Queensland Health

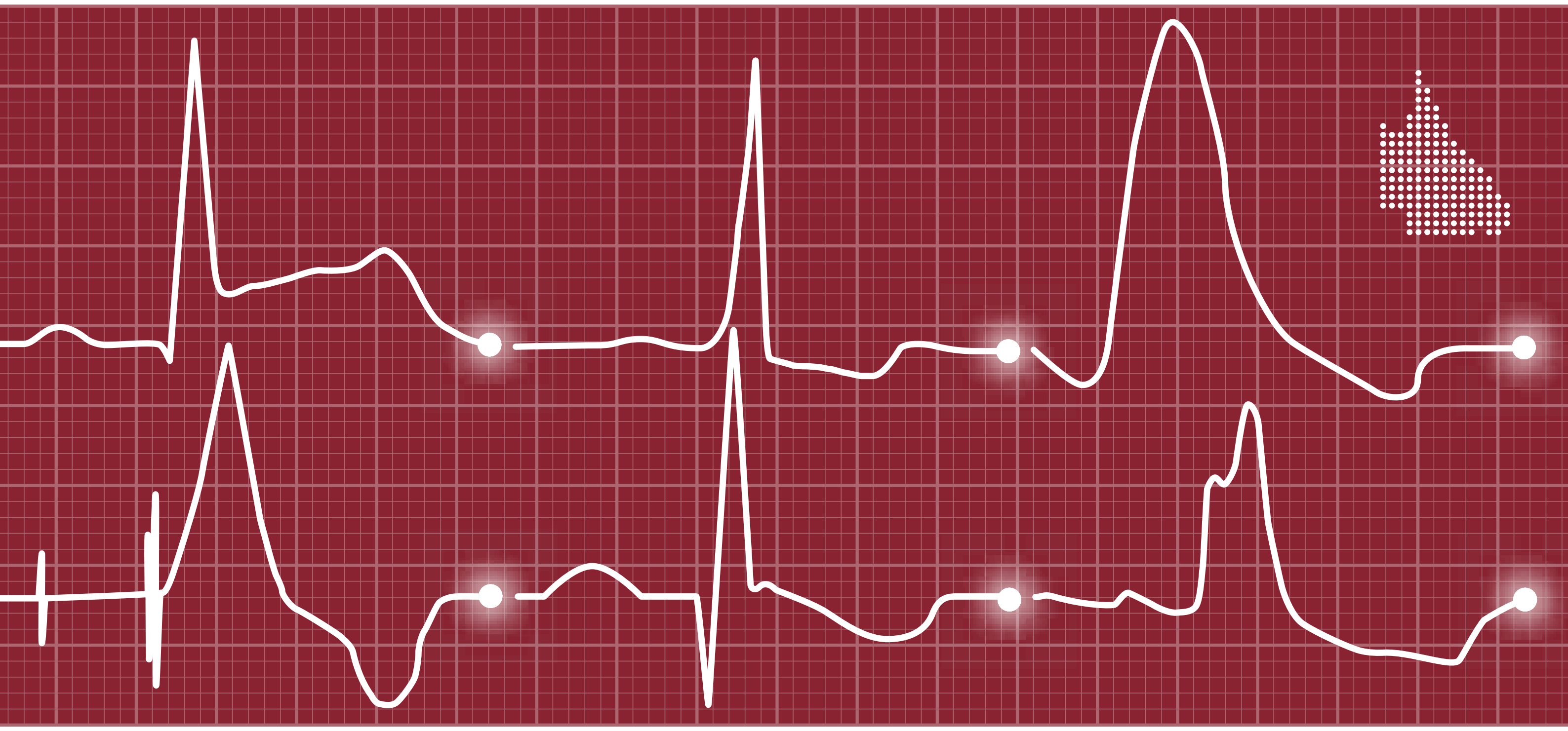
Clinical **Excellence** Queensland

Queensland Cardiac Clinical Network

Queensland Cardiac Outcomes Registry

2022 Annual Report

Cardiac Surgery Audit



Improvement | Transparency | Patient Safety | Clinician Leadership | Innovation

Queensland Government

Contents

Queensland Cardiac Outcomes Registry 2022 Annual Report

Published by the State of Queensland (Queensland Health), December 2023

For more information contact:
Queensland Cardiac Clinical Network,
Department of Health, GPO Box 48,
Brisbane QLD 4001,
email scciu@health.qld.gov.au

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

1 Message from the Queensland Cardiac Clinical Network Chair

It is with great pleasure that we present the Annual Report of the Queensland Cardiac Outcomes Registry. This report serves as a testament to the relentless pursuit of excellence in cardiovascular care within the Queensland region. The data, analyses, and insights presented here reflect the collective efforts of our passionate team, whose commitment to improving patient outcomes remains unwavering.

QCOR remains one of the most comprehensive clinician-led clinical registries in the country, incorporating modules reporting on interventional cardiology, cardiac surgery, thoracic surgery, electrophysiology and pacing, cardiac rehabilitation and heart failure support services. Through rigorous data collection, innovative research endeavours, and collaborative efforts, we have made significant strides in enhancing patient outcomes, advancing medical knowledge, and fostering a healthier future for our community.

We continue to keenly await the delivery of a contemporary statewide cardiovascular information system for diagnostic and interventional cardiology and echocardiography. Following a successful procurement process, the platform for a forward-thinking, all-encompassing solution has been laid and throughout the process to date, the collegiality and cooperation of cardiac clinicians throughout the state has once again been exemplified.

In the era of expanding datasets and advanced analytics, our commitment will be to translating the knowledge gained from this program into information supporting patient safety and quality initiatives. We are looking forward to expanded capability for data collection and analysis to become part of real-time care delivery, recognising always the patient as the focus of our efforts. We trust that this report will serve as a valuable for knowledge exchange, and ultimately, better cardiovascular outcomes for our community.

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

2 Acknowledgements

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

QCOR Interventional Cardiology Committee

- Dr Sugeet Baveja, Townsville University Hospital
- Dr Yohan Chacko, Ipswich Hospital
- Dr Christopher Hammett, Royal Brisbane & Women's Hospital
- Dr Dale Murdoch, The Prince Charles Hospital
- A/Prof Atifur Rahman, Gold Coast University Hospital
- Dr Sam Sidharta, Rockhampton Hospital
- Dr Yash Singbal, Princess Alexandra Hospital
- Dr Gregory Starmer, Cairns Hospital
- Dr Michael Zhang, Mackay Base Hospital
- Dr Rohan Poulter, Sunshine Coast University Hospital (Chair)

QCOR Cardiothoracic Surgery Committee

- Dr Manish Mathew, Townsville University Hospital
- Dr Rishendran Naidoo, Metro North Hospital and Health Service
- Dr Anil Prabhu, The Prince Charles Hospital
- Dr Andrie Stroebel, Gold Coast University Hospital
- Dr Christopher Cole, Princess Alexandra Hospital (Chair)

QCOR Electrophysiology and Pacing Committee

- Dr Naresh Dayananda, Sunshine Coast University Hospital
- A/Prof John Hill, Princess Alexandra Hospital
- Dr Paul Martin, Royal Brisbane & Women's Hospital
- Dr Caleb Mengel, Toowoomba Hospital
- Dr Sachin Nayyar, Townsville University Hospital
- Dr Kevin Ng, Cairns Hospital
- Dr Robert Park, Gold Coast University Hospital
- Dr Russell Denman, The Prince Charles Hospital (Chair)

QCOR Cardiac Rehabilitation Committee

- Ms Wendy Fry, Cairns and Hinterland Hospital and Health Service
- Ms Emma Harmer, Metro South Hospital and Health Service
- Ms Audrey Miller, Health Contact Centre – Self Management of Chronic Conditions Service
- Ms Samara Phillips, Statewide Cardiac Rehabilitation Coordinator
- Ms Rebecca Pich, Metro South Hospital and Health Service
- Ms Alexandra Samuels, Gold Coast Hospital and Health Service
- Ms Michelle Aust, Sunshine Coast University Hospital (Co-Chair)
- Ms Maura Barnden, Metro North Hospital and Health Service (Co-Chair)

QCOR Heart Failure Support Services Committee

- Ms Melanie Burgess, Ipswich Hospital
- Dr Wandy Chan, The Prince Charles Hospital
- Ms Deepali Gupta, Queen Elizabeth II Hospital
- Ms Annabel Hickey, Statewide Heart Failure Services Coordinator
- Dr Rita Hwang, PhD, Princess Alexandra Hospital
- Ms Sophie Lloyd, Royal Brisbane & Women's Hospital
- Ms Menaka Louis, Gold Coast Hospital and Health Service
- Ms Kellie Mikkelsen, Redcliffe Hospital
- Ms Melissa Moore, Townsville University Hospital
- Ms Rachelle Mulligan, Princess Alexandra Hospital
- Ms Louvaine Wilson, Toowoomba Hospital
- Prof John Atherton, Royal Brisbane & Women's Hospital (Chair)

Statewide Cardiac Clinical Informatics Unit

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

Queensland Ambulance Service

- Dr Tan Doan, PhD

3 Introduction

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

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

Goals and mission

- Identify, through data and analytics, initiatives to improve the quality, safety and effectiveness of cardiac care in Queensland.
- Provide data, analysis expertise, direction and advice to the Department of Health and Hospital and Health Services concerning cardiac care-related service planning and emerging issues at the local, statewide and national levels.
- Provide decision support, expertise, direction and advice to clinicians caring for patients within the domain of cardiac care services.
- Develop an open and supportive environment for clinicians and consumers to discuss data and analysis relative to cardiac care in Queensland.
- Foster education and research in cardiac care best practice.

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

The SCCIU team consists of:

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

* Principal contact officer/QCOR program lead

The application custodian for QCOR is the Executive Director, Healthcare Improvement Unit, CEQ, while data custodianship for the overarching data collection of QCOR is the Chair/s of the QCCN. The individual modular data collections are governed by the Chair of each of the individual QCOR specialty committees.

The QCOR Clinical specialty committees provide direction and oversight for each domain of the Registry. An overarching QCOR Advisory Committee provides collective oversight with each of these groups reporting to the QCCN. Through the QCOR committees, clinicians are continually developing and shaping the scope of the Registry based on contemporary best practices and the unique requirements of each clinical domain.

QCOR manages the Cardiothoracic Surgery Quality Assurance Committee which has been formed under Part 5 of the *Hospital and Health Boards Regulation 2023* to facilitate the participation of clinicians and administrators responsible for the management and delivery of cardiac services. This group enables the peer review of safety and quality of the cardiothoracic services delivered in Queensland and guides any service improvement activities that may be required.

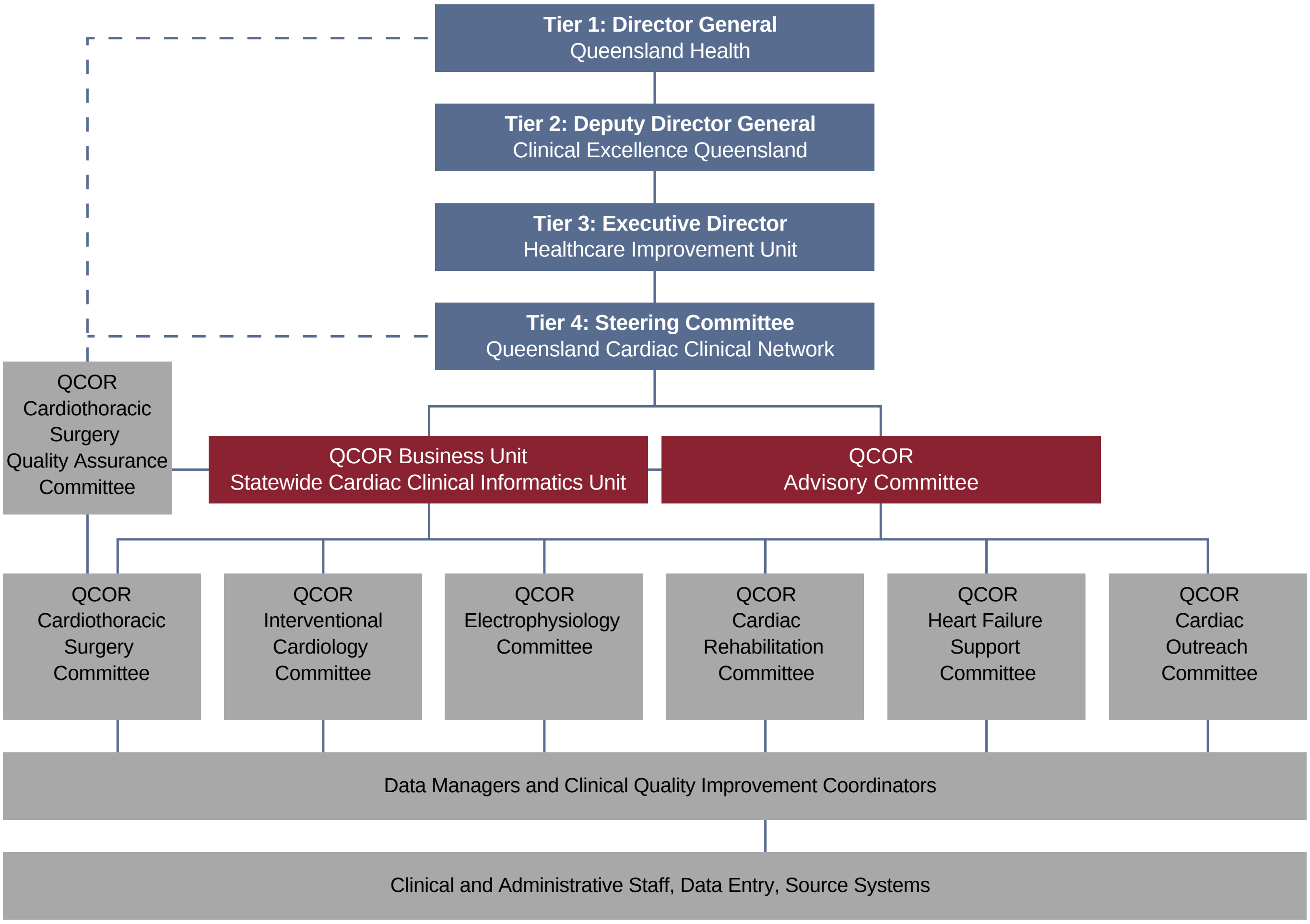


Figure 1: Governance structure

QCOR functions in line with the accepted and endorsed clinical quality registry feedback loop where improvements in clinical care through data-based initiatives and regular interaction with clinicians and stakeholders.

QCOR acts under a well-defined data custodianship model that ensures clearly defined processes and usage of the data collected. The operation of QCOR is guided by the principles outlined by the Australian Commission on Safety and Quality in Health Care in the Framework for Australian clinical quality registries.

The Registry data collection is a blend of clinician-entered data along with various data linkages activities as outlined above. The data is scrutinised using in-app data validations and automated routine data quality reporting. The data quality auditing processes aim to identify and resolve incomplete or inaccurate data to ensure clinician trust in the analysis and outcome reporting process, along with routine reporting and requests for information functions.

In 2014, the Australian Commission on Safety and Quality in Healthcare published a Framework for Australian clinical quality registries*. Since then, QCOR has worked to align itself with these guidelines and subsequent frameworks and standards which form the basis of its quality and safety program. It is recognised that clinical quality registries collect, analyse and report back essential risk-adjusted clinical information to patients, consumers, frontline clinicians and government, with a focus on quality improvement.

The measurement of clinical indicators and benchmarks aims to support the feedback of safety and quality data to several levels of the health system, including consumers, clinicians, administrators and funders. Meaningful metrics are required to understand what the major safety issues are across the care continuum, proactively mitigate patient safety risks and stimulate improvement. Evidence demonstrates that safety and quality improve when clinicians and managers are provided with relevant and timely clinical information.

Through the availability of data insights, clinical reporting and clinical documentation produced by both patient-facing and technical solutions. QCOR has allowed the instantaneous delivery of clinical reports and documentation to clinicians via enterprise solutions. Data insights, performance measure and clinical indicator reporting is also made available in real time via dashboards and reports delivered to clinicians at a frequency and medium of their choosing. Access to real-time data enables key staff to plan and deliver more efficient care to more patients.

QCOR data and analytics have informed and supported statewide healthcare planning activities for capital expansion as well as made possible market share activities for procurement of high-cost clinical consumables resulting in multimillion dollar savings to the healthcare system.

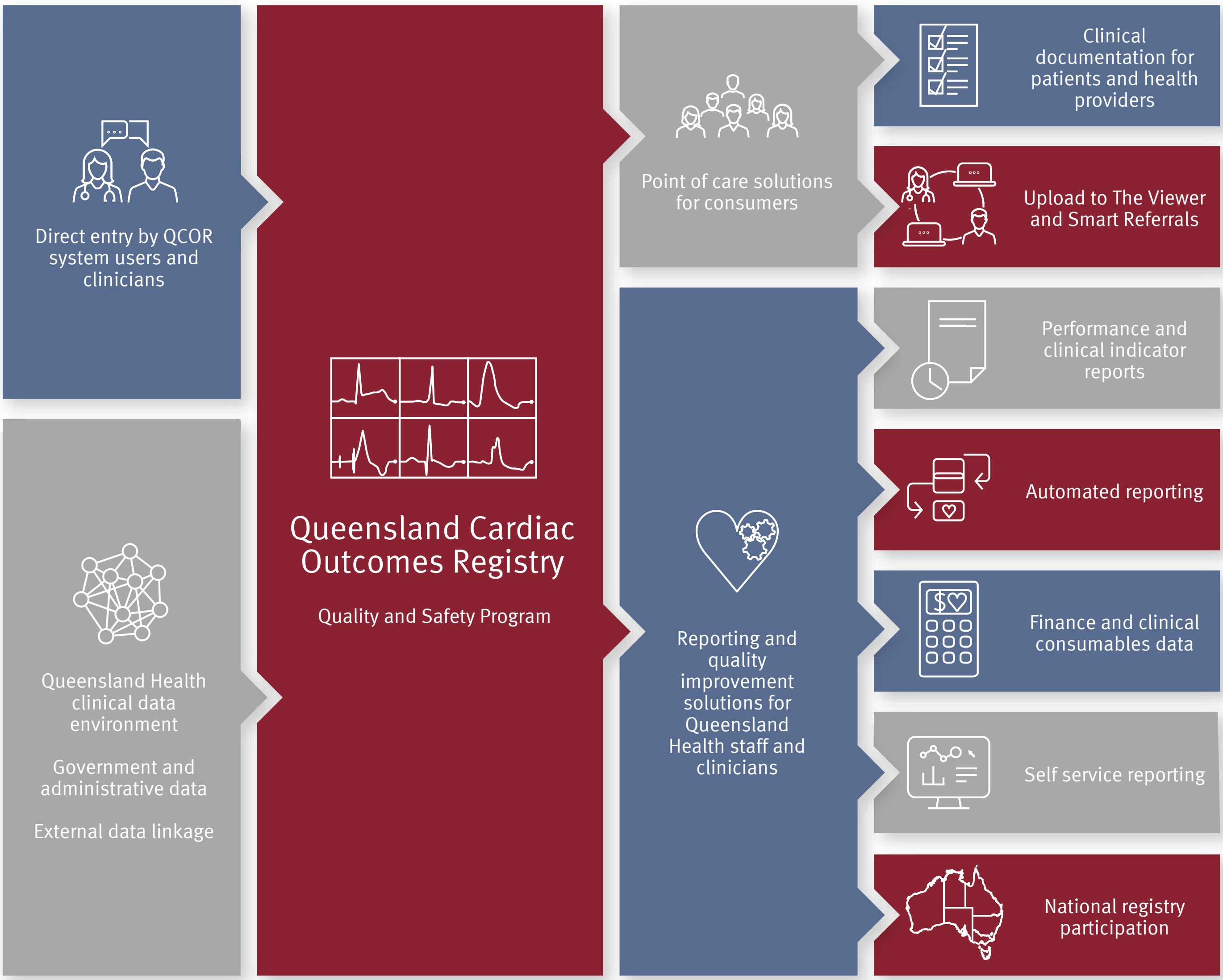


Figure 2: QCOR data flow

* The Australian Commission on Safety and Quality in Health Care (ACSQHC). Framework for Australian clinical quality registries. Sydney: ACSQHC; 2014

Queensland Cardiac Outcomes Registry

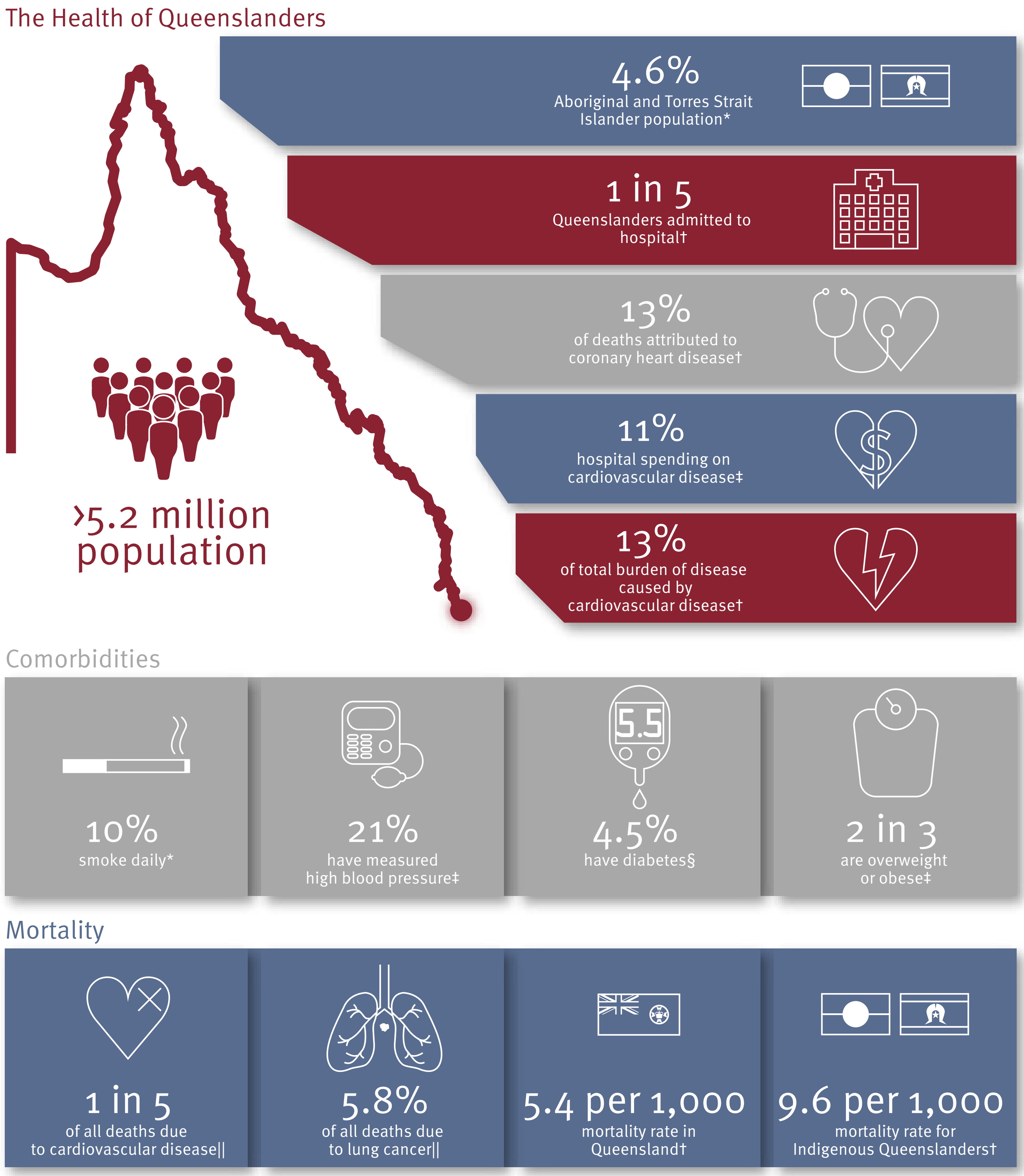


Figure 3: QCOR 2022 infographic

* Australian Bureau of Statistics. (2022, July 1). Queensland: Aboriginal and Torres Strait Islander population summary. ABS. https://www.abs.gov.au/articles/queensland-aboriginal-and-torres-strait-islander-population-summary

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

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

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

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

2022 Activity at a Glance

What's New?

- Cardiac Surgery health equity spotlight
- Cardiac Rehabiliation expanded outcomes audit
- Heart Failure Support Services SGLT2 inhibitor indicator
- Interventional Cardiology adjunct devices review

Interventional Cardiology

4,818
percutaneous coronary interventions

617
structural heart disease interventions

335
transcatheter aortic valve replacements

14,769
total coronary procedures

Cardiothoracic Surgery

2,230
adult cardiac surgeries

918
adult thoracic surgeries

Electrophysiology & Pacing

5,305
electrophysiology and pacing procedures

3,611
cardiac implantable electronic device procedures

Heart Failure Support Services

6,438
heart failure support services referrals

Cardiac Rehabilitation

9,317
cardiac rehabilitation referrals

Paediatric Cardiac Surgery

292
paediatric cardiac surgeries

Clinical Indicator Progress

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

0.2%
procedural tamponade rate for cardiac device and electrophysiology procedures

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

92%
of cardiac rehabilitation referrals within 3 days of discharge

1.5%
mortality rate for coronary artery bypass surgery at 30 days

4 Facility profiles

4.1 Townsville University Hospital

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

4.2 The Prince Charles Hospital

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

4.3 Queensland Children's Hospital

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

4.4 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
- Cardiac genomics clinics provider
- Networked cardiac services outreach hub for Metro South, Darling Downs and South West Hospital and Health Service

4.5 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

Cardiac Surgery Audit

1 Message from the QCOR Cardiothoracic Steering Committee Chair

In 2022, 400 fewer Queenslanders underwent cardiac surgery than in 2021. The number of patients who had gone through the journey of cardiac surgery had been stable in 2019, 2020, and 2021, despite increases in the Queensland population. However, in 2022, that number dropped by 400, approximately 15%. The number of units, surgeons and theatres did not change, but due to well described public health response reasons, the ability of our systems to take a patient who is listed for surgery, admit them to hospital, perform their surgery, admit them to intensive care, have them recover enough to reach the ward, and then recover further until they can be discharged home, was reduced. As all Queensland cardiac surgical units are not stand-alone but are in hospitals that have other specialty units that treat the wide array of diseases and conditions, this reflects likely reflect an increase in demand from competing specialties. More beds occupied in hospitals by patients suffering from non cardiac surgical conditions unfortunately means that cardiac surgery cannot be performed. Despite the willingness of teams to perform complex cardiac surgical procedures, competing capacity demands in our hospital system reduces access for cardiac surgical patients.

The rate of cardiac surgery per population has changed with technology, but over the last three years, there has not been a significant change in practice to explain a change in the numbers of cardiac surgical patients. Instead, reduced capacity usually results in longer waiting times for surgery, and reduced numbers of procedures. What is noticed over the QCOR Cardiac Surgery Annual Reports from 2018 to 2022 is that the rate of elective surgery has dropped from 60% to below 50%. Cardiac surgery is often an urgent or emergent procedure. A condition develops rapidly, or a condition reaches a critical level, and surgery must be performed in an urgent time frame. For some Queenslanders, their heart condition has a degree of stability, and they wait at home, carefully going about their lives, waiting for an admission to hospital to undergo their surgery. In a system under pressure, urgent or emergent inpatient operations continue to be done out of necessity .While we do not have data about the morbidity or mortality of the waiting list we do have data on the patients who reach surgery. We do not have data on the stable patients, on the waiting list for surgery, who then become unstable, are admitted acutely and then undergo emergency or urgent surgery. The hearts of Queenslanders seem able to withstand these testing times to a degree that there has not been an increase in mortality after cardiac surgery. Hearts waiting for surgery gradually deteriorate, and longer waiting times can then increase the risk of surgery. However, cardiac surgery continues to be performed at a high level with expected or better than expected rates of mortality for those Queenslanders who arrive on our operating tables.

The QCOR project of examining the quality of surgery has continued to expand, with the Quality Assurance Committee (QAC) that was established having improved the outcomes of surgery, as evidenced in the research presented by the team, led by Mr Vollbon.*†‡

The cardiothoracic surgery QAC under QCOR uses multiple statistical analyses and markers, which are demonstrated in this report within the mortality and morbidity reporting section that shows the exponentially weighted moving averages. There are patterns, variations and spikes in the reporting. This report shows statewide results across time. In the QAC meetings, under qualified privilege with representatives from each unit, unit-based results are discussed and variations from the expected and changes in the rates are discussed and units provide actions and responses. The nature of cardiac surgeons is to compete for high performance, and regular reviews of performance encourage us all to lead our teams to high performance.

Hopefully as Queensland Health builds increased capacity in the system, the ability of Queenslanders to undergo timely surgery will improve.

Dr Christopher Cole
Chair
QCOR Cardiothoracic Surgery Committee

* Vollbon, W., Poulter, R., Stewart, P., Atherton, J., Kidby, K., Starmer, G., Hammett, C., Cole, C., Hill, J., Mallouhi, M., Prior, M., Smith, I., Bryce, V., Hickey, A., & Phillips, S. (2023). Establishment of a Clinical Quality Program for Cardiac Services in Queensland Public Hospitals: The Evolution of the Queensland Cardiac Outcomes Registry (QCOR)). *Heart, Lung and Circulation, 32*. https://doi.org/10.1016/j.hlc.2023.06.810

† Vollbon, W., Cole, C., Windsor, M., Prabhu, A., Stroebel, A., Mathew, M., Prior, M., Mallouhi, M., & Smith, I. (2023) Deep Sternal Wound Infection Following Cardiothoracic Surgery—Insights and Outcomes of Public Reporting in Queensland Public Hospitals. *Heart, Lung and Circulation, 32*. https://doi.org/10.1016/j.hlc.2023.06.457

‡ Vollbon, W., Cole, C., Windsor, M., Prabhu, A., Stroebel, A., Mathew, M., Prior, M., Mallouhi, M., & Smith, I. (2023). Establishment of a Cardiothoracic Surgical Clinical Quality Assurance Committee in Queensland Public Hospitals. *Heart, Lung and Circulation, 32*. https://doi.org/10.1016/j.hlc.2023.06.459

2 Key findings

This Queensland Cardiac Surgery Audit describes baseline demographics, risk factors, surgeries performed and surgery outcomes for 2022.

