Queensland Cardiac Clinical Network

Queensland Cardiac Outcomes Registry

2024 Annual Report

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1 Message from the Queensland Cardiac Clinical Network Chair

It is with great pride that we present the tenth public Annual Report of the Queensland Cardiac Outcomes Registry. This milestone marks a decade of clinician-led commitment to improving cardiovascular care across Queensland through robust data collection, analysis, and collaboration.

Since its inception, QCOR has been a national leader in clinical quality reporting—most notably through its early adoption and consistent benchmarking of the 60 minute door-to-balloon target for patients presenting with ST-elevation myocardial infarction (STEMI). This year's report reflects a significant shift in clinical standards, with the newly released Australian Clinical Guideline for Diagnosing and Managing Acute Coronary Syndromes 2025 endorsing the 60 minute benchmark over the previously accepted 90 minute target. QCOR has long held this higher standard, and we are proud to continue leading in this space.

Over the past decade, QCOR has grown to become one of the most comprehensive cardiac registries in the country, encompassing interventional cardiology, cardiac surgery (adult and paediatric), thoracic surgery, electrophysiology and pacing, structural heart interventions, cardiac rehabilitation, and heart failure support services. This breadth enables a holistic view of cardiac care delivery and outcomes across Queensland.

In alignment with the National Heart Foundation's 25 year vision for heart health in Australia, this report provides a comprehensive analysis of acute coronary syndrome care across the continuum. It examines hospital efficiency in the timely management of myocardial infarction, focusing on system responsiveness, adherence to evidence-based protocols, and equity in access to urgent interventions. The report also evaluates the importance of effective outpatient support services. By synthesising performance data and highlighting both strengths and areas for improvement, the analysis aims to inform governance decisions that advance state and national priorities such as, reducing cardiovascular mortality, improving patient outcomes, and ensuring access to high-quality care.

Looking ahead, the staged launch of a statewide cardiovascular information system from July 2025 represents a transformative step forward. This platform will enable real-time data integration and reporting, reduce duplication, and enhance access to diagnostic and procedural information—ultimately improving outcomes for patients across the state.

As we reflect on a decade of progress, we remain focused on the future: translating data into actionable insights, supporting multidisciplinary care, and ensuring that every patient remains at the heart of our efforts. We thank all contributors – clinicians, hospital teams, and partners for their continued support and shared vision. Together, we are shaping a healthier future for Queensland.

Dr Johanne Neill and Ms Vivian Bryce

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 Queensland 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 Rustem Dautov, The Prince Charles Hospital
- Dr Naim Mridha, Gold Coast University Hospital
- Dr Sam Sidharta, Rockhampton Hospital
- Dr Yash Singbal, Princess Alexandra Hospital
- Dr James Wardley, Cairns Hospital
- Dr Pavan Thaneeru, 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 Morgan Windsor, Royal Brisbane & Women's Hospital
- 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
- Dr Matthew Rowe, Princess Alexandra Hospital
- Dr Paul Martin, Royal Brisbane & Women's Hospital
- Dr Caleb Mengel, Toowoomba Hospital
- Dr Corey Smith, Cairns Hospital
- Dr Robert Park, Gold Coast University Hospital
- Dr Russell Denman, The Prince Charles Hospital (Chair)

Special acknowledgement

QCOR would like to acknowledge the support of **Novartis Pharmaceuticals Australia Pty Ltd** in providing a grant to support the development of an improved system for reporting of Heart Failure patient outcomes. This new system was implemented across all statewide public heart failure support services in Queensland during 2024.

QCOR Cardiac Rehabilitation Committee

- Ms Melanie Gam, Health Contact Centre – Self Management of Chronic Conditions Service
- Ms Sharyn Furze, Metro South Hospital and Health Service
- Mr Rebecca Harkness, Metro North Hospital and Health Service
- Ms Samara Phillips, Statewide Cardiac Rehabilitation Coordinator
- Ms Holly Shobbrook, Sunshine Coast University Hospital
- Ms Jenna Stewart, Gold Coast Hospital and Health Service
- Mr Joanne Thomae, Darling Downs Hospital and Health Service
- Mr Luke Zannes, Metro South Hospital and Health Service
- Ms Bella Cole, Metro South Hospital and Health Service (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
- Ms Alicia McClurg, Statewide Heart Failure Services Coordinator
- Ms Rachelle Mulligan, Princess Alexandra Hospital
- Dr Nicholas Sowden, Queen Elizabeth II 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
- Mr Karl Wortmann

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.

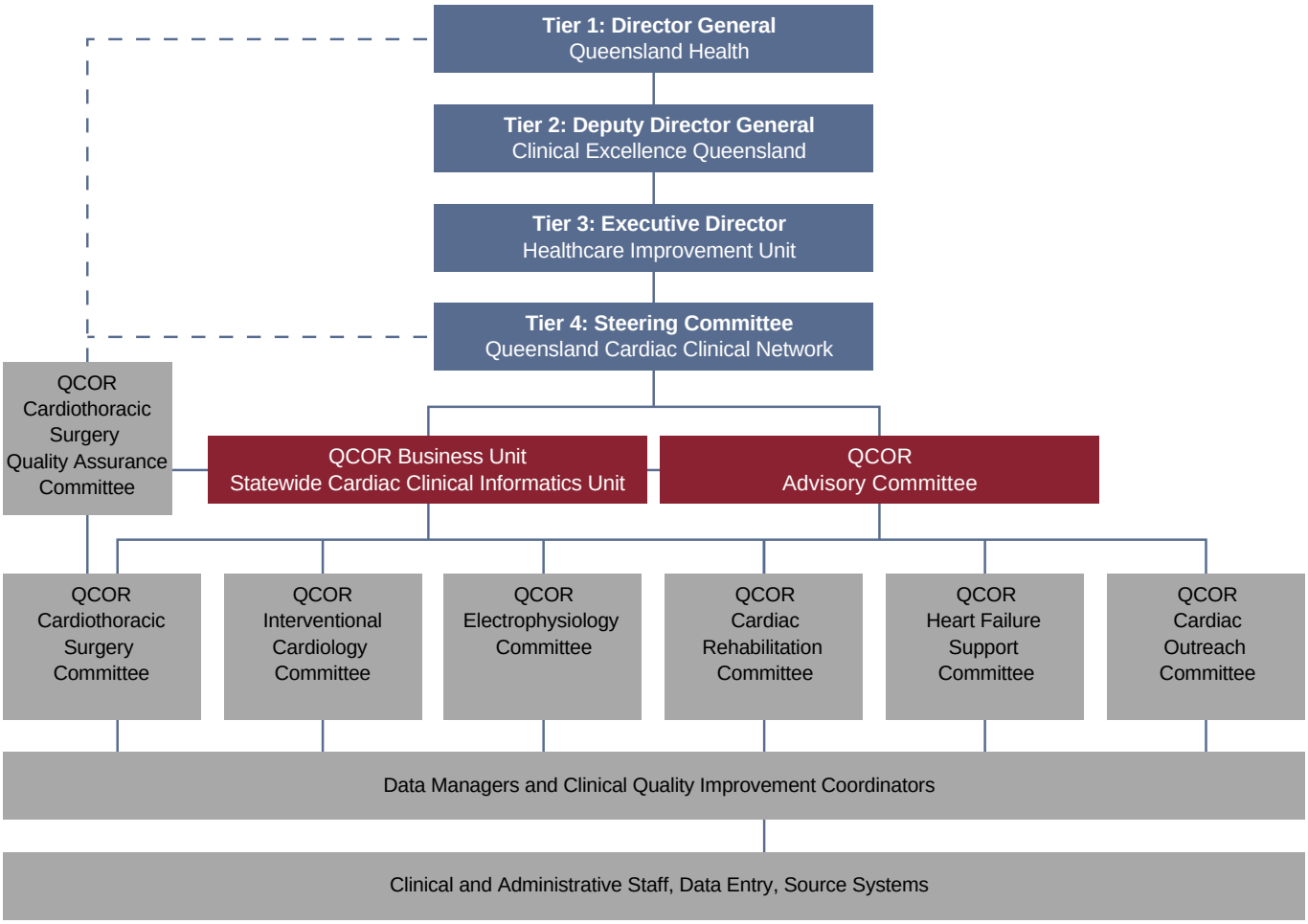


Figure 1: Governance structure

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.

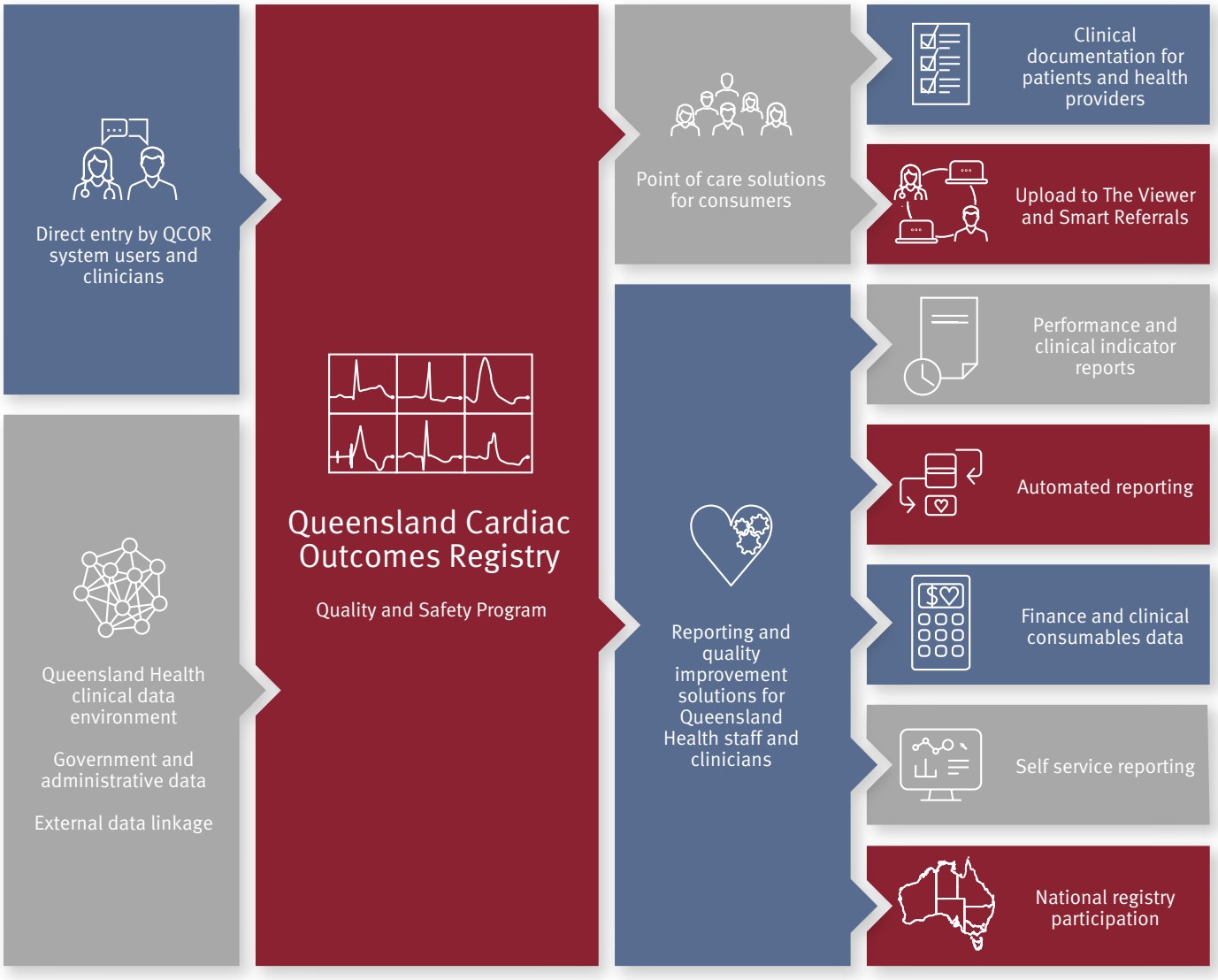
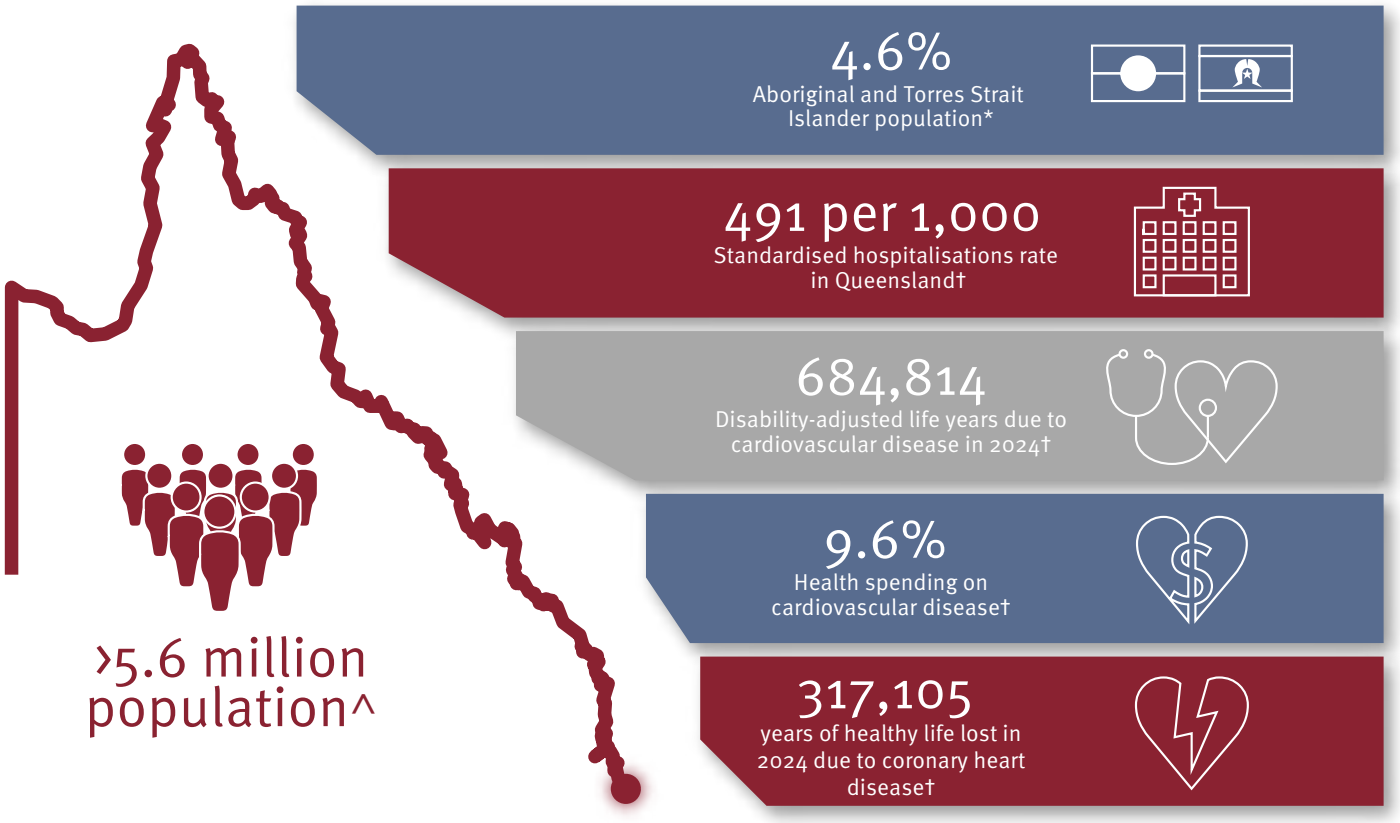


Figure 2: QCOR data flow

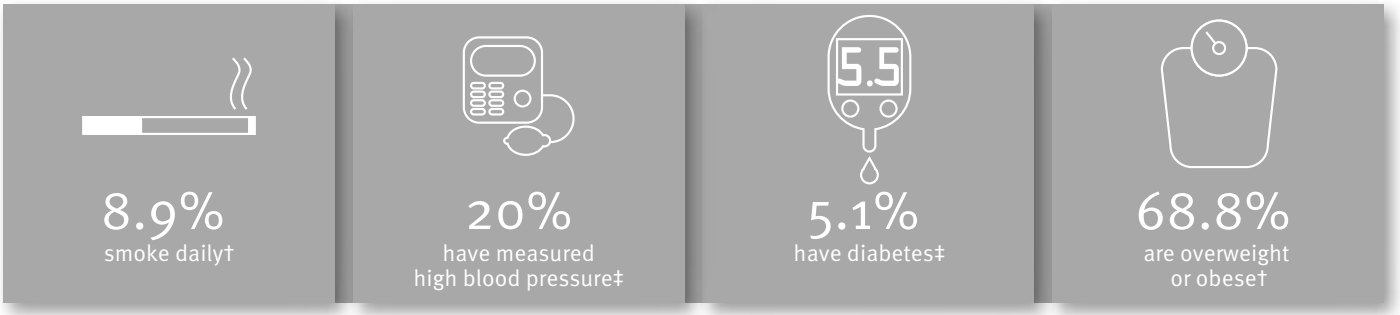
* The Australian Commission on Safety and Quality in Health Care (ACSQHC). Framework for Australian clinical quality registries. Sydney: ACSQHC; 2014

Queensland Cardiac Outcomes Registry

The Health of Queenslanders



Comorbidities



Mortality

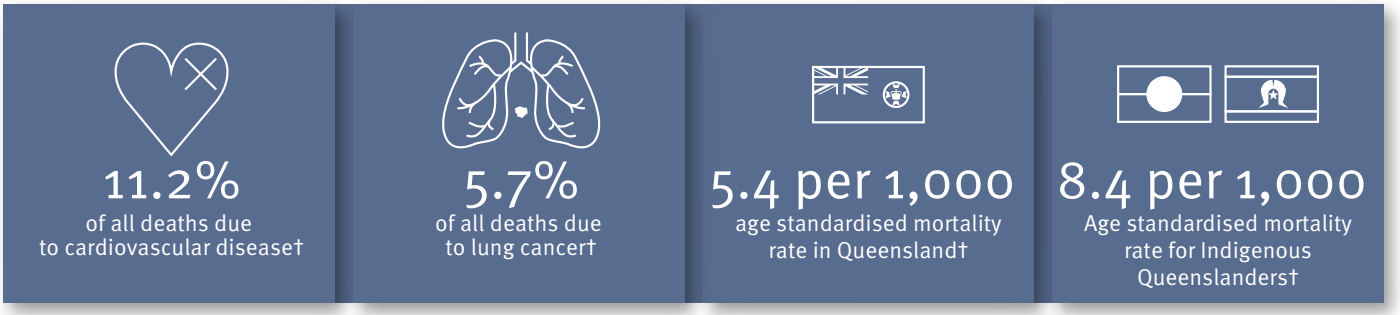


Figure 3: QCOR 2024 infographic

^ Australian Bureau of Statistics. (2024, December). National, state and territory population. ABS. https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/dec-2024

* 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. (2025). The health of Queenslanders. Report of the Chief Health Officer Queensland. Queensland Government: Brisbane.

‡ Australian Bureau of Statistics. (2022). National Health Survey: State and territory findings, ABS Website. Accessed: 10 October 2025.

2024 Activity at a Glance

What's New?

- Revised Heart Failure Support Services indicators
- Same day discharge for elective PCI analysis
- QCOR Cardiothoracic Surgery quality assurance committee overview
- Cardiac rehabilitation model of care spotlight

Interventional Cardiology

5,174
percutaneous coronary interventions

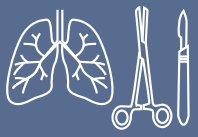
853
structural heart disease interventions

492
transcatheter aortic valve replacements

15,138
total coronary procedures

Cardiothoracic Surgery

2,411
adult cardiac surgeries



1,138
adult thoracic surgeries

Electrophysiology & Pacing

6,181
electrophysiology and pacing procedures

4,299
cardiac implantable electronic device procedures

Heart Failure Support Services

7,442
heart failure support services referrals

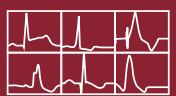
Cardiac Rehabilitation

9,773
cardiac rehabilitation referrals

Paediatric Cardiac Surgery

510
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

91%
of patients with HFrEF prescribed ACEI, ARB or ARNI at the time of first clinical review

92%
of cardiac rehabilitation referrals within 3 days of discharge

1.3%
mortality rate for coronary artery bypass surgery at 30 days

4 Publications in 2024

Chan, N., Atherton, J. J., Hammett, C., Stewart, P., Mallouhi, M., Vollbon, W., & Prasad, S. B. (2024). Diastolic dysfunction and survival in patients with preserved or mildly reduced left ventricular ejection fraction. *European Heart Journal*, *45*(Supplement_1), ehae666.101. https://doi.org/10.1093/eurheartj/ehae666.101

Chan, N. I., Atherton, J. J., Hammett, C., Stewart, P., Mallouhi, M., Vollbon, W., & Prasad, S. B. (2024). Sex differences in diastolic function following myocardial infarction on Doppler echocardiography. *European Heart Journal*, *45*(Supplement_1), ehae666.100. https://doi.org/10.1093/eurheartj/ehae666.100

Chong, A., Sen, J., Reyaldeen, R., Wahi, S., Huynh, Q., Wang, W. Y., & Marwick, T. H. (2024). Prognostication and interventional guidance using acceleration-ejection time ratio in undifferentiated paradoxical low-flow low-gradient aortic stenosis. *JACC: Cardiovascular Imaging*, *17*(11), 1290–1301. https://doi.org/10.1016/j.jcmg.2024.05.015

Crawford, L., Marathe, S. P., Betts, K. S., Karl, T. R., Mattke, A., Rahiman, S., Campbell, I., Inoue, T., Nair, H., Iyengar, A., Konstantinov, I. E., Venugopal, P., & Alphonso, N. (2024). Early outcomes after post-cardiotomy extracorporeal membrane oxygenation in paediatric patients: A contemporary, binational cohort study. *European Journal of Cardio-Thoracic Surgery*, *65*(4), ezae124. https://doi.org/10.1093/ejcts/ezae124

Crawford, L., Marathe, S., Betts, K., Konstantinov, I., Iyengar, A., Venugopal, P., & Alphonso, N. (2024). Extracorporeal membrane oxygenation after neonatal cardiac surgery: A binational cohort study. *Heart, Lung and Circulation*, *33*, S1–S2. https://doi.org/10.1016/j.hlc.2024.04.006

Harvey, R. T., Starmer, K., Sklavos, T., Cahill, T., Starmer, G., O'Neill, J., & Mitchell, R. (2024). Characteristics and outcomes of patients with cardiac conditions requiring emergency medical retrieval from the Great Barrier Reef, Australia. *Rural and Remote Health*, *24*(4), 1-5. https://doi.org/10.22605/RRH8233

Krishnan, A., Chan, N., Hammett, C., Stewart, P., Mallouhi, M., Vollbon, W., & Prasad, S. (2024). A multi-parametric clinical and echocardiographic model to predict mortality following myocardial infarction in patients with mid-range or preserved left ventricular ejection fraction [Abstract]. *Heart, Lung and Circulation*, *33*(Suppl. 1), S33. https://doi.org/10.1016/j.hlc.2024.06.451

Mallouhi, M., Vollbon, W., Prior, M., Cole, C., Mathew, M., Prabhu, A., ... & Smith, I. (2024). Cardiac Surgery Outcomes for Patients Undergoing Coronary Artery Bypass Grafting (CABG) in Queensland: Does the Gender Variance Continue?. *Heart, Lung and Circulation*, *33*, S232-S233. https://doi.org/10.1016/j.hlc.2024.06.223

Mylonas, G., Chan, N., Mallouhi, M., Vollbon, W., Atherton, J., & Prasad, S. (2024). Standard modifiable cardiovascular risk factors (SMuRFs): Prevalence in a representative Queensland cohort with myocardial infarction [Abstract]. *Heart, Lung and Circulation*, *33*(Suppl. 4), S538. https://doi.org/10.1016/j.hlc.2024.06.901

Prasad, S. B., Chan, N. I., Krishnan, A., Martin, P., Stewart, P., Mallouhi, M., Vollbon, W., & Atherton, J. J. (2024). Novel combined echocardiographic score comprising prognostically validated measures of left ventricular size and function to predict long-term survival following myocardial infarction: A proposal to improve risk stratification. *Echocardiography*, *41*(9), e15922. https://doi.org/10.1111/echo.15922

Sargent, S. R., Mladenovic, J. R., Liaw, J. J. T., Siller, J., Russell, P. L., Tung, M. K. Y., & Holland, D. J. (2024). Catheter Ablation for Atrial Fibrillation-Influence of Modifiable Risk Factors and Ablation Modality on Procedural Efficacy and Safety. *Heart, Lung & Circulation*, *33*(6), 882–889. https://doi.org/10.1016/j.hlc.2024.02.009

Savage, M. L., Hay, K., Vollbon, W., Murdoch, D. J., Hammett, C., Crowhurst, J., Poon, K., Poulter, R., Walters, D. L., Denman, R., Ranasinghe, I., & Raffel, O. C. (2024). Differences between sexes in STEMI treatment and outcomes with contemporary primary PCI. *Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions*, *104*(5), 934–944. https://doi.org/10.1002/ccd.31206

Vollbon, W., Cole, C., Prior, M., Mallouhi, M., Stroebel, A., Mathew, M., ... & Smith, I. (2024). Blood product usage as a predictor of adverse outcomes following cardiac surgery: A Queensland experience [Abstract]. *Heart, Lung and Circulation*, *33*(Suppl.), S232. https://doi.org/10.1016/j.hlc.2024.06.222

Vollbon, W., Cole, C., Mallouhi, M., Prior, M., Prabhu, A., Stroebel, A., ... & Smith, I. (2024). Factors associated with bleeding and blood loss in patients undergoing cardiac surgery: A Queensland perspective [Abstract]. *Heart, Lung and Circulation*, *33*(Suppl.), S237. https://doi.org/10.1016/j.hlc.2024.06.234

Dhanapathy, V., Jones, S., & He, C. (2024). Wire cerclage versus rigid plate fixation: A retrospective cohort study and cost-benefit analysis on method of sternotomy closure following cardiac surgery [Abstract]. *Heart, Lung and Circulation*, *33*(Suppl. 2), S56. https://doi.org/10.1016/j.hlc.2024.04.056

Dhanapathy, V., Jones, M., Stroebel, A., & He, C. (2025). Wire cerclage versus rigid plate fixation: A retrospective cohort study and cost-benefit analysis on method of sternotomy closure after cardiac surgery [Abstract]. *Heart, Lung and Circulation*, *34*(Suppl. 2), S56. https://doi.org/10.1016/j.hlc.2024.04.056

Millhouse, J., Kamalanathan, H., & McMaster, A. (2024). Sex differences and factors associated with increased onset to door time in patients with STEMI—A single centre experience [Abstract]. *Heart, Lung and Circulation*, *33*(Suppl. 4), S410–S411. https://doi.org/10.1016/j.hlc.2024.06.618

Grace, S. L., Hagström, E., Harrison, A. S., Phillips, S., Bovin, A., Yokoyama, M. N., Niebauer, J., Makita, S., Raidah, F., Back, M., & ICRR Investigators. (2024). Cardiac rehabilitation registries around the globe: Current status and future needs. *European Journal of Preventive Cardiology*, *31*(16), e117–e121. https://doi.org/10.1093/eurjpc/zwae182

Chan, N., Krishnan, A., Mallouhi, M., Stewart, P., Vollbon, W., Hammett, C., Atherton, J., & Prasad, S. (2024). Spectrum of valvular heart disease in patients with myocardial infarction: Prevalence and impact on outcomes [Abstract]. *Heart, Lung and Circulation*, *33*(Suppl. 4), S220. https://doi.org/10.1016/j.hlc.2024.06.194

Chen, Y., Marshall, A., Wu, C. J., Hattingh, L., Howes, L., Jayasinghe, R., Poulter, R., Rahman, A., Starmer, G., Singbal, Y., Yadav, R., & Smith, I. (2024). Trends and predictors of cardiac rehabilitation referrals and participation in patients undergoing elective percutaneous coronary intervention. *European Heart Journal*, *45*(Suppl. 1), ehae666.3378. https://doi.org/10.1093/eurheartj/ehae666.3378

Low, Y., Chuah, T., & Mathew, M. (2024). Outcomes of valve replacements in North Queensland, comparing Aboriginal/Torres Strait Islander population and non-Indigenous population—A retrospective single centre study [Abstract]. *Heart, Lung and Circulation*, *33*(Suppl. 2), S136. https://doi.org/10.1016/j.hlc.2024.04.136

5 Executive summary

This report comprises an account for cases performed in the ten cardiac catheterisation laboratories (CCL), nine electrophysiology and pacing (EP) facilities, and five cardiothoracic surgery units operating across Queensland public hospitals in 2024. All referrals to heart failure support (HFSS) and cardiac rehabilitation (CR) services are also included in this Annual Report.

- 15,138 diagnostic or interventional cases were performed across the ten public CCL facilities in Queensland hospitals. Percutaneous coronary intervention (PCI) was performed in 5,174 of these cases.
- Patient outcomes following PCI remain encouraging. The 30 day all-cause mortality rate following PCI was 2.4%, and of the 123 deaths observed, 48% were classed as either salvage or emergency PCI.
- When analysing the ST segment elevation myocardial infarction (STEMI) patient cohort, the median time from first diagnostic electrocardiograph (ECG) to reperfusion was 85 minutes, while the median time from arrival at PCI facility to reperfusion was measured at 40 minutes.
- For STEMI presenting within six hours of symptom onset the median time from arrival at PCI facility to reperfusion was 32 minutes for cases performed in working hours (8am to 6pm, Monday to Friday, excluding public holidays), while cases occurring out of hours had a median time of 44 minutes.
- There were 853 structural heart interventions performed across participating CCL facilities. This included 614 transcatheter valve procedures, of which 578 were transcatheter aortic valve replacement procedures. The unadjusted all-cause 30 day mortality rate for all SHD interventions was 2.0%.
- Across the four sites with a cardiac surgery unit, a total of 2,411 cases were performed including 1,061 coronary artery bypass grafting (CABG) procedures, 1,160 valve procedures, and 234 CABG and valve procedures.
- The observed rates for cardiac surgery mortality and morbidity are either within the expected range or better than expected depending on the risk model used to evaluate these outcomes. This is consistent with the results of previous Audits.
- Across the period of July 2019 to June 2024, 1,323 children underwent cardiac surgery, including 271 children in 2023–24. There were 1,443 paediatric cardiac surgical procedures performed from July 2019 to June 2024, either with or without cardiopulmonary bypass (1,126 and 317 procedures respectively). The thirty day mortality rate after paediatric cardiac surgery between July 2019 to June 2024 was 0.7%.
- A total of 1,138 thoracic surgery (TS) cases were performed across the five public hospitals providing TS services in 2024. Almost one-quarter (24%) of surgeries followed a surgical indication of primary lung cancer, while other cancer accounted for 33% all cases.
- The unadjusted all-cause 30 day mortality rate following TS was 1.1%, increasing to 2.2% at 90 days post surgery.
- At the nine public EP sites, a total of 5,769 cases were performed, which included 4,299 cardiac device procedures and 1,470 cardiac electrophysiology procedures.
- The EP clinical indicator audit identified a median wait time of 105 days for complex ablation procedures, and 37 days for elective implantable cardioverter defibrillator (ICD) implants. The median wait time for a standard ablation procedure was 97 days.
- There was a total of 9,773 referrals to public CR services in 2024. 69% of referrals followed an admission at a public hospital in Queensland.
- Over two-thirds (72%) of CR referrals proceeded to pre assessment by a CR service. The most common reason this did not take place was that the patient declined.
- The majority (92%) of referrals to CR were created within three days of the patient being discharged from hospital, while over half (67%) of patients went on to complete an initial assessment by CR within 28 days of discharge.
- There were 7,442 new referrals to a HFSS in 2024, with 59% originating from an inpatient setting.
- At first clinical review, the prescription of an ACEI/ARB or ARNI, beta blocker, MRA or SGLT2 inhibitor for heart failure with reduced ejection fraction (HFrEF) were measured at 91%, 91%, 65% and 67% respectively.
- 50% of patients with HFpEF were prescribed an SGLT2 inhibitor at their first HFSS clinical review.
- At the time of titration review, 78% of patients achieved either the guideline-recommended target dose or their maximum tolerated dose of beta blocker.

6 Facility profiles

6.1 Cairns Hospital

- Referral hospital for Cairns and Hinterland and Torres and Cape Hospital and Health Services, serving a population of approximately 280,000
- Public tertiary level invasive cardiac services provided at Cairns Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
- Cardiac genomics clinics provider
- Networked cardiac services outreach hub for Cairns and Hinterland and Torres and Cape Hospital and Health Services

6.2 Townsville University Hospital

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

6.3 Mackay Base Hospital

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

6.4 Sunshine Coast University Hospital

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

6.5 The Prince Charles Hospital

- Referral hospital for Metro North, Wide Bay and Central Queensland Hospital and Health Services, serving a population of approximately 900,000 (shared referral base with the Royal Brisbane & 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

6.6 Royal Brisbane & Women's Hospital

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

6.7 Queensland Children's Hospital

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

6.8 Princess Alexandra Hospital

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

6.9 Toowoomba Hospital

- Referral hospital for Darling Downs Hospital and Health Services, servicing a population of approximately 280,000
- Public invasive cardiac services provided at the Toowoomba Hospital include:
  - Coronary angiography
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
- Networked cardiac services outreach hub for Darling Downs Hospital and Health Service

6.10 Ipswich Hospital

- Referral hub for West Moreton Hospital and Health Service. Ipswich Hospital provides health services to more than 320,000 people across the Somerset, Scenic Rim, Lockyer Valley and Ipswich communities.
- Public invasive cardiac services provided at the Ipswich Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
- Networked cardiac services outreach hub for West Moreton Hospital and Health Service

6.11 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

7 Spotlight: Annual activity trends

7.1 Introduction

In 2024, Queensland's health services maintained consistent access to cardiac care. Elective surgeries, procedures, and both inpatient and outpatient diagnostic studies and consultations proceeded in a stable manner with growth across a number of key areas. Outpatient support services, including cardiac rehabilitation and heart failure support, demonstrated steady operation, with some areas experiencing growth in service delivery.

7.2 Procedure volumes

Activity data from 2020 to 2024 reveals several notable trends. Interventional cardiology experienced a slight decline from 4,966 in 2020 to 4,818 in 2022, but saw a significant increase to 5,174 in 2024, indicating a recovery to above pre-pandemic volumes even when new services are considered. Structural heart interventions have also shown a steady increase, from 468 in 2020 to 735 in 2024. This rise reflects advancements in structural heart disease treatments and in particular a growth in aortic valve interventions.

Cardiac surgery numbers fluctuated, peaking at 2,651 in 2020, dropping to 2,230 in 2022, and then rising again to 2,411 in 2024. This pattern likely reflects the impact of the COVID-19 pandemic, with a notable drop in 2022 due to healthcare system strains, followed by a recovery as conditions improved. Thoracic surgery saw a decrease in 2022, falling to 918 from previous levels, before increasing to a five year peak of 1,138 in 2024, suggesting a temporary reduction during the pandemic, with a return to normal levels as healthcare services stabilised.

Electrophysiology and pacing procedures have consistently increased, from 5,201 in 2020 to 5,769 in 2024, highlighting growing demand.

Table 1: Total cases for interventional cardiology, cardiac surgery, thoracic surgery and electrophysiology and pacing by year, 2020–2024

Service line	2020 n	2021 n	2022 n	2023 n	2024 n
Percutaneous coronary intervention	4,966	4,894	4,818	5,145	5,174
Structural heart interventions	468	485	617	730	835
Cardiac surgery	2,651	2,624	2,230	2,529	2,411
Thoracic surgery	1,093	1,067	918	1,097	1,138
Electrophysiology and pacing	5,201	5,269	5,305	5,768	5,769

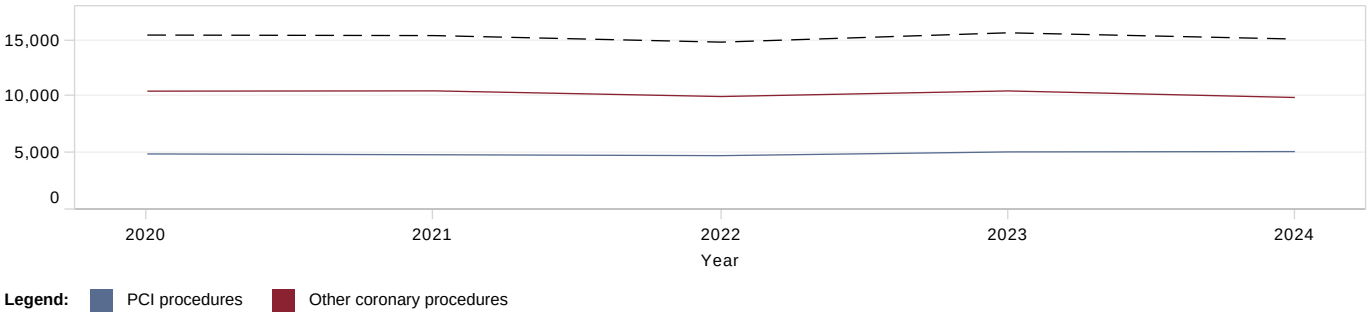


Figure 1: Proportion of all diagnostic and interventional cardiology cases by case category, 2020–2024

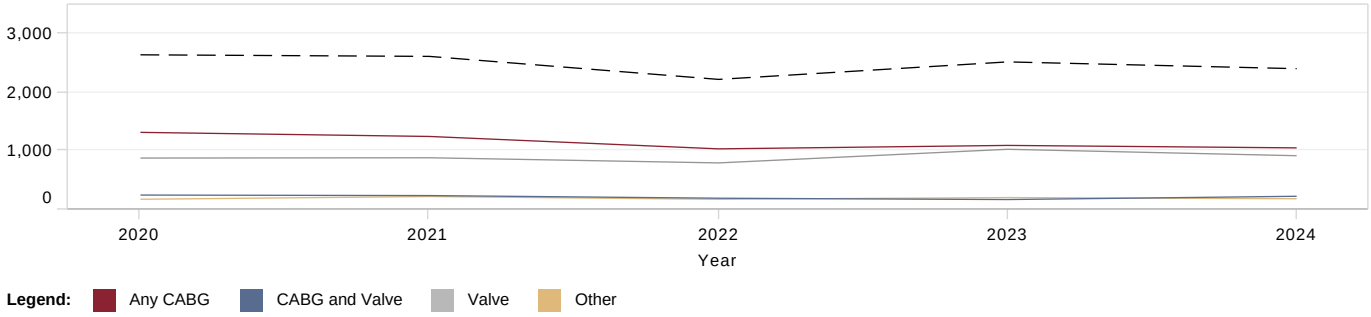


Figure 2: Proportion of all cardiac surgery cases by procedure category, 2020–2024

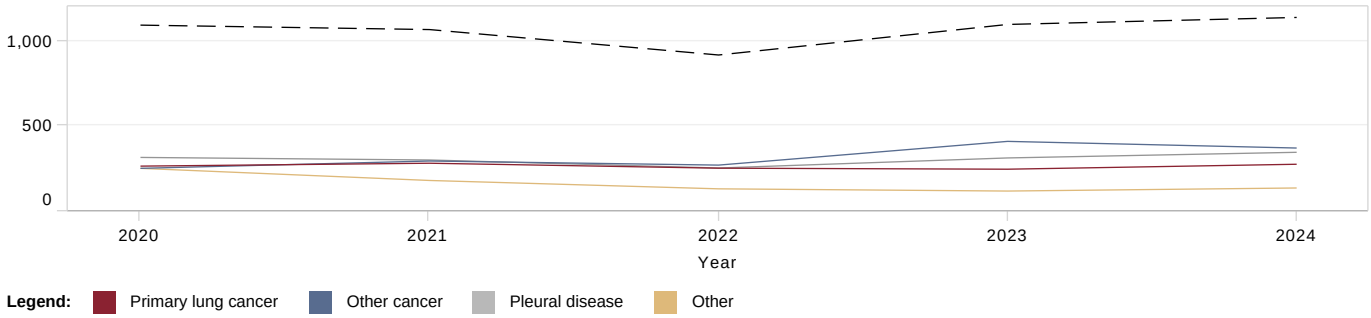


Figure 3: Proportion of all thoracic surgery cases by indication, 2020–2024

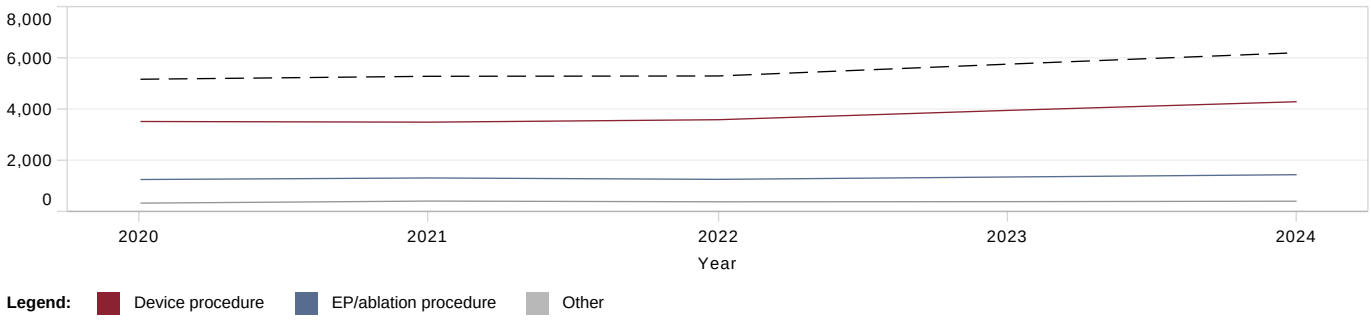


Figure 4: Proportion of all electrophysiology and pacing cases by procedure category, 2020–2024

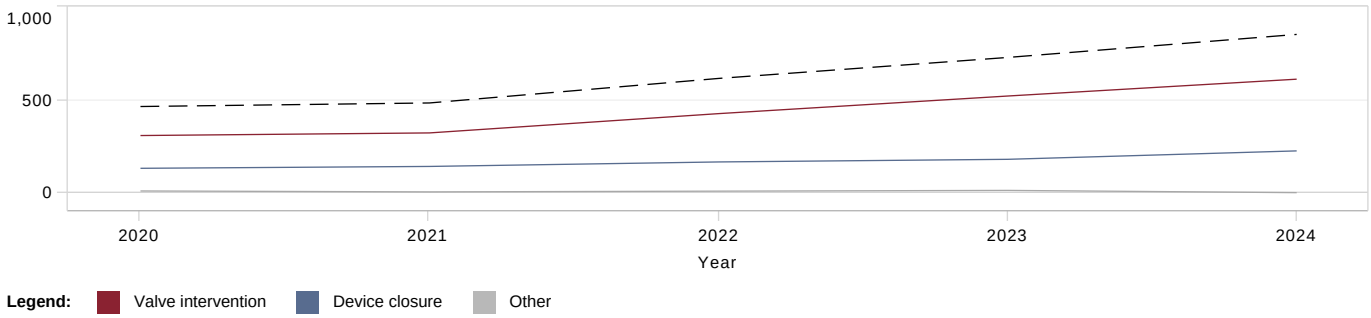


Figure 5: Proportion of all SHD cases by procedure category and year, 2020–2024

7.3 Admission status

The patient admission status for various procedures across most service lines are largely similar across the years.

Table 2: Procedure status for interventional cardiology, cardiac surgery, thoracic surgery and electrophysiology and pacing by year, 2020–2024

Service line	2020	2021	2022	2023	2024
Interventional cardiology, n	4,966	4,894	4,818	5,145	5,174
Elective, n (%)	1,059 (21.3)	1,055 (21.6)	977 (20.3)	1,091 (21.2)	1,022 (19.8)
Urgent, n (%)	2,585 (52.1)	2,568 (52.5)	2,588 (53.7)	2,692 (52.3)	2,779 (53.7)
Emergent, n (%)	1,252 (25.2)	1,174 (24.0)	1,156 (24.0)	1,259 (24.5)	1,258 (24.3)
Salvage, n (%)	70 (1.4)	91 (1.9)	97 (2.0)	103 (2.0)	115 (2.2)
Cardiac surgery, n	2,651	2,624	2,230	2,529	2,411
Elective, n (%)	1,472 (55.5)	1,432 (54.6)	1,103 (49.5)	1,304 (51.6)	1,122 (46.5)
Urgent, n (%)	990 (37.3)	970 (37.0)	928 (41.6)	994 (39.3)	1,107 (45.9)
Emergent, n (%)	185 (7.0)	211 (8.0)	191 (8.6)	221 (8.7)	178 (7.4)
Salvage, n (%)	4 (0.2)	10 (0.4)	8 (0.4)	10 (0.4)	4 (0.2)
Thoracic surgery, n	1,093	1,067	918	1,097	1,138
Elective, n (%)	719 (65.8)	734 (68.8)	631 (68.7)	773 (70.5)	756 (66.4)
Urgent, n (%)	282 (25.8)	131 (12.3)	186 (20.3)	218 (19.9)	242 (21.3)
Emergent, n (%)	92 (8.4)	202 (18.9)	101 (11.0)	106 (9.7)	140 (12.3)
Electrophysiology and pacing, n	5,201*	5,269†	5,305‡	5,768§	5,769‖
Category 1, n (%)	3,051 (58.7)	3,123 (59.3)	3,034 (61.2)	3,355 (61.1)	3,163 (54.8)
Category 2, n (%)	1,365 (26.2)	1,377 (26.1)	1,423 (28.7)	1,588 (28.9)	1,715 (29.7)
Category 3, n (%)	459 (8.8)	487 (9.2)	500 (10.1)	549 (10.0)	729 (12.6)

Category 1: Clinically indicated within 30 days

Category 2: Clinically indicated within 90 days

Category 3: Clinically indicated within 365 days

* 6.3% missing data

† 5.4% missing data

‡ 8.0% missing data

§ 6.9% missing data

‖ 2.8% missing data

7.4 Outpatient support services

The data for cardiac rehabilitation (CR) from 2020 to 2024 shows some reduction in the number of referrals over time, declining from 11,117 in 2020 to 9,773 in 2024. Some of these trends are likely attributable to increased verification of referrals being entered into the system resulting in a lower number of duplicated entry for the same patients. It should also be noted that while the overall number of referrals to CR decreased by 12% from 2020 and 2024, the proportion of these patients receiving a CR pre assessment increased from 64% to 72%. This suggests some efforts by referring services to reduce the number of ineligible patients being referred to CR.

Heart failure support services (HFSS) have experienced steady growth over recent years, increasing from 5,664 referrals in 2020 to a peak of 7,514 in 2023, a 33% rise. Although 2024 saw a slight decline to 7,442 referrals, volumes remain significantly elevated compared to earlier years. This sustained demand highlights the ongoing need for HF support, likely driven by demographic shifts such as an aging population, alongside improvements in clinical detection, earlier intervention, and increased public and professional awareness of heart failure.

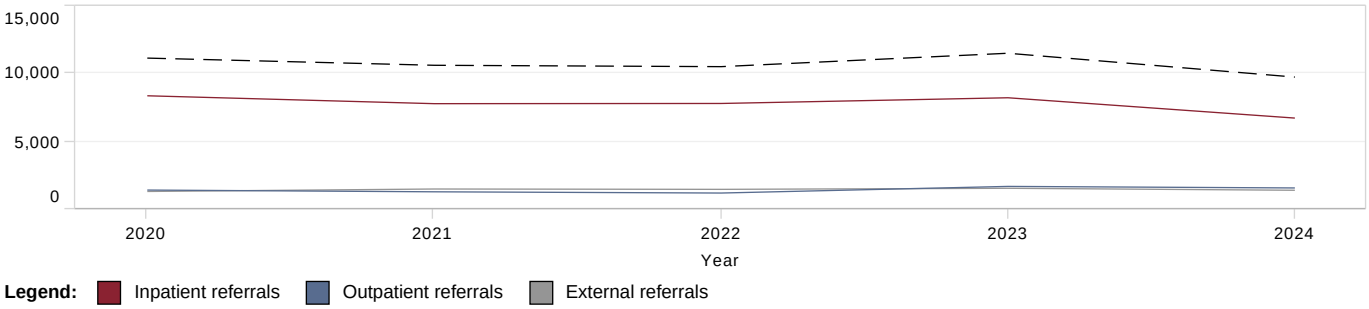


Figure 6: Cardiac rehabilitation referral source, 2020–2024

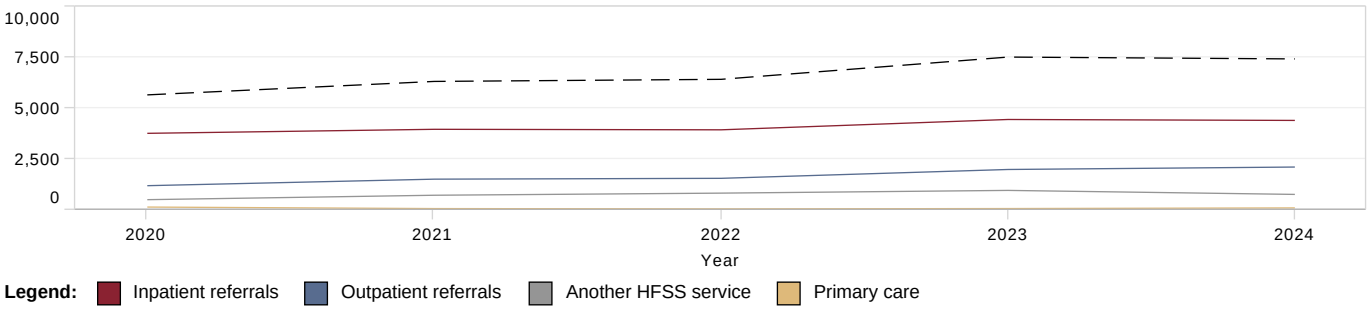


Figure 7: Heart failure support services referral source, 2020–2024

Table 3: Outpatient support services referral volumes, 2020–2024

Service line	2020 n	2021 n	2022 n	2023 n	2024 n
Cardiac rehabilitation	11,177	10,647	9,317	10,076	9,773
Heart failure support services	5,664	6,326	6,438	7,514	7,442

7.5 Clinical performance indicators

Key clinical performance indicators for Queensland cardiac services in 2024 were largely similar to the previous year.

Table 4: Performance measures for interventional cardiology, electrophysiology and pacing, cardiac rehabilitation and heart failure support services by year, 2020–2024

Service line	2020	2021	2022	2023	2024
Interventional cardiology					
Proportion of STEMI* patients presenting within six hours of symptom onset who received an intervention within 90 minutes of first diagnostic ECG (%)	67	63	58	61	59
Proportion of STEMI* patients with arrival at PCI facility to first device time less than 60 minutes (%)	70	74	69	73	72
Proportion of all NSTEMI† patients who received angiography within 72 hours of first hospital admission (%)	69	69	67	70	69
Electrophysiology and pacing					
Median wait time for elective pacemaker implantation (days)	3	2	13	16	21
Median wait time for elective ICD‡ implantation (days)	36	21	21	28	37
Median wait time for elective standard§ ablation (days)	55	53	53	70	97
Median wait time for elective complex§ ablation (days)	104	84	98	90	105
Cardiac rehabilitation					
Timely referral – documented referral to CR within three days of discharge (%)	93	93	92	90	92
Timely assessment (inpatients) – initial CR pre assessment completed within 28 days of discharge date (%)	62	64	58	61	67
Timely assessment (non-acute patients) – proportion of CR patients completing a CR pre assessment within 28 days of referral date (%)	57	61	64	61	63
Timely journey (inpatients) – composite of timely referral and assessment (%)	58	59	53	61	67
Heart failure support services					
Follow-up of acute patients within two weeks (%)	80	78	79	78	76
Follow-up of non-acute patients within four weeks (%)	84	84	79	81	84
Assessment of left ventricular ejection fraction within two years (%)	96	97	98	98	98
ACEI/ARB‖ or ARNI# at first clinical review (%)	92	93	92	91	91
Beta blocker prescription at first clinical review (%)	92	92	92	91	91
Prescription of MRA for HFrEF** at time of first HFSS clinical review (%)	46	51	58	63	65
SGLT2 inhibitor prescription for HFrEF** at time of first clinical review (all referrals) (%)	–	–	40	58	67
Beta blocker titration status review at six months post referral (%)	75	79	74	75	67
Beta blocker achievement of guideline recommended target (%)	32	31	27	26	25
Beta blocker guideline recommended target dose or max. tolerated dose (%)	77	80	72	75	78
SGLT2†† inhibitor prescription for HFpEF‡‡ at time of first clinical review (all referrals) (%)	–	–	14	30	50

* ST-elevation myocardial infarction

† Non-ST-elevation myocardial infarction

‡ Implantable cardioverter defibrillator

§ Recalculated using revised definitions for standard vs complex ablation

‖ Angiotensin receptor-neprilysin inhibitor

\# Mineralocorticoid receptor antagonists

** Heart failure with reduced ejection fraction

†† Sodium glucose cotransporter-2

‡‡ Heart failure with preserved ejection fraction

8 Spotlight: Networked Cardiac Services

The Networked Cardiac Services (NCS) program is an integrated model of care for the delivery of cardiac services to regional and remote areas of Queensland, underpinned by building regional capability and organisational accountability. Implementation of the NCS program has been directed at improving key metrics identified as critical to the success of cardiac in-reach and outreach services across Queensland.

Since 2019, five HHSs have adopted the NCS program. In 2022, three more were funded to deliver Better Cardiac Care teams, and work is now underway to expand the data collection to include services already undertaken by Metro North HHS. The program is strongly supported by Queensland Health, the Queensland Cardiac Clinical Network, and regional partners.

Areas targeted for improvement by the NCS program include:

- Significant variations in healthcare and outcomes across Queensland. People living in rural and remote locations and Aboriginal and Torres Strait Islander people are admitted to hospital for cardiac-related conditions two to three times more than the broader population*
- Inequitable access to health care due to Queensland's vast geographical size and dispersed population.
- Lack of integration and continuity between and within health sectors
- Poor access to and/or use of technology
- Limited or no data about or evaluation of existing services
- Unreliable funding and disparate resource allocation
- Historical models of care persist, whereby patients and clinicians travel past the closest health care facility, creating inefficiency, inequitable resource allocation, untapped potential, uncoordinated and potentially unsafe care
- Successful, existing improvement initiatives in the field are not leveraged or spread to other jurisdictions

The implementation framework for NCS is guided by the following principles:

- Care close to home – including clinic consultation, testing and case management
- Coordination and integration including Better Cardiac Care Teams
- Evidence, evaluation, and improvement
- Utilisation of technology to support healthcare
- Sustainable funding and resources
- Governance and accountability
- Harness existing investments and programs

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

Since 2019, five HHSs have implemented the NCS program including outreach and in-reach. Funding for the remaining sites is yet to be identified, however in 2022 funding was provided for a further three HHSs to implement in-reach, Better Cardiac Care teams, providing the patient coordination aspect of NCS.

Table 1: NCS program participating units

Network Service (Outreach and Better Cardiac Care)	**Hub facility**	**Commenced date**
Cairns and Far North Queensland	Cairns Hospital	November 2019
Townsville and North West Queensland	Townsville University Hospital	January 2020
Mackay Hospital*	Mackay Hospital	November 2022
Rockhampton Hospital*	Rockhampton Hospital	October 2022
Metro South and South West	Princess Alexandra Hospital	July 2020
Ipswich Hospital and West Moreton	Ipswich Hospital	November 2020
Redland Hospital	Redland Hospital	July 2021
Gold Coast University Hospital*	Gold Coast University Hospital	October 2022
Toowoomba Hospital and Darling Downs	Toowoomba Hospital	August 2020

* Better Cardiac Care service only

NCS outreach programs are delivering on their core philosophy of providing care to Aboriginal and Torres Strait Islander people and delivering care closer to home. A variety of models of care exist across cardiac outreach units with most providing specialist medical consults, cardiac physiologists including cardiac sonographers, nursing staff, Aboriginal and Torres Strait Islander health workers and pharmacists. Multidisciplinary teams are vital to delivering on the core outputs of NCS.

The provision of onsite cardiac diagnostic services is an important aspect of NCS and varies according to the specific needs of each community. The most commonly performed tests are electrocardiography and transthoracic echocardiography. In response to high demand, dedicated echocardiography clinics are conducted. These clinics ensure timely and efficient access to essential cardiac diagnostics, helping to address the unique healthcare needs of each community.

Future directions for NCS include the collation of the different models of care in use and analysis of how experiences in various hubs may be transferable to other HHSs, and the implementation of a NCS-centric performance measure to monitor access to care within clinically recommended timeframes. With these measures available, NCS will continue to improve in its goal to provide appropriate specialist cardiac care to all Queenslanders regardless of where they live.

