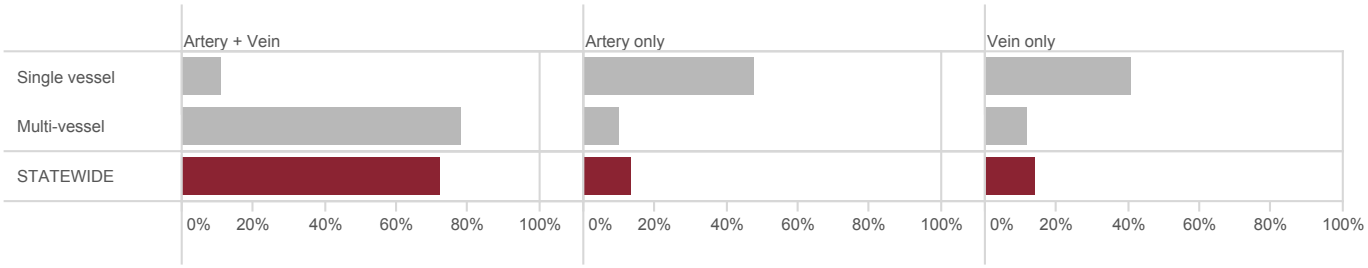
Table 11: Mean number of grafts by number of diseased vessels

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

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

23.3.3 Conduits used

In CABG, including surgeries involving valvular intervention, the most common form of revascularisation required the use of a combination of an arterial and vein graft (72%). Total arterial revascularisation occurred in 13% of cases.



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

Figure 21: Proportion of diseased vessels by conduits used

Table 12: Conduits used by number of diseased vessels

	Artery + Vein n (%)	Artery only n (%)	Vein only n (%)
Single vessel	14 (10.9)	62 (48.1)	53 (41.1)
Multi-vessel	1,027 (78.4)	132 (10.1)	151 (11.5)
STATEWIDE	**1,041 (72.3)**	**194 (13.5)**	**204 (14.2)**

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

23.3.4 Off pump CABG

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

Table 13: Off pump CABG

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

23.3.5 Y or T grafts

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

Table 14: Y or T graft used by procedure category

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

23.4 Aortic surgery

There was a total of 209 cases that included a procedure involving the aorta (not including procedures conducted on the aortic valve).

Most aortic surgery procedures included replacement of the ascending aorta in isolation (68%), while surgery to replace both the ascending aorta and aortic arch accounted for 15% of cases.

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

Table 15: Aortic surgery by procedure type

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

23.4.1 Aortic pathology

Table 16: Aortic surgery cases by pathology type

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

23.5 Valve surgery

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

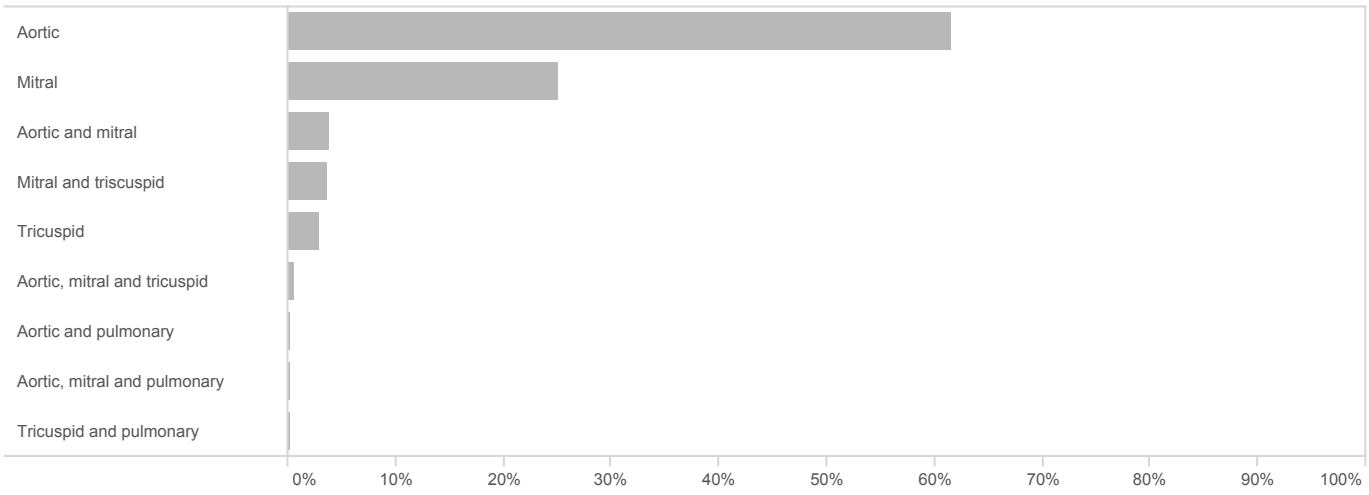


Figure 22: Proportion of valve surgery cases by valve

Table 17: Valve surgery cases by valve

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

22.5.1 Valve pathology

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

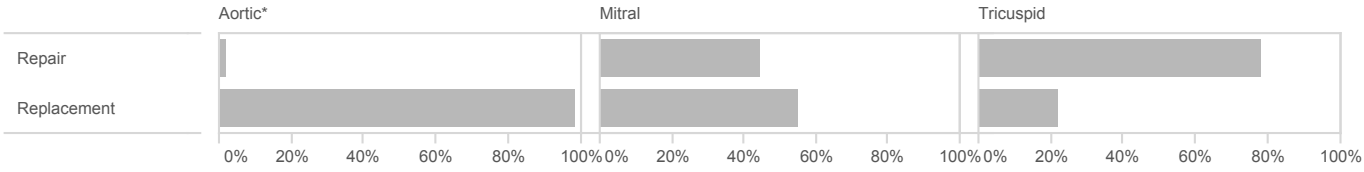
Table 18: Valve pathology by valve type

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

23.5.2 Types of valve surgery

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

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



* Aortic replacement category includes transcatheter aortic valve replacement cases