Key findings include:

- The number of surgeries performed across the four public adult cardiac surgery units in Queensland were 2,230.
- The majority of patients were aged between 61 years and 80 years of age (69%) with a median age of 67 years old.
- Approximately three quarters of patients were male (74%).
- The majority of all patients were overweight or obese (74%), with less than one quarter (24%) of patients having a body mass index within the normal range.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 6.6%, and had a wide variation between sites with 19% of patients in Townsville identifying as Aboriginal and Torres Strait Islander.
- The majority of patients had high blood pressure (64%) or high cholesterol (68%) or presented with a combination of several background risk factors.
- There were 29% of patients reported to be diabetic at the time of their operation, increasing to 38% of all patients undergoing coronary artery bypass grafting (CABG).
- Over one quarter (29%) of patients had an element of left ventricular systolic dysfunction at the time of surgery.
- Half of all cases were elective admissions with 18% of elective patients being admitted on the day of surgery.
- In 2022, 1,246 patients had a CABG procedure, of whom the majority (91%) had multi-vessel disease.
- There were 243 patients who underwent aortic surgery. The majority of aortic procedures involved aortic replacement surgery (73%).
- Among the 1,003 patients undergoing valve surgery, the most common interventions were single valve replacements of the aortic valve (64%) or mitral valve (21%). Approximately 13% of valve surgeries involved multiple valves.
- The primary pathology for patients undergoing valvular surgery was degenerative valve disease (47%).
- Cardiac surgeons were involved in 47% of the 335 transcatheter aortic valve replacements performed in Queensland public hospitals.
- Major morbidities were evaluated using Society of Thoracic Surgeons (STS) models with most results demonstrating that the observed rate of adverse events is within or better than expected.
- The mortality rate after surgery is either within the expected range or lower than expected, depending on the risk model used to evaluate this outcome.

3 Participating sites

There are four public cardiac surgery units located throughout Queensland's Metropolitan and rural areas. The QCOR cardiac surgery database program received data directly from each surgical unit.

Many patients lived close to Queensland's eastern coastline; however patients came from a wide range of geographic locations, including interstate.

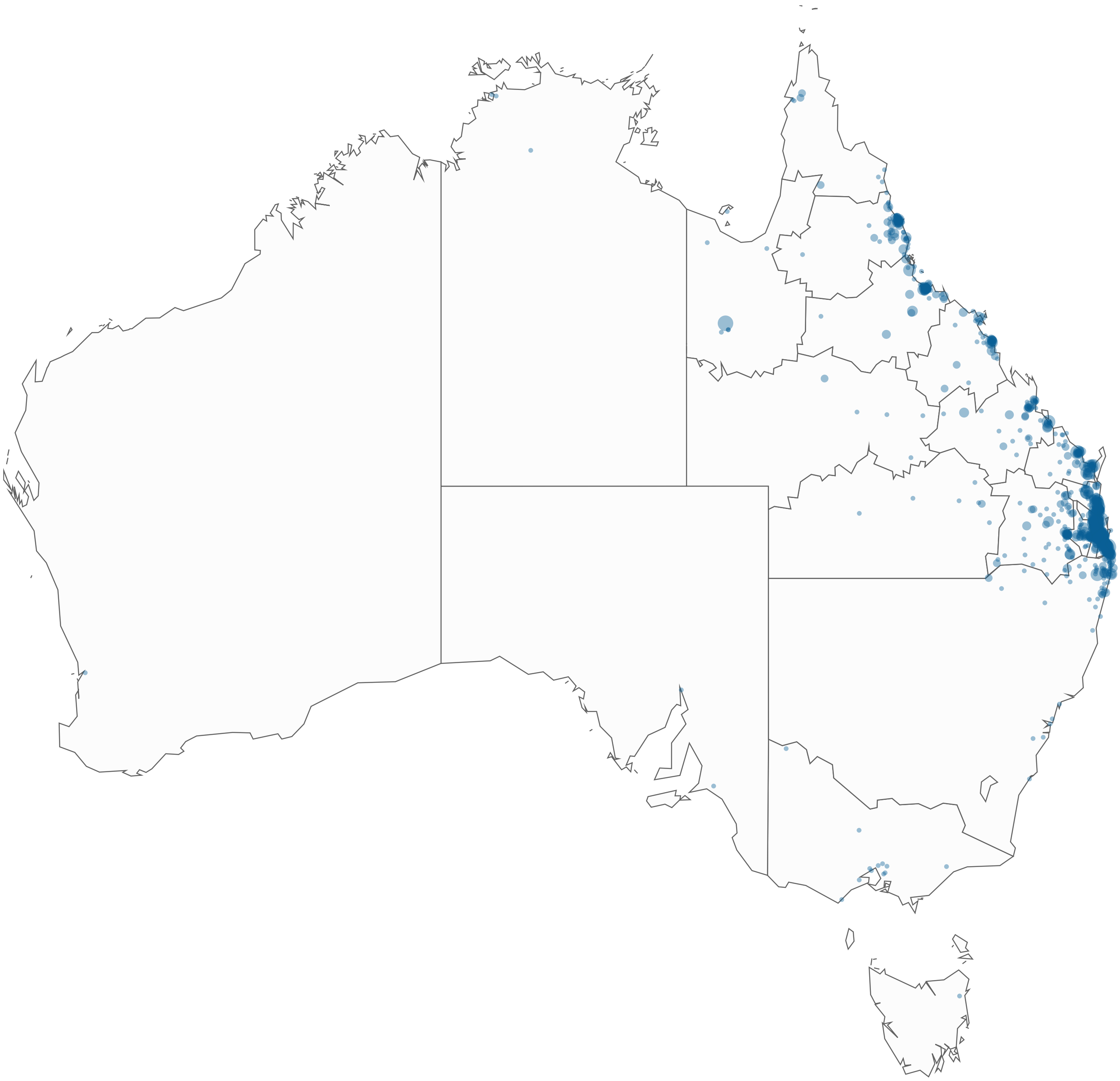


Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

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

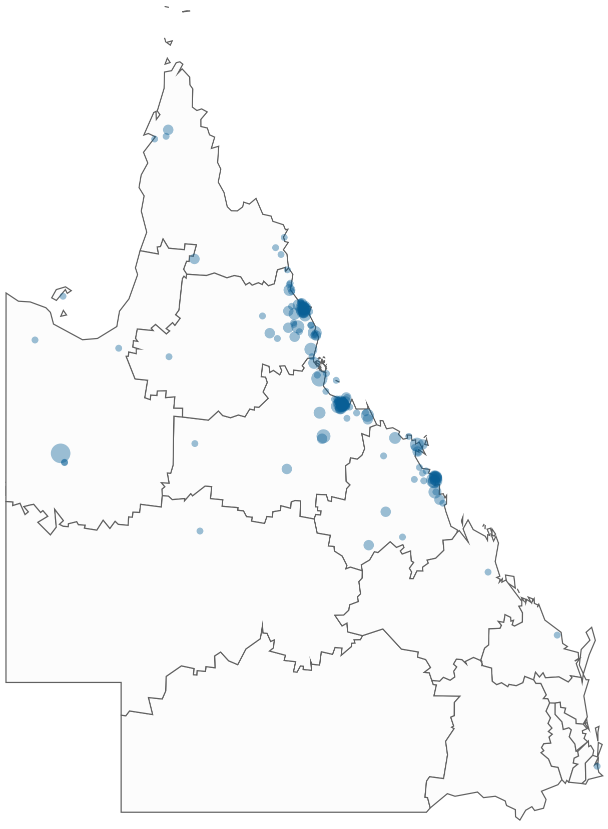


Figure 2: Townsville University Hospital

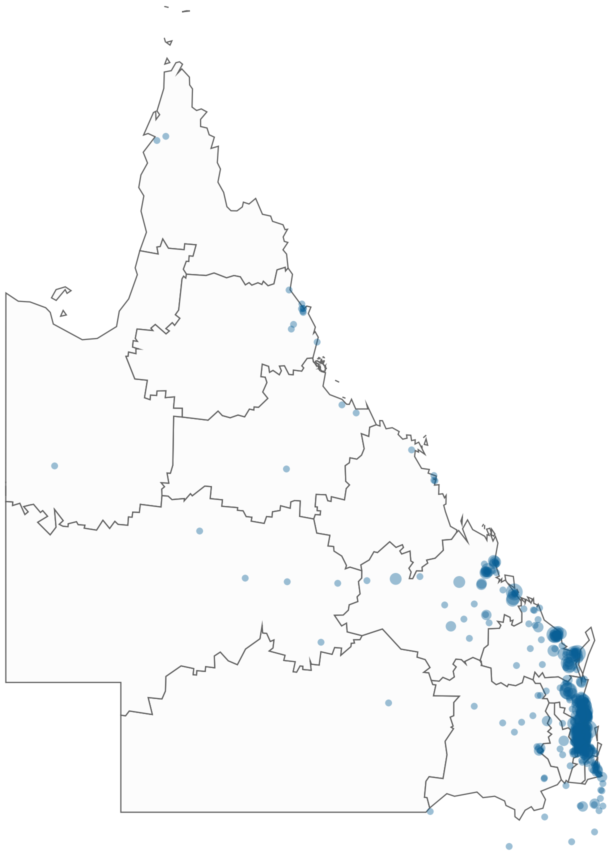


Figure 3: The Prince Charles Hospital

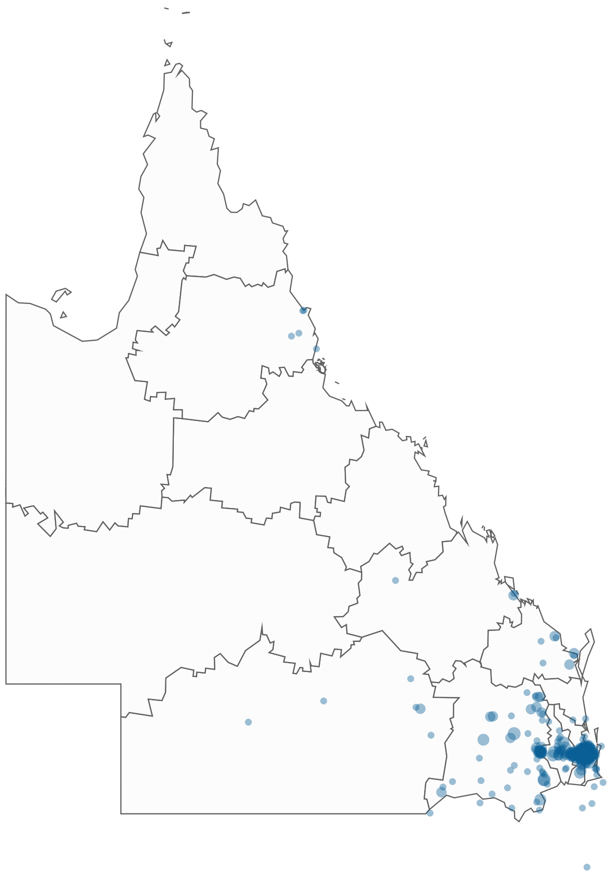


Figure 4: Princess Alexandra Hospital

Figure 5: Gold Coast University Hospital

4 Case totals

4.1 Total surgeries

In 2022, the four public hospitals performed a total of 2,230 cardiac surgical procedures. For the purposes of this report, each of the procedure combinations included in those cases has been assigned to a cardiac surgery procedure category.

There was a notable reduction of the total number of cases compared to the previous year, where the number of cardiac surgical procedures was 2,623.

Table 2: Procedure counts and surgery category

Procedure combination	Category*	Count n
CABG	ANY CABG	989
CABG + other cardiac procedure		42
CABG + aortic procedure		6
CABG + other non cardiac procedure		6
CABG + aortic procedure + other cardiac procedure		1
CABG + other cardiac procedure + other non cardiac procedure		1
CABG + valve	CABG + VALVE	153
CABG + valve + aortic procedure		24
CABG + valve + other cardiac procedure		17
CABG + valve + aortic procedure + other cardiac procedure		3
CABG + valve + other non cardiac procedure		3
CABG + valve + aortic procedure + other non cardiac procedure		1
Valve	VALVE†	569
Valve + aortic procedure		107
Valve + other cardiac procedure		95
Valve + aortic procedure + other cardiac procedure		26
Valve + other non cardiac procedure		3
Valve + aortic procedure + other non cardiac procedure		1
Valve + other cardiac procedure + other non cardiac procedure		1
Other cardiac procedure	OTHER	105
Aortic procedure		61
Aortic procedure + other cardiac procedure		7
Aortic procedure + other non cardiac procedure		6
Other cardiac procedure + other non cardiac procedure		3
ALL		**2,230**

* Category procedure combination allocated

† Includes TAVR procedures involving CTS (n=157)

4.2 Cases by category

Over half (56%) of all cardiac surgery procedures involved coronary artery bypass grafting (CABG) with 9% involving a simultaneous CABG and valve procedure.

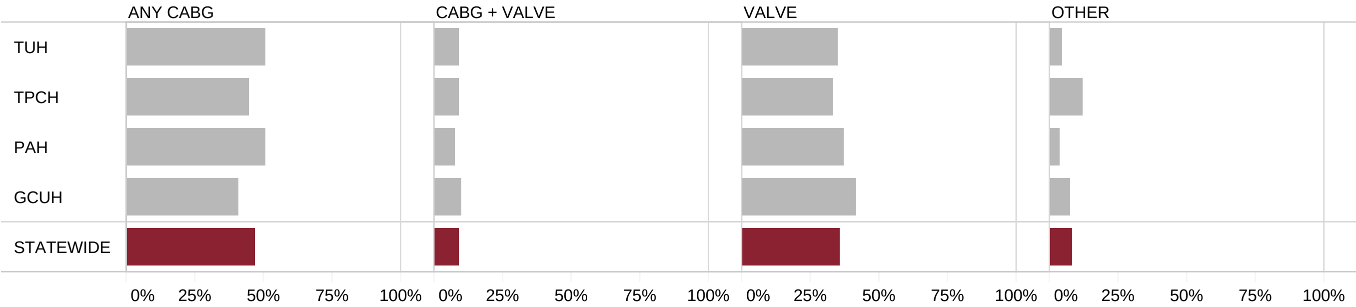


Figure 6: Proportion of cases by site and surgery category

Table 3: Proportion of cases by surgery category

SITE	Total cases n	ANY CABG* n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)
TUH	338	172 (50.9)	32 (9.5)	118 (34.9)	16 (4.7)
TPCH	985	443 (45.0)	90 (9.1)	332 (33.7)	120 (12.2)
PAH	566	290 (51.2)	45 (8.0)	210 (37.1)	21 (3.7)
GCUH	341	140 (41.1)	34 (10.0)	142 (41.6)	25 (7.3)
STATEWIDE	**2,230**	**1,045 (46.9)**	**201 (9.0)**	**802 (36.0)**	**182 (8.2)**

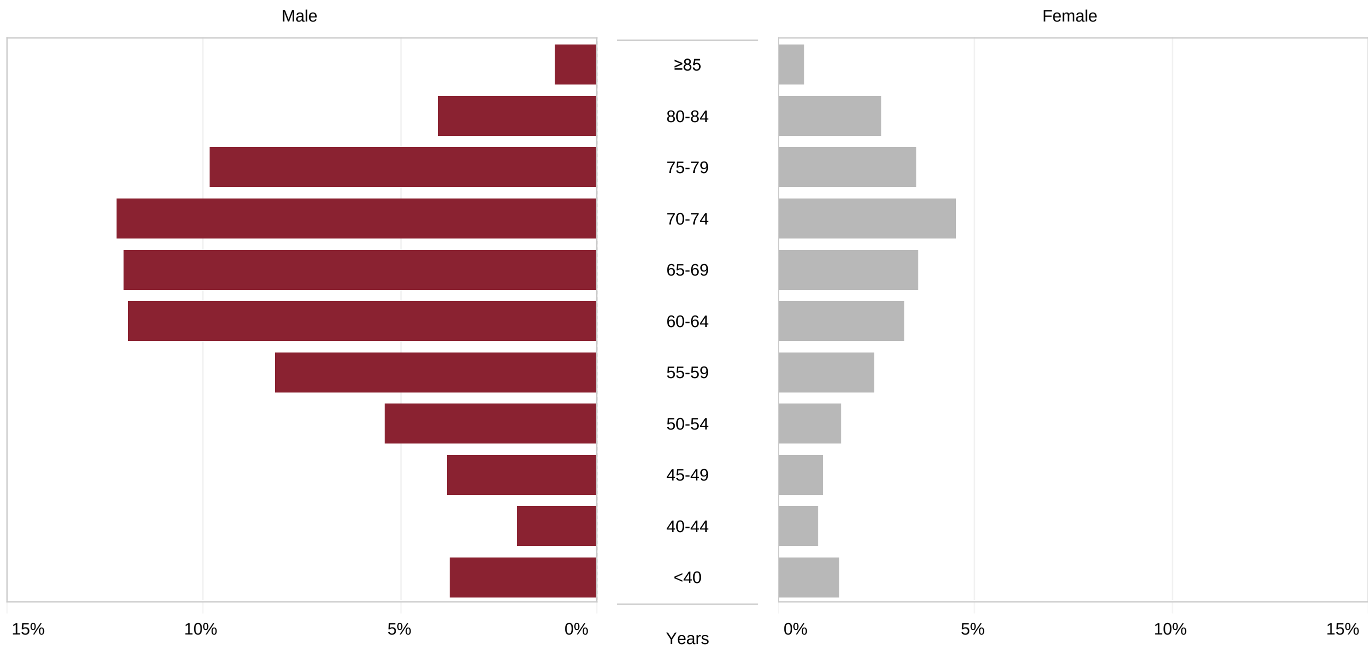
* Coronary artery bypass grafting procedures not including concurrent valve surgery, these operations may occur in isolation or in conjunction with aortic, non cardiac or non valvular cardiac interventions

5 Patient characteristics

5.1 Age and gender

Age is a demonstrated risk factor for developing cardiovascular disease. More than two thirds of patients were aged between 61 years and 80 years (69%). The male cohort of 70 years to 74 years accounted for the largest proportion of cases (12% of all cases or 17% of males). Approximately 8% of surgeries were performed on patients younger than 45 years of age.

The median age for both males and females undergoing cardiac surgery was 67 years. Females undergoing cardiac surgery were more likely to be older than males (68 years vs. 66 years respectively).



% of total (n=2,230)

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	1,045	66	68	67
CABG + VALVE	201	70	71	71
VALVE	802	67	70	69
OTHER	182	59	61	60
ALL	**2,230**	**66**	**68**	**67**

Overall, almost three quarters of patients were male (74%).

The largest proportion of females were represented in the other cardiac surgery group (37%) and valve surgery (34%) categories, whilst surgeries involving CABG were more commonly performed on males than females (82% vs. 18% respectively).

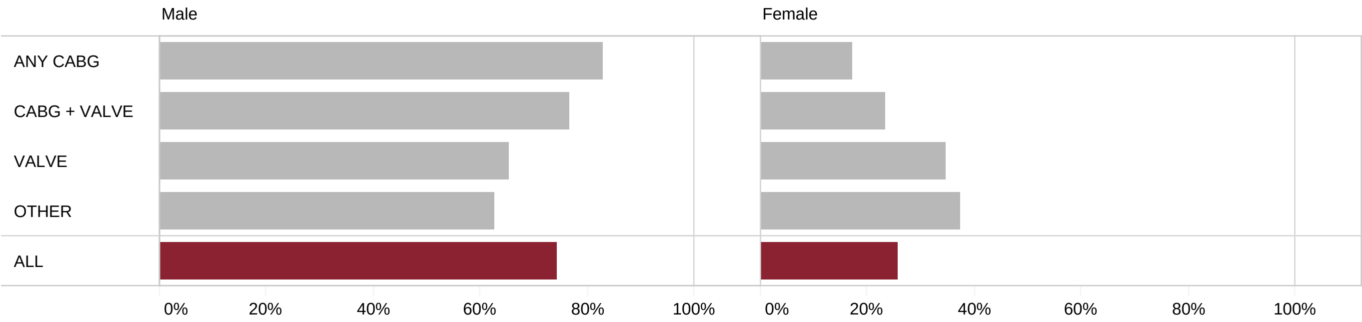


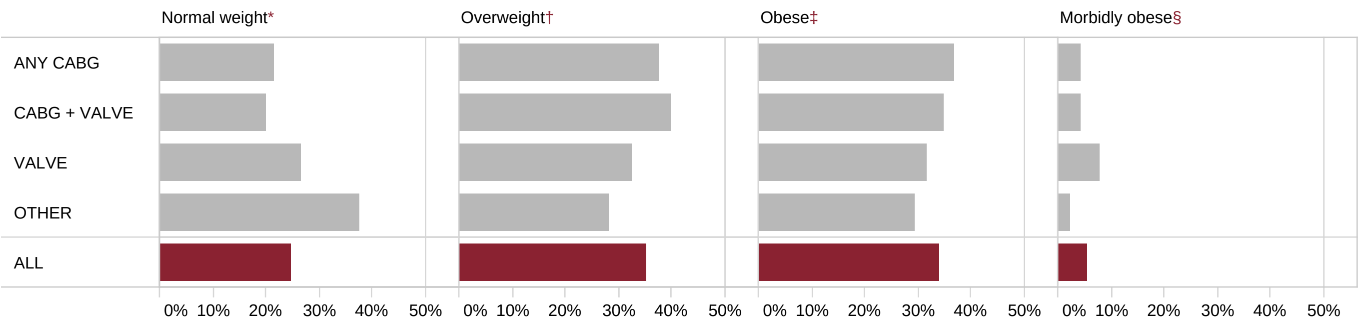
Figure 8: Proportion of cases by gender and surgery category

5.2 Body mass index

Only 24% of patients undergoing heart surgery had a body mass index (BMI) in the healthy range, compared to 74% of patients who fell into the categories of overweight, obese, or severely obese.

Just over one quarter (27%) of all patients undergoing valve surgery were classed as having a BMI in the normal range.

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



Excludes missing data (<0.1%)

- * BMI 18.5–24.9 kg/m²
- † BMI 25.0–29.9 kg/m²
- ‡ BMI 30.0–39.9 kg/m²
- § BMI ≥40.0 kg/m²

Figure 9: Proportion of cases by BMI and surgery category

Table 5: Cases by BMI and surgery category

	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
ANY CABG	4 (0.4)	223 (21.3)	390 (37.3)	384 (36.7)	44 (4.2)
CABG + VALVE	2 (1.0)	40 (19.9)	80 (39.8)	70 (34.8)	9 (4.5)
VALVE	12 (1.5)	214 (26.7)	261 (32.5)	253 (31.5)	62 (7.7)
OTHER	6 (3.3)	68 (37.4)	51 (28.0)	53 (29.1)	4 (2.2)
ALL	**24 (1.1)**	**545 (24.4)**	**782 (35.1)**	**760 (34.1)**	**119 (5.3)**

5.3 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of cardiovascular disease development. Aboriginal and Torres Strait Islander peoples, in particular are recognised as having higher incidence and prevalence of coronary heart disease than other ethnic groups.[1]

Overall, the proportion of identified Aboriginal and Torres Strait Islander patients undergoing cardiac surgery was 6.6%. This proportion is larger than the estimated 4.6% of the overall Queensland population that Aboriginal and Torres Strait Islander people account for.[2]

Approximately one fifth (19%) of patients undergoing cardiac surgery at TUH identified as Aboriginal and Torres Strait Islander.

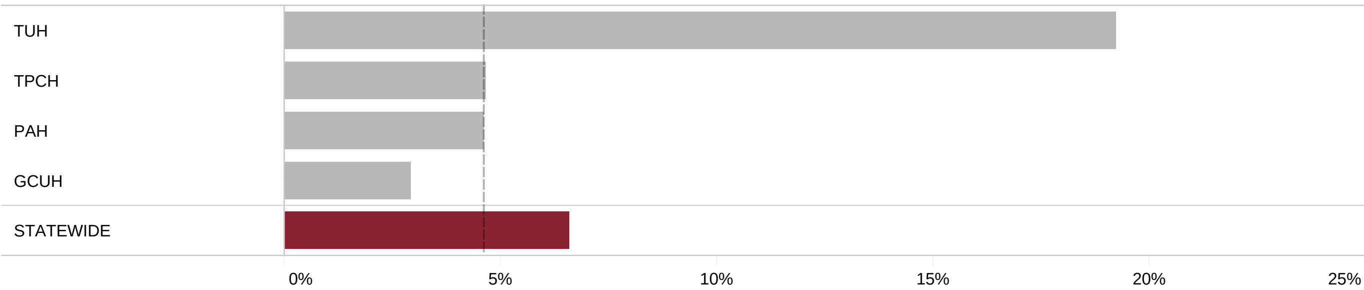


Figure 10: Proportion of all cardiac surgical cases by identified Aboriginal and Torres Strait Islander status and site

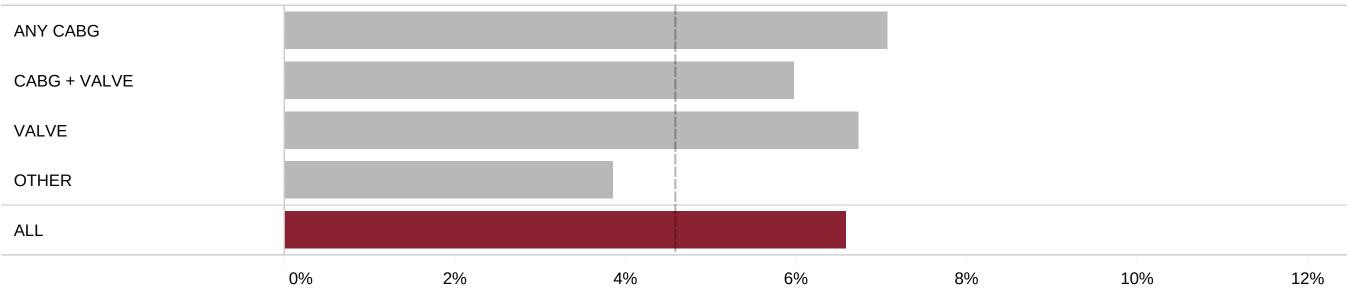
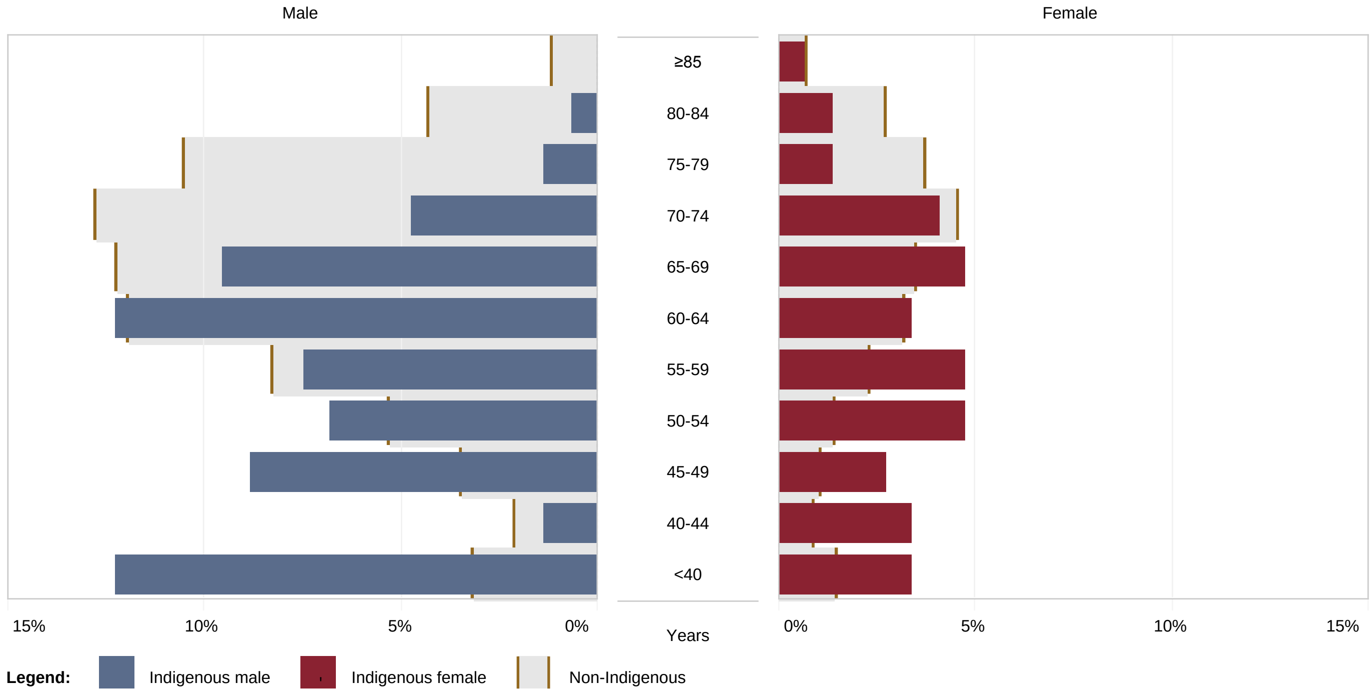


Figure 11: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

The median age for Aboriginal and Torres Strait Islander Queenslanders undergoing cardiac surgery was 58 years, whereas the median age of non-Indigenous patients was 67 years.



% of total Aboriginal and Torres Strait Islander (n=147) vs. total non-Indigenous (n=2,230)

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

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

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

6 Risk factors and comorbidities

The development of cardiovascular disease is dependent on several background variables and risk factors. Within our cohort the majority of patients undergoing cardiac surgery present with a combination of several different risk factors.

- The majority of patients (57%) had a history of tobacco use including 18% current smokers (defined as smoking within 30 days of the procedure) and 39% former smokers.
- Overall, 29% of all cardiac surgical patients were reported as diabetic. The prevalence of diabetes was highest in the CABG patient group (38%).
- Hypertension, defined as receiving antihypertensive medications at the time of surgery, was present in 63% of patients with considerable variation by surgery type (range 39% to 72%).
- Overall, 68% of patients had hypercholesterolaemia at the time of surgery, ranging from 83% in the CABG category to 35% in the other surgery category.
- Over half (53%) of all patients were identified as having impaired renal function (eGFR ≤89 mL/min/1.73 m^2) at the time of their surgery.
- There were 103 patients with active or previous infective endocarditis.
- Over one quarter (29%) of patients were classed as having an impaired left ventricular ejection fraction (LVEF), including, 4% with severe LV dysfunction (LVEF less than 30%), 6% with moderate LV dysfunction (LVEF between 30% to 39%) and 19% having mild LV dysfunction (LVEF between 40% to 49%) at the time of surgery.
- 39% of patients had a BMI which was classed as obese or morbidly obese (BMI ≥30 kg/m^2).