Table 2: NCS outreach program practitioner roles

Network team	**Cardiologist/ medical specialist**	**Cardiac physiologist/ sonographer**	**Nurse**	**RHD* nurse**	**Indigenous health worker**	**Pharmacist**
Cairns and Far North	✓	✓	✓	✓	✓	✓
Townsville and North West	✓	✓	✓	✓	✓	✓
Princess Alexandra Hospital	✓	✓	✓	–	✓	✓
Toowoomba Hospital	✓	✓	✓	–	✓	–
Redland Hospital	✓	✓	✓	–	–	–
Ipswich Hospital	✓	✓	✓	–	–	✓

* Rheumatic heart disease

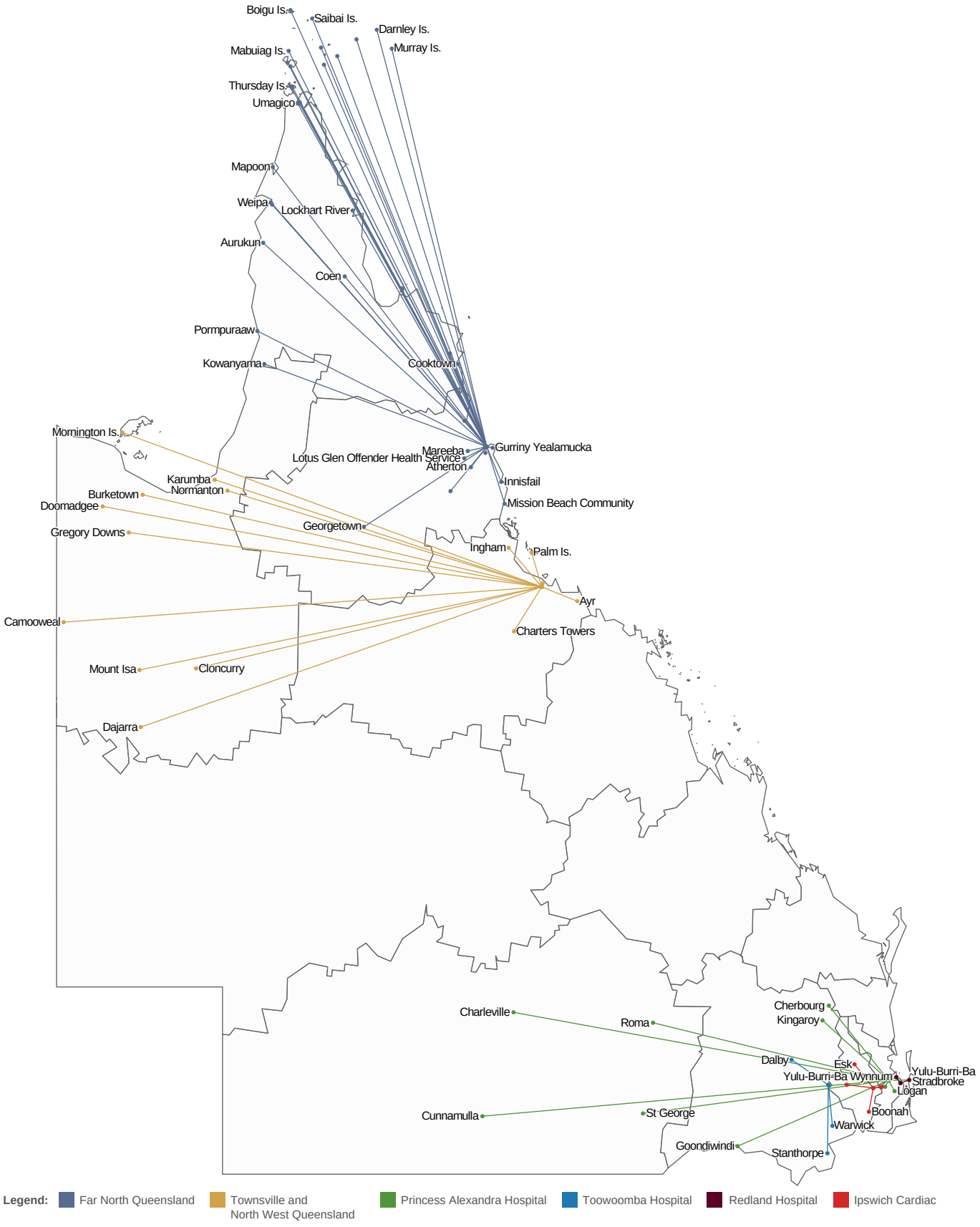


Figure 1: NCS outreach service hub and spoke locations

Cardiac outreach units each have a responsibility to provide services to a differing number of spoke sites. Each spoke site has its own requirements and workflow which requires units to be agile and able to adapt to many different clinic environments. Spoke site numbers may change over time with new services being identified based on need and the capacity for the hub units to provide services.

In 2024, participating NCS outreach units delivered services across a total of 73 spoke sites. The Far North Queensland unit provided services to 38 sites extending north to the Torres Strait Island region. The Townsville and North West Queensland and Princess Alexandra Hospital units delivered services to 15 and 12 spoke sites respectively, while the Toowoomba, Redland and Ipswich units delivered outreach services to 10 spoke sites collectively.

Table 3: Total spoke sites by NCS outreach unit

Cardiac outreach unit	Total spoke sites n
Cairns and Far North Queensland	38
Townsville and North West Queensland	15
Princess Alexandra Hospital	12
Toowoomba Hospital	3
Redland Hospital	2
Ipswich Hospital	5
ALL	**73**

There were 713 clinics operated by NCS outreach units in 2024.

Table 4: Total clinics by NCS outreach unit

Cardiac outreach unit	Total clinics n
Cairns and Far North Queensland	227
Townsville and North West Queensland	314
Princess Alexandra Hospital	112
Toowoomba Hospital	24
Redland Hospital	4
Ipswich Hospital	32

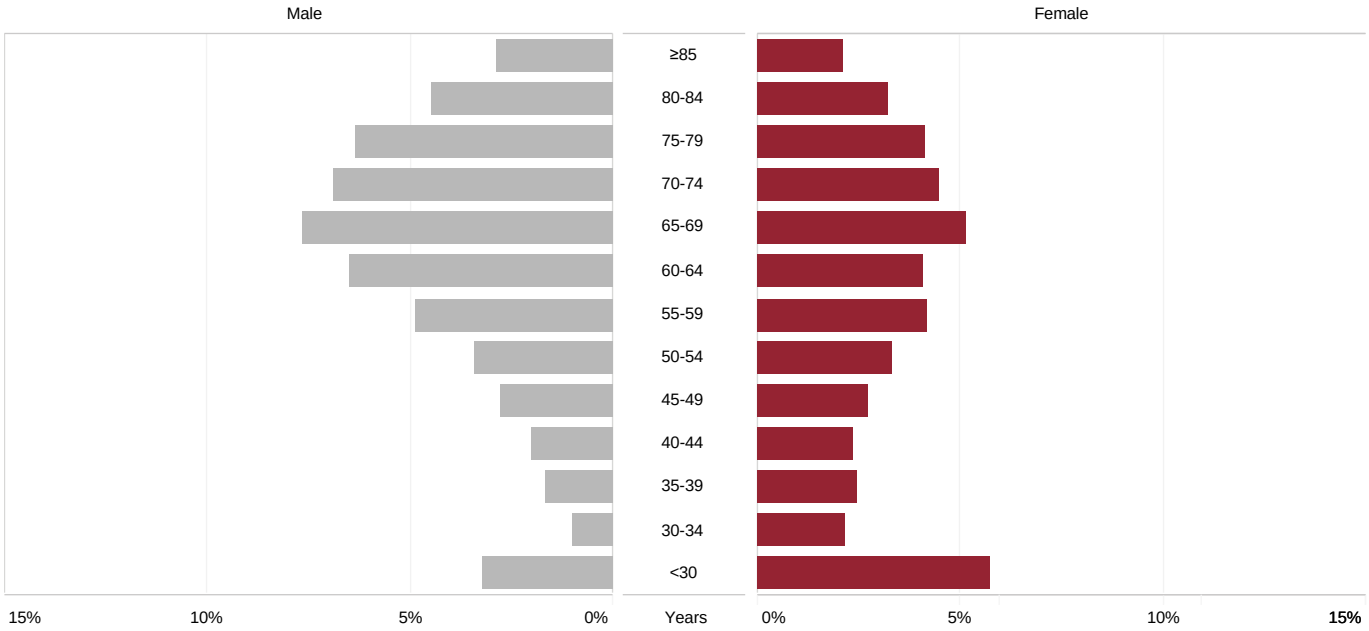
During 2024, 8,073 total consults were delivered by NCS outreach units, with the greatest numbers delivered by the more established outreach programs.

Table 5: Total consults performed by NCS outreach unit

Cardiac outreach unit	Total consults n	Total patients* n
Cairns and Far North Queensland	3,311	2,685
Townsville and North West Queensland	2,011	1,516
Princess Alexandra Hospital	2,156	1,636
Toowoomba Hospital	265	237
Redland Hospital	21	21
Ipswich Hospital	309	254
ALL	**8,073**	**6,338**

* Total of all individual rows is greater than 6,338 due to patients seen by multiple units

There were 6,338 patients seen by NCS outreach units in 2024. Of these patients 3,368 (53.1%) were male. The median age for all patients was 63 years, ranging from 58 years to 66 years across outreach units. One-quarter of all patients were under the age of 50 years (26%).



% of total consults (n=8,073)

Figure 2: Proportion of NCS outreach consults by age and gender

Table 6: Median patient age by gender and cardiac outreach unit

Cardiac outreach unit	Male years	Female years	ALL years
Cairns and Far North Queensland	64	56	60
Townsville and North West Queensland	66	57	62
Princess Alexandra Hospital	65	65	65
Toowoomba Hospital	66	71	66
Redland Hospital	59	50	58
Ipswich Hospital	64	62	63
Total	**65**	**59**	**63**

Aboriginal and Torres Strait Islander patients accounted for 40% of the overall cohort enrolled in NCS outreach programs (n=2,548) in 2024. This is considerably higher than the resident proportion of Aboriginal and Torres Strait Islander population of Queensland of 4.6%.*

A higher proportion of Aboriginal and Torres Strait Islander patients presented in the younger age categories, with Indigenous patients under 45 years old representing 18% of all patients, compared to 8% for non-Indigenous patients.

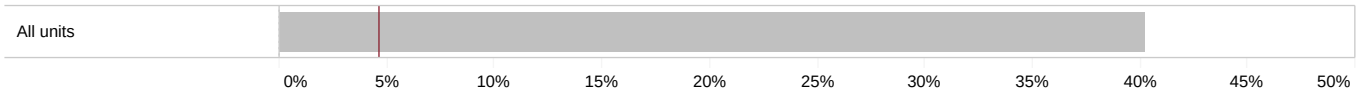
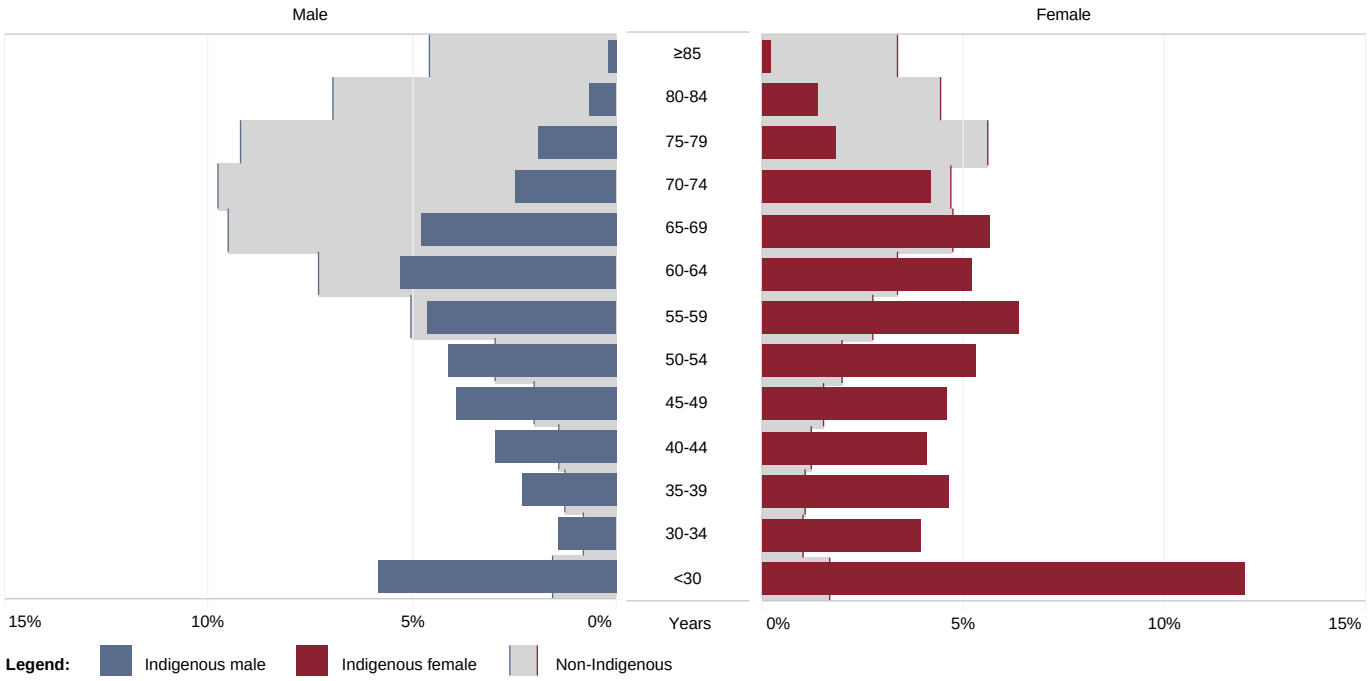


Figure 3: Proportion of Aboriginal and Torres Strait Islander patients seen in cardiac outreach

The median age of Aboriginal and Torres Strait Islander patients was lower than that of non Aboriginal and Torres Strait Islander patients (51 years vs 69 years).



% of total Aboriginal and Torres Strait Islander (n=2,548) vs total non-Indigenous (n=3,790)

Figure 4: Aboriginal and Torres Strait Islander status and age category

Table 7: Median patient age by gender and Aboriginal and Torres Strait Islander status

	Male years	Female years	ALL years
Aboriginal and Torres Strait Islander	54	49	51
Non Aboriginal and Torres Strait Islander	69	68	69
Total	**65**	**59**	**63**

* Australian Bureau of Statistics. (2021). *Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians*. ABS. https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/census-population-and-housing-counts-aboriginal-and-torres-strait-islander-australians/latest-release (viewed October 2024)

Patients who reside in the Cairns and Hinterland HHS account for the largest proportion (22%) of patients seen. This is followed closely by the Torres and Cape HHS (20%) and Darling Downs (15%). A small proportion of patients had an interstate residential address at the time of their encounter (1%).

It should be noted that some patients may temporarily reside in one HHS while their usual address is elsewhere. For the purpose of this analysis, the usual address is presented.

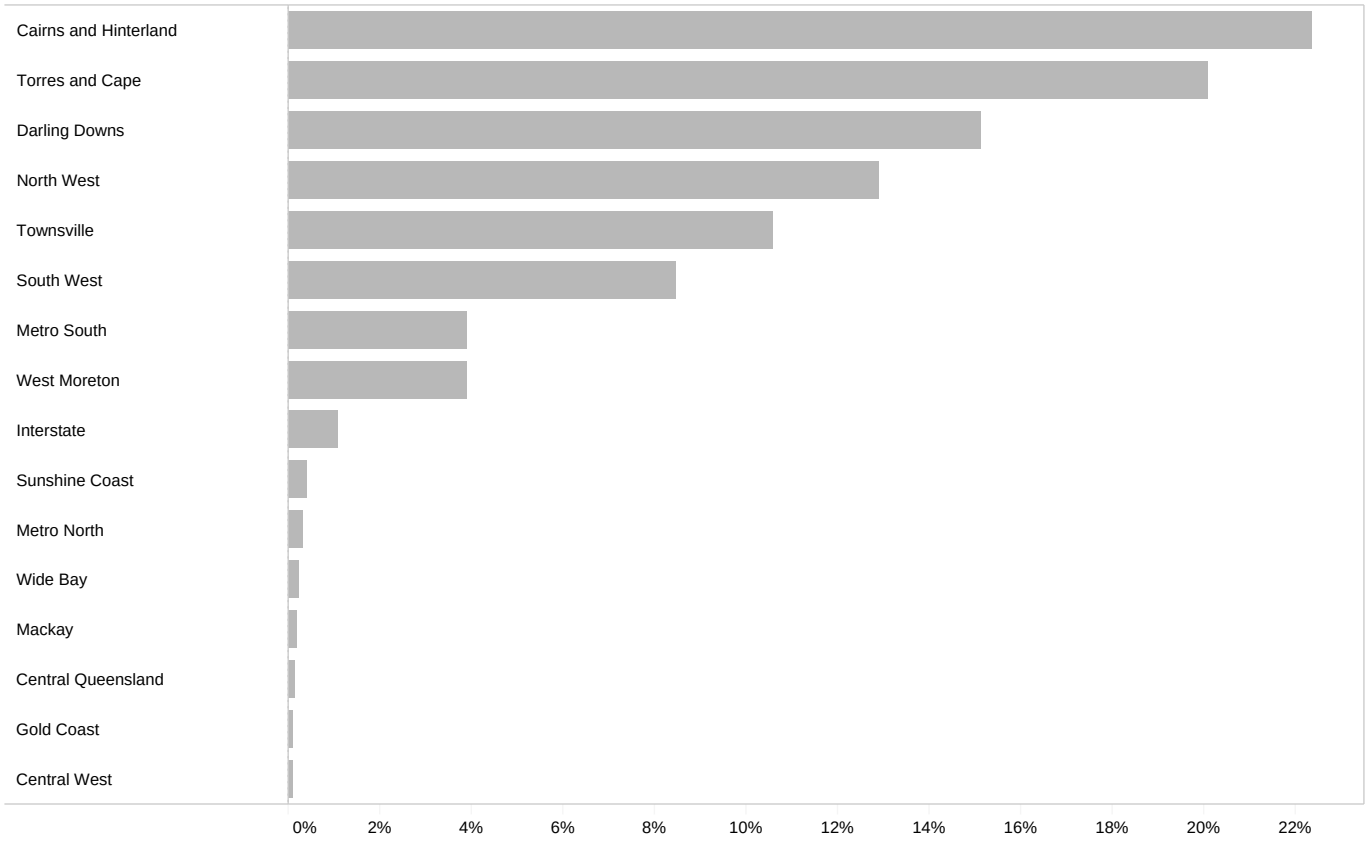


Figure 5: Proportion of patients seen by HHS of usual residence

Of the 8,073 total consults delivered by NCS outreach units, 30% of these consults were new encounters, which represents a large volume of clinical work and attention to establish patient rapport, assess often complex medical history, and formulate a plan of treatment and management. The proportion of new patients has decreased over time, from 45% in 2020 to 34% in 2023, indicating a growing cohort of patients receiving ongoing review and management provided by NCS.

Table 8: Number and proportion of new and review consults

Consult type	n (%)
New	2,447 (30.3)
Review	5,626 (69.7)
ALL	**8,073 (100.0)**

NCS outreach services are flexible and look to add value where opportunity presents. Opportunistic specialist review of inpatients while treating teams are in regional facilities allows for expert clinical treatment and efficient facilitation of treatment and escalation for transfer where appropriate. NCS teams are also instrumental in the organisation and provision of telehealth consultations which are performed both in clinic and in other non-clinic locations such as GP practices and other healthcare facilities.

Table 9: Number and proportion of in person and telehealth consults by clinic mode

Delivery mode	Clinic n (%)	Non-clinic n (%)	ALL n (%)
In person	7,085 (87.8)	89 (1.1)	7,174 (88.9)
Telehealth	218 (2.7)	681 (8.4)	899 (11.1)
Total	**7,303 (90.5)**	**770 (9.5)**	**8,073 (100.0)**

The majority of patients seen resided less than 50 kilometres from their consult location (82%), demonstrating that cardiac outreach units are meeting their objective to provide care closer to home. A smaller proportion of patients (7%) still needed to travel more than 150 kilometres to access specialist care, which highlights the barriers to care and travel distances faced by Queenslanders living in regional and remote locations.

Table 10: Number and proportions of patients by driving distance to consult

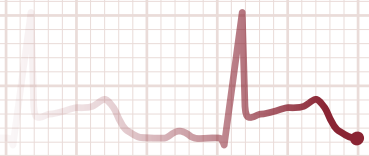
Driving distance – home to consult	n (%)
≤50 km	6,597 (81.7)
50–99 km	748 (9.3)
100–150 km	183 (2.3)
>150 km	537 (6.7)
Incomplete data	8 (0.1)
ALL	**8,073 (100.0)**

NCS offered large travel distance savings by enabling patients to attend clinics closer to home, at local spoke sites. These values are calculated based on the estimated driving distance between the patient's place of residence to the hub site compared to the patient's place of residence to the spoke site.

Table 11: Median patient travel distance avoided

Distance category	Median distance saved km
≤50 km	4
50–99 km	75
100–150 km	112
>150 km	657
Total	**216**

Interventional Cardiology Audit



1 Key findings

The Interventional Cardiology Audit describes key aspects of the care and treatment of cardiac patients receiving percutaneous coronary interventions (PCI) during 2024.

Key findings include:

- 15,138 diagnostic coronary or interventional cases were performed across the ten cardiac catheterisation laboratory (CCL) facilities in Queensland public hospitals, including 5,174 PCI cases.
- 76% of all PCI patients residing in Queensland had a place of residence within 50 km of the nearest public PCI capable facility, while 13% of patients resided more than 150 km from the nearest facility.
- A large proportion of PCI patients (77%) were classed as having an unhealthy body mass index (BMI) over 25 kg/m^2.
- The proportion of patients identified as Aboriginal and Torres Strait Islander (7.4%) illustrates a stepwise gradient based on geographical area, with the highest proportions found in the north of the state.
- The median age of Aboriginal and Torres Strait Islander patients was ten years younger than non Aboriginal and Torres Strait Islander patients (56 years vs 66 years).
- The majority of PCI cases (80%) were classed as urgent, emergent or salvage, highlighting the acute and often unstable patient cohort.
- There were 1,665 PCI cases following presentation with ST elevation myocardial infarction (STEMI), of which 59% were managed by primary PCI.
- There was a total of 455 thrombolysed STEMI presentations, for whom the median time from first diagnostic electrocardiograph (ECG) to the administration of thrombolysis was 38 minutes. The median time from thrombolysis to coronary angiography was 15 hours, with 67% of cases receiving angiography within 24 hours.
- Median time to reperfusion from first diagnostic ECG for STEMI patients presenting within six hours of symptom onset was 85 minutes (range 72 minutes to 89 minutes across sites).
- Median hospital door-to-device time for STEMI patients presenting within six hours of symptom onset was 40 minutes (range 36 minutes to 50 minutes across sites).
- PCI for non-ST elevation myocardial infarction (NSTEMI) represented 30% of all cases, with the median time to angiography of 47 hours. Patients presenting to a non PCI capable facility have a median wait time to coronary angiography of 31 hours longer than those who present directly to a PCI capable facility (66 hours vs 35 hours).
- Mortality within 30 days following PCI was 2.4% (122 deaths). Of these 122 deaths, 79% were classed as either salvage or emergency PCI.
- Of all cases, 0.54% recorded a major intra-procedural complication. Coronary artery perforation (0.39%) accounted for the majority of these events.
- Radiation doses were found to be under the high dose threshold in 99.0% of PCI cases across all sites and ›99.9% of other coronary procedures.

2 Participating sites

There were ten public hospitals which offered CCL services across metropolitan and regional Queensland.

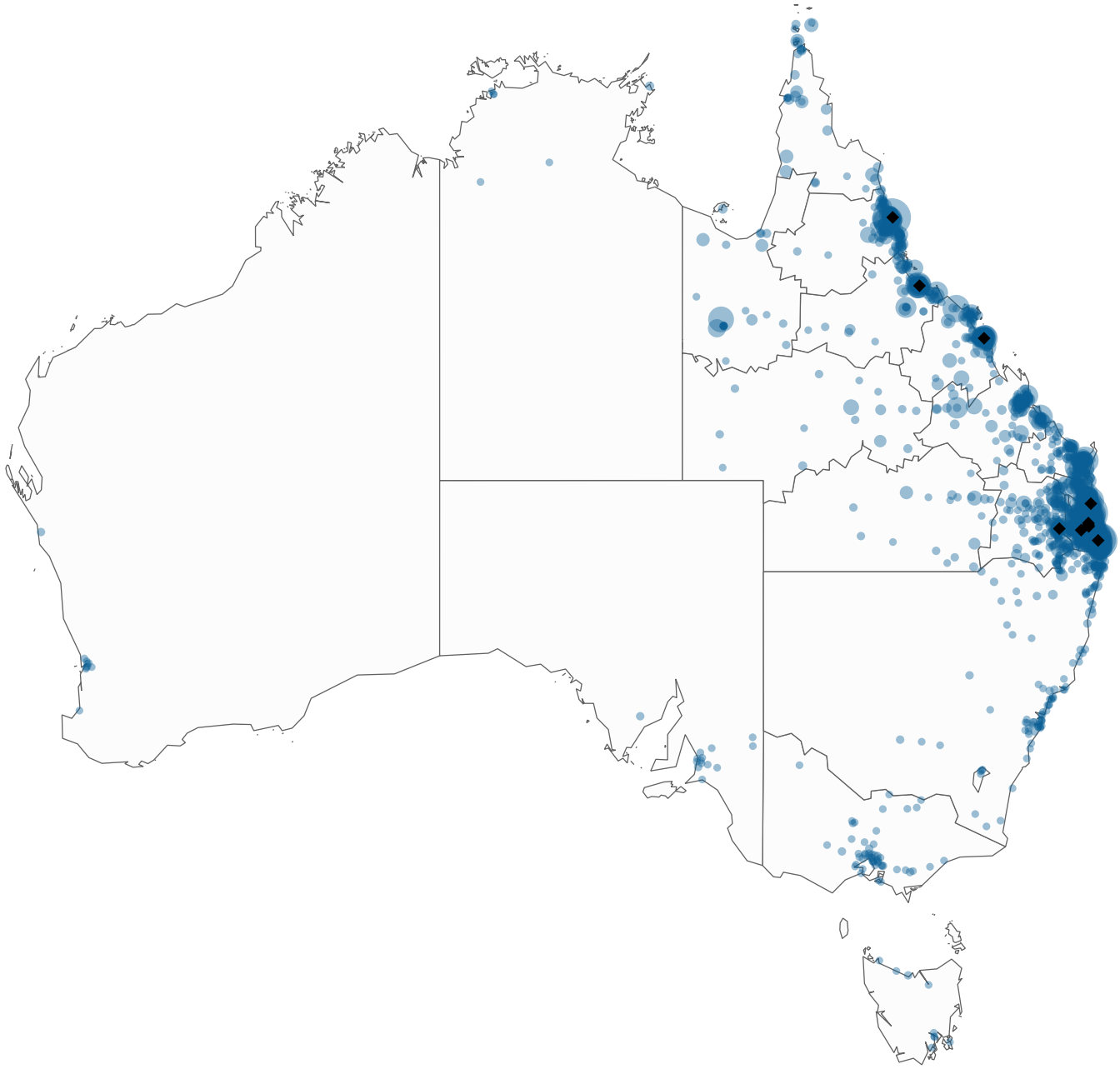
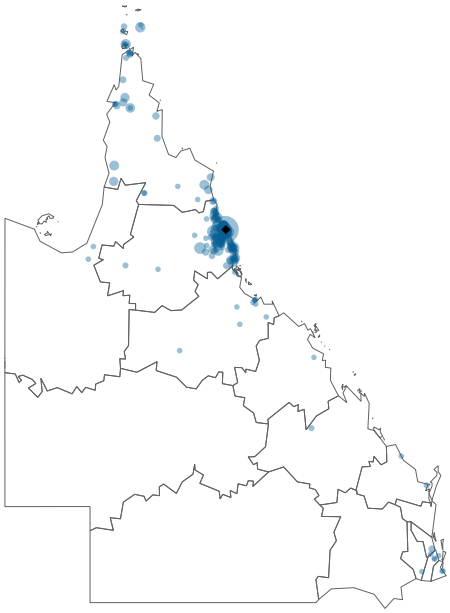


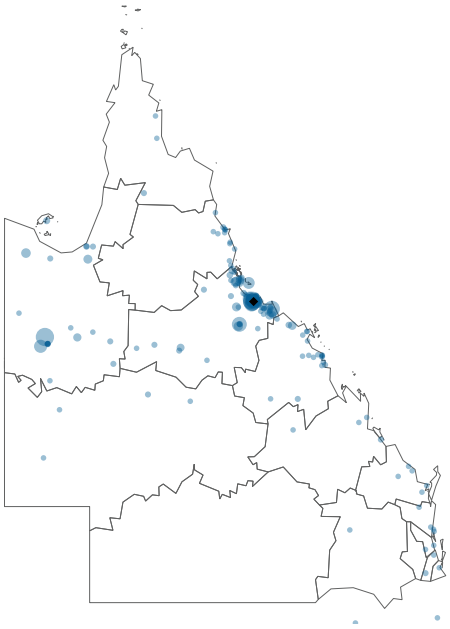
Figure 1: Statewide PCI and coronary cases by patient place of usual residence (by residential postcode)

Table 1: Participating sites

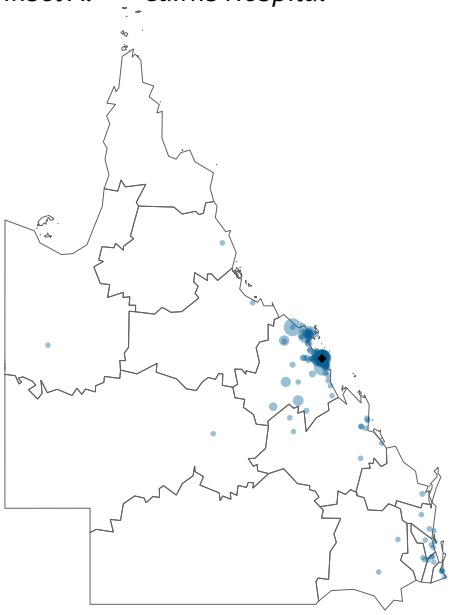
Acronym	Site name
CH	Cairns Hospital
TUH	Townsville University Hospital
MBH	Mackay Base Hospital
SCUH	Sunshine Coast University Hospital
TPCH	The Prince Charles Hospital
RBWH	Royal Brisbane & Women's Hospital
PAH	Princess Alexandra Hospital
IPH	Ipswich Hospital
TWH	Toowoomba Hospital
GCUH	Gold Coast University Hospital



Inset A: Cairns Hospital

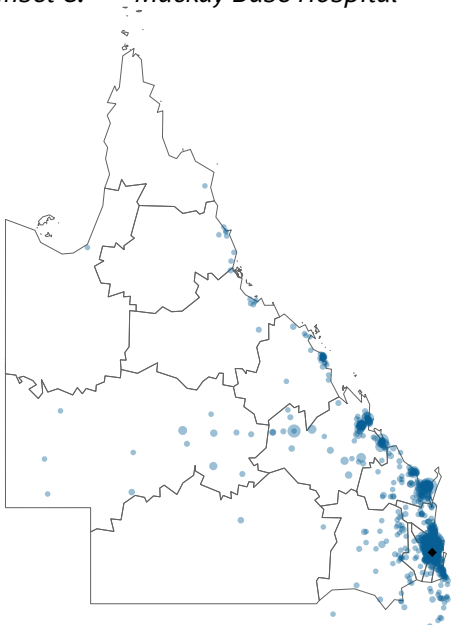


Inset B: Townsville University Hospital

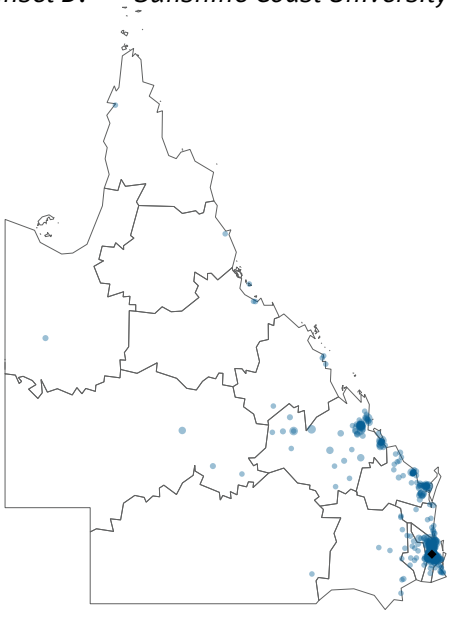


Inset C: Mackay Base Hospital

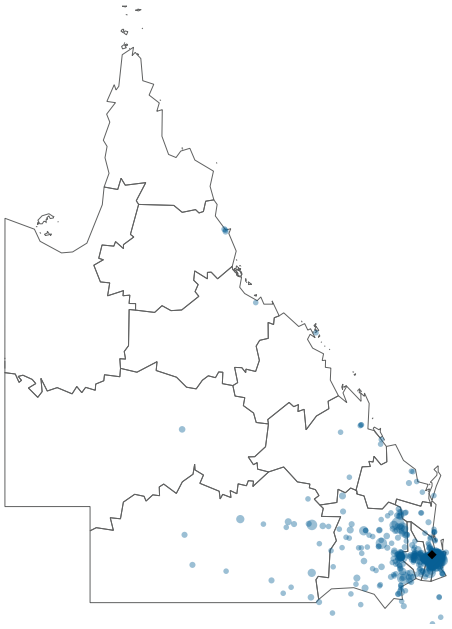
Inset D: Sunshine Coast University Hospital



Inset E: The Prince Charles Hospital



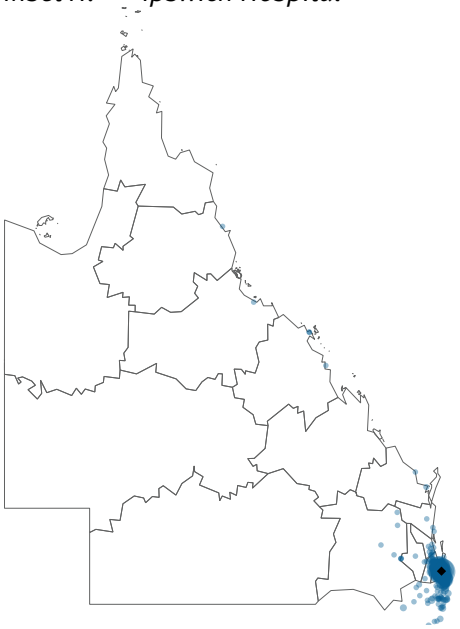
Inset F: Royal Brisbane & Women's Hospital



Inset G: Princess Alexandra Hospital

Inset H: Ipswich Hospital

Inset I: Toowoomba Hospital



Inset J: Gold Coast University Hospital

3 Total coronary cases

A total of 15,138 coronary cases were performed across the ten contributing cardiac catheterisation sites, with 5,174 patients (34%) undergoing a percutaneous coronary intervention (PCI). These patients form the cohort at the centre of this Audit.

Since the focus of this report is a specialised subset of invasive cardiology cases performed in the CCL, non coronary procedures such as right heart catheterisation, right ventricular cardiac biopsy and peripheral intervention cases are excluded from analysis.

In addition, detail for 853 structural heart disease interventions including percutaneous valve replacement, valvuloplasty and device closure procedures is included as a supplement to this Audit. Furthermore, Queensland electrophysiology and pacing procedure activity is included in a separate Audit within the QCOR Annual Report.

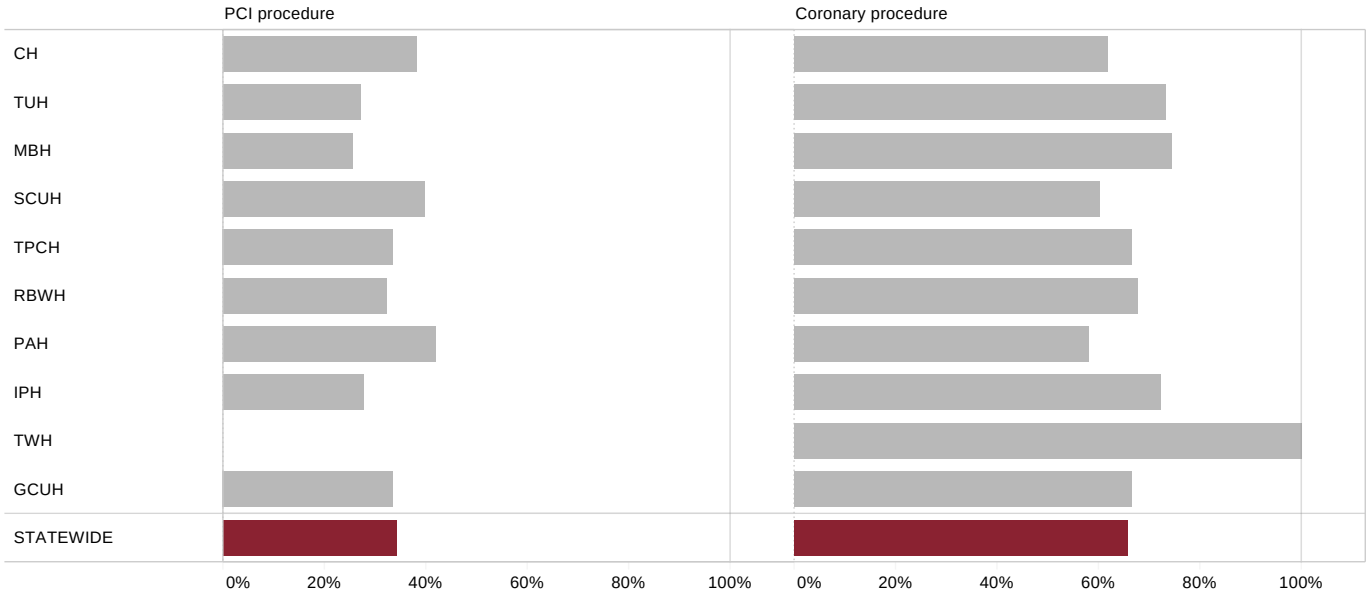


Figure 2: Proportion of cases by procedure category

Table 2: Total cases by procedure category

Site	PCI procedure* n (%)	Other coronary procedure† n (%)	Total coronary cases n
CH	506 (38.2)	819 (61.8)	1,325
TUH	298 (27.0)	806 (73.0)	1,104
MBH	214 (25.6)	622 (74.4)	836
SCUH	497 (39.6)	757 (60.4)	1,254
TPCH	1,279 (33.5)	2,544 (66.5)	3,823
RBWH	415 (32.3)	868 (67.7)	1,283
PAH	1,075 (41.9)	1,488 (58.1)	2,563
IPH	150 (27.8)	390 (72.2)	540
TWH	–	200 (100.0)	200
GCUH	740 (33.5)	1,470 (66.5)	2,210
STATEWIDE	**5,174 (34.2)**	**9,964 (65.8)**	**15,138**

* Includes balloon angioplasty, coronary stenting, PTCRA/atherectomy, coronary lithotripsy and thrombectomy of coronary arteries

† Includes coronary angiography, aortogram, coronary artery bypass graft study, left ventriculography, left heart catheterisation, coronary fistula embolisation, intravascular ultrasound, optical coherence tomography, and pressure derived indices for assessing coronary artery stenosis

3.1 Total cases by clinical presentation

Within the larger cohort, the most common presentation category was of NSTEMI, while STEMI cases represented 13% of all cases, and 32% of all PCI cases.

The most common clinical presentation across all cases was acute coronary syndrome (ACS), which accounted for over one-third of all cases (35%). The majority of PCI procedures undertaken were categorised as either STEMI or NSTEMI (62%).

Clinical presentation is derived from the procedural indication and reflects the diagnosis made with respect to the findings of the investigation/procedure. It must be acknowledged that there is some degree of variation in practice across sites which is a focus for future work.

Table 3: Total coronary cases by clinical presentation category

Site	STEMI n (%)	NSTEMI n (%)	Other n (%)
CH	171 (12.9)	298 (22.5)	856 (64.6)
TUH	127 (11.5)	229 (20.7)	748 (67.8)
MBH	75 (9.0)	162 (19.4)	599 (71.7)
SCUH	238 (19.0)	274 (21.9)	742 (59.2)
TPCH	434 (11.4)	768 (20.1)	2,621 (68.6)
RBWH	132 (10.3)	337 (26.3)	814 (63.4)
PAH	525 (20.5)	704 (27.5)	1,334 (52.0)
IPH	8 (1.5)	149 (27.6)	384 (70.9)
TWH	–	37 (18.5)	163 (81.5)
GCUH	322 (14.6)	354 (16.0)	1,534 (69.4)
STATEWIDE	**2,032 (13.4)**	**3,312 (21.9)**	**9,794 (64.7)**

Table 4: PCI cases by clinical presentation category

Site	STEMI n (%)	NSTEMI n (%)	Other n (%)
CH	146 (28.9)	157 (31.0)	203 (40.1)
TUH	102 (34.2)	97 (32.6)	99 (33.2)
MBH	65 (30.4)	63 (29.4)	86 (40.2)
SCUH	192 (38.6)	119 (23.9)	186 (37.4)
TPCH	354 (27.7)	360 (28.1)	565 (44.2)
RBWH	106 (25.5)	159 (38.3)	150 (36.1)
PAH	415 (38.6)	349 (32.5)	311 (28.9)
IPH	8 (5.3)	71 (47.3)	71 (47.3)
GCUH	277 (37.4)	163 (22.0)	300 (40.5)
STATEWIDE	**1,665 (32.2)**	**1,538 (29.7)**	**1,971 (38.1)**

3.2 Place of residence

The vast majority of PCI patients (95%) had a usual place of residence within Queensland, with a smaller proportion originating from interstate (4%) and overseas (1%). For the Gold Coast University Hospital, 17% of cases originated from outside of Queensland.

Patients came from a wide geographical area with a large proportion of patients residing on the Eastern Seaboard. Almost three-quarters (71%) of all patients were seen inside their local Hospital and Health Service (HHS). Of those patients residing in Queensland, the majority (76%) had a usual place of residence within 50 kilometres of the nearest public PCI facility. While this proportion is high, it must be acknowledged that access to PCI services for a large number of Queenslanders involves considerable distance and travel.

Table 5: PCI cases by place of usual residence category

Site	Queensland %	Within HHS %	Interstate %	Overseas %
CH	97.0	83.5	1.4	1.6
TUH	94.2	75.3	4.1	1.7
MBH	97.2	88.7	2.8	0.0
SCUH	98.0	89.3	1.6	0.4
TPCH	97.4	63.9	2.3	0.2
RBWH	95.6	50.1	2.7	1.7
PAH	97.0	62.6	1.4	1.6
IPH	98.7	79.2	0.7	0.7
GCUH	83.2	79.5	14.7	2.2
STATEWIDE	**95.0**	**71.2**	**3.8**	**1.1**

Excludes missing data (0.4%)

Table 6: Queensland PCI cases by distance from usual place of residence to nearest public PCI facility

Site	<50 km n (%)	50–150 km n (%)	>150 km n (%)
CH	317 (64.8)	113 (23.1)	59 (12.1)
TUH	179 (64.4)	58 (20.9)	41 (14.7)
MBH	133 (65.5)	27 (13.3)	43 (21.2)
SCUH	370 (77.2)	101 (21.1)	8 (1.7)
TPCH	901 (72.5)	68 (5.5)	274 (22.0)
RBWH	258 (65.3)	13 (3.3)	124 (31.4)
PAH	836 (80.8)	133 (12.9)	66 (6.4)
IPH	120 (82.2)	21 (14.4)	5 (3.4)
GCUH	607 (99.3)	3 (0.5)	1 (0.2)
STATEWIDE	**3,721 (76.3)**	**537 (11.0)**	**621 (12.7)**

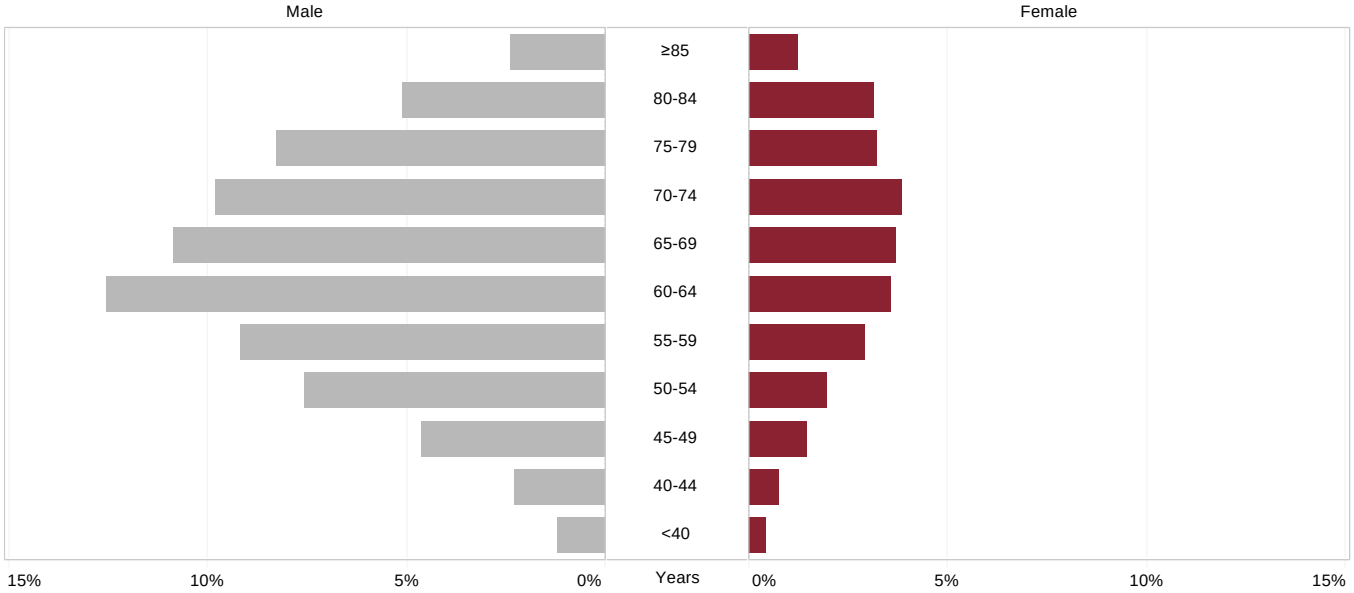
Excludes missing data (0.4%)

4 Patient characteristics

4.1 Age and gender

Age is a well described risk factor in the development of cardiovascular disease. The median age of patients undergoing PCI was 65 years of age and ranged from 62 years to 68 years across sites.

The majority of patients were male (74%), which reflects the increased risk of cardiovascular disease by gender. The median age for females was also higher than for males (67 years vs 64 years).



% of total PCI (n=5,174)

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

Table 7: Median PCI patient age by gender and site

Site	Male years	Female years	ALL years
CH	64	66	65
TUH	63	60	62
MBH	63	68	64
SCUH	67	70	68
TPCH	66	70	67
RBWH	64	69	65
PAH	62	67	63
IPH	62	59	62
GCUH	66	67	66
STATEWIDE	**64**	**67**	**65**

4.2 Body mass index

Patients across all sites displayed similar trends for BMI, with approximately one fifth of patients (22%) in the normal BMI range and 37%, 35% and 5% classified as overweight, obese and morbidly obese respectively. There were 1% of cases classified as underweight (BMI ‹18.5 kg/m²).

Excludes missing/invalid data (0.3%)

* 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 4: Proportion of all PCI cases by body mass index category

Table 8: All PCI cases by body mass index category

Site	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
CH	16 (3.2)	137 (27.3)	176 (35.1)	152 (30.3)	21 (4.2)
TUH	2 (0.7)	63 (21.2)	92 (31.0)	118 (39.7)	22 (7.4)
MBH	5 (2.3)	42 (19.7)	73 (34.3)	80 (37.6)	13 (6.1)
SCUH	2 (0.4)	131 (26.5)	199 (40.3)	146 (29.6)	16 (3.2)
TPCH	16 (1.3)	249 (19.5)	453 (35.4)	487 (38.1)	74 (5.8)
RBWH	3 (0.7)	81 (19.6)	154 (37.2)	152 (36.7)	24 (5.8)
PAH	10 (0.9)	214 (20.0)	400 (37.3)	373 (35.3)	74 (6.9)
IPH	–	29 (19.3)	56 (37.3)	53 (35.3)	12 (8.0)
GCUH	6 (0.8)	173 (23.4)	297 (40.2)	239 (32.3)	24 (3.2)
STATEWIDE	**60 (1.2)**	**1,119 (21.7)**	**1,900 (36.8)**	**1,800 (34.9)**	**280 (5.4)**

Excludes missing data (0.3%)

4.3 Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of health with a particular impact on the development of cardiovascular disease. It is recognised that the Aboriginal and Torres Strait Islander people experience high levels of health inequality resulting in a higher incidence and prevalence of coronary artery disease.[1]

Despite accounting for only 4.6% of the Queensland population[2], Aboriginal and Torres Strait Islander patients are overrepresented in the PCI cohort across all sites (7.4%).

The increased proportion of identified Aboriginal and Torres Strait Islander patients undergoing PCI in the northern HHSs (CH, 24% and TUH, 20%) is reflective of the resident population within these areas and should be noted for service provision and planning. Elevated proportions of Aboriginal and Torres Strait Islander patients were also observed at three other sites.

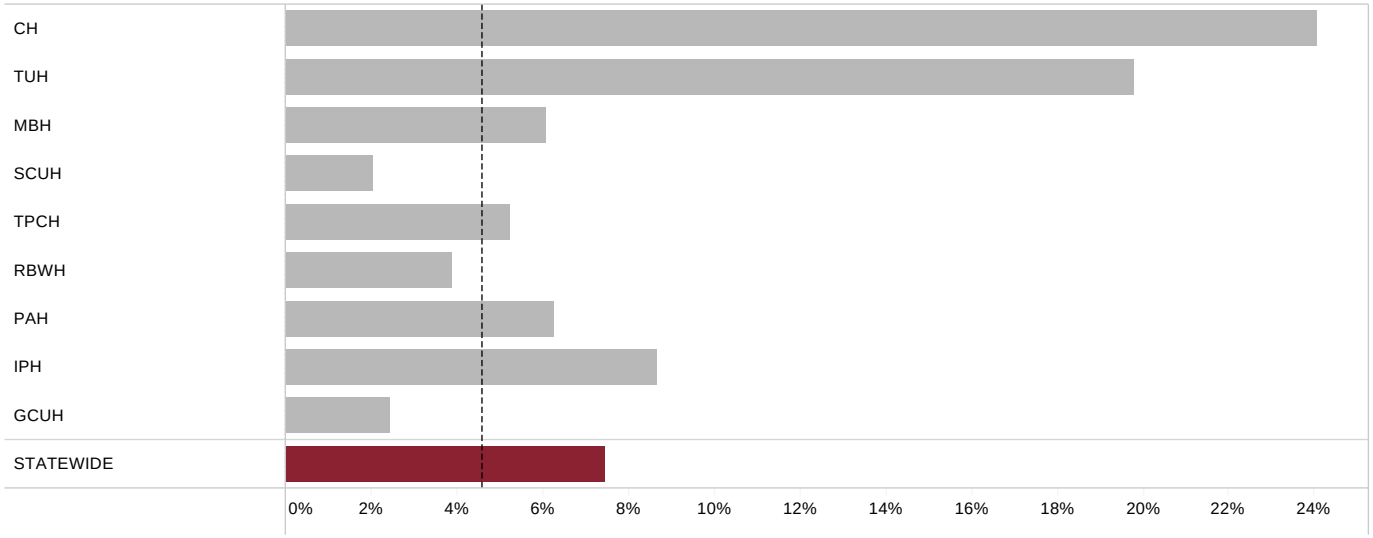


Figure 5: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

The median age of Aboriginal and Torres Strait Islander patients undergoing PCI was lower than that of non Aboriginal and Torres Strait Islander patients (56 years vs 66 years).

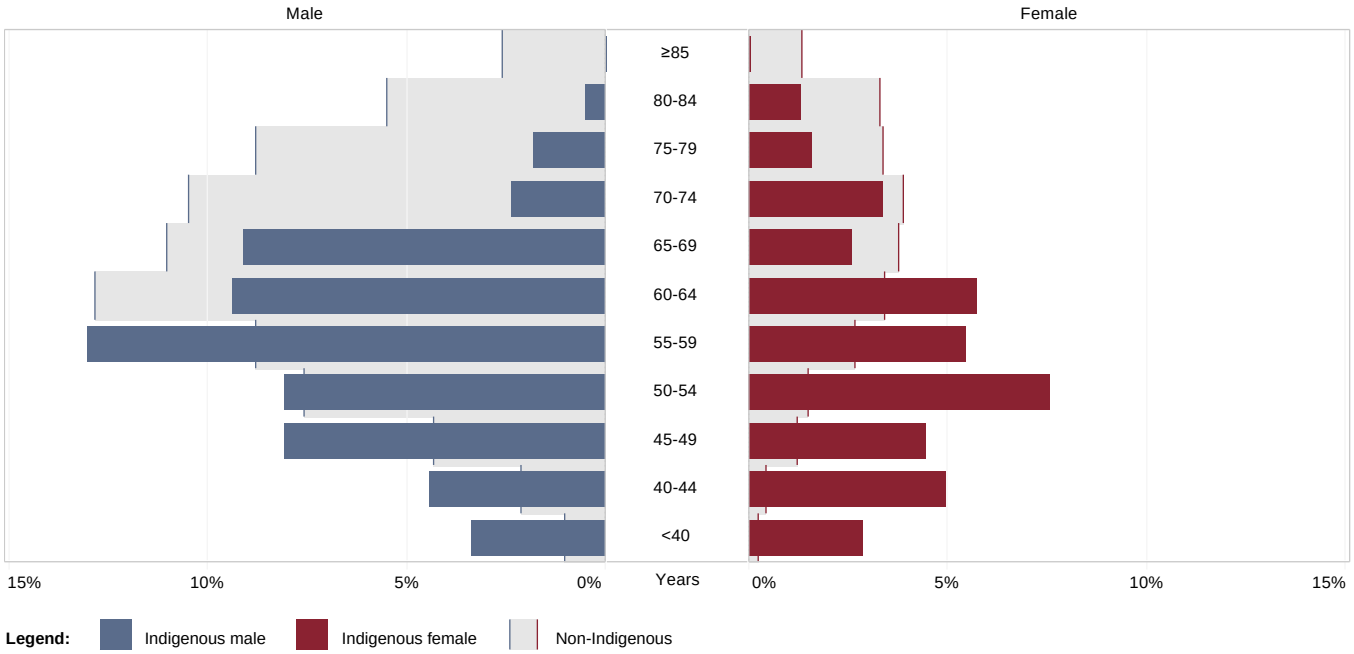


Figure 6: Proportion of all PCI cases by age group and Indigenous status

Table 9: PCI cases median patient age by gender and Indigenous status

	Male years	Female years	ALL years
Aboriginal and Torres Strait Islander	56	55	56
Non Aboriginal and Torres Strait Islander	65	69	66
Total	**64**	**67**	**65**

5 Care and treatment of PCI patients

5.1 Admission status

There were 5,174 PCI procedures performed in 2024 by nine of ten public CCL sites across Queensland. Patients are categorised by admission status, with elective, urgent and emergency categories defined according to the National Cardiovascular Data Registry (NCDR) as stated below.[3]

From 2020, a contemporary definition of the salvage status was developed by the QCOR Interventional Cardiology Committee in order to best describe this subset of acutely ill patients who presented to Queensland public CCL services.

This definition expands on the previous NCDR classification to include the subset of patients who did not fit the strict salvage inclusion criteria but were indeed on a trajectory for a poor clinical outcome regardless of intervention.

Table 10: Diagnostic coronary angiography status

Status	Definition
Elective	The procedure can be performed on an outpatient basis or during a subsequent hospitalisation without significant risk of infarction or death. For stable inpatients, the procedure is being performed during this hospitalisation for convenience and ease of scheduling and not because the patient's clinical situation demands the procedure prior to discharge.
Urgent	The procedure is being performed on an inpatient basis and prior to discharge because of significant concerns that there is risk of ischaemia, infarction and/or death. Patients who are outpatients or in the emergency department at the time the cardiac catheterisation is requested would warrant an admission based on their clinical presentation.
Emergency	The procedure is being performed as soon as possible because of substantial concerns that ongoing ischaemia and/or infarction could lead to death. "As soon as possible" refers to a patient who is of sufficient acuity that you would cancel a scheduled case to perform this procedure immediately in the next available room during business hours, or you would activate the on call team were this to occur during off hours.
Salvage	The procedure is performed on a critically unwell patient with a high risk of imminent death from either a cardiac or non-cardiac cause, and it is recognised that PCI may not change the outcome AND; The patient is in cardiogenic shock (SCAI Class C or greater[4]) when the PCI begins (i.e. at the time of the first guidewire or intracoronary device introduction into a coronary artery or bypass graft for the purpose of mechanical revascularisation) AND/OR; The patient has also received active cardiopulmonary resuscitation within the last ten minutes prior to the start of the case or during the diagnostic portion of the case, OR; The patient has been on unanticipated extracorporeal circulatory support (e.g. extracorporeal mechanical oxygenation) OR cardiopulmonary support that includes non elective intubation.

Urgent and emergent cases accounted for the majority (78%) of PCI cases, reflecting the acute and often complex case mix flowing to Queensland public hospitals.

Salvage cases varied between institutions, with these exceptional and highly complex clinical scenarios ranging from 1% to 4% of PCI volumes by site and accounted for 2% of all PCI cases.