Figure 23: Valve surgery category by valve

Table 19: Valve surgery category by valve type

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

23.5.3 Valve repair surgery

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

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

Table 20: Valve repair surgery by valve type

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

23.5.4 Valve replacement surgery

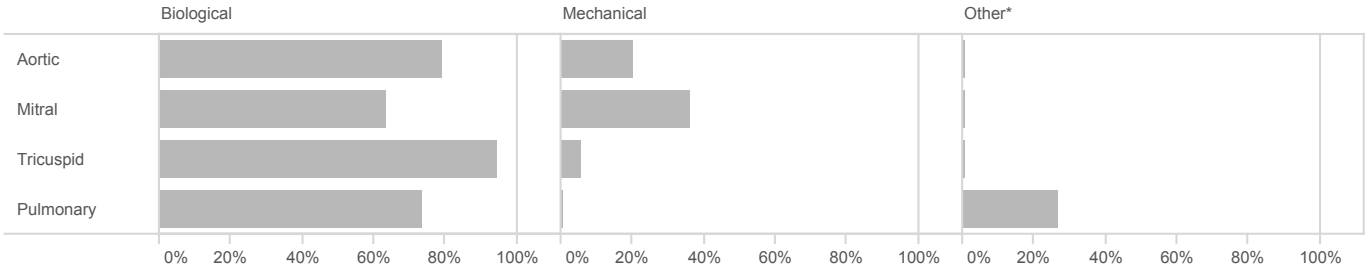
Aortic valve replacement accounted for the majority of valve replacement surgeries (75%). The reported number of TAVR cases reflects those in which a cardiothoracic surgeon was present during the procedure and does not represent the total number of these surgeries performed throughout Queensland in 2017.

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

Table 21: Valve replacement surgery by valve type

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

The most common form of valve prostheses used across all valve types were biological (76%). Mechanical prostheses were used in 31% of cases with a greater proportion represented in mitral valve replacement surgeries. Bovine pericardial aortic valve prostheses accounted for the largest proportion of all valves used (34%).



* Includes homograft/allograft and autograft

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

Table 22: Types of valve prosthesis by valve type

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

23.6 Other cardiac surgery

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

Table 23: Other cardiac procedures

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

* Bilateral sequential single lung transplantation

† Patent foramen ovale

‡ Left ventricular outflow tract

23.7 Blood product usage

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

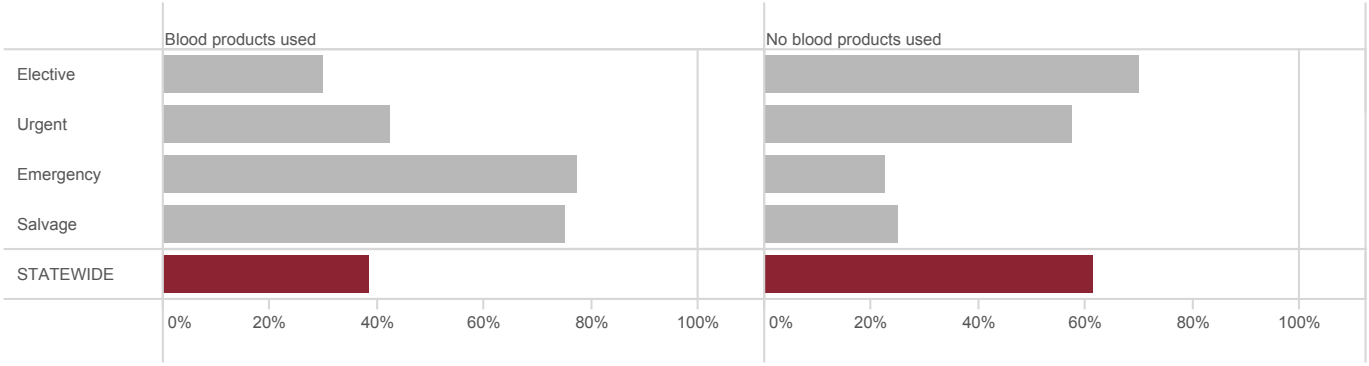


Figure 25: Blood product usage by admission status

Table 24: Blood product usage by admission status

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

24 Outcomes

There are two aspects of outcomes analysis for procedural related specialties: the risk of complications from procedures, and key targets for optimal procedural performance. This report focuses on the risk of complications from procedures and compared the aggregated outcomes of the 4 adult cardiac surgical units against calculated risk scores.

24.1 Risk prediction models

Risk adjustment algorithms are a means of estimating the likelihood of an outcome based on patient and clinical factors known at the time of surgery. Risk scores in cardiac surgery are developed on large patient cohorts and are usually relevant for a particular period in time and in a particular geographic area. In developing the scores, patient and surgical factors are analysed, and factors that are identified as statistically associated with the level of risk of surgery are identified. This statistical analysis allows the adjustment of risk for patients with certain characteristics, who are undergoing particular types of surgery.

The most common outcome evaluated using these risk adjustment algorithms is death after an operation, however, the Society of Thoracic Surgeons (STS) has also developed a range of algorithms predictive of the risk of complications (morbidity) after an operation. The risk models used in evaluating the 2017 clinical outcomes for cardiac surgical cases are:

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

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

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

The graphs provided in the following sections compare the actual observed rates of mortality and morbidities to that predicted using each risk model. However, when interpreting the messages provided by this analysis it is important to understand that there is more to performance in surgery than simply the decisions made by the surgeon in before, during and after the patient enters the operating theatre. Several aspects of the patient's entire journey to disease and through treatment and recovery may combine to influence the outcome of surgery.