Table 7: Summary of risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
Former smoker	466 (42.7)	87 (43.3)	282 (35.2)	57 (31.3)	872 (39.1)
Current smoker	228 (21.8)	36 (17.9)	112 (14.0)	32 (17.6)	408 (18.3)
Diabetes	401 (38.4)	65 (32.3)	155 (19.3)	25 (13.7)	646 (29.0)
Hypertension	753 (72.1)	138 (68.7)	464 (57.9)	70 (38.5)	1,425 (63.9)
Hypercholesterolaemia	869 (83.3)	153 (76.1)	420 (52.4)	63 (34.6)	1,505 (67.5)
eGFR 60–89 mL/min/1.73 m^2	350 (33.5)	72 (35.8)	242 (30.2)	58 (31.9)	722 (32.4)
eGFR 30–59 mL/min/1.73 m^2	155 (14.8)	51 (25.4)	195 (24.3)	21 (11.5)	422 (18.9)
eGFR <30 mL/min/1.73 m^2	15 (1.4)	5 (2.5)	21 (2.6)	3 (1.6)	44 (2.0)
Infective endocarditis	3 (0.3)	7 (3.5)	3 (1.6)	90 (11.2)	103 (4.6)
LVEF 40–50%	236 (22.6)	46 (22.4)	133 (16.6)	10 (5.5)	424 (19.0)
LVEF 30–39%	79 (7.6)	16 (8.0)	36 (4.5)	4 (2.2)	135 (6.1)
LVEF <30%	36 (3.4)	8 (4.0)	29 (3.6)	12 (6.6)	85 (3.8)
BMI ≥30 kg/m^2	428 (41.0)	79 (39.3)	315 (39.3)	57 (31.3)	879 (39.4)

The majority of patients (90%) had a combination of two or more of those risk factors outlined in Table 8, while almost one third of patients undergoing CABG (31%) had five or more risk factors. This demonstrates the variation of disease processes associated with underlying pathology and highlights the complex medical history of this cohort.

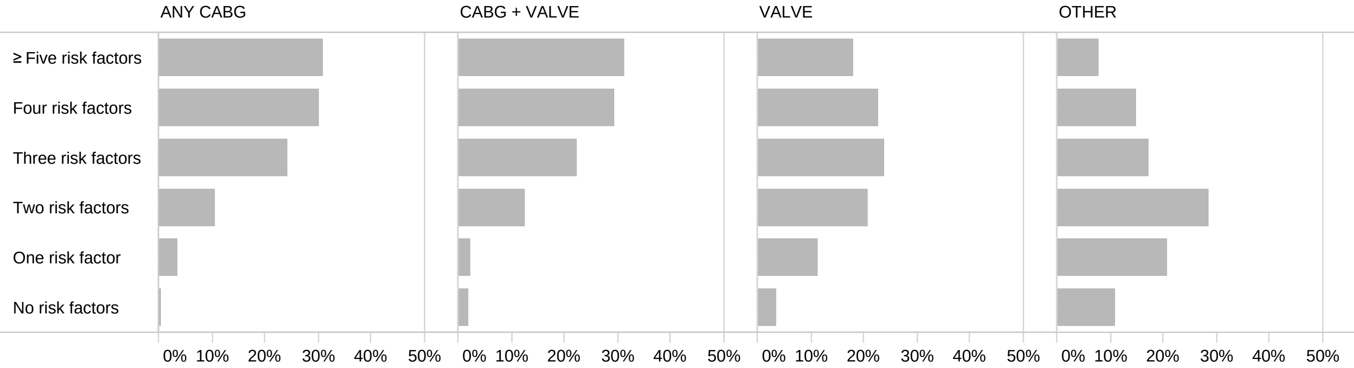


Figure 13: Number of patient risk factors by surgery category

Table 8: Aggregated patient risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
Five or more risk factors	322 (30.8)	63 (31.3)	142 (17.7)	13 (7.1)	540 (24.2)
Four risk factors	316 (30.2)	59 (29.4)	182 (22.7)	28 (15.4)	585 (26.2)
Three risk factors	254 (24.3)	45 (22.4)	192 (23.9)	31 (17.0)	522 (23.4)
Two risk factors	111 (10.6)	25 (12.4)	168 (20.9)	52 (28.6)	356 (16.0)
One risk factor	37 (3.5)	5 (2.5)	90 (11.2)	38 (20.9)	170 (7.6)
No risk factors	5 (0.5)	4 (2.0)	28 (3.5)	20 (11.0)	57 (2.6)
Total	**1,045 (100.0)**	**201 (100.0)**	**802 (100.0)**	**182 (100.0)**	**2,230 (100.0)**

6.1 Infective endocarditis

There were 103 cases of infective endocarditis (IE) that required cardiac surgical intervention. At the time of surgery, over three quarters (79%) were active infections.

Native valve endocarditis was observed in 72% of active infections, with prosthetic valve infection apparent in 17% of active endocarditis cases.

Table 9: Infective endocarditis status

Endocarditis status	n (%)
Active	81 (78.6)
Treated	22 (21.4)
Total	**103 (100.0)**

Table 10: Active infective endocarditis by site of infection

Active endocarditis site	n (%)
Native valve	58 (71.6)
Prosthetic valve	12 (14.8)
Aortic root	8 (9.9)
Aortic root and prosthetic valve	2 (2.5)
Aortic conduit	1 (1.2)
Total	**81 (100.0)**

6.1.1 Organism

Nearly two thirds (32%) of all active IE cases were identified as Methicillin-susceptible Staphylococcus aureus, while a Streptococcus infection was responsible for one quarter of all surgeries for active IE. The responsible organism was unidentified in 5% of cases.

Table 11: Identified organism in active IE cases

Active organism	n (%)
MSSA*	26 (32.1)
Streptococcus	20 (24.7)
Other	12 (14.8)
Enterococcus faecalis	11 (13.6)
Staphylococcus (other)	5 (6.2)
Aggregatibacter	3 (3.7)
Organism unidentified	4 (4.9)
Total	**81 (100.0)**

* Methicillin-susceptible Staphylococcus aureus

6.1.2 Intravenous drug use

Overall, 21% of all active infective endocarditis cases were linked to a history of intravenous drug use (IVDU) with the majority being previous IVDU.

Table 12: Proportion of intravenous drug use associated with active IE

IVDU history	n (%)
Current IVDU (≤3 months)	5 (6.2)
Previous IVDU (>3 months)	12 (14.8)
No history of IVDU	55 (67.9)
Unknown	9 (11.1)
Total	**81 (100.0)**

Cardiac Surgery

7 Care and treatment of patients

7.1 Admission status

The admission status of patients undergoing cardiac surgery varied widely. Most CABG cases were performed as urgent cases, whilst also contributing to a significant proportion (37%) of the emergency cases. Over one third (38%) of all operations in the 'Other surgery' category were performed on an emergent basis, in particular correction of aortic dissection. Valve procedures were mostly performed on an elective basis.

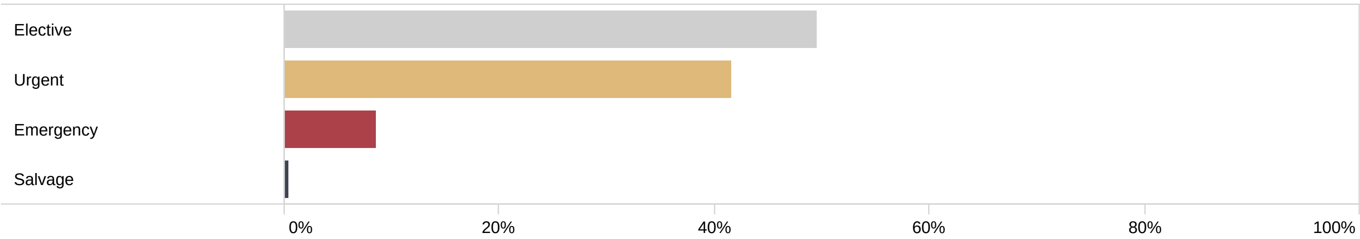


Figure 14: Proportion of cases by admission status

Table 13: Cases by admission status and surgery category

	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)
ANY CABG	335 (32.1)	647 (61.9)	58 (5.6)	5 (0.5)
CABG + VALVE	112 (55.7)	74 (36.8)	14 (7.0)	1 (0.5)
VALVE	561 (70.0)	190 (23.7)	50 (6.2)	1 (0.1)
OTHER	95 (52.2)	17 (9.3)	69 (37.9)	1 (0.5)
ALL	**1,103 (49.5)**	**928 (41.6)**	**191 (8.6)**	**8 (0.4)**

7.2 Day of surgery admission

Day of surgery admission (DOSA) rates accounted for 18% of all elective cases, with some variation observed across some surgery categories.

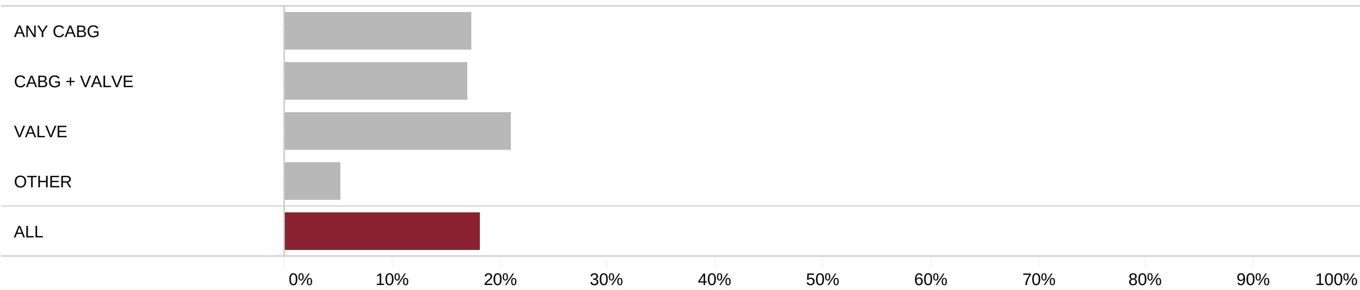


Figure 15: Proportion of elective cases for DOSA cases by surgery category

Table 14: DOSA cases by surgery category

	Total elective cases n	DOSA cases n (%)
ANY CABG	335	58 (17.3)
CABG + VALVE	112	19 (17.0)
VALVE	561	118 (21.0)
OTHER	95	5 (5.3)
Total	**1,103**	**200 (18.1)**

7.3 Coronary artery bypass grafting

7.3.1 Number of diseased vessels

There were 1,246 CABG procedures performed across all sites. The majority (91%) had multi-vessel disease.

When CABG was performed in conjunction with a valve procedure, 69% of patients had multi-vessel disease compared to 95% when CABG surgery was performed without a valve intervention.

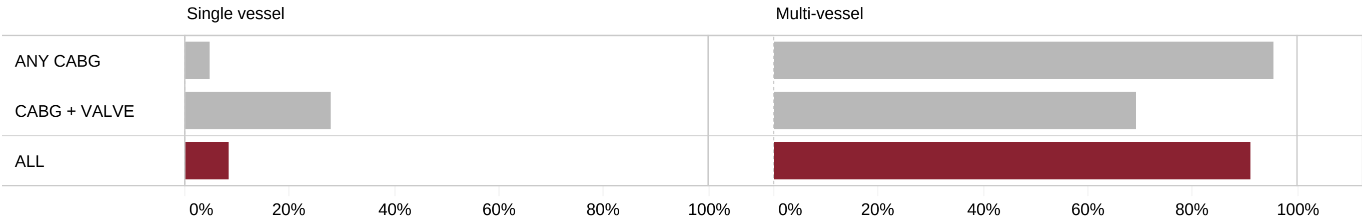


Figure 16: Number of diseased vessels by surgery category

Table 15: Number of diseased vessels by surgery category

	Single vessel n (%)	Multi-vessel n (%)	Total n (%)
ANY CABG	48 (4.6)	997 (95.4)	1,045 (100.0)
CABG + VALVE	56 (27.9)	139 (69.2)	201 (100.0)
ALL	**104 (8.3)**	**1,136 (91.2)**	**1,246 (100.0)**

Missing data not displayed (n=6)

7.3.2 Number of grafts

For CABG procedures an average of 2.6 grafts were used. In multi vessel CABG, the mean number of grafts utilised was 2.8.

Table 16: Number of grafts by number of diseased vessels

	Single vessel mean	Multi-vessel mean	Multi-vessel median	Total mean
ANY CABG	1.3	2.8	3.0	2.8
CABG + VALVE	1.0	2.3	2.0	1.9
ALL	**1.2**	**2.8**	**3.0**	**2.6**

7.3.3 Conduits used

In CABG, including surgeries involving valvular intervention, the most common method of revascularisation included the use of a combination of an arterial and venous graft (64%). Over one quarter of cases (28%) underwent total arterial revascularisation.

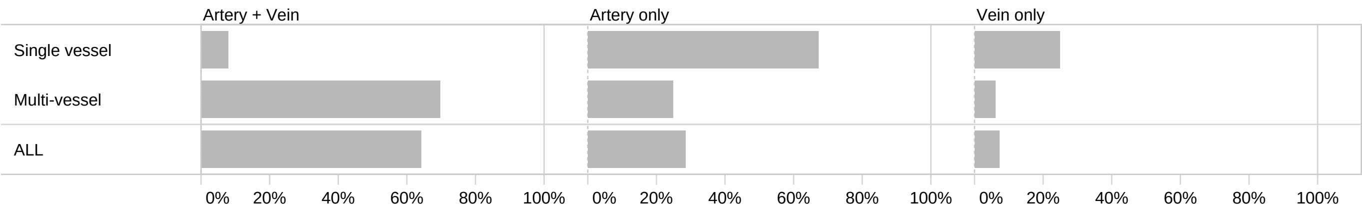


Figure 17: Proportion of diseased vessels by conduits used

Table 17: Conduits used by number of diseased vessels

	Artery + vein n (%)	Artery only n (%)	Vein only n (%)
Single vessel	8 (7.7)	70 (67.3)	26 (25.0)
Multi-vessel	789 (69.5)	280 (24.6)	67 (5.9)
ALL	**797 (64.3)**	**350 (28.2)**	**93 (7.5)**

Excludes missing data (n=9)

7.3.4 Off pump CABG

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

Table 18: Off pump CABG

	Total cases n	Off pump n (%)
Isolated CABG	989	24 (2.4)

7.3.5 Y or T grafts

Approximately 6% of all CABG surgeries utilised a Y or T graft.

Table 19: Y or T graft used by procedure category

	Total cases n	Y or T graft n (%)
ANY CABG	1,045	67 (6.4)
CABG + VALVE	201	6 (3.0)
ALL	**1,246**	**73 (5.9)**

7.4 Aortic surgery

There were 243 cases that included a procedure involving the aorta (not including procedures performed on the aortic valve). Aortic aneurysm was the primary reason for aortic surgery (51%), while acute aortic dissection was the pathology responsible for one quarter of aortic surgery cases.

Most aortic surgery procedures included replacement of the ascending aorta in isolation (40%), while surgery to replace both the ascending aorta and aortic arch accounted for 12% of cases.

Aortoplasty involving patch repair was performed in approximately 14% of aortic surgery cases.

Table 20: Aortic surgery by procedure type

Aortic surgery type	n (%)
Replacement	**136 (56.0)**
Ascending aorta	97 (39.9)
Ascending aorta + aortic arch	28 (11.5)
Aortic arch	4 (1.6)
Ascending aorta + aortic arch + descending aorta	3 (1.2)
Descending aorta	2 (0.8)
Ascending aorta + descending aorta	1 (0.4)
Descending aorta + thoraco-abdominal	1 (0.4)
Aortoplasty	**66 (27.2)**
Direct aortoplasty	33 (13.6)
Patch repair	33 (13.6)
Aortoplasty and replacement	**41 (16.9)**
Direct aortoplasty + ascending aorta	15 (6.2)
Patch repair + ascending aorta	13 (5.3)
Direct aortoplasty + ascending aorta + aortic arch	6 (2.5)
Patch repair + ascending aorta + aortic arch	4 (1.6)
Patch repair + aortic arch	3 (1.2)
ALL	**243 (100.0)**

7.4.1 Aortic pathology

Table 21: Aortic surgery cases by pathology type

Aortic pathology type	n (%)
Aortic aneurysm	125 (51.4)
Aortic dissection (≤2 weeks)	61 (25.1)
Abscess	17 (7.0)
Calcification	13 (5.3)
Aortic dissection (>2 weeks)	6 (2.5)
Rupture	2 (0.8)
Traumatic transection	1 (0.4)
Other	18 (7.4)
Total	**243 (100.0)**

7.5 Valve surgery

There were 1,003 valve surgery procedures performed at the participating sites during 2022.

The aortic valve was the most commonly operated on valve either with or without other valves (70%). While over one fifth (21%) of valve surgeries were performed on the mitral valve in isolation.

Overall, 13% of valve operations performed comprised of intervention to multiple valves.

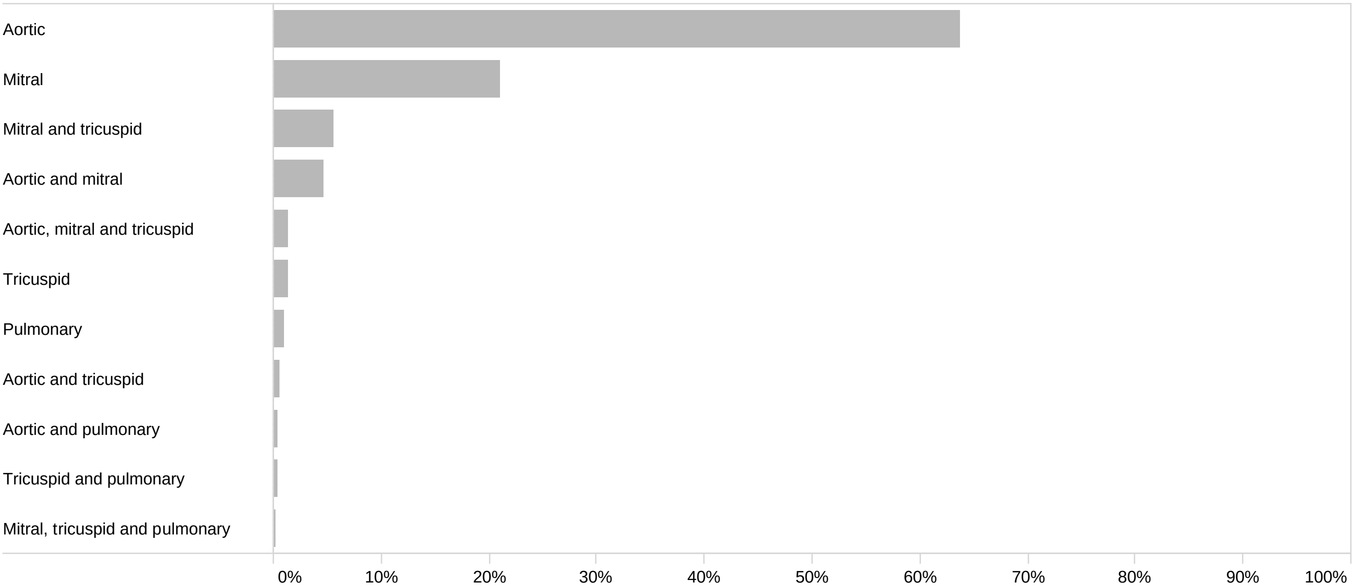


Figure 18: Proportion of valve surgery cases by valve

Table 22: Valve surgery cases by valve

Type of valve surgery	n (%)
Aortic	639 (63.7)
Mitral	212 (21.1)
Mitral and tricuspid	57 (5.7)
Aortic and mitral	46 (4.6)
Aortic, mitral and tricuspid	13 (1.3)
Tricuspid	13 (1.3)
Pulmonary	10 (1.0)
Aortic and tricuspid	5 (0.5)
Aortic and pulmonary	4 (0.4)
Tricuspid and pulmonary	3 (0.3)
Mitral, tricuspid and pulmonary	1 (0.1)
ALL	**1,003 (100.0)**

7.5.1 Valve pathology

The most common valve pathology across all valve types was a degenerative cause (47%) which accounted for the largest proportion of all aortic (52%) and mitral (47%) valve procedures.

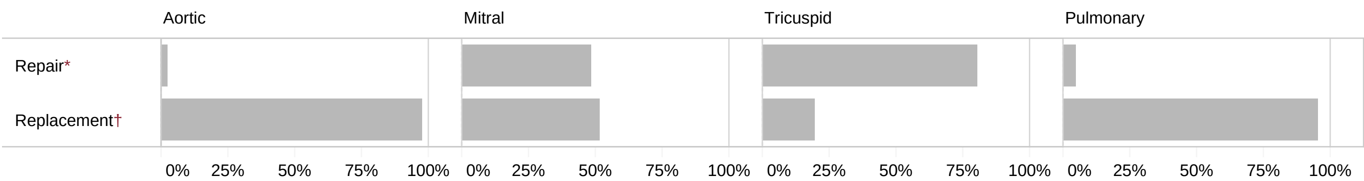
Table 23: Valve pathology by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Degenerative	366 (51.8)	155 (47.1)	18 (19.6)	–	539 (47.0)
Congenital	154 (21.8)	6 (1.8)	3 (3.3)	9 (50.0)	172 (15.0)
Rheumatic	19 (2.7)	50 (15.2)	15 (16.3)	–	84 (7.3)
Infection	51 (7.2)	45 (13.7)	11 (12.0)	5 (27.8)	112 (9.8)
Prosthesis failure	40 (5.7)	23 (7.0)	2 (2.2)	4 (22.2)	69 (6.0)
Dissection	36 (5.1)	–	–	–	36 (3.1)
Annuloaortic ectasia	24 (3.4)	–	–	–	24 (2.1)
Functional	–	12 (3.6)	38 (41.3)	–	50 (4.4)
Ischaemic	–	22 (6.7)	–	–	22 (1.9)
Failed prior repair	–	–	1 (1.1)	–	1 (0.1)
Peri-prosthetic leak	3 (0.4)	–	–	–	3 (0.3)
Trauma	–	1 (0.3)	–	–	1 (0.1)
Other	14 (2.0)	15 (4.6)	4 (4.3)	–	33 (2.9)
ALL	**707 (100.0)**	**329 (100.0)**	**92 (100.0)**	**18 (100.0)**	**1,146 (100.0)**

7.5.2 Types of valve surgery

Fifty five percent of valve interventions involved aortic valve surgery. The most common aortic valve procedure was replacement surgery (97%).

Mitral valve replacement was more commonly undertaken compared with mitral valve repair (59% vs. 41%).



Inspection only procedures not shown (n=2)

* Includes transcatheter mitral valve repair procedures involving CTS

† Includes transcatheter valve replacement (TAVR or TMVR) procedures involving CTS

Figure 19: Valve surgery category by valve

Table 24: Valve surgery category by valve type

Valve surgery category	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Repair*	23 (3.3)	134 (40.7)	77 (83.7)	–	234 (20.4)
Replacement†	683 (96.6)	195 (59.3)	15 (16.3)	18 (100.0)	911 (79.5)
Inspection only	1 (0.1)	–	–	–	2 (0.1)
ALL	**707 (100.0)**	**329 (100.0)**	**92 (100.0)**	**18 (100.0)**	**1,288 (100.0)**

* Includes transcatheter mitral valve repair procedures involving CTS

† Includes transcatheter valve replacement (TAVR or TMVR) procedures involving CTS

Transcatheter aortic valve replacement (TAVR)

A multidisciplinary heart team involving both cardiologists and cardiac surgeons is often required to plan and perform a TAVR procedure. Despite the varied role of the surgeon in the heart team, 47% of all TAVR were performed with a cardiac surgeon involved in the valve procedure.

This Audit reflects those TAVR cases where a cardiothoracic surgeon was present during the procedure. As such, it does not represent the total number of these interventions performed in Queensland public hospitals in 2022.

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

Table 25: TAVR cases by site and CS involvement

Site	ALL TAVR n	Combined CS and cardiologist TAVR n (%)
TUH	24	24 (100.0)
TPCH	179	8 (4.5)
PAH	103	96 (93.2)
GCUH	29	29 (100.0)
STATEWIDE	**335**	**157 (46.9)**

7.5.3 Valve repair surgery

Over two-thirds (71%) of valve repair surgery were repair/reconstruction with annuloplasty followed by annuloplasty only (13%). The most common individual valve repair surgery type was mitral valve repair/reconstruction with annuloplasty, comprising close to half of overall valve repair surgery (47%).

There were no pulmonary valve repair procedures recorded at participating sites for 2022.

Table 26: Valve repair surgery by valve type

Surgery category	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Total n (%)
Repair/reconstruction with annuloplasty	–	112 (83.6)	53 (61.9)	165 (70.5)
Annuloplasty only	–	11 (8.2)	19 (30.4)	30 (12.8)
Repair/reconstruction without annuloplasty	3 (13.0)	6 (4.5)	5 (5.4)	14 (6)
Resuspension of the aortic valve	10 (43.5)	–	–	10 (4.3)
Root reconstruction with valve sparing	9 (39.1)	–	–	9 (3.8)
Tumour tissue removal	1 (4.3)	3 (2.2)	–	4 (1.7)
Paravalvular leak repair	–	2 (1.5)	–	2 (0.9)
ALL	**23 (100.0)**	**134 (100.0)**	**77 (100.0)**	**234 (100.0)**

7.5.4 Valve replacement surgery

Aortic valve replacement accounted for the majority of valve replacement surgeries (75%), which included 158 TAVR procedures and 96 aortic root reconstruction surgeries utilising a valved conduit.

Table 27: Valve replacement surgery by valve type

Surgery type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Surgical valve replacement	429 (62.8)	193 (99.0)	15 (100.0)	18 (100.0)†	655 (71.9)
Transcatheter valve replacement*	158 (23.1)	2 (1.0)	–	–	160 (17.6)
Root reconstruction with valve conduit	96 (14.1)	–	–	–	96 (10.5)
ALL	**683 (100.0)**	**195 (100.0)**	**15 (100.0)**	**18 (100.0)**	**911 (100.0)**

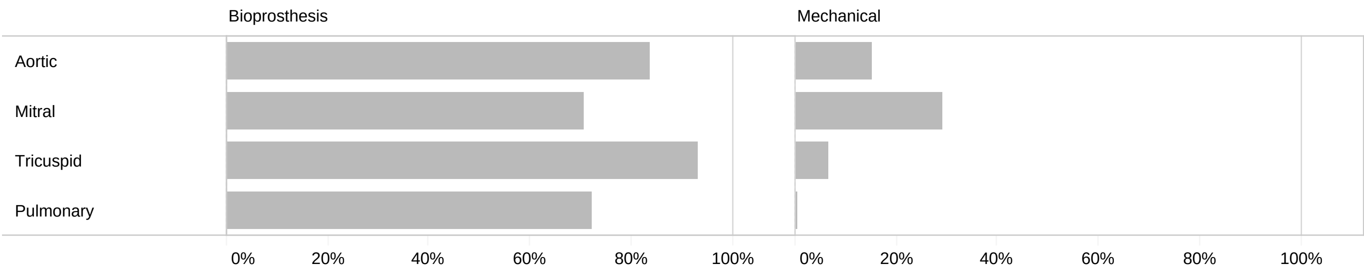
* Includes TAVR or TMVR procedures involving a cardiothoracic surgeon

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

Prosthesis type

The most common form of valve prostheses used across all valve types were biological (81%), either bovine (64%) or porcine (17%). Mechanical prostheses were used in 18% of cases with a greater proportion represented in mitral valve replacement surgeries.

Bovine-derived aortic valve prostheses accounted for the largest proportion of all valves used, representing 79% of all aortic valve prostheses and 64% of the total valvular prostheses used.



Homograft/allograft and autograft prosthesis not displayed (1.4%)

Figure 20: Proportion of valve replacements by valve prosthesis category and valve type

Table 28: Types of valve prosthesis by valve type

Prosthesis type	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Biological – bovine	540 (79.1)	26 (13.3)	4 (26.7)	13 (72.2)	583 (64.0)
Biological – porcine	31 (4.5)	112 (57.4)	10 (66.7)	–	153 (16.8)
Mechanical	104 (15.2)	57 (29.2)	1 (6.7)	–	162 (17.8)
Homograft/allograft	7 (1.0)	–	–	3 (16.7)	10 (1.1)
Autograft	1 (0.1)	–	–	2 (11.1)	3 (0.3)
ALL	**683 (100.0)**	**195 (100.0)**	**15 (100.0)**	**18 (100.0)**	**911 (100.0)**

7.6 Other cardiac surgery

The most common form of other cardiac surgery were left atrial appendage closure (32%), followed by atrial arrhythmia surgery, accounting for 10% of other cardiac surgeries. These procedures may have been performed in conjunction with a cardiac procedure or solely as an index operation.

Table 29: Other cardiac procedures

Procedure	n (%)
Left atrial appendage closure	116 (32.0)
Atrial arrhythmia surgery	37 (10.2)
Lung transplant – BSSLTx*	23 (6.3)
Atrial septal defect repair	23 (6.3)
Cardiac tumour	23 (6.3)
Other congenital cardiac procedure	20 (5.5)
LVOT† myectomy for HOCM‡	11 (3.0)
Other vascular surgery	11 (3.0)
Other thoracic surgery	9 (2.5)
VAD§ procedure	9 (2.5)
Cardiac transplant	8 (2.2)
CIED|| procedure (revision/removal)	8 (2.2)
Permanent LV epicardial lead	5 (1.4)
RVOT# repair/reconstruction	5 (1.4)
Acquired ventricular septal defect repair	4 (1.1)
Left ventricular reconstruction	4 (1.1)
Lung transplant – single lung	4 (1.1)
Aortic root/LVOT† procedure to facilitate AVR	4 (1.1)
Trauma	3 (0.8)
Pulmonary thrombo-endarterectomy	3 (0.8)
Lung resection	3 (0.8)
Pericardiectomy	2 (0.6)
LV rupture repair	2 (0.6)
LV aneurysm repair	2 (0.6)
Coronary endarterectomy	2 (0.6)
Mitral annulus repair	2 (0.6)
Cardiopulmonary transplant	1 (0.3)
ECMO** procedure	1 (0.3)
Other cardiac	15 (4.1)
Total	**363 (100.0)**

* Bilateral sequential single lung transplantation

† Left ventricular outflow tract

‡ Hypertrophic obstructive cardiomyopathy

§ Ventricular assist device

|| Cardiac implantable electronic device

Right ventricular outflow tract

** Extracorporeal membrane oxygenation

7.7 Blood product usage

The majority of surgeries did not require blood product transfusion (64%). However, as the urgency of operations increased, so too did the requirement for red blood cells (RBC) and non-red blood cells (NRBC). Over three quarters (77%) of all emergency cases utilised at least one blood product.