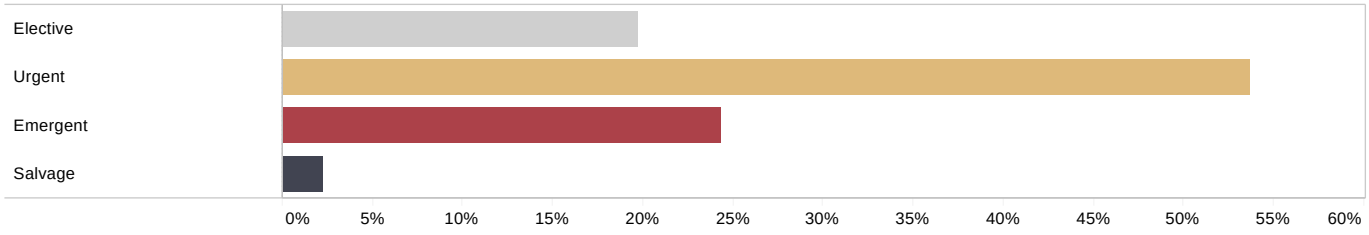


Figure 7: Proportion of all PCI cases by admission status

Table 11: PCI cases by site and admission status

Site	Elective n (%)	Urgent n (%)	Emergent n (%)	Salvage n (%)
CH	128 (25.3)	274 (54.2)	87 (17.2)	17 (3.4)
TUH	34 (11.4)	183 (61.4)	77 (25.8)	4 (1.3)
MBH	71 (33.2)	88 (41.1)	54 (25.2)	1 (0.5)
SCUH	91 (18.3)	255 (51.3)	142 (28.6)	9 (1.8)
TPCH	326 (25.5)	664 (51.9)	268 (21.0)	21 (1.6)
RBWH	49 (11.8)	270 (65.1)	82 (19.8)	14 (3.4)
PAH	119 (11.1)	650 (60.5)	283 (26.3)	23 (2.1)
IPH	47 (31.3)	99 (66.0)	4 (2.7)	–
GCUH	157 (21.2)	296 (40.0)	261 (35.3)	26 (3.5)
STATEWIDE	**1,022 (19.8)**	**2,779 (53.7)**	**1,258 (24.3)**	**115 (2.2)**

Same-day discharge (SDD) following elective PCI has evolved over the past two decades, reflecting advancements in procedural safety, optimised patient selection, and known benefits to healthcare efficiency. Historically, PCI was considered an inpatient procedure due to concerns about acute ischaemic complications, such as abrupt vessel closure and vascular access management. However, improvements in stent technology, radial access techniques, and adjunctive pharmacotherapy have substantially reduced these risks, allowing SDD to become a viable option for selected patients.[5]

Contemporary clinical practice emphasises careful patient selection for SDD, with eligibility parameters that may vary site-to-site based on local facility protocols. Ideal candidates are those undergoing elective, non-urgent PCI with uncomplicated procedures and adequate social support. Radial access is preferred due to its lower bleeding risk, and procedures are typically scheduled early in the day to allow for sufficient post-procedure monitoring. Post-procedural protocols include vascular access site monitoring, clinical observation for 4–6 hours, medication reconciliation (especially P2Y12 inhibitors), and clear discharge instructions including emergency contact information.[6,7]

Clinical safety of SDD has been extensively studied. A 2025 meta-analysis of 14 randomised controlled trials involving over 3,200 patients found no significant difference in major adverse cardiovascular events, bleeding, vascular complications, or rehospitalisation between SDD and overnight stay groups.[8]

The advantages of SDD are multifaceted. From a patient perspective, it offers greater satisfaction, reduced exposure to hospital-acquired infections, and a more comfortable recovery environment. For healthcare systems, SDD improves bed availability, streamlines patient flow, and significantly reduces costs. Estimates suggest that if 50% of elective PCI patients in the United States were discharged the same day, annual savings could range from US$200 million to US$500 million.[6] In Queensland, Australia, a study using QCOR data found that SDD reduced a hospital stay by 18 hours and saved an average of A$3,695 per patient.[9]

Guidelines and expert consensus statements have reinforced the value of SDD. The 2021 American College of Cardiology Expert Consensus Decision Pathway provides a structured checklist for implementing SDD safely, considering clinical, social, and procedural factors.[6]

In Queensland public PCI facilities, the uptake of SDD has shown slight growth over the past 4 years. Elective PCI in Queensland public facilities often accounts for approximately 20% of all PCI cases undertaken, resulting in a modest proportionate cohort size. In 2024, of the 1,009 elective PCIs eligible for analysis, 14% were SDD. Compared to 2021, where SDD rates were 11%, this upward trend is encouraging while also demonstrating a potential area of focus for improvement.

Table 12: Rates of same day discharge for Queensland public PCI facilities, 2021–2024

	2021	2022	2023	2024
Total PCI, n	4,894	4,818	5,145	5,174
Eligible elective PCI*, n	1,033	966	1,068	1,009
Same day discharge, n (%)	115 (11.1)	127 (13.1)	102 (9.6)	137 (13.6)

* Discharged to place of usual residence

5.2 Stent usage

The majority of PCI cases (89%) involved the deployment of one or more stents, which ranged from 79% to 94% of PCI cases between centres. The mean number of stents deployed for each case was 1.49.

Table 13: Mean number of stents used for PCI cases by site

Site	Total stenting cases n	Proportion of PCI cases %	Mean stents per case n
CH	434	85.8	1.40
TUH	235	78.9	1.37
MBH	188	87.9	1.28
SCUH	455	91.5	1.53
TPCH	1,106	86.5	1.52
RBWH	382	92.0	1.48
PAH	981	91.3	1.62
IPH	141	94.0	1.52
GCUH	660	89.2	1.37
STATEWIDE	**4,582**	**88.6**	**1.49**

5.3 Access route

The majority of PCI cases (96%) used a single access route, with 84% being via the radial approach and 22% femoral. Another access route including brachial or ulnar was utilised in less than 1% of cases. The use of the radial approach varied between different PCI centres (78% to 95%).

Table 14: PCI access route by site

Site	Total PCI cases n	Radial approach %	Femoral approach %	Other approach %
CH	506	80.8	22.5	0.2
TUH	298	80.2	27.5	0.3
MBH	214	90.2	13.1	0.5
SCUH	497	95.0	7.0	1.0
TPCH	1,279	83.9	23.1	0.9
RBWH	415	88.4	16.4	0.5
PAH	1,075	77.5	30.9	0.3
IPH	150	91.3	8.0	0.0
GCUH	740	84.6	21.4	0.0
STATEWIDE	**5,174**	**84.1**	**21.7**	**0.5**

Totals >100% due to multiple access sites

Table 15: PCI total access routes by site

Site	Single approach %	Multiple approaches %
CH	96.4	3.6
TUH	91.9	8.1
MBH	96.3	3.7
SCUH	97.2	2.8
TPCH	92.0	8.0
RBWH	94.7	5.3
PAH	91.3	8.7
IPH	99.3	0.7
GCUH	94.1	5.9
STATEWIDE	**93.7**	**6.3**

There was no variation observed between access routes in the overall PCI cohort and the STEMI presenting within six hours of symptom onset cohort (22% vs 22% femoral approach respectively).

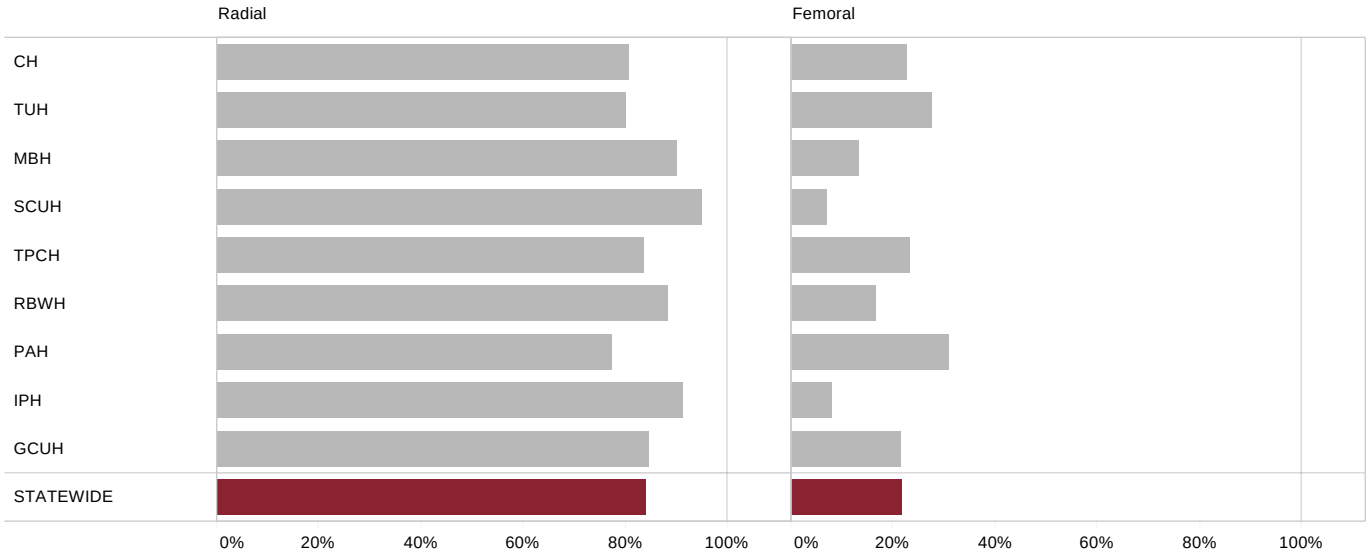


Figure 8: Proportion of PCI cases using radial and femoral access routes by site

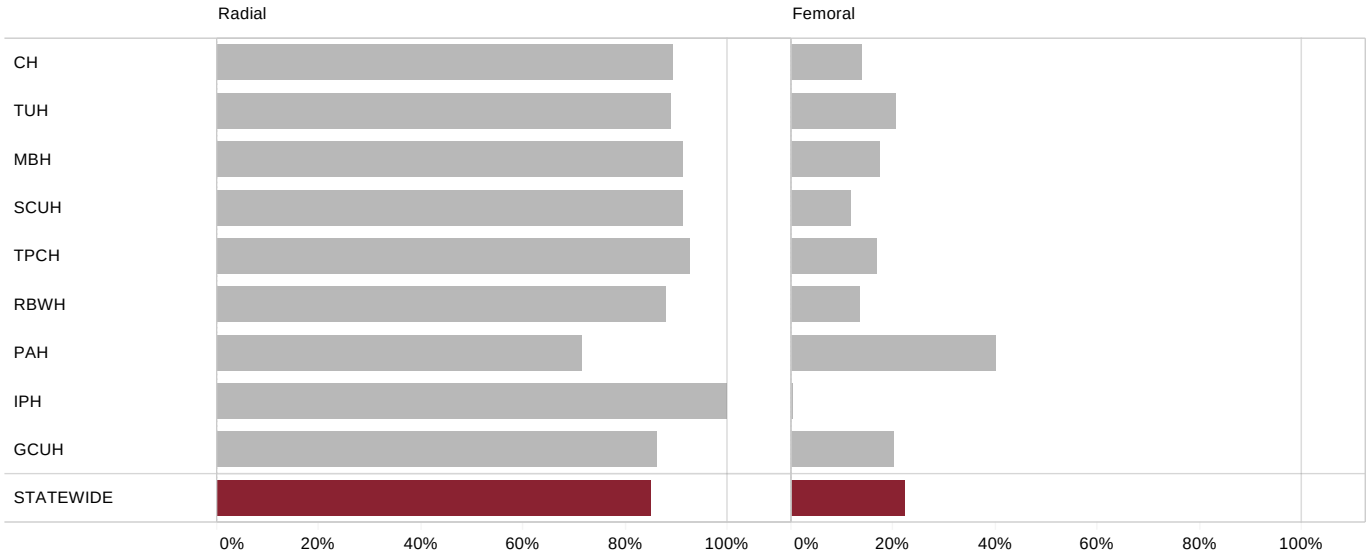


Figure 9: Proportion of STEMI presenting within six hours PCI cases using radial and femoral access routes by site

5.4 Vessels treated

The vast majority of vessels treated were native vessels with coronary bypass graft PCI accounting for 2% of interventions.

Of the vessels treated, 48% of cases involved the left anterior descending coronary artery (LAD), followed by the right coronary artery (RCA) at 36%, the circumflex coronary artery (LCx) at 26% and the left main coronary artery (LMCA) at 5%.

Multi-vessel PCI to native coronary arteries was performed in 13% of cases.

Table 16: Grafts and vessels treated by site

Site	LAD %	LMCA %	LCx %	RCA %	Graft %
CH	47.4	3.6	25.9	31.6	2.6
TUH	46.6	3.4	24.2	31.9	3.0
MBH	40.7	0.9	26.6	36.4	1.4
SCUH	45.3	6.0	25.6	36.2	1.4
TPCH	52.1	6.3	24.7	38.6	3.3
RBWH	42.7	4.6	23.1	37.3	2.2
PAH	47.7	6.0	27.8	36.9	1.5
IPH	48.0	2.0	27.3	29.3	0.7
GCUH	45.8	2.4	25.9	35.4	2.4
STATEWIDE	**47.5**	**4.7**	**25.7**	**36.0**	**2.3**

Table 17: Total native vessels treated by site

Site	Single vessel n (%)	Two vessels n (%)	Three or more vessels n (%)
CH	444 (90.1)	42 (8.5)	7 (1.4)
TUH	266 (92.0)	19 (6.6)	4 (1.4)
MBH	199 (94.3)	11 (5.2)	1 (0.5)
SCUH	429 (87.6)	52 (10.6)	9 (1.8)
TPCH	993 (80.3)	190 (15.4)	53 (4.3)
RBWH	366 (90.1)	40 (9.9)	–
PAH	895 (84.5)	123 (11.6)	41 (3.9)
IPH	139 (93.3)	9 (6.0)	1 (0.7)
GCUH	639 (88.6)	74 (10.3)	8 (1.1)
STATEWIDE	**4,370 (86.5)**	**560 (11.1)**	**124 (2.5)**

Excludes any graft PCI (n=118)

Table 18: Grafts treated by site

Site	Graft only n (%)	Graft and native vessel/s n (%)
CH	13 (100.0)	–
TUH	9 (100.0)	–
MBH	3 (100.0)	–
SCUH	5 (71.4)	2 (28.6)
TPCH	31 (73.8)	11 (26.2)
RBWH	8 (88.9)	1 (11.1)
PAH	12 (75.0)	4 (25.0)
IPH	1 (100.0)	–
GCUH	18 (100.0)	–
STATEWIDE	**100 (84.7)**	**18 (15.3)**

5.5 Adjunctive procedures

The use of ancillary intracoronary imaging technologies and physiological assessment of coronary lesions in routine clinical practice is increasing as these technologies are adopted and the evidence base for use grows. Of the 5,174 PCI cases in 2024, intravascular ultrasound (IVUS) was utilised during 16% of interventions with flow and pressure derived indices used in 5% of PCI cases. Optical coherence tomography (OCT) was utilised in 3% of interventions. The figures reported below do not include the use of these adjunctive techniques undertaken in diagnostic coronary procedures.

Rotational atherectomy (PTCRA) was utilised in 5% of PCI procedures and intracoronary lithotripsy (IVL) was used in 2%. Intra-aortic balloon pumps (IABP) for support of haemodynamically unstable patients were inserted in approximately 2% of interventions.

Table 19: Proportion of PCI cases by adjunctive procedure utilisation

Site	IVUS* %	Coronary physiology assessment† %	PTCRA‡ %	OCT§ %	IABP‖ %	IVL# %
CH	8.9	5.1	4.7	2.0	0.6	–
TUH	16.4	7.4	3.0	0.7	0.3	2.0
MBH	13.1	3.7	0.5	0.5	0.9	3.3
SCUH	31.6	2.8	3.2	2.6	0.6	3.2
TPCH	35.0	7.5	7.3	1.2	2.7	1.0
RBWH	2.7	2.9	8.2	5.8	3.9	1.4
PAH	4.1	3.9	6.9	6.7	2.3	2.7
IPH	21.3	4.7	–	–	–	–
GCUH	3.8	3.1	1.2	0.8	0.7	2.2
STATEWIDE	**16.3**	**4.8**	**5.0**	**2.8**	**1.7**	**1.8**

* Intravascular ultrasound

† Includes fractional flow reserve, instantaneous wave-free ratio, diastolic hyperaemia-free ratio, resting full-cycle ratio

‡ Percutaneous transluminal coronary rotational atherectomy

§ Optical coherence tomography

‖ Intra-aortic balloon pump

\# Intra-coronary lithotripsy

5.6 PCI following presentation with STEMI

Acute STEMI is a recognised medical emergency in which time to treatment is critical to both short- and long-term patient outcomes. PCI capable hospitals have therefore developed rapid triage and transfer strategies to fast-track STEMI patients into the CCL for rapid mechanical revascularisation (primary PCI).

Choice of reperfusion method depends on many factors including the timeliness of treatment, individual patient characteristics and access to interventional facilities. Given the time-critical nature of this condition, ongoing improvement and review of hospital and pre-hospital processes is vital to meet the recommended timeframes for reperfusion in STEMI patients.

It is important to recognise there remains a group of STEMI patients who do not present to hospital or are conservatively managed, however this element of care is outside the scope of this procedure-based registry.

5.6.1 Clinical presentation

There were 1,665 documented STEMI PCI cases, with over half (59%) presenting as primary PCI cases and 12% presenting after 12 hours (late presenters).

Less than one fifth (15%) of patients had received successful thrombolysis (lysis) prior to invasive coronary revascularisation while 5% required rescue PCI following unsuccessful thrombolysis.

Table 20: Proportion of STEMI PCI cases by presentation

Site	Transient STEMI n (%)	STEMI <6 hours n (%)	STEMI 6–12 hours n (%)	Late presentation n (%)	Post successful thrombolysis n (%)	Rescue PCI (failed thrombolysis) n (%)
CH	15 (10.3)	65 (44.5)	7 (4.8)	13 (8.9)	40 (27.4)	6 (4.1)
TUH	8 (7.8)	54 (52.9)	2 (2.0)	11 (10.8)	24 (23.5)	3 (2.9)
MBH	3 (4.6)	23 (35.4)	5 (7.7)	17 (26.2)	8 (12.3)	9 (13.8)
SCUH	22 (11.5)	94 (49.0)	9 (4.7)	20 (10.4)	30 (15.6)	17 (8.9)
TPCH	20 (5.6)	174 (49.2)	32 (9.0)	58 (16.4)	60 (16.9)	10 (2.8)
RBWH	8 (7.5)	59 (55.7)	7 (6.6)	16 (15.1)	14 (13.2)	2 (1.9)
PAH	61 (14.7)	215 (51.8)	23 (5.5)	33 (8.0)	61 (14.7)	22 (5.3)
IPH	2 (25.0)	4 (50.0)	1 (12.5)	1 (12.5)	–	–
GCUH	10 (3.6)	173 (62.5)	31 (11.2)	35 (12.6)	10 (3.6)	18 (6.5)
STATEWIDE	**149 (8.9)**	**861 (51.7)**	**117 (7.0)**	**204 (12.3)**	**247 (14.8)**	**87 (5.2)**

5.6.2 Admission pathway

After first medical contact, 68% of STEMI PCI patients were admitted directly to the treating centre.

As expected, admission pathway varied considerably by STEMI presentation. For thrombolysed and rescue PCI, there were 85% and 60% admitted via interhospital transfer respectively, whereas a large proportion (92%) of the STEMI presenting within six hours of symptom onset cohort presented directly to a PCI facility.

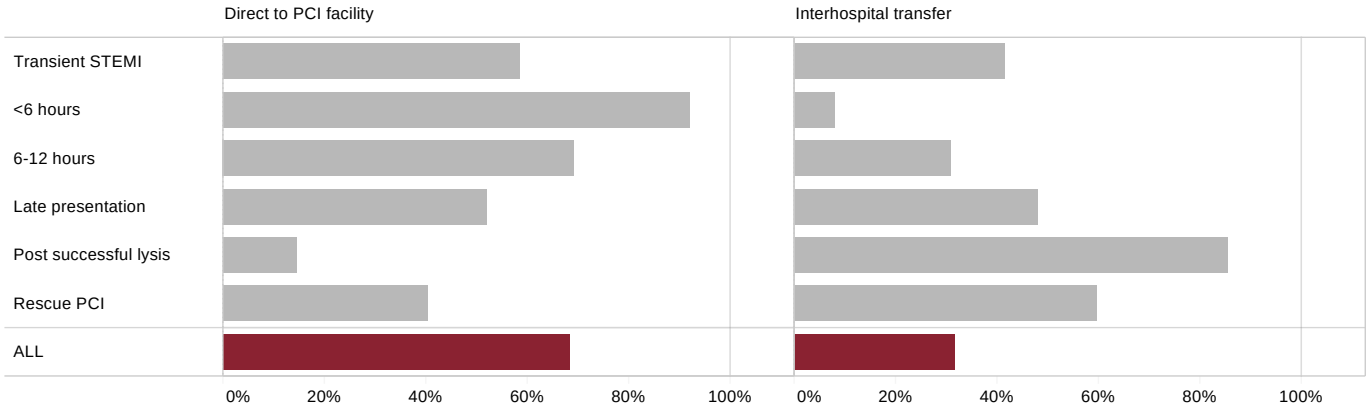
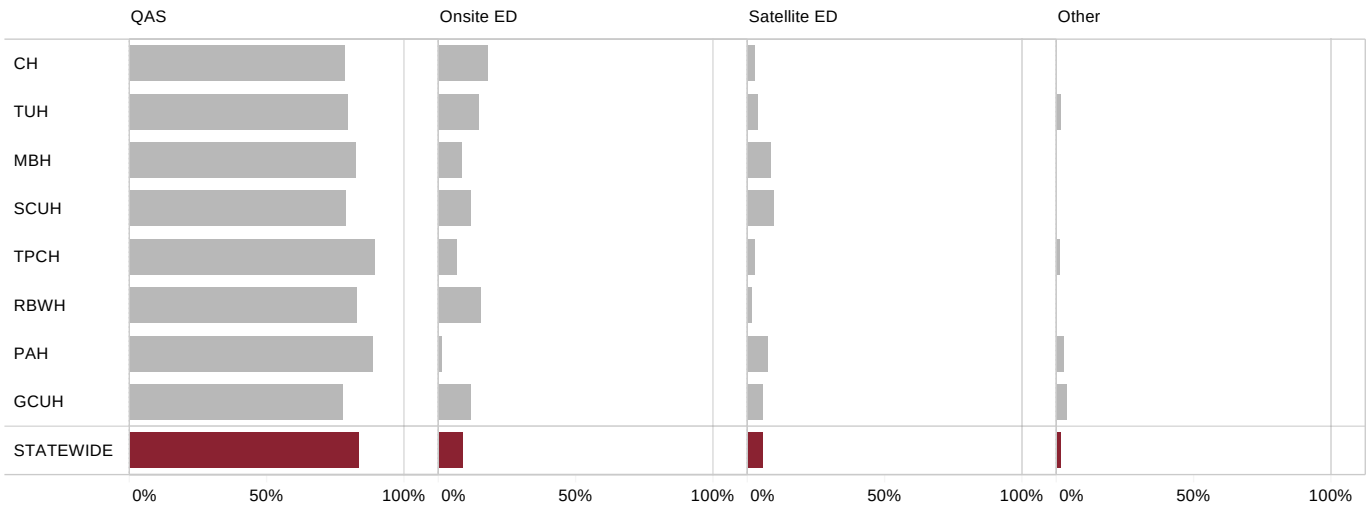


Figure 10: Proportion of STEMI PCI cases by admission pathway and clinical presentation

5.6.3 First medical contact

For STEMI cases presenting for PCI within six hours of symptom onset, most patients presented via the Queensland Ambulance Service (QAS) (83%), while a smaller proportion self-presented to the emergency department (ED) of either a PCI (on-site ED) or non PCI capable (satellite ED) facility (9% and 5% respectively). The remaining 3% presented to other health facilities such as GP clinics, community health centres or any other outpatient setting.



IPH not displayed due to <20 cases available for analysis

Figure 11: Proportion of STEMI PCI cases presenting within six hours of symptom onset by first medical contact

5.6.4 Thrombolysed patients

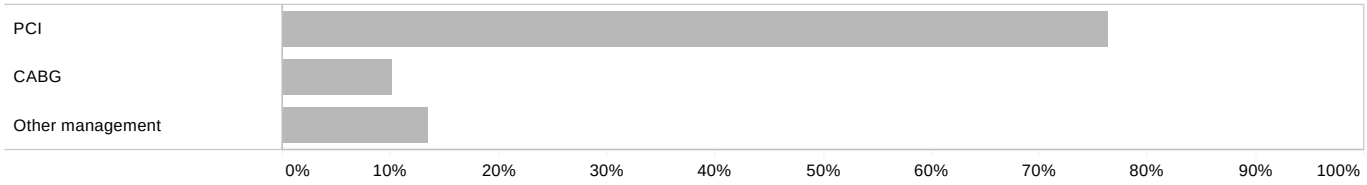
As mentioned above, the method of reperfusion depends on many factors which together determine the treatment method most appropriate for the particular presentation.

For patients presenting out of range of a PCI facility, thrombolytic therapy is highly effective and, unless medically contraindicated, is able to be administered in the field by attending paramedics or clinicians at a non PCI capable hospital.

There was a total of 455 thrombolysed STEMI presentations with the majority (73%) receiving a PCI, which increased to 77% when accounting for subsequent interventions within 90 days (Table 22). A smaller proportion (10%) went on to receive coronary artery bypass graft surgery (CABG) at a Queensland Health facility within 90 days.

Table 21: Total thrombolysed STEMI cases by tertiary cardiac centre

Site	Total thrombolysed STEMIs n	Receiving a PCI n (%)	Proportion of all PCI cases %
CH	58	46 (79.3)	9.1
TUH	40	27 (67.5)	9.1
MBH	19	17 (89.5)	7.9
SCUH	63	47 (74.6)	9.5
TPCH	101	70 (69.3)	5.5
RBWH	25	16 (64.0)	3.9
PAH	114	83 (72.8)	7.7
IPH	0	–	–
GCUH	35	28 (80.0)	3.8
STATEWIDE	**455**	**334 (73.4)**	**6.6**



PCI and CABG revascularisation not displayed (0.2%)

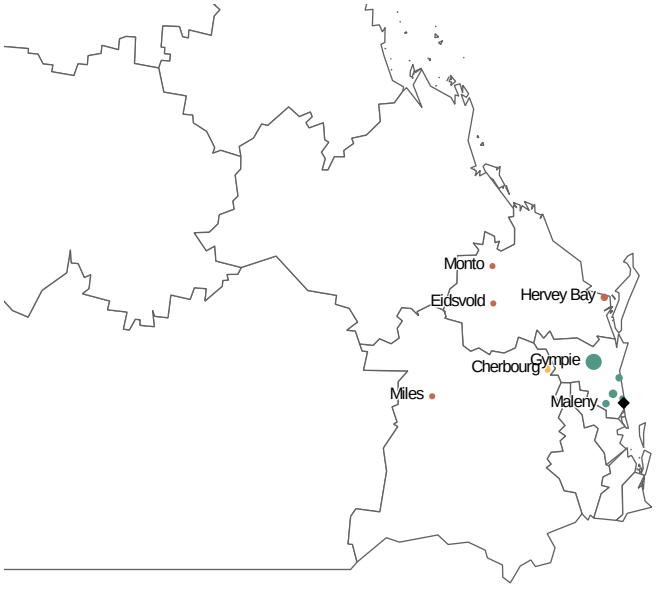
Figure 12: Proportion of thrombolysed patients by clinical management

Table 22: Thrombolysed patients by revascularisation method within 90 days

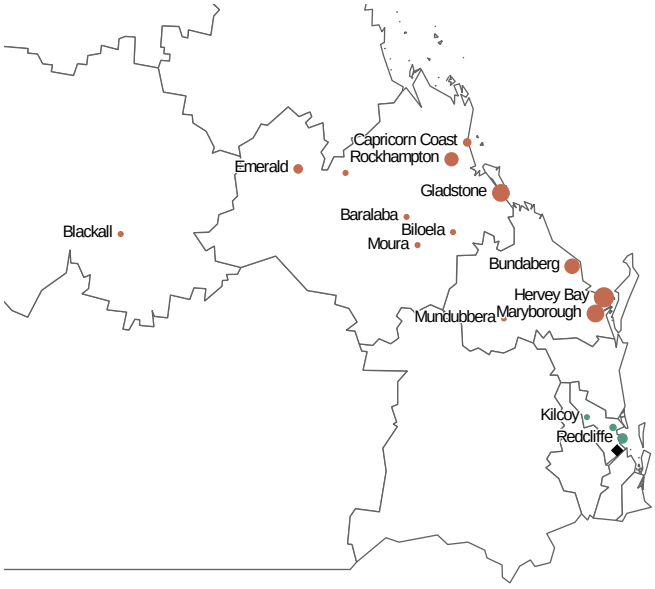
Site	PCI revascularisation %	CABG revascularisation %	PCI + CABG revascularisation %	Other management* %
CH	78.9	12.3	1.8	7.0
TUH	67.5	15.0	–	17.5
MBH	94.7	–	–	5.3
SCUH	80.6	11.3	–	8.1
TPCH	71.4	12.2	–	16.3
RBWH	76.0	–	–	24.0
PAH	75.0	10.7	–	14.3
GCUH	82.9	2.9	–	14.3
STATEWIDE	**76.3**	**10.0**	**0.2**	**13.4**

* Includes medical management and transfer to a private or interstate facility

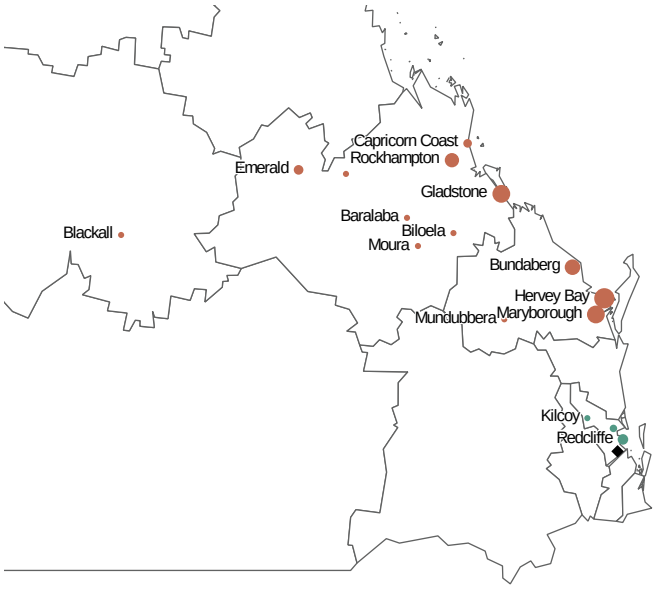
Figure 13: Thrombolysed STEMI interhospital transfers by estimated distance to transfer from referring centre



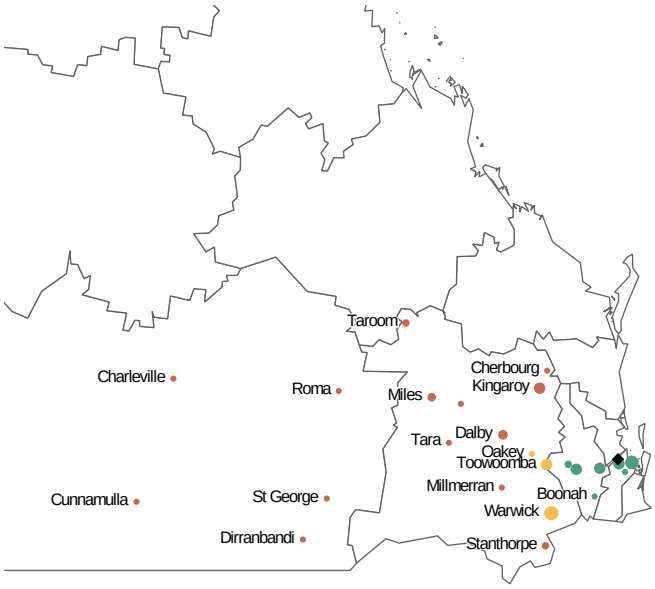
Inset A: Sunshine Coast University Hospital



Inset B: The Prince Charles Hospital



Inset C: Royal Brisbane & Women's Hospital



Inset D: Princess Alexandra Hospital

Inset E: Gold Coast University Hospital

Overall, there were 455 thrombolysed STEMI patients who reached a public hospital CCL site in 2024, with a median time from first diagnostic ECG (FdECG) to thrombolysis of 38 minutes.

Time from FdECG to thrombolysis varied depending on the pathway by which it was administered, with patients presenting directly to the thrombolysis facility having a higher median time from FdECG to thrombolysis compared to those receiving prehospital thrombolysis by QAS paramedics (37 minutes vs 30 minutes).

The patients in the other hospital thrombolysis group took a median of 57 minutes from FdECG to thrombolysis. The extended time delay likely representative of the travel time taken to arrive at a thrombolysis facility, noting Queensland's vast geography and rural and remote population.

Table 23: Definitions for STEMI time to thrombolysis

Time	Definition
First medical contact	The timestamp when the patient is initially assessed by a trained medical professional who can obtain and interpret an ECG and deliver initial interventions such as defibrillation. First medical contact (FMC) may occur in the hospital or pre-hospital setting.
First diagnostic ECG	First diagnostic ECG (FdECG) refers to the timestamp when the ECG shows ST-segment elevation. The interpretation of FdECG may be undertaken by ambulance personnel, general practitioner (GP) or hospital-based medical staff.
Time thrombolysis administered	The timepoint when thrombolytic therapy had been administered to the patient, which may be pre-hospital or in hospital.

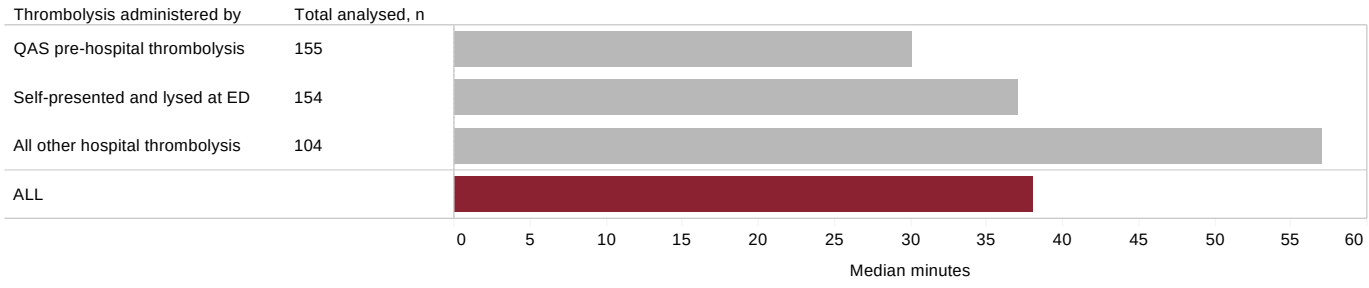
Table 24: Total thrombolysed STEMI cases by thrombolysis administration pathway

	Total thrombolysed STEMIs n	Total analysed n	Median FdECG to thrombolysis minutes	Interquartile range minutes
QAS pre-hospital thrombolysis	168	155	30	20–40
Self-presented and lysed at ED	159	154	37	23–63
Other pre-hospital thrombolysis*	15	13	N/A	N/A
All other hospital thrombolysis†	113	104	57	37–93
ALL	**455**	**426**	**38**	**23–58**

N/A Not displayed due to <20 cases for analysis

* Thrombolysed by Royal Flying Doctor Service, primary health care centre or other first responder

† Includes initial presentation to QAS or GP and subsequent thrombolysis in hospital



Excludes other pre-hospital thrombolysis (n=15)

Figure 14: Median time from first diagnostic ECG to thrombolysis therapy by administration pathway

For the cohort of thrombolysed patients, the median time to angiography was 15 hours post thrombolysis with 67% of patients undergoing coronary angiography within 24 hours. The unadjusted all-cause mortality within 30 days for STEMI patients receiving thrombolysis was 3.1%.

Table 25: Median time from thrombolysis to angiography by site

Site	Total cases n	Total analysed n	Median time to angiography hours	Interquartile range hours	Met 24 hours target %
CH	58	57	16	6–31	61.4
TUH	40	39	20	11–39	64.1
MBH	19	19	7	4–18	78.9
SCUH	63	62	11	3–28	69.4
TPCH	101	97	14	7–23	75.3
RBWH	25	25	20	9–26	64.0
PAH	114	112	19	5–30	57.1
GCUH	35	35	6	4–19	80.0
STATEWIDE	**455**	**446**	**15**	**6–28**	**67.0**

Table 26: Unadjusted all-cause thrombolysed STEMI mortality within 30 days of procedure

	Total cases n	Median time to angiography hours	Total salvage n (%)	In-lab death n	In hospital death n	Post discharge to 30 days n	Total mortality n (%)
Post successful thrombolysis	368	20	6 (1.6)	0	5	1	6 (1.6)
Rescue PCI	87	3	12 (13.8)	1	7	0	8 (9.2)
ALL	**455**	**15**	**18 (4.0)**	**1**	**12**	**1**	**14 (3.1)**

5.7 NSTEMI presentations

Of all PCI and coronary cases performed in CCLs during 2024, there were 3,312 coded with a procedural indication of NSTEMI. These cases accounted for 30% of all PCI cases across all centres, with site variation ranging from 22% to 47%. This is largely consistent with the proportions reported in the 2019–2023 patient cohorts.

Of patients presenting with NSTEMI, 46% were revascularised via PCI, which increased only modestly when accounting for staged interventions within 90 days of index presentation (Table 28). A further 13% underwent CABG, while the remainder were medically managed or referred outside of Queensland Health. This analysis may include revascularisation procedures undertaken at other public centres, such as for sites without PCI or CABG services.

5.7.1 Case load

Table 27: NSTEMI cases by site

Site	Total NSTEMI cases n	NSTEMI receiving PCI n (%)	Proportion of all PCI cases %
CH	298	157 (52.7)	31.0
TUH	229	97 (42.4)	32.6
MBH	162	63 (38.9)	29.4
SCUH	274	119 (43.4)	23.9
TPCH	768	360 (46.9)	28.1
RBWH	337	159 (47.2)	38.3
PAH	704	349 (49.6)	32.5
IPH	149	71 (47.7)	47.3
TWH	37	0 (0.0)	N/A
GCUH	354	163 (46.0)	22.0
STATEWIDE	**3,312**	**1,538 (46.4)**	**29.7**

N/A No PCI procedures performed in 2024

Table 28: NSTEMI patients by site and revascularisation method within 90 days

Site	PCI revascularisation %	CABG revascularisation %	PCI + CABG revascularisation %	Other management* %
CH	59.2	11.2	1.8	27.8
TUH	45.0	13.3	0.9	40.8
MBH	42.6	8.6	–	48.8
SCUH	50.2	14.6	–	35.2
TPCH	51.2	9.2	0.4	39.2
RBWH	55.0	15.8	0.3	28.9
PAH	53.8	14.6	0.3	31.3
IPH	53.8	13.3	–	32.9
TWH	32.4	10.8	–	56.8
GCUH	48.5	13.5	0.6	37.4
STATEWIDE	**51.5**	**12.6**	**0.5**	**35.5**

* Medical management or referred outside of Queensland Health

5.7.2 Admission source

There were similar numbers of NSTEMI cases where the patient was transferred from another facility or presenting directly to the PCI centre (both 50% respectively). Interhospital transfer for NSTEMI patients can present many challenges for guideline adherence with many logistical considerations making target adherence for invasive coronary angiography difficult. These issues are explored further in the clinical indicators section of the Audit.

Considerable variation was observed between sites, with the proportion of interhospital transfers for NSTEMI ranging from 16% to 72% for sites eligible for analysis. This can largely be explained by the makeup of the individual catchment area. Where higher volumes and larger median distances to PCI centres exist, it is reasonable to expect that the proportion of cases meeting targets would be smaller. Table 30 and Figure 15 provide perspective based on cases where geographical data were available.

Table 29: NSTEMI admission source to treating facility

Site	Direct to PCI facility n (%)	Interhospital transfer n (%)
CH	173 (58.1)	125 (41.9)
TUH	153 (66.8)	76 (33.2)
MBH	94 (58.0)	68 (42.0)
SCUH	149 (54.4)	125 (45.6)
TPCH	349 (45.4)	419 (54.6)
RBWH	91 (27.0)	246 (73.0)
PAH	244 (34.7)	460 (65.3)
IPH	118 (79.2)	31 (20.8)
TWH	31 (83.8)	6 (16.2)
GCUH	240 (67.8)	114 (32.2)
STATEWIDE	**1,642 (49.6)**	**1,670 (50.4)**

Table 30: NSTEMI interhospital transfers by estimated distance to transfer

Site	Total analysed n	Median kilometres	Interquartile range kilometres
CH	102	90	63–93
TUH	66	302	133–853
MBH	62	125	125–192
SCUH	110	47	30–93
TPCH	339	275	39–505
RBWH	211	281	45–611
PAH	400	24	24–155
IPH	28	91	91–177
TWH	4	N/A	N/A
GCUH	73	17	17–17
STATEWIDE	**1,395**	**90**	**27–281**

N/A Not displayed due to <20 cases eligible for analysis

Excludes interhospital transfers originating in New South Wales or from a private hospital

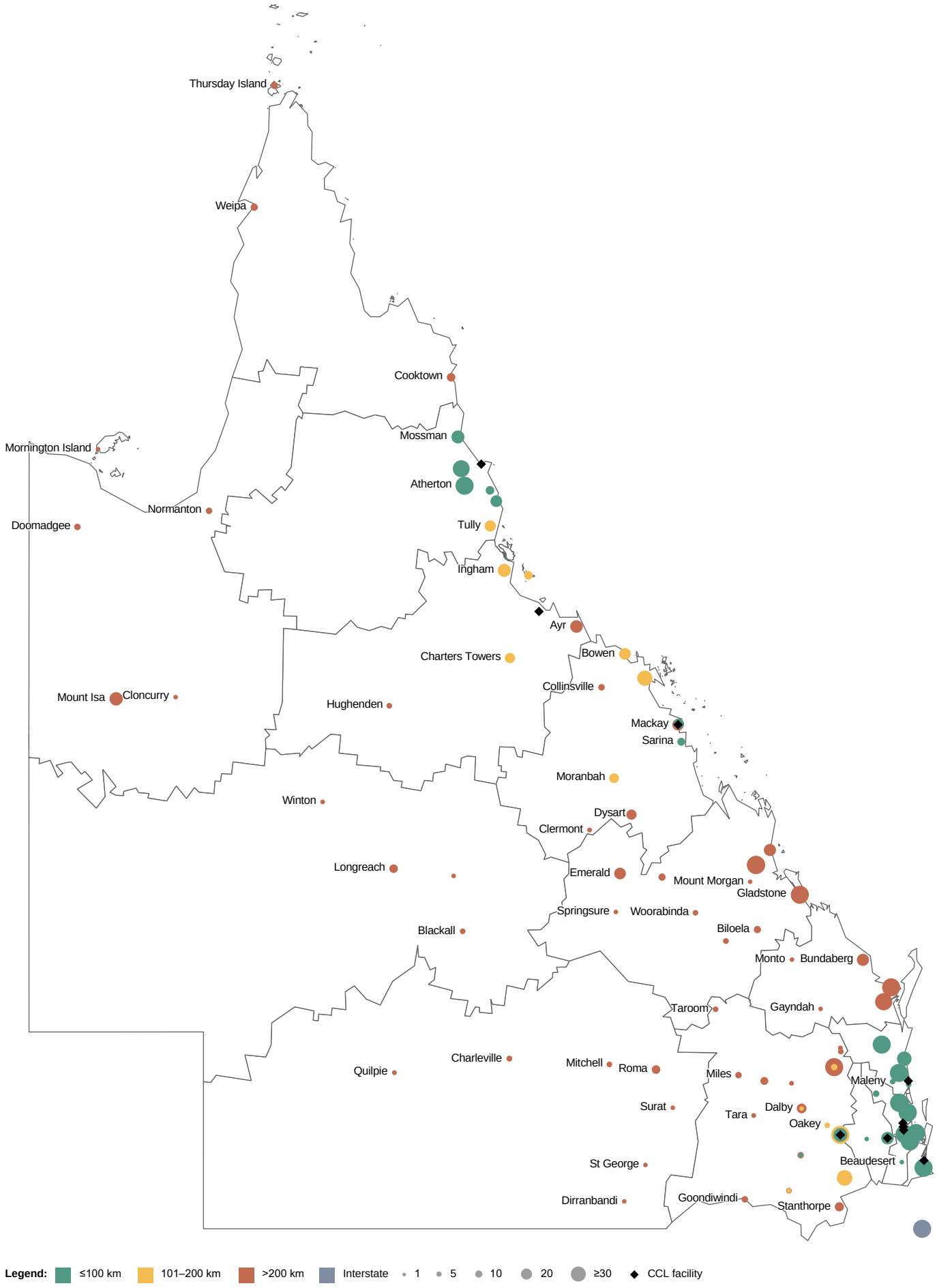
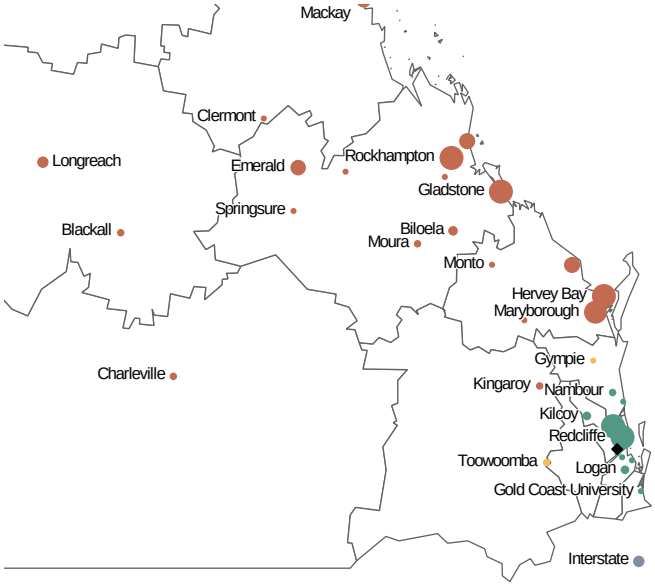
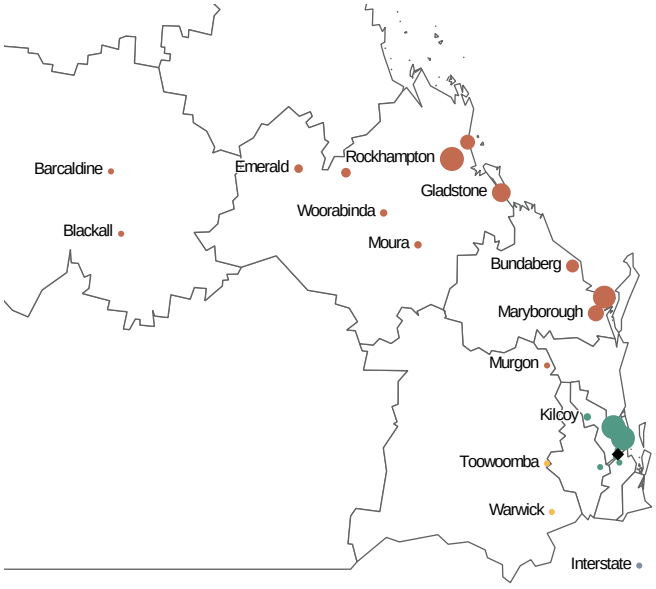


Figure 15: NSTEMI interhospital transfers by estimated distance to transfer from referring centre

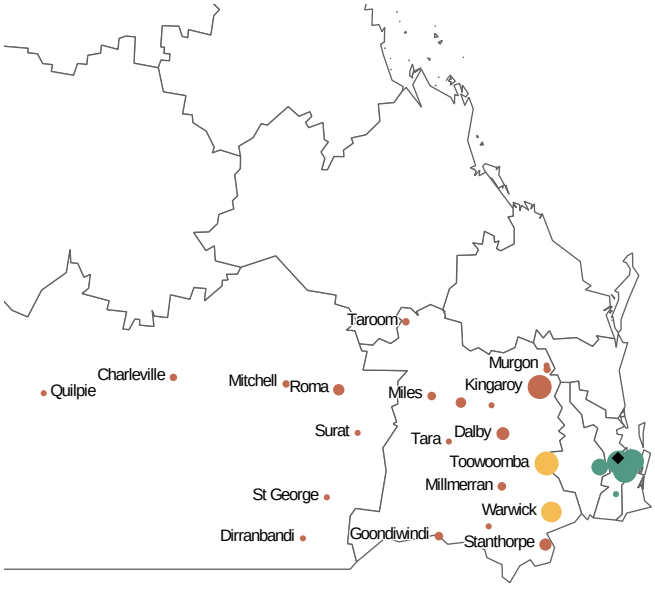
Inset A: Sunshine Coast University Hospital



Inset B: The Prince Charles Hospital



Inset C: Royal Brisbane & Women's Hospital



Inset D: Princess Alexandra Hospital

Inset E: Ipswich Hospital

Inset F: Gold Coast University Hospital

6 Clinical indicators

The clinical indicator program is a valuable focus of QCOR. Many key guidelines advise the use of defined and validated quality indicators as a means of measuring and improving patient care. An indicator that is clinically relevant and useful should highlight specific issues that may require attention or signal areas for improvement.

The clinical quality and outcome indicators included in this Interventional Cardiology Audit have been selected after consideration of international PCI and ACS treatment guidelines and are in line with contemporary best practice recommendations. There is emerging recognition that a capacity to evaluate and report on quality is a critical building block for system-wide improvement of healthcare delivery and patient outcomes.

The quality and safety indicators which have been nominated by the QCOR Interventional Cardiology Committee are outlined in Table 31.

Table 31: Diagnostic and interventional cardiology clinical indicators

Clinical indicator	Description
1	Risk adjusted all-cause 30 day mortality post PCI
2	Proportion of STEMI patients presenting within six hours of symptom onset who received an intervention within 90 minutes of first diagnostic ECG
3	Proportion of all NSTEMI patients who received angiography within 72 hours of first hospital admission
4	Proportion of major in-lab events post PCI (coronary artery perforation, death, tamponade, emergency coronary artery bypass graft or cerebrovascular accident-stroke)
5	Proportion of cases where total entrance dose exceeded the high dose threshold (5Gy)

6.1 Mortality outcomes

6.1.1 Risk adjusted all-cause 30 day mortality post PCI

This clinical indicator includes all patient mortalities within 30 days of a PCI procedure. It does not necessarily indicate a causal relationship between the PCI procedure and the subsequent death. Overwhelmingly, death in these patients occurs from the underlying condition for which PCI is being done despite successful PCI being performed.

The overall 30 day unadjusted mortality rate for patients undergoing PCI procedures at Queensland public hospitals for 2024 was 2.4%. This result compares similarly with the 30 day mortality rate of 1.8% for the 2024 Victoria, Australia PCI cohort[10] and 2.8% presented by the British Cardiovascular Interventional Society (BCIS) in their review of PCI outcomes for the 2014 calendar year. This metric is chosen as the comparator as BCIS reports in subsequent years have given in-hospital rather than 30 day mortality.[11]

Table 32 presents unadjusted mortality according to admission status. As should be expected, the risk of death increases according to the severity of the patient's condition (admission status). 30 day mortality was 50% in the critically ill patients who underwent salvage PCI.

Table 32: All-cause unadjusted mortality within 30 days post PCI by admission status (% of total cases by presentation and site)

Site	Total cases n	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)	Total deaths n (%)
CH	506	0 (0.0)	4 (1.5)	3 (3.4)	8 (47.1)	15 (3.0)
TUH	298	0 (0.0)	2 (1.1)	1 (1.3)	3 (75.0)	6 (2.0)
MBH	214	0 (0.0)	1 (1.1)	4 (7.4)	1 (100.0)	6 (2.8)
SCUH	497	0 (0.0)	0 (0.0)	3 (2.1)	5 (55.6)	8 (1.6)
TPCH	1,279	1 (0.3)	6 (0.9)	11 (4.1)	12 (57.1)	30 (2.3)
RBWH	415	0 (0.0)	3 (1.1)	6 (7.3)	10 (71.4)	19 (4.6)
PAH	1,075	2 (1.7)	6 (0.9)	4 (1.4)	8 (34.8)	20 (1.9)
IPH	150	0 (0.0)	1 (1.0)	1 (25.0)	–	2 (1.3)
GCUH	740	0 (0.0)	0 (0.0)	5 (1.9)	11 (42.3)	16 (2.2)
STATEWIDE	**5,174**	**3 (0.3)**	**23 (0.8)**	**38 (3.0)**	**58 (50.4)**	**122 (2.4)**

Figure 16 presents the observed mortality rates by site, superimposed on the predicted mortality rates (with 95% confidence interval) calculated using the Victorian Cardiac Outcomes Registry (VCOR) risk adjustment model[12]. This analysis used an imputed dataset accounting for any missing data.

Reassuringly, observed mortality rates from all sites are within the expected range for their respective risk adjusted mortality rates. This is despite the limited risk adjustment model, which only adjusts for six factors – ACS, age, LAD coronary artery involvement, eGFR, LVEF, and cardiogenic shock. Other critical presentations with very high mortality risk, such as out of hospital ventricular fibrillation arrest with uncertain neurological recovery, are not adjusted for and therefore the model is likely to underestimate true mortality risk. This is relevant in our dataset where there were marked differences between hospitals in the proportion of high-risk salvage patients taken for PCI (ranging from 0.5%–3.5% of PCI volume).

There were also considerable differences in salvage case mortality rates across different hospitals (Table 32). This variation may relate to differences in case mix at different hospitals, differences in the threshold for performing PCI in critically ill unstable patients, differences in classification of admission status, or a combination of all three factors. Given this variation, and the inability of the current risk prediction model to accurately predict expected mortality in the extreme risk salvage category, Figure 17 presents the observed and expected mortality rates excluding salvage.

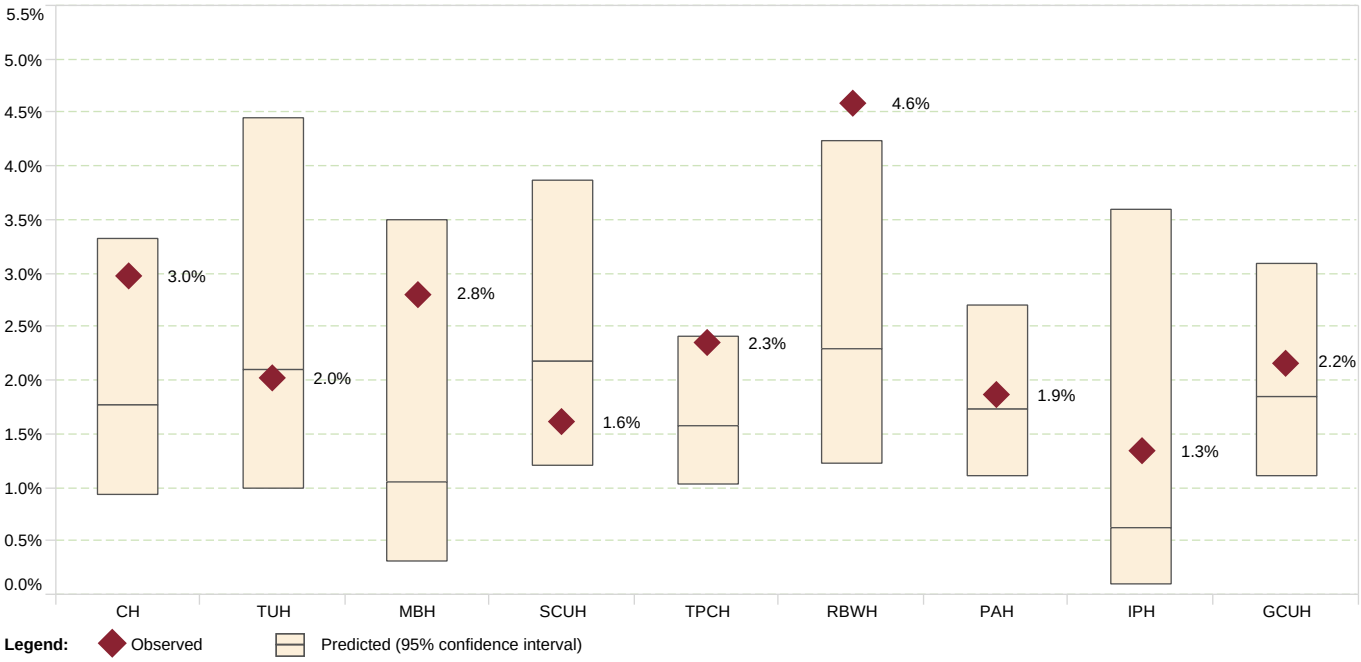
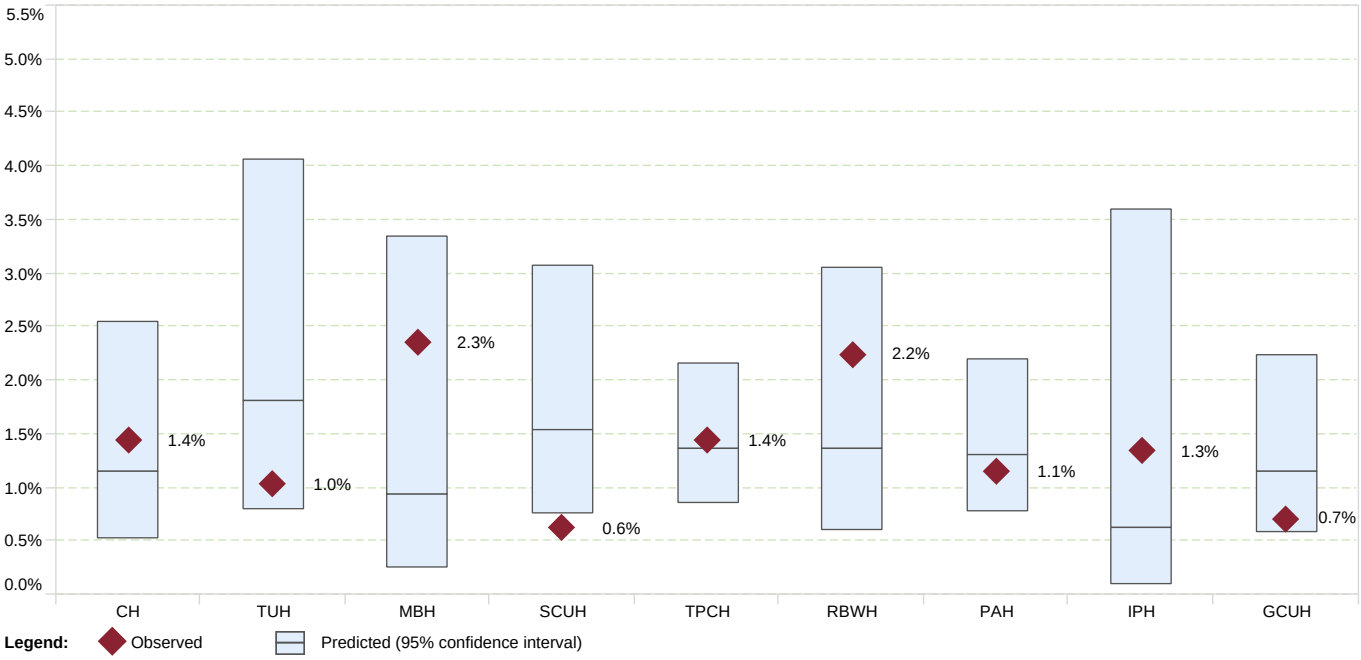


Figure 16: Comparison of observed and predicted mortality rates by site

As was outlined in previous QCOR reports, poorly calibrated risk adjustment is known to introduce bias into the monitoring process. Great care, therefore, needs to be exercised in the choice and use of risk adjustment tools to ensure they are relevant and have adequate performance for the patient cohort under scrutiny. Unfortunately, there are very few universally accepted risk models in interventional cardiology. We determined the VCOR model for risk adjustment of 30 day mortality to have the greatest utility for our current dataset, compared to other models such as those of the BCIS[11], and the American College of Cardiology (ACC) CathPCI registry.[13] These models are critically dependant on completeness of data elements.