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

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

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

24.1.1 Mortality

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

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

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

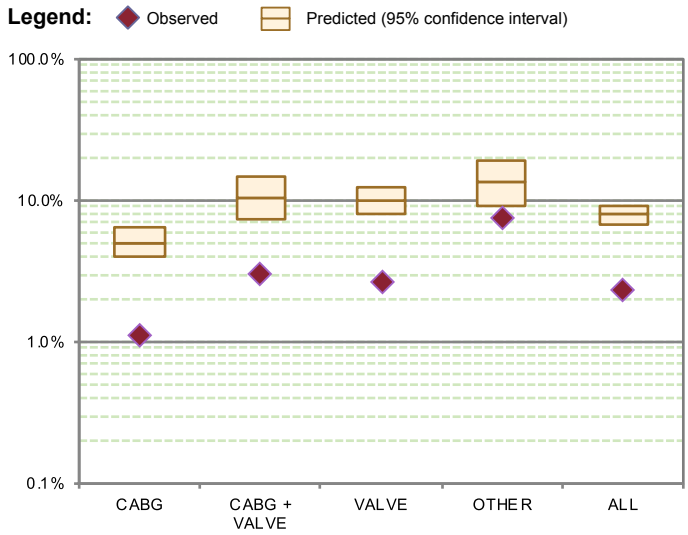


Figure 26: EuroSCORE

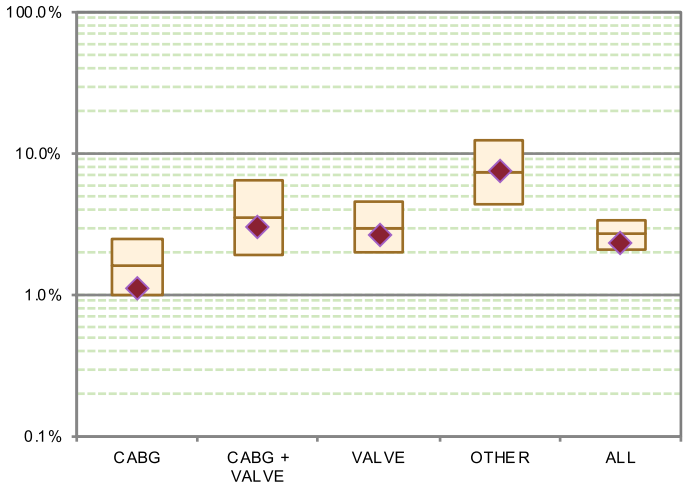


Figure 27: ANZSCTS General Score

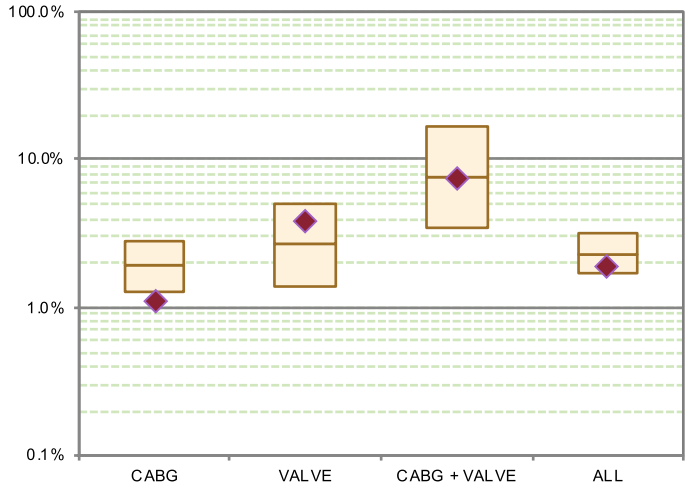


Figure 28: STS (death)

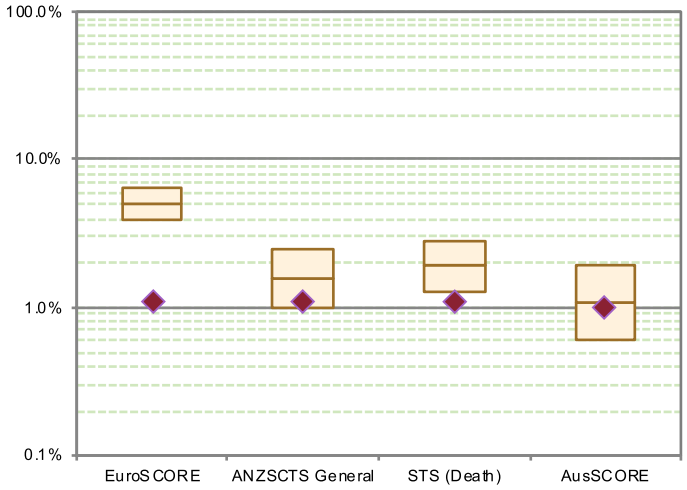


Figure 29: CABG

24.1.2 Morbidity

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

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

For 2017, most comparisons between the observed event rate and the rate predicted using the respective risk scores, demonstrate that outcomes are within expectation. The exception is deep sternal wound infection (DSWI) in CABG cases where the rate appears to be significantly higher. This data is not directly comparable with 2016 because that dataset was from three units, whereas 2017 included four units, and the significant variations in caseload with the addition of the fourth unit means that statistical comparisons from year to year cannot be made. Nevertheless, the data again demonstrates a higher observed rate than expected from the STS risk score calculator.