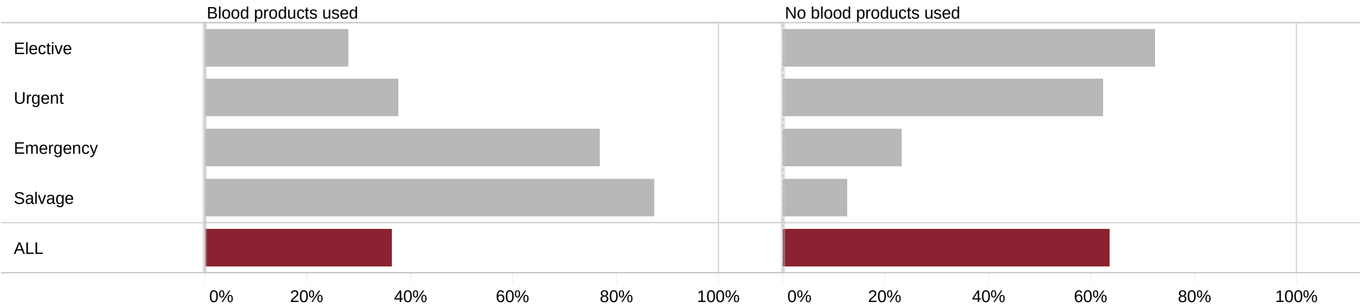


Figure 21: Blood products used by admission status

Table 30: Blood product type used by admission status

Admission status	Both RBC and NRBC n (%)	RBC only n (%)	NRBC only n (%)	No blood products n (%)
Elective	106 (9.6)	91 (8.3)	109 (9.9)	797 (72.3)
Urgent	142 (15.3)	137 (14.8)	72 (7.8)	577 (62.2)
Emergency	106 (55.5)	14 (7.3)	27 (14.1)	44 (23.0)
Salvage	5 (62.5)	1 (12.5)	1 (12.5)	1 (12.5)
ALL	**359 (16.1)**	**243 (10.9)**	**209 (9.4)**	**1,419 (63.6)**

8 Outcomes

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

8.1 Risk prediction models

Cardiac Surgery

Patient-specific comorbidities and clinical factors present at the time of surgery can significantly influence the likelihood that a patient will experience an adverse perioperative event. To account for these factors in cohort analysis, risk adjustment models are commonly employed. These statistical tools enable the adjustment of risk for individual patients, attempting to correct for patients who may be undergoing surgery in a critical pre-operative state, for example cardiogenic shock, as opposed to an elective procedure in a patient with limited comorbid factors.

Risk scores are usually established from large patient cohorts and are relevant for a particular period in time, and in a particular geographical area with specific ethnic, socioeconomic and cultural factors.

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

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

The risk prediction models used in evaluating the 2022 clinical outcomes for cardiac surgical cases are:

- EuroSCORE[24]
- EuroSCORE II[25]
- ANZSCTS General Score[26]
- AusSCORE[27]
- STS Score (mortality and morbidity)[28,29,30]

8.1.1 Mortality

The risk adjustment analysis of 30 day mortality has been evaluated using a range of well described risk models. The EuroSCORE[24], EuroSCORE II[25], and ANZSCTS General Score[26] can be applied to evaluate deaths for all types of cardiac surgical cases, whereas the AusSCORE model[27] applies for mortality in CABG cases only.

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

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

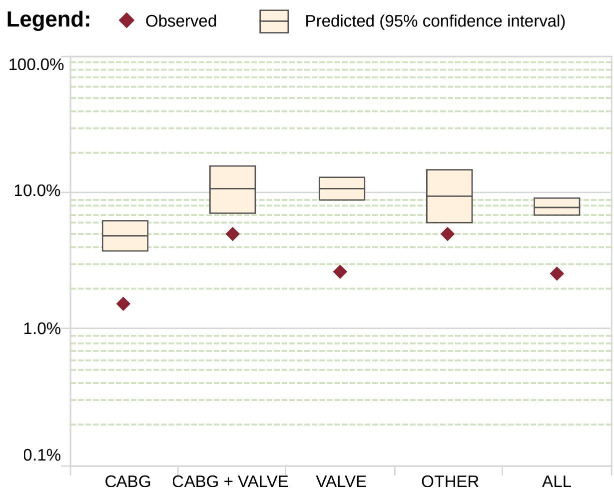


Figure 22: EuroSCORE

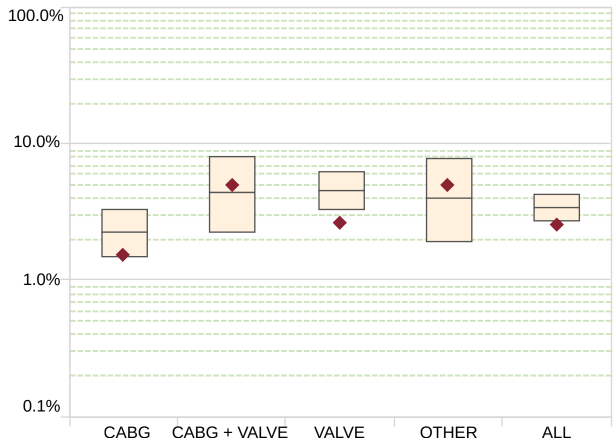


Figure 23: EuroSCORE II

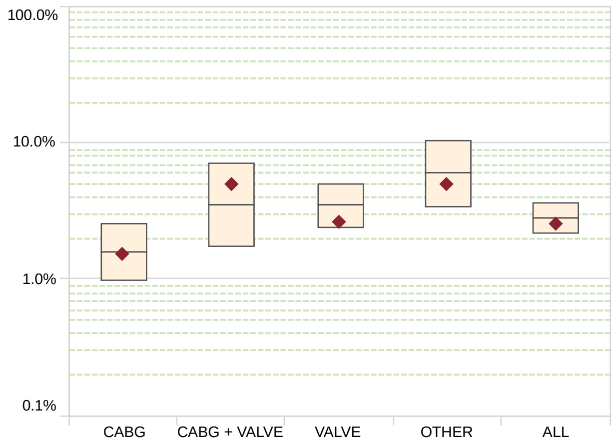


Figure 24: ANZSCTS (General Score)

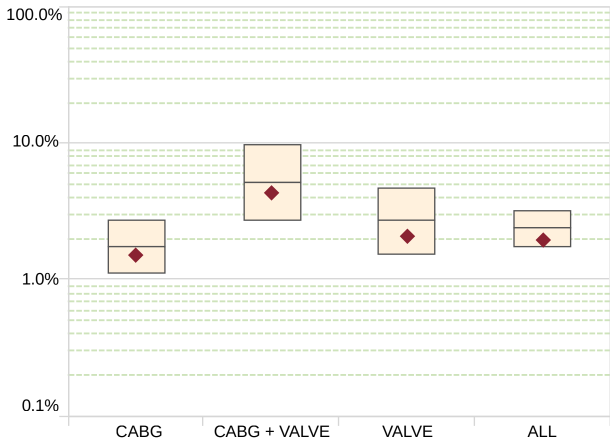


Figure 25: STS (death)

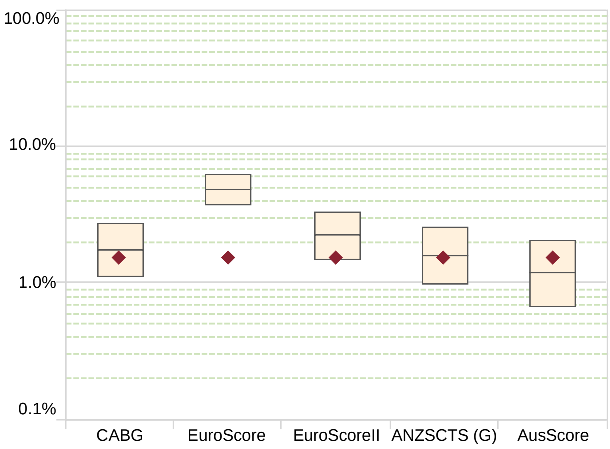


Figure 26: CABG

8.1.2 Morbidity

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

The aggregated morbidities chart (Figure 32) represents the observed rate of cases involving at least one of the five morbidities.

Most comparisons between the observed event rate and the rate predicted using the respective risk scores demonstrate that outcomes are within expectation. The incidence of prolonged ventilation for CABG patients and the rate of cerebrovascular accident in patients undergoing valve surgery is better than predicted.

Deep sternal wound infection

The rate of deep sternal wound infection (DSWI) is a significant postoperative adverse outcome that increases the risk of death for a patient and has significant consequences in terms of healthcare system resource utilisation. As such, it continues to be a focus for all participating units. Historically this outcomes had been consistently identified as occurring at a rate higher than predicted by the STS model.

Establishment of a correction factor was based on the DSWI data presented in the Australian and New Zealand Society of Cardiac & Thoracic Surgeons Cardiac Surgery Database Program Annual Report for 2020[31]. This report suggests that the national rate of DSWI in public hospitals for 2017–2019 was approximately 1.13% while for 2020 the rate had dropped to 0.91% (comparable rates for Queensland public hospitals in the same time period were 1.7% and 1.4% respectively).

Therefore, for the purposes of quality assurance and monitoring, the STS model was adjusted to deliver an expected event rate of 1.13% using an odds correction factor of 3.70.

After applying an odds correction of 3.70 to the 2022 cohort, the observed rate of DSWI is within the expected rate for all surgical categories.

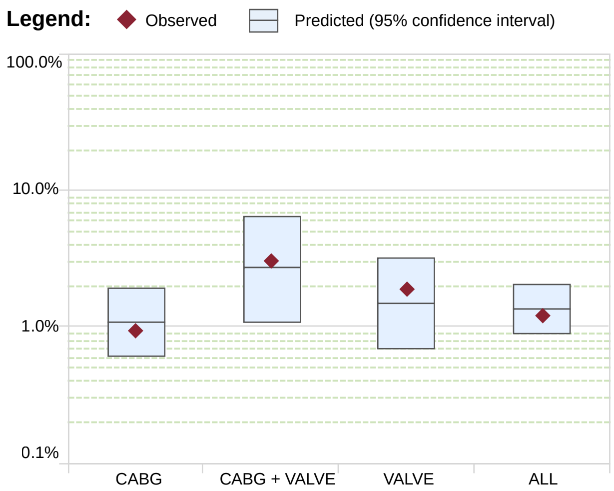


Figure 27: Cerebrovascular accident

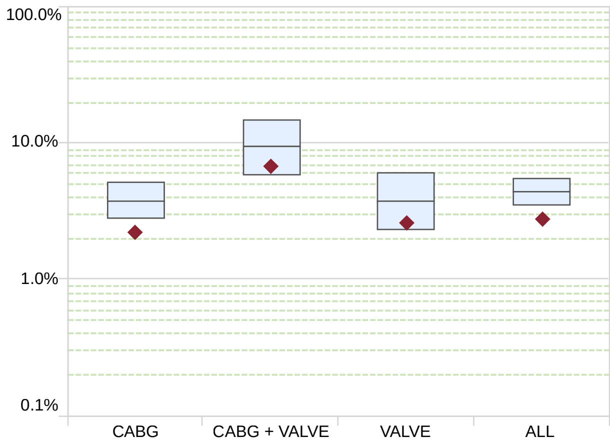


Figure 28: Renal failure

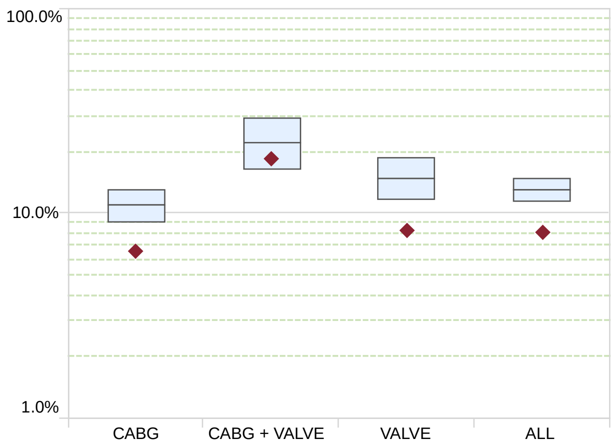


Figure 29: Ventilation >24 hours

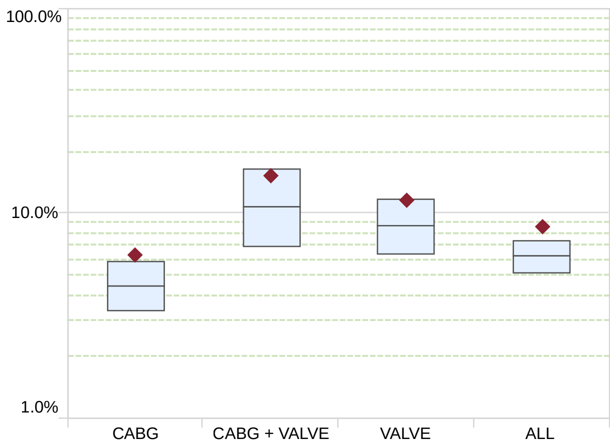


Figure 30: Reoperation

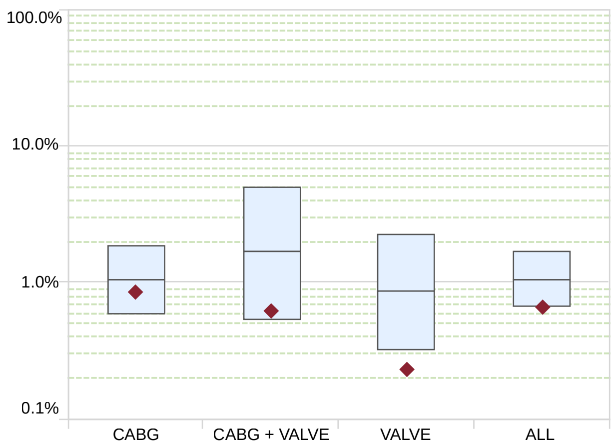


Figure 31: Deep sternal wound infection

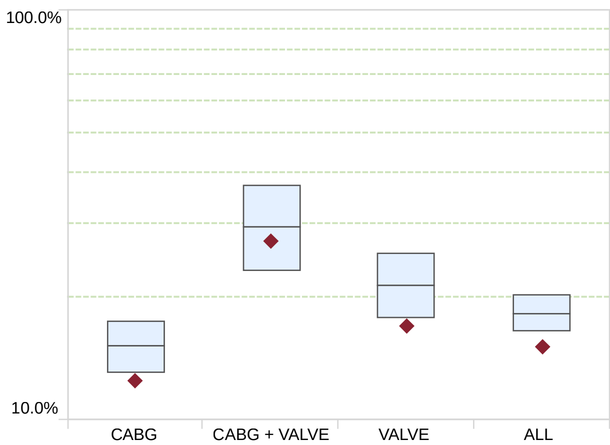


Figure 32: Major morbidity

8.1.3 Measures of process

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

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

The LOS comparison indicates that the proportion of cases staying less than six days is lower than expected, regardless of surgery category. Similarly, the proportion of patients who stay longer than 14 days is greater than predicted.

Further investigation is needed to delineate whether this outcome is prolonged due to institutional processes or factors relating to patient care.

Legend: Observed; Predicted (95% confidence interval)

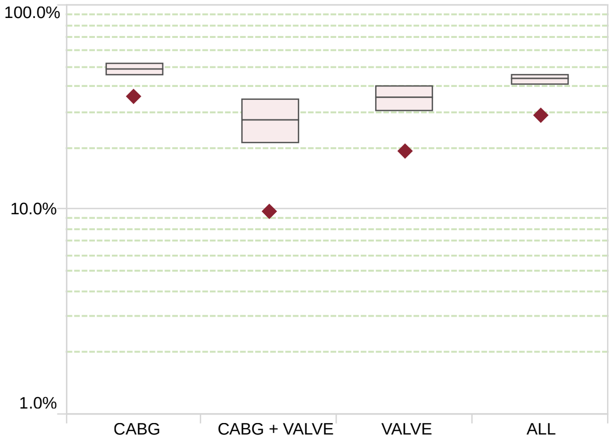


Figure 33: LOS ‹6 days

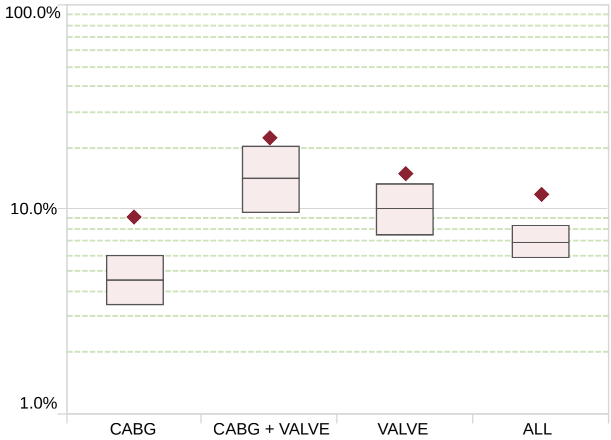


Figure 34: LOS ›14 days

8.1.4 Failure to rescue

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

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

From this analysis, the FTR observed rate across all surgery categories is similar to the predicted rate, suggesting that the processes in place to deal with adverse events are functioning at the expected level.

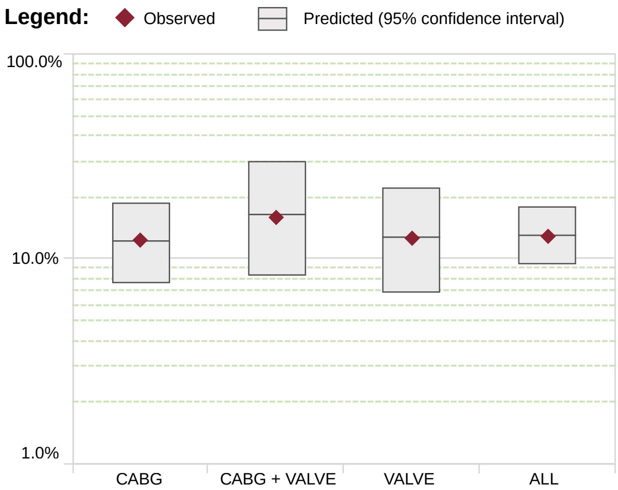


Figure 35: Failure to rescue

8.1.5 Outcome trends

Quality improvement systems are employed to support the effectiveness of clinical care and performance. Health service organisations should use these and other established safety and quality systems to support the monitoring, reporting and implementation of quality improvement strategies for clinical care. Stakeholder engagement at all levels of the organisation is an essential part of quality improvement systems and to lead change.

Ongoing monitoring of adverse events allows organisations to gain insight into whether there are safety gaps in their clinical care processes, and to modify these processes to suit the individual service. Evaluation allows organisations to measure the progress and impact of clinical change or intervention processes and possible improvement strategies.

Ensuring that processes are in place to facilitate feedback and provide review of findings from the monitoring of quality improvement processes to relevant committees or meetings about governance and leadership is imperative. Members of the relevant QCOR Cardiothoracic Surgery Committee are responsible to ensure that actions are taken to improve clinical performance and dissemination of performance data.

The QCOR Cardiothoracic Surgery Committee employ the clinical quality registry feedback loop whereby surgical case data is entered, analysed and made available for clinical review in a timely manner. Any outliers or variation in outcomes are promptly flagged with interventions and improvements in care implemented.

Where anomalies or outliers may exist, the pyramid model of investigation of clinical outcome variation where data is provided to sites with the opportunity for review and amendment. This ensures that a statistically sound baseline is established before escalation upward on the pyramid to investigate other potential causes of the outlier.

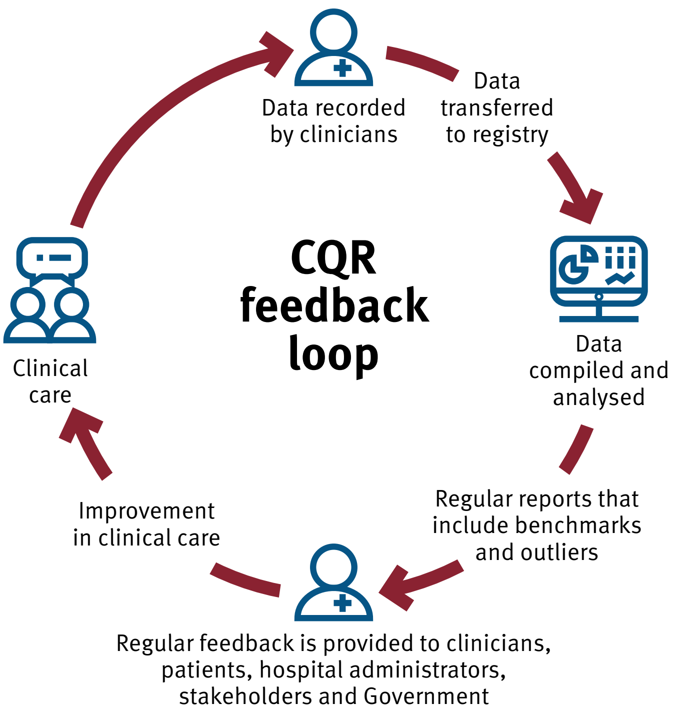


Figure 36: Clinical Quality Registry feedback loop

Since the inception of the QCOR quality and safety program for cardiac surgery, statistical models for mortality rates have been published which utilise EuroSCORE II[25], ANZSCTS General Score[26] and STS mortality models [28,29,30], while morbidity, measures of process and failure to rescue are displayed using the STS models. An exponentially weighted moving average (EWMA) is used to provide a comparison of the trend in predicted risk and observed outcomes.

The following analysis reviews trends in clinical outcomes across mortality and morbidity as well as measures of process such as length of stay and failure to rescue.

Mortality

As previously stated, EuroSCORE II[25], and ANZSCTS General Score[26] can be applied to evaluate mortality for all types of cardiac surgical cases, whereas the AusSCORE model[27] applies for mortality in CABG cases only and has not been shown in this analysis. For the STS model clearly defined sub-groups of procedures are used – CABG only[28], Valve only[29] and CABG + Valve[30] models. Patients who met the inclusion criteria were assessed and the remainder of patients excluded from the analysis.

For all prediction models employed, the mortality rate has trended towards being below the predicted range. Peaks in the observed mortality rates were often accompanied by an uptick in the expected range, likely reflecting the complexity or high-risk nature of this dynamic cohort.

Legend: Observed, EWMA; Predicted (95% confidence interval), EWMA

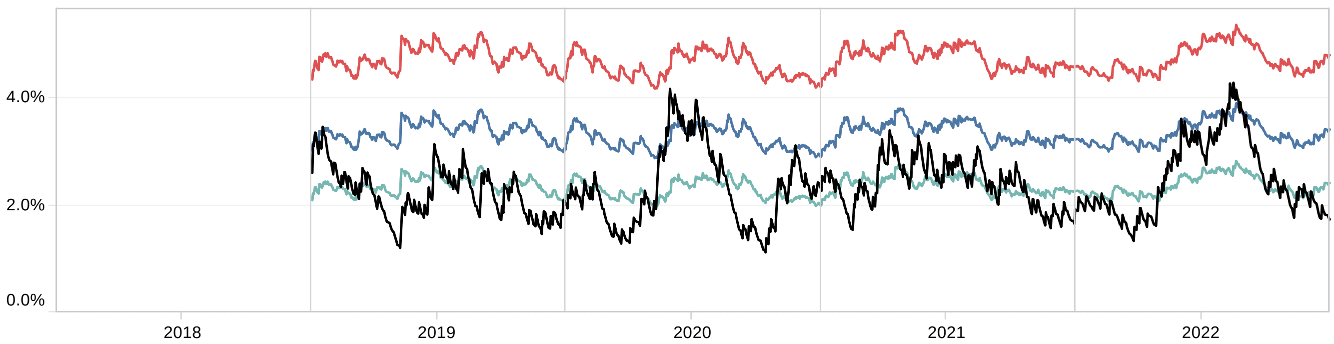


Figure 37: EuroSCORE II, 2018–2022

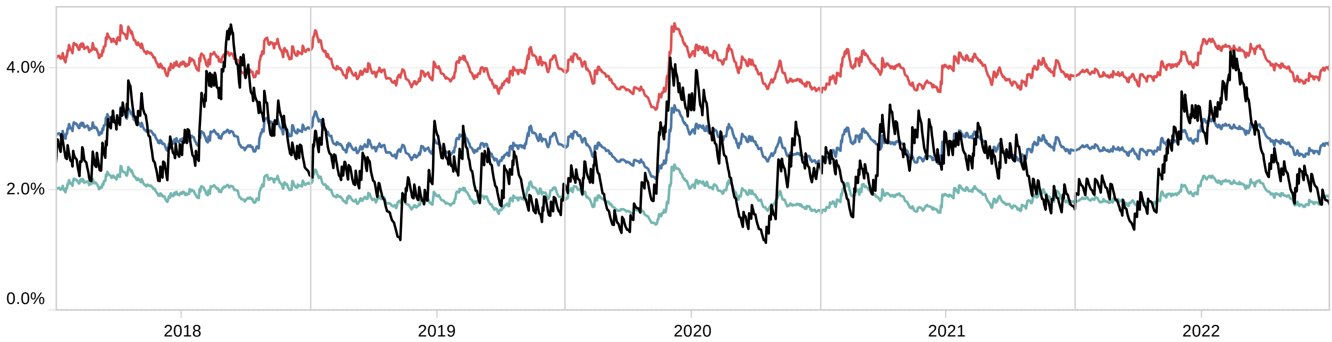


Figure 38: ANZSCTS General Score, 2018–2022

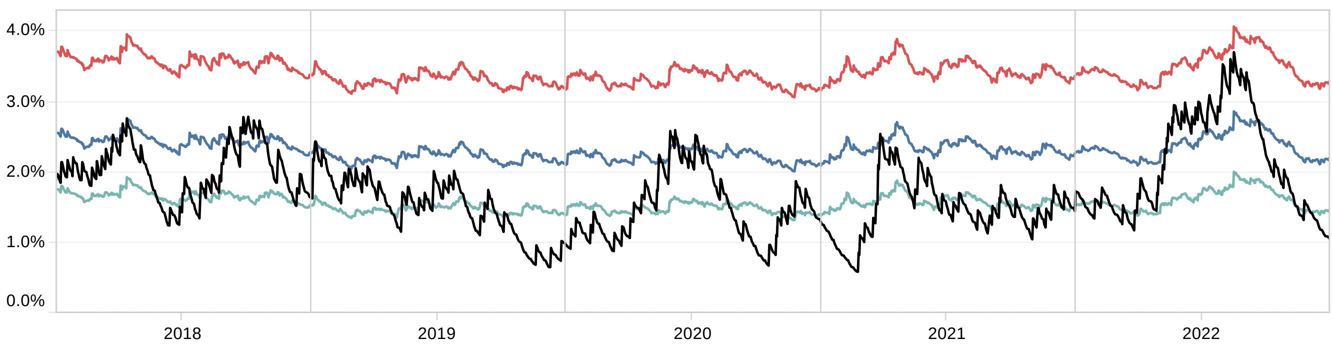


Figure 39: STS mortality, 2018–2022

Morbidity

Cerebrovascular accident or stroke, defined as a new central neurologic deficit that persists for greater than 72 hours, caused by an ischaemic or haemorrhagic event peri or postoperatively is a recognised complication and risk of cardiac surgery. Over the monitored period the incidence of cerebrovascular accident has varied, while remaining within or below the expected range.

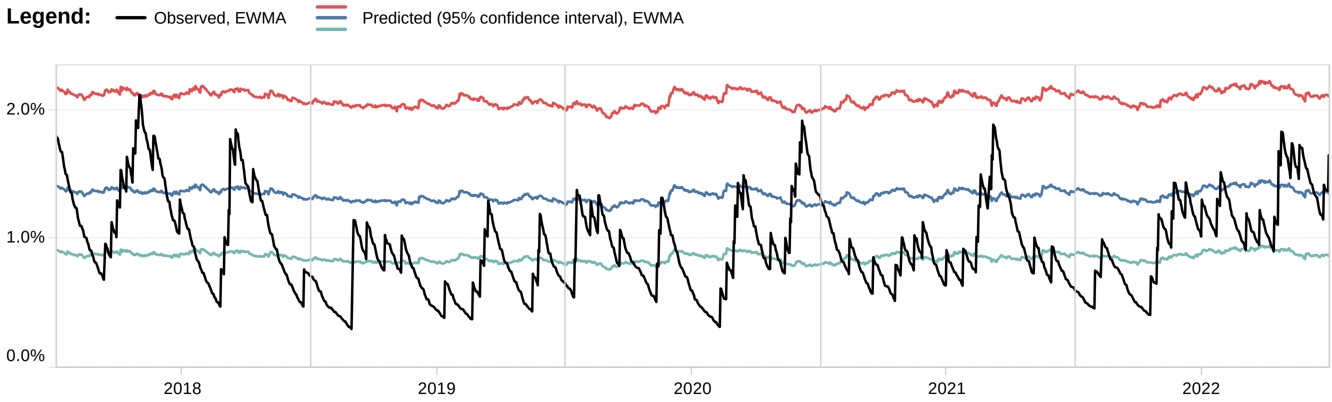


Figure 40: Cerebrovascular accident, 2018–2022

Renal insufficiency following cardiac surgery is a known postoperative complication associated with poorer patient outcomes. Renal insufficiency is measured by an increase in postoperative serum creatinine levels or a new requirement for renal dialysis or haemofiltration. The rates of renal insufficiency have trended downward over time. The incidence is also lower than the expected rate for much of the sample period.