With an expanded dataset of reliable data, a more thorough evaluation of international PCI risk adjustment models can be explored. This would allow for recalibration and the option to adapt one of these models to the specific characteristics of the QCOR dataset, or develop a new, locally relevant model. The variation in salvage cases between different hospitals highlights the importance of this. Some of these cases are STEMI complicated by out of hospital ventricular fibrillation (VF) arrest, where there is a high yet uncertain chance of mortality, which is not well adjusted for. Small differences in the caseload of such patients, or variation in the likelihood of taking such cases for PCI, would have an undue effect on mortality rates, and yet there is no adjustment for this in the risk prediction model being applied.

In the ideal model, factors which are known to impact on patient outcomes, and which are beyond the control of the clinician or service being monitored, are either controlled for in the analysis or excluded. In measuring performance outcomes, it is important to maintain focus on the process under scrutiny (PCI outcomes), without distortion by uncorrected bias.



Excluding salvage cases (n=115)

Figure 17: Comparison of observed and predicted mortality rates by site, excluding salvage

6.1.2 STEMI mortality

A separate analysis was performed to assess mortality in patients presenting with STEMI. Of the 2,032 documented STEMI cases in 2024, 1,665 cases (82%) included a PCI intervention and are the subject of the following outcomes analyses. For this analysis, patients presenting as salvage are excluded, allowing focus to be retained on the measurement of PCI outcomes.

The outcomes for the cohort of STEMI patients who underwent PCI remain encouraging. All-cause mortality rates at 30 days for those sites that offered a dedicated 24/7 STEMI service and eligible for analysis varied from 1.0% to 6.3%, with a statewide rate of 2.4%. Of these 1,575 patients analysed, a total of 38 mortalities were identified with the majority (68%) occurring in hospital. In 2024, IPH did not offer a 24/7 STEMI service.

Table 33: Mortality up to 30 days in patients who underwent PCI for STEMI

Site	In-lab n	In hospital n	Post discharge to 30 days n	Total cases* n	Total mortality n (%)
CH	0	2	1	135	3 (2.2)
TUH	0	1	0	99	1 (1.0)
MBH	0	3	1	64	4 (6.3)
SCUH	0	3	0	184	3 (1.6)
TPCH	2	7	1	338	10 (3.0)
RBWH	1	2	3	96	6 (6.3)
PAH	0	1	5	396	6 (1.5)
IPH	N/A	N/A	N/A	8	N/A
GCUH	0	4	1	255	5 (2.0)
STATEWIDE	**3**	**23**	**12**	**1,575**	**38 (2.4)**

* Excluding salvage cases (n=90)

N/A Due to <20 cases for analysis

6.1.3 STEMI presentation within 6 hours from symptom onset

Further analysis of the STEMI cohort who underwent primary PCI within six hours of symptom onset demonstrates a statewide all-cause 30 day mortality rate of 1.9%.

For this analysis, patients presenting as high-risk salvage cases have been excluded.

Table 34: Mortality up to 30 days in patients who underwent PCI for STEMI presenting within six hours of symptom onset

Site	In-lab n	In hospital n	Post discharge to 30 days n	Total cases* n	Total mortality n (%)
CH	0	1	1	61	2 (3.3)
TUH	0	1	0	52	1 (1.9)
MBH	0	0	0	23	0 (0.0)
SCUH	0	3	0	91	3 (3.3)
TPCH	1	3	0	163	4 (2.5)
RBWH	0	1	0	52	1 (1.9)
PAH	0	0	1	202	1 (0.5)
IPH	N/A	N/A	N/A	4	N/A
GCUH	0	3	0	158	3 (1.9)
STATEWIDE	**1**	**12**	**2**	**806**	**15 (1.9)**

* Excluding salvage cases (n=53)

N/A Due to <20 cases for analysis

6.1.4 Out of hospital cardiac arrest

Out of hospital cardiac arrest (OOHCA) is associated with very poor prognosis. It has been reported that only 12% of all OOHCA with attempted resuscitation survive to hospital discharge or 30 days following the arrest.[14] Furthermore, where the presumed cause of arrest is cardiac in nature and the case is not witnessed by emergency services, survival to hospital discharge or 30 days is also 12%. It is therefore recognised that patients who present with OOHCA have a guarded prognosis and any attempt to revascularise these patients may ultimately still result in death as a result of other factors or clinical pathology such as poor neurological recovery.

The analysis focuses on patients who survived the arrest and underwent coronary intervention. Given the severity of this condition, it is acknowledged that some presentations were not suitable to proceed to PCI. This could be due to the arrest being unwitnessed or due to other confounding factors affecting the clinical presentation.

With this in mind, it is imperative that these cases be interpreted with caution noting that the outcomes reflect an 76% survival rate to 30 days which is markedly better than the larger OOHCA with resuscitation group. This is reassuring and indicates that patient selection for PCI in this high-risk, critically unwell group is appropriate.

Variation exists among sites with OOHCA accounting for 0% to 5.1% of total PCI cases and a statewide proportion of 2.2%. In this group, death within 30 days of the PCI procedure in 2024 exclusively occurred in hospital.

Table 35: Total out of hospital cardiac arrest cases by site

Site	Total cases n	Proportion of PCI cases %
CH	4	0.8
TUH	6	2.0
MBH	7	3.3
SCUH	12	2.4
TPCH	23	1.8
RBWH	8	1.9
PAH	16	1.5
IPH	0	0.0
GCUH	38	5.1
STATEWIDE	**114**	**2.2**

Table 36: Out of hospital cardiac arrest mortality up to 30 days post procedure

	Total cases n	In-lab n	In hospital n	Post discharge to 30 days n	Total deaths n (%)
STATEWIDE	**114**	**2**	**25**	**27 (23.7)**	**33 (29.5)**

6.2 STEMI less than six hours from symptom onset – time to reperfusion

The most critical factor influencing outcome for patients who experience a STEMI is the total ischaemic time, defined as the time interval from symptom onset to successful reperfusion. The exact time of symptom onset is often difficult to ascertain, and the time between symptom onset and call for help is primarily a patient dependent factor.

Therefore, STEMI guidelines worldwide now advocate first diagnostic ECG (FdECG)-to-device time as an important modifiable and objective measure of overall STEMI system performance.[15,16]

The European Society of Cardiology 2023 Guidelines for Acute Coronary Syndromes IC16 maintains a target of less than 90 minutes for patients undergoing primary PCI, while the ACC/AHA guideline[16] similarly advocates for rapid reperfusion strategies within regional networks.

Achieving these times requires efficient coordination of care within and between the ambulance service and transferring/receiving hospitals. Accepted strategies to improve reperfusion times include pre-hospital activation of the cardiac catheter laboratory, an immediate response of the on call PCI team to be operational within 30 minutes of alert and bypass of the emergency department.

Table 37: Definitions for STEMI time to reperfusion

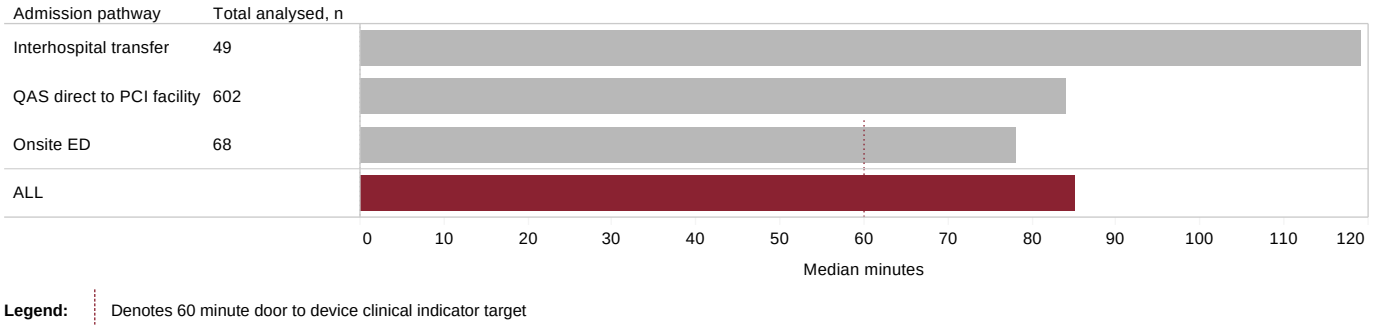
Time	Definition
First diagnostic ECG	First diagnostic ECG refers to the timestamp when the ECG shows ST-segment elevation (or equivalent) and can be regarded as time zero in the therapeutic pathway. The interpretation of the first diagnostic ECG may be undertaken by ambulance personnel, general practitioners or hospital based medical staff.
Door time	Door time refers to the timestamp when the patient presents to the PCI hospital and can be regarded as time zero in the therapeutic pathway for patients presenting via this method.
First device time	The first device time, as a surrogate for reperfusion, is the first timestamp recorded of the earliest device used: • first balloon inflation, or • first stent deployment, or • first treatment of lesion (thrombectomy/aspiration device, rotational atherectomy) If the lesion cannot be crossed with a guidewire or device (and thus none of the above applies), the time of guidewire introduction is used. If there is already TIMI 3* flow observed on initial angiography, that timestamp is used instead of first device time.

* Grade 3 (complete perfusion)[17]

The QCOR Interventional Cardiology Committee established the benchmark target of 75% of patients to receive timely reperfusion measured from FdECG to reperfusion, as well as from arrival at PCI facility to reperfusion.

In total, there were 861 STEMI primary PCI cases presenting within six hours of symptom onset. Of these, there were 135 cases which had been excluded per the criteria in Table 38 leaving 726 cases eligible for the FdECG to reperfusion analysis. For the arrival at PCI facility to reperfusion indicator, another 16 patients were excluded due to STEMI onset occurring while already in hospital for a different reason.

As observed in previous Annual Reports, there was considerable variation in time from FdECG to reperfusion depending on the admission pathway to the treating facility, ranging from 119 minutes to 78 minutes for interhospital transfers and PCI facility onsite ED respectively.



Excludes other admission pathways such as GP or community health (n=7)

Figure 18: STEMI presenting within six hours of symptom onset – median first diagnostic ECG to first device time by admission pathway

Table 38: STEMI presenting within six hours of symptom onset cases ineligible for analysis

Summary	n (%)
Salvage	50 (37.0)
Out of hospital arrest	25 (18.5)
Thrombolysis contraindicated	18 (13.3)
Previous CABG	11 (8.1)
Significant comorbidities/frailty	7 (5.2)
Unsuccessful PCI	6 (4.4)
Shock/acute pulmonary oedema	4 (3.0)
Intubation	3 (2.2)
Incomplete data	11 (8.1)
Total	**135 (100.0)**

6.2.1 Time from first diagnostic ECG to first device

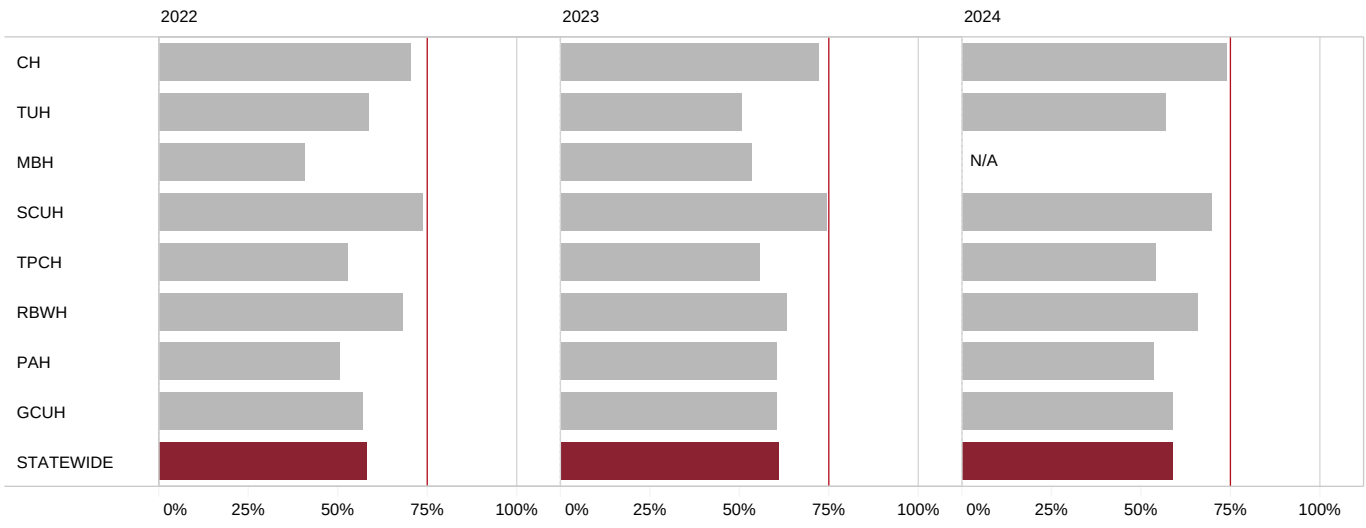
The all-site median time from FdECG to reperfusion was 85 minutes, with median individual site times ranging from 72 minutes to 89 minutes. These results indicate that overall Queensland public facilities are approaching the ambitious benchmark of 90 minutes from time of FdECG to first device. However, only 59% of patients analysed receive timely reperfusion per the current benchmark (FdECG to reperfusion within 90 minutes), supporting the view that the current target is idealistic.[16]

FdECG to reperfusion is a multi layered metric with the involvement of QAS, emergency and cardiology physicians and, along with the large geographical variations across Queensland, presents a clinical and logistical challenge for all involved. Nonetheless, the measure of time to reperfusion remains a useful tool for monitoring processes and efficiencies and demonstrates the potential for improvement or maintenance of system and hospital performance.

Table 39: First diagnostic ECG to reperfusion for STEMI presenting within six hours of symptom onset

Site	Total cases n	Total analysed n	Median minutes	Interquartile range minutes	Met 90 min target %
CH	65	58	72	59–94	74.1
TUH	54	42	87	67–99	57.1
MBH	23	19	N/A	N/A	N/A
SCUH	94	80	80	67–94	70.0
TPCH	174	155	89	74–109	54.2
RBWH	59	50	80	65–105	66.0
PAH	215	180	88	78–104	53.9
IPH	4	3	N/A	N/A	N/A
GCUH	173	139	85	73–98	59.0
STATEWIDE	**861**	**726**	**85**	**71–101**	**59.0**

N/A Not displayed due to <20 cases eligible for analysis



IPH not displayed due to <20 cases eligible for analysis

N/A Not displayed due to <20 cases eligible for analysis

Figure 19: Proportion of STEMI cases (presenting within six hours of symptom onset) where time from first diagnostic ECG to reperfusion met 90 min target, 2022–2024

6.2.1.1 Pre-hospital notification processes

Pre-hospital emergency care is provided to the Queensland population by the QAS. Pre-hospital STEMI identification, pre-hospital reperfusion therapy, field activation of CCL, and rapid transport are integral parts of the treatment cascade for pre-hospital STEMI patients in the State.[18]

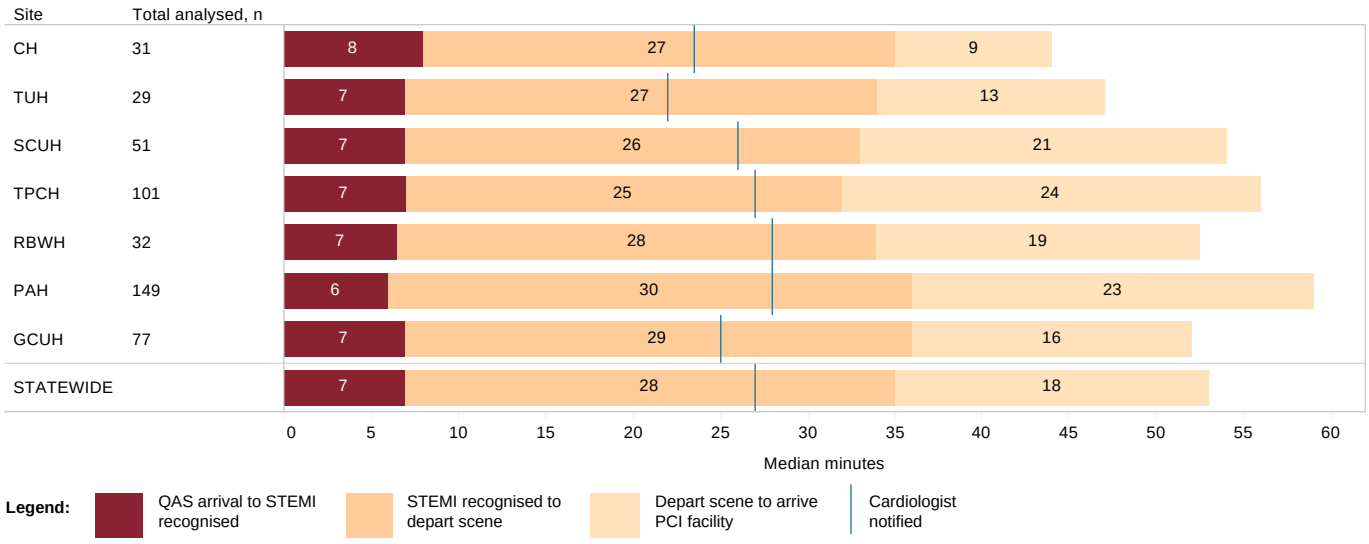
For STEMI, the QAS uses a two-tiered response model that consists of Advanced Care Paramedics (ACP) and Critical Care Paramedics (CCP). A typical response to a pre-hospital STEMI involves the concurrent deployment of ACPs and CCPs, where CCP resources are available. On recognition of pre-hospital STEMI, if the patient does not have any absolute contraindications to prehospital reperfusion treatment (less than 18 years of age, Modified Rankin Scale ≥4, ischaemic chest pain ›12 hours, history of terminal illness or under the management of a palliative care service, and symptoms suggestive of an acute aortic dissection), paramedics fast-track treatment by either directly referring the patient to a specialist cardiac hospital for primary PCI or by administering pre-hospital fibrinolysis.

Direct PCI referral is considered when the patient is located less than 60 minutes total transport time from STEMI identification to a PCI-capable hospital, has a Glasgow Coma Scale of 15, and has classic ongoing ischaemic chest pain less than 12 hours in duration.

Pre-hospital fibrinolysis is considered when the patient is located more than 60 minutes total transport time from STEMI identification to a PCI-capable hospital, has a Glasgow Coma Scale of 15, has classic ongoing ischaemic chest pain less than 6 hours in duration and is less than 75 years of age and has no absolute contraindications to pre-hospital fibrinolysis (active bleeding [excluding menstruation] or history of bleeding/clotting disorders, significant closed head injury or facial trauma within the past 3 months , prior intracranial haemorrhage, ischaemic stroke within the past 3 months, known cerebral vascular lesion/shunt/malformation, known malignant intracranial neoplasm, and known allergy to tenecteplase).

Some patients do not receive pre-hospital reperfusion therapy due to being contraindicated within the QAS reperfusion guidelines, and/or close proximity to a hospital, with some exceptions when patients refuse treatment. These patients were still identified for pre-notification to the receiving facility to ensure rapid assessment and treatment upon arrival.

When direct PCI referral is the selected pre-hospital reperfusion treatment pathway, a dedicated telephone line is utilised to make direct contact with the on call interventional cardiologist at the receiving PCI hospital to refer the patient and confer regarding pre-hospital management. If the patient is accepted, the CCL is activated by the receiving hospital staff, concomitant antiplatelet therapy and anticoagulant therapy are given in the field by paramedics, as requested by the interventional cardiologist.



IPH and MBH not displayed due to ‹20 cases available for analysis

Figure 20: STEMI presenting within six hours of symptom onset pre-hospital component breakdown – QAS direct to PCI facility

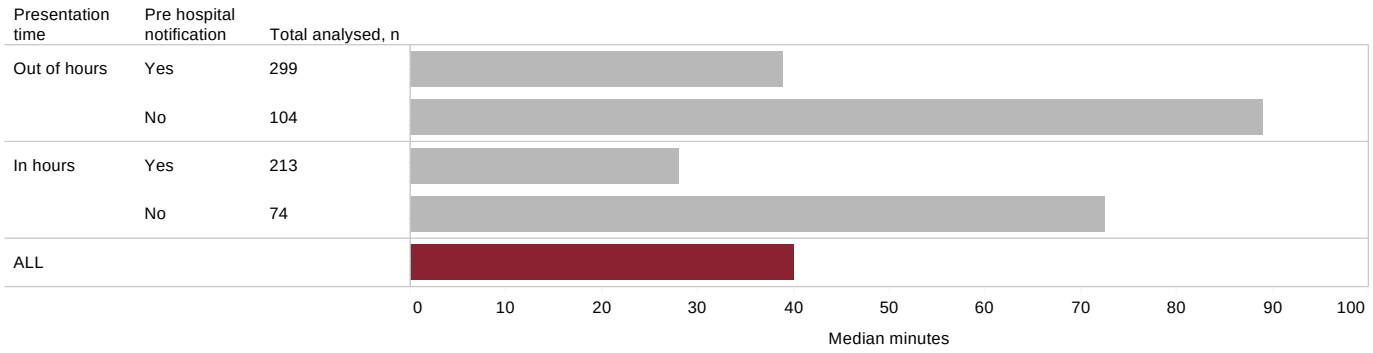
6.2.1.2 Hospital processes

All hospitals have established pathways for notification of and receiving STEMI patients. Some hospital processes vary across the state depending on factors including the time of day or the local requirement of some patients to transit via the ED.

Pre-hospital notification plays an important role in readying CCL teams for incoming patients with acute myocardial infarction. It has been demonstrated to significantly shorten time to reperfusion, and is also linked to a lower 30 day and one year cardiovascular mortality in this local Queensland cohort.[19] Different processes and protocols are in place depending on whether the patient presents within business hours or out of hours. For the purpose of this analysis, in hours was defined as 8am–6pm, Monday to Friday, excluding public holidays.

When examining arrival at PCI facility to reperfusion, pre-hospital notification resulted in marked differences in system performance. Pre-hospital notification was associated with a 45 minute improvement for in hours cases and a 50 minute improvement for out of hours cases. These findings support the importance of pre-hospital notification and the effect it has on providing an efficient, systematic approach to patient care.

It is important to note that the out of hours cohort accounts for the larger proportion of cases (59% out of hours vs 41% in hours), meaning particular attention can be paid to this group for future quality improvement activities.



In hours: 8am–6pm Monday to Friday, excluding public holidays

Figure 21: STEMI presenting within six hours of symptom onset – arrival PCI facility to reperfusion by presentation time and pre-hospital notification

6.2.2 Time from arrival PCI capable facility to first device

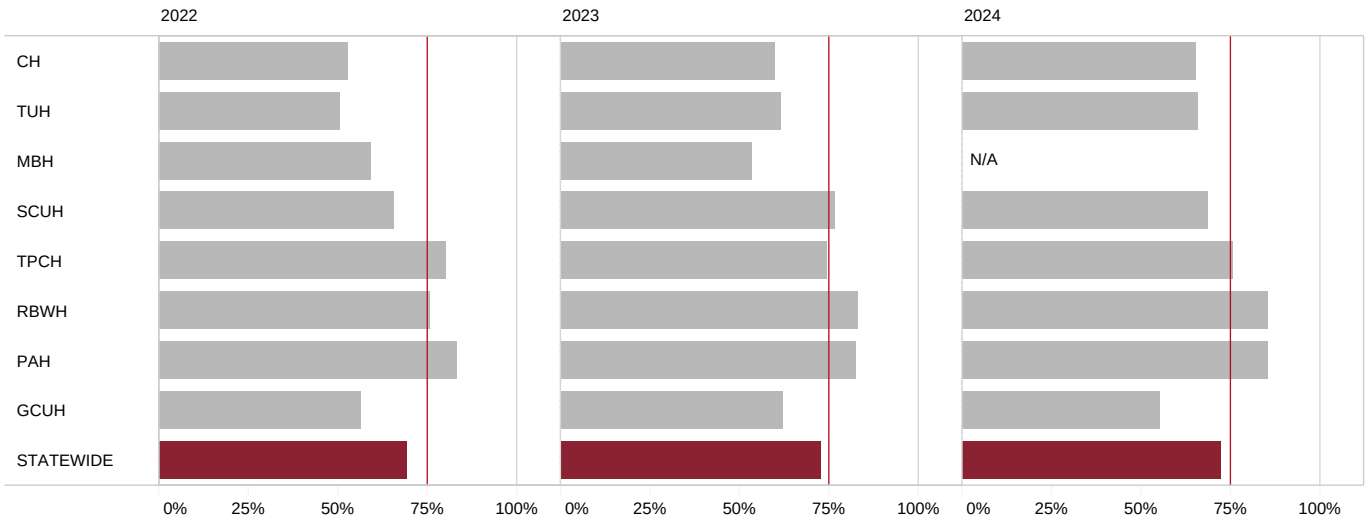
The time between PCI hospital arrival and reperfusion ('door-to-device time') is currently the accepted measure of PCI hospital system performance in STEMI. Historically, hospitals have worked to a goal of less than 90 minutes, although more recent guidelines have shortened this target time to less than 60 minutes.[15,16]

Results demonstrate that for almost three-quarters of cases (72%), participating PCI facilities are meeting a target door-to-device time of less than 60 minutes, with an overall statewide median time of 40 minutes (ranging from 36 minutes to 50 minutes across sites). These results demonstrate either a modest improvement or similar performance compared to previous years (2021 median – 39 minutes, 2022 median – 42 minutes, 2023 median – 40 minutes). There were three sites that met the benchmark target.

Table 40: Arrival at PCI hospital to first device for STEMI presenting within six hours of symptom onset

Site	Total cases n	Total analysed n	Median minutes	Interquartile range minutes	Met 60 min target %
CH	65	55	40	26–76	65.5
TUH	54	41	50	33–69	65.9
MBH	23	19	N/A	N/A	N/A
SCUH	94	77	38	26–71	68.8
TPCH	174	153	39	27–58	75.8
RBWH	59	49	38	27–49	85.7
PAH	215	178	36	27–50	85.4
IPH	4	3	N/A	N/A	N/A
GCUH	173	135	50	33–86	55.6
STATEWIDE	**861**	**710**	**40**	**29–66**	**72.3**

N/A Not displayed due to <20 cases eligible for analysis



IPH not displayed due to <20 cases available for analysis

N/A Not displayed due to <20 cases eligible for analysis

Figure 22: Proportion of cases where arrival at PCI hospital to first device ≤60 minutes was met for STEMI presenting within six hours of symptom onset, 2022–2024

6.2.2.1 In hours versus out of hours presentation

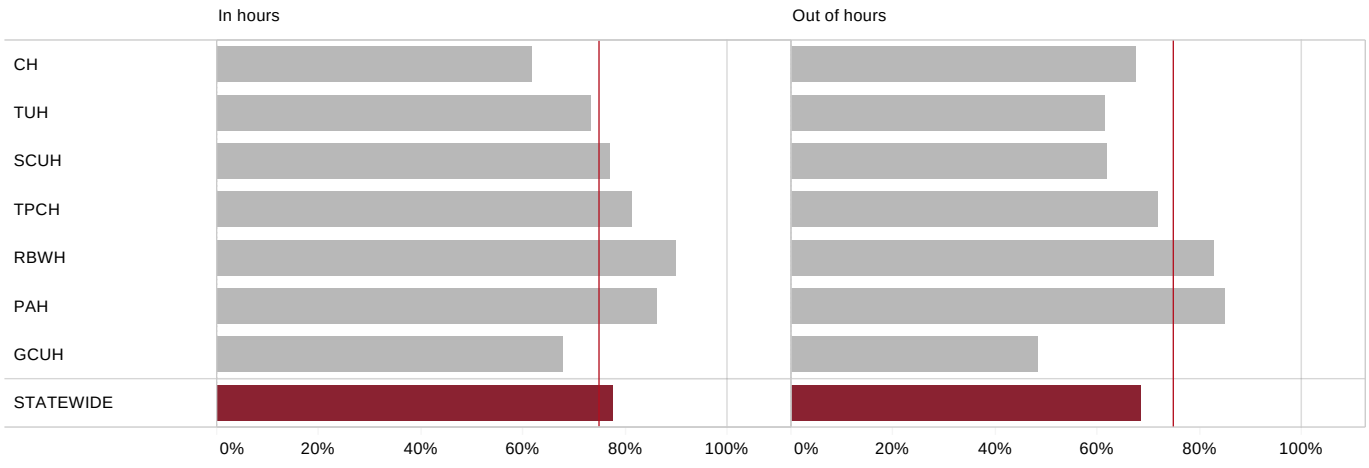
The majority of cases (59%) presented out of hours. For the purpose of this analysis, business hours were defined as 8am–6pm, Monday to Friday, excluding public holidays. This high proportion of out of hours cases demonstrates the frequency at which teams are required to respond to these medical emergencies. Each out of hours case has its own logistical challenges and requires a whole-of-system approach to ensuring timely intervention. It is important to note that this analysis does not include all out of hours work performed by CCL teams with a wide and varied case mix regularly encountered.

When examining PCI hospital arrival and reperfusion, patient presentation in hours was associated with better performance. Over three-quarters (78%) of cases met the door-to-device time target of 60 minutes in hours compared to 69% out of hours.

Table 41: STEMI presenting within six hours of symptom onset – arrival PCI facility to reperfusion by site and time of presentation

Site	Total analysed n	Proportion out of hours %	In hours median minutes	Out of hours median minutes	In hours target met %	Out of hours target met %
CH	55	61.8	34	42	61.9	67.6
TUH	41	63.4	43	50	73.3	61.5
MBH	19	N/A	N/A	N/A	N/A	N/A
SCUH	77	54.5	29	44	77.1	61.9
TPCH	153	58.2	32	44	81.3	71.9
RBWH	49	59.2	32	39	90.0	82.8
PAH	178	55.6	30	39	86.1	84.8
IPH	3	N/A	N/A	N/A	N/A	N/A
GCUH	135	63.0	35	63	68.0	48.2
STATEWIDE	**710**	**58.6**	**32**	**44**	**77.6**	**68.5**

N/A Not displayed due to <20 cases eligible for analysis



In hours: 8am–6pm Monday to Friday, excluding public holidays

IPH and MBH not displayed due to <20 cases eligible for analysis

Figure 23: STEMI presenting within six hours of symptom onset – proportion of cases where arrival at PCI hospital to first device ≤60 minutes by time of presentation and site

6.2.2.2 Pre-hospital notification

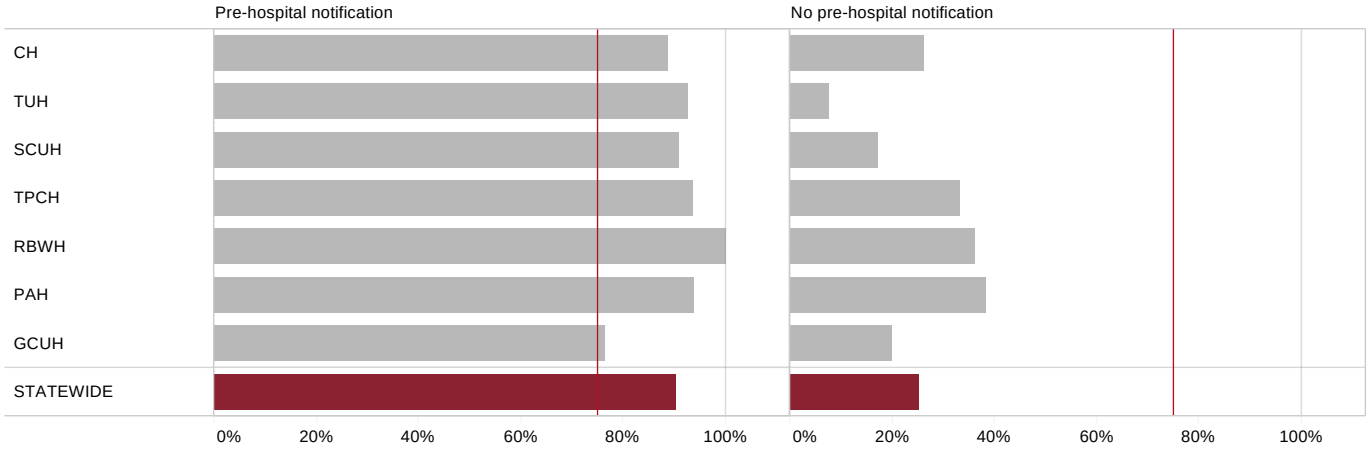
Pre-hospital notification was utilised approximately three quarters (74%) of cases, with considerable variation observed among sites. Achievement of the benchmark of 75% of cases meeting the 60 minute target was achieved at all sites where pre-hospital notification was utilised. Statewide, the 60 minute timeframe was achieved in 90% of cases where there was pre-hospital notification compared to 25% without pre-hospital notification.

This further supports the importance of pre-hospital notification and the need for effective synergies between hospital departments and emergency services.

Table 42: STEMI presenting within six hours of symptom onset – arrival PCI facility to reperfusion by pre-hospital notification and site

Site	Total analysed n	Proportion with pre-hospital notification %	Pre-hospital notification median minutes	No pre-hospital notification median minutes	Pre-hospital notification target met %	No pre-hospital notification target met %
CH	54	64.8	31	77	88.6	26.3
TUH	40	67.5	40	75	92.6	7.7
MBH	19	N/A	N/A	N/A	N/A	N/A
SCUH	77	70.1	29	84	90.7	17.4
TPCH	136	80.1	34	76	93.6	33.3
RBWH	49	77.6	32	73	100.0	36.4
PAH	177	85.3	34	85	94.0	38.5
IPH	3	N/A	N/A	N/A	N/A	N/A
GCUH	135	63.0	39	88	76.5	20.0
STATEWIDE	**690**	**74.2**	**34**	**83**	**90.2**	**25.3**

N/A Not displayed due to <20 cases eligible for analysis



IPH and MBH not displayed due to <20 cases eligible for analysis

Figure 24: STEMI presenting within six hours of symptom onset – proportion of cases where arrival at PCI hospital to first device ≤60 minutes by site and pre-hospital notification

6.3 NSTEMI – time to angiography

Time to coronary angiography for patients presenting to hospital with a NSTEMI remains a key clinical quality indicator for QCOR. Coronary angiography is necessary to determine the severity of coronary disease with both quality of life and prognostic implications for patients presenting with NSTEMI. National and International guidelines recommend coronary angiography should be performed within 72 hours of diagnosis. This duration is reduced to 24 hours for those deemed to be at high risk of major cardiac events.[20]

For this indicator, the QCOR committee recommended that the treatment timeframe for analysis should remain 72 hours in order to capture all-comers with the working diagnosis of NSTEMI.

A major barrier to early angiography is the time taken to transfer patients from non PCI capable facilities to the accepting PCI centre. Multiple reasons for delays include prolonged time to tertiary facility referral, capacity constraints at the ambulance and hospital level as well as patient transfer logistics in a large geographic area. In addition, several patient factors such as anaemia, renal impairment, language barriers and other delays to a patient's readiness for care can introduce further barriers to accessing timely angiography. It is hoped this may be able to be examined in detail in subsequent QCOR Audits.

Table 43 lists the cases excluded from analysis and the reasons for exclusion. These often relate to the clinical status of the patient at the time of their myocardial infarct or the course of events leading to their admission to a Queensland public interventional facility.

Table 43: NSTEMI time to angiography – cases excluded from analysis

	n
Planned or staged PCI	160
Admitted with an unrelated principal diagnosis	151
Transferred from an interstate hospital	40
Transferred from a private hospital	37
Stable non admitted patients transferred directly to lab for planned angiography	37
Coronary angiography not performed at index admission	28
Incomplete data	21
Total ineligible	**474**

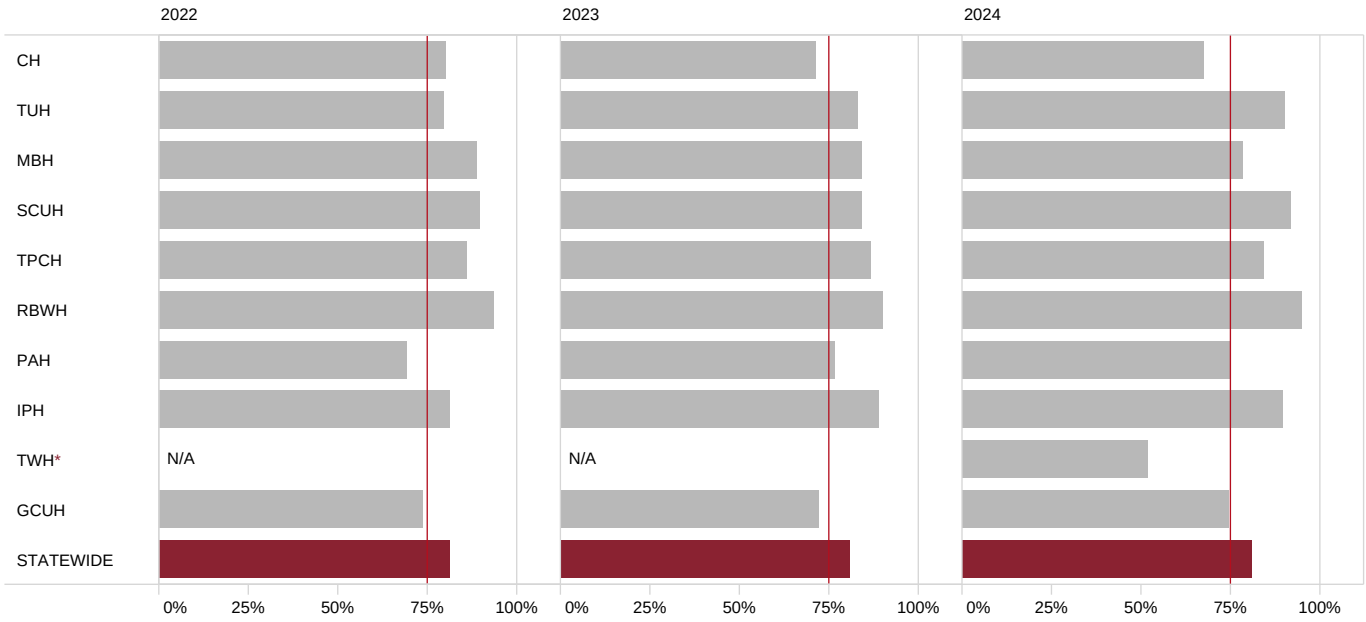
Patients presenting directly to a PCI capable facility had a median wait to coronary angiography time of 35 hours and were more likely to have angiography performed within the target timeframe of 72 hours compared with interhospital transfers (81% vs 56%).

For direct presenters, the wide range of 21 hours to 69 hours before angiography is influenced by several factors including patient demographics, clinical case mix and competing caseloads. The centres with ‹75% meeting target had the widest interquartile ranges, providing opportunity to review local factors that may be modifiable to promote time efficiencies.

Across the state, in comparison with 2023, there was for direct presenters (Table 44) a lower number of analysable NSTEMI cases (1,480 vs 1,592) and similar proportion meeting the 72 hour target. While for interhospital transfers (Table 45), there was an increased number of analysable cases (1,358 vs 1,282) and a slight increase in the proportion meeting the target (56% vs 55%). Some of these patterns may be attributable to new angiography-capable facilities coming online during 2022 (IPH) and 2023 (TWH) leading to a reduced number of interhospital transfers for NSTEMI.

Table 44: Time to angiography – direct to CCL facility

Site	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	173	152	46	23–82	67.8
TUH	153	139	26	16–47	90.6
MBH	94	89	27	18–70	78.7
SCUH	149	142	24	15–47	92.3
TPCH	349	306	29	15–51	84.3
RBWH	91	78	21	12–28	94.9
PAH	244	207	44	23–72	75.4
IPH	118	109	38	25–51	89.9
TWH	31	31	69	36–102	51.6
GCUH	240	227	43	21–72	74.9
STATEWIDE	**1,642**	**1,480**	**35**	**18–63**	**81.2**



* New CCL facility from 2023 onwards

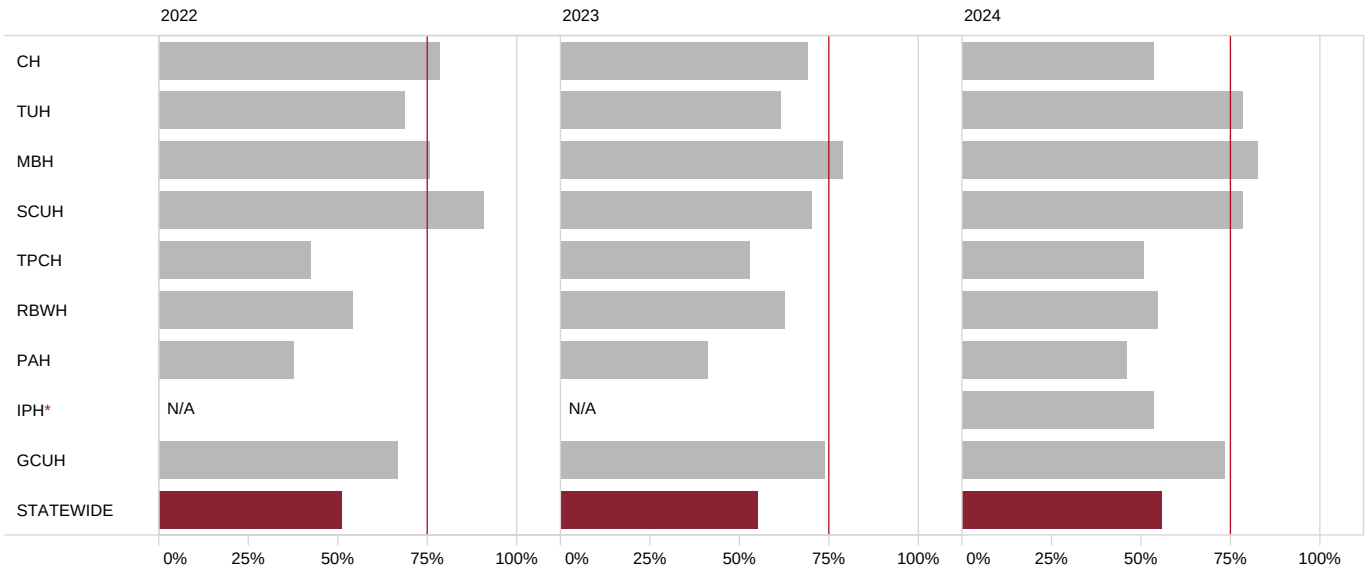
Figure 25: Proportion of NSTEMI direct presenters receiving angiography within 72 hours, 2022–2024

These data highlight the ongoing potential for overall system improvement and need to review statewide and local strategies to deal with two distinct cohorts – direct presenters and interhospital transfers. The median time to angiography in this group has decreased to 66 hours from 70 hours in 2022, however this is still above the 63 hours reported in 2021.

Table 45: Time to angiography – interhospital transfers

Site	Total cases n	Total analysed n	Median hours	Interquartile range hours	Met 72 hour target %
CH	125	102	70	40–97	53.9
TUH	76	66	47	31–68	78.8
MBH	68	53	49	28–66	83.0
SCUH	125	89	44	27–68	78.7
TPCH	419	338	71	41–116	50.6
RBWH	246	210	68	40–94	54.8
PAH	460	396	76	48–118	46.2
IPH	31	28	71	47–113	53.6
TWH	6	N/A	N/A	N/A	N/A
GCUH	114	72	45	23–72	73.6
STATEWIDE	**1,670**	**1,358**	**66**	**40–103**	**56.0**

N/A Not displayed due to <20 cases eligible for analysis



TWH is not displayed due to <20 cases available for analysis per year

* Service not offered in 2022 and 2023

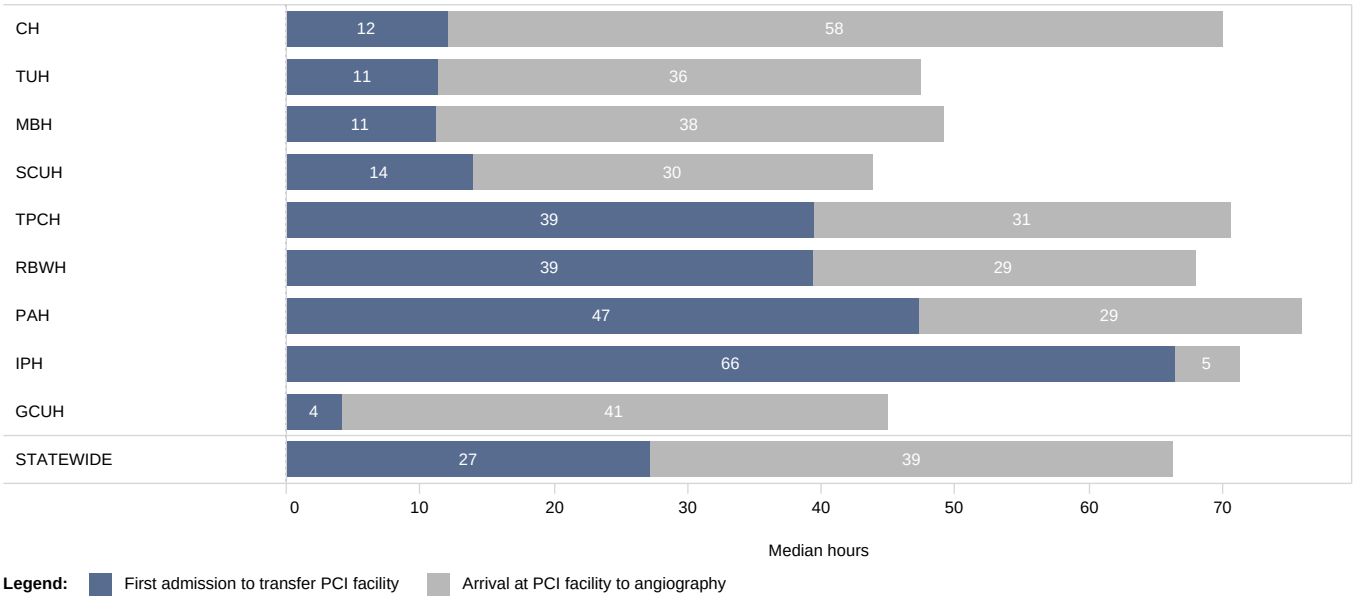
Figure 26: Proportion of NSTEMI interhospital transfers receiving angiography within 72 hours, 2022–2024

6.3.1 NSTEMI interhospital transfers – time to transfer to PCI facility

The median time to transfer NSTEMI patients to the PCI-capable facility for angiography was 27 hours, ranging from 3 hours to 51 hours by institution.

The trend towards increased time to transfer NSTEMI patients within the Metropolitan areas is likely attributable to referring facilities having a higher capacity to hold and monitor NSTEMI patients prior to being transferred.

Once transferred to the PCI facility the median time from arrival to angiography being performed was 40 hours.



Excludes interhospital transfers originating in New South Wales or from a private hospital

TWH not displayed due to <20 cases eligible for analysis

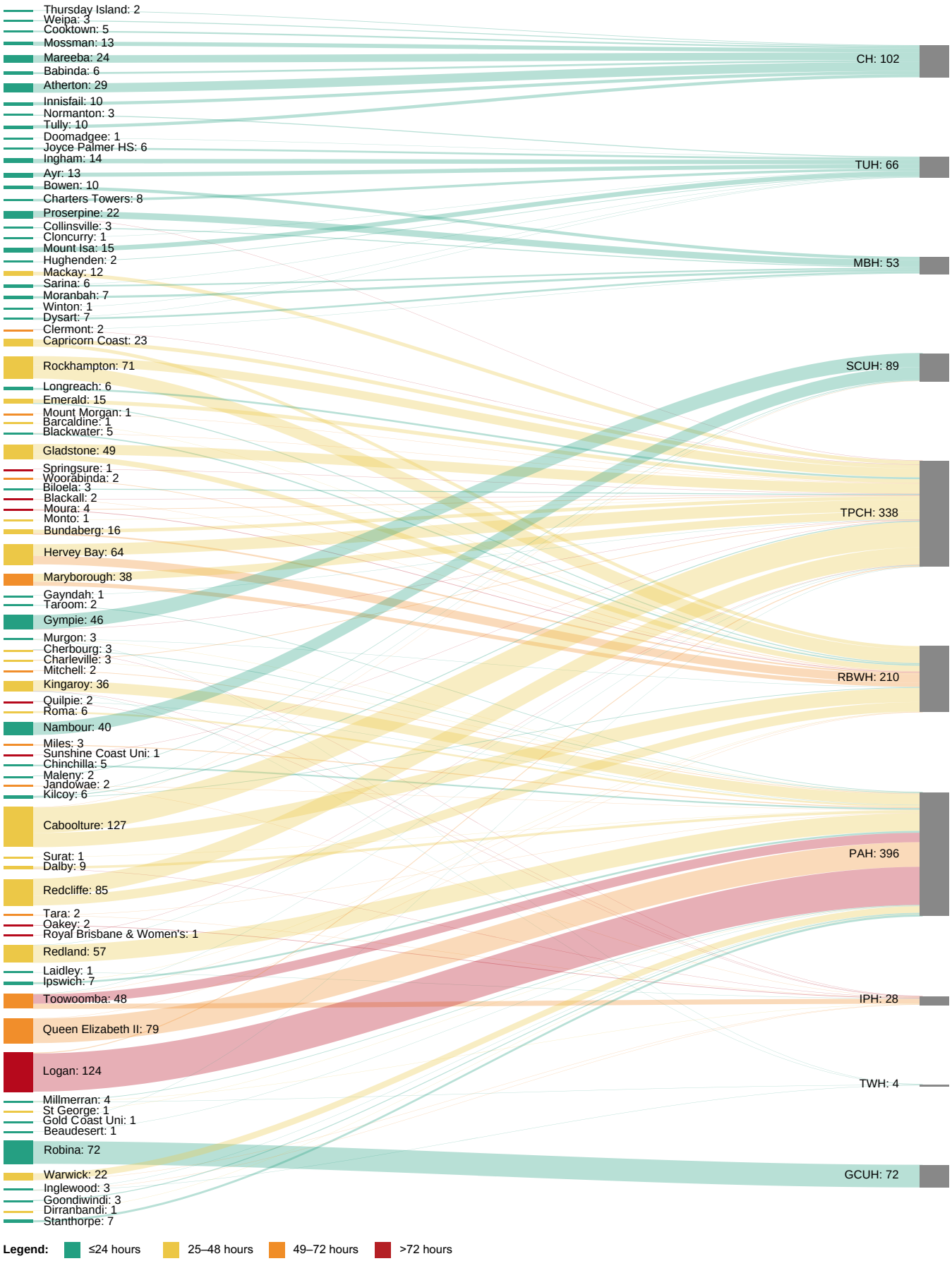
Figure 27: Median duration to transfer to CCL facility for angiography, NSTEMI interhospital transfers

Table 46: Median times to transfer to CCL facility for angiography, NSTEMI interhospital transfers

Site	Total cases n	Total analysed n	Median (IQR) distance transferred kilometres	Median time to transfer to PCI facility hours	Median overall time to angiography hours
CH	125	102	90 (63–93)	12	70
TUH	76	66	302 (133–853)	11	47
MBH	68	53	125 (125–192)	11	49
SCUH	125	89	47 (30–93)	14	44
TPCH	419	338	275 (39–505)	39	71
RBWH	246	210	281 (45–611)	39	68
PAH	460	396	24 (24–155)	47	76
IPH	31	28	91 (91–177)	66	71
TWH	6	4	N/A	N/A	N/A
GCUH	114	72	17 (17–17)	4	45
STATEWIDE	**1,670**	**1,358**	**90 (27–281)**	**27**	**66**

Excludes interhospital transfers originating in New South Wales or from a private hospital

N/A Not displayed due to <20 cases eligible for analysis



Excludes interhospital transfers originating in New South Wales or from a private hospital

Figure 28: Median times to transfer to PCI facility for angiography by transferring facility

Of 3,312 total NSTEMI cases, there were 2,838 cases included in the analysis of which 50% were interhospital transfers. The median time to angiography with or without PCI was 47 hours. This consistent with the previous year. There was a modest decrease in the proportion of cases meeting the target time (69%) compared to 70% in 2023.

Table 47: NSTEMI time to angiography by site

Site	Total NSTEMI cases n	Total analysed n	Interhospital transfers %	Median hours	Interquartile range hours	Met 72 hour target %
CH	298	254	41.9	53	27–91	62.2
TUH	229	205	33.2	35	19–57	86.8
MBH	162	142	42.0	41	20–68	80.3
SCUH	274	231	45.6	34	18–54	87.0
TPCH	768	644	54.6	46	23–90	66.6
RBWH	337	288	73.0	49	26–85	65.6
PAH	704	603	65.3	66	39–105	56.2
IPH	149	137	20.8	42	28–63	82.5
TWH	37	35	16.2	64	36–102	54.3
GCUH	354	299	32.2	43	21–72	74.6
STATEWIDE	**3,312**	**2,838**	**50.4**	**47**	**24–82**	**69.2**

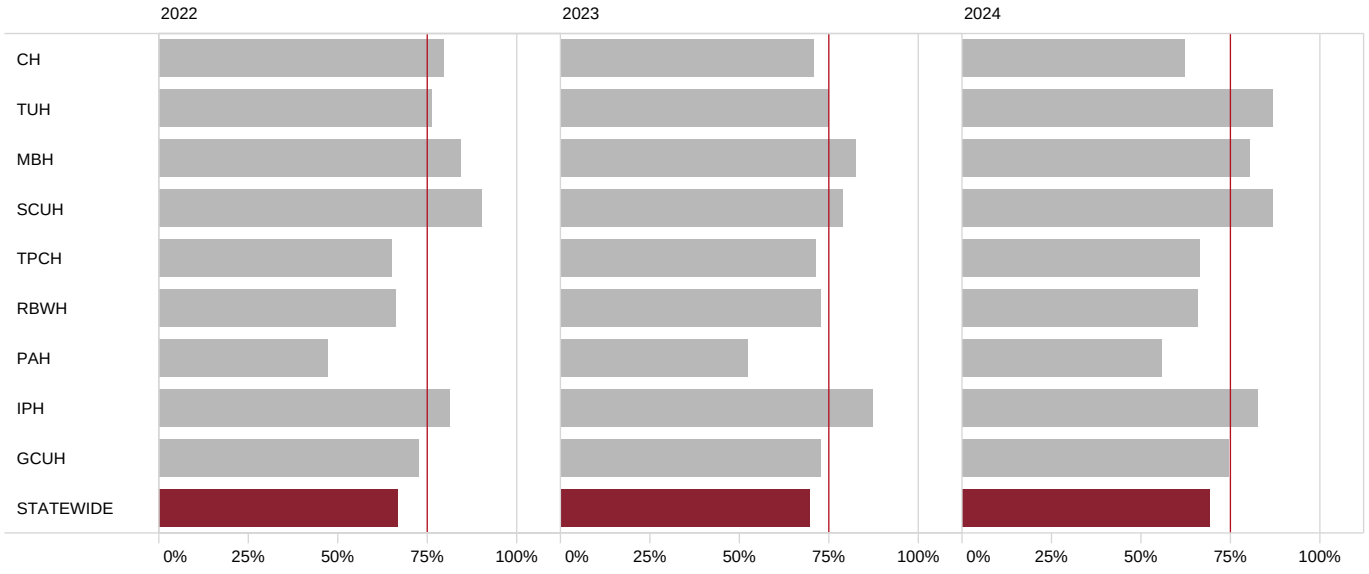


Figure 29: Proportion of NSTEMI cases meeting time to angiography target of 72 hours, 2022–2024

6.4 Major procedural complications

This quality indicator examines in-lab intra-procedural complications. In 2024, 28 cases (0.54%) recorded an immediate major procedural complication.