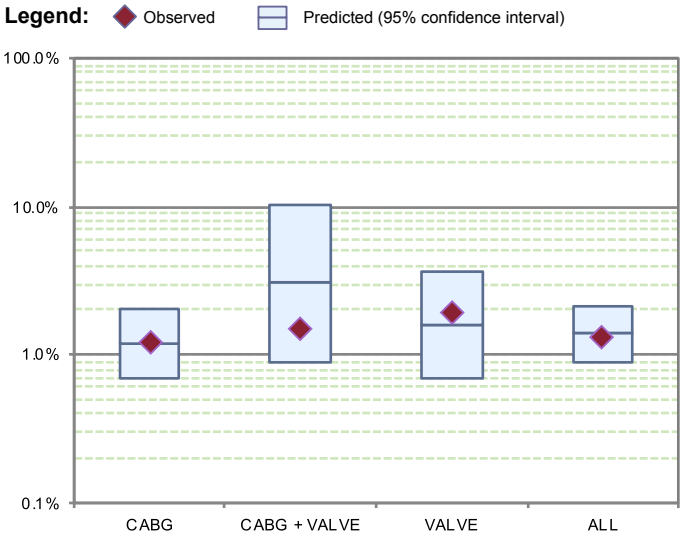


Figure 30: CVA

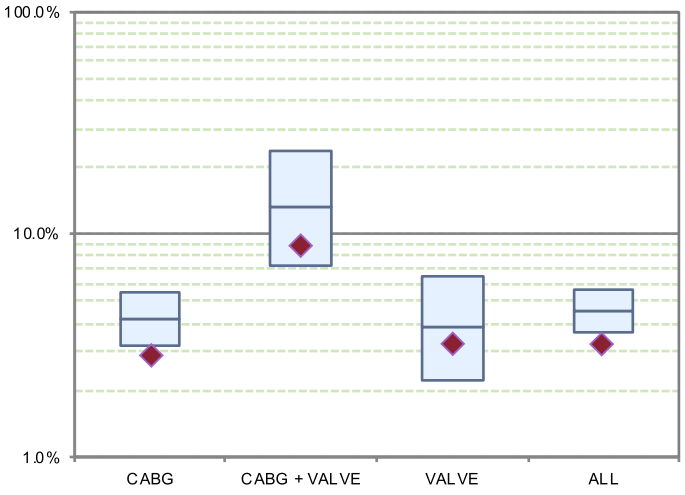


Figure 31: Renal failure

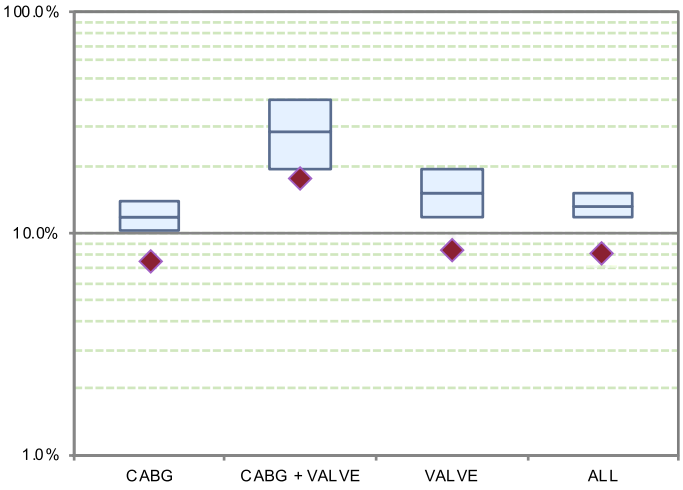


Figure 32: Ventilation >24 hours

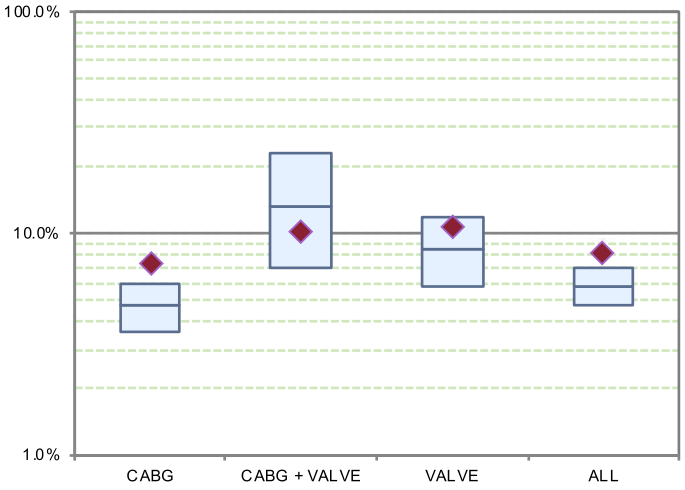


Figure 33: Reoperation

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

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

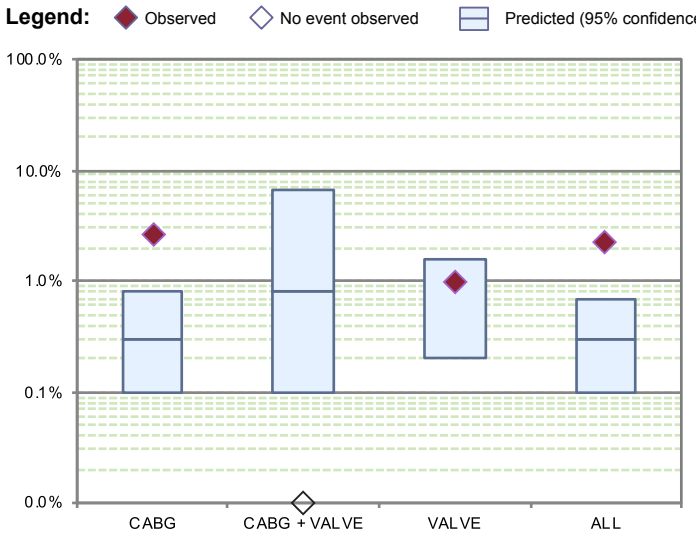


Figure 34: Deep sternal wound infection

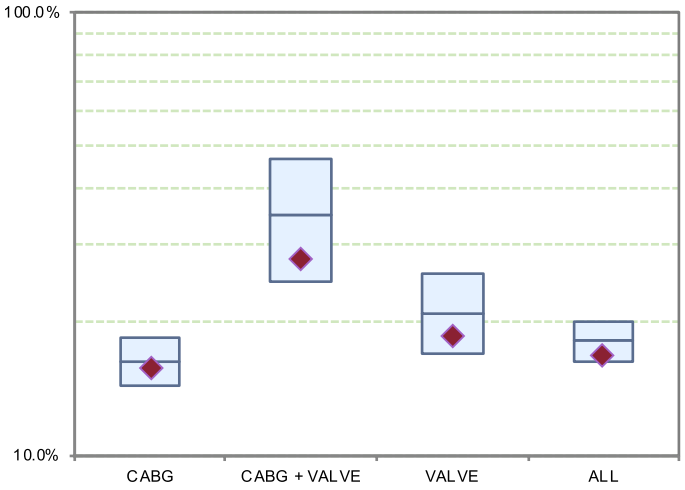


Figure 35: Major morbidity

24.1.3 Measures of process

The following charts evaluate the length of stay (LOS) of patients compared with that predicted by the STS score. LOS less than 6 days is a measure of process that allows for elective weekly booking procedures. LOS greater than 14 days excludes the patients who may stay several days after the 6 day cut off for minor reasons, but instead are on a prolonged recovery pathway.

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

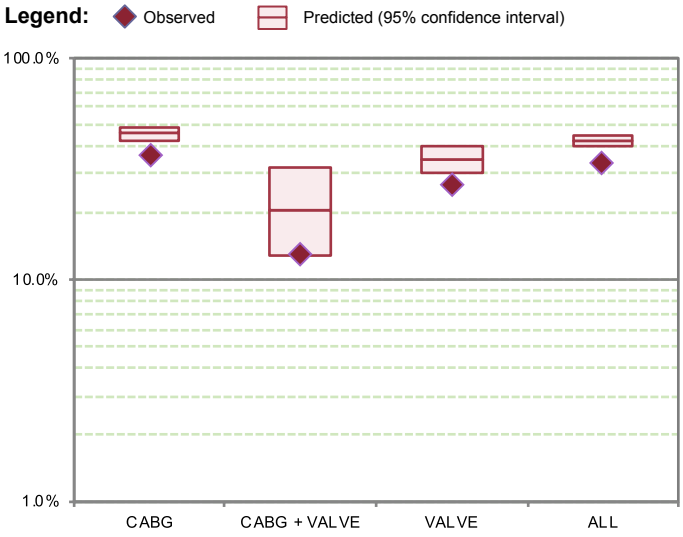


Figure 36: LOS ‹6 days

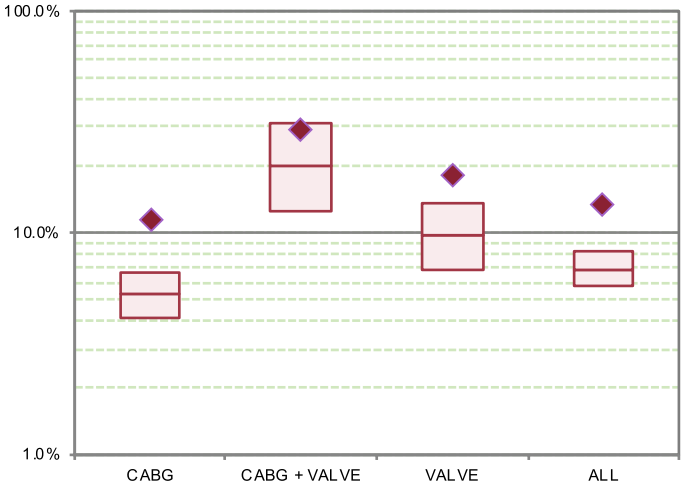


Figure 37: LOS ›14 days

24.1.4 Failure to rescue

One explanation for improved outcomes in high volume centres is that patients who suffer a complication are better treated, and hence are rescued from further progression of complications that can lead to death. Failure to rescue is a measure calculated from the risk of adverse events and the risk of death in combination, based on the assumption that an adverse event can result in death if not appropriately rescued by the hospital processes.

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

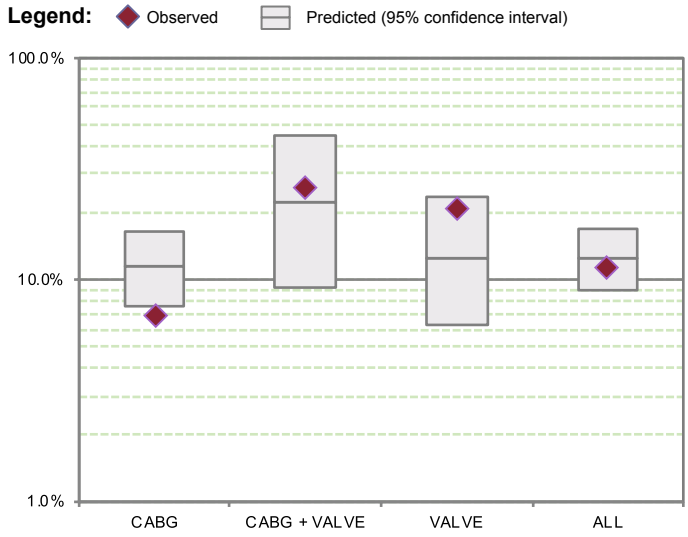


Figure 38: Failure to rescue

24.1.5 DSWI 2016

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

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

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

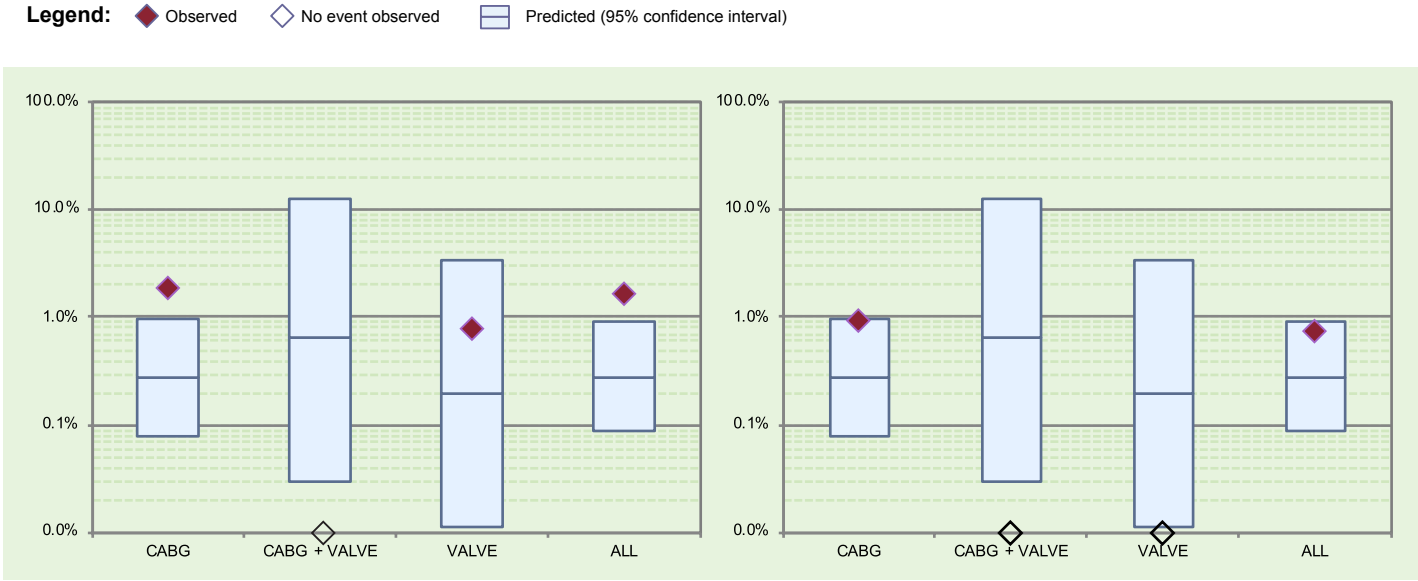


Figure 39: Comparison of 2016 deep sternal wound infection rates, pre vs. post audit

25 Conclusions

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

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

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

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

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

26 Recommendations

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

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

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

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

27 Supplement: Infective endocarditis

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

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

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

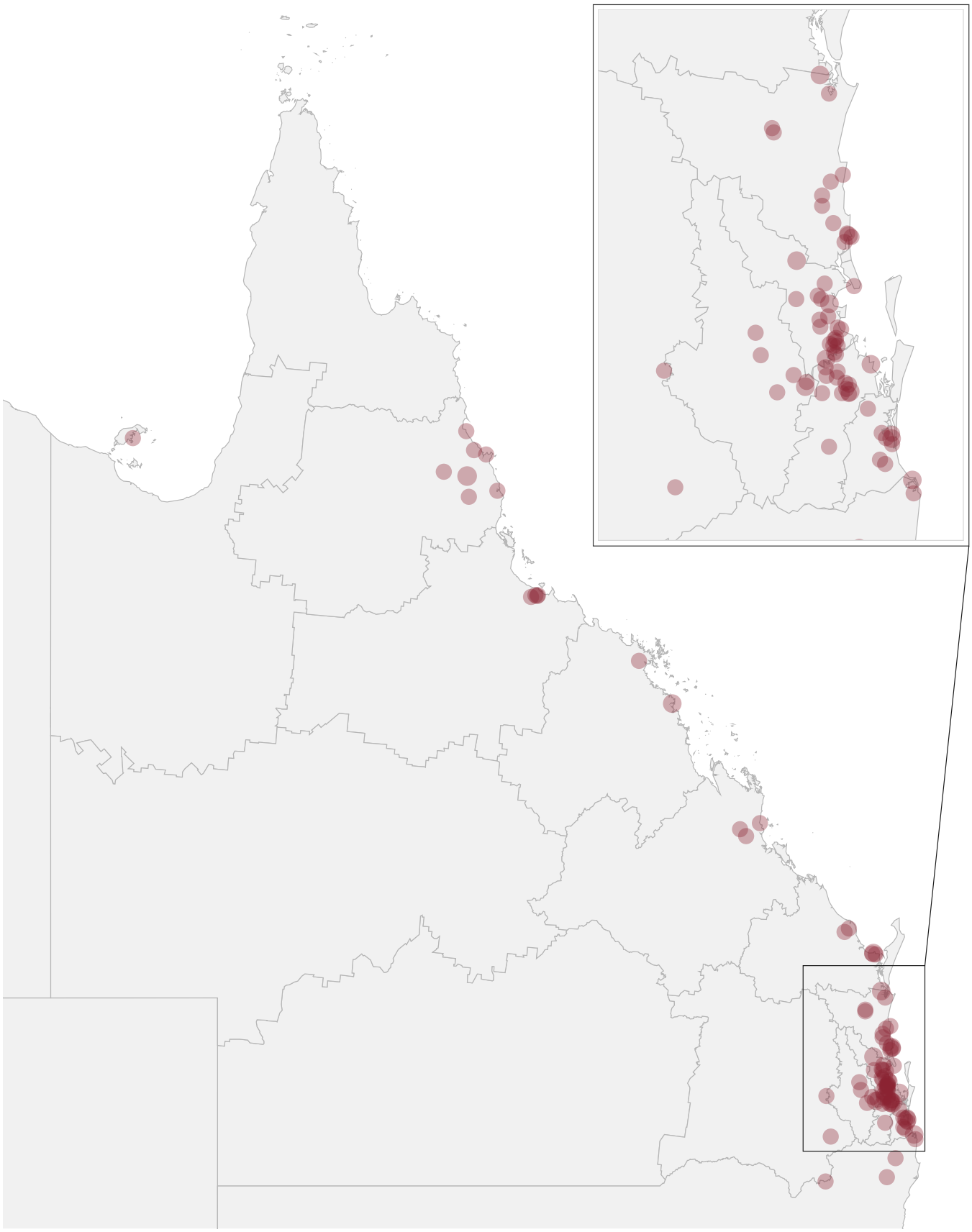


Figure 1: Infective endocarditis cases by residential postcode

27.1 Patient characteristics

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

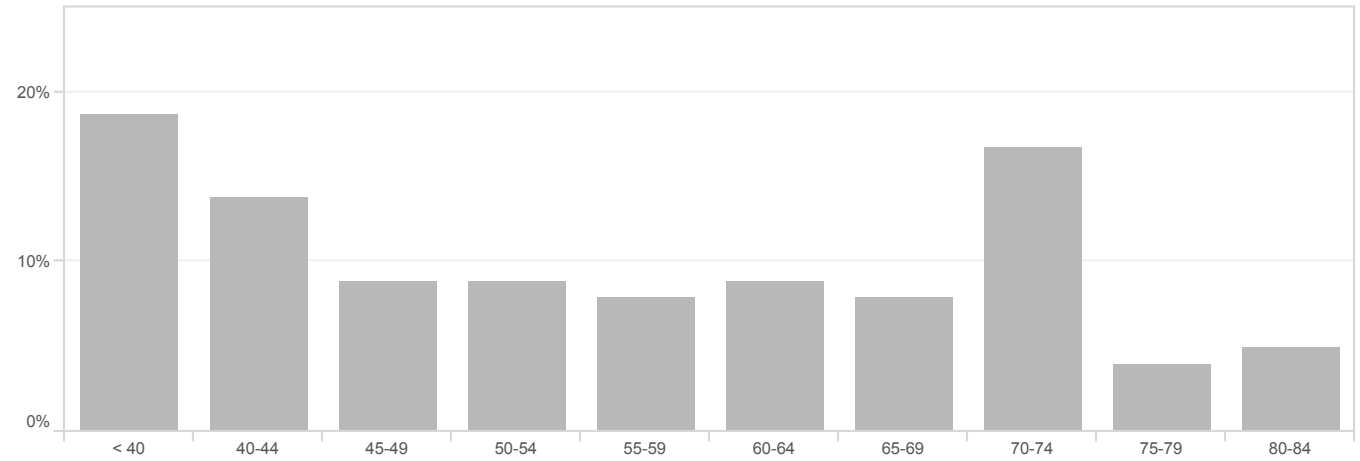


Figure 2: Infective endocarditis cases by age category

Table 1: Infective endocarditis cases by gender and age category

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

27.2 Care and treatment of infective endocarditis patients

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

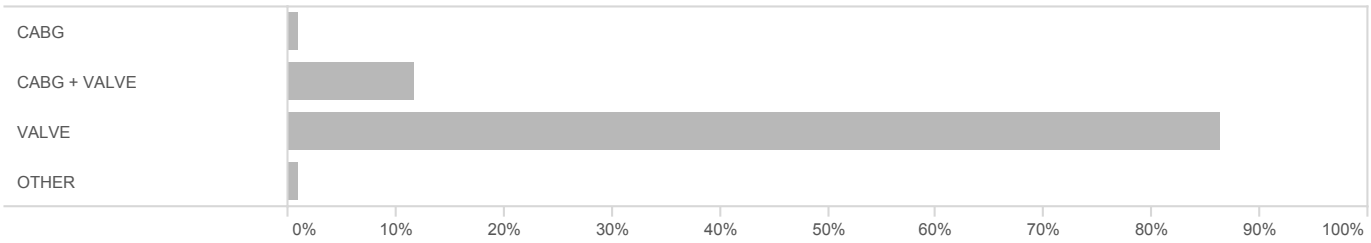


Figure 3: Infective endocarditis cases by surgery category

Table 2: Infective endocarditis cases by surgery category

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

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

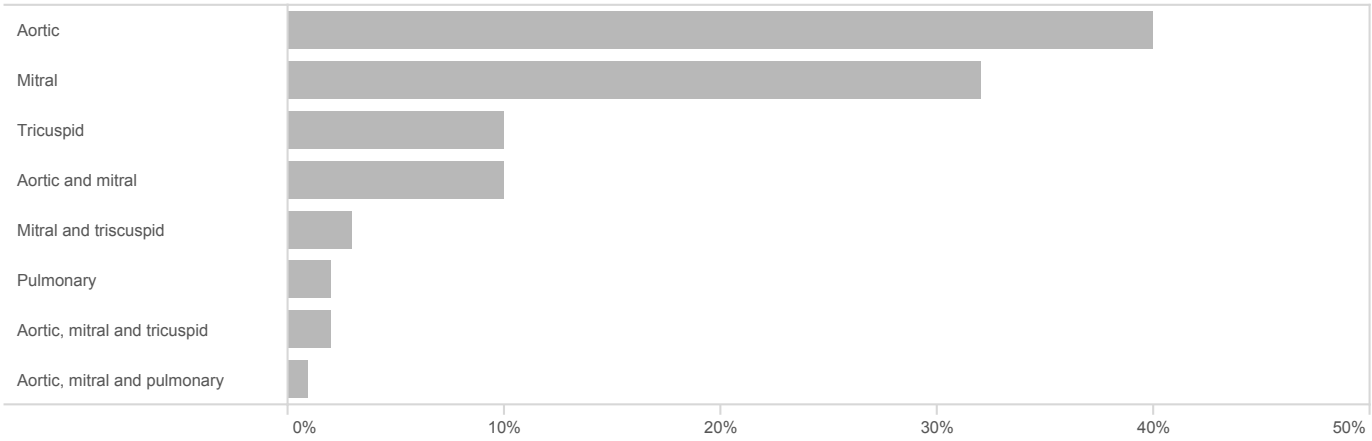


Figure 4: Infective endocarditis cases by type of valve

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

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

Table 4: Valve surgery procedures by valve type

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

27.3 Comorbidities

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

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

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

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

* eGFG ≤89mL/min/1.73m^2

† Pre operative creatinine >200µmol

‡ Insufficient data for analysis

27.4 Microbiology

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

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

Table 6: Infective endocarditis cases by infection status

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

Table 7: Active infective endocarditis cases by organism type

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

Excludes missing data (n=2)

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

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

Excludes missing data (n=2)

27.5 Patient outcomes

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

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

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

27.6 Discussion

There are several points to highlight from this data.

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

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

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

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

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

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

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59 Glossary

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

60 Upcoming initiatives

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

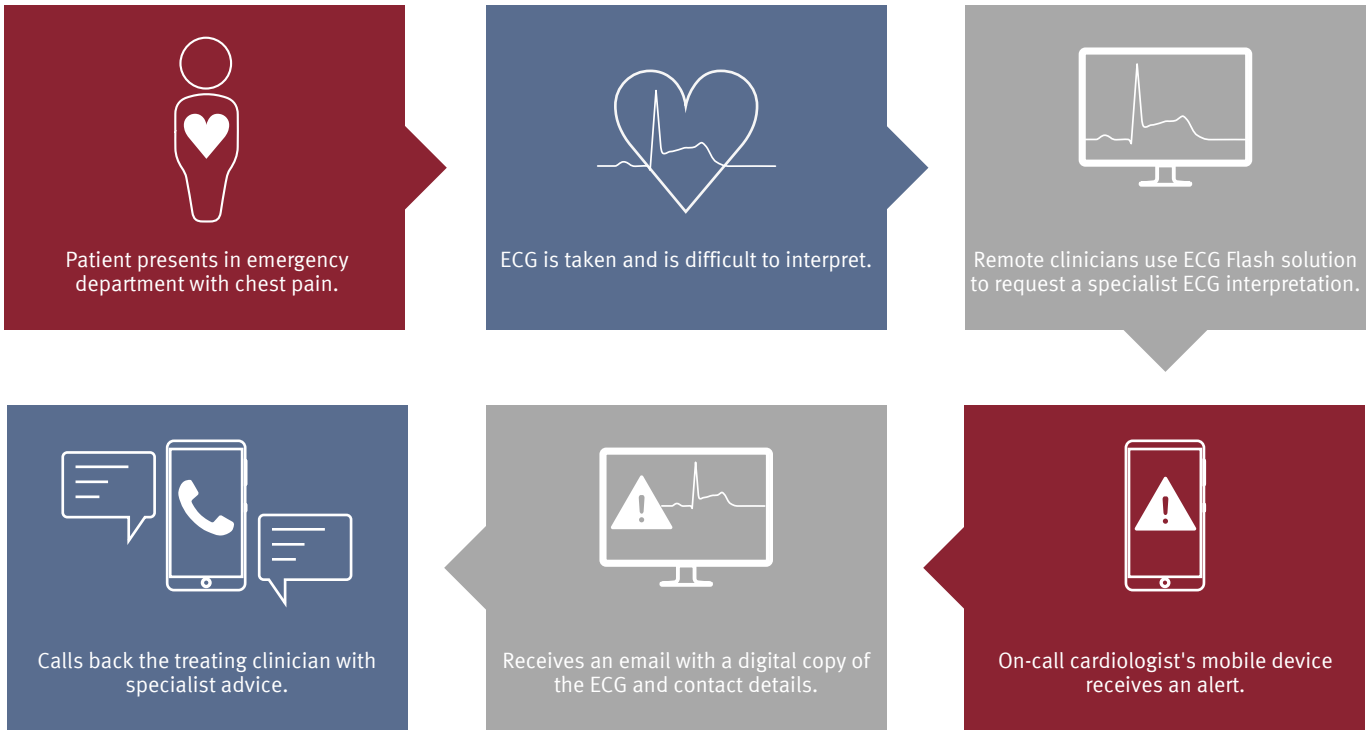

Figure C: Concept model for rapid inter-hospital clinical interpretation of 12-lead ECGs (CISP ECG Flash Project)