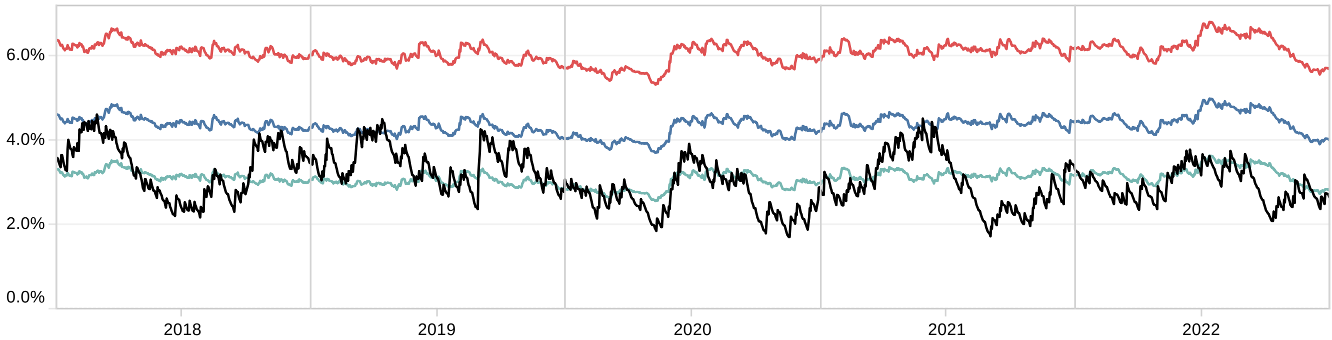


Figure 41: Renal failure, 2018–2022

The requirement for ventilator support for over 24 cumulative hours postoperatively is an index of importance in cardiac surgery as it may be associated with a considerable risk of morbidity and mortality. The incidence of prolonged ventilation in this cohort is consistently low compared to the expected rate.

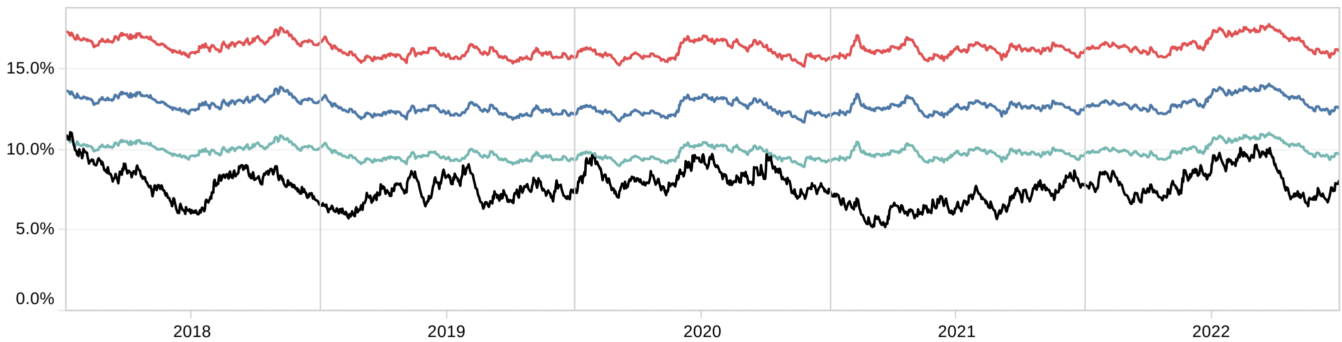


Figure 42: Ventilation >24 hours, 2018–2022

DSWI is a significant postoperative adverse outcome that increases the risk of death for a patient and has significant consequences in terms of healthcare system resource utilisation. Over the past five years, there has been a reduction in the observed rate of DSWI. Various sites have implemented a range of quality improvement activities, projects and audits to investigate and reflect on local practices with an aim to understand the contributing factors that may increase the likelihood of a patient suffering DSWI.

Legend: — Observed, EWMA — Predicted (95% confidence interval), EWMA

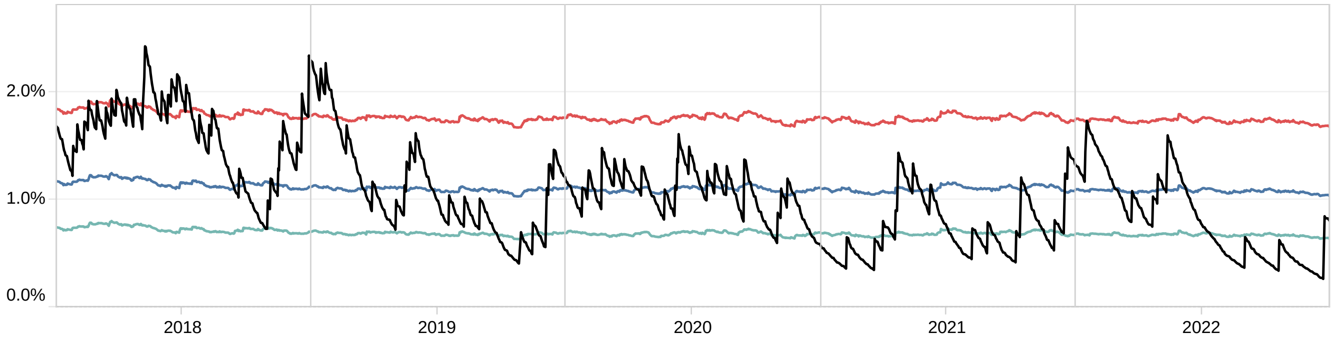


Figure 43: Deep sternal wound infection, 2018–2022

Reoperation following cardiac surgery is performed as a last resort to correct a surgical complication or unplanned sequalae of the index operation. This outcome has been largely within, or exceeding the upper limit of, the predicted rate.

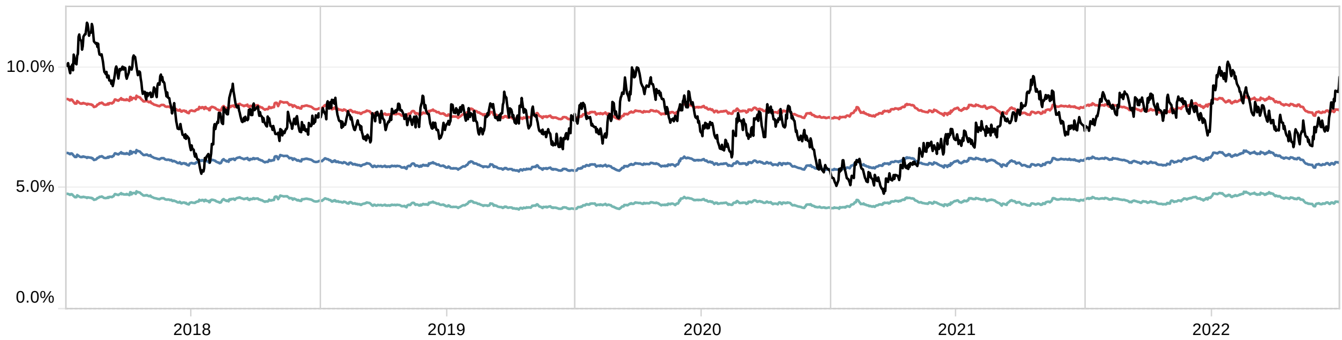


Figure 44: Reoperation, 2018–2022

The development of any of the five major morbidities previously described (including DSWI) is an important aggregate measure of surgical outcomes. Since the inception of the quality program for cardiac surgery, the major morbidity rate has remained largely consistent within the expected range or below the expected rate.

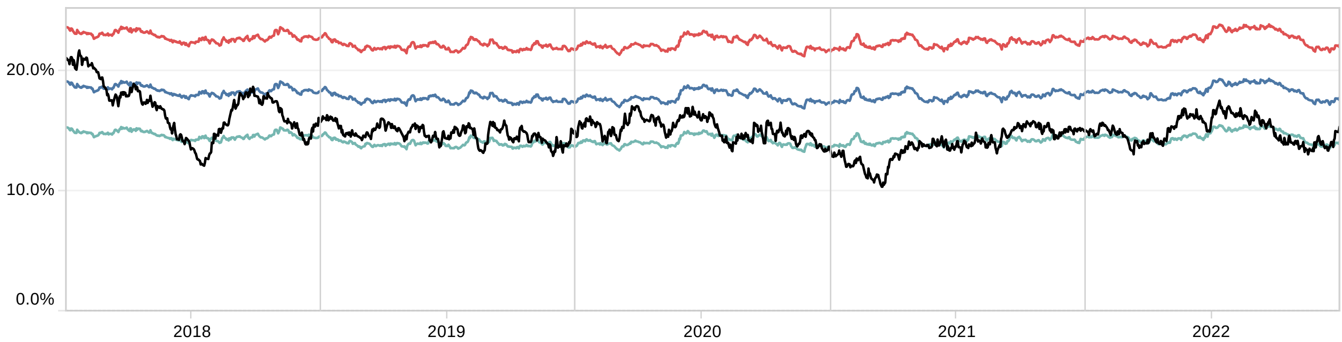


Figure 45: Major morbidity, 2018–2022

Measures of process

Previous QCOR Reports have investigated factors which influence postoperative length of stay and, after adjusting for clinical characteristics and other procedural factors, found a positive correlation between the remoteness of the patient's place of residence and the likelihood the patient would remain in hospital >14 days postoperatively. Paradoxically, it was also found that patients residing in an Inner Regional and Outer Regional area had a higher likelihood of having a length of stay <6 days.

The analysis demonstrates the length of stay of patients compared with that predicted by the STS score. The LOS comparison indicates that the proportion of cases staying less than six days is consistently less than expected, indicating that despite efforts to investigate and communicate this measure that has capacity for improvement, benchmarks are not being met despite being close at some points.

Similarly, the proportion of patients who stay longer than 14 days is consistently larger than expected, though sites are able to achieve close to the expected rate. This suggests that the STS targets are realistic, even though they may not account for Queensland's well-described geographic challenges and with sustained focus, performance within the benchmark range may be possible.

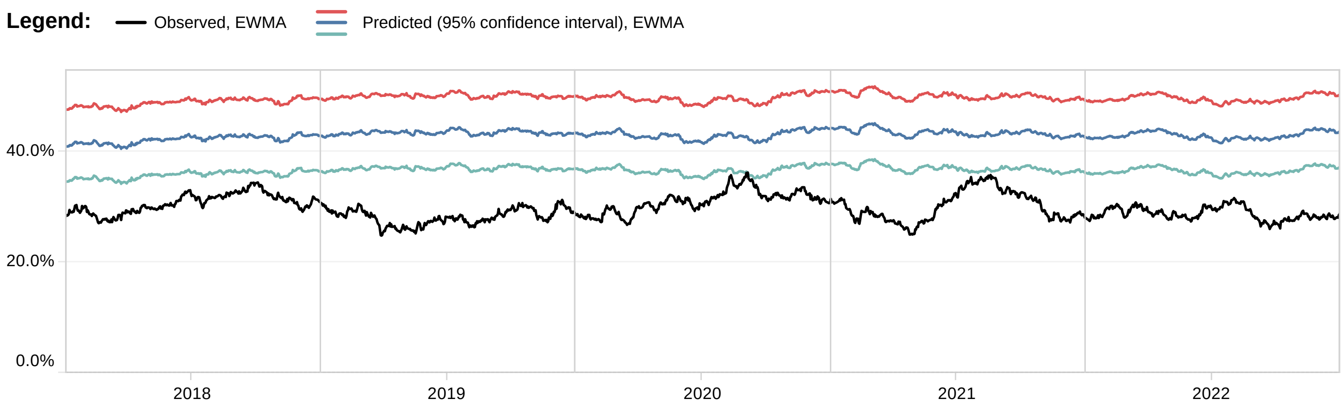


Figure 46: LOS <6 days, 2018–2022

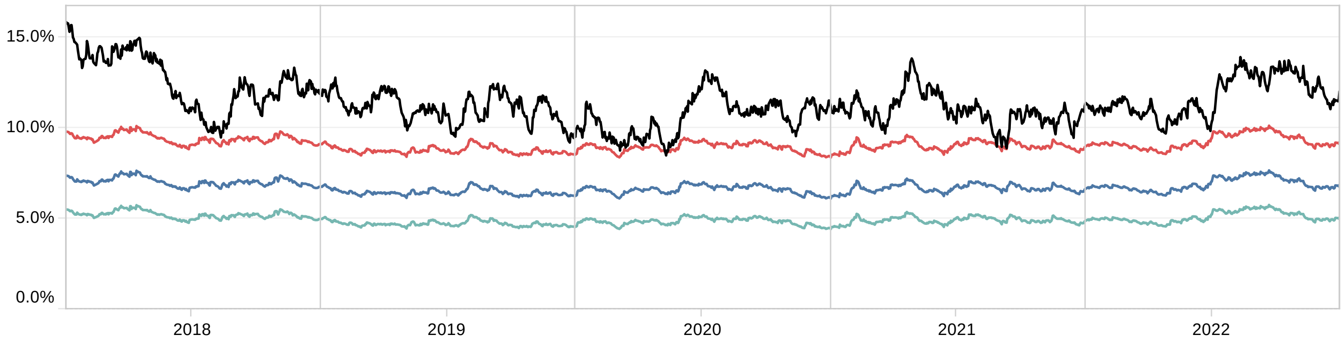


Figure 47: LOS >14 days, 2018–2022

Failure to rescue

As previously described FTR is calculated from the risk of adverse events and the risk of death in combination. It assumes that an adverse event can result in death if not appropriately intervened on by the hospital processes. For this analysis all surgical categories are examined, and it has found that for the majority of the sample period, the rates of FTR are lower than expected.

As FTR is an indicator of quality that focuses primarily on the system of care rather than the surgical procedure, it suggests that processes are in place to deal with adverse events and appear to be functioning at or better than the expected level.

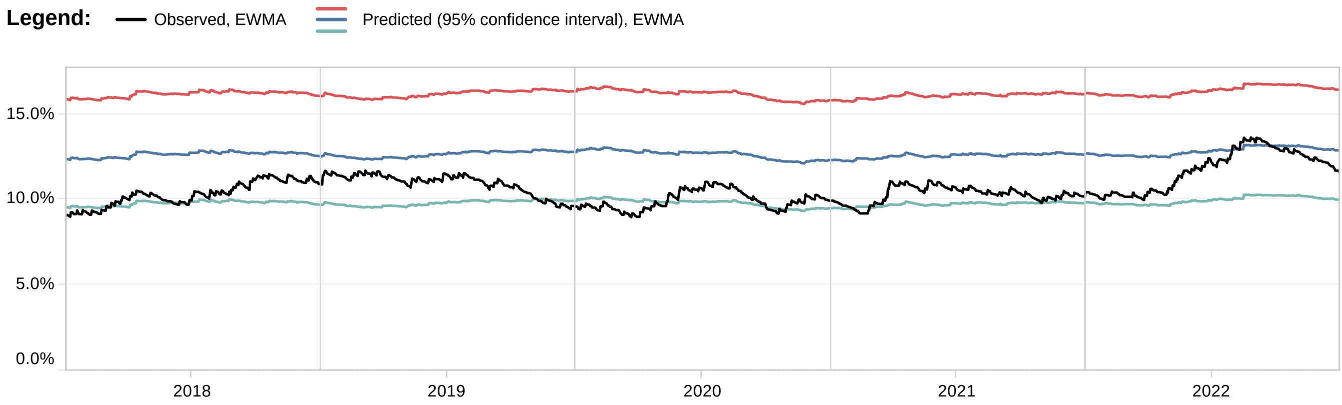


Figure 48: Failure to rescue, 2018–2022

9 Supplement: Cardiac surgery equity

A health system that demonstrates equity would have an absence of disparities in health outcomes and access to healthcare services among different population groups. In Australia, there are several health equity challenges that have been identified. These challenges stem from social, economic, and structural factors. Key health equity themes and challenges in Australia include:

- **Aboriginal and Torres Strait Islander persons health disparities**
  One of the most significant health equity challenges in Australia is the gap in health status and outcomes between Aboriginal and Torres Strait Islander peoples and Australians of other descent. Aboriginal and Torres Strait Islander peoples experience higher rates of chronic diseases, lower life expectancy, and poorer access to healthcare services compared to non Aboriginal and Torres Strait Islander persons.[32]
- **Geographic disparities**
  Rural and remote areas in Australia often have limited access to healthcare services, including doctors and specialists. This has been linked to disparities in health outcomes between urban and regional/remote populations.[32]
- **Gender health inequities**
  Gender-based disparities exist in areas such as reproductive health, domestic violence, and access to gender-specific healthcare services. Women and gender-diverse individuals may face unique health challenges or present with clinical signs and symptoms of disease that vary from medical norms.[32]
- **Socioeconomic disparities**
  Socioeconomic status is a significant determinant of health outcomes in Australia. People from lower socioeconomic backgrounds often face higher rates of chronic conditions, mental health issues, and reduced access to healthcare services.[32]

Efforts to address these health equity challenges in Australia have involved policy initiatives at local, state and federal government levels, community-based programs, and research collaborations. It is important to note that the health equity landscape is constantly evolving with the impacts of various programs to investigate and improve equity currently underway across the country.

This supplement aims to investigate and analyse these key determinants of health equity and their trends over time in a cohort of Queenslanders who have undergone cardiac surgery in public surgical units from 2017 to 2022.

9.1 Aboriginal and Torres Strait Islander persons health disparities

Access to cardiac surgery for Aboriginal and Torres Strait patients has been a longstanding concern due to various social, economic, geographic, and healthcare system factors. This issue highlights disparities in healthcare and outcomes among Aboriginal and Torres Strait Islander Australians.

First Nations Australians experience significantly higher rates of cardiovascular disease, including coronary artery disease, heart failure, and rheumatic heart disease, compared to Australians of other descent.[32] These disparities are linked to a range of social determinants of health, such as lower socioeconomic status, limited access to healthcare services, and higher rates of risk factors like smoking, poor nutrition, and physical inactivity.[33] Many Indigenous Queenslander communities are in remote or rural areas, making it challenging to access specialised cardiac care facilities. Transportation barriers, including long distances to hospitals and the cost of travel, can limit access for First Nations patients to timely cardiac care.

Aboriginal and Torres Strait Islander persons often present with more advanced cardiac diseases due to delayed access to care, leading to higher surgical risks.[32] Comorbidities like diabetes and kidney disease are more prevalent among First Nations patients, increasing the complexity of cardiac surgeries.[33]

Cultural competence among healthcare providers is essential for providing quality care to First Nations peoples. Insensitivity to cultural beliefs and practices is also a barrier for Aboriginal and Torres Strait Islander people in need of healthcare.[34] Communication issues, including language and cultural differences, may lead to misunderstandings and hinder patient-provider relationships.[34]

9.2 Geographic disparities

Access to cardiac surgery for Australians living in rural and remote locations can be a significant challenge. These areas often face geographical, infrastructural, and healthcare workforce limitations that can affect the timely delivery of specialised medical services, such as cardiac surgery.

Safe performance of cardiac surgery requires a certain volume of case load. As case loads relate to absolute population numbers, when servicing a low density, sparsely populated regional area, the area is necessarily large, resulting in significant travel times from regional and remote communities. Along with the challenge of attracting and retaining medical specialists, the need for minimum volume and outcome considerations relating to the minimum surgical volumes for units to attain and retain accreditation necessarily creates an upper limit on the number of cardiac surgical units that can be supported in regional areas. Telehealth solutions, while improving, might not always be sufficient for cardiac surgery consultations or follow-up care.[37]

Rural and remote areas in Australia are often far from major healthcare facilities, including cardiac surgery centres. This distance can delay access to timely care, especially in emergencies. Limited transportation options can further hinder access.[35] Some patients may struggle to reach medical centres, leading to delayed diagnosis and treatment. Harsh weather conditions and challenging terrain in some remote regions can make travel to healthcare centres even more difficult.[35]

Rural and remote areas often suffer from a shortage of specialist medical practitioners, including cardiac surgeons. Attracting and retaining healthcare professionals in remote areas can be challenging due to factors like professional isolation and limited career opportunities for their spouses.[36]

Patients may face significant expenses related to travel, accommodation, and meals when seeking cardiac surgery in urban centres. Limited private insurance coverage for surgeries outside of major cities can also be a challenge. Furthermore, support networks and access to family can also present challenges for patients whose support network resides outside of major cities.

The allocation of healthcare resources and funding often favours urban areas, leaving rural and remote regions with fewer healthcare services. There is a need for targeted policy initiatives to address these disparities, such as subsidies for healthcare providers in remote areas.[38]

9.3 Gender health inequities

When discussing gender-specific issues related to access to cardiac surgery for Australian women, several key aspects have been found to be important.

It has been reported that women often underestimate their risk of heart disease, and healthcare providers may not recognise the symptoms in women as readily as they do in men.[39] This can lead to delays in diagnosis and treatment. Encouraging awareness campaigns about heart disease and its symptoms in women is crucial.

Women may experience symptoms of myocardial infarction that differ from the traditional crushing chest pain sometimes accompanied by arm or jaw pain commonly experienced by males.[39] Women with myocardial infarction may have atypical symptoms such as nausea, shortness of breath, or back pain. The atypical nature of these symptoms, disease manifestation differences, and tendency to present later in life can lead to misdiagnosis or delayed diagnosis.[39] The system is biased toward the “typical” presentation of diseases, and hence a system bias exists against the atypical presentations that are more common in women. The majority of cardiac surgical cases are performed on males, with typical presentations, and so the system is geared toward this activity, and biased against non-males with atypical presentations.

The different life expectancy of men and women means that a larger proportion of older woman, who may have multiple comorbidities may face increased challenges due to higher surgical risks than mean.[32] Shared decision-making between patients, their families and healthcare providers is crucial in such cases to ensure the best possible outcome and timely intervention to avoid disease progression.[40]

9.4 Socioeconomic disparities

Social disadvantage is a factor that also encompasses other factors such as socioeconomic status, education level, geographic location, cultural background, and Aboriginal and Torres Strait Islander descent.

Socioeconomic disparities can affect access to cardiac surgery. People with lower incomes may have limited access to private healthcare options, which can result in longer wait times for publicly funded surgeries.[41]

The distance of patients in rural and remote areas to cardiac surgery centres creates a barrier for the socioeconomically disadvantaged.[41] Expanding telehealth services and providing specialist outreach clinics can help bridge the gap for patients in remote areas, whilst also essential to invest in regional healthcare infrastructure and improve transportation options.

Patients from culturally diverse backgrounds may face language and cultural barriers when seeking cardiac surgery. Developing culturally sensitive healthcare services, employing interpreters, and training healthcare providers in cultural competence can enhance access for culturally diverse populations.[41]

Aboriginal and Torres Strait Islander peoples often face disparities in healthcare access, including cardiac surgery.[34] Historical and systemic factors contribute to this issue.[34] Culturally appropriate healthcare services, community engagement, and improving access to healthcare facilities in Aboriginal and Torres Strait Islander communities are crucial steps.[34] Collaborative efforts with Aboriginal and Torres Strait Islander communities are essential to address this issue effectively.

Low health literacy can hinder individuals from seeking timely cardiac care or understanding treatment options.[41] Public health campaigns and educational programs can raise awareness about cardiovascular health and available treatment options, especially among disadvantaged populations.

9.5 Patient characteristics

A total of 14,813 patients having surgery between 2017 and 2022 were included in the analysis. Of this cohort, the largest proportion were males (74% of total) who underwent CABG, followed by males who underwent isolated valve surgery. Females accounted for 26% of the overall cohort and were more likely to have undergone isolated valve surgery followed by CABG. Aboriginal and Torres Strait Islander patients accounted for 6.8% of the cohort with the largest proportion of the group (62%) undergoing CABG. 9% of the overall cohort were elective day of surgery admissions.

Table 1: Demographic and treatment characteristics by surgery category, 2017–2022

	ANY CABG* n (%)	CABG + Valve n (%)	Valve n (%)	Other n (%)
Gender				
Male	5,933 (54.4)	1,147 (10.5)	3,138 (28.8)	684 (6.3)
Female	1,351 (34.5)	272 (7.0)	1,822 (46.6)	466 (11.9)
Age group (years)				
<40	74 (8.8)	5 (0.6)	488 (58.2)	272 (32.4)
40–49	474 (40.9)	47 (4.1)	454 (39.2)	183 (15.8)
50–59	1,615 (57.8)	153 (5.5)	802 (28.7)	226 (8.1)
60–69	2,629 (58.2)	442 (9.8)	1,166 (25.8)	284 (6.3)
70–79	2,140 (49.5)	623 (14.4)	1,400 (32.4)	158 (3.7)
≥80	352 (29.9)	149 (12.6)	650 (55.2)	27 (2.3)
Body mass index (BMI) category				
Underweight†	32 (17.7)	8 (4.4)	101 (55.8)	40 (22.1)
Normal range‡	1,402 (41.0)	284 (8.3)	1,361 (39.8)	370 (10.8)
Overweight§	2,759 (51.3)	546 (10.2)	1,693 (31.5)	375 (7.0)
Obese||	2,760 (54.0)	521 (10.2)	1,520 (29.7)	311 (6.1)
Morbidly obese#	331 (46.0)	60 (8.3)	285 (39.6)	44 (6.1)
Admission status				
Elective	2,824 (34.8)	880 (10.8)	3,875 (47.8)	535 (6.6)
Urgent	4,085 (73.6)	484 (8.7)	857 (15.4)	127 (2.3)
Emergency	351 (32.1)	53 (4.8)	219 (20.0)	470 (43.0)
Salvage	24 (45.3)	2 (3.8)	9 (17.0)	18 (34.0)
Aboriginal and Torres Strait Islander descent				
Aboriginal and Torres Strait Islander peoples	625 (62.2)	76 (7.6)	253 (25.2)	51 (5.1)
Australians of other descent	6,659 (48.2)	1,343 (9.7)	4,707 (34.1)	1,099 (8.0)
Elective day of surgery admission				
Yes	498 (36.8)	122 (9.0)	673 (49.8)	59 (4.4)
No	6,786 (50.4)	1,297 (9.6)	4,287 (31.8)	1,091 (8.1)
ALL	**7,284 (49.2)**	**1,419 (9.6)**	**4,960 (33.5)**	**1,150 (7.8)**

Excludes missing data: BMI (n=10, <0.1%)

* Includes coronary artery bypass grafting procedures not including concurrent valve surgery, these operations may occur in isolation or in conjunction with aortic, non cardiac or non valvular cardiac interventions

† BMI <18.5 kg/m²

‡ BMI 18.5–24.9 kg/m²

§ BMI 25.0–29.9 kg/m²

|| BMI 30.0–39.9 kg/m²

BMI ≥40.0 kg/m²

9.6 Socioeconomic Indexes for Areas

Socioeconomic Indexes for Areas (SEIFA) is a suite of measures compiled by the Australian Bureau of Statistics (ABS) that ranks areas in Australia according to relative socioeconomic advantage and disadvantage. These indices were developed using variables collected during the ABS Census that span several areas including household income, employment, education status, occupation, housing and other indicators of advantage and disadvantage. The scores of these indices are standardised to a distribution where the average equals 1,000 and roughly two-thirds of the scores lie between 900 and 1,100.

The four indexes are below:

- Index of Relative Socioeconomic Disadvantage (IRSD)
- Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD)
- Index of Economic Resources (IER)
- Index of Education and Occupation (IEO)

For the purpose of this analysis, SEIFA indexes were derived from the postcode of the patient's usual place of residence. Overseas patients were excluded from the analysis.

Index of Relative Socioeconomic Disadvantage (IRSD)

The ISRD contains only indicators of relative disadvantage and as such provides a broad measure of disadvantage.

An ISRD score above 1,000 indicates a relative lack of disadvantage whereas, a score below 1,000 indicates relatively greater disadvantage in general.

For example, an area could have a low score if there are:

- many households with low income,
- many people with no qualifications, or
- many people in low skill occupations.

Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD)

The ISRAD contains both indicators of relative advantage and disadvantage. As such the ISRAD provides a summary of the economic and social conditions.

An ISRAD score above 1,000 indicates a relative lack of disadvantage and greater advantage, whereas a low score indicates relatively greater disadvantage and a lack of advantage in general.

For example, an area could have a low score if there are:

- many households with low incomes, or many people in unskilled occupations, AND
- few households with high incomes, or few people in skilled occupations.

Index of Economic Resources (IER)

The IER takes into account the financial aspects of relative socioeconomic advantage and disadvantage.

Education and occupation are excluded because they are not direct measures of economic resources.

The IER ignores some asset classes such as savings or equities which could not be included as this data was not collected in the 2016 Census.

For example, an area could have a low score if there are:

- many households with low income, or many households paying low rent, AND
- few households with high income, or few owned homes.

Index of Education and Occupation (IEO)

The IEO was compiled to reflect the educational and occupational level of populations. The IEO does not include any income variables but rather focuses on education variables (highest level of qualification achieved or whether further education is being undertaken) and occupation classification (occupation skill level and unemployment).

A low score indicates relatively lower education and occupation status of people in the area in general.

For example, an area could have a low score if there are:

- many people without qualifications, or many people in low skilled occupations or many people unemployed, AND
- few people with a high level of qualifications or in highly skilled occupations.

In this cohort, there was relative parity in socioeconomic scores between males and females. The median scores for the overall cohort were below 1,000 indicating that a large proportion of this group experience some form of disadvantage. Aboriginal and Torres Strait Islander patients included in the analysis had more disadvantage than Australians of other descent.

Patients who underwent any form of CABG surgery tended to have a greater propensity for disadvantage than those who had isolated valve or other cardiac surgery. Those patients who resided in major cities were less likely to experience disadvantage compared to those living in regional or remote locations.

Table 2: Median SEIFA indexes by surgery category, 2017–2022

	Total cases n	Median (IQR) IRSD* score	Median (IQR) IRSAD† score	Median (IQR) IER‡ score	Median (IQR) IEO§ score
Gender					
Male	10,902	988 (938–1,024)	964 (912–1,010)	991 (956–1,022)	956 (905–1,001)
Female	3,911	987 (936–1,024)	964 (912–1,009)	989 (956–1,020)	957 (905–1,001)
Aboriginal and Torres Strait Islander descent					
Aboriginal and Torres Strait Islander peoples	1,005	953 (896–985)	931 (884–966)	956 (911–990)	916 (886–965)
Australians of other descent	13,808	991 (943–1,028)	964 (919–1,013)	992 (960–1,023)	958 (905–1,004)
Surgery category					
Any CABG	7,284	985 (936–1,023)	963 (910–1,005)	988 (956–1,020)	952 (903–994)
CABG + Valve	1,419	985 (936–1,023)	963 (910–1,007)	982 (955–1,020)	952 (905–995)
Valve	4,960	990 (939–1,026)	964 (915–1,010)	991 (959–1,021)	958 (905–1,001)
Other	1,150	1,000 (954–1,035)	980 (927–1,022)	1,000 (960–1,032)	971 (911–1,020)
Remoteness category					
Major cities	8,021	1,013 (967–1,041)	995 (956–1,028)	1,008 (975–1,035)	986 (949–1,028)
Inner regional	3,969	954 (930–991)	927 (904–961)	972 (959–1,000)	908 (895–954)
Outer regional	2,273	965 (931–998)	945 (908–967)	962 (941–994)	927 (890–973)
Remote	219	944 (870–975)	927 (855–947)	941 (887–976)	906 (884–934)
Very remote	331	948 (765–963)	935 (850–949)	931 (716–948)	924 (882–928)
ALL	**14,813**	**988 (938–1,024)**	**964 (912–1,009)**	**991 (956–1,022)**	**956 (905–1,001)**

* Index of Relative Socioeconomic Disadvantage

† Index of Relative Socioeconomic Advantage and Disadvantage

‡ Index of Economic Resources

§ Index of Education and Occupation

An illustration of Queensland postal areas ranked by the decile of the associated SEIFA index is included in Figure 1–Figure 4. Darker colours indicate higher relative advantage according to the index.

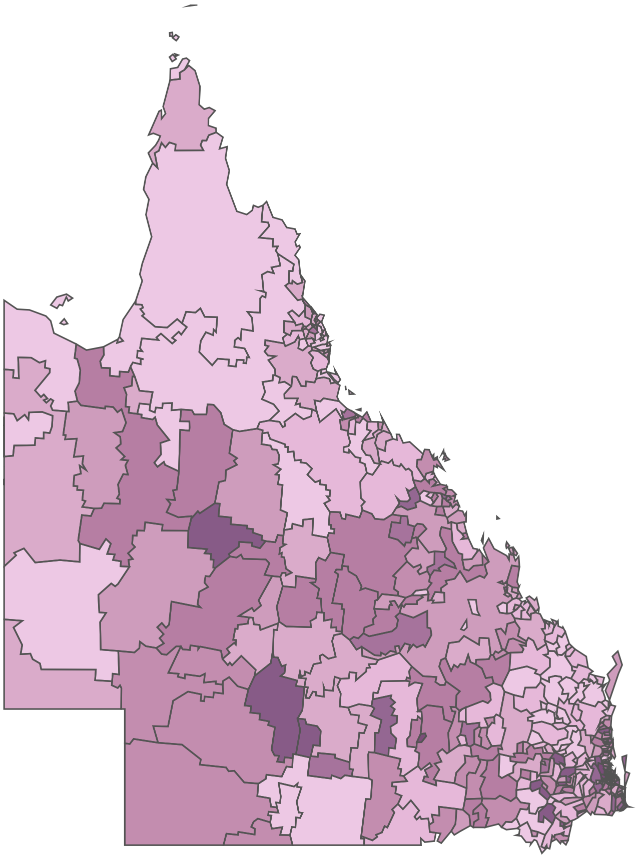


Figure 1: Queensland postal areas by Index of Relative Socioeconomic Disadvantage (IRSD) decile

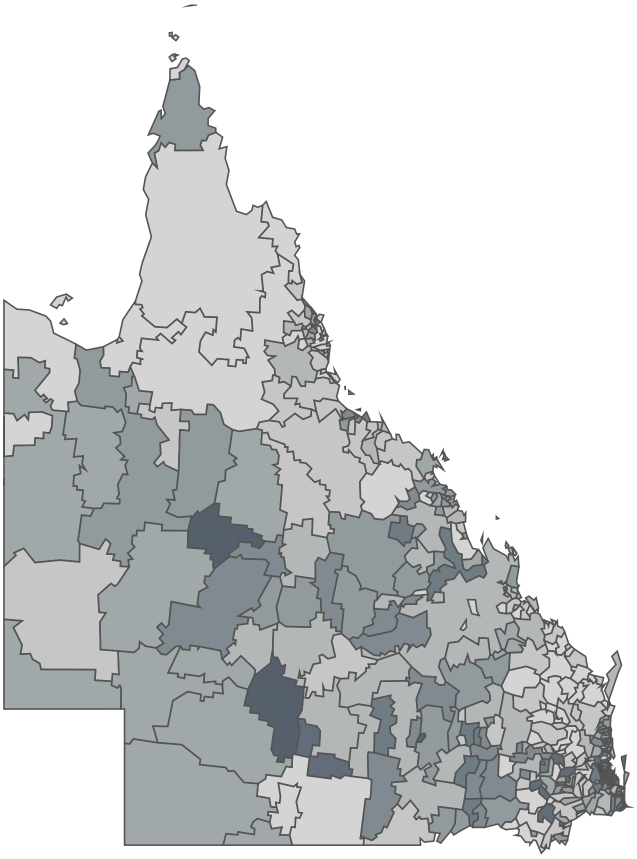


Figure 2: Queensland postal areas by Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD) decile

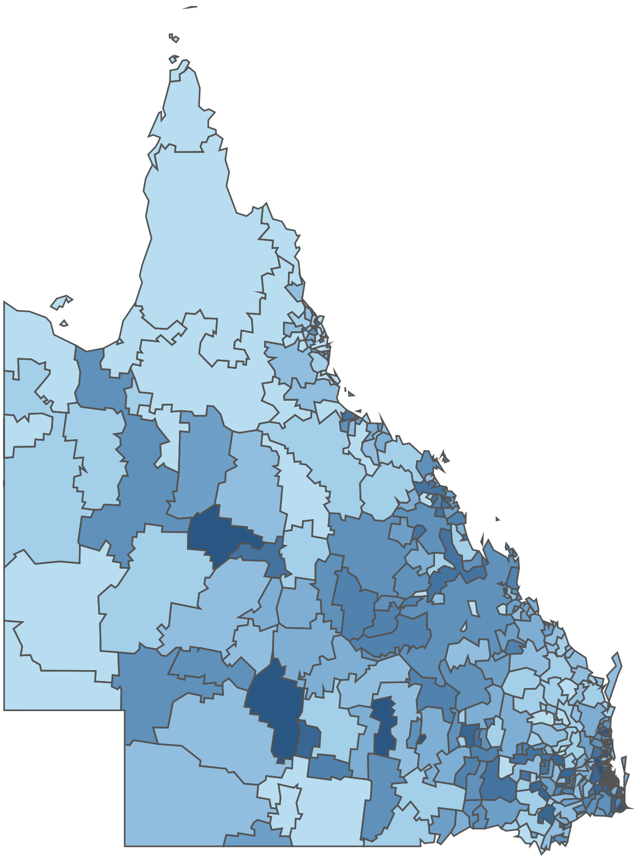


Figure 3: Queensland postal areas by Index of Economic Resources decile

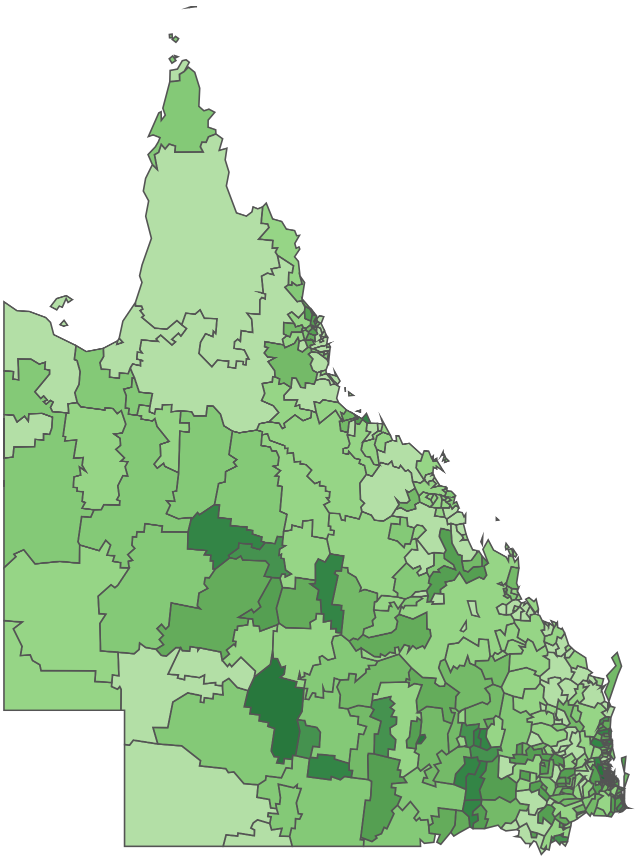


Figure 4: Queensland postal areas by Index of Education and Occupation decile

9.7 Patient outcomes

Mortality

For this analysis, the ANZSCTS General Score[42] has been utilised as this has been shown to be the best performing comprehensive predictive model (discrimination and calibration) in the QCOR cohort. This analysis presents the standardised incidence ratio (SIR) which is defined as a ratio of the observed number of events divided by the predicted number of events. Unlike many other outcome measures, this clinical indicator is based on the number of events, not population. A SIR greater than 100% indicates poorer than expected performance.

Aboriginal and Torres Strait Islander peoples and mortality

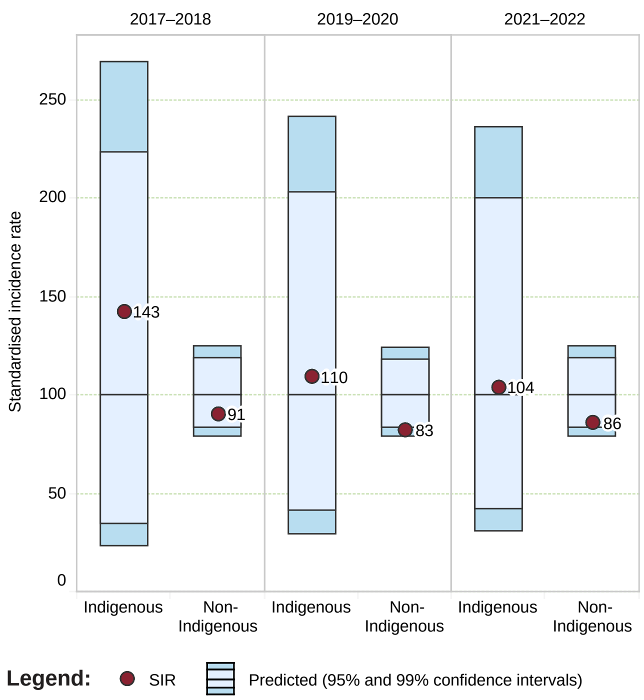


Figure 5: Standardised incidence of mortality by Aboriginal and Torres Strait Islander descent and year

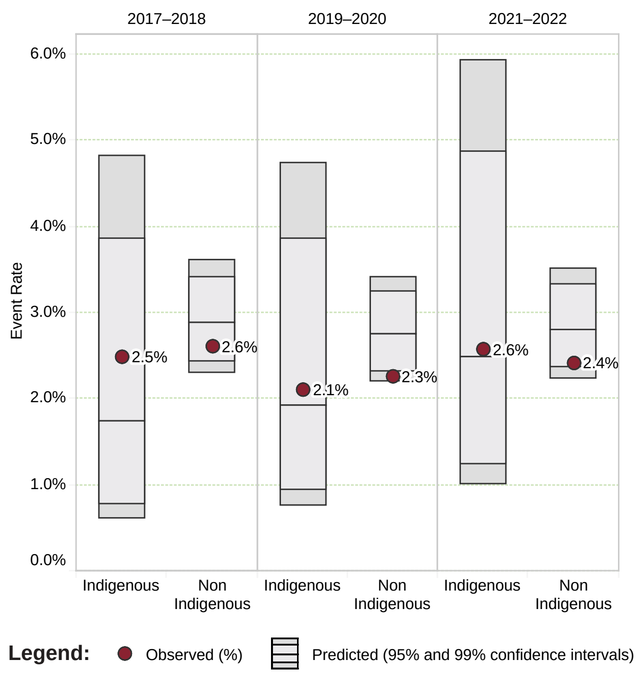


Figure 6: Mortality rate by Aboriginal and Torres Strait Islander descent and year

When comparing outcomes between 2017–2018 and 2021–2022, for Australians of other descent, the SIR remains around 90% for both periods, residing at the lower end of the confidence interval. For Aboriginal and Torres Strait Islander patients, the SIR has decreased from 143% to 104%, although neither change is statistically significant. However, both figures remain higher than those for Australians of other descent, reflecting a trend to potentially poorer than expected outcomes.

When examining event rates, there appears to be no discernible difference in the raw mortality rate between First Nations peoples and Australians of other descent across the two periods, with rates ranging between 2.4% and 2.6%. Yet, the expected mortality rate for the First Nations peoples in 2017–2018 is notably lower than that for First Nations and Australians of other descent in 2021–2022.

It should be noted that the confidence intervals in the above analysis are based on the predicted rate and the number at risk in each cohort. As such First Nations peoples will have broader confidence intervals due to the relatively smaller cohort size.

Since 2017–2018 many initiatives have been implemented to improve access to care for patients living remotely, in Aboriginal and Torres Strait Islander communities and areas with high proportions of Aboriginal and Torres Strait Islander peoples such as the Networked Cardiac Services initiative.

Remoteness and mortality

In this analysis, the disparity in mortality rates between individuals in remote areas and those in other locations has diminished between 2017 and 2022. During 2017–2018, even though the expected mortality rates were similar for both cohorts at approximately 2.7%, the observed mortality rate in remote areas was roughly 40% higher (3.7% vs. 2.6%). In 2021–2022, the SIR in remote areas stood at 121%, compared to 87% in non-remote centres indicating poorer outcomes for those living in remote areas.

However, across all years examined, the observed mortality rate for those patients living remotely was 1.8% vs. 2.4% for those living in non remote locations. For the same period, the SIR was 89% for those living remotely vs. 87% for all others.

For the purpose of this analysis, patients residing in remote and very remote areas were combined into a single group.

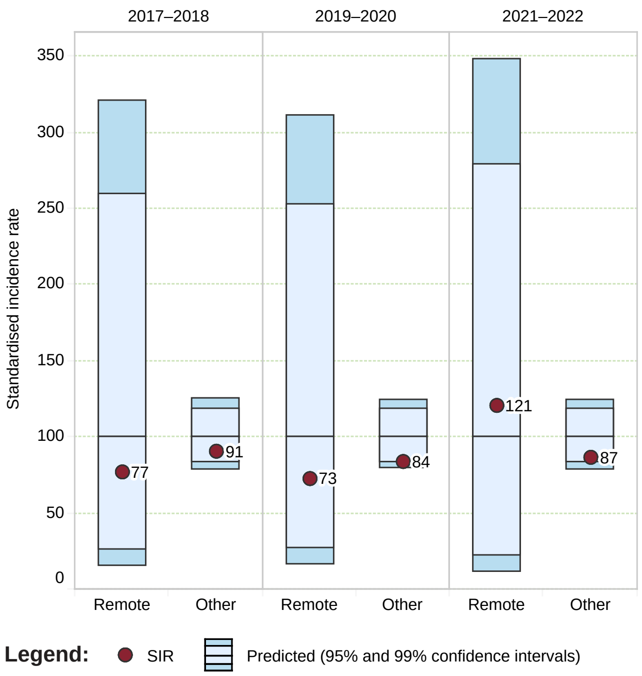


Figure 7: Standardised incidence of mortality by Remote/Very Remote status and year

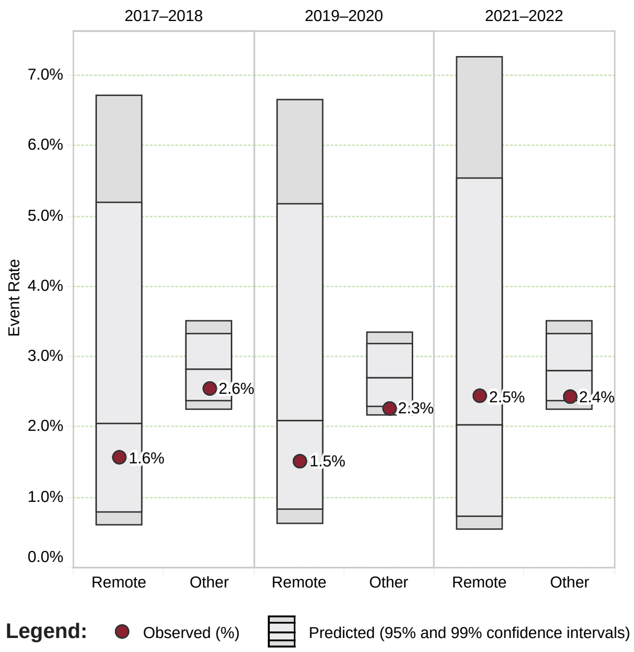


Figure 8: Mortality rate by Remote/Very Remote status and year

Gender and mortality

In the ANZSCTS General Score risk model, being of female sex is associated with a higher expected risk of death. When comparing outcomes between 2017–2018 and 2021–2022 the SIR for males has remained relatively constant, remaining at approximately 85%. However, the SIR for females has decreased from 104 to 91. Although this change is not statistically significant, it represents a reduction of over 12%. When comparing observed and predicted mortality rates, it is apparent that women still exhibit a mortality rate approximately twice as high as that of males (3.7% vs. 2.0%).

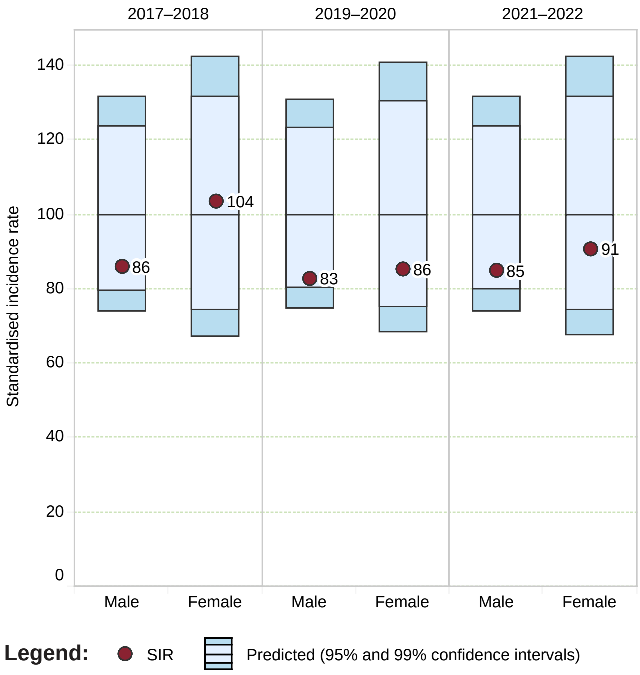


Figure 9: Standardised incidence of mortality by gender and year

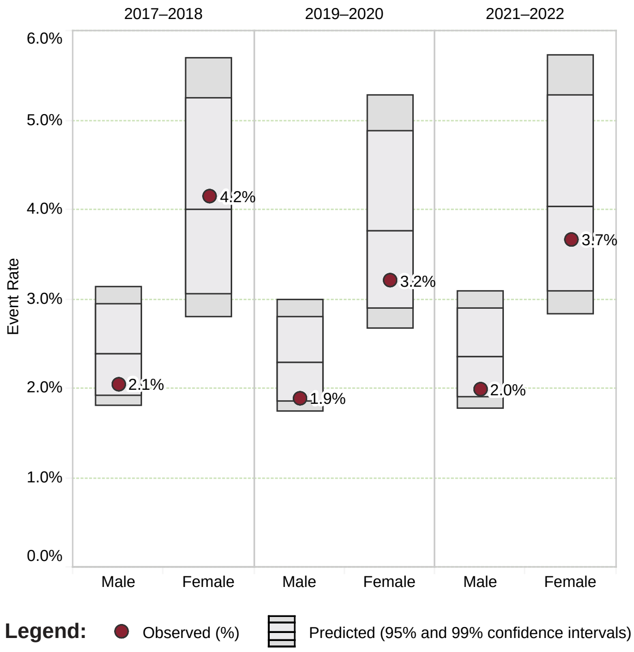


Figure 10: Mortality rate by gender and year

9.8 Multivariate analysis

To explore the impact of key health equity themes and challenges and how they relate to patient outcomes, multivariate logistic regression analysis has been employed. Inputs for this analysis included factors inherent in the patient preoperatively (age, gender and BMI), the urgency with which the surgery was required, the type of surgery (CABG only, CABG + valve, valve only or other), Aboriginal and Torres Strait Islander descent and various indices of socioeconomic advantage or disadvantage. The output of this analysis for each factor is the odds ratio. This is a measure of association of the factor (or category of factor) in the context of the other factors explored compared to a reference cohort. Outcomes explored include mortality and other major postoperative adverse events (myocardial infarction, deep sternal wound infection, or cerebrovascular accident).

An odds ratio of:

- **Approximately 1.0** (p=not significant) indicates that the odds of exposure among case-patients are the same as, or similar to, the odds of exposure among the reference cohort. The exposure is not associated with the disease.
- **Greater than 1.0** ($p<0.05$) indicates that the odds of exposure among case-patients are greater than the odds of exposure among controls. The exposure might be a **risk factor** for the disease.
- **Less than 1.0** ($p<0.05$) indicates that the odds of exposure among case-patients are lower than the odds of exposure among controls. The exposure might be a **protective factor** against the disease.

When all factors present are taken into consideration, the magnitude of the odds ratio reflects the likelihood the patient will experience the outcome if the factor is present by comparison to the reference cohort.

Mortality

When considering a range of geographic, social, and demographic variables, a number of observations can be made. The risk of death has shown relatively little change since 2017. As demonstrated in univariate analysis, being of the female sex is associated with a higher risk of death, and this association is statistically significant.

Although Aboriginal and Torres Strait Islander descent in isolation does not appear to be a significant risk factor, this analysis suggests that the odds of death for this cohort are only slightly elevated compared to the Australians of other descent population undergoing surgery. This result, however, must be interpreted with the knowledge that patients in outer regional and remote areas (where a higher proportion of First Nations patients are located) also face an increased risk of death.

Patients undergoing valve surgery, either alone or with concurrent CABG, appear to be at a higher risk of death. While the odds of death tend to increase with age, this increase is not statistically significant. Patient geographic remoteness does not seem to have a significant impact on outcomes.

The risk of death appears to be influenced by socioeconomic advantage/disadvantage and education/occupation status, with those in the highest quartile facing a significantly higher risk of death. Access to economic resources, however, does not appear to be linked to significantly elevated odds, though a discernible trend is evident.

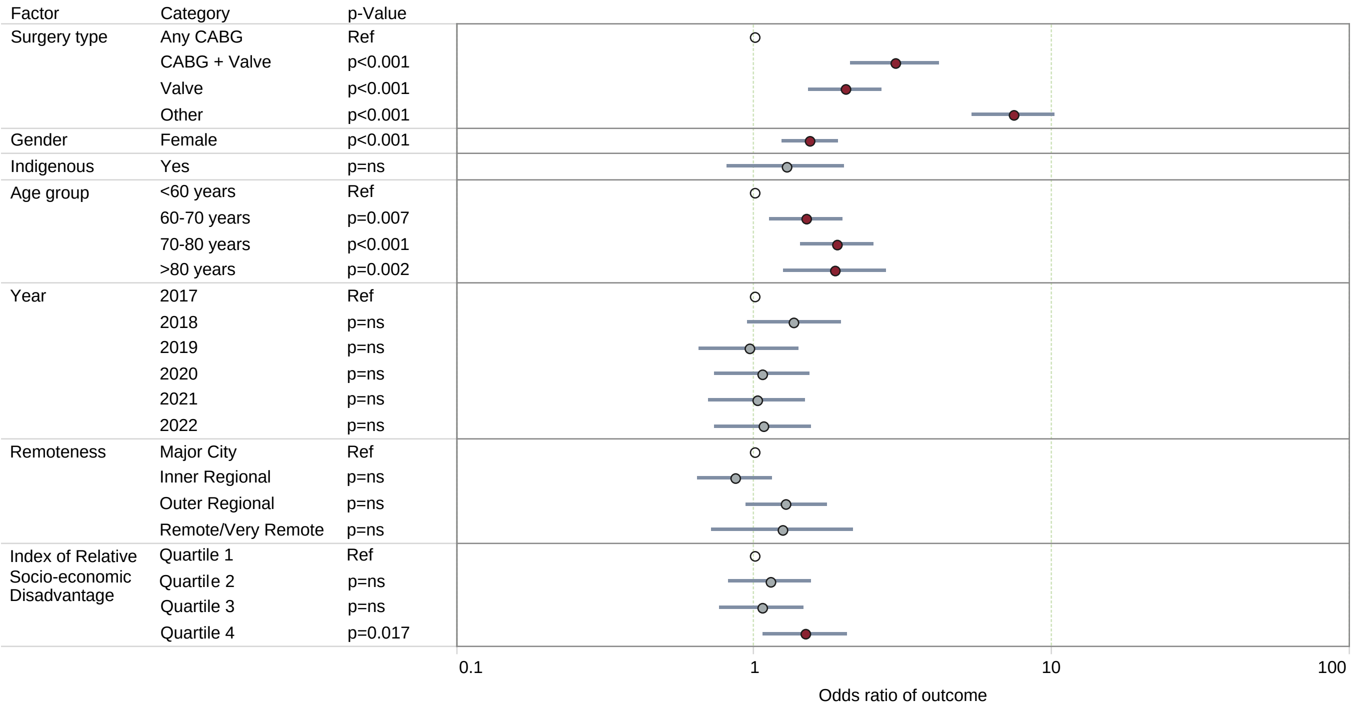


Figure 11: Association of factors including IRSD index with mortality

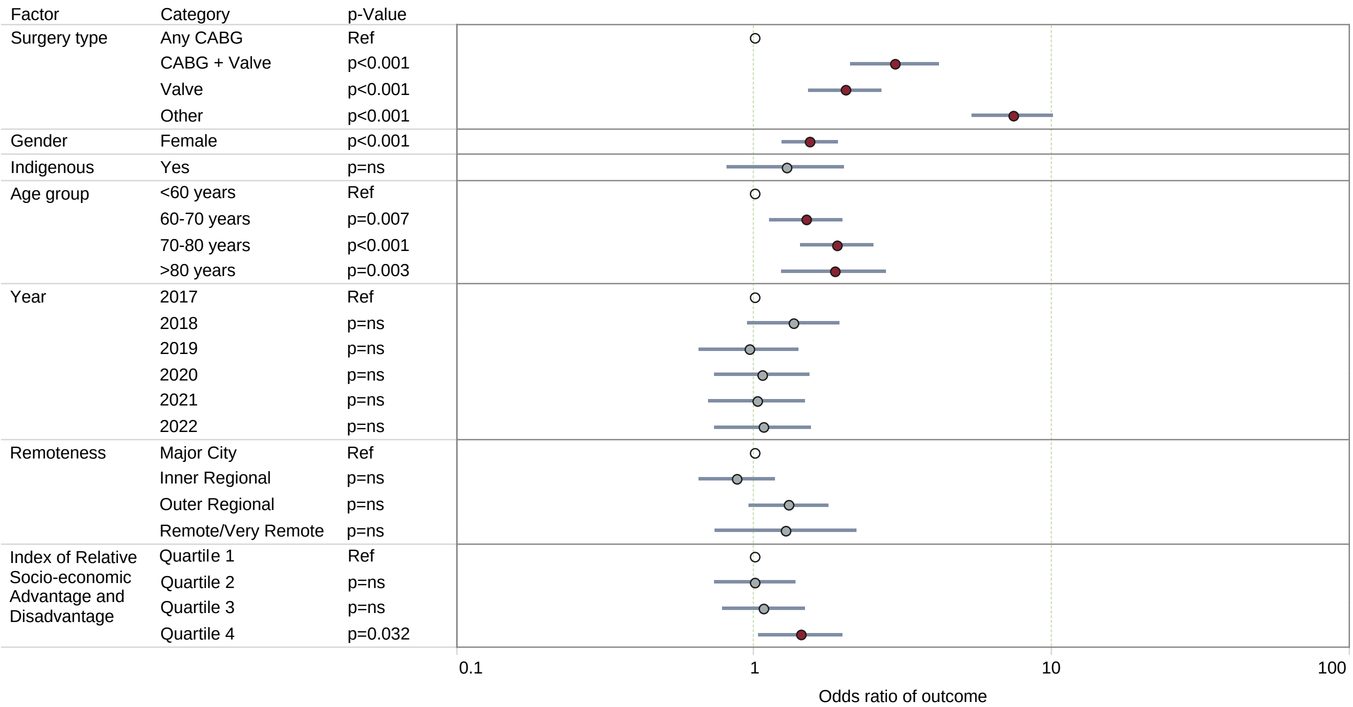


Figure 12: Association of factors including IRSAD index with mortality

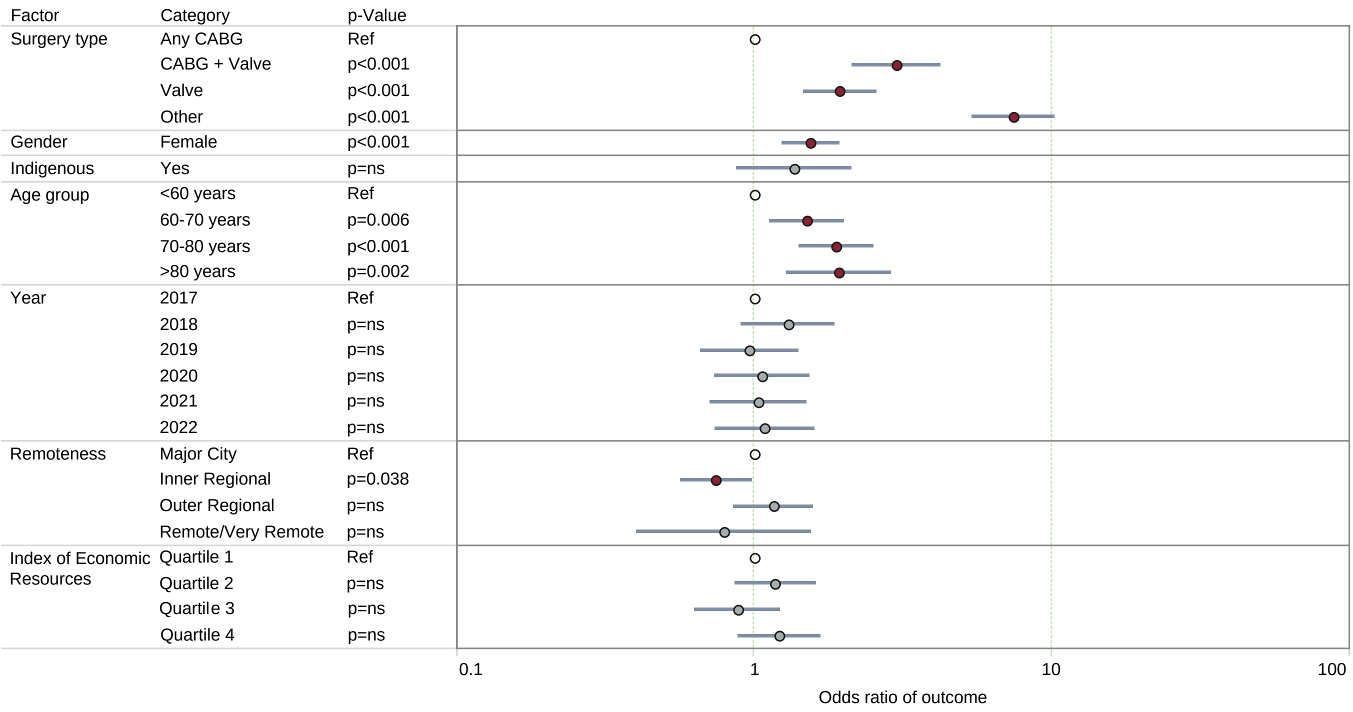


Figure 13: Association of factors including IER index with mortality

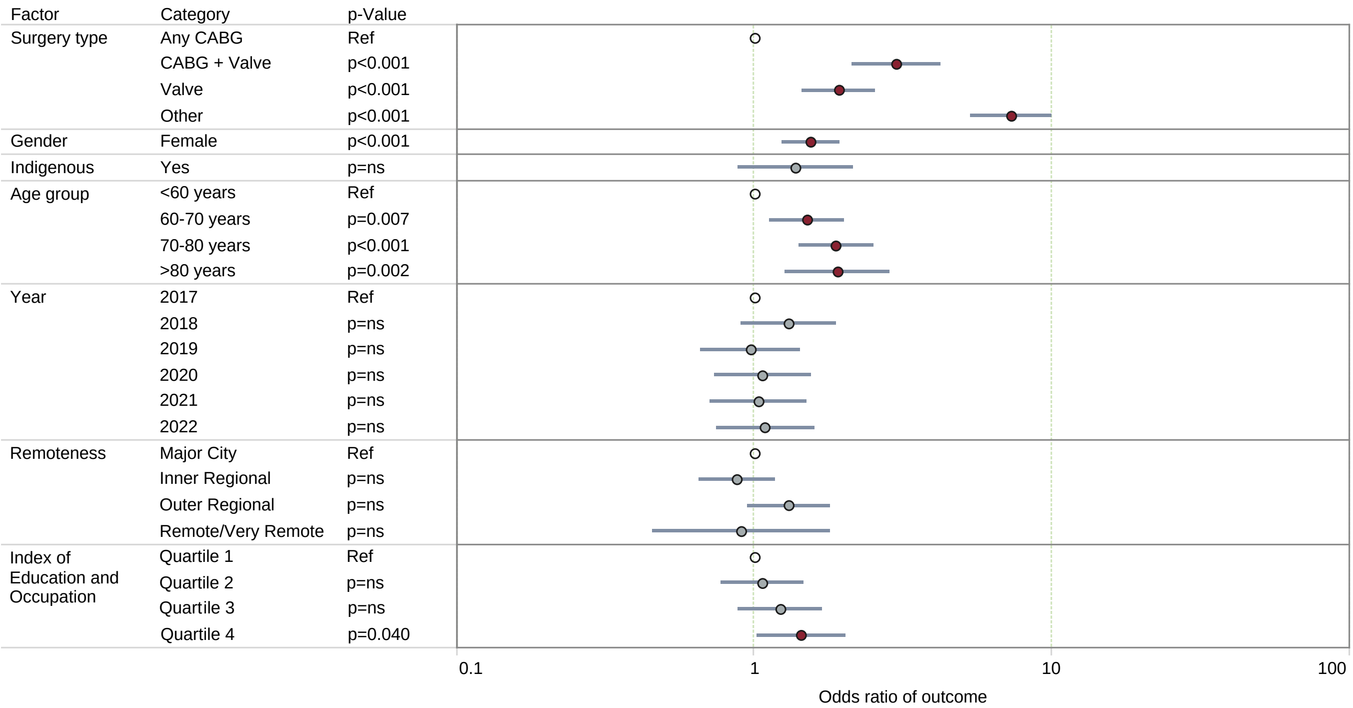


Figure 14: Association of factors including IEO index with mortality

Major morbidity

When considering a range of geographic, social, and demographic variables, it becomes evident that since 2017–2018, the likelihood of experiencing a major postoperative adverse event (including death, myocardial infarction, deep sternal wound infection and cerebrovascular accident) has exhibited a decline. Notably, this decline reached statistical significance in two of the years, namely 2019 and 2021.

Similar to the pattern observed with death, female patients are at a significantly higher risk than males of experiencing a major adverse event. This has been shown in multiple analyses and data sets around the world. While not achieving statistical significance, Aboriginal and Torres Strait Islander patients do show a tendency toward a higher risk of major postoperative events.

Patients undergoing valve-only surgery do not appear to carry a significantly higher risk of adverse events when compared to isolated CABG procedures. However, cases involving concurrent valve surgery have an odds ratio of 2, and other cardiac surgery cases have an odds ratio of 4, signifying a markedly higher risk of adverse events.

The odds of experiencing a major adverse event generally show an increasing trend with advancing age.

Patient geographic remoteness does not have a substantial impact on these outcomes. The risk of a major adverse event does not appear to be significantly influenced by socioeconomic advantage/disadvantage, access to economic resources, or education/occupation status.

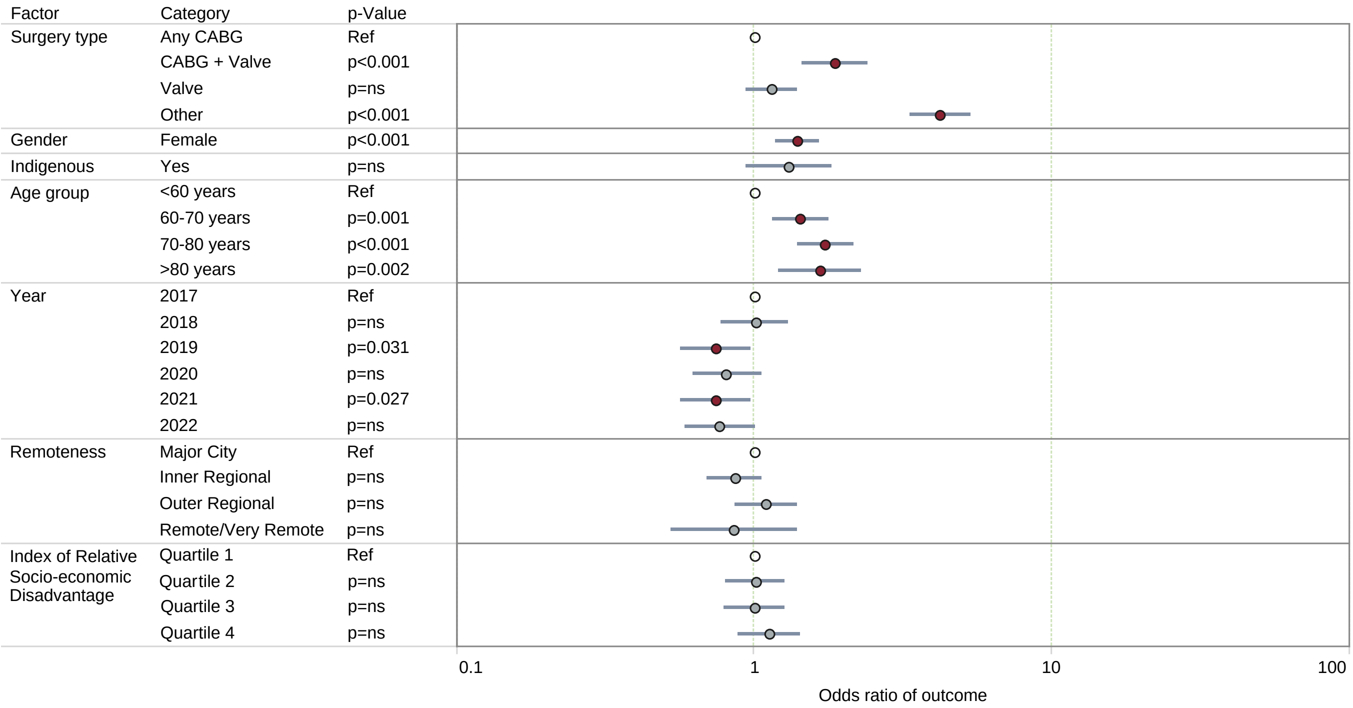


Figure 15: Association of factors including IRSD index with major morbidity

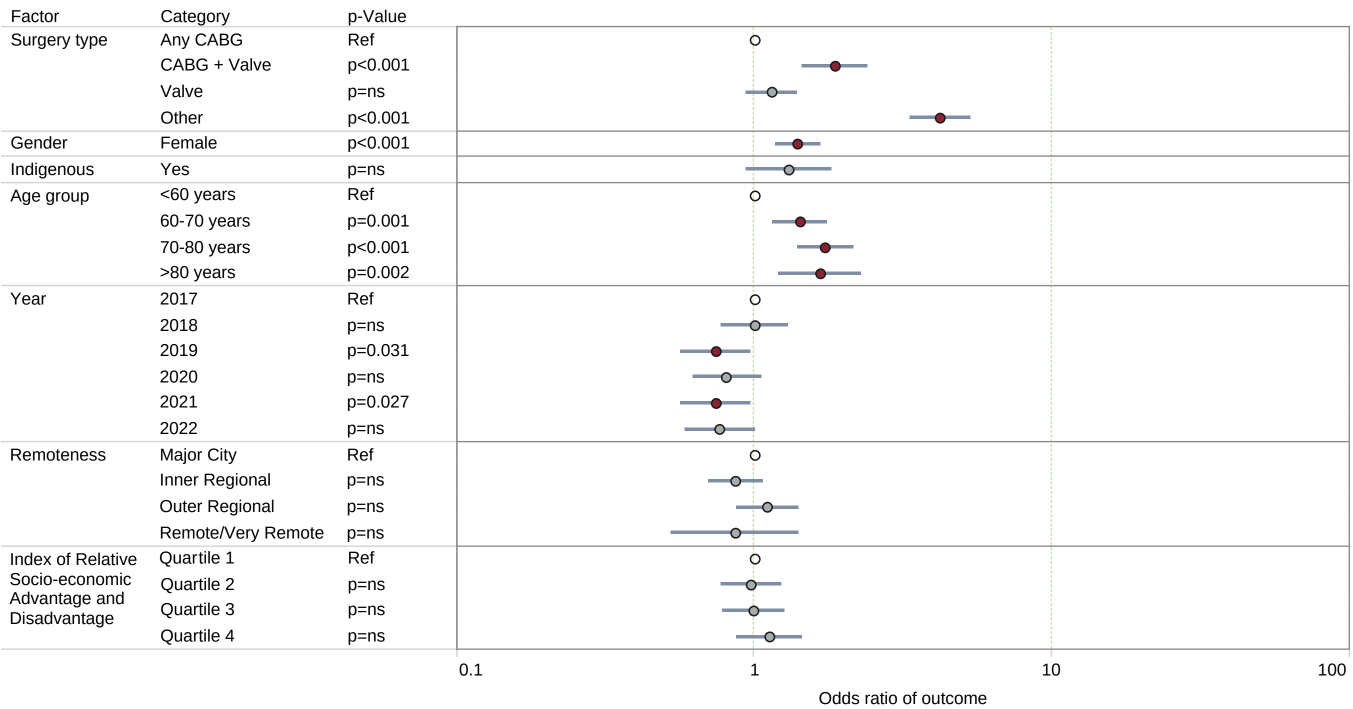


Figure 16: Association of factors including IRSAD index with major morbidity

Factor	Category	p-Value
Surgery type	Any CABG	Ref
	CABG + Valve	p<0.001
	Valve	p=ns
	Other	p<0.001
Gender	Female	p<0.001
Indigenous	Yes	p=ns
Age group	<60 years	Ref
	60-70 years	p=0.001
	70-80 years	p<0.001
	>80 years	p=0.002
Year	2017	Ref
	2018	p=ns
	2019	p=0.029
	2020	p=ns
	2021	p=0.026
	2022	p=ns
Remoteness	Major City	Ref
	Inner Regional	p=ns
	Outer Regional	p=ns
	Remote/Very Remote	p=ns
Index of Economic Resources	Quartile 1	Ref
	Quartile 2	p=0.038
	Quartile 3	p=ns
	Quartile 4	p=ns

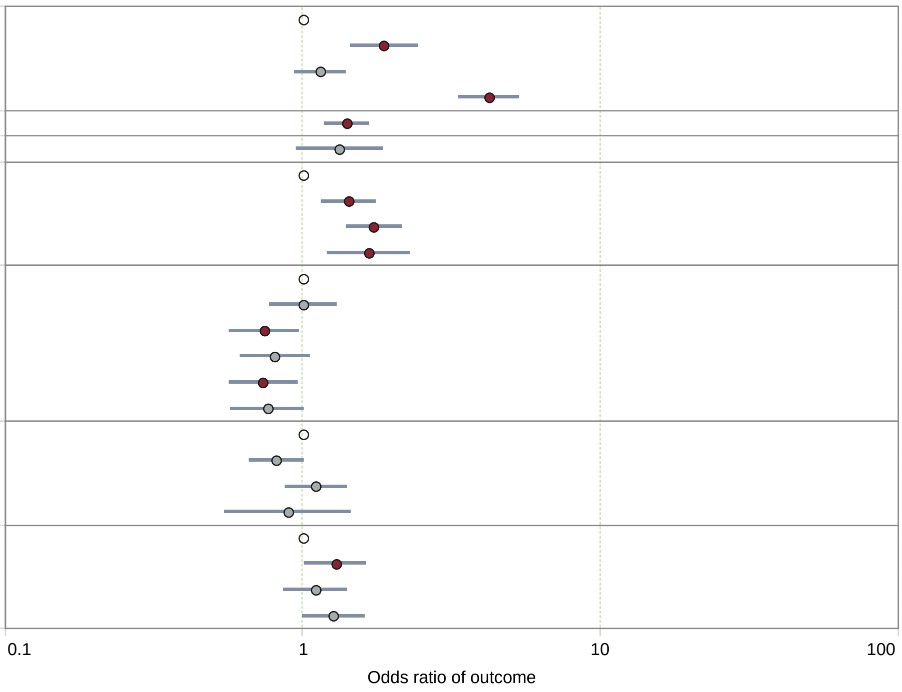


Figure 17: Association of factors including IER index with major morbidity

Factor	Category	p-Value
Surgery type	Any CABG	Ref
	CABG + Valve	p<0.001
	Valve	p=ns
	Other	p<0.001
Gender	Female	p<0.001
Indigenous	Yes	p=ns
Age group	<60 years	Ref
	60-70 years	p=0.002
	70-80 years	p<0.001
	>80 years	p=0.002
Year	2017	Ref
	2018	p=ns
	2019	p=0.032
	2020	p=ns
	2021	p=0.027
	2022	p=ns
Remoteness	Major City	Ref
	Inner Regional	p=ns
	Outer Regional	p=ns
	Remote/Very Remote	p=ns
Index of Education and Occupation	Quartile 1	Ref
	Quartile 2	p=ns
	Quartile 3	p=ns
	Quartile 4	p=ns

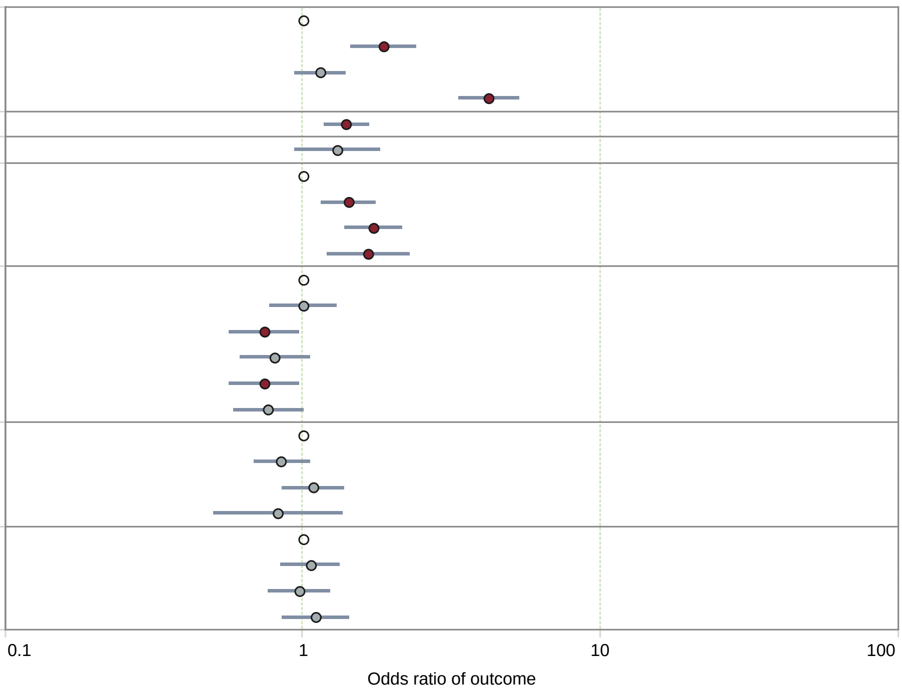


Figure 18: Association of factors including IEO index with major morbidity

9.9 Time to care

It is evident that Aboriginal and Torres Strait Islander patients travel considerably greater distances to access care, however, the time between cardiac catheterisation (an indicative marker of the time a definitive diagnosis or indication for surgery is confirmed) for elective surgery is notably shorter (64 days vs. 91 days in 2021–2022).

Additionally, it is noted that although the delay has increased for Australians of other descent, rising from 59 days to 91 days, the median delay for Aboriginal and Torres Strait Islander patients has remained similar (61 days vs. 64 days) although, an increase in time to care has been noted at the upper end of the interquartile range.

The time to elective surgery was longer for females as compared to males across 2017–2022 (72 days vs. 61 days respectively). The median days to elective cardiac surgery for those patients living in regional and remote areas was 11 days less than those Queenslanders who resided in non remote areas.

Overall, there was a slight increase in the time to treatment for all patients for 2021–2022, which is likely attributable to treatment delays resulting from the impacts of the COVID-19 pandemic.

Table 3: Median days to care for elective surgery by Aboriginal and Torres Strait Islander descent, 2017–2022

Year of surgery	Aboriginal and Torres Strait Islander descent Median (IQR) days	Australians of other descent Median (IQR) days
2017–2018	61 (21–123)	59 (22–111)
2019–2020	48 (13–105)	71 (24–133)
2021–2022	64 (16–141)	91 (41–170)
ALL	**61 (20–125)**	**72 (27–136)**

Table 4: Median days to care for elective surgery by patient gender, 2017–2022

Year of surgery	Male Median (IQR) days	Female Median (IQR) days
2017–2018	56 (21–106)	68 (29–125)
2019–2020	70 (21–129)	73 (26–140)
2021–2022	90 (38–165)	98 (42–174)
ALL	**61 (20–125)**	**72 (27–136)**

Table 5: Median days to care for elective surgery by remoteness status, 2017–2022

Year of surgery	Remote Median (IQR) days	Not Remote Median (IQR) days
2017–2018	52 (32–119)	59 (22–111)
2019–2020	58 (17–99)	71 (23–133)
2021–2022	75 (19–180)	91 (40–168)
ALL	**61 (20–125)**	**72 (27–136)**

Table 6: Median distance from usual place of residence by Aboriginal and Torres Strait Islander descent, 2017–2022

Year of surgery	Aboriginal and Torres Strait Islander descent Median (IQR) kilometres	Australians of other descent Median (IQR) kilometres
2017–2018	258 (30–513)	36 (15–167)
2019–2020	213 (34–510)	34 (14–140)
2021–2022	173 (25–345)	33 (14–140)
ALL	**213 (30–492)**	**35 (14–156)**

9.10 Discussion

Addressing access to cardiac surgery for socially disadvantaged patients in Australia requires a multifaceted approach that considers socioeconomic, cultural, and geographic factors. Collaborative efforts from healthcare providers, policymakers, and communities are crucial in achieving equitable access to cardiac surgical care.

Various initiatives have been implemented to improve access to cardiac surgery and other cardiac services. Programs such as the Queensland Rheumatic Register and Networked Cardiac Services program have focused on improving access, equity and quality of care for Aboriginal and Torres Strait Islander patients and those residing in rural and remote communities. Culturally sensitive healthcare programs and outreach services help bridge the gap between rural and remote, and Aboriginal and Torres Strait Islander communities and healthcare facilities. Telehealth services have also been used to provide specialist consultations and testing for remote Aboriginal and Torres Strait Islander communities. Regular data collection and research are crucial for understanding the specific needs of Aboriginal and Torres Strait Islander cardiac patients and monitoring healthcare disparities. Research studies have highlighted the importance of community-driven interventions and culturally appropriate healthcare models.

Lack of social support networks can impact a patient's ability to navigate the healthcare system. Providing assistance programs and support groups can help patients access the necessary resources and emotional support to undergo cardiac surgery. An example of this is the Bridging the Heart Gap preoperative telehealth program that has been implemented to better support Aboriginal and Torres Strait Islander and rural and remote children who need cardiac surgery.

Queensland Health has implemented a First Nations health equity agenda[44] as part of a legislative requirement passed by the Queensland Parliament in 2020 and 2021 for Hospital and Health Services to co-develop and co-implement Health Equity Strategies. This reflects a commitment to working in partnership with prescribed Aboriginal and Torres Strait Islander stakeholders and is embedded in a legal framework guiding the public health system in Queensland to achieve health equity and improve Aboriginal and Torres Strait Islander outcomes, eliminate institutional racism and racial discrimination from the public health sector, and strengthen decision-making and power sharing arrangements with Aboriginal and Torres Strait Islander peoples.

Furthermore, the Queensland Women and Girls' Health Strategy[45] aims to address health inequity and improve accessibility to healthcare for women and girls living in Queensland. The Strategy will take a whole-of-government approach to health and wellbeing by considering the social determinants of health and the roles that other Queensland Government agencies play in supporting the health of women and girls.

Policymakers and healthcare institutions need to recognise the specific needs of women in cardiac care and invest in research to address gender disparities. Addressing these issues requires a multi-faceted approach, including education, healthcare provider training, policy changes, and efforts to reduce socioeconomic disparities.

This Audit demonstrates that there is still significant work to be done to create equitable access and outcomes for all Queenslanders. This brief analysis is an important monitoring and evaluation activity in understanding some of the barriers to care and areas for improvement. It provides valuable insights to guide the priorities of clinical and administrative staff in order to meet targets and drive improvement.

10 Supplement: Australia and New Zealand Congenital Outcomes Registry for Surgery (ANZCORS) – Queensland snapshot

10.1 Message from the chair

It is my pleasure to present Queensland's paediatric cardiac surgical data from the Australia and New Zealand Congenital Outcomes Registry for Surgery (ANZCORS) as part of the QCOR Annual Report for 2022. The cardiac surgical team at the Queensland Children's Hospital has validated all the data included in this Report.

ANZCORS was created in 2017 and represents a collaborative effort between the five hospitals delivering paediatric cardiac surgery across Australia and New Zealand. The Registry is managed by a dedicated team of surgeons and data analysts at the Children's Health Research Centre, Brisbane. Using ANZCORS, the team benchmarks outcomes after paediatric cardiac surgery across the region and translate findings that are important for consumers into practice in a timely manner. The risk model used by ANZCORS incorporates machine learning methodology. To better understand longer-term outcomes, the Registry is also expanding its data linkage activities. Over the past year the team has been working in collaboration with the Australia and New Zealand Society of Cardiothoracic Surgeons, Akkodis, and eHealth Queensland to develop a new cloud-based data platform for ANZCORS.

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

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

Dr Prem Venugopal
Director of Cardiac Surgery, Children's Health Queensland
Chair, ANZCORS Steering Committee

10.2 Acknowledgements

Data Custodian and ANZCORS Program Manager

- Dr Nelson Alphonso

ANZCORS Data Analysts

- Ms Janelle Johnson
- Mr Jason Christiansen

Biostatistician and Machine Learning

- Dr Kim Betts, PhD

Cardiac Surgeons at Queensland Children's Hospital

- Nelson Alphonso
- Supreet Marathe
- Prem Venugopal, Director

ANZCORS Steering Committee

- Prem Venugopal, Queensland Children's Hospital, Committee Chair
- Matthew Liava'a, The Children's Hospital at Westmead
- Christian Brizard, The Royal Children's Hospital, Melbourne
- David Andrews, Perth Children's Hospital
- Kirsten Finucane, Starship Children's Hospital, Auckland
- Robert Justo, Queensland Children's Hospital
- Tom Gentles, Starship Children's Hospital, Auckland
- Jayme Bennetts, ANZSCTS Past president

10.3 Introduction

This report provides an overview of the major findings from the 2022 annual ANZCORS report for Queensland. The data covers the five year rolling period from July 2017 to June 2022 and includes 1,728 cardiothoracic procedures (1,140 using cardiopulmonary bypass, 352 without cardiopulmonary bypass, 236 delayed sternal closures).

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

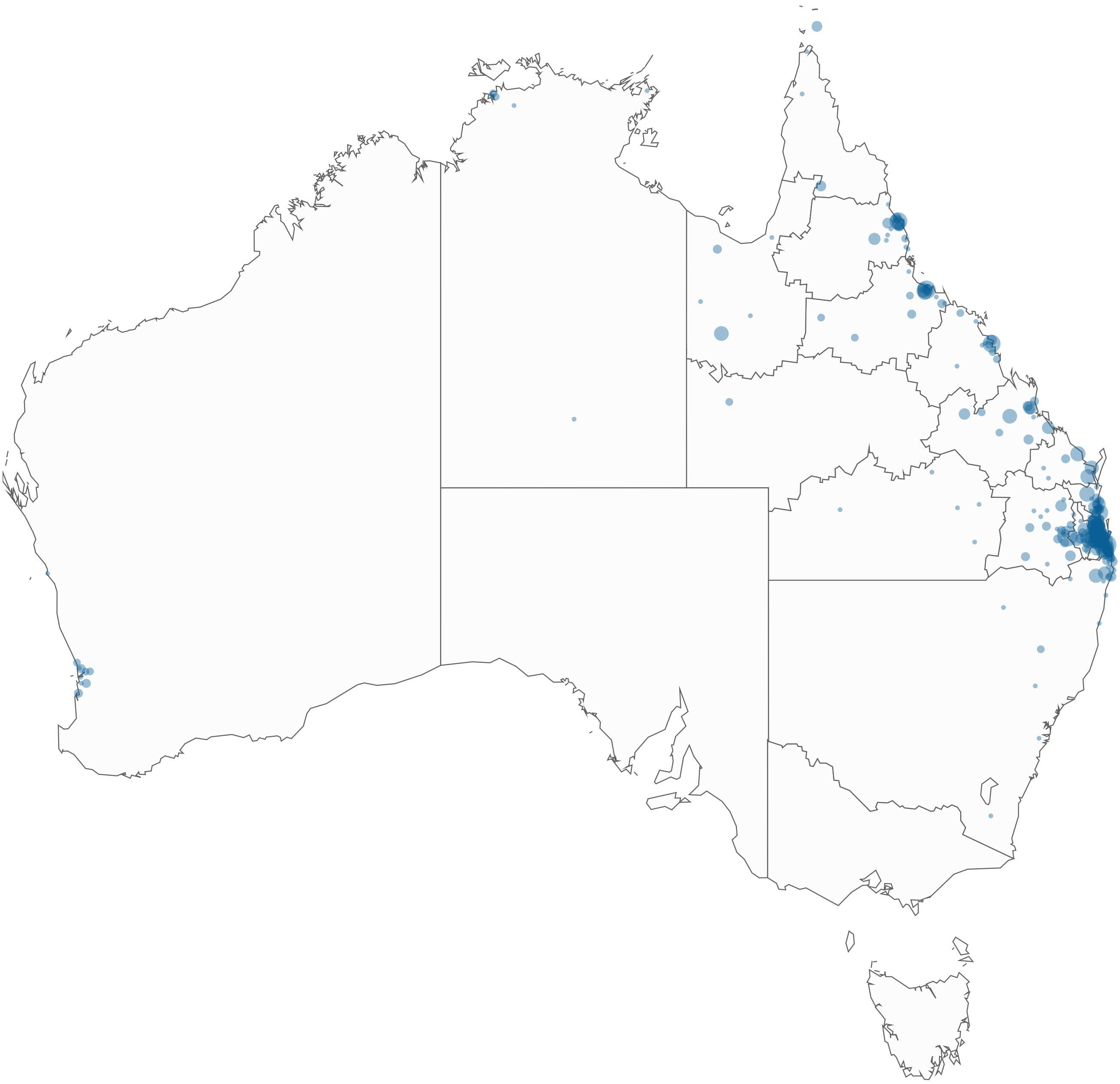


Figure 1: Cardiac patients treated by the Queensland Paediatric Cardiac Service between 2017–2022, by patient's place of usual residence (residential postcode)

10.4 Childhood heart surgery patients and procedures

During the five year reporting period from July 2017 to June 2022 there were 2,335 procedures performed by the Queensland Paediatric Cardiac Service at the Queensland Children's Hospital. These procedures included cardiac surgical procedures with and without the use of cardiopulmonary bypass, extracorporeal membrane oxygenation (ECMO), thoracic and delayed sternal wound closure procedures (Table 1). The focus of this report is cardiac surgical procedures either for childhood heart disease and as such delayed sternal closure, ECMO and thoracic procedures are excluded from the analysis.

Over the five year reporting period, there were 1,340 patients with childhood heart disease who underwent 1,492 cardiothoracic surgical procedures either with or without cardiopulmonary bypass (1,140 and 352 procedures respectively) at the Queensland Children's Hospital.

Table 1: Total procedures by case category, 2017–2022

Case category	2017/18 n	2018/19 n	2019/20 n	2020/21 n	2021/22 n	ALL n (%)
CPB*	246	214	209	240	231	1,140 (48.82)
Non-CPB*	86	68	65	72	61	352 (15.07)
Delayed sternal closure	55	40	44	50	47	236 (10.11)
ECMO†	61	50	68	34	38	251 (10.75)
Thoracic‡	43	74	82	63	52	314 (13.45)
Other§	9	7	11	11	4	42 (1.80)
Total	**500**	**453**	**479**	**470**	**433**	**2,335 (100.0)**

* Cardiopulmonary bypass

† Extracorporeal membrane oxygenation – includes pre and post cardiotomy and all ECMO not related to cardiac surgery

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

§ Other procedures include catheterisation procedures, hybrid procedures, and miscellaneous procedures

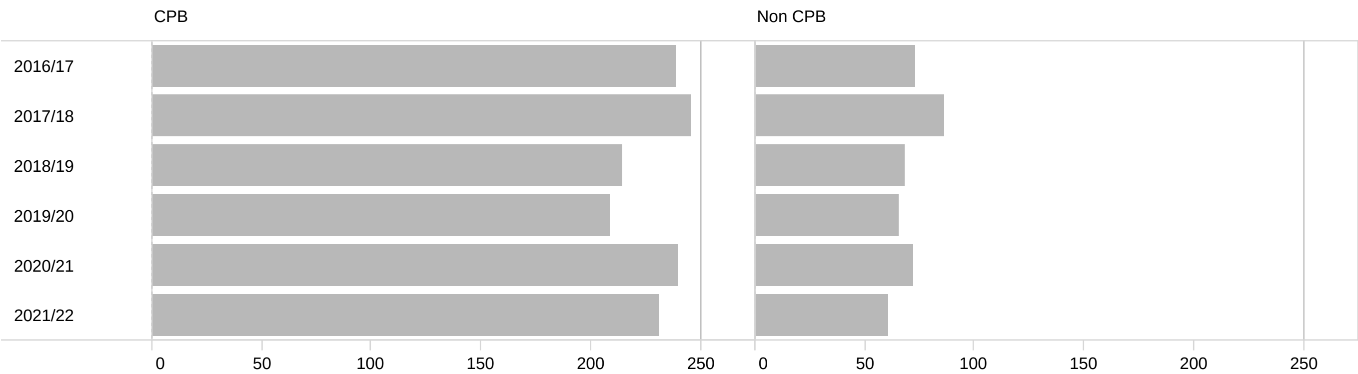


Figure 2: Number of cardiac patients by utilisation of cardiopulmonary bypass, 2017–2022

Table 2: Total cardiac patients and procedures, 2017–2022

	2017/18 n	2018/19 n	2019/20 n	2020/21 n	2021/22 n	ALL n
Cardiac patients	287	245	252	287	269	1,340
Cardiac procedures	332	282	274	312	292	1,492

10.5 Patient characteristics

10.5.1 Age and gender

Approximately 20% of the patient population were neonates aged between 0 and 28 days. Thirty-three percent were infants aged between 29 days and 365 days. Thus, 53% of the patient population were under 1 year of age. Forty-five percent of the cohort were aged between one and sixteen years, and 2% were over sixteen years of age.

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

Table 3: Cardiac procedures by age group and year, 2017–2022

Age group	2017/18 n (%)	2018/19 n (%)	2019/20 n (%)	2020/21 n (%)	2021/22 n (%)	ALL n (%)
>16 years	12 (3.6)	6 (2.0)	3 (1.1)	5 (1.6)	4 (1.4)	30 (2.0)
1–16 years	149 (44.9)	140 (49.6)	124 (45.3)	145 (46.5)	113 (38.7)	671 (45.0)
29–365 days	102 (30.7)	84 (30)	85 (31.0)	101 (32.4)	118 (40.4)	490 (32.8)
0–28 days	69 (20.8)	52 (18.4)	62 (22.6)	61 (19.5)	57 (19.5)	301 (20.2)
Total	**332 (100.0)**	**282 (100.0)**	**274 (100.0)**	**312 (100.0)**	**292 (100.0)**	**1,492 (100.0)**

Table 4: Cardiac procedures by gender and year, 2017–2022

Gender	2017/18 n (%)	2018/19 n (%)	2019/20 n (%)	2020/21 n (%)	2021/22 n (%)	ALL n (%)
Female	146 (44.0)	127 (45.0)	130 (47.4)	136 (43.6)	134 (46)	673 (45.0)
Male	186 (56.0)	155 (55.0)	144 (52.6)	176 (56.4)	158 (54)	819 (55.0)
Total	**332 (100.0)**	**282 (100.0)**	**274 (100.0)**	**312 (100.0)**	**292 (100.0)**	**1,492 (100.0)**

10.5.2 Aboriginal and Torres Strait Islander status

The overall proportion of identified Aboriginal and Torres Strait Islander patients undergoing cardiac surgery was 13% with an increasing trend over the five year period.

Table 5: Cardiac procedures by Aboriginal and Torres Strait Islander status, 2017–2022

	2017/18 n (%)	2018/19 n (%)	2019/20 n (%)	2020/21 n (%)	2021/22 n (%)	ALL n (%)
Indigenous	38 (11.4)	32 (11.3)	41 (15.0)	43 (13.8)	46 (15.7)	200 (13.4)
Non-Indigenous	294 (88.6)	250 (88.7)	233 (85.0)	269 (86.2)	246 (84.3)	1,292 (86.6)
Total	**332 (100.0)**	**282 (100.0)**	**274 (100.0)**	**312 (100.0)**	**292 (100.0)**	**1,492 (100.0)**

10.6 Procedural complexity

10.6.1 Aristotle Comprehensive Complexity score

The Aristotle Comprehensive Complexity Score (ACC)[46] is a risk stratification tool that rates the projected complexity of the surgical procedures performed. By stratifying patients by complexity, the ACC aims to facilitate more realistic evaluation of surgical outcomes and more meaningful comparison of outcomes between paediatric cardiac surgical centres. The complexity score is based on three subjective determinations; potential for mortality, potential for morbidity, and anticipated surgical difficulty. Complexity is calculated in two phases. Firstly, the basic complexity of the procedure involved is scored from 0.5 to 15.0. This rates only the simplest form of the cardiac surgical procedure. Secondly, a specific value is added, based on a precise analysis of the associated pathology along with any comorbid conditions that are present. Procedure dependent factors include anatomical variations, associated procedures, and patient age, and can add a maximum of 5 points to the basic score. Procedure independent factors include patient characteristics which are more general but have the potential to significantly affect the outcome. Procedure independent factors can add an additional 5 points.

Between 2017 and 2022, 1,340 patients underwent 1,492 cardiac procedures, including those performed without using cardiopulmonary bypass. Fifty percent of procedures belonged in the higher-risk categories, with an ACC score of ten or above and a predicted mortality of >10%.

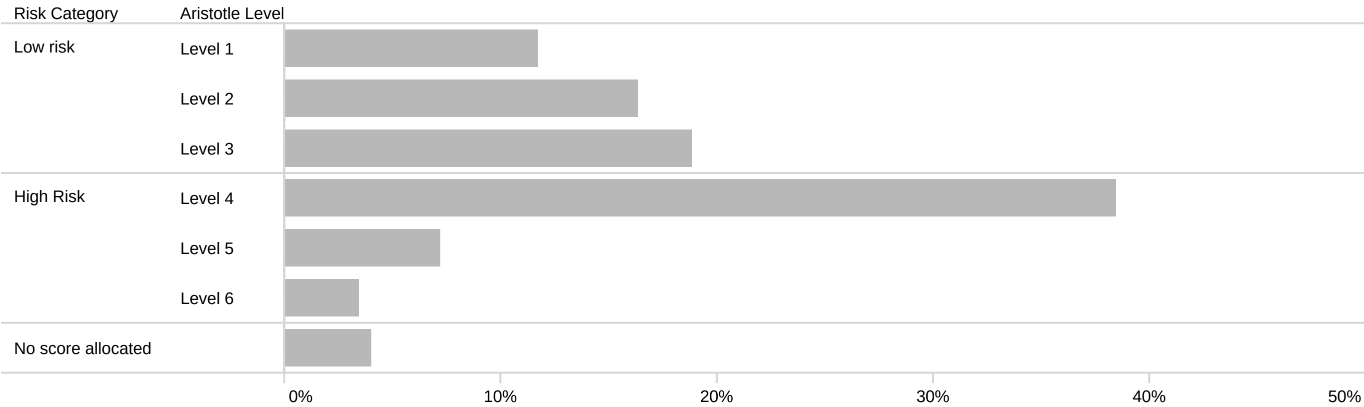


Figure 3: Proportion of all cardiac procedures stratified by Aristotle Comprehensive Complexity score and risk category

Table 6: Cardiac procedures by Aristotle Comprehensive Complexity score, 2017–2022

Complexity category	2017/18 n (%)	2018/19 n (%)	2019/20 n (%)	2020/21 n (%)	2021/22 n (%)	ALL n (%)
Level 1	39 (11.7)	33 (11.8)	26 (9.5)	42 (13.5)	34 (11.6)	174 (11.7)
Level 2	57 (17.2)	45 (16.0)	49 (17.9)	53 (17.0)	40 (13.7)	244 (16.3)
Level 3	69 (20.8)	43 (15.2)	52 (19)	62 (19.8)	55 (18.8)	281 (18.8)
Level 4	115 (34.7)	127 (45.0)	102 (37.3)	110 (35.3)	120 (41.1)	574 (38.5)
Level 5	26 (7.8)	10 (3.5)	22 (8.0)	22 (7.1)	27 (9.3)	107 (7.2)
Level 6	11 (3.3)	10 (3.5)	13 (4.7)	11 (3.5)	7 (2.4)	52 (3.5)
No score	15 (4.5)	14 (5.0)	10 (3.6)	12 (3.8)	9 (3.1)	60 (4.0)
Total	**332 (100.0)**	**282 (100.0)**	**274 (100.0)**	**312 (100.0)**	**292 (100.0)**	**1,492 (100.0)**

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

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

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

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

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

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

Cardiac Surgery

10.7 Outcomes – length of stay

10.7.1 Paediatric intensive care unit length of stay for cardiac patients

In 2017–2022, the median length of stay in the paediatric intensive care unit (PICU) for cardiac patients was 2 days, with a mean of 5.8 days.

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

PICU length of stay	2017/18 days	2018/19 days	2019/20 days	2020/21 days	2021/22 days	ALL days
Maximum length of stay	294	97	504	186	101	504
Median length of stay	2	2	2	2	3	2
Mean length of stay	6.0	4.8	8.0	5.2	5.3	5.8

10.7.2 Hospital length of stay for cardiac patients

In 2017–2022, the median hospital length of stay for cardiac patients was 10 days, with a mean of 22.6 days.

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

Hospital length of stay	2017/18 days	2018/19 days	2019/20 days	2020/21 days	2021/22 days	ALL days
Maximum length of stay	329	272	504	308	308	504
Median length of stay	9	10	9	10	11	10
Mean length of stay	21.0	22.6	22.0	25.8	21.2	22.6

10.8 Outcomes – mortality

10.8.1 30 day mortality by Aristotle Comprehensive Complexity score

Overall, the 30 day mortality after paediatric cardiac surgery from 2017–2022 was less than 1%. Most deaths (7 of 9) were in the high-risk procedure categories (ACC level 4–6). Twenty two percent of the deaths that occurred after cardiac surgical procedures belonging in the highest risk ACC category. The observed incidence of mortality across the five year period was consistently below the predicted mortality for each ACC risk category.

There was some variation noted across the reporting period, reflective of the heterogenous patient population, spectrum of congenital heart defects and the complex and unpredictable nature of the work. The mortality rate was the same for non-cardiopulmonary bypass (CPB) patients compared to those performed with CPB (0.7% versus 0.7% over the five year reporting period).

Table 9 shows the 30 day mortality for cardiac surgical procedures performed with or without using cardiopulmonary bypass over the five year period. In 2017/18, there was one death in a patient who underwent patent ductus arteriosus ligation without CPB. The cause of death in this patient was unrelated to their cardiac condition.

Table 9: Cardiac patients 30 day surgical mortality by case category (patients), 2017–2022

	2016/17	2017/18	2018/19	2019/20	2020/21	ALL
Patients, n	**287**	**245**	**252**	**287**	**269**	**1,340**
CPB, n	231	199	196	228	212	1,066
Non-CPB, n	56	46	56	59	57	274
Deaths, n (%)	**4 (1.4)**	**2 (0.8)**	**0 (0.0)**	**2 (0.7)**	**1 (0.4)**	**9 (0.7)**
CPB, n	3	2	0	2	0	7
Non-CPB, n	1	0	0	0	1	2

Figure 4 shows the observed mortality rate over the five year reporting period, superimposed on the predicted mortality rates given by the ACC score.

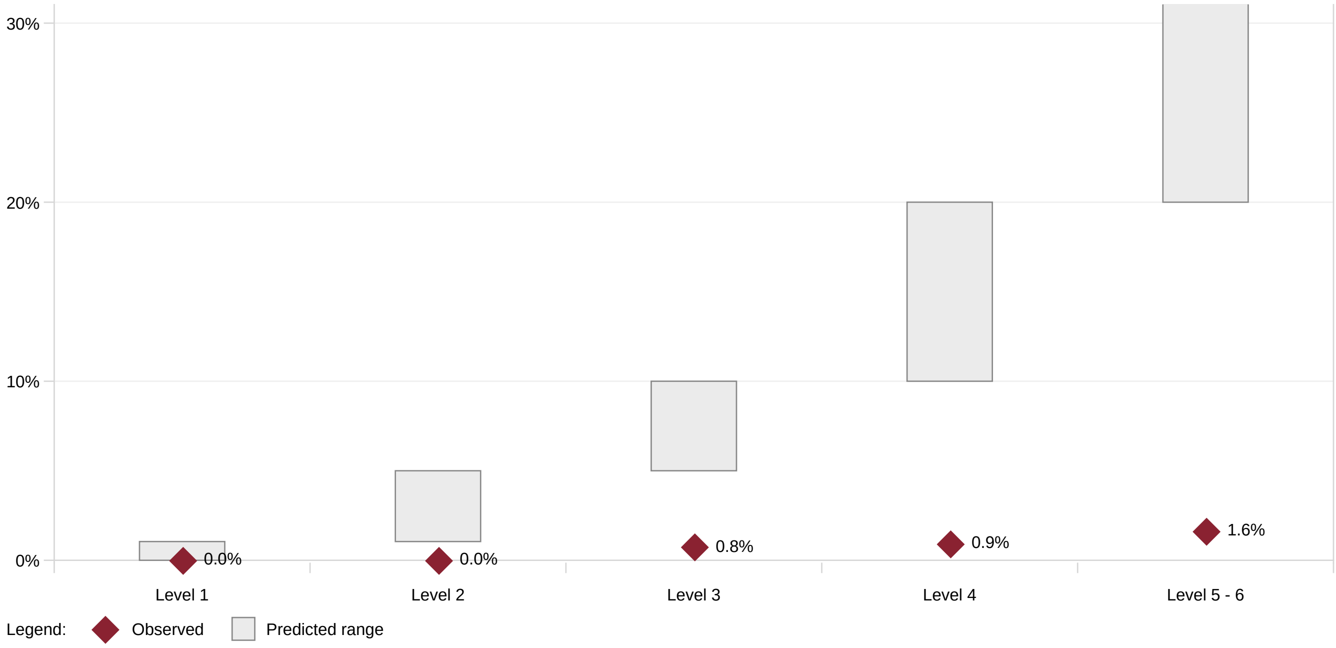


Figure 4: Cardiac patients 30 day mortality by Aristotle Comprehensive Complexity score, 2017–2022

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

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

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

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

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

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

Table 10: Cardiac patients 30 day surgical mortality by complexity level (patients), 2017–2022

	2017/18	2018/19	2019/20	2020/21	2021/22	ALL
Patients, n	**287**	**245**	**252**	**287**	**269**	**1,340**
Level 1, n	30	28	26	42	33	159
Level 2, n	56	42	47	52	39	236
Level 3, n	62	39	52	58	54	265
Level 4, n	110	119	96	106	111	542
Level 5, n	20	9	19	20	21	89
Level 6, n	8	6	7	9	4	34
No score, n	1	2	5	0	7	15
Deaths, n (%)	**4 (1.4)**	**2 (0.8)**	**0 (0.0)**	**2 (0.7)**	**1 (0.4)**	**9 (0.7)**
Level 1, n	0	0	0	0	0	0
Level 2, n	0	0	0	0	0	0
Level 3, n	0	1	0	0	1	2
Level 4, n	2	1	0	2	0	5
Level 5, n	0	0	0	0	0	0
Level 6, n	2	0	0	0	0	2
No score, n	0	0	0	0	0	0

References

Cardiac Surgery Audit

24 Roques, F. (2003). The logistic EuroSCORE. *European Heart Journal, 24*(9), 882. https://doi.org/10.1016/s0195-668x(02)00799-6

25 Nashef, S. A., Roques, F., Sharples, L. D., Nilsson, J., Smith, C., Goldstone, A. R., & Lockowandt, U. (2012). Euroscore II. *European Journal of Cardio-Thoracic Surgery, 41*(4), 734–745. https://doi.org/10.1093/ejcts/ezs043

26 Billah, B., Reid, C. M., Shardey, G. C., & Smith, J. A. (2010). A preoperative risk prediction model for 30-day mortality following cardiac surgery in an Australian cohort. *European Journal of Cardio-Thoracic Surgery, 37*(5), 1086–1092. https://doi.org/10.1016/j.ejcts.2009.11.021

27 Reid, C., Billah, B., Dinh, D., Smith, J., Skillington, P., Yii, M., Seevanayagam, S., Mohajeri, M., & Shardey, G. (2009). An Australian risk prediction model for 30-day mortality after isolated coronary artery bypass: The AusSCORE. *The Journal of Thoracic and Cardiovascular Surgery, 138*(4), 904–910. https://doi.org/10.1016/j.jtcvs.2009.03.020

28 Shahian, D. M., O'Brien, S. M., Filardo, G., Ferraris, V. A., Haan, C. K., Rich, J. B., Normand, S.-L. T., DeLong, E. R., Shewan, C. M., Dokholyan, R. S., Peterson, E. D., Edwards, F. H., & Anderson, R. P. (2009). The Society of Thoracic Surgeons 2008 cardiac surgery risk models: Part 1—coronary artery bypass grafting surgery. *The Annals of Thoracic Surgery, 88*(1). https://doi.org/10.1016/j.athoracsur.2009.05.053

29 O'Brien, S. M., Shahian, D. M., Filardo, G., Ferraris, V. A., Haan, C. K., Rich, J. B., Normand, S.-L. T., DeLong, E. R., Shewan, C. M., Dokholyan, R. S., Peterson, E. D., Edwards, F. H., & Anderson, R. P. (2009). The Society of Thoracic Surgeons 2008 cardiac surgery risk models: Part 2—isolated valve surgery. *The Annals of Thoracic Surgery, 88*(1). https://doi.org/10.1016/j.athoracsur.2009.05.056

30 Shahian, D. M., O'Brien, S. M., Filardo, G., Ferraris, V. A., Haan, C. K., Rich, J. B., Normand, S.-L. T., DeLong, E. R., Shewan, C. M., Dokholyan, R. S., Peterson, E. D., Edwards, F. H., & Anderson, R. P. (2009). The Society of Thoracic Surgeons 2008 cardiac surgery risk models: Part 3—valve plus coronary artery bypass grafting surgery. *The Annals of Thoracic Surgery, 88*(1). https://doi.org/10.1016/j.athoracsur.2009.05.055

\

31 Shardey, G., Tran, L., Williams-Spence, J., Solman, N., McLaren, J., Marrow, N., Janssan, A. and Reid, C. *The Australian and New Zealand Society of Cardiac and Thoracic Surgeons' Cardiac Surgery Database Program Annual Report 2020*. Monash University, Department of Epidemiology and Preventive Medicine, December 2021. Report No 14, 93 pages. https://anzscts.org/wp-content/uploads/2022/01/211123-ANZSCTS-Annual-Report-2020_Electronic.pdf

32 Australian Institute of Health and Welfare. (2022). *Australia's health 2022: in brief*. Canberra: AIHW. Retrieved from: https://www.aihw.gov.au/reports/australias-health/australias-health-2022-in-brief/summary

33 Australian Institute of Health and Welfare. (2019). *Cardiovascular disease, diabetes and chronic kidney disease—Australian facts: Aboriginal and Torres Strait Islander people*. Retrieved from https://www.aihw.gov.au/reports/indigenous-health-welfare/chronic-disease

34 Durey, A., McEvoy, S., Swift-Otero, V., Taylor, K., Katzenellenbogen, J., & Bessarab, D. (2016). Improving healthcare for Aboriginal Australians through effective engagement between community and Health Services. *BMC Health Services Research, 16*(1). https://doi.org/10.1186/s12913-016-1497-0

35 Australian Institute of Health and Welfare. (2023). *Rural and remote health*. Retrieved from https://www.aihw.gov.au/reports/rural-remote-australians/rural-and-remote-health

36 Cosgrave, C., Malatzky, C., & Gillespie, J. (2019). Social Determinants of Rural Health Workforce Retention: A Scoping Review. *International journal of environmental research and public health, 16*(3), 314. https://doi.org/10.3390/ijerph16030314

37 Ajibade, A., Younas, H., Pullan, M., & Harky, A. (2020). Telemedicine in cardiovascular surgery during COVID-19 pandemic: A systematic review and our experience. *Journal of Cardiac Surgery, 35*(10), 2773–2784. https://doi.org/10.1111/jocs.14933

38 Australian Healthcare and Hospitals Association. (2021). *Rural and Remote Health*. Retrieved from https://ahha.asn.au/rural-and-remote-health

39 Mehta, L. S., Beckie, T. M., DeVon, H. A., Grines, C. L., Krumholz, H. M., Johnson, M. N., Lindley, K. J., Vaccarino, V., Wang, T. Y., Watson, K. E., Wenger, N. K., & American Heart Association Cardiovascular Disease in Women and Special Populations Committee of the Council on Clinical Cardiology, Council on Epidemiology and Prevention, Council on Cardiovascular and Stroke Nursing, and Council on Quality of Care and Outcomes Research (2016). Acute Myocardial Infarction in Women: A Scientific Statement From the American Heart Association. *Circulation, 133*(9), 916–947. https://doi.org/10.1161/CIR.0000000000000351

40 Mosca, L., Benjamin, E. J., Berra, K., Bezanson, J. L., Dolor, R. J., Lloyd-Jones, D. M., Newby, L. K., Piña, I. L., Roger, V. L., Shaw, L. J., Zhao, D., Beckie, T. M., Bushnell, C., D'Armiento, J., Kris-Etherton, P. M., Fang, J., Ganiats, T. G., Gomes, A. S., Gracia, C. R., Haan, C. K., … Wenger, N. K. (2011). Effectiveness-based guidelines for the prevention of cardiovascular disease in women--2011 Update: A guideline from the American Heart Association. *Circulation, 123*(11), 1243–1262. https://doi.org/10.1161/CIR.0b013e31820faaf8

41 Australian Institute of Health and Welfare. (2023). *Heart, stroke and vascular disease: Australian facts*. Retrieved from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/hsvd-facts

42 Australian Bureau of Statistics. (2018). *Census of Population and Housing: Socioeconomic Indexes for Areas (SEIFA), Australia, 2016*. Retrieved from https://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001

43 Billah, B., Reid, C. M., Shardey, G. C., & Smith, J. A. (2010). A preoperative risk prediction model for 30-day mortality following cardiac surgery in an Australian cohort. *European Journal of Cardio-Thoracic Surgery, 37*(5), 1086–1092. https://doi.org/10.1016/j.ejcts.2009.11.021

44 The State of Queensland; Queensland Health; (2023, July 14). *First Nations Health Equity*. Queensland Health. https://www.health.qld.gov.au/public-health/groups/atsihealth/making-tracks-together-queenslands-atsi-health-equity-framework

45 The State of Queensland; Queensland Health; (2023b, October 20). *Queensland Women and girls' health strategy*. Queensland Health. https://www.health.qld.gov.au/system-governance/strategic-direction/plans/womens-health-strategy

Glossary

6MWT	Six Minute Walk Test
ACC	Aristotle Comprehensive Complexity
ACEI	Angiotensin Converting Enzyme Inhibitor
ACP	Advanced Care Paramedic
ACS	Acute Coronary Syndromes
AEP	Accredited Exercise Physiologist
ANZCORS	Australia and New Zealand Congenital Outcomes Registry for Surgery
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
AQoL	Assessment of Quality of Life
ARB	Angiotensin II Receptor Blocker
ARNI	Angiotensin Receptor-Neprilysin Inhibitors
ASD	Atrial Septal Defect
AV	Atrioventricular
AVNRT	Atrioventricular Nodal Re-entry Tachycardia
AVRT	Atrioventricular Re-entrant Tachycardia
BCIS	British Cardiovascular Intervention Society
BiV	Biventricular
BMI	Body Mass Index
BNH	Bundaberg Hospital
BSSLTx	Bilateral Sequential Single Lung Transplant
CABG	Coronary Artery Bypass Graft
CAD	Coronary Artery Disease
CBH	Caboolture Hospital
CCL	Cardiac Catheter Laboratory
CCP	Critical Care Paramedic
CH	Cairns Hospital
CI	Clinical Indicator
CIED	Cardiac Implantable Electronic Device
CNC	Clinical Nurse Consultant
COVID-19	Coronavirus disease 2019
CPB	Cardiopulmonary Bypass
CR	Cardiac Rehabilitation
CRT	Cardiac Resynchronisation Therapy
CS	Cardiac Surgery
CVA	Cerebrovascular Accident
CVD	Cardiovascular Disease
DAOH	Days Alive and Out of Hospital
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
EuroSCORE	European System for Cardiac Operative Risk Evaluation
EWMA	Exponentially Weighted Moving Average
FdECG	First Diagnostic Electrocardiograph
FMC	First Medical Contact
FTR	Failure to Rescue
GAD	Generalised Anxiety Disorder
GC	Genetic Counsellor
GCCH	Gold Coast Community Health
GCS	Glasgow Coma Scale
GCUH	Gold Coast University Hospital
GLH	Gladstone Hospital
GP	General Practitioner
GYH	Gympie Hospital
HB	Haemoglobin
HBH	Hervey Bay Hospital (includes Maryborough)
HCC	Health Contact Centre
HF	Heart Failure
HFpEF	Heart Failure with Preserved Ejection Fraction
HFrEF	Heart Failure with Reduced Ejection Fraction
HFSS	Heart Failure Support Service
HHS	Hospital and Health Service
HOCM	Hypertrophic Obstructive Cardiomyopathy
IC	Interventional Cardiology
ICD	Implantable Cardioverter Defibrillator
IE	Infective Endocarditis
IER	Index of Economic Resources
IEO	Index of Education and Occupation
IHD	Ischaemic Heart Disease
IHT	Inter hospital Transfer
IPCH	Ipswich Community Health
IQR	Inter Quartile Range
IRSAD	Index of Relative Socioeconomic Advantage and Disadvantage
IRSD	Index of Relative Socioeconomic Disadvantage
IVDU	Intravenous Drug Use
LAA	Left Atrial Appendage
LAD	Left Anterior Descending Artery
LCX	Circumflex Artery
LGH	Logan Hospital
LMCA	Left Main Coronary Artery
LOS	Length Of Stay
LV	Left Ventricle

LVEF	Left Ventricular Ejection Fraction
LVOT	Left Ventricular Outflow Tract
MDT	Multidisciplinary Team Meeting
MBH	Mackay Base Hospital
MI	Myocardial Infarction
MIH	Mt Isa Hospital
MKH	Mackay Base Hospital
MRA	Mineralocorticoid Receptor Antagonists
MSSA	Methicillin Susceptible Staphylococcus Aureus
MTHB	Mater Adult Hospital, Brisbane
NCDR	The National Cardiovascular Data Registry
NCS	Networked Cardiac Services
NN	Nurse Navigator
NP	Nurse Practitioner
NRBC	Non-Red Blood Cells
NSTEMI	Non-ST Elevation Myocardial Infarction
OOHCA	Out of Hospital Cardiac Arrest
ORIF	Open Reduction Internal Fixation
PAH	Princess Alexandra Hospital
PCI	Percutaneous Coronary Intervention
PDA	Patent Ductus Arteriosus
PFO	Patent Foramen Ovale
PHQ	Patient Health Questionnaire
PICU	Paediatric intensive care unit
PPM	Permanent Pacemaker
PROMS	Patient Reported Outcome Measures
QAC	Quality Assurance Committee
QAS	Queensland Ambulance Service
QCCN	Queensland Cardiac Clinical Network
QCGP	Queensland Cardiology Genomics Project
QCOR	Queensland Cardiac Outcomes Registry
QEII	Queen Elizabeth II Jubilee Hospital
QHAPDC	Queensland Hospital Admitted Patient Data Collection
QPCR	Queensland Paediatric Cardiac Research
RBC	Red Blood Cells
RBWH	Royal Brisbane & Women's Hospital
RCA	Right Coronary Artery
RDH	Redcliffe Hospital
RHD	Rheumatic Heart Disease
RKH	Rockhampton Hospital
RLH	Redland Hospital
RVOT	Right Ventricular Outflow Tract
SAVR	Surgical Aortic Valve Replacement
SCCIU	Statewide Cardiac Clinical Informatics Unit
SCUH	Sunshine Coast University Hospital
SEIFA	Socioeconomic Indexes for Areas
SGLT2	Sodium-Glucose Cotransporter-2
SHD	Structural Heart Disease
SIR	Standardised Incidence Ratio
SMoCC	Self Management of Chronic Conditions
STEMI	ST-Elevation Myocardial Infarction
STS	Society of Thoracic Surgery
SVT	Supraventricular Tachycardia
TAVR	Transcatheter Aortic Valve Replacement
TIMI	Thrombolysis in Myocardial Infarction
TMVR	Transcatheter Mitral Valve Replacement
TNM	Tumour, Lymph Node, Metastases
TPCH	The Prince Charles Hospital
TPVR	Transcatheter Pulmonary Valve Replacement
TUH	Townsville University Hospital
TWH	Toowoomba Hospital
TTE	Transthoracic echocardiogram
VAD	Ventricular Assist Device
VATS	Video Assisted Thoracic Surgery
VCOR	Victorian Cardiac Outcomes Registry
VF	Ventricular Fibrillation
VSD	Ventricular Septal Defect