Events included in this analysis are coronary artery perforation, in-lab death, cerebrovascular accident (CVA), pericardial tamponade and emergency CABG. Processes are in place to ensure data integrity relating to these events. Limitations exist with using administrative datasets and intra-registry data linkage to examine complication rates, however these do assist with examining cases where complications occurred during the patient admission or encounter.

While the use of data linkage provides a means of verification, this indicator remains dependant on high-quality data being entered by clinicians in the first instance. The numbers of reported events remain low, rendering further comment difficult other than to state that it is reassuring.

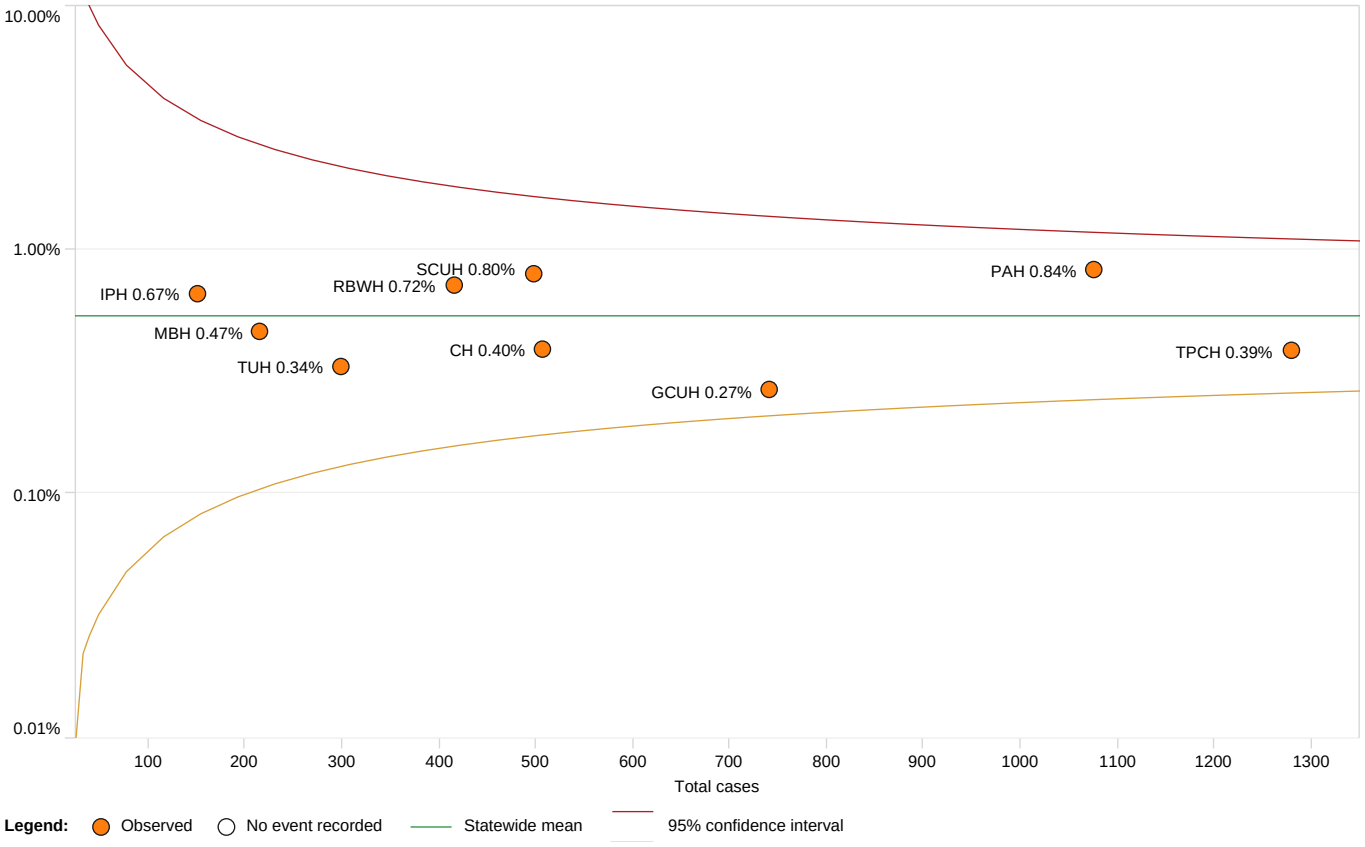


Figure 30: Proportion of PCI cases with immediate major procedure complication by site

Table 48: All PCI cases by immediate major procedural complication type

Complication type	Case n	%
Major intra-procedural complication	**28**	**0.54**
Coronary artery perforation	20	0.39
In-lab death*	4	0.08
Tamponade	2	0.04
Emergency CABG	2	0.04
No immediate major procedural complication	5,146	99.46
Total	**5,174**	**100.00**

* Excluding salvage deaths

6.5 High radiation doses

Staff and patients are exposed to ionising radiation during the majority of all procedures performed in the CCL. Ionising radiation is known to cause both delayed (stochastic) and immediate (deterministic) effects. The main stochastic effect is cancer, with the probability of experiencing the effect presumed to be proportional to the dose received (with no minimum threshold). For deterministic effects (such as erythema, epilation and desquamation), there is believed to be a threshold dose below which no effect is likely to occur but above which the severity of the effect is linked to the dose received.

Fortunately, conservative thresholds are applied and monitored throughout Queensland to maximise the benefit received by the patient while minimising the risk of experiencing any deterministic effects. However, as the complexity of procedural work undertaken by interventional cardiologists increases, along with an increase in patients with a large body mass, it is increasingly important to remain vigilant about radiation hygiene. This indicator examines the proportion of cases exceeding the high dose threshold of 5 Gy that has been set to identify patients at risk of developing deterministic effects.

Patients exceeding this threshold are proactively managed by the individual units to ensure that any deterministic effects that may subsequently arise are identified and treated appropriately.

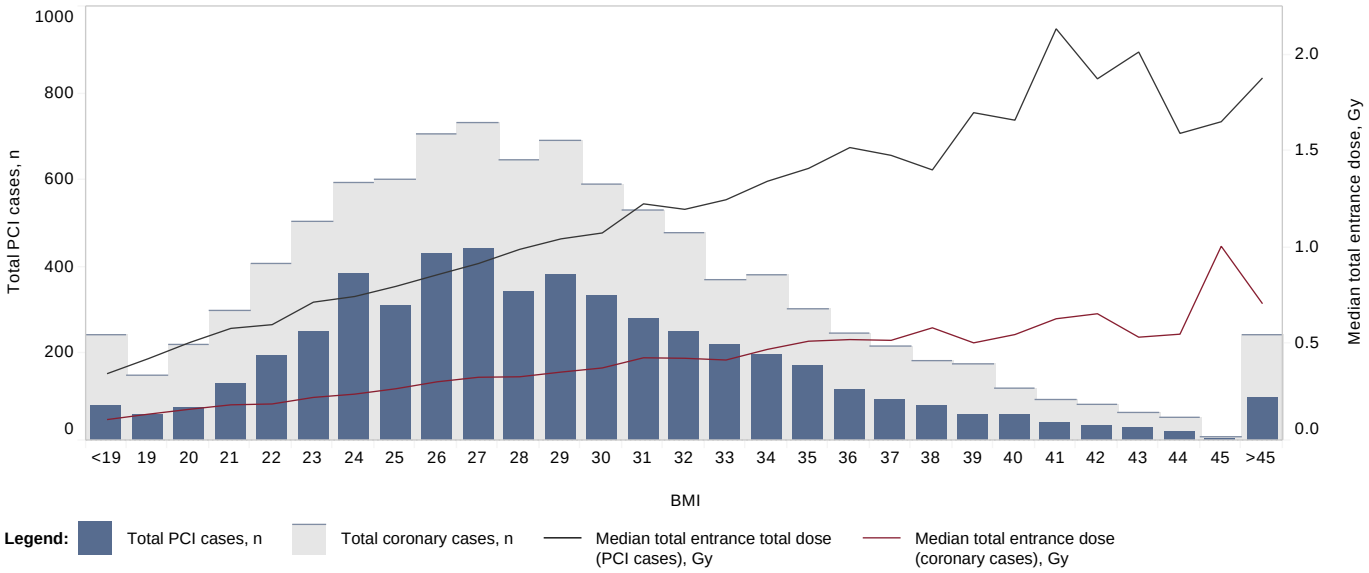


Figure 31: PCI and other coronary procedures median total entrance dose by body mass index

Table 49: Proportion of cases meeting the safe dose threshold by case type

Site	PCI procedures %	Other coronary procedures %
CH	100.0	99.9
TUH	100.0	99.9
MBH	100.0	99.8
SCUH	100.0	99.9
TPCH	99.1	100.0
RBWH	99.8	100.0
PAH	97.1	100.0
IPH	99.3	99.5
TWH	–	100.0
GCUH	99.2	100.0
STATEWIDE	**99.0**	**›99.9**

7 Supplement: Structural heart disease

Transcatheter interventions have transformed the management of valvular and structural heart disease (SHD), offering less invasive alternatives to surgery for an expanding patient population. The most notable shift has been the adoption of transcatheter aortic valve replacement (TAVR) as the preferred therapy for severe symptomatic aortic stenosis for the majority of patients. Once reserved for inoperable patients, robust evidence from landmark trials and registry data has demonstrated equivalent or superior outcomes for TAVI compared with surgical valve replacement, with shorter hospital stays, faster recovery, and durable long-term results.

Advances in device technology, imaging, and procedural techniques have driven this evolution. Contemporary transcatheter valves feature lower-profile delivery systems, improved sealing skirts, and enhanced durability, while multimodality imaging has optimised patient selection and procedural precision. The integration of CT planning, conscious sedation, and minimalist procedural pathways has further streamlined TAVR, reducing complications and broadening access in routine clinical practice.

Beyond the aortic valve, transcatheter therapies are rapidly expanding into other domains of structural heart disease. Mitral and tricuspid transcatheter repair and replacement systems, left atrial appendage occlusion, and percutaneous closure of paravalvular leaks exemplify the technological and clinical progress redefining structural intervention.

Since 2018, there has been a 123% increase in the volume of transcatheter valve interventions including percutaneous valvuloplasty and replacement procedures in Queensland public facilities. With a notable 88% increase evident in the period from 2021 to 2024. Device closure procedures have seen growth of 129% since 2018.

For transcatheter valve replacements the total number of procedures undertaken across Queensland public facilities increased 243% from 151 in 2018 to 518 in 2024 – including a 232% increase in TAVR procedures, from 148 to 492.

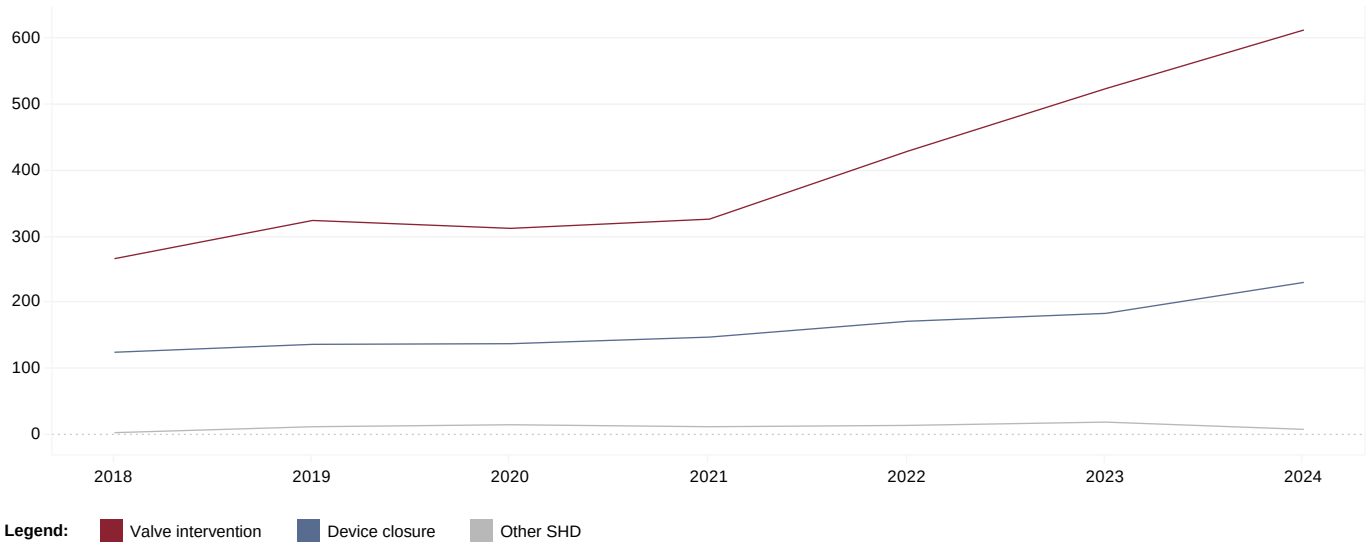


Figure 1: SHD cases by procedure category (2018–2024)

7.1 Participating sites

A total of 853 SHD interventions were performed across the seven Queensland public cardiac catheterisation laboratories. Almost three-quarters (72%) of cases were valvular interventions including percutaneous valve replacement and valvuloplasty procedures.

Table 1: Total SHD cases by participating site

Site	Total cases n	Device closure* n (%)	Valvular intervention† n (%)	Other‡ n (%)
CH	31	27 (87.1)	4 (12.9)	–
TUH	33	4 (12.1)	29 (87.9)	–
SCUH	26	22 (84.6)	4 (15.4)	–
TPCH	353	51 (14.4)	297 (84.1)	5 (1.4)
RBWH	26	24 (92.3)	2 (7.7)	–
PAH	294	78 (26.5)	213 (72.4)	3 (1.0)
GCUH	90	25 (27.8)	65 (72.2)	–
STATEWIDE	**853**	**231 (27.1)**	**614 (72.0)**	**8 (0.9)**

* Includes percutaneous closure of ASD, PFO, PDA, LAA, VSD and paravalvular leak

† Percutaneous valve replacement and valvuloplasty

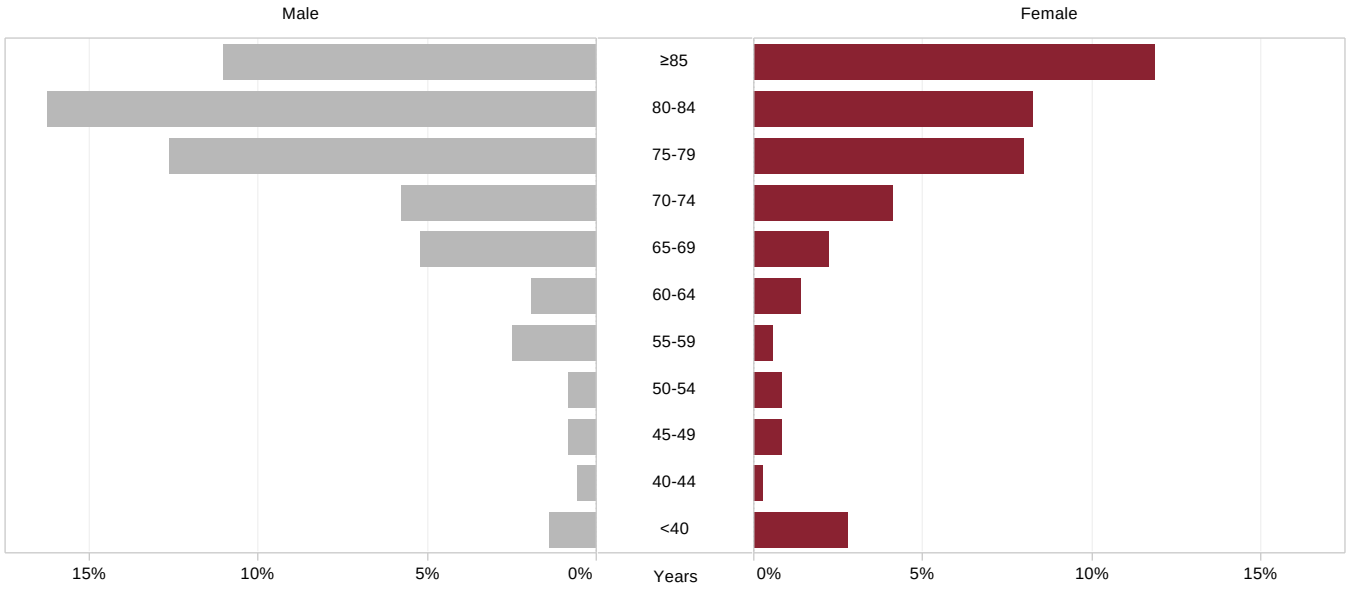
‡ Myocardial septal ablation, renal denervation and percutaneous insertion of pulmonary arterial pressure monitoring device

7.2 Patient characteristics

7.2.1 Age and gender

Most patients undergoing an SHD intervention were male (62%). Almost one-quarter (23%) of all procedures were performed on patients aged 85 years and older.

Age varied considerably by procedure category, with patients undergoing a valvular intervention having an overall median age of 81 years compared to 49 years for device closure procedures.



% of total (n=853)

Figure 2: Proportion of all SHD cases by gender and age group

Table 2: Median age by gender and procedure category

	Male years	Female years	ALL years
Device closures	53	49	52
Valvular intervention	80	80	80
Other	57	64	57
ALL	77	78	77

7.3 Care and treatment of SHD patients

7.3.1 Device closures

There were 231 device closures performed across the seven participating centres. The majority of procedures involved atrial septal closure devices for the correction of a patent foramen ovale (PFO) and atrial septal defect (ASD), at 66% and 21% of case volumes respectively. A smaller proportion of cases were for left atrial appendage (LAA) closure and interventions to address prosthetic valve paravalvular leaks.

Table 3: Device closure procedures by participating site

Site	Total cases n	PFO* n (%)	ASD† n (%)	VSD‡ n (%)	PDA§ n (%)	LAA‖ n (%)	Paravalvular leak n (%)
CH	27	21 (77.8)	6 (22.2)	–	–	–	–
TUH	4	2 (50.0)	2 (50.0)	–	–	–	–
SCUH	22	16 (72.7)	6 (27.3)	–	–	–	–
TPCH	51	22 (43.1)	6 (11.8)	1 (2.0)	1 (2.0)	15 (29.4)	6 (11.8)
RBWH	24	21 (87.5)	3 (12.5)	–	–	–	–
PAH	75	51 (65.4)	19 (24.4)	–	–	8 (10.3)	–
GCUH	25	19 (76.0)	6 (24.0)	–	–	–	–
STATEWIDE	**231**	**152 (65.8)**	**48 (20.8)**	**1 (0.4)**	**1 (0.4)**	**23 (10.0)**	**6 (2.6)**

* Patent foramen ovale

† Atrial septal defect

‡ Ventricular septal defect

§ Patent ductus arteriosus

‖ Left atrial appendage

7.3.2 Valvular interventions

The total number of valvular interventions performed across the seven participating sites was 614, comprising of transcatheter valve replacement (84%) and transcatheter valvuloplasty (16%) procedures.

The aortic valve was the most common valve requiring intervention, accounting for 88% of cases.

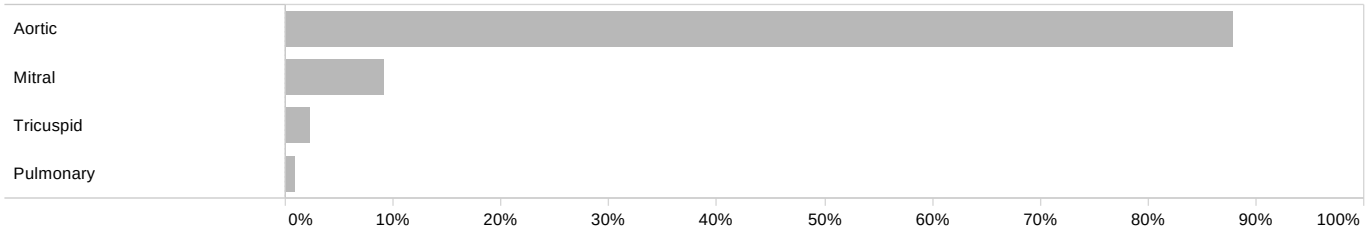


Figure 3: Proportion of all transcatheter valvular interventions by valve type

Table 4: Transcatheter valvular interventions by cardiac valve

Site	Total cases n	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)
CH	4	3 (75.0)	–	–	1 (25.0)
TUH	29	28 (96.6)	1 (3.4)	–	–
SCUH	4	4 (100.0)	–	–	–
TPCH	297	242 (81.5)	38 (12.8)	13 (4.4)	4 (1.3)
RBWH	2	2 (100.0)	–	–	–
PAH	213	195 (91.5)	17 (8.0)	1 (0.5)	–
GCUH	65	65 (100.0)	–	–	–
STATEWIDE	**614**	**539 (87.8)**	**56 (9.1)**	**14 (2.3)**	**5 (0.8)**

Table 5: Transcatheter valvular interventions by type

Site	Total cases n	Transcatheter valve replacement n (%)	Transcatheter valvuloplasty* n (%)
CH	4	–	4 (100.0)
TUH	29	26 (89.7)	3 (10.3)
SCUH	4	–	4 (100.0)
TPCH	297	234 (78.8)	63 (21.2)
RBWH	2	–	2 (100.0)
PAH	213	196 (92.0)	17 (8.0)
GCUH	65	62 (95.4)	3 (4.6)
STATEWIDE	**614**	**518 (84.4)**	**96 (15.6)**

* Includes transcatheter edge-to-edge repair procedures

Transcatheter procedures to repair heart valves comprised of 16% of all valve procedures. Edge-to-edge valve repair accounted for 46% of all valvuloplasty procedures, with mitral edge-to-edge repair being most common (84%).

The evolution of transcatheter based technology has meant that transcatheter valve replacement procedures have become an increasing common approach for treating patients with conditions often otherwise reliant on cardiac surgery. There were four sites that offered transcatheter valve replacement procedures where the vast majority were transcatheter aortic valve replacement (95%).

Table 6: Transcatheter valvuloplasty procedures

Site	Balloon aortic valvuloplasty n (%)	Balloon mitral valvuloplasty n (%)	Balloon tricuspid valvuloplasty n (%)	Balloon pulmonary valvuloplasty n (%)
CH	3 (75.0)	–	–	1 (25.0)
TUH	2 (66.7)	1 (33.3)	–	–
SCUH	4 (100.0)	–	–	–
TPCH	28 (93.3)	2 (6.7)	–	–
RBWH	2 (100.0)	–	–	–
PAH	5 (83.3)	1 (16.7)	–	–
GCUH	3 (100.0)	–	–	–
STATEWIDE	**47 (90.4)**	**4 (7.7)**	**0 (0.0)**	**1 (1.9)**

Table 7: Transcatheter edge-to-edge repair procedures

Site	Mitral valve edge-to-edge repair n (%)	Tricuspid valve edge-to-edge repair n (%)
TPCH	26 (78.8)	7 (21.2)
PAH	11 (100.0)	–
STATEWIDE	**37 (84.1)**	**7 (15.9)**

Table 8: Transcatheter valve replacement procedures

Site	TAVR* n (%)	TMVR† n (%)	TTVR‡ n (%)	TPVR§ n (%)
TUH	26 (100.0)	–	–	–
TPCH	214 (91.5)	10 (4.3)	6 (2.6)	4 (1.7)
PAH	190 (96.9)	5 (2.6)	1 (0.5)	–
GCUH	62 (100.0)	–	–	–
STATEWIDE	**492 (95.0)**	**15 (2.9)**	**7 (1.4)**	**4 (0.8)**

* Transcatheter aortic valve replacement/implantation

† Transcatheter mitral valve replacement

‡ Transcatheter tricuspid valve replacement

§ Transcatheter pulmonary valve replacement

Table 9: Other structural heart disease interventions

Site	Myocardial septal ablation n (%)	Percutaneous insertion of pulmonary arterial pressure monitoring device n (%)	Renal denervation n (%)
TPCH	2 (40.0)	2 (40.0)	1 (20.0)
PAH	3 (100.0)	–	–
STATEWIDE	**5 (62.5)**	**2 (25.0)**	**1 (12.5)**

7.4 Patient outcomes

7.4.1 All-cause 30 day mortality

Thirty day mortality rates typically reflect the success of the procedural or technical component of any intervention. Across the seven public cardiac catheterisation laboratories in Queensland that offer SHD interventions, the all-cause, unadjusted 30 day mortality rate for all SHD procedures was 2.0%. Further descriptions of longer term outcomes for TAVR cohorts from previous years are discussed further in the subsequent analysis.

Table 10: All-cause unadjusted 30 day mortality post SHD intervention by procedure category and site

Site	Total cases n	Device closure n (%)	Valvular intervention n (%)	Other n (%)	Total mortality n (%)
CH	31	0 (0.0)	1 (25.0)	–	1 (3.2)
TUH	33	0 (0.0)	1 (3.4)	–	1 (3.0)
SCUH	26	0 (0.0)	0 (0.0)	–	0 (0.0)
TPCH	353	2 (3.9)	11 (3.7)	0 (0.0)	13 (3.7)
RBWH	26	0 (0.0)	0 (0.0)	–	0 (0.0)
PAH	294	0 (0.0)	1 (0.5)	0 (0.0)	1 (0.3)
GCUH	90	0 (0.0)	1 (1.5)	–	1 (1.1)
STATEWIDE	**853**	**2 (0.9)**	**15 (2.4)**	**0 (0.0)**	**17 (2.0)**

7.4.2 Transcatheter aortic valve replacement cases

Patients who undergo TAVR are typically of relatively advanced age and usually present with multiple comorbidities and risk factors that result in a transcatheter therapy being a more suitable procedure than a traditional open surgical aortic valve replacement (SAVR). Patient selection is based on a large volume of published randomised control trial data. Multiple data-sets have indicated overall comparable short and longer-term outcomes with TAVR and SAVR but with shorter length of stay and a trend to a lower risk of major complications, greater patient satisfaction and lower mortality.[21,22,23,24] Longer term data is so far showing an apparent equivalent valve durability between TAVR and SAVR bio-prostheses although longer term and larger data-sets are required.[23] The age of patients undergoing TAVR is slowly falling as the propensity to use TAVR on lower risk patients increases – this is in-line with and supported by large randomised trial data in addition to international guidelines.[25] There is also an expanding scope for TAVR as treatment for degenerated previously implanted SAVR bioprostheses as a lower risk management strategy.[26]

Table 11: Median age of TAVR patients by year

Year	Total cases n	Median age at procedure years	Interquartile range years	Proportion ≥80 years age at procedure %
2018	148	85	80–88	73.0
2019	249	83	78–86	66.3
2020	249	81	76–85	60.2
2021	239	83	77–86	62.3
2022	335	81	76–86	57.0
2023	420	81	75–86	54.4
2024	492	80	77–85	51.6

2024 cases

Of the four sites performing TAVR in 2024, the all-cause unadjusted mortality rate within 30 days of the procedure for the statewide cohort was 2.0%.

Table 12: All-cause unadjusted 30 day mortality post TAVR by site

Site	Total cases n	Male %	Median age at procedure years	30 day mortality n (%)
TUH	26	65.4	81	0 (0.0)
TPCH	214	59.8	81	8 (3.7)
PAH	190	58.9	78	1 (0.5)
GCUH	62	74.2	82	1 (1.6)
STATEWIDE	**492**	**61.6**	**80**	**10 (2.0)**

2023 and 2022 cases

Of the four sites performing TAVR in 2023, the overall all-cause unadjusted mortality rate within 30 days of the procedure was 2.6%, and 9.0% at one year. For the TAVR procedures performed in 2022, the overall all-cause unadjusted mortality rate at two years post procedure was 12.2%. This is in-line with similarly age and risk matched international cohorts from high-volume TAVR centres.[27,28,29] It is recognised that all-cause mortality, especially beyond 30 days, include patient factors not necessarily related to the procedure or intervention in this older and often comorbid patient group.

Table 13: All-cause unadjusted 30 day and 1 year mortality post TAVR by site (2023 cohort)

Site	Total cases n	Median age at procedure years	Interquartile range years	30 day mortality n (%)	1 year mortality n (%)
TUH	22	80	79–86	2 (9.1)	4 (18.2)
TPCH	204	82	76–86	7 (3.4)	23 (11.3)
PAH	154	79	74–84	1 (0.6)	8 (5.2)
GCUH	41	84	78–86	1 (2.4)	3 (7.3)
STATEWIDE	**421**	**81**	**75–86**	**11 (2.6)**	**38 (9.0)**

Table 14: All-cause unadjusted mortality up to 2 years post TAVR by site (2022 cohort)

Site	Total cases n	Median age at procedure years	Interquartile range years	30 day mortality n (%)	1 year mortality n (%)	2 year mortality n (%)
TUH	24	83	80–86	0 (0.0)	0 (0.0)	1 (4.2)
TPCH	179	83	76–87	4 (2.2)	12 (6.7)	29 (16.2)
PAH	103	79	75–83	1 (1.0)	5 (4.9)	9 (8.7)
GCUH	29	82	80–86	1 (3.4)	1 (3.4)	2 (6.9)
STATEWIDE	**335**	**81**	**76–86**	**6 (1.8)**	**18 (5.4)**	**41 (12.2)**

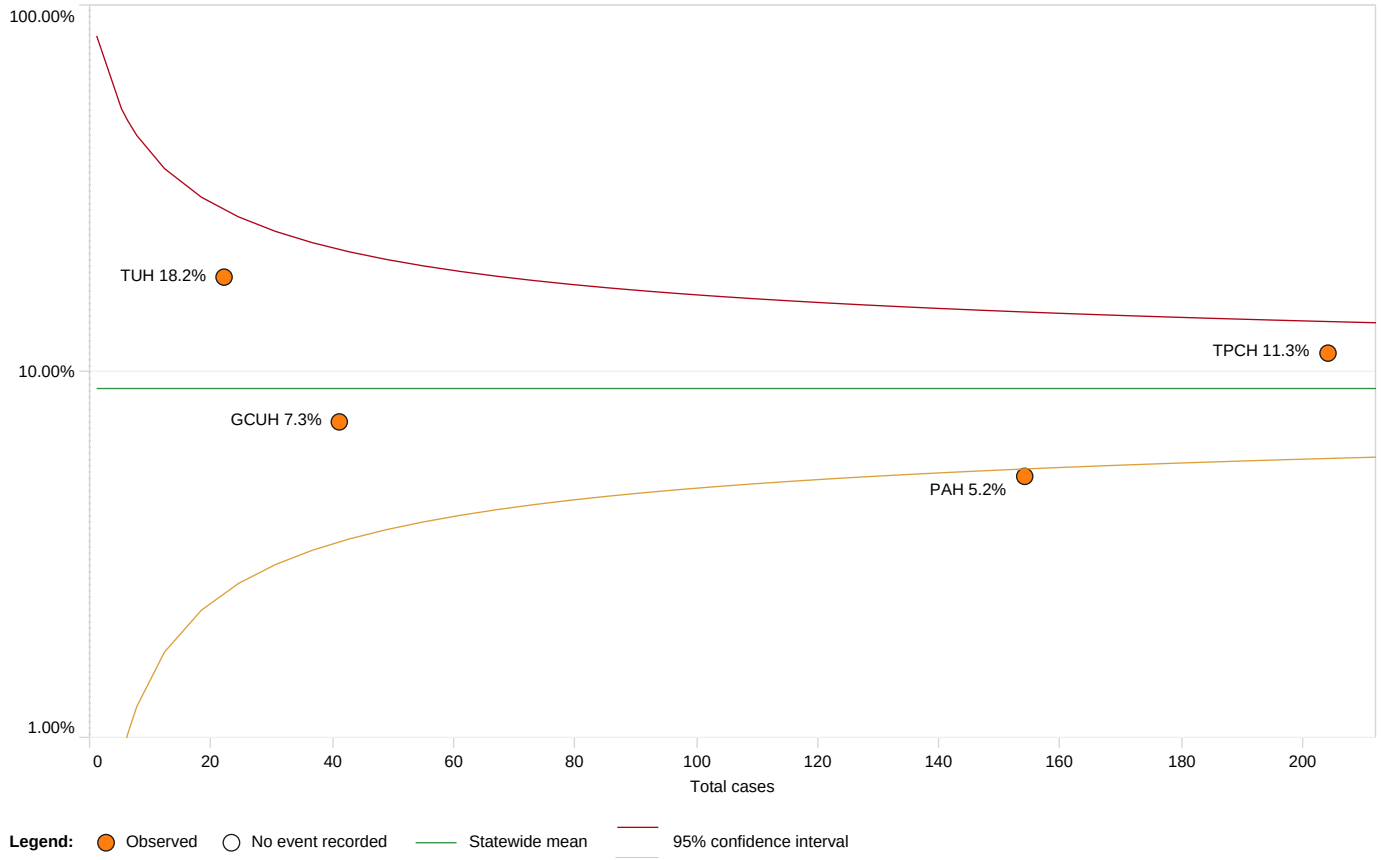
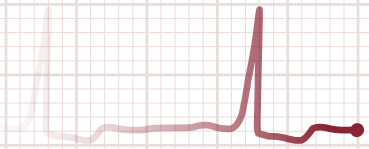


Figure 4: One year mortality post TAVR by site (2023 cohort)

Cardiac Surgery Audit



1 Key findings

This Queensland Cardiac Surgery Audit describes baseline demographics, risk factors, surgeries performed and surgery outcomes for 2024.

Key findings include:

- The number of surgeries performed across the four public adult cardiac surgery units in Queensland were 2,411.
- The majority of patients were aged between 61 years and 80 years of age (68%) with a median age of 66 years old.
- Approximately three-quarters of patients were male (75%).
- The majority of all patients were overweight or obese (75%), while almost one-quarter (24%) of patients had a body mass index within the normal range.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 7.7%, and had a wide variation between sites with 24% of patients in Townsville identifying as Aboriginal and Torres Strait Islander.
- The majority of patients had high blood pressure (69%) or high cholesterol (63%) or presented with a combination of several background risk factors.
- There were 28% of patients reported to be diabetic at the time of their operation, increasing to 39% 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.
- Almost half of all cases (47%) were elective admissions with 25% of elective patients being admitted on the day of surgery.
- In 2024, 1,295 patients had a CABG procedure, of whom the majority (92%) had multi-vessel disease.
- There were 285 patients who underwent aortic surgery. The majority of aortic procedures involved aortic replacement surgery (75%).
- Among the 1,160 patients undergoing valve surgery, the most common interventions were single valve replacements of the aortic valve (59%) or mitral valve (23%). Fourteen percent of valve surgeries involved multiple valves.
- The primary pathology for patients undergoing valvular surgery was degenerative valve disease (43%).
- Cardiac surgeons were involved in 29% of the 492 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.

2 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.

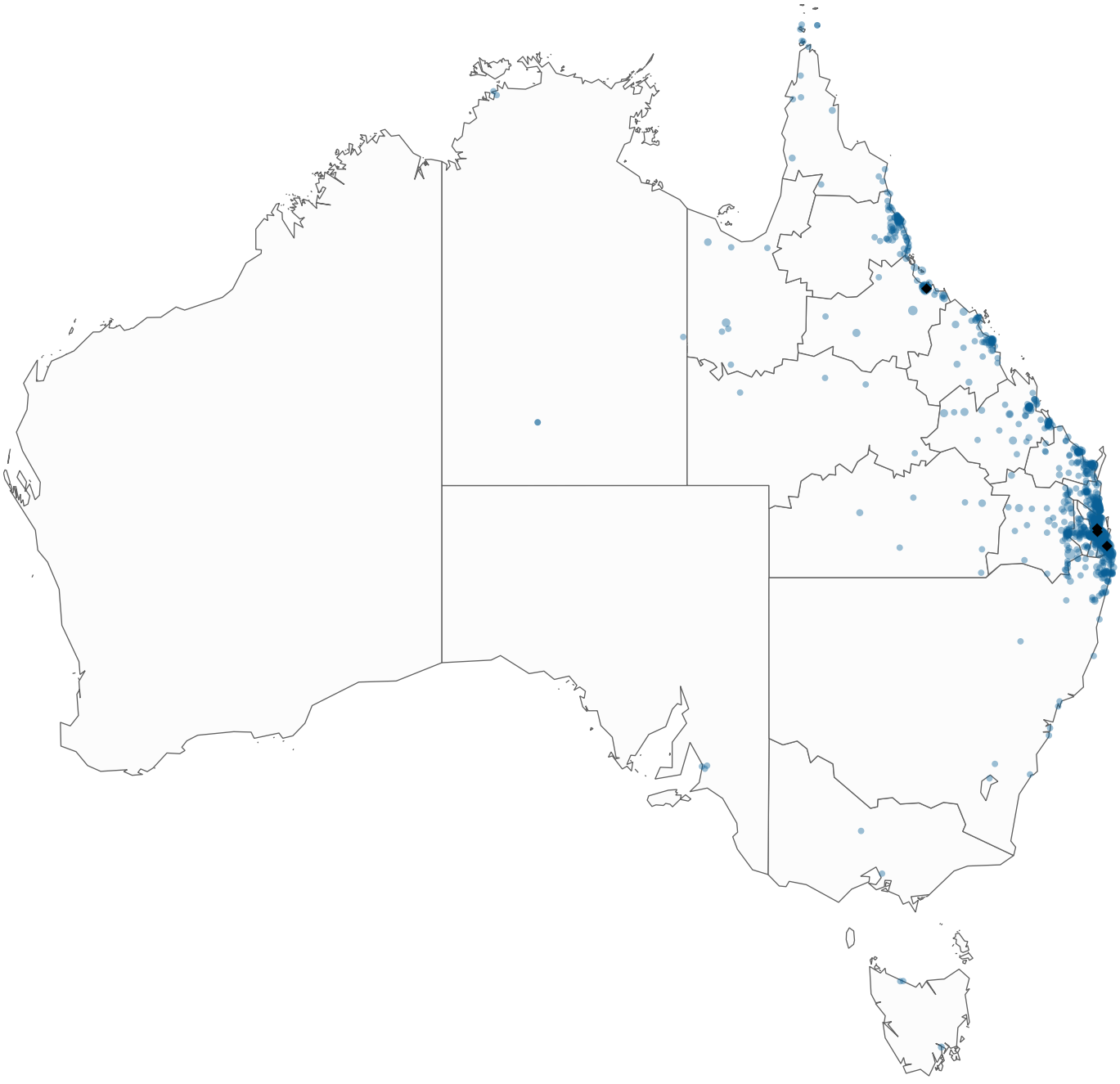
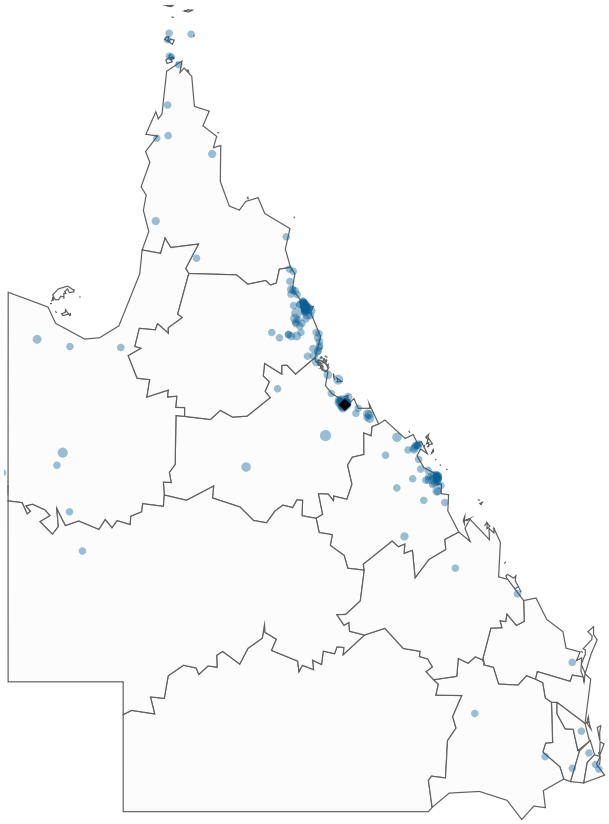


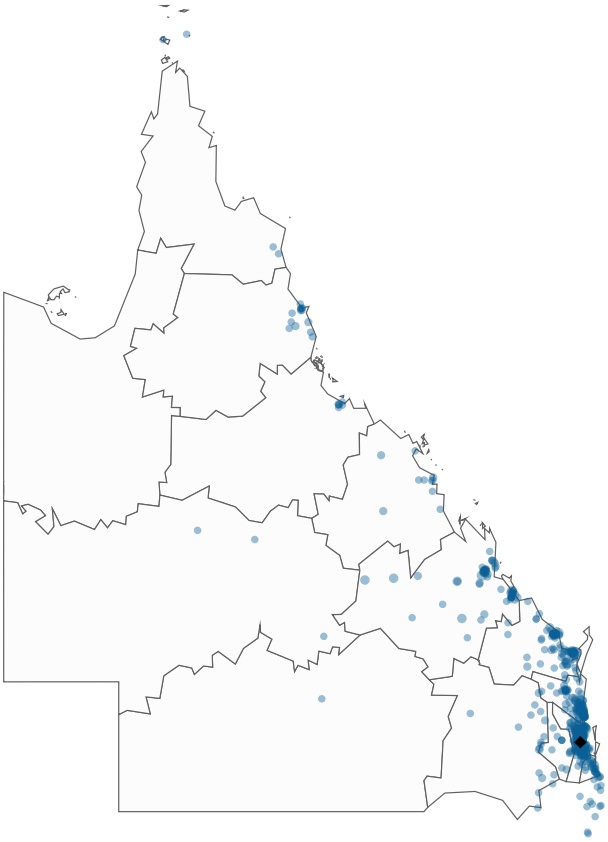
Figure 1: Cardiac surgery cases by residential postcode

Table 1: Participating sites

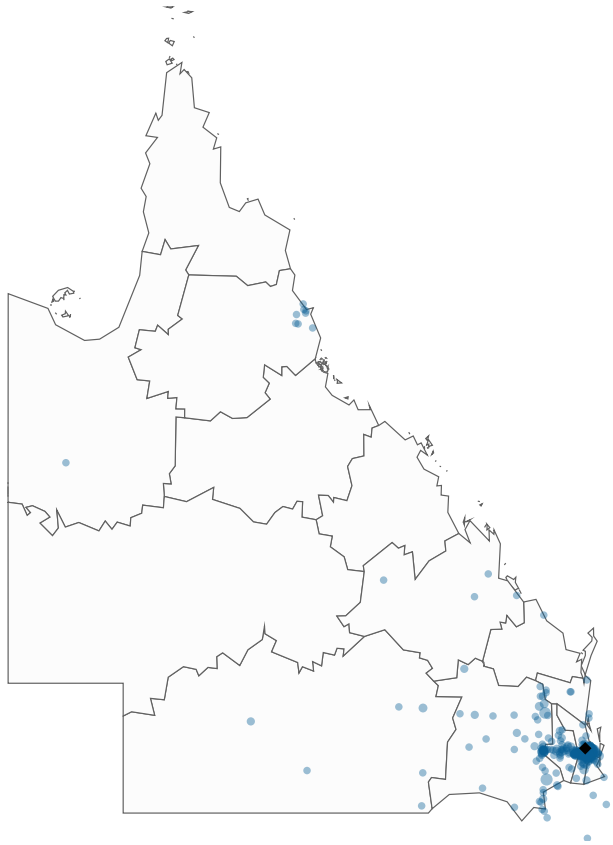
Acronym	Name
TUH	Townsville University Hospital
TPCH	The Prince Charles Hospital
PAH	Princess Alexandra Hospital
GCUH	Gold Coast University Hospital



Inset A: *Townsville University Hospital*



Inset B: *The Prince Charles Hospital*



Inset C: *Princess Alexandra Hospital*

Inset D: *Gold Coast University Hospital*

3 Case totals

3.1 Total surgeries

In 2024, the four public hospitals performed a total of 2,411 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 slight decrease in the total number of cases compared to the previous year, where the number of cardiac surgical procedures was 2,529.

Table 2: Procedure counts and surgery category

Procedure combination	Category*	Count n
CABG	ANY CABG	974
CABG + other cardiac procedure		68
CABG + other non-cardiac procedure		11
CABG + aortic procedure		7
CABG + other cardiac procedure + other non-cardiac procedure		1
CABG + valve	CABG + VALVE	161
CABG + valve + other cardiac procedure		47
CABG + valve + aortic procedure		15
CABG + valve + other non-cardiac procedure		6
CABG + valve + aortic procedure + other cardiac procedure		3
CABG + valve + other cardiac procedure + other non-cardiac procedure		2
Valve	VALVE†	522
Valve + other cardiac procedure		219
Valve + aortic procedure		142
Valve + aortic procedure + other cardiac procedure		22
Valve + other cardiac procedure + other non-cardiac procedure		10
Valve + other non-cardiac procedure		6
Valve + aortic procedure + other non-cardiac procedure		5
Other cardiac procedure	OTHER	81
Aortic procedure		78
Other cardiac procedure + other non-cardiac procedure		18
Aortic procedure + other cardiac procedure		12
Aortic procedure + other non-cardiac procedure		1
ALL		**2,411**

* Category procedure combination allocated

† Includes TAVR procedures involving CTS (n=140)

3.2 Cases by category

Approximately half (51%) of all cardiac surgery procedures involved coronary artery bypass grafting (CABG) with 7% involving a simultaneous CABG and valve procedure.

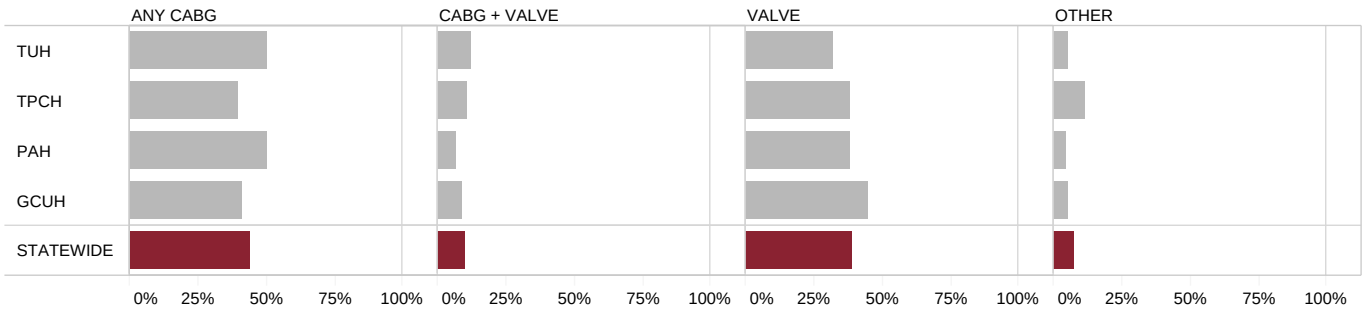


Figure 2: Proportion of cases by site and surgery category

Table 3: Proportion of cases by surgery category

SITE	All cases n	ANY CABG* n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)
TUH	366	184 (50.3)	45 (12.3)	117 (32.0)	20 (5.5)
TPCH	1,003	393 (39.2)	109 (10.9)	383 (38.2)	118 (11.8)
PAH	605	304 (50.2)	41 (6.8)	231 (38.2)	29 (4.8)
GCUH	437	180 (41.2)	39 (8.9)	195 (44.6)	23 (5.3)
STATEWIDE	**2,411**	**1,061 (44.0)**	**234 (9.7)**	**926 (38.4)**	**190 (7.9)**

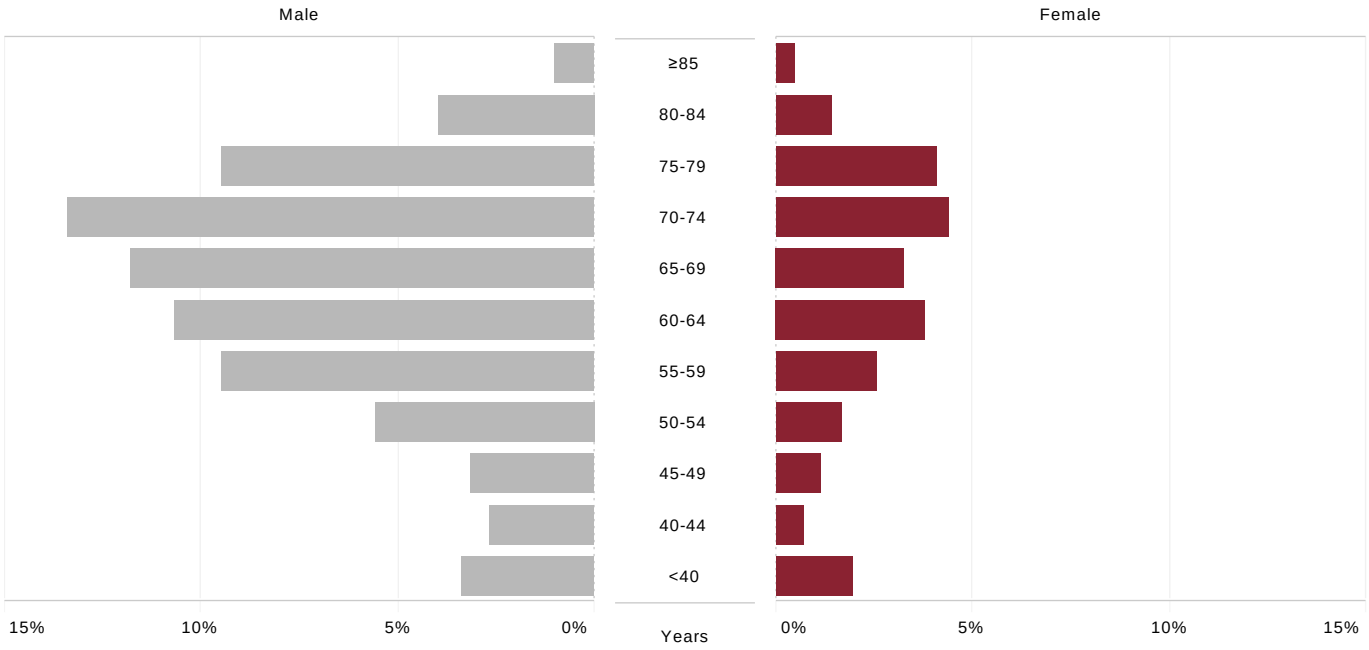
* Coronary artery bypass grafting procedures not including concurrent valve surgery, these operations may occur in isolation or in conjunction with aortic, non-cardiac or non-valvular cardiac interventions

4 Patient characteristics

4.1 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 (68%). The male cohort of 70 years to 74 years accounted for the largest proportion of cases (13% of all cases or 18% of males). Approximately 9% of surgeries were performed on patients younger than 45 years of age.

The median age for both males and females undergoing cardiac surgery was 66 years.



% of total (n=2,411)

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

Table 4: Median age by gender and surgery category

	Total cases n	Male years	Female years	ALL years
ANY CABG	1,061	66	65	66
CABG + VALVE	234	71	70	70
VALVE	926	66	67	66
OTHER	190	59	62	60
Total	**2,411**	**66**	**66**	**66**

Overall, three-quarters of patients were male (75%).

The largest proportion of females were represented in the valve surgery group (36%), closely followed by the other cardiac surgery (35%) category.

Surgeries involving CABG were more commonly performed on males than females (84% vs 16% respectively).

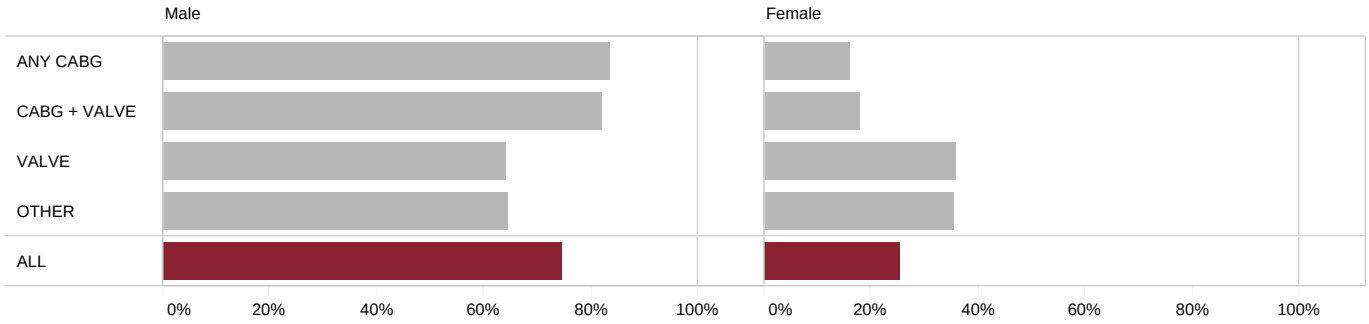


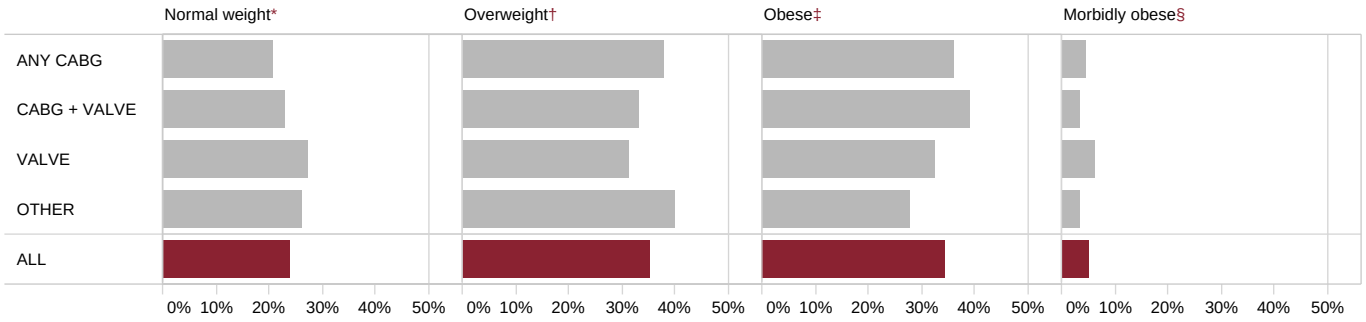
Figure 4: Proportion of cases by gender and surgery category

4.2 Body mass index

Almost one-quarter (24%) of patients undergoing heart surgery had a body mass index (BMI) in the healthy range, compared to 75% of patients who fell into the categories of overweight, obese, or morbidly obese.

Over on fifth (21%) of all patients undergoing CABG surgery were classed as having a BMI in the normal range.

Patients classed as underweight (BMI <18.5 kg/m²) represented 2% of all cases.



* 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 5: 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	8 (0.8)	221 (20.8)	401 (37.8)	383 (36.1)	48 (4.5)
CABG + VALVE	3 (1.3)	54 (23.1)	78 (33.3)	91 (38.9)	8 (3.4)
VALVE	24 (2.6)	252 (27.2)	291 (31.4)	302 (32.6)	57 (6.2)
OTHER	4 (2.1)	50 (26.3)	76 (40.0)	53 (27.9)	7 (3.7)
ALL	**39 (1.6)**	**577 (23.9)**	**846 (35.1)**	**829 (34.4)**	**120 (5.0)**

4.3 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 7.7%. This proportion is larger than the estimated 4.6% of the overall Queensland population that Aboriginal and Torres Strait Islander people account for.[2]

Almost one quarter (24%) of patients undergoing cardiac surgery at TUH identified as Aboriginal and Torres Strait Islander.

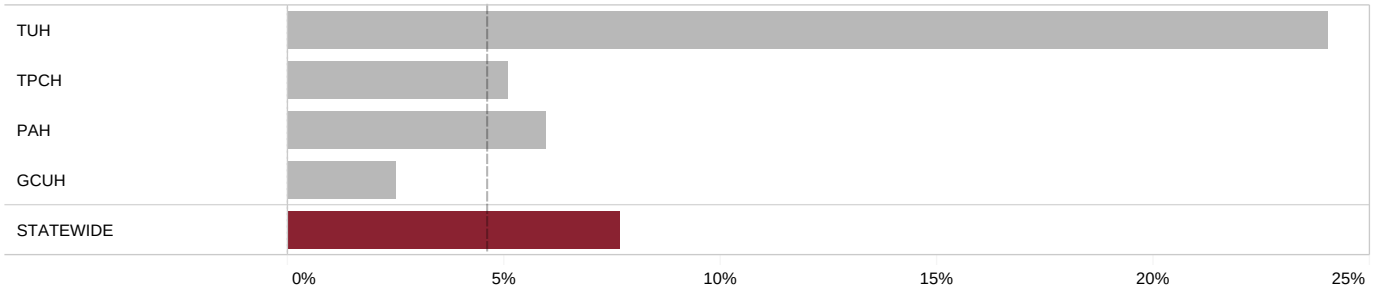


Figure 6: Proportion of all cardiac surgical cases by identified Aboriginal and Torres Strait Islander status and site

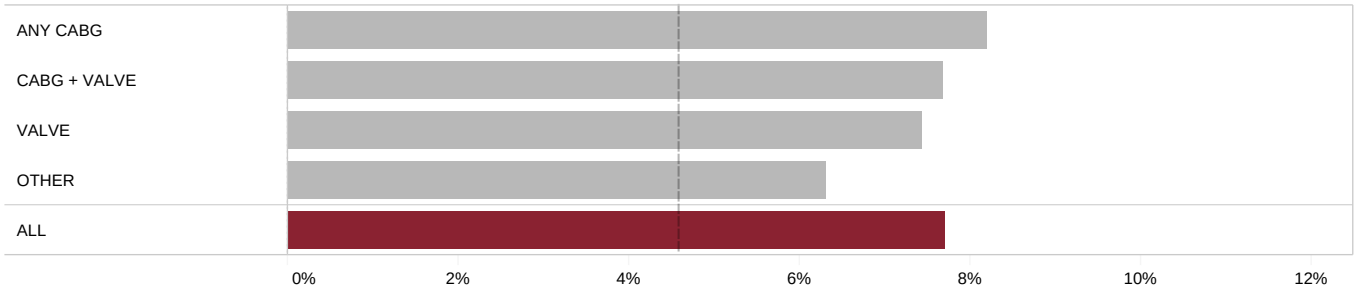
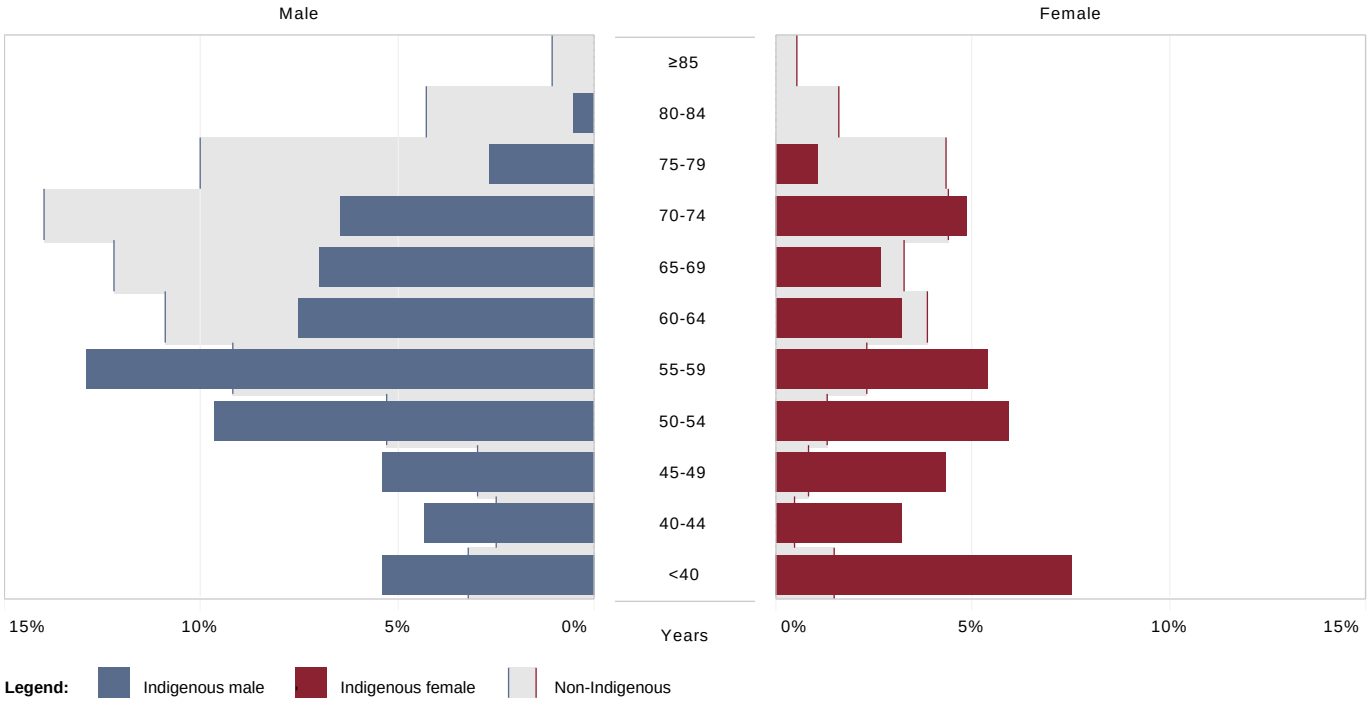


Figure 7: Proportion of cases by identified Aboriginal and Torres Strait Islander status and surgery category

The median age for Aboriginal and Torres Strait Islander Queenslanders undergoing cardiac surgery was 56 years, whereas the median age of non-Indigenous patients was 67 years.



% of total Aboriginal and Torres Strait Islander (n=186) vs total non-Indigenous (n=2,225)

Figure 8: 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	57	54	56
Non Aboriginal and Torres Strait Islander	66	67	67
Total	**66**	**66**	**66**

5 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 (58%) had a history of tobacco use including 19% current smokers (defined as smoking within 30 days of the procedure) and 40% former smokers.
- Overall, 28% of all cardiac surgical patients were reported as diabetic. The prevalence of diabetes was highest in the CABG patient group (39%).
- Hypertension, defined as receiving antihypertensive medications at the time of surgery, was present in 69% of patients with considerable variation by surgery type (range 59% to 80%).
- Overall, 63% of patients had hypercholesterolaemia at the time of surgery, ranging from 79% in the CABG category to 37% in the other surgery category.
- Over half (57%) 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 119 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 18% 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	438 (41.3)	113 (48.3)	359 (38.8)	58 (30.5)	968 (40.1)
Current smoker	270 (25.4)	35 (15.0)	112 (12.1)	29 (15.3)	446 (18.5)
Diabetes	415 (39.1)	78 (33.3)	162 (17.5)	18 (9.5)	673 (27.9)
Hypertension	812 (76.5)	186 (79.5)	551 (59.5)	113 (59.5)	1,662 (68.9)
Hypercholesterolaemia	841 (79.3)	179 (76.5)	435 (47.0)	71 (37.4)	1,526 (63.3)
eGFR 60–89 mL/min/1.73 m^2	386 (36.4)	95 (40.6)	327 (35.3)	64 (33.7)	872 (36.2)
eGFR 30–59 mL/min/1.73 m^2	169 (15.9)	53 (22.6)	196 (21.2)	23 (12.1)	441 (18.3)
eGFR <30 mL/min/1.73 m^2	28 (2.6)	7 (3.0)	24 (2.6)	–	61 (2.5)
Infective endocarditis	–	2 (0.9)	115 (12.4)	2 (1.1)	119 (4.9)
LVEF 40–50%	257 (24.2)	46 (19.7)	124 (13.4)	13 (6.8)	440 (18.2)
LVEF 30–39%	89 (8.4)	21 (9.0)	36 (3.9)	–	149 (6.2)
LVEF <30%	39 (3.7)	8 (3.4)	34 (3.7)	–	105 (4.4)
BMI ≥30 kg/m2	431 (40.6)	99 (42.3)	359 (38.8)	60 (31.6)	949 (39.4)

Over half of all patients (52%) had a combination of four or more risk factors outlined in Table 7, while over a quarter (26%) of patients undergoing surgery had two or less risk factors.

Greater than one-third of patients undergoing CABG (35%) 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.

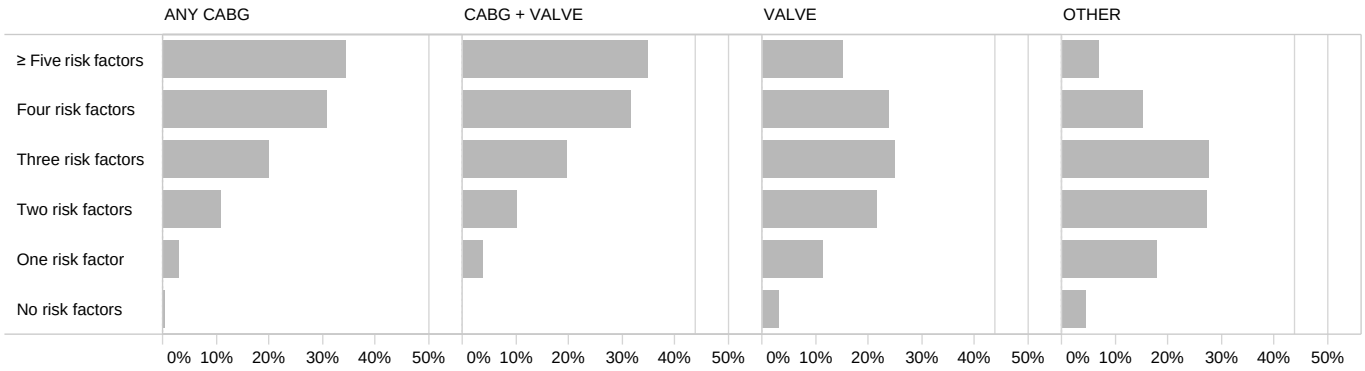


Figure 9: Number of patient risk factors by surgery category

Table 8: Aggregated patient risk factors by surgery category

	ANY CABG n (%)	CABG + VALVE n (%)	VALVE n (%)	OTHER n (%)	ALL n (%)
≥Five risk factors	366 (34.5)	81 (34.6)	142 (15.3)	13 (6.8)	602 (25.0)
Four risk factors	328 (30.9)	74 (31.6)	219 (23.7)	29 (15.3)	650 (27.0)
Three risk factors	213 (20.1)	46 (19.7)	231 (24.9)	53 (27.9)	543 (22.5)
Two risk factors	114 (10.7)	24 (10.3)	200 (21.6)	52 (27.4)	390 (16.2)
One risk factor	35 (3.3)	9 (3.8)	105 (11.3)	34 (17.9)	183 (7.6)
No risk factors	5 (0.5)	–	29 (3.1)	9 (4.7)	43 (1.8)
Total	**1,061 (100.0)**	**234 (100.0)**	**926 (100.0)**	**190 (100.0)**	**2,411 (100.0)**

5.1 Infective endocarditis

There were 119 cases of infective endocarditis (IE) that required cardiac surgical intervention, at the time of surgery, three-quarters (n=89) were active infections.

Native valve endocarditis was observed in 82% of active infections, with prosthetic valve infection apparent in 10% of active endocarditis cases.

Table 9: Infective endocarditis status

Endocarditis status	n (%)
Active	89 (74.8)
Treated	30 (25.2)
Total	**119 (100.0)**

Table 10: Active infective endocarditis by site of infection

Active endocarditis site	n (%)
Native valve	73 (82.0)
Prosthetic valve	9 (10.1)
Aortic root	5 (5.6)
Aortic root and Prosthetic valve	1 (1.1)
Aortic root and Mitral annulus	1 (1.1)
Total	**89 (100.0)**

5.1.1 Organism

Methicillin-susceptible Staphylococcus aureus and Streptococcus infections was responsible for almost half of all surgeries for active IE (46%). The responsible organism was unidentified in 11% of cases.

Table 11: Identified organism in active IE cases

Active organism	n (%)
Streptococcus	25 (28.1)
MSSA*	15 (16.9)
Staphylococcus (other)	14 (15.7)
Other	8 (9.0)
Enterococcus faecalis	8 (9.0)
Cutibacterium	3 (3.4)
Coxiella burnetii	2 (2.2)
MRSA†	2 (2.2)
Aggregatibacter	2 (2.2)
Organism unidentified	10 (11.2)
Total	**89 (100.0)**

* Methicillin-susceptible Staphylococcus aureus

† Methicillin-resistant Staphylococcus aureus

5.1.2 Intravenous drug use

Overall, 23% of all active infective endocarditis cases were linked to a history of intravenous drug use (IVDU) with the majority being current IVDU.

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

IVDU history	n (%)
Current IVDU (≤3 months)	16 (18.0)
Previous IVDU (›3 months)	4 (4.5)
No history of IVDU	60 (67.4)
Unknown	9 (10.1)
Total	**89 (100.0)**

6 Care and treatment of patients

6.1 Admission status

The admission status of patients undergoing cardiac surgery varied widely. Most CABG cases were performed as urgent cases (63%), whilst also contributing to a significant proportion (35%) of the emergency cases. Valve procedures were mostly performed on an elective basis. More than one-third (36%) of all operations in the 'Other surgery' category were performed on an emergent basis, in particular correction of aortic dissection.

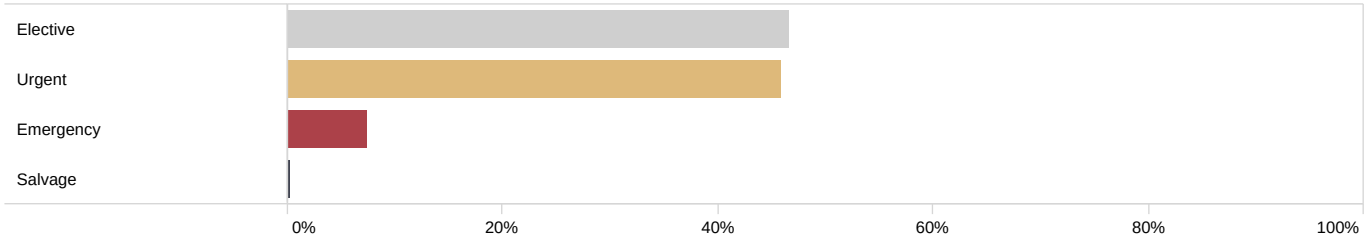


Figure 10: Proportion of cases by admission status

Table 13: Cases by admission status and surgery category

	Elective n (%)	Urgent n (%)	Emergency n (%)	Salvage n (%)
ANY CABG	290 (27.3)	717 (67.6)	53 (5.0)	1 (0.1)
CABG + VALVE	122 (52.1)	102 (43.6)	10 (4.3)	–
VALVE	622 (67.2)	258 (27.9)	46 (5.0)	–
OTHER	88 (46.3)	30 (15.8)	69 (36.3)	3 (1.6)
ALL	**1,122 (46.5)**	**1,107 (45.9)**	**178 (7.4)**	**4 (0.2)**

6.2 Day of surgery admission

Day of surgery admission (DOSA) rates accounted for one-quarter of all elective cases (25%), with some variation observed across some surgery categories.

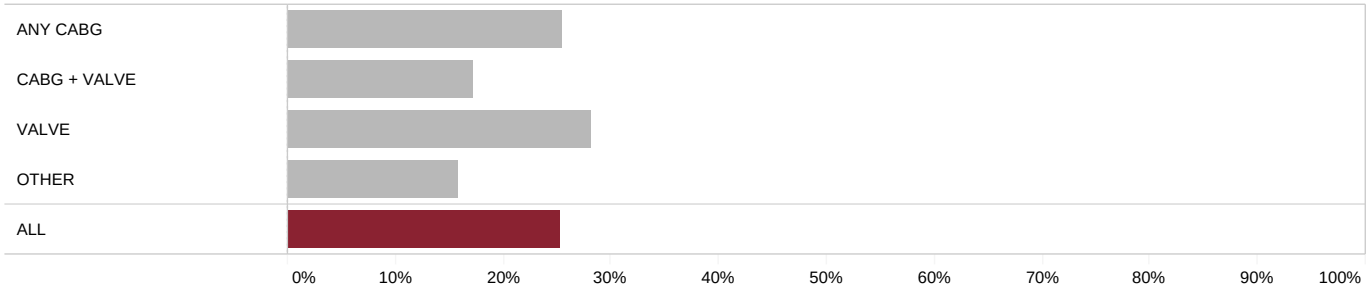


Figure 11: Proportion of elective cases for DOSA cases by surgery category

Table 14: DOSA cases by surgery category

	Total elective cases n	DOSA cases n (%)
ANY CABG	290	74 (25.5)
CABG + VALVE	122	21 (17.2)
VALVE	622	175 (28.1)
OTHER	88	14 (15.9)
Total	**1,122**	**284 (25.3)**

6.3 Coronary artery bypass grafting

6.3.1 Number of diseased vessels

There were 1,295 CABG procedures performed across all sites. The majority (92%) had multi-vessel disease.

When CABG was performed in conjunction with a valve procedure, 74% of patients had multi-vessel disease compared to 96% when CABG surgery was performed without a valve intervention.

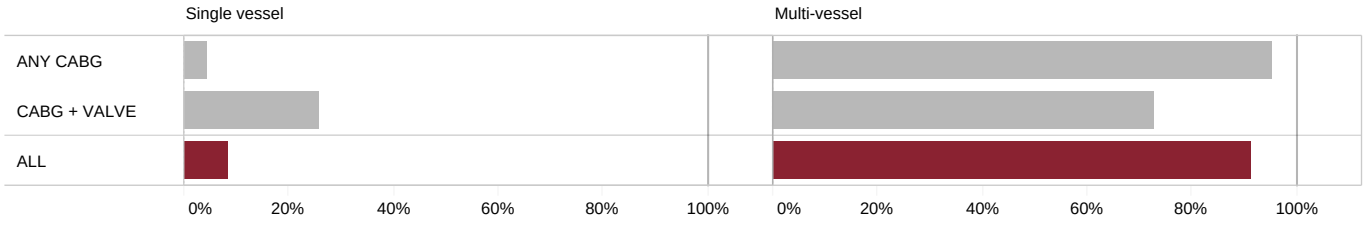


Figure 12: Number of diseased vessels by surgery category

Table 15: Number of diseased vessels by surgery category

	Single vessel n (%)	Multi-vessel n (%)	Total n (%)
ANY CABG	47 (4.4)	1,012 (95.6)	1,059 (100.0)
CABG + VALVE	60 (26.3)	168 (73.7)	228 (100.0)
ALL	**107 (8.3)**	**1,180 (91.7)**	**1,287 (100.0)**

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6.3.2 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 2.7.

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	1.1	2.3	2.0	1.9
ALL	**1.1**	**2.7**	**3.0**	**2.6**

6.3.3 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 (59%). Over one-third of cases (35%) underwent total arterial revascularisation.

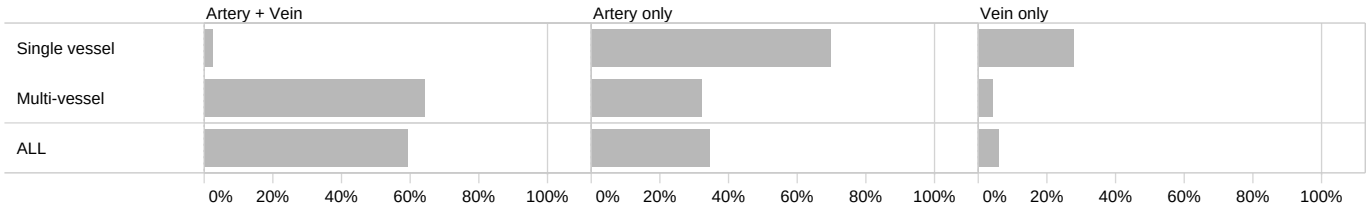


Figure 13: Proportion of diseased vessels by conduits used

Table 17: Conduits used by number of diseased vessels

	Artery + vein n (%)	Artery only n (%)	Vein only n (%)
Single vessel	2 (2.2)	62 (69.7)	25 (28.1)
Multi-vessel	685 (63.8)	341 (31.8)	47 (4.4)
ALL	**687 (59.1)**	**403 (34.7)**	**72 (6.2)**

Excludes missing data (n=8)

6.3.4 Off pump CABG

Overall, 3% 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	974	26 (2.7)

6.3.5 Y or T grafts

Approximately 5% of all CABG surgeries utilised a Y or T graft.

Table 19: Y or T graft used by procedure category

	Total cases n	Y or T graft n (%)
ANY CABG	1,061	115 (10.8)
CABG + VALVE	234	15 (6.4)
ALL	**1,295**	**130 (5.4)**

6.4 Aortic surgery

There were 285 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 (59%), while acute aortic dissection was the pathology responsible for 20% of aortic surgery cases.

Most aortic surgery procedures included replacement of the ascending aorta in isolation (55%), while surgery to replace both the ascending aorta and aortic arch accounted for 15% of cases.

Aortoplasty involving patch repair was performed in approximately 7% of aortic surgery cases.

Table 20: Aortic surgery by procedure type

Aortic surgery type	n (%)
Replacement	**215 (75.4)**
Ascending aorta	158 (55.4)
Ascending aorta + aortic arch	42 (14.7)
Descending aorta	9 (3.2)
Aortic arch	5 (1.8)
Aortic arch + descending aorta	1 (0.4)
Aortoplasty	**54 (18.9)**
Direct aortoplasty	34 (11.9)
Patch repair	20 (7.0)
Aortoplasty and replacement	**15 (5.3)**
Patch repair + ascending aorta	5 (1.8)
Patch repair + ascending aorta + aortic arch	4 (1.4)
Direct aortoplasty + ascending aorta	3 (1.1)
Direct aortoplasty + aortic arch	1 (0.4)
Direct aortoplasty + ascending aorta + aortic arch	1 (0.4)
Patch repair + descending aorta	1 (0.4)
ALL	**285 (100.0)**

6.4.1 Aortic pathology

Table 21: Aortic surgery cases by pathology type

Aortic pathology type	n (%)
Aortic aneurysm	169 (59.3)
Aortic dissection (≤2 weeks)	58 (20.4)
Abscess	16 (5.6)
Intramural haematoma	8 (2.8)
Aortic dissection (>2 weeks)	7 (2.5)
Calcification	5 (1.8)
Penetrating ulcer	1 (0.4)
Rupture	1 (0.4)
Other	20 (7.0)
ALL	**285 (100.0)**

6.5 Valve surgery

There were 1,160 valve surgery procedures performed at the participating sites during 2024.

The aortic valve was the most commonly operated on valve either with or without other valves (66%). Nearly one quarter (23%) of valve surgeries targeted only the mitral valve.

Overall, 14% of valve operations performed comprised of intervention to multiple valves.

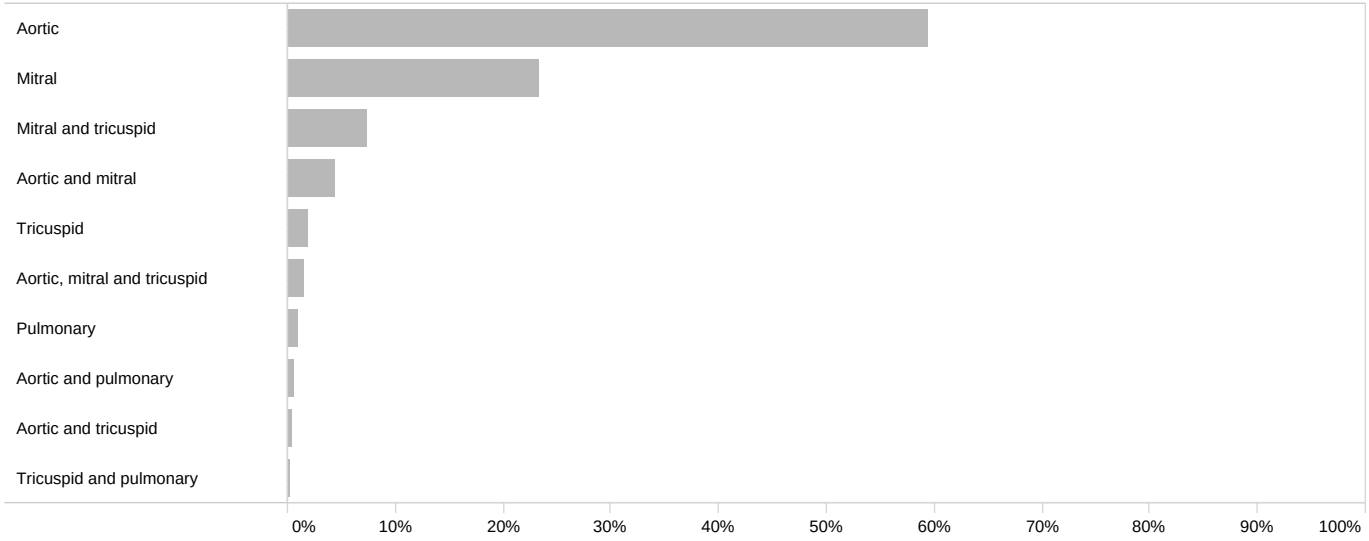


Figure 14: Proportion of valve surgery cases by valve

Table 22: Valve surgery cases by valve

Type of valve surgery	n (%)
Aortic	689 (59.4)
Mitral	270 (23.3)
Mitral and tricuspid	86 (7.4)
Aortic and mitral	52 (4.5)
Tricuspid	22 (1.9)
Aortic, mitral and tricuspid	17 (1.5)
Pulmonary	12 (1.0)
Aortic and pulmonary	6 (0.5)
Aortic and tricuspid	4 (0.3)
Tricuspid and pulmonary	2 (0.2)
Total	**1,160 (100.0)**

6.5.1 Valve pathology

The most common valve pathology across all valve types was a degenerative cause (43%). Degenerative pathology was responsible for most of all aortic and mitral valve procedures (49% and 45% respectively).

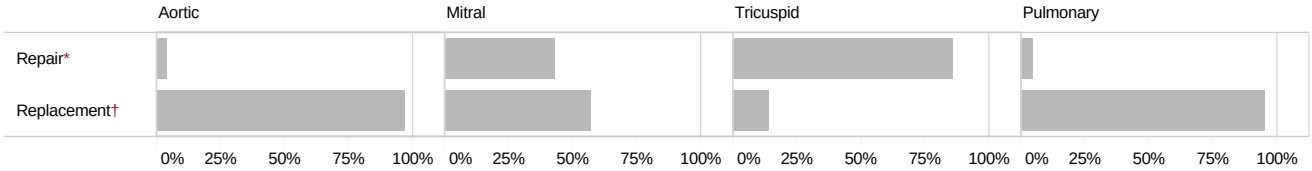
Table 23: Valve pathology by valve type

	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Degenerative	377 (49.1)	189 (44.5)	17 (13.0)	–	583 (43.4)
Congenital	161 (21.0)	13 (3.1)	7 (5.3)	9 (45.0)	190 (14.1)
Rheumatic	29 (3.8)	81 (19.1)	17 (13.0)	–	127 (9.4)
Infection	55 (7.2)	46 (10.8)	7 (5.3)	4 (20.0)	112 (8.3)
Prosthesis failure	34 (4.4)	19 (4.5)	–	4 (20.0)	57 (4.2)
Dissection	30 (3.9)	–	–	–	30 (2.2)
Annuloaortic ectasia	59 (7.7)	–	–	–	59 (4.4)
Functional	–	43 (10.1)	74 (56.5)	–	117 (8.7)
Ischaemic	–	23 (5.4)	–	–	23 (1.7)
Failed prior repair	–	–	2 (1.5)	2 (10.0)	4 (0.3)
Trauma	1 (0.1)	1 (0.2)	–	–	2 (0.1)
Peri-prosthetic leak	1 (0.1)	–	–	–	1 (0.1)
Iatrogenic	–	–	1 (0.8)	–	1 (0.1)
Failed TMVR	–	1 (0.2)	–	–	1 (0.1)
Other	21 (2.7)	9 (2.1)	6 (4.6)	1 (5.0)	37 (2.8)
ALL	**768 (100.0)**	**425 (100.0)**	**131 (100.0)**	**20 (100.0)**	**1,344 (100.0)**

6.5.2 Types of valve surgery

More than half of valve interventions involved aortic valve surgery (57%). The most common aortic valve procedure was replacement surgery (97%).

Mitral valve replacement was more commonly undertaken compared with mitral valve repair (57% vs 43%).



Inspection only procedures not shown (n=7)

* Includes transcatheter mitral valve repair procedures involving CTS

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

Figure 15: 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*	27 (3.5)	181 (42.6)	113 (86.3)	1 (5.0)	271 (24.0)
Replacement†	741 (96.6)	244 (57.4)	18 (13.7)	19 (95.0)	1,093 (76.0)
Inspection only	–	–	–	–	–
ALL	**768 (100.0)**	**425 (100.0)**	**131 (100.0)**	**20 (100.0)**	**1,344 (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. Almost one-third (29%) 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 2024.

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	26	–
TPCH	214	9 (4.2)
PAH	190	72 (37.9)
GCUH	62	59 (95.2)
STATEWIDE	**492**	**140 (28.5)**

6.5.3 Valve repair surgery

Nearly two-thirds (73%) 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 more than half of all valve repair surgery (51%).

Table 26: Valve repair surgery by valve type

Surgery category	Aortic n (%)	Mitral n (%)	Tricuspid n (%)	Pulmonary n (%)	Total n (%)
Repair/reconstruction with annuloplasty	–	165 (91.2)	71 (62.8)	–	236 (73.3)
Annuloplasty only	–	6 (3.3)	36 (31.9)	–	42 (13.0)
Repair/reconstruction without annuloplasty	–	7 (3.9)	5 (4.4)	–	12 (3.7)
Resuspension of the aortic valve	9 (33.3)	–	–	–	9 (2.8)
Root reconstruction with valve sparing	13 (48.1)	–	–	–	13 (4.0)
Tumour tissue removal	3 (11.1)	2 (1.1)	1 (0.9)	1 (100.0)	7 (2.2)
Thrombus removal	1 (3.7)	1 (0.6)	–	–	2 (0.6)
Resection of Sub-Aortic Stenosis	1 (3.7)	–	–	–	–
ALL	**27 (100.0)**	**181 (100.0)**	**113 (100.0)**	**1 (100.0)**	**322 (100.0)**

6.5.4 Valve replacement surgery

Aortic valve replacement accounted for the majority of valve replacement surgeries (73%), which included 140 TAVR procedures and 82 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	520 (70.1)	244 (100.0)	18 (100.0)	19 (100.0)†	801 (78.3)
Transcatheter valve replacement*	140 (18.9)	–	–	–	140 (13.7)
Root reconstruction with valve conduit	82 (11.1)	–	–	–	81 (8.0)
ALL	**742 (100.0)**	**244 (100.0)**	**18 (100.0)**	**19 (100.0)**	**1,023 (100.0)**

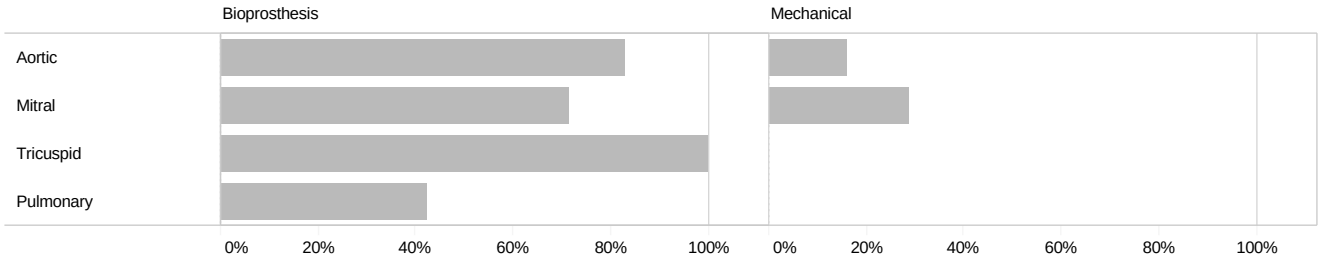
* Includes TAVR or TMVR procedures involving a cardiothoracic surgeon

† 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 (80%), either bovine (66%) or porcine (14%). 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 82% of all aortic valve prostheses and 66% of the total valvular prostheses used.



Homograft/allograft and autograft prosthesis not displayed (1.9%)

Figure 16: 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	604 (81.5)	59 (24.2)	4 (22.2)	8 (42.1)	675 (66.0)
Biological – porcine	11 (1.5)	115 (47.1)	14 (77.8)	–	140 (13.7)
Mechanical	118 (15.9)	70 (28.7)	–	–	188 (18.4)
Autograft	2 (0.3)	–	–	5 (26.3)	7 (0.7)
Homograft/allograft	6 (0.8)	–	–	6 (31.6)	12 (1.2)
ALL	**741 (100.0)**	**244 (100.0)**	**18 (100.0)**	**19 (100.0)**	**1,022 (100.0)**

6.6 Other cardiac surgery

The most common form of other cardiac surgery was left atrial appendage closure (51%), followed by atrial arrhythmia surgery, accounting for 10% of other cardiac surgeries. These procedures may have been performed in conjunction with another cardiac procedure, or solely as an index operation.

Table 29: Other cardiac procedures

Procedure	n (%)
Left atrial appendage closure	305 (50.9)
Atrial arrhythmia surgery	58 (9.7)
Atrial septal defect repair	39 (6.5)
Lung transplant – BSSLTX*	20 (3.3)
Cardiac tumour	17 (2.8)
Other congenital cardiac procedure	15 (2.7)
VAD† procedure	16 (2.5)
LVOT‡ myectomy for HOCM§	12 (2.0)
Cardiac transplant	11 (1.8)
Lung resection	8 (1.3)
LV aneurysm	6 (1.0)
Permanent LV epicardial lead	5 (0.8)
Cardiac thrombectomy	5 (0.8)
Patent foramen ovale closure	5 (0.8)
Acquired ventricular septal defect repair	5 (0.8)
RVOT|| repair/reconstruction	5 (0.8)
CIED# procedure	5 (0.8)
Pulmonary thrombectomy	4 (0.7)
PAPVD** repair	4 (0.7)
MV annulus patch repair	4 (0.7)
Pulmonary artery repair/reconstruction	3 (0.5)
Cardiopulmonary transplant	3 (0.5)
Trauma	2 (0.3)
LV reconstruction	2 (0.3)
Pericardial fluid drainage	2 (0.3)
LV exploration	1 (0.2)
Patent ductus arteriosus repair	1 (0.2)
LV reconstruction	1 (0.2)
Lung transplant – single lung	1 (0.2)
LVOT‡ reconstruction	1 (0.2)
Myocardial biopsy	1 (0.2)
Carotid endarterectomy	1 (0.2)
Other	33 (5.5)
Total	601 (100.0)

* Bilateral sequential single lung transplantation

† Ventricular assist device

‡ Left ventricular outflow tract

§ Hypertrophic obstructive cardiomyopathy

|| Right ventricular outflow tract

Cardiac implantable electronic device

** Partial anomalous pulmonary venous drainage

6.7 Blood product usage

The majority of surgeries did not require blood product transfusion (56%). However, as the urgency of operations increased, so too did the requirement for red blood cells (RBC) and non-red blood cells (NRBC). The majority of (82%) emergency cases utilised at least one blood product.

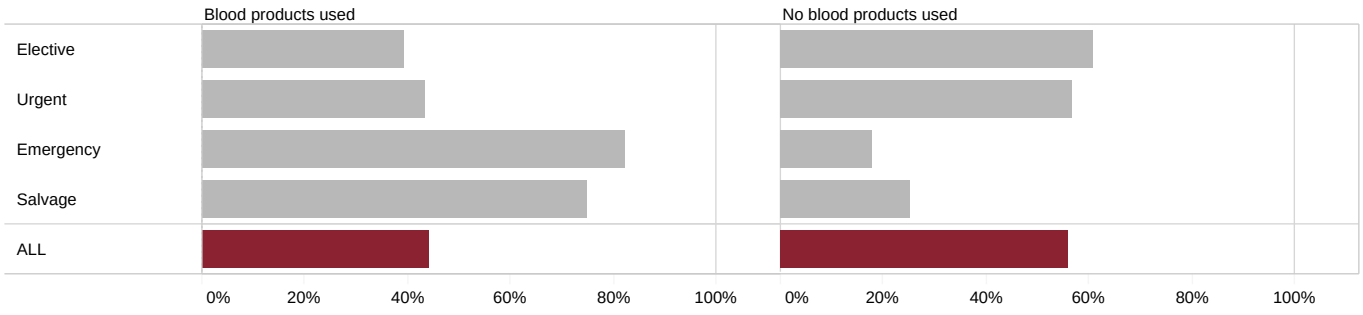


Figure 17: Blood products used by admission status

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	180 (16.0)	99 (8.8)	161 (14.3)	682 (60.8)
Urgent	210 (19.0)	160 (14.5)	108 (9.8)	629 (56.8)
Emergency	110 (61.8)	19 (10.7)	17 (9.6)	32 (18.0)
Salvage	3 (75.0)	–	–	1 (25.0)
ALL	**503 (20.9)**	**278 (11.5)**	**286 (11.9)**	**1,344 (55.7)**

7 Outcomes

This section of the cardiac surgery report focuses on factors influencing the risk of complications from procedures and key targets for optimal performance. It aims to compare the aggregated outcomes of the four Queensland adult cardiac surgical units against nationally and internationally recognised risk scores.

7.1 Risk prediction models

Patient-specific comorbidities and clinical factors at the time of surgery can significantly impact the likelihood of adverse perioperative events. To account for these factors in cohort analysis, risk adjustment models are commonly used. These statistical tools adjust for individual patient risks, correcting for those undergoing surgery in critical preoperative states, such as cardiogenic shock, versus elective procedures in patients with fewer comorbidities.

Risk scores are typically derived from large patient cohorts and are relevant for specific periods and geographical areas with distinct ethnic, socioeconomic, and cultural factors. Therefore, it is crucial to explore multiple scores to ensure no relevant signals for potential improvement are overlooked. Additionally, it is important to adapt and adopt new risk scores as they become available and integrate them into routine practice.

Mortality after surgery is the most commonly evaluated outcome using risk adjustment algorithms. However, the Society of Thoracic Surgeons (STS) has also developed algorithms predicting the risk of postoperative complications (morbidity).

The risk prediction models used to evaluate the 2024 clinical outcomes for cardiac surgical cases include:

- EuroSCORE[30]
- EuroSCORE II[31]
- ANZSCTS General Score[32]
- AusSCORE[33]
- STS Score (mortality and morbidity)[34,35,36]

7.1.1 Mortality

The 30 day mortality risk adjustment analysis has been evaluated using various well-known risk models. The he EuroSCORE[30], EuroSCORE II[31], and ANZSCTS General Score[32] can be applied to all types of cardiac surgical cases, while the AusSCORE model [33] is specific to mortality in CABG cases.

The STS models apply to specific procedural subgroups, with only patients meeting defined inclusion criteria considered for analysis. Cases were grouped in the following categories CABG only, Valve only, and combined CABG + Valve procedures, all other cases were excluded from the analysis. Similarly, the AusSCORE model is presented alongside other risk prediction tools, focusing exclusively on CABG cases.

Across all risk adjusted models, observed mortality rates are consistently within or below predicted rate.

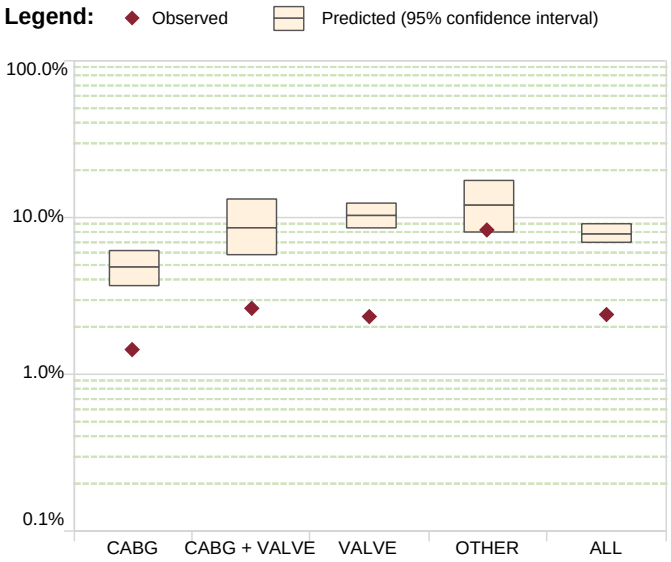


Figure 18: EuroSCORE

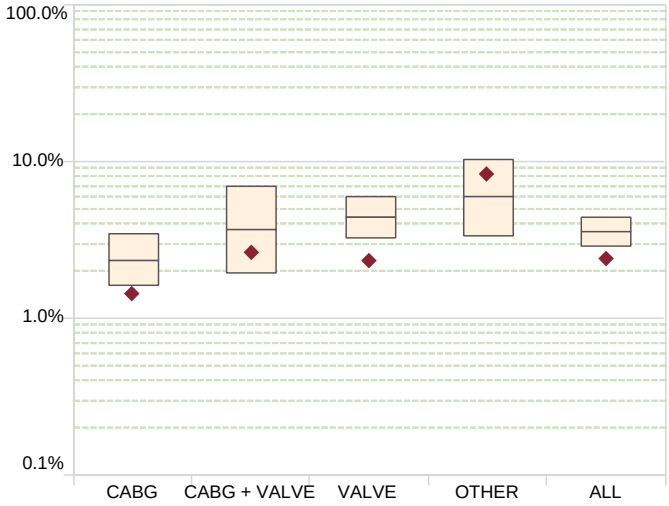


Figure 19: EuroSCORE II

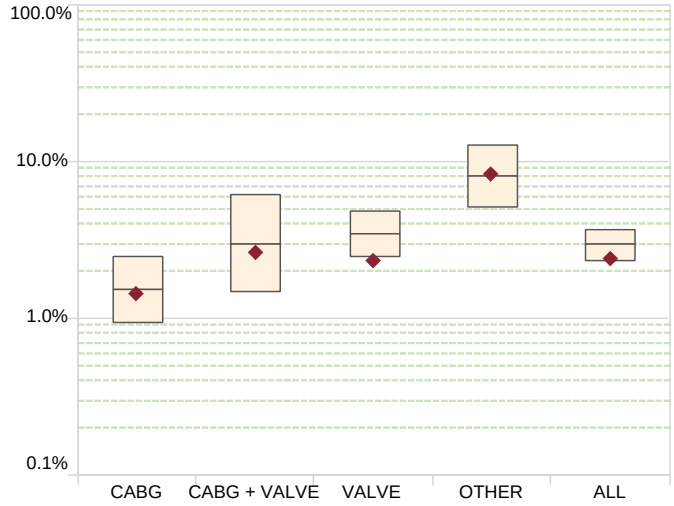


Figure 20: ANZSCTS (General Score)

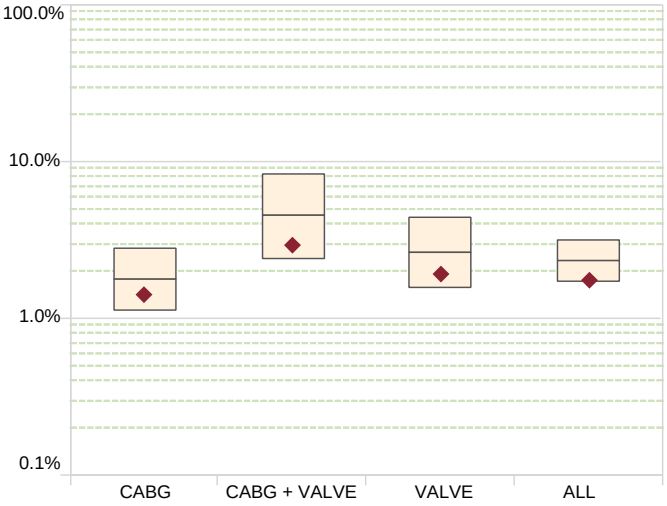


Figure 21: STS (death)

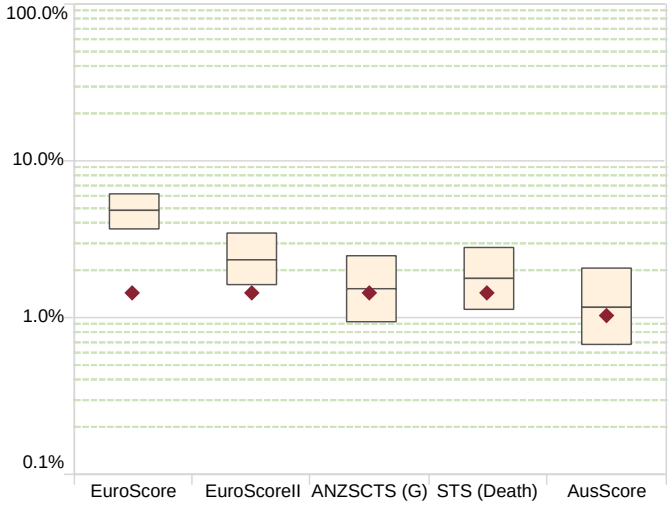


Figure 22: CABG

7.1.2 Morbidity

Patients undergoing cardiac surgery face the risk of various significant morbidities during the postoperative period. The STS risk adjustment models estimate the likelihood of these morbidities occurring in patients undergoing cardiac surgery. These models have been applied to specific surgical subgroups based on distinct inclusion criteria.

The aggregated morbidities chart (Figure 28) shows the observed rate of cases involving at least one of the five morbidities. Most comparisons between the observed event rate and the predicted rate using the respective risk scores indicate that outcomes are within expectations. Notably, the incidence of prolonged ventilation for CABG patients and the rate of cerebrovascular accidents in valve surgery patients are better than predicted.

Deep sternal wound infection

The rate of DSWI is a significant postoperative adverse outcome that increases the risk of death and has substantial implications for healthcare resource utilisation. Consequently, it remains a focus for all participating units. Historically, this outcome has been consistently identified as occurring at a higher rate than predicted by the STS model.

A correction factor was established based on DSWI data from the Australian & New Zealand Society of Cardiac & Thoracic Surgeons Cardiac Surgery Database Program Annual Report for 2020[37]. This report indicates that the national rate of DSWI in public hospitals for 2017–2019 was approximately 1.13%, while for 2020, the rate dropped to 0.91% (with comparable rates for Queensland public hospitals being 1.7% and 1.4%, respectively).

For quality assurance and monitoring purposes, the STS model was adjusted to deliver an expected event rate of 1.13% using an odds correction factor of 3.70. After applying this correction to the 2024 cohort, the observed rate of DSWI is within the expected range for all surgical categories.

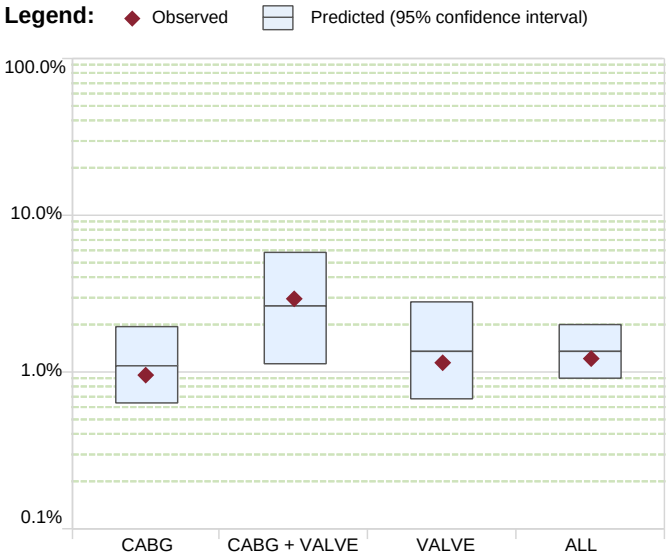


Figure 23: Cerebrovascular accident

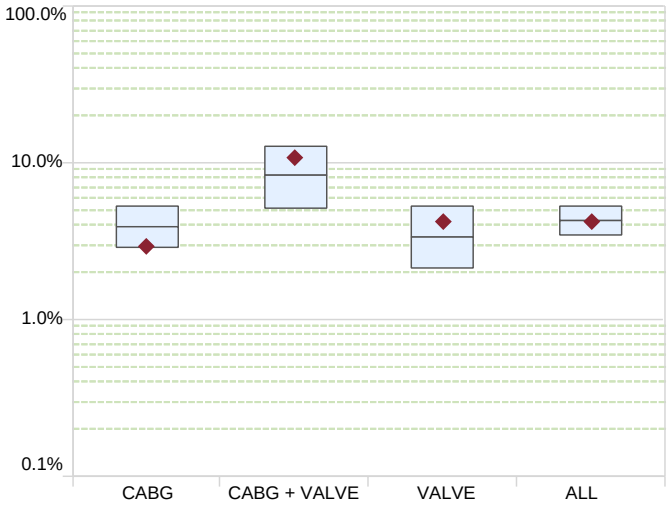


Figure 24: Renal failure

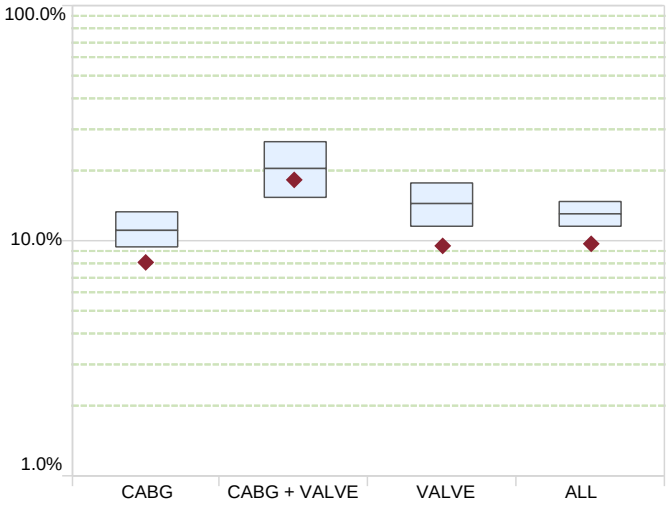


Figure 25: Ventilation >24 hours

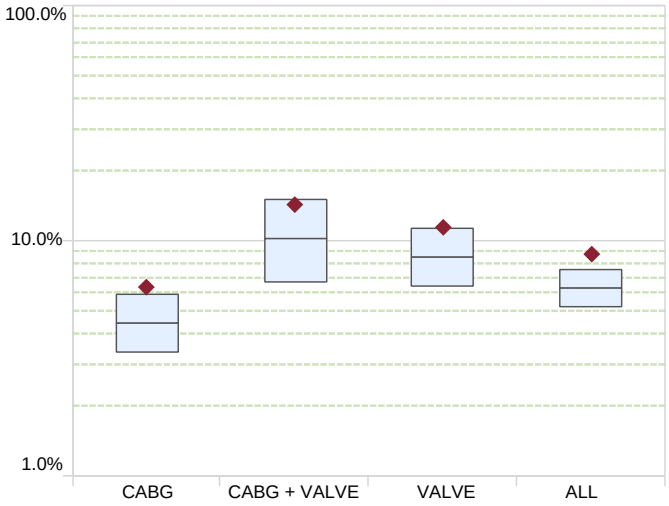


Figure 26: Reoperation

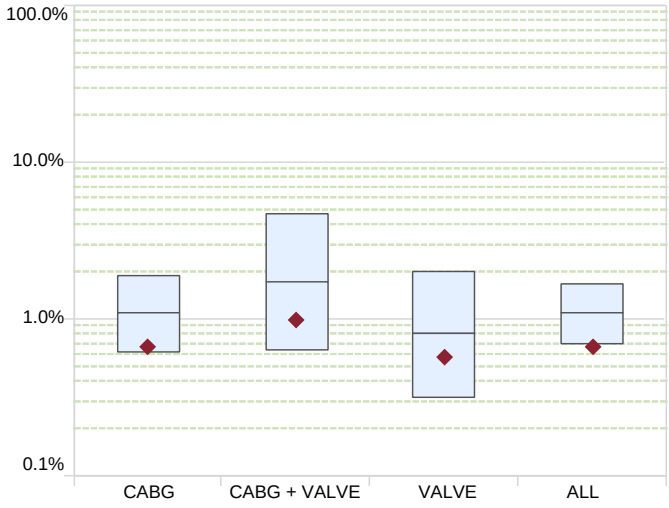


Figure 27: Deep sternal wound infection

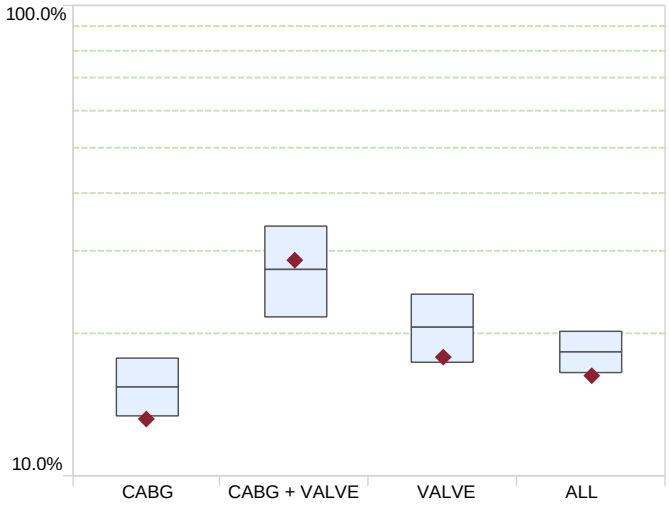


Figure 28: Major morbidity

7.1.3 Measures of process

The following graphs evaluate the length of stay (LOS) of patients compared to predictions made by the STS score. An LOS of less than six days is a process measure that facilitates elective weekly booking procedures. Conversely, an LOS greater than 14 days excludes patients who may stay a few extra days beyond the six day mark for minor reasons, focusing instead on those on a prolonged recovery pathway.

The LOS comparison reveals that the proportion of cases with a stay of less than six days is lower than expected, regardless of the surgery category. Similarly, the proportion of patients staying longer than 14 days is higher than predicted.

Further investigation is needed to determine whether these outcomes are influenced by institutional factors such as discharge planning, resource availability, and postoperative care protocols, or by patient-related variables including preexisting comorbidities, severity of complications, and social determinants of health.

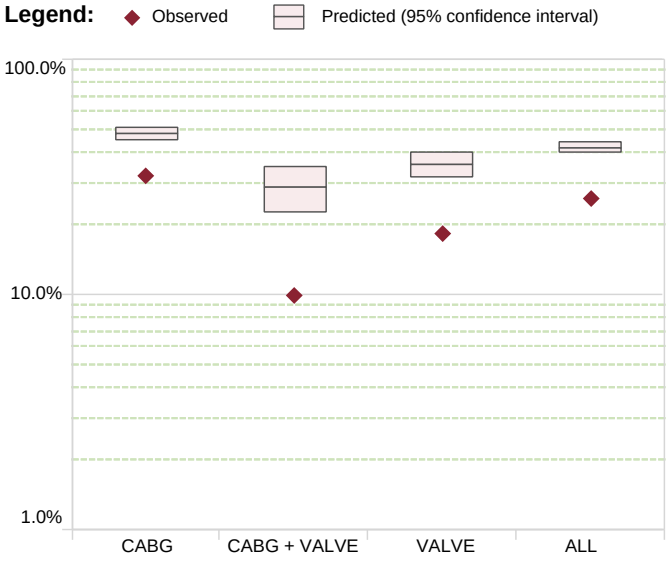


Figure 29: LOS ‹6 days

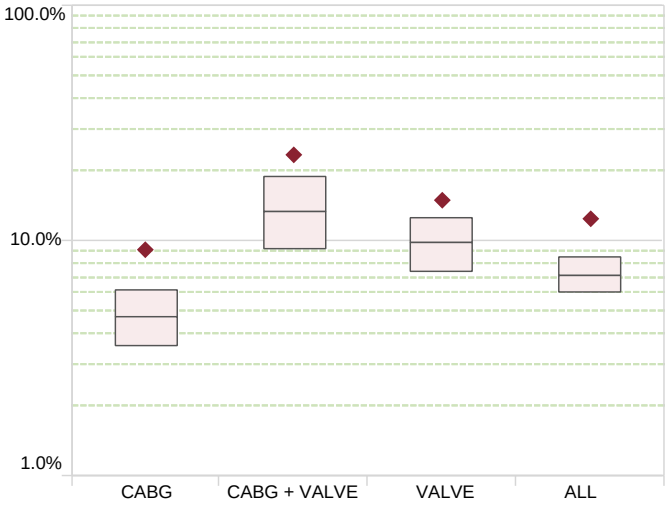


Figure 30: LOS ›14 days

7.1.4 Failure to rescue

Failure to Rescue (FTR) serves as a clinical quality metric in cardiac surgery, reflecting the efficacy of institutional systems in managing postoperative complications rather than the technical success of the surgical procedure alone. It assesses patient outcomes following major adverse events, providing insight into the capacity of healthcare teams and protocols to prevent mortality once complications arise.

FTR is measured by integrating the likelihood of experiencing a complication with the subsequent risk of death, under the premise that mortality following an adverse event is largely contingent upon the effectiveness of hospital response mechanisms.

The STS model identifies stroke, renal failure, reoperation, deep sternal wound infection, and ventilation beyond 24 hours as key contributors to FTR.

Current analysis reveals that the observed FTR rates across various surgical categories closely align with predicted benchmarks, indicating that existing clinical pathways and escalation protocols are performing within expected parameters.

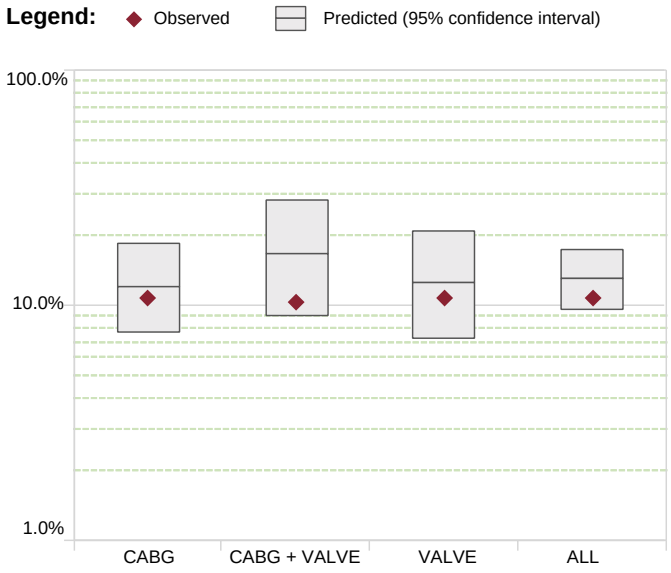


Figure 31: Failure to rescue

7.1.5 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.

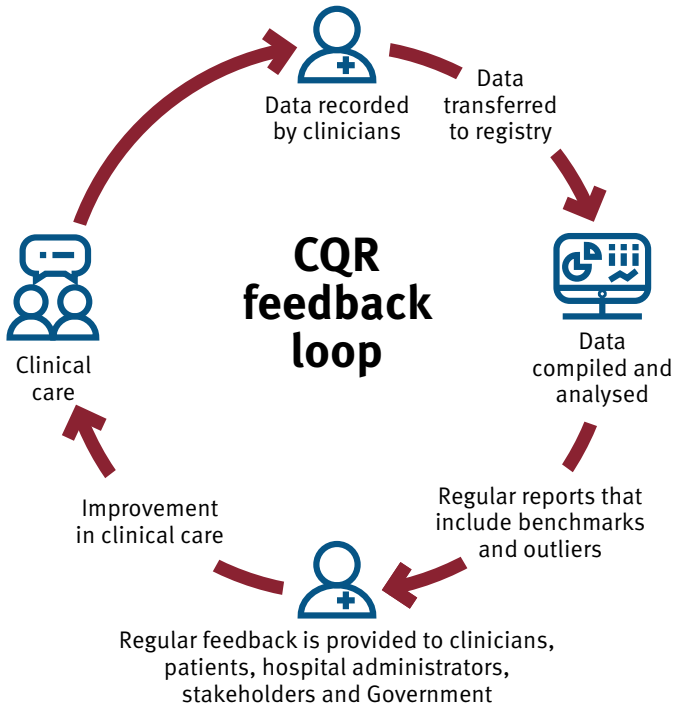


Figure 32: Clinical Quality Registry feedback loop

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[31], ANZSCTS General Score[32] and STS mortality models [34,35,36], 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[31], and ANZSCTS General Score[32] can be applied to evaluate mortality for all types of cardiac surgical cases, whereas the AusSCORE model[33] 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[34], Valve only[35] and CABG + Valve[36] models. Patients who met the inclusion criteria were assessed and the remainder of patients excluded from the analysis.

Across all prediction models used, the observed mortality rate has consistently trended below the predicted range. Periods of elevated mortality were typically matched by increases in the expected rate, likely reflecting the complexity and high-risk characteristics of this evolving patient cohort.

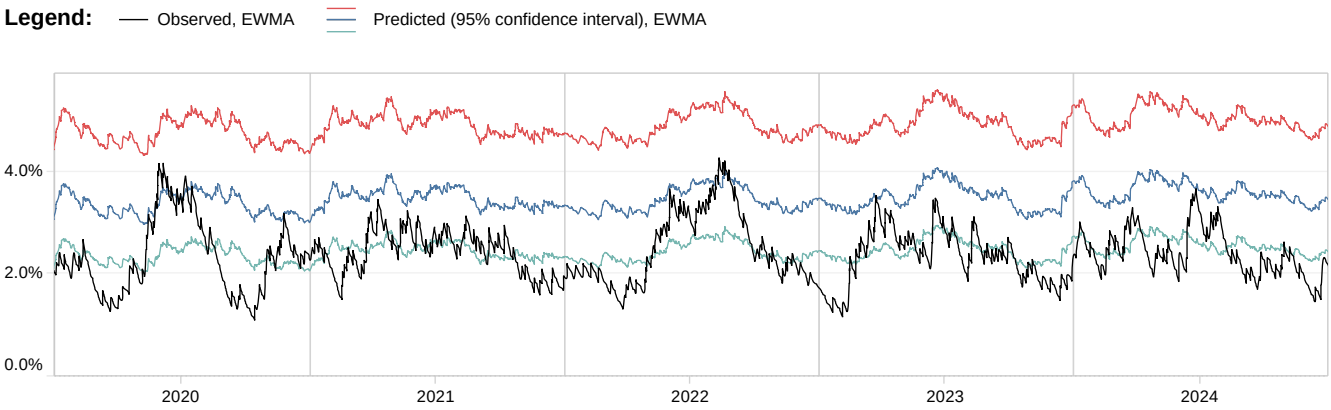


Figure 33: EuroSCORE II, 2020–2024

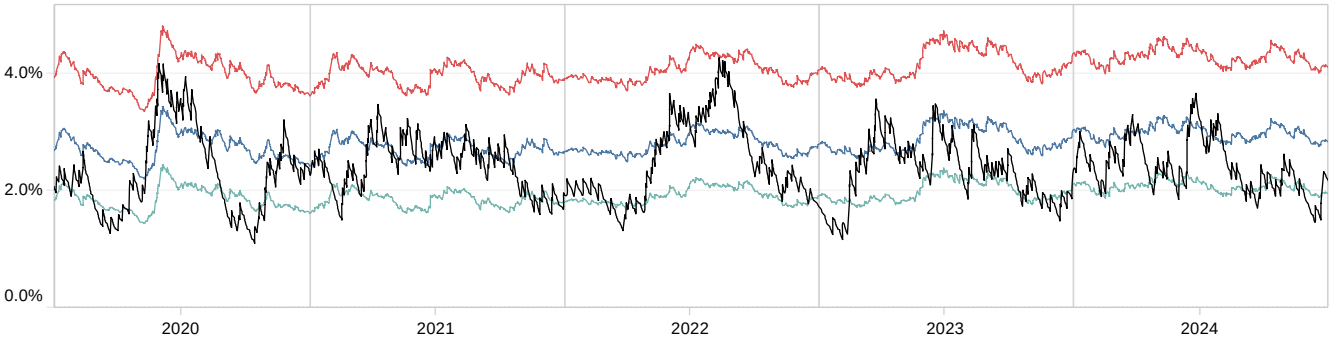


Figure 34: ANZSCTS General Score, 2020–2024

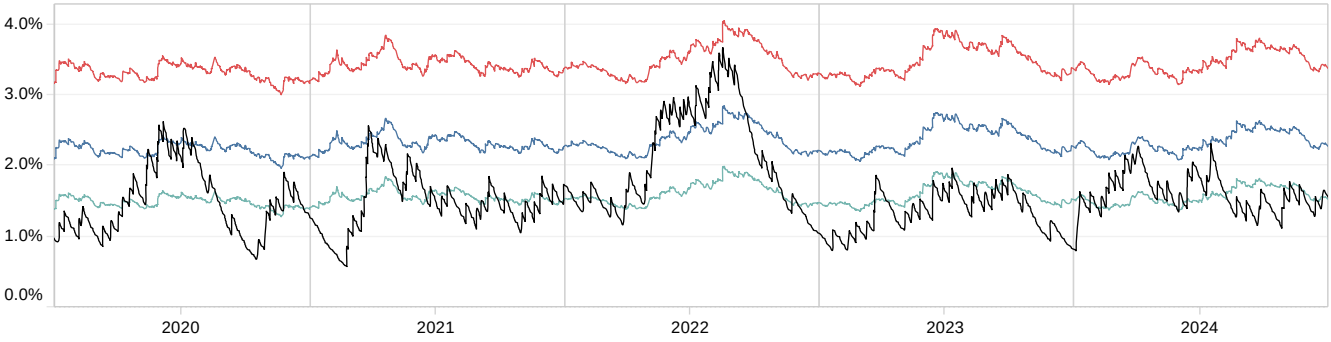


Figure 35: STS mortality, 2020–2024

Morbidity

Cerebrovascular accident (stroke) is a recognised complication of cardiac surgery, defined as the onset of a new central neurological deficit lasting more than 72 hours, resulting from either an ischaemic or haemorrhagic event occurring perioperatively or postoperatively. Throughout the monitored period, the incidence of stroke has fluctuated but has consistently remained within or below the expected range.

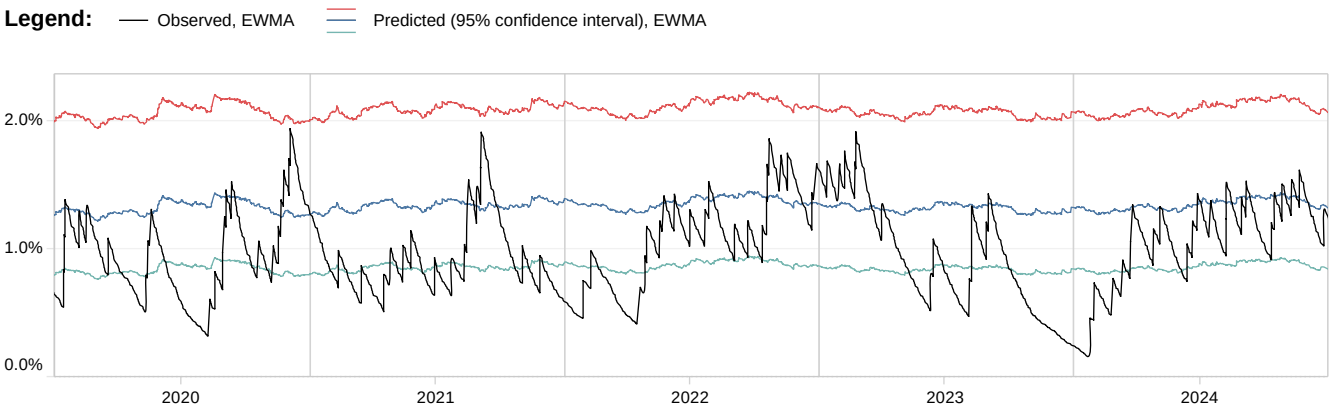


Figure 36: Cerebrovascular accident, 2020–2024

Renal insufficiency is a recognised postoperative complication of cardiac surgery, often linked to adverse patient outcomes. It is identified by an elevation in postoperative serum creatinine levels or the initiation of renal replacement therapy such as dialysis or haemofiltration. During the sample period the observed rates of renal insufficiency has remained within or below the expected rate.

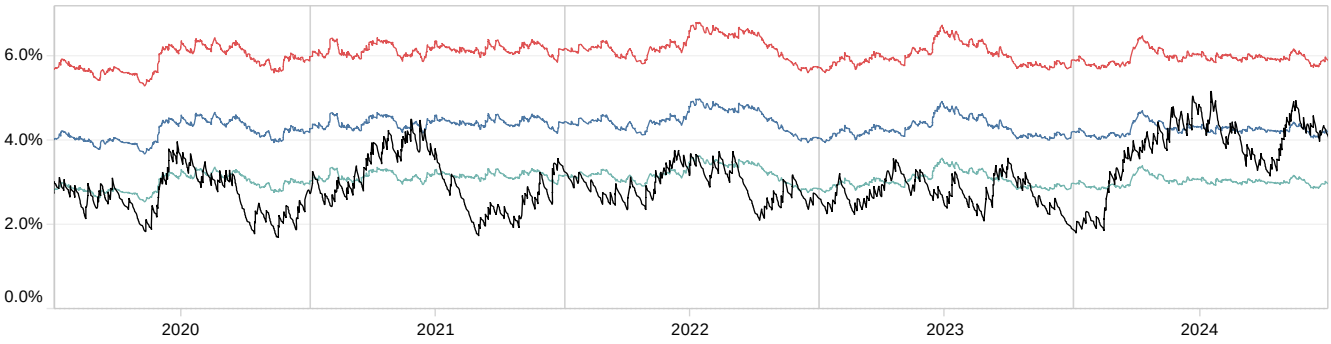


Figure 37: Renal failure, 2020–2024

Prolonged ventilation after cardiac surgery, defined as more than 24 cumulative hours postoperatively, is a clinically important measure linked to increased risks of complications such as respiratory failure, infection, and extended ICU stays, and associated with higher mortality risk. In this cohort, the rate of prolonged ventilation has remained consistently low compared to expected levels, indicating strong perioperative care and effective respiratory management practices.

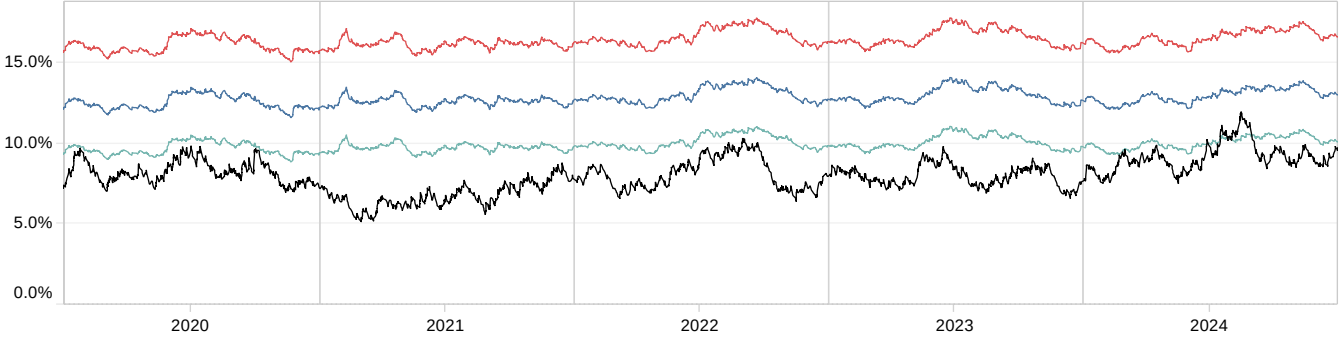


Figure 38: Ventilation >24 hours, 2020–2024

Deep sternal wound infection (DSWI) is a serious postoperative complication associated with increased mortality risk and substantial healthcare resource utilisation. Over the past five years, the observed rate of DSWI has remained consistently within or below the expected benchmark. This trend reflects the impact of quality improvement initiatives, audits, and targeted projects undertaken across various sites to examine and refine local practices. These efforts aim to identify and mitigate factors that contribute to DSWI, supporting sustained performance within benchmarked rates.

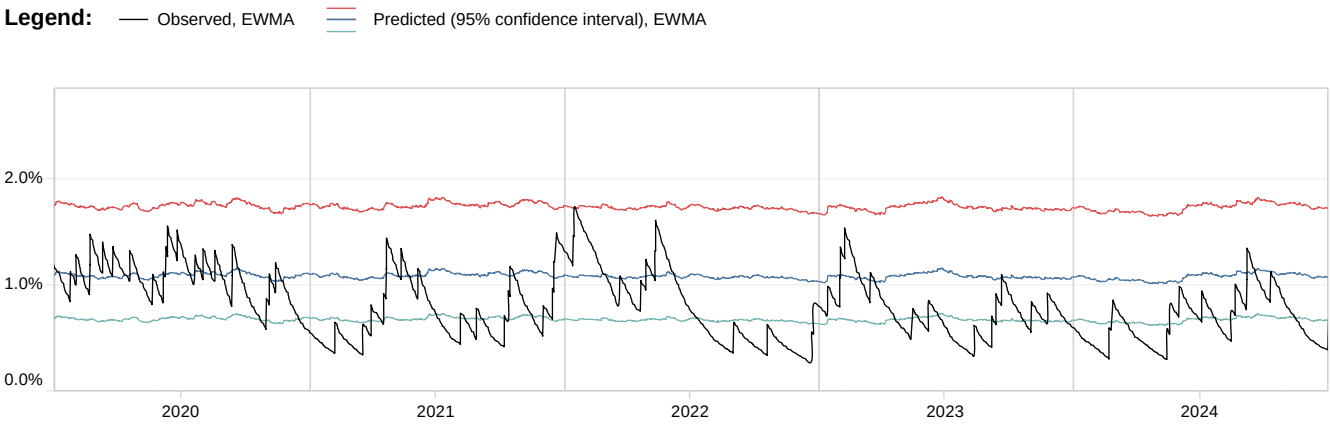


Figure 39: Deep sternal wound infection, 2020–2024

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.

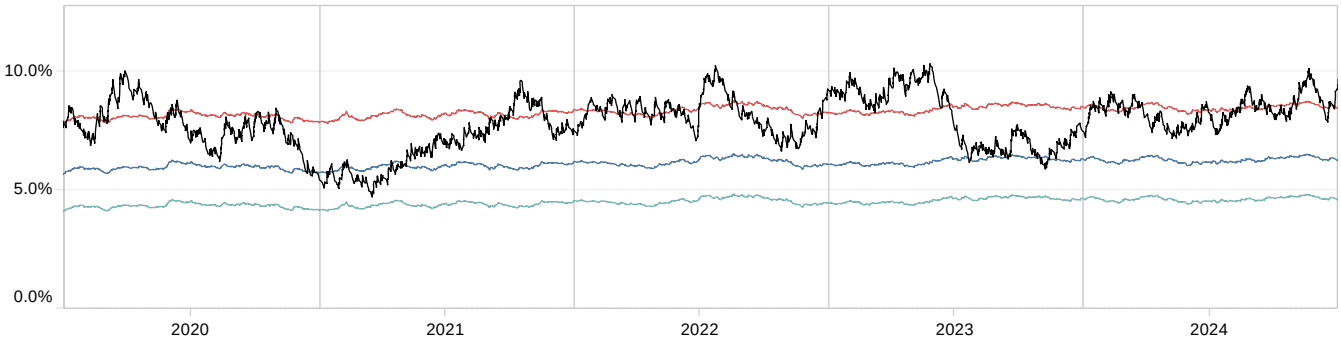


Figure 40: Reoperation, 2020–2024

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.

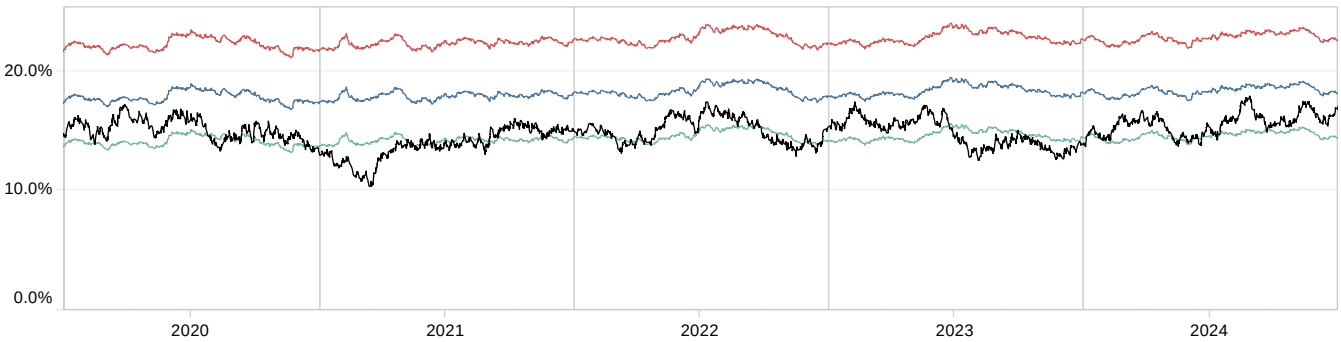


Figure 41: Major morbidity, 2020–2024

Measures of process

Previous QCOR reports have examined factors influencing postoperative length of stay (LOS) and, after adjusting for clinical characteristics and procedural variables, identified a positive correlation between the remoteness of a patient's residence and the likelihood of remaining in hospital for more than 14 days postoperatively. Interestingly, patients from Inner Regional and Outer Regional areas were also found to have a higher likelihood of a hospital stay shorter than six days.

This analysis compares actual patient LOS with predictions based on the STS score. It shows that the proportion of cases with stays under six days is consistently lower than expected and the proportion of patients staying longer than 14 days remains consistently above the expected range. Previous investigations have suggested that STS targets may be idealistic and not adequately account for Queensland's well-recognised geographic challenges.

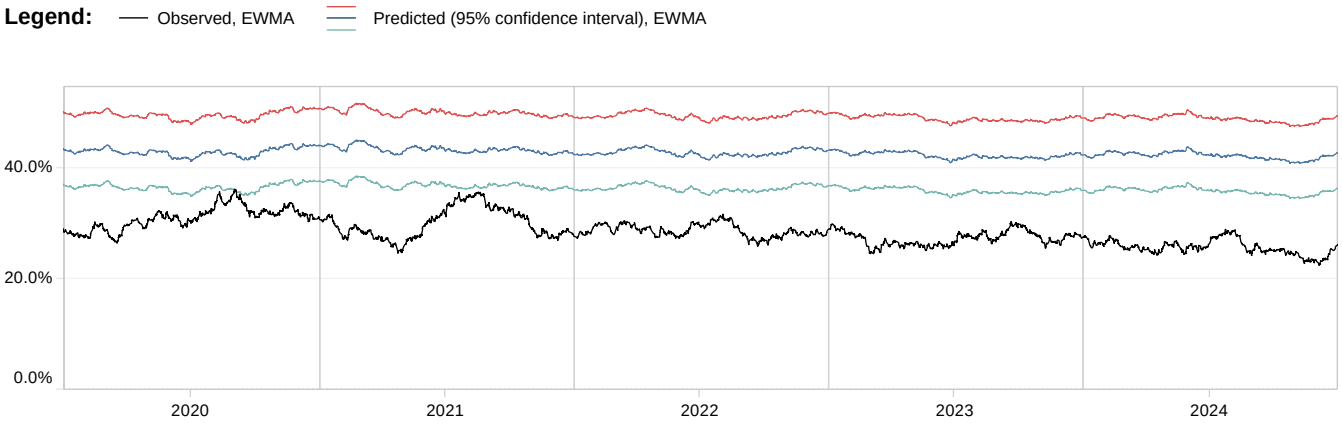


Figure 42: LOS ‹6 days, 2020–2024

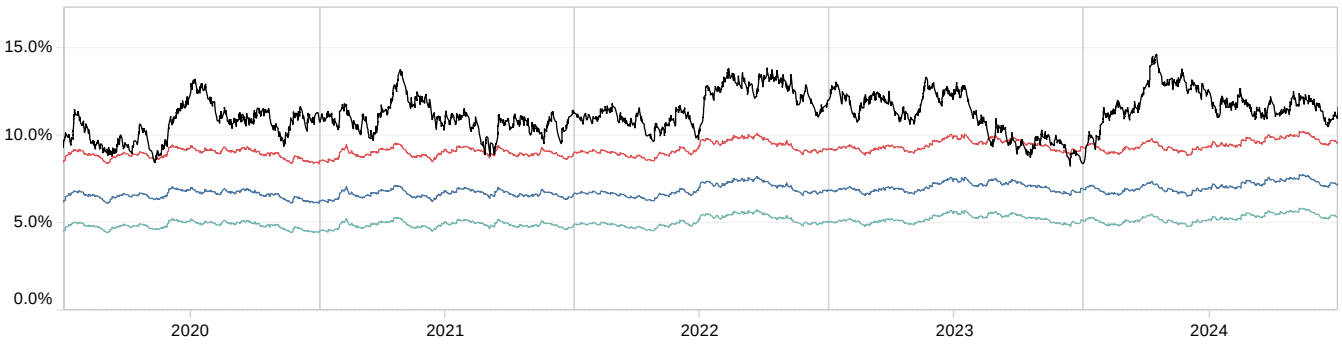


Figure 43: LOS ›14 days, 2020–2024

Failure to rescue

As previously outlined, FTR is calculated by combining the risk of adverse events with the risk of death. It operates on the assumption that, without appropriate hospital intervention, an adverse event may lead to death. This analysis includes all surgical categories and has found that, for the majority of the sample period, FTR rates were lower than predicted.

Since FTR is a quality indicator that primarily reflects the system of care rather than the surgical procedure itself, the findings suggest that mechanisms to manage adverse events are in place and are performing within the expected range.

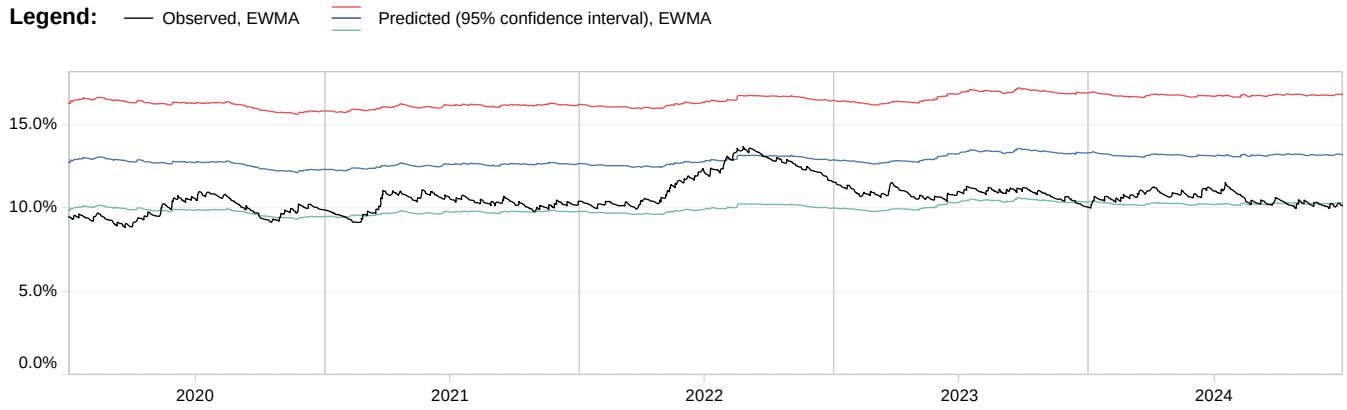


Figure 44: Failure to rescue, 2020–2024

8 Supplement: Queensland cardiothoracic surgery quality assurance committee

8.1 Background

The 2005 *Queensland Public Hospitals Commission of Inquiry Report* exposed opportunities for improvement in clinical governance across the state's public hospitals, particularly in the areas of clinical audit, peer review, as well as morbidity and mortality (M&M) meetings. These mechanisms are essential for upholding high standards of patient care, ensuring clinician accountability, and fostering a culture of continuous improvement.

Clinical audit is defined as the systematic evaluation of clinical performance against established benchmarks. According to the Royal Australasian College of Surgeons, effective audit comprises three core components:

- data collection on clinical activities and outcomes,
- analysis using performance indicators, and
- peer review of findings.

Common indicators include metrics associated with patient outcomes (periprocedural complications, treatment success, 30 day mortality, unplanned readmissions) and measures of the process of care.

The *Commission of Inquiry* found that these processes were often absent, poorly implemented, or lacked transparency. It recommended that hospitals formally allocate time for M&M meetings, encourage broad participation, and ensure audit findings are integrated into executive level decision making. Importantly, audit and peer review should complement, not replace, incident reporting and complaints systems.

When functioning effectively, clinical audit and peer review offer a longitudinal perspective on clinician, hospital and health system performance, support credentialing decisions, and promote safer, more accountable healthcare. The Commission's findings underscore the need to embed these practices as standard across Queensland's public health system.

Under the *Hospital and Health Boards Act 2011* (HHB Act), Quality Assurance Committees (QACs) are formal bodies established to support the continuous improvement of health services. Their primary role, similar to M&M meetings is to assess, monitor, and evaluate the quality of care provided, and to make recommendations aimed at enhancing patient safety and service delivery. QACs are supported by strong legislative protections for information handled within their operations and these protections act to foster an environment where QAC members can engage openly and honestly, which is essential for effective quality assurance and improvement.

QACs may be established by a Hospital and Health Service (HHS), the Director General of Queensland Health, a professional health-related association, or the licensee of a private health facility. In some cases, multiple entities may jointly establish a QAC.

Membership must include individuals with appropriate training and experience relevant to the health services under review. While there is no mandated number of members, the composition should reflect the expertise required to effectively carry out the QAC's functions. Additional individuals may be involved to assist with administrative or advisory tasks.

QACs are afforded legal protections under the *HHB Act*, including qualified privilege for members acting in good faith, strict confidentiality provisions, and exemption from the *Right to Information Act 2009*. These safeguards are designed to encourage open and honest evaluation of health services without fear of legal repercussions. QACs also have various periodic administrative reporting requirements to ensure proper governance, oversight and functioning.

8.2 CTS QAC overview

The Statewide Cardiothoracic Surgery Quality Assurance Committee (CTS QAC) was established to enhance the safety, quality, and outcomes of cardiothoracic surgery across Queensland. The CTS QAC operates within a confidential and privileged environment to facilitate peer review, clinical benchmarking, and service improvement. This supplement outlines the QAC's background, purpose, functions, governance, and operational framework, and its role in fostering statewide collaboration and continuous quality improvement in cardiothoracic surgical care.

QCOR was established in 2015 by Queensland Health to address the information needs of adult cardiac and cardiothoracic surgical services. It serves as a centralised data repository and analytics platform, enabling the collection, analysis, and reporting of cardiac-related clinical outcomes across the state. In 2021, the CTS QAC was formed to support clinical improvement through peer review and collaboration among clinicians and administrators. The CTS QAC provides a forum for evaluating performance, identifying trends, and guiding service enhancements. This is achieved by using clinical data and outcome indicators, to benchmark against national and international guidelines and standards, and to monitor the implementation of its recommendations across health services.

The CTS QAC was founded with clear objectives aimed at monitoring and improving cardiothoracic surgical care statewide. These include collecting and analysing morbidity and mortality data to identify trends and unit level performance, enabling peer review among clinicians and administrators, and supporting clinician-led initiatives to enhance public sector cardiothoracic services. The CTS QAC also works collaboratively with care providers to improve safety and quality through shared learning and benchmarking, offers advisory input on safety and quality issues to Queensland public health organisations and their interstate and Commonwealth counterparts, and partners with the Queensland Cardiac Clinical Network to achieve shared goals. These objectives reflect a commitment to transparency, accountability, and continuous improvement.

Governance of the CTS QAC is structured to ensure transparency, inclusivity, and adherence to best practices. The Chairperson is appointed with Director General approval following an expression of interest or member vote and may serve up to three consecutive terms. Members are appointed for three year terms through an expression of interest process and must meet eligibility criteria, including relevant training and experience and no practice restrictions enforced by Australian Health Practitioner Regulation Agency or similar bodies within the past 15 years.

8.3 Information disclosure

Confidentiality is paramount within QACs. All information acquired or created by QAC members or relevant persons in the course of their duties—including internal adverse event reports, meeting minutes, clinical performance data, and other sensitive materials—is subject to strict confidentiality obligations under the Act. This confidentiality extends beyond personal or identifiable information, covering a broad spectrum of data. Unauthorised disclosure of such information is prohibited and can lead to prosecution, emphasising the legal and ethical seriousness of maintaining confidentiality.

Despite these strict rules, there are carefully defined exceptions allowing disclosure in limited circumstances. Members must not disclose information acquired through their QAC role unless it is for exercising their QAC functions or sharing with another QAC if it is pertinent to that QAC's role. Information can also be disclosed to prescribed patient safety entities, such as Patient Safety and Quality within Clinical Excellence Queensland or safety committees established by HHS Boards, but only for authorised purposes. Other permitted disclosures include reporting to the Chief Executive if the QAC reasonably believes a health professional poses a serious risk of harm due to their health, conduct, or performance. Additionally, disclosures must be made to the Health Ombudsman if a registered practitioner engages in conduct defined as public risk notifiable conduct. Finally, information may be shared with inspectors under the HHB Act, though no current regulations further specify disclosures beyond these provisions.

Mandatory disclosures to the Chief Executive are triggered when the QAC forms a reasonable belief that a health professional poses a serious risk of harm to others, whether through intoxication while practising or a significant departure from professional standards that could cause harm. It is important to note that the term "serious risk of harm" is not explicitly defined in the legislation, leaving some room for contextual interpretation and professional judgment.

In relation to reporting to the Office of the Health Ombudsman, QAC members face a higher threshold. They are obligated to report only if a practitioner's conduct places the public at substantial harm, as opposed to harm in general. This includes cases where impairment or a significant departure from accepted professional standards creates that substantial risk. Certain conduct such as intoxication without substantial harm or sexual misconduct that does not endanger the public may be excluded from mandatory reporting. Importantly, QAC members are exempt from mandatory reporting requirements for knowledge of excluded conduct acquired during their QAC functions.

When disclosing information to prescribed patient safety entities, the use of such information is tightly controlled. These entities include patient safety and quality committees established by HHS Boards in which case the information must be used solely for authorised purposes, ensuring the focus remains on improving patient outcomes and service quality without compromising confidentiality.

These legal and procedural frameworks aim to balance the need for transparency and accountability with protections that ensure the QAC's ability to operate effectively. By providing the protections, the legislation encourages open communication and thorough quality assurance processes that ultimately enhance the safety and quality of healthcare services.

8.4 Meeting format and order of proceedings

The CTS QAC comprises representatives from each participating CTS unit, with a quorum requirement of at least half of the QAC members (or half the members plus one, if half is not a whole number). The QAC convenes at least twice annually to review outcome data and assess the performance of CTS services across Queensland public hospitals. Proxies are not permitted due to confidentiality requirements, members are not remunerated, and all conflicts of interest must be declared. Members are expected to act solely in the interest of the CTS QAC's objectives, and as previously outlined, misuse of information is strictly prohibited.

The Statewide Cardiac Clinical Informatics Unit (SCCIU) serves as the Secretariat for the CTS QAC and plays a critical role in supporting its operations. Responsibilities include preparing and distributing meeting materials, attending meetings for minute taking, and coordinating correspondence. The SCCIU also has a key role in preparing the statistical analyses and clinical indicator reports to enable the review of CTS unit performance by the CTS QAC. The SCCIU also retains original documentation related to the CTS QAC's activities and ensures compliance with privacy and confidentiality obligations. Staff within the SCCIU are designated as relevant persons under section 84(2) of the *HHB Act 2011*, ensuring their authority and accountability in supporting the CTS QAC's operations.

Reports produced by the CTS QAC include:

- **Safety and quality report for units**—identifies trends and issues in CTS mortality and outcomes. Unit specific results are reported against statewide results. Reports are unit specific and are usually produced twice a year (or at, minimum once a year) for distribution to Directors of each specific CTS units, the Medical Director of the Hospital housing the specific CTS Unit, and the Medical Director of the HHS that houses the specific CTS Unit.
- **Annual activity statement**—prepared every 12 months and includes the chairperson's name, all members' names, details of new and departing members, and meeting dates. This report is distributed to the Director-General of Queensland Health.
- **Triennial report**—prepared every three years and reviews the QAC's functions, provides member details, summarises activities and outcomes, and includes the privacy policy. This report is distributed to the Director-General of Queensland Health and made available publicly.

8.5 Quality indicators

Using an exponentially weighted moving average (EWMA) and benchmarking against predicted outcomes derived from various risk models, the QAC evaluates a comprehensive set of quality indicators.

The indicators reviewed by the CTS QAC are subject to ongoing refinement, and new measures may be introduced as deemed appropriate by the QAC.

Current indicators assessed for cardiac surgery include:

Mortality:

- EuroSCORE II[31]
- Society of Thoracic Surgeons (STS) Score [34,35,36]
- ANZSCTS General Score[32]

STS defined major morbidities:

- Cerebrovascular accident (CVA)
- New renal failure
- Ventilation >24 hours
- Deep sternal wound infection (DSWI)
- Reoperation
- Major morbidity
- Postoperative length of stay (LOS) >14 days

QCOR defined outcomes:

- MACCE (Death, CVA) + DSWI
- Postoperative LOS >14 days or readmission within 30 days
- Reoperation for bleeding or transfusion of >10 units of blood products
- Isolated postoperative LOS >14 days

Current indicators assessed for thoracic surgery include:

Patient outcomes:

- Death within 90 days
- Air leak >7 days
- Any major morbidity (excluding air leak)
- Return to theatre
- Postoperative LOS >14 days or readmission within 30 days (or death per admission)

TNM staging:

- Upstaging
- Downstaging

8.6 Data analysis and outcomes reporting

The QAC has also advanced outcomes monitoring and transparency by enabling committee members to track their unit's outcomes over time and with other participating facilities, fostering a culture of accountability and continuous improvement. Outcome measures are presented using an exponentially weighted moving average (EWMA) chart over eight years, offering a nuanced view of performance trends. Specific improvements in clinical practice have been observed and documented, reflecting the QAC's promotion of a culture of collegiality and shared responsibility.

Furthermore, the SCCIU's analytics capabilities support data-driven decision making, with robust data quality and audit processes, and use of statistical process control tools, ensuring the reliability and relevance of recommendations.

Statistical process control tools facilitate near real-time performance monitoring allowing early detection, evaluation and intervention in altered performance and have been demonstrated to be helpful in detecting and differentiating systemic vs individual variation in cardiac surgery[38]. Described by Roberts[39] and adapted to the clinical setting by Cook[40], an EWMA chart is a statistical tool used to monitor for changes in a process over time. They are particularly useful for detecting sustained small or gradual shifts that might be missed by traditional Shewhart individuals type control charts[41]. It works by assigning more weight to recent data points while still incorporating past observations, creating a smoothed trend line that reflects the current state of the process. Construction involves a weighting factor, which determines how much influence more recent data points have. A higher weighting factor makes the chart more sensitive to short-term changes, while a lower factor emphasises long-term trends. Each new EWMA value is derived from a combination of the latest observation and the previous EWMA value, allowing the chart to respond dynamically to shifts in performance. As proposed by Cook for applications where the risk of the event monitored varies from case to case, the chart is constructed by overlaying the EWMA of the observed results on the EWMA of expected outcomes (derived using the risk scores of the cases monitored) with control limits derived from the variance estimated based on the expected values. In clinical quality monitoring, such as tracking infection rates after surgery, EWMA charts help identify emerging trends early, enabling timely interventions and continuous improvement.

The chart below (Figure 1) depicts the EWMA of observed outcomes (black line) overlayed on the EWMA of predicted process outcomes (blue line) which is derived using a risk prediction model that takes into account the characteristics of each case to assign a predicted risk of the event. The upper and lower control limits (UCL – red and LCL – green) define the range within which the process is considered stable. When the EWMA crosses these limits (e.g between January and February 2024), it signals a statistically significant deviation from predicted performance, suggesting that the process may be delivering events at a rate higher than expected and as such requires investigation to identify potential causes* and possible interventions to address these issues.

* Potential causes may include data quality issues, clinical complexity not addressed by the risk model, availability of resources and appropriate technology, process of care issues and clinical decision making and performance

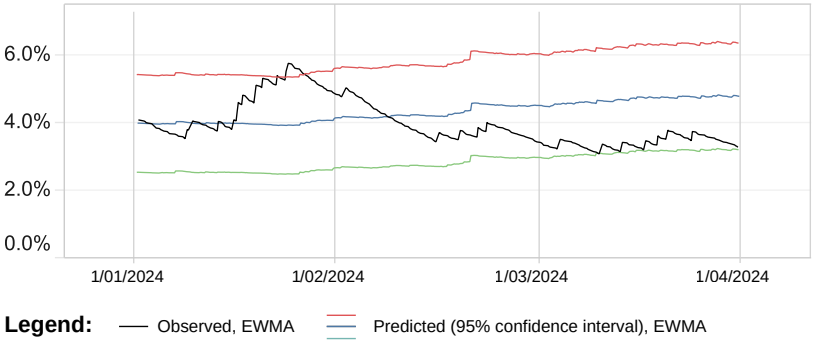


Figure 1: EWMA chart example

The box plot (Figure 2) is a benchmarking visualisation that compares an observed percentage against an expected range based on statistical confidence intervals. The vertical bar is divided into segments, representing different performance zones, usually confidence intervals, and the circle indicates the observed rate for a specific measure or site (filled circles indicate a statistical outlier). The horizontal bar near the middle of the visualisation represents the predicted incidence rate for the unit and is derived using the calibrated risk model for the event monitored. Also included are the 95% and 99% confidence intervals, which serve as reference limits for what is considered statistically typical. If the observed value (circle) falls within the target range, performance is consistent with expectations. If it falls outside, it suggests a significant deviation that may warrant further investigation.

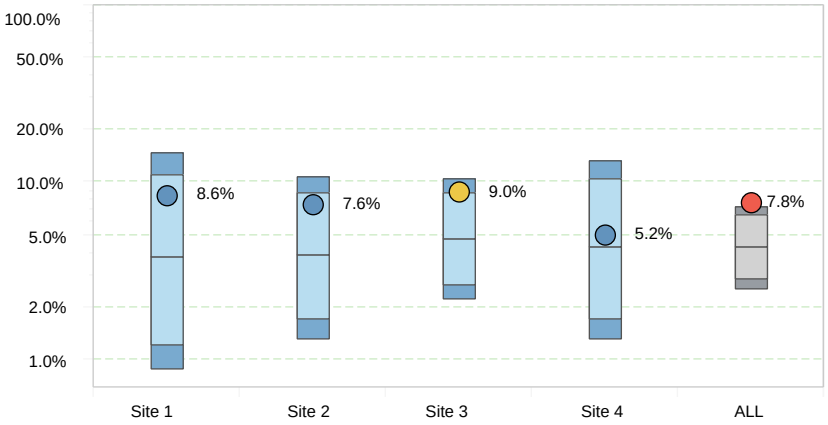


Figure 2: Box plot example

8.7 Control limits

In risk adjusted process monitoring, it is important to distinguish between alerts and alarms when interpreting clinical performance variation. When the process monitoring signals a breach of the alert limit, this potentially indicates that performance variation has moved beyond what would normally be expected due to chance events and may suggest emerging outlier behaviour; it warrants a preliminary review, typically focused on straightforward checks such as data quality, coding accuracy, and obvious process of care issues. A breach of the Alarm threshold, by contrast, reflects a statistically robust deviation from expected performance, providing a high degree of confidence that a true change has occurred and signalling the need for a more detailed investigation that not only focusses on the aspects covered by the alert but may cover a range of clinical performance issues such as clinician and clinical team protocols and decision making.

These thresholds are commonly defined using statistical confidence limits: a 95% interval provides a sensitive early-warning boundary suited to detecting possible issues, while a 99% interval offers a more conservative limit used to trigger formal escalation only when the evidence for a true deviation is strong. Balancing these levels helps minimise false positives while ensuring genuine performance changes are detected promptly.

Consistent with these principles, the QCOR CTS QAC applies both 95% and 99% confidence limits when reviewing outcomes—using vertical box-plot summaries for defined review periods and EWMA charts to monitor temporal trends—to help identify when changes in outcomes occur and to isolate factors that may have contributed to those changes. In this way, potential concerns can prompt early checks and interventions that may reduce the likelihood of reaching an alarm level; however, when an alarm level is reached, the pre-emptive focus on addressing any potential data or cohort issues enables rapid escalation to a comprehensive review of clinical performance.

Figure 3: Sample safety and quality report for units

8.8 Outlier management and translation of findings

The management process adopted by the QAC is a structured clinical governance pathway designed to manage and respond to identified outliers in clinical performance or outcomes. It begins with review of performance within a CTS QAC that is outside of the expected range for two consecutive review periods. The relevant clinical unit is notified and conducts an internal review and analysis of the report to determine the validity and implications of the outlier status. If the unit concludes that the outlier status remains unresolved or warrants further attention, the process escalates to a formal pathway involving additional meetings and deeper analysis.

Depending on the outcome of this escalation, the process includes mandatory reporting to senior health authorities. These include the Minister for Health, Director General, Deputy Director General(s), the HHS Chief Executive, and the Executive Director responsible for the relevant clinical domain. The Clinical Unit Director is also informed. This ensures transparency, accountability, and appropriate oversight at each stage of the review and escalation process.

Since its inception, the CTS QAC has made measurable contributions to improving CTS care across Queensland. One of its key achievements is the enhancement of peer review processes, providing a confidential forum for rigorous discussion of clinical performance and empowering clinicians to share insights and learn from one another.

Another area of clinical focus has been deep sternal wound infection (DSWI). A rare but serious complication following cardiothoracic surgery, DSWI is associated with significant morbidity and increased healthcare costs. Since 2017, the QCOR CTS QAC has monitored DSWI rates across Queensland public cardiothoracic units using a recalibrated STS risk model to account for case mix variation.

A review undertaken in 2022 found that across 9,942 cases, DSWI rates have significantly declined over time. In 2017, the unadjusted rate was 1.86% (SIR 1.64), falling to 0.85% (SIR 0.77) by 2021 ($p=0.006$). Among patients undergoing isolated coronary artery bypass grafting ($n=6,283$), rates dropped from 2.52% in 2017 (SIR 2.2) to 0.80% in 2021 (SIR 0.71, $p=0.0008$).

DSWI is a complex outcome influenced by multiple clinical and operational factors. The structured feedback loop established through the QCOR CTS QAC has driven improvements in data quality and clinical engagement. Where elevated infection rates were identified, surgical units used the data to review local practices and implement targeted quality improvement initiatives. These included enhanced infection control protocols, staff education, and procedural refinements.

The observed reduction in DSWI rates highlights the value of transparent reporting and data driven clinical governance. The translation of QAC results into practice has fostered a culture of continuous improvement and accountability. Ongoing work to develop predictive models for surgical site infection aims to enable earlier interventions and further reduce adverse outcomes.

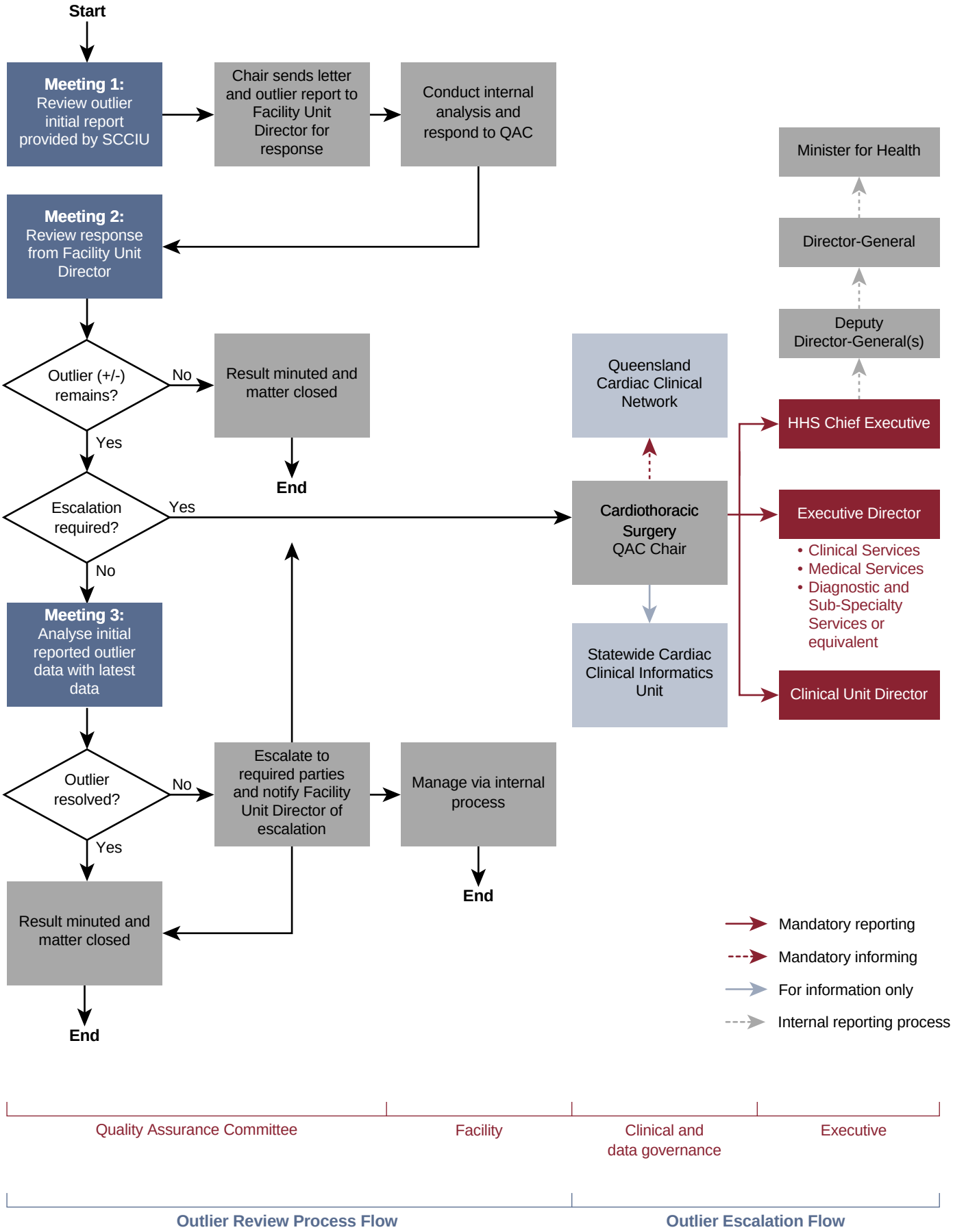


Figure 4: Sample safety and quality report for units

8.9 Conclusion

The QCOR CTS QAC represents a model of collaborative, data driven quality assurance in healthcare. Its establishment has enabled Queensland to take a proactive and structured approach to improving cardiothoracic surgical outcomes. Through robust governance, comprehensive data analysis, and a steadfast commitment to confidentiality, the QAC has fostered a culture of continuous improvement and professional accountability. Looking ahead, the CTS QAC is well placed to expand its impact by enhancing integration with other clinical networks and registries, supporting research and innovation in CTS, strengthening engagement with rural and Indigenous health services, and leveraging technology to improve data collection and reporting. By continuing to evolve and adapt, the CTS QAC will remain a cornerstone of quality improvement in Queensland's cardiac care landscape.

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

9.1 Message from the Chair

It is my pleasure to present Queensland's 2019–2024 financial year paediatric cardiac surgical data from the Australia and New Zealand Congenital Outcomes Registry for Surgery (ANZCORS) as part of the QCOR Annual Report for 2024. The cardiac surgical team at the Queensland Children's Hospital has validated all data included in this report.

ANZCORS was created in 2017 and represents a collaborative effort between the five institutions 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. Through ANZCORS, we benchmark outcomes after paediatric cardiac surgery across the region and translate findings that are important to 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 with the National Death Index through the Australian Institute of Health and Welfare. Over the past year the team has been continued working in collaboration with the Australia and New Zealand Society of Cardiothoracic Surgeons and industry partners to further 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 Queensland Health and QCOR, which provides funding for the Registry's core activities and advice and infrastructure support.

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

Dr Prem Venugopal
Deputy Director of Cardiac Surgery, Queensland Children's Hospital
Chair, Australia and New Zealand Congenital Outcomes Registry for Surgery Steering Committee

9.2 Acknowledgements

Data Custodian and Chief Operating Officer

- Dr Nelson Alphonso

ANZCORS Program Manager

- Kerry Johnson

ANZCORS Data Analyst

- Jason Christiansen

Biostatistician and Machine Learning

- Dr Kim Betts, PhD

Data Manager at Queensland Children's Hospital

- Michelle Byrnes

Cardiac Surgeons at Queensland Children's Hospital

- Nelson Alphonso
- Supreet Marathe
- Prem Venugopal

ANZCORS Steering Committee

- Dr 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)
- Ajay Iyengar (Starship Children's Hospital, Auckland)
- Robert Justo (Queensland Children's Hospital)
- Julian Ayer (The Children's Hospital at Westmead)
- Emily Granger (ANZSCTS Past President)

9.3 ANZCORS publications

1. Betts, K. S., Marathe, S. P., Suna, J., Venugopal, P., Chai, K., & Alphonso, N.; Queensland Paediatric Cardiac Research (QPCR) Group. (2022). Machine learning in paediatric cardiac surgery: Ready for prime time? *Heart Lung and Circulation*, *31*(5), 613–615. https://doi.org/10.1016/j.hlc.2021.12.005

2. Marathe, S. P., Suna, J., Betts, K. S., Merlo, G., Konstantinov, I. E., Iyengar, A. J., Venugopal, P., & Alphonso, N.; ANZCORS Collaborative. (2022). The Australia and New Zealand Congenital Outcomes Registry for Surgery (ANZCORS): Methodology and preliminary results. *ANZ Journal of Surgery*, *92*(12), 3154–3161. https://doi.org/10.1111/ans.17886

3. Suna, J. M., Marathe, S. P., Venugopal, P., Justo, R., Alphonso, N., Merlo, G., & Hall, L. (2023). Clinical stakeholder preferences for paediatric cardiac surgery outcome reporting in Australia and New Zealand. *Cardiology in the Young*, *33*(11), 2236–2242. https://doi.org/10.1017/s1047951122003912

4. Betts, K. S., Marathe, S. P., Chai, K., Konstantinov, I., Iyengar, A., Suna, J.; ANZCORS Collaborative; Venugopal, P., & Alphonso, N. (2023). A machine learning approach to predicting 30-day mortality following paediatric cardiac surgery: Findings from the Australia New Zealand Congenital Outcomes Registry for Surgery (ANZCORS). *European Journal of Cardio-Thoracic Surgery*, *64*(2), ezad160. https://doi.org/10.1093/ejcts/ezad160

5. Crawford, L., Marathe, S. P., Betts, K. S., Karl, T. R., Mattke, A., Rahiman, S., Campbell, I., Inoue, T., Nair, H., Iyengar, A., Konstantinov, I. E.; ANZCORS Collaborative; Venugopal, P., & Alphonso, N. (2024). Early outcomes after post-cardiotomy extracorporeal membrane oxygenation in paediatric patients: A contemporary, binational cohort study. *European Journal of Cardio-Thoracic Surgery*, *65*(4), ezae124. https://doi.org/10.1093/ejcts/ezae124

9.4 Introduction

This report provides an overview of the major findings from the 2024 annual ANZCORS report for Queensland. The data covers the five year rolling period from July 2019 to June 2024 and includes 2,349 cardiothoracic surgical procedures.

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.

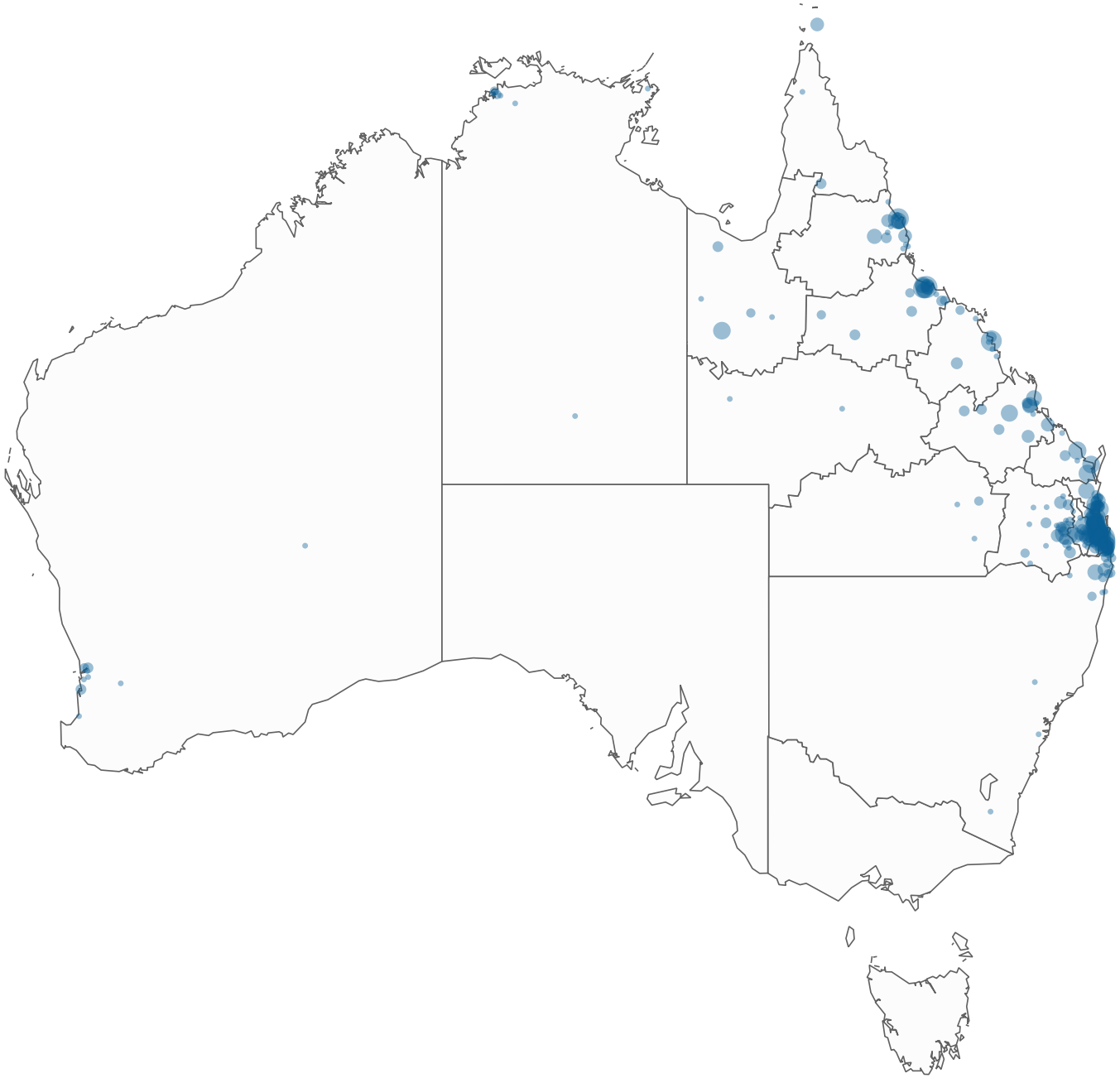


Figure 1: Cardiac patients treated by the Queensland Paediatric Cardiac Service between 2019–2024, by patient's place of usual residence (residential postcode)

9.5 Childhood heart surgery patients and procedures

During the five year reporting period from July 2019 to June 2024 there were 2,349 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 (CPB), extracorporeal membrane oxygenation (ECMO), thoracic and delayed sternal wound closure procedures (Table 1). The focus of this report is cardiac surgical procedures for congenital and acquired childhood heart disease. Acquired childhood heart disease includes children who required surgery for rheumatic fever and infective endocarditis. Delayed sternal closure, ECMO and thoracic procedures are excluded from the analysis for length of intensive care unit and hospital stay.

Over the five year reporting period, there were 1,323 patients with childhood heart disease who underwent 2,349 cardiothoracic surgical procedures. There were 1,126 (48%) cardiac procedures performed using CPB and 317 (14%) cardiac procedures performed without using CPB at the Queensland Children's Hospital.

Table 1: Total procedures by case category, 2019–2024

Case category	2019/20 n	2020/21 n	2021/22 n	2022/23 n	2023/24 n	ALL n (%)
CPB*	209	240	231	202	244	1,126 (47.9)
Non-CPB*	65	72	61	62	57	317 (13.5)
Thoracic‡	82	63	53	71	45	314 (13.4)
Delayed sternal closure	44	50	47	40	70	251 (10.7)
ECMO†	68	34	38	63	45	248 (10.6)
Other§	11	11	3	19	49	93 (4.0)
Total	**479**	**470**	**433**	**457**	**510**	**2,349 (100.0)**

* Cardiopulmonary bypass

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

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

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

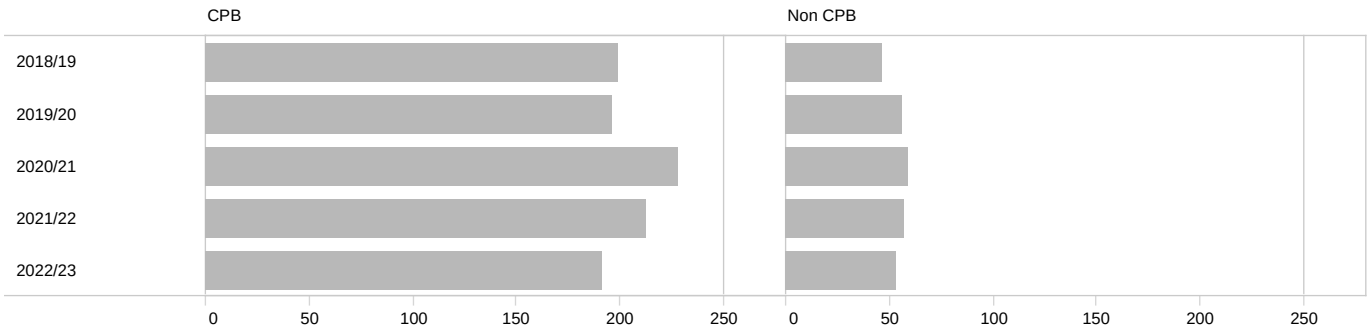


Figure 2: Number of cardiac patients by utilisation of cardiopulmonary bypass, 2019–2024

Table 2: Total cardiac patients and procedures, 2019–2024

	2019/20 n	2020/21 n	2021/22 n	2022/23 n	2023/24 n	ALL n
Cardiac patients	252	287	269	244	271	1,323
Cardiac procedures	274	312	292	264	301	1,443

Includes CPB and non-CPB procedures

9.6 Patient characteristics

9.6.1 Age and gender

Approximately 21% 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, 54% of the patient population were under one year of age. Forty-four percent of the cohort were aged between one and sixteen years, and 1.9% were over 16 years of age.

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

Table 3: Cardiac procedures (cardiopulmonary bypass and non-cardiopulmonary bypass) by age group and year, 2019–2024

Age group	2019/20 n (%)	2020/21 n (%)	2021/22 n (%)	2022/23 n (%)	2023/24 n (%)	ALL n (%)
0–28 days	62 (22.6)	61 (19.6)	57 (19.5)	58 (22.0)	63 (20.9)	301 (20.9)
29–365 days	85 (31.0)	101 (32.4)	118 (40.4)	83 (31.4)	93 (30.9)	480 (33.3)
1–16 years	124 (45.3)	145 (46.5)	113 (38.7)	120 (45.5)	133 (44.2)	635 (44.0)
≥17 years	3 (1.1)	5 (1.6)	4 (1.4)	3 (1.1)	12 (4.0)	27 (1.9)
Total	**274 (100.0)**	**312 (100.0)**	**292 (100.0)**	**264 (100.0)**	**301 (100.0)**	**1,443 (100.0)**

Table 4: Cardiac procedures (cardiopulmonary bypass and non-cardiopulmonary bypass) by gender and year, 2019–2024

Gender	2019/20 n (%)	2020/21 n (%)	2021/22 n (%)	2022/23 n (%)	2023/24 n (%)	ALL n (%)
Female	130 (47.4)	136 (43.6)	134 (45.9)	108 (40.9)	138 (45.8)	646 (44.8)
Male	144 (52.6)	176 (56.4)	158 (54.1)	156 (59.1)	163 (54.2)	797 (55.2)
Total	**274 (100.0)**	**312 (100.0)**	**292 (100.0)**	**264 (100.0)**	**301 (100.0)**	**1,443(100.0)**

9.6.2 Aboriginal and Torres Strait Islander status

Approximately 14% of the overall population of patients undergoing a cardiac procedure were identified as Aboriginal and Torres Strait Islander patients. The proportion of Aboriginal and Torres Strait Islander patients undergoing a cardiac procedure has decreased from 15% to 11% from 2019 to 2024.

Table 5: Cardiac procedures by Aboriginal and Torres Strait Islander status, 2019–2024

	2019/20 n (%)	2020/21 n (%)	2021/22 n (%)	2022/23 n (%)	2023/24 n (%)	ALL n (%)
Indigenous	41 (15.0%)	43 (13.8%)	46 (15.8%)	37 (14.0%)	32 (10.6%)	199 (13.8%)
Non-Indigenous	233 (85.0%)	269 (86.2%)	246 (84.2%)	227 (86.0%)	269 (89.4%)	1,244 (86.2%)
Total	**274 (100.0%)**	**312 (100.0%)**	**292 (100.0%)**	**264 (100.0%)**	**301 (100.0%)**	**1,443 (100.0%)**

9.7 Outcomes – length of stay

9.7.1 Paediatric intensive care unit length of stay

In 2019–2024, the median length of stay in the paediatric intensive care unit (PICU) for cardiac patients was 2 days, with a mean of 5.5 days.

Table 6: Median PICU length of stay for cardiac patients by year

PICU length of stay	2019/20 days	2020/21 days	2021/22 days	2022/23 days	2023/24 days	ALL days
Maximum length of stay	504	167	47	56	164	504
Mean length of stay	8.0	5.2	5.3	4.1	5.2	5.5
Median length of stay	2	2	3	2	2	2

9.7.2 Hospital length of stay

In 2019–2024, the median hospital length of stay for cardiac patients was 10 days, and a mean of 23 days.

Table 7: Hospital length of stay for cardiac patients by year

Hospital length of stay	2019/20 days	2020/21 days	2021/22 days	2022/23 days	2023/24 days	ALL days
Maximum length of stay	506	308	230	272	335	506
Mean length of stay	22.0	25.8	21.2	23.8	23.0	23.2
Median length of stay	9	10	11	13	9	10

9.8 Outcomes – mortality

9.8.1 30 day mortality

Table 8 shows the 30 day mortality for cardiac surgical procedures performed over the five year period. 30 day mortality includes all deaths, regardless of cause, that occurred either during the hospital admission or after discharge from hospital, but before the end of the 30th postoperative day.

The exclusion of organ procurement procedures in Table 8 is due to the inherent outcome of death.

Table 8: 30 day mortality for all procedures by case category

	2019/20	2020/21	2021/22	2022/23	2023/24	ALL
Patients, n	**297**	**333**	**300**	**296**	**320**	**1,546**
CPB*	196	228	212	191	223	1,050
Non-CPB*	56	59	57	53	48	273
ECMO† (cardiac)	8	4	5	4	1	22
ECMO† (non-cardiac)	13	8	5	12	11	49
Thoracic‡	23	30	21	27	21	122
Other§	1	4	0	9	16	30
Deaths, n (%)	**4**	**10**	**2**	**10**	**3**	**29**
CPB*	0	2	0	1	2	5
Non-CPB*	0	0	1	2	0	3
ECMO† (cardiac)	2	3	1	1	0	7
ECMO† (non-cardiac)	2	3	0	6	1	12
Thoracic‡	0	0	0	0	0	0
Other§	0	2	–	0	0	2
Total deaths, n (%)	**4 (1.3)**	**10 (3.0)**	**2 (0.7)**	**10 (3.4)**	**3 (0.9)**	**29 (1.9)**
Total excluding ECMO, n (%)	**0 (0.0)**	**4 (1.2)**	**1 (0.3)**	**3 (1.1)**	**2 (0.6)**	**10 (0.7)**

* 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

9.8.2 Hospital mortality

Table 9 displays hospital mortality for all surgical procedures performed over the five year period. Hospital mortality includes all deaths, regardless of cause, that have occurred during the hospitalisation in which the operation took place.

The exclusion of organ procurement procedures in Tables 9 is due to the inherent outcome of death.

Table 9: Hospital mortality for all procedures by case category

	2019/20	2020/21	2021/22	2022/23	2023/24	ALL
Patients, n	**297**	**333**	**300**	**296**	**320**	**1,546**
CPB*	196	228	212	191	223	1,050
Non-CPB*	56	59	57	53	48	273
ECMO† (cardiac)	8	4	5	4	1	22
ECMO† (non-cardiac)	13	8	5	12	11	49
Thoracic‡	23	30	21	27	21	122
Other§	1	4	0	9	16	30
Deaths, n (%)	**14**	**13**	**4**	**15**	**4**	**50**
CPB*	5	3	2	2	2	14
Non-CPB*	1	1	1	3	0	6
ECMO† (cardiac)	4	3	1	2	0	10
ECMO† (non-cardiac)	4	4	0	8	2	18
Thoracic‡	0	0	0	0	0	0
Other§	0	2	0	0	0	2
Total deaths, n (%)	**14 (4.7)**	**13 (3.9)**	**4 (1.3)**	**15 (5.1)**	**4 (1.3)**	**50 (3.2)**
Total excluding ECMO, n (%)	**6 (2.2)**	**6 (1.9)**	**3 (1.0)**	**5 (1.8)**	**2 (0.6)**	**22 (1.5)**

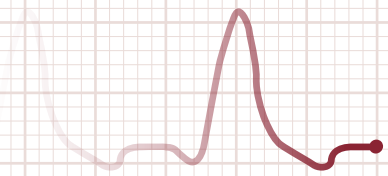
* Cardiopulmonary bypass

† 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

Thoracic Surgery Audit



1 Key findings

Key findings include:

- There were 1,138 thoracic surgical cases entered for 2024 across the five public thoracic surgery units in Queensland.
- Operations performed for preoperative diagnoses of primary lung cancer were undertaken in 24% of all cases, while pleural disease accounted for 31% of all surgeries. A diagnosis of other thoracic cancer was reported in 33% of surgeries while other thoracic surgery was performed in 12% of cases.
- The median age of patients undergoing thoracic surgery was 63 years of age, with 17% of patients aged under 40 years of age.
- Over one quarter of patients (28%) were within the normal body mass index (BMI) range, while patients classed as overweight or obese made up more than half of the patient cohort (62%) including 5% classed as morbidly obese.
- The proportion of Aboriginal and Torres Strait Islander patients undergoing thoracic surgery was 5.4% of the total cohort.
- Almost two thirds of patients had some smoking history, including 25% who were classified as current smokers at the time of surgery.
- Elective procedures accounted for 66% of the total surgeries performed, while 12% of cases were emergency operations. Of elective cases, 57% were performed on a day of surgery admission pathway.
- Lymph node sampling (79%) and lobectomy (78%) and were the most common procedures performed on patients with an indication of primary lung cancer.
- Overall, 7% of all cases required a blood product transfusion.
- The median postoperative length of stay for thoracic surgery patients was 4 days.
- There were 128 cases documented as having one or more new major morbidities post procedure. The most common major morbidity was reoperation, which was recorded for approximately 3% of all patients.
- Pathological upstaging occurred in 38% of primary lung cancer cases while 18% were downstaged postoperatively and 44% had no change to the preoperative staging classification.
- Unadjusted all-cause mortality at 30 days was 1.1%, increasing to 2.2% at 90 days. Patients diagnosed with other thoracic cancer had the highest unadjusted mortality rates at 30 days (2.4%).

2 Participating sites

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

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

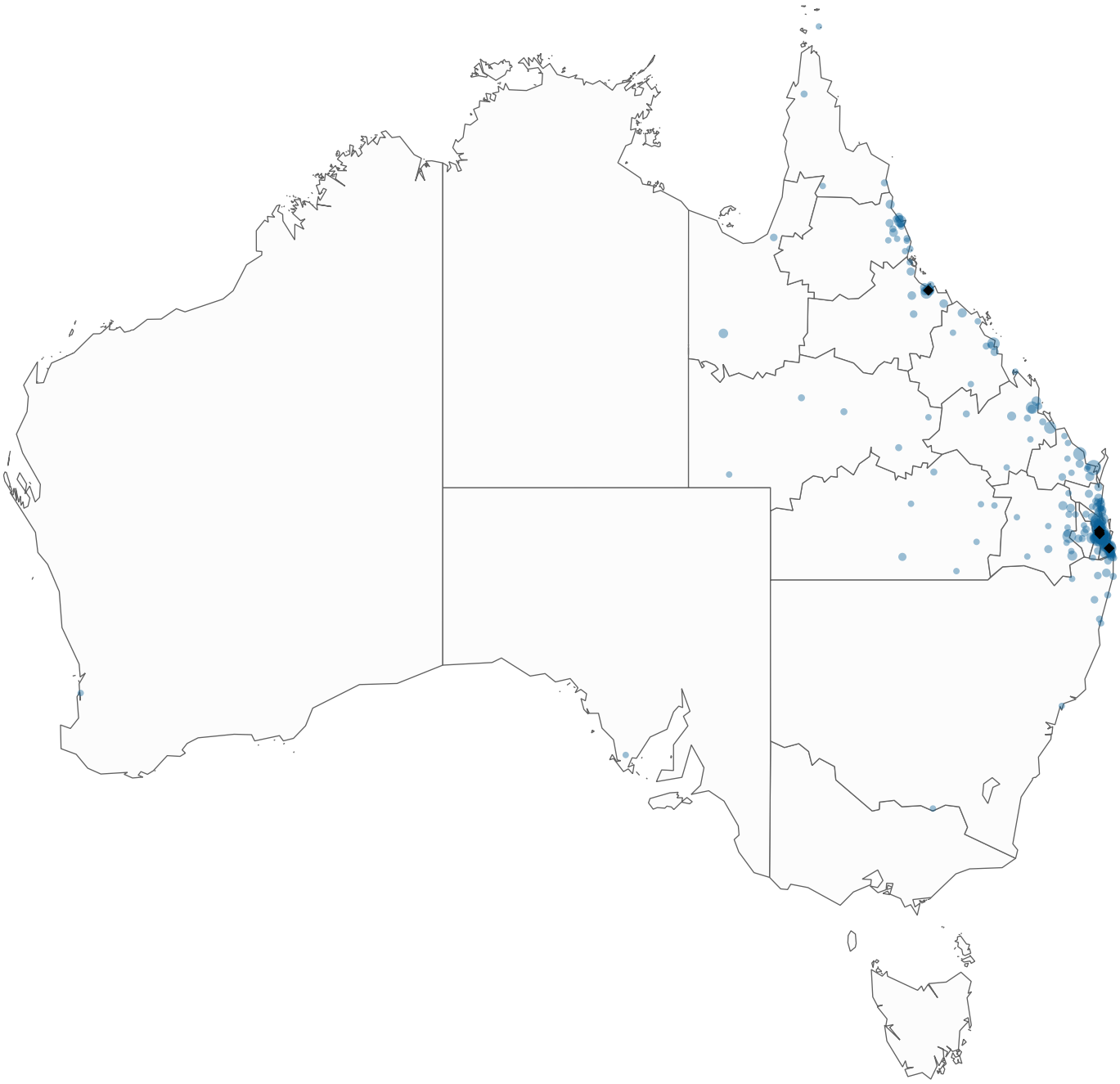
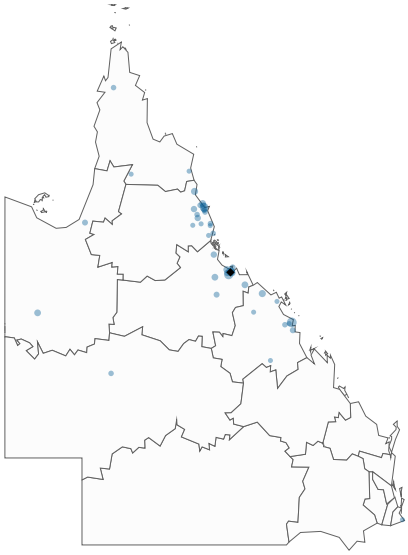


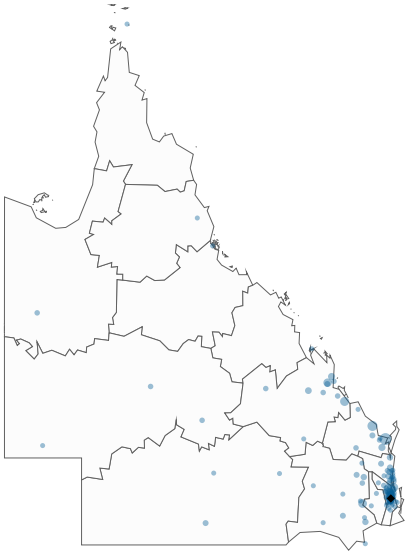
Figure 1: Thoracic surgery cases by residential postcode

Table 1: Participating sites

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



Inset A: Townsville University Hospital



Inset B: The Prince Charles Hospital

Inset C: Royal Brisbane & Women's Hospital

Inset D: Princess Alexandra Hospital

Inset E: Gold Coast University Hospital

3 Case totals

3.1 Total surgeries

Across the five public thoracic surgery units in Queensland, a total of 1,138 procedures were performed. Each patient was assigned an indication category: primary lung cancer, other cancer, pleural disease, or other non cancer indications.

Overall, 57% of patients presented with a cancer-related diagnosis, with primary lung cancer accounting for nearly one-quarter of cases (24%), and other forms of cancer comprising 33%. The remaining 43% of cases were non cancer related, including pleural disease (31%) and other non cancer indications (12%).

Table 2: Cases by site and indication category

SITE	Total n	Primary lung cancer n (%)	Other cancer* n (%)	Pleural disease† n (%)	Other‡ n (%)
TUH	172	42 (24.4)	55 (32.0)	55 (32.0)	20 (11.6)
TPCH	386	109 (28.2)	156 (40.4)	99 (25.6)	22 (5.7)
RBWH	68	15 (22.1)	16 (23.5)	26 (38.2)	11 (16.2)
PAH	341	72 (21.1)	101 (29.6)	124 (36.4)	44 (12.9)
GCUH	171	40 (23.4)	45 (26.3)	44 (25.7)	42 (24.6)
STATEWIDE	**1,138**	**278 (24.4)**	**373 (32.8)**	**348 (30.6)**	**139 (12.2)**

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

† Pneumothorax, haemothorax, empyema or pleural thickening/nodules

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

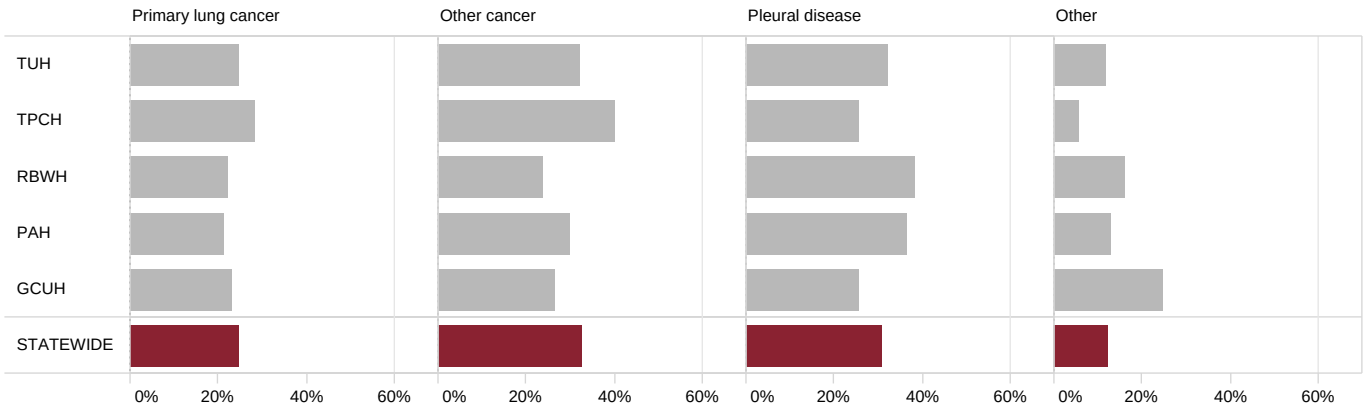


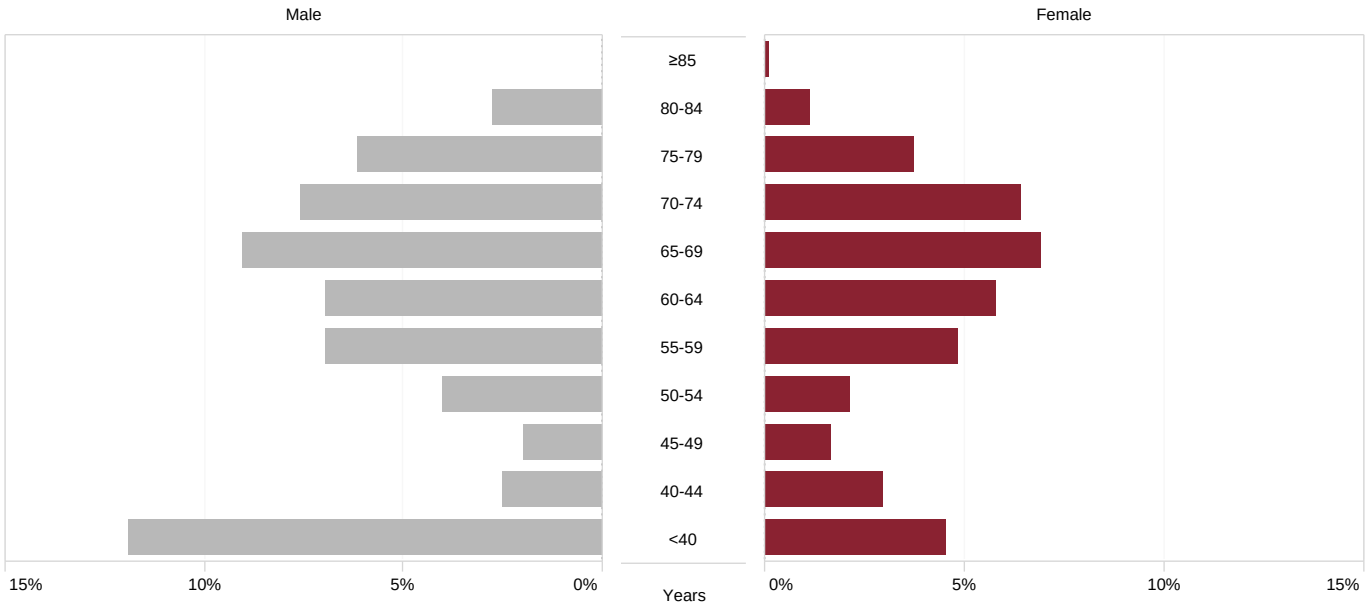
Figure 2: Proportion of cases by site and indication category

4 Patient characteristics

4.1 Age and gender

The median age for thoracic surgical patients was 63 years, while nearly one in five (17%) patients were less than 40 years of age.

The majority of patients were male (60%), with a similar distribution between genders among patients with a preoperative cancer diagnosis. By contrast, over three-quarters of patients with pleural disease were male (76%).



% of total (n=1,138)

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

Table 3: Median age by gender and indication category

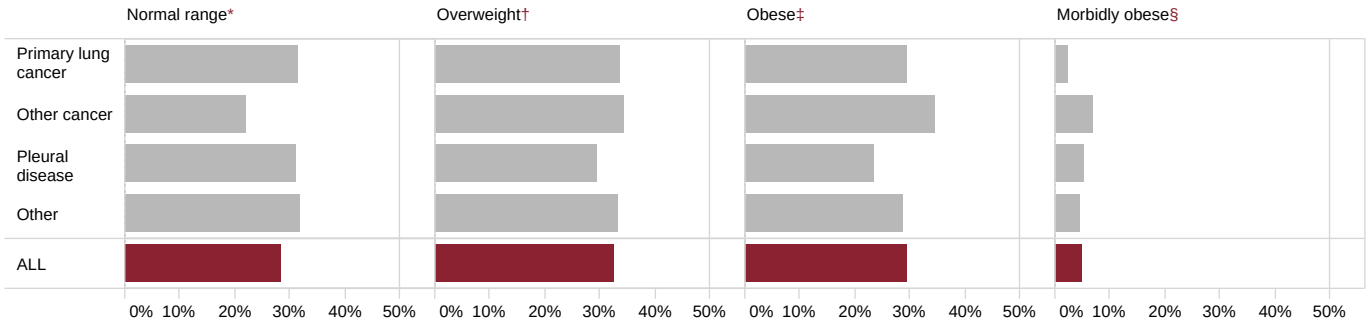
Indication	Male years	Female years	ALL years
Primary lung cancer	69	68	69
Other cancer	66	65	65
Pleural disease	52	55	53
Other	63	57	60
ALL	**63**	**64**	**63**

Table 4: Proportion of cases by gender and indication category

Indication	Male n (%)	Female n (%)
Primary lung cancer	135 (48.6)	143 (51.4)
Other cancer	183 (49.1)	190 (50.9)
Pleural disease	264 (75.9)	84 (24.1)
Other	102 (73.4)	37 (26.6)
ALL	**684 (60.1)**	**454 (39.9)**

4.2 Body mass index

Nearly two-thirds of thoracic surgery patients (62%) were classed as overweight or obese, while 28% of patients had a body mass index (BMI) classed within the normal range. There were 5% of patients classed as underweight.



Underweight category (BMI <18.5 kg/m2) is not displayed (5.0%)

* 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 4: Proportion of cases by BMI and indication categories

Table 5: BMI category by indication category

Indication	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obese n (%)	Morbidly obese n (%)
Primary lung cancer	8 (3.0)	85 (31.5)	91 (33.7)	80 (29.6)	6 (2.2)
Other cancer	9 (2.5)	79 (21.8)	125 (34.5)	125 (34.5)	24 (6.6)
Pleural disease	36 (11.0)	102 (31.1)	96 (29.3)	77 (23.5)	17 (5.2)
Other	2 (1.5)	42 (31.8)	44 (33.3)	38 (28.8)	6 (4.5)
ALL	**55 (5.0)**	**308 (28.2)**	**356 (32.6)**	**320 (29.3)**	**53 (4.9)**

Excludes missing data (4.0%)

4.3 Aboriginal and Torres Strait Islander status

The overall proportion of identified Aboriginal and Torres Strait Islanders undergoing thoracic surgery was 5.4%.

Table 6: Aboriginal and Torres Strait Islander status by indication category

Indication	Indigenous n (%)	Non-Indigenous n (%)
Primary lung cancer	10 (3.6)	268 (96.4)
Other cancer	21 (5.6)	349 (93.6)
Pleural disease	21 (6.1)	324 (93.9)
Other	10 (7.2)	129 (92.8)
ALL	**62 (5.4)**	**1,070 (94.0)**

Excludes missing data (0.6%)

5 Risk factors and comorbidities

5.1 Risk factor profile

Patients undergoing thoracic surgery often present with a range of clinical risk factors that reflect the diversity and complexity of their underlying health status. The prevalence of comorbidities in this thoracic surgery cohort has important implications for perioperative planning and resource allocation.

Collectively, these findings highlight the importance of a multidisciplinary approach to preoperative assessment and tailored postoperative care pathways to mitigate risk and optimise outcomes.

In this cohort, commonly observed risk factors included smoking history, diabetes, varying degrees of respiratory disease, coronary artery disease, renal impairment (eGFR), cerebrovascular events, and peripheral vascular disease.

- Nearly two-thirds of patients (65%) had a history of tobacco use, comprising 25% current smokers (defined as smoking within 30 days of the procedure) and 40% former smokers.
- Diabetes was reported in 13% of patients.
- A quarter (25%) of patients presented with some form of respiratory disease, with 14% having moderate or severe disease.
- Coronary artery disease was reported in 12% of patients.
- Impaired renal function (eGFR ≤89 mL/min/1.73 m²) was identified in 55% of the cohort.
- Fewer than 5% of patients had a history of cerebrovascular accident, with either reversible or irreversible deficit.
- Peripheral vascular disease was reported in 4% of patients.

Table 7: Summary of risk factors by preoperative diagnosis category

	Primary lung cancer n (%)	Other cancer n (%)	Pleural disease n (%)	Other n (%)	ALL n (%)
Former smoker	141 (50.7)	169 (45.3)	108 (31)	41 (29.5)	459 (40.3)
Current smoker	80 (28.8)	68 (18.2)	103 (29.6)	28 (20.1)	279 (24.5)
Diabetes	35 (12.6)	57 (15.3)	43 (12.4)	25 (18)	160 (14.1)
Mild respiratory disease*	42 (15.1)	50 (13.4)	38 (10.9)	8 (5.8)	138 (12.1)
Moderate respiratory disease†	32 (11.5)	41 (11)	35 (10.1)	11 (7.9)	119 (10.5)
Severe respiratory disease‡	3 (1.1)	7 (1.9)	12 (3.4)	6 (4.3)	28 (2.5)
Coronary artery disease	26 (9.4)	42 (11.3)	33 (9.5)	34 (24.5)	135 (11.9)
eGFR 60–89 mL/min/1.73 m²	125 (45)	126 (33.8)	70 (20.1)	36 (25.9)	357 (31.4)
eGFR 30–59 mL/min/1.73 m²	41 (14.7)	48 (12.9)	24 (6.9)	21 (15.1)	134 (11.8)
eGFR <30 mL/min/1.73 m²	4 (1.4)	2 (0.5)	6 (1.7)	3 (2.2)	15 (1.3)
CVA with reversible deficit§	7 (2.5)	8 (2.1)	13 (3.7)	3 (2.2)	31 (2.7)
CVA with irreversible deficit‖	2 (0.7)	6 (1.6)	3 (0.9)	4 (2.9)	15 (1.3)
Peripheral vascular disease	15 (5.4)	12 (3.2)	10 (2.9)	6 (4.3)	43 (3.8)

* Patient is on chronic inhaled or oral bronchodilator therapy

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

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

§ Typically includes transient ischaemic attack

‖ Typically includes cerebrovascular accident

5.2 Previous interventions

5.2.1 Previous thoracic surgery

There were 14% of patients with a history of prior thoracic surgery, ranging from approximately 6% in the primary lung cancer group to 23% in the other thoracic surgery indication category.

Table 8: Previous thoracic surgery by indication category

Indication	Yes n (%)	No n (%)
Primary lung cancer	16 (5.9)	254 (94.1)
Other cancer	45 (12.4)	317 (87.6)
Pleural disease	61 (18.3)	272 (81.7)
Other	29 (23.0)	97 (77.0)
ALL	**151 (13.8)**	**940 (86.2)**

Excludes missing (4.1%)

5.2.2 Previous pulmonary resection

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

Table 9: Previous pulmonary resection surgery by indication category

Indication	Yes n (%)	No n (%)
Primary lung cancer	12 (4.4)	259 (95.6)
Other cancer	22 (6.1)	340 (93.9)
Pleural disease	30 (9.1)	301 (90.9)
Other	6 (4.6)	125 (95.4)
ALL	**70 (6.4)**	**1,025 (93.6)**

Excludes missing data (3.8%)

6 Care and treatment of patients

6.1 Admission status

Over two-thirds of all cases (66%) were classed as elective, while emergency admissions accounted for 12% of cases.

An indication of pleural disease was noted in 77% of all emergency cases and 64% of all urgent cases.

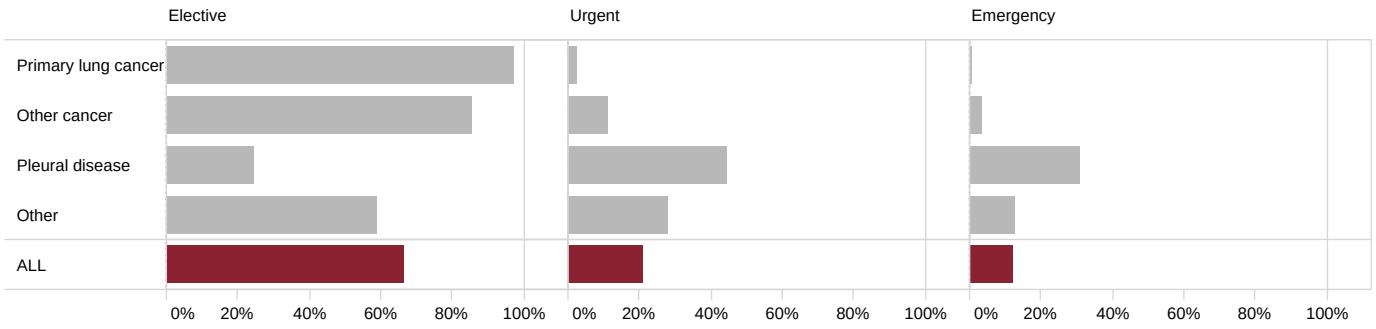


Figure 5: Admission status by indication category

Table 10: Admission status by indication category

Indication	ALL n	Elective n (%)	Urgent n (%)	Emergency n (%)
Primary lung cancer	278	270 (97.1)	7 (2.5)	1 (0.4)
Other cancer	373	319 (85.5)	41 (11.0)	13 (3.5)
Pleural disease	348	85 (24.4)	155 (44.5)	108 (31.0)
Other	139	82 (59.0)	39 (28.1)	18 (12.9)
STATEWIDE	**1,138**	**756 (66.4)**	**242 (21.3)**	**140 (12.3)**

6.1.1 Elective day of surgery admissions

Of the 756 elective cases, 57% were recorded as day of surgery admissions (DOSA).

Table 11: Day of surgery admissions by indication category

Indication	DOSA n (%)
Primary lung cancer	159 (58.9)
Other cancer	170 (53.3)
Pleural disease	37 (43.5)
Other	61 (74.4)
ALL	**427 (56.5)**

6.2 Surgical technique

6.2.1 Video-assisted thoracic surgery

Overall, 69% of cases utilised video-assisted thoracic surgery (VATS), including 83% of cases in the pleural disease category.

Of procedures undertaken through VATS, 33% utilised 3 ports for the operation.

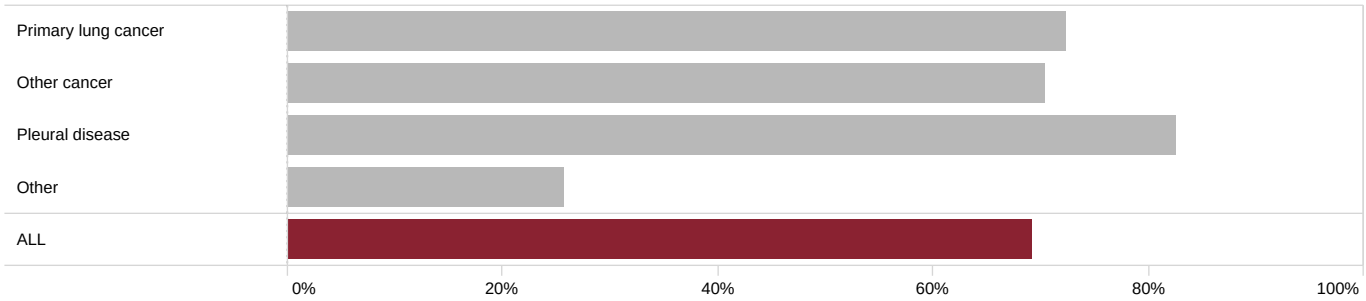


Figure 6: Proportion of cases utilising VATS by indication category

Table 12: VATS cases by number of ports used and indication category

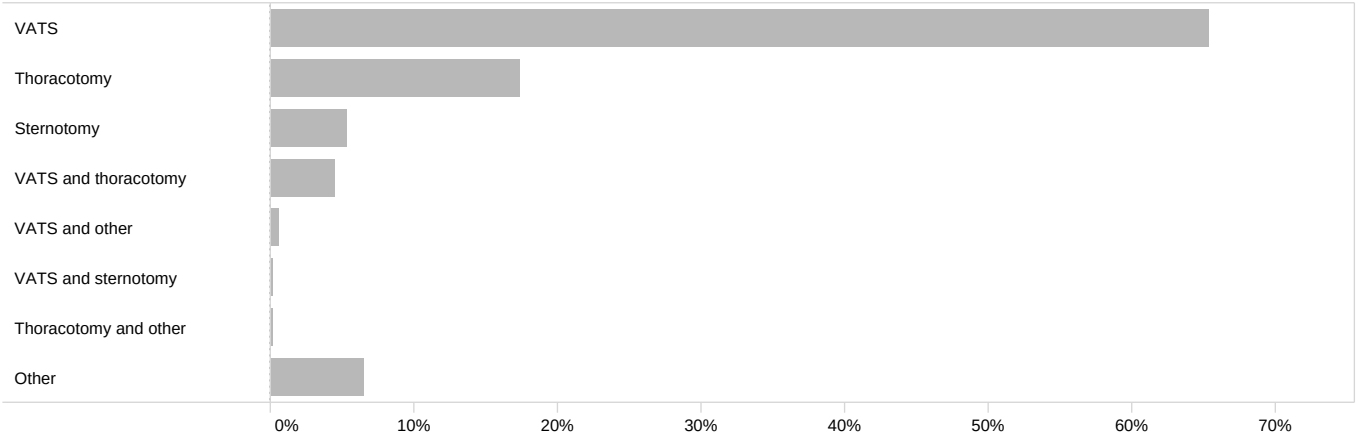
Indication	1 port n (%)	2 ports n (%)	3 ports n (%)	≥4 ports n (%)
Primary lung cancer	16 (8.2)	107 (54.6)	71 (36.2)	2 (1.0)
Other cancer	44 (17.1)	133 (51.8)	78 (30.4)	2 (0.8)
Pleural disease	84 (30.7)	99 (36.1)	87 (31.8)	4 (1.5)
Other	7 (20.6)	12 (35.3)	13 (38.2)	2 (5.9)
ALL	**151 (19.8)**	**351 (46.1)**	**249 (32.7)**	**10 (1.3)**

6.2.2 Incision type

Almost two-thirds of all surgeries (65%) were solely video assisted, while 22% of the total surgeries were performed via a thoracotomy.

Video-assisted thoracoscopy access was more likely for patients presenting with pleural disease, where the most common approaches were by VATS only (79%), thoracotomy only (15%), or VATS and thoracotomy (3%).

Overall, a sternotomy was performed in 6% of cases.



Excludes missing data (5.2%)

Figure 7: Proportion of all cases by incision type

Table 13: Incision type by indication category

Incision type	Primary lung cancer n (%)	Other cancer n (%)	Pleural disease n (%)	Other n (%)	ALL n (%)
VATS	176 (65.2)	239 (66.2)	262 (78.9)	28 (24.1)	705 (65.3)
Thoracotomy	72 (26.7)	51 (14.1)	49 (14.8)	16 (13.8)	188 (17.4)
VATS and thoracotomy	20 (7.4)	16 (4.4)	9 (2.7)	3 (2.6)	48 (4.4)
Sternotomy	–	40 (11.1)	5 (1.5)	13 (11.2)	58 (5.4)
VATS and sternotomy	–	1 (0.3)	1 (0.3)	–	2 (0.2)
VATS and other	–	1 (0.3)	3 (0.9)	3 (2.6)	7 (0.6)
Thoracotomy and other	–	–	1 (0.3)	–	1 (0.1)
Other	2 (0.7)	13 (3.6)	2 (0.6)	53 (45.7)	70 (6.5)
ALL	**270 (100.0)**	**361 (100.0)**	**332 (100.0)**	**116 (100.0)**	**1,079 (100.0)**

Excludes missing data (5.2%)

6.3 Surgery types

Thoracic surgery cases will often involve a number of procedures undertaken in combination. For patients with an indication of primary lung cancer, there was an average of 1.9 procedures per operation with a lobectomy being the most frequently performed procedure type (65%).

Lymph node sampling (37%) and lobectomy (32%) were the most common procedures performed in the other cancer cohort, while pleural disease was commonly treated with decortications and pleurodesis (45% and 37% respectively).

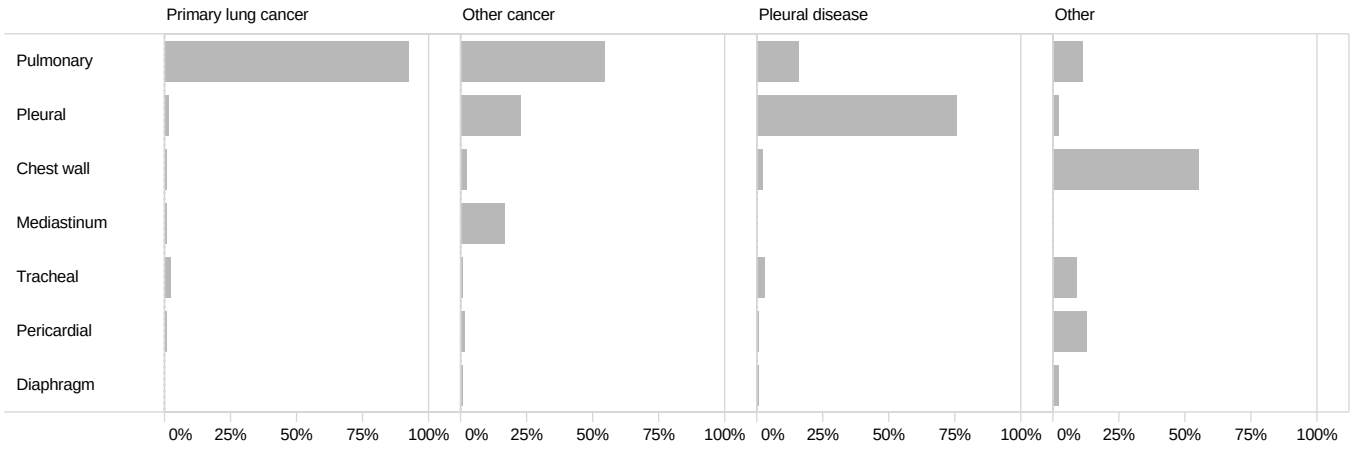


Figure 8: Proportion of procedure types by thoracic structure and indication category

Table 14: Surgical procedures for primary lung cancer

	n (%)
Lymph node sampling	219 (78.8)
Lobectomy	216 (77.7)
Wedge resection	27 (9.7)
Lymph node dissection	18 (6.5)
Segmentectomy	15 (5.4)
Pneumonectomy	11 (4.0)
Bronchoscopy	8 (2.9)
Pleurodesis	5 (1.8)
Bilobectomy	3 (1.1)
Planned surgery abandon	3 (1.1)
Chest wall resection / reconstruction	2 (0.7)
Pleural biopsy	2 (0.7)
Pleural drainage	2 (0.7)
Other	8 (2.9)
Total	**278 (100.0)**

Table 15: Surgical procedures for other cancer

	n (%)
Lymph node sampling	136 (36.5)
Lobectomy	118 (31.6)
Wedge resection	53 (14.2)
Pleural biopsy	50 (13.4)
Resection mediastinal mass	42 (11.3)
Pleurodesis	35 (9.4)
Pleural drainage	33 (8.8)
Thymectomy	31 (8.3)
Segmentectomy	26 (7.0)
Mediastinoscopy	13 (3.5)
Decortication	11 (2.9)
Clot evacuation	8 (2.1)
Lung biopsy	7 (1.9)
Lymph node dissection	7 (1.9)
Chest wall resection	4 (1.1)
Bronchoscopy	4 (1.1)
Pericardial window	4 (1.1)
Chest wall biopsy	2 (0.5)
Pleural tent	2 (0.5)
Plication	2 (0.5)
Rib resection	2 (0.5)
Bilobectomy	1 (0.3)
Lung volume reduction	1 (0.3)
Planned surgery abandon	1 (0.3)
Pneumonectomy	1 (0.3)
Sternectomy	1 (0.3)
Tracheal resection	1 (0.3)
Other	43 (11.5)
Total	**373 (100.0)**

Table 16: Surgical procedures for pleural disease

	n (%)
Decortication	158 (45.4)
Pleurodesis	128 (36.8)
Pleural drainage	95 (27.3)
Wedge resection	71 (20.4)
Pleural biopsy	60 (17.2)
Clot evacuation	36 (10.3)
Washout procedure	27 (7.8)
Bullectomy	21 (6.0)
Bronchoscopy	16 (4.6)
Air leak control	6 (1.7)
Lobectomy	5 (1.4)
Hernia repair	3 (0.9)
ORIF ribs*	3 (0.9)
Planned surgery abandon	2 (0.6)
Pericardial window	2 (0.6)
Pleural tent	2 (0.6)
Rib resection	2 (0.6)
Chest wall resection	1 (0.3)
Lung volume reduction	1 (0.3)
Plication	1 (0.3)
Sternectomy	1 (0.3)
Thoracoplasty	1 (0.3)
Other	21 (6.0)
Total	**348 (100.0)**

* Open reduction internal fixation

Table 17: Surgical procedures for all other surgeries

	n (%)
Sternal wiring/plating procedure	36 (25.9)
Pericardial procedure (e.g. window, drainage)	17 (10.3)
ORIF ribs*	10 (7.2)
Chest wall reconstruction/resection	9 (6.5)
Rib resection	9 (6.5)
Bronchoscopy	8 (5.8)
Wedge resection	7 (5.0)
CIED† procedure	5 (3.6)
Washout procedure	5 (3.6)
Sternectomy	5 (3.6)
Pectus repair	4 (2.9)
Removal of foreign body	4 (2.9)
Hernia repair	3 (2.2)
Muscle flap	3 (2.2)
Plication	3 (2.2)
Chest wall biopsy	2 (1.4)
Decortication	2 (1.4)
Lobectomy	2 (1.4)
Biopsy	2 (1.4)
Wound debridement	2 (1.4)
Xyphoidectomy	2 (1.4)
Bullectomy	1 (0.7)
Lymph node dissection	1 (0.7)
Lymph node sampling	1 (0.7)
Bronchial stump repair	1 (0.7)
Pneumonectomy	1 (0.7)
Tracheoesophageal fistula repair	1 (0.7)
Other	19 (13.7%)
Total	**139 (100.0)**

* Open reduction internal fixation

† Cardiac implantable electronic device

6.4 Blood product usage

Blood products were used in 7% of all thoracic surgical cases, with more than 2% of patients requiring a transfusion of both red blood cell (RBC) and non-red blood cell products (NRBC).

Overall, 13% of patients diagnosed with pleural disease required some blood product transfusion.

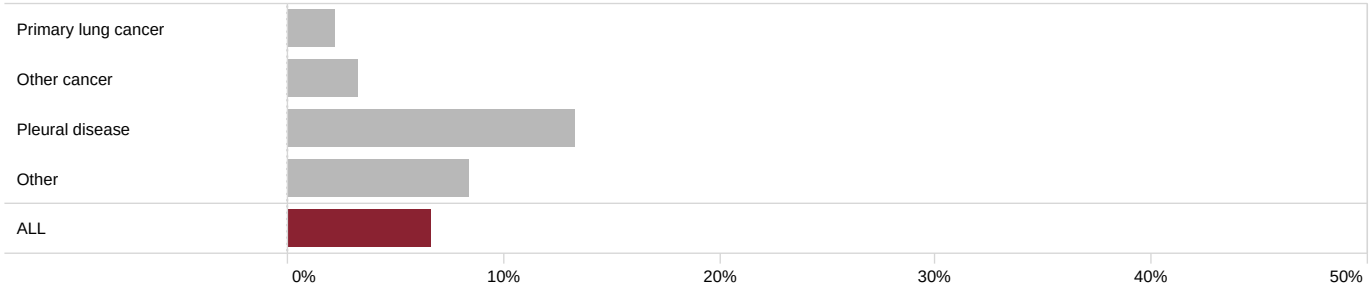


Figure 9: Proportion of cases requiring blood product transfusion

Table 18: Blood product types used by indication category

Indication	RBC and NRBC n (%)	RBC only n (%)	NRBC only n (%)	No blood products used n (%)
Primary lung cancer	1 (0.4)	4 (1.5)	1 (0.4)	264 (97.8)
Other cancer	3 (0.8)	8 (2.2)	1 (0.3)	351 (96.7)
Pleural disease	16 (4.8)	25 (7.5)	3 (0.9)	288 (86.7)
Other	6 (4.5)	4 (3.0)	1 (0.8)	121 (91.7)
ALL	**26 (2.4)**	**41 (3.7)**	**6 (0.5)**	**1,024 (93.3)**

Missing data (3.6%)

7 Clinical outcomes

7.1 Length of stay

The median length of stay and postoperative length of stay (LOS) for thoracic surgery patients was seven days and four days respectively.

For primary lung cancer cases the median LOS was five days, with an interquartile (IQR) range of 4–8 days. These results compare similarly to results published through the Queensland Lung Cancer Quality Index (six days).[42]

Table 19: Length of stay by indication category

Indication	LOS Median (IQR) days	Postoperative LOS Median (IQR) days
Primary lung cancer	5 (4–8)	5 (3–7)
Other cancer	5 (3–10)	4 (3–7)
Pleural disease	12 (7–21)	5 (4–12)
Other	5 (2–17)	4 (2–8)
ALL	**7 (4–13)**	**4 (3–8)**

7.2 Major morbidity

There were 128 cases (11.2%) having one or more new major morbidities recorded post procedure. The incidence rate of major morbidity ranged from 14% in the primary lung cancer group to 10% in the other thoracic surgery category.

Approximately 3% of all patients undergoing thoracic surgery required reoperation.

Table 20: New major morbidity by diagnosis category

Indication	Yes n (%)	No n (%)
Primary lung cancer	40 (14.4)	238 (85.6)
Other cancer	37 (9.9)	336 (90.1)
Pleural disease	37 (10.6)	311 (89.4)
Other	14 (10.1)	125 (89.9)
ALL	**128 (11.2)**	**1010 (88.8)**

Missing data (3.2%)

Table 21: Type of major morbidity

Major morbidity type	n (%)
Reoperation	38 (3.4)
Air leak >7 days	32 (2.9)
Atrial fibrillation	32 (2.9)
Pneumonia	18 (1.6)
Wound infection	17 (1.5)
Pulmonary embolism	6 (0.5)
Cerebrovascular accident – irreversible	1 (0.1)
Other major morbidity	37 (3.4)

Missing data (3.2%)

7.3 Primary lung cancer outcomes

7.3.1 Final histopathology

In patients with a preoperative suspicion of primary lung malignancy, adenocarcinoma (66%) was the most common lung cancer according to final histopathology, followed by squamous cell carcinoma (19%).

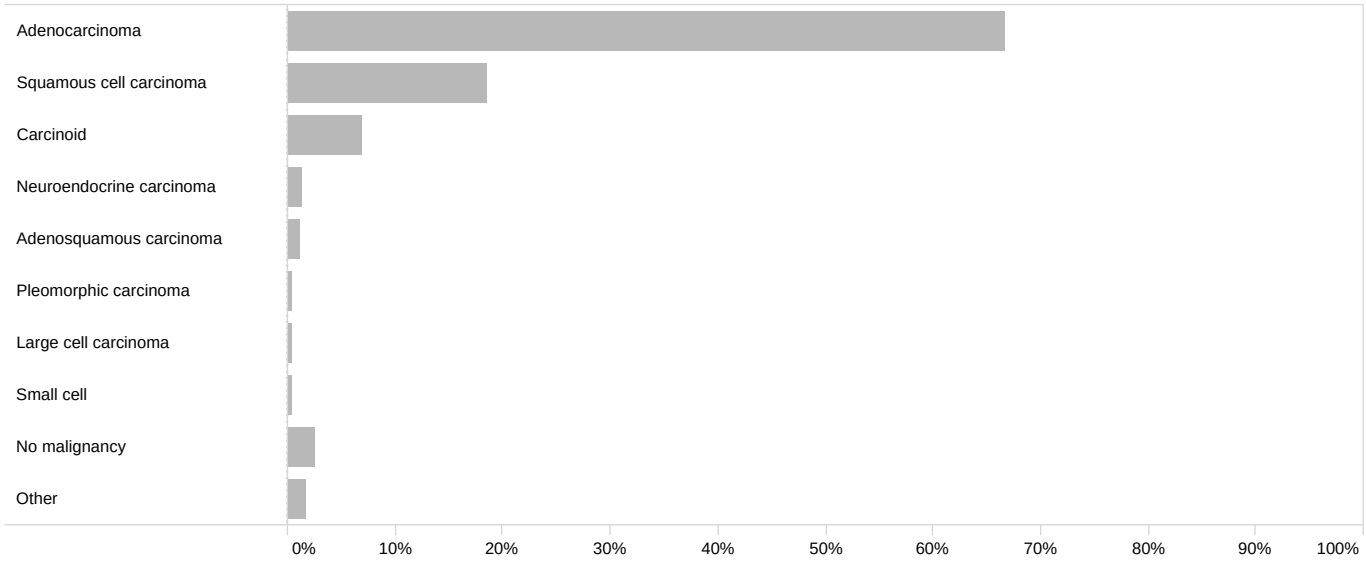


Figure 10: Proportion of primary lung cancer cases by final histopathology

Table 22: Final histopathology results for primary lung malignancy

Histopathology	n (%)
Adenocarcinoma	182 (66.4)
Squamous cell carcinoma	51 (18.6)
Carcinoid	19 (6.9)
Neuroendocrine carcinoma	4 (1.5)
Adenosquamous carcinoma	3 (1.1)
Pleomorphic carcinoma	1 (0.4)
Large cell carcinoma	1 (0.4)
Small cell	1 (0.4)
No malignancy	8 (2.9)
Other	4 (1.5)
Total	**274 (100.0)**

Excludes planned surgery abandoned (n=4)

7.3.2 Stage classification

The tumour-node-metastasis (TNM)[43] staging classification system has been used to categorise lung cancer cases into stages of severity. Primary lung malignancy patients are clinically staged in the preoperative period as well as pathologically staged postoperatively. Assessing cancer staging plays an important role in guiding treatment options for patients. It is important to note that these cases below are the cohort of primary lung cancer patients who proceeded to surgical intervention.

Tumours graded Ib (22%) were the most common postoperative pathological TNM classification for primary lung malignancy, followed by Ia2 (19%) and Ia3 (17%). Preoperatively diagnosed stage four cancers (2.3%) were the least likely malignancy to proceed to surgery when compared with other cancer stages.

Table 23: Primary lung malignancy by preoperative clinical classification

Clinical classification	n (%)
Ia1	9 (3.3)
Ia2	75 (27.3)
Ia3	61 (22.2)
Ib	49 (17.8)
IIa	15 (5.5)
IIb	32 (11.6)
IIIa	21 (7.6)
IIIb	5 (1.8)
IIIc	1 (0.4)
IVa	5 (1.8)
IVb	1 (0.4)
ALL	**274 (100.0)**

Table 24: Primary lung malignancy by postoperative pathological classification

Pathological classification	n (%)
Ia1	8 (2.9)
Ia2	51 (18.6)
Ia3	46 (16.8)
Ib	59 (21.5)
IIa	16 (5.8)
IIb	39 (14.2)
IIIa	34 (12.4)
IIIb	3 (1.1)
IVa	9 (3.3)
IVb	1 (0.4)
No malignancy	8 (2.9)
ALL	**274 (100.0)**

Of the 274 primary lung cancer procedures with complete data, pathological upstaging occurred in 38% of cases, while 18% were downstaged postoperatively. The remaining 44% of cases had no change in preoperative staging classification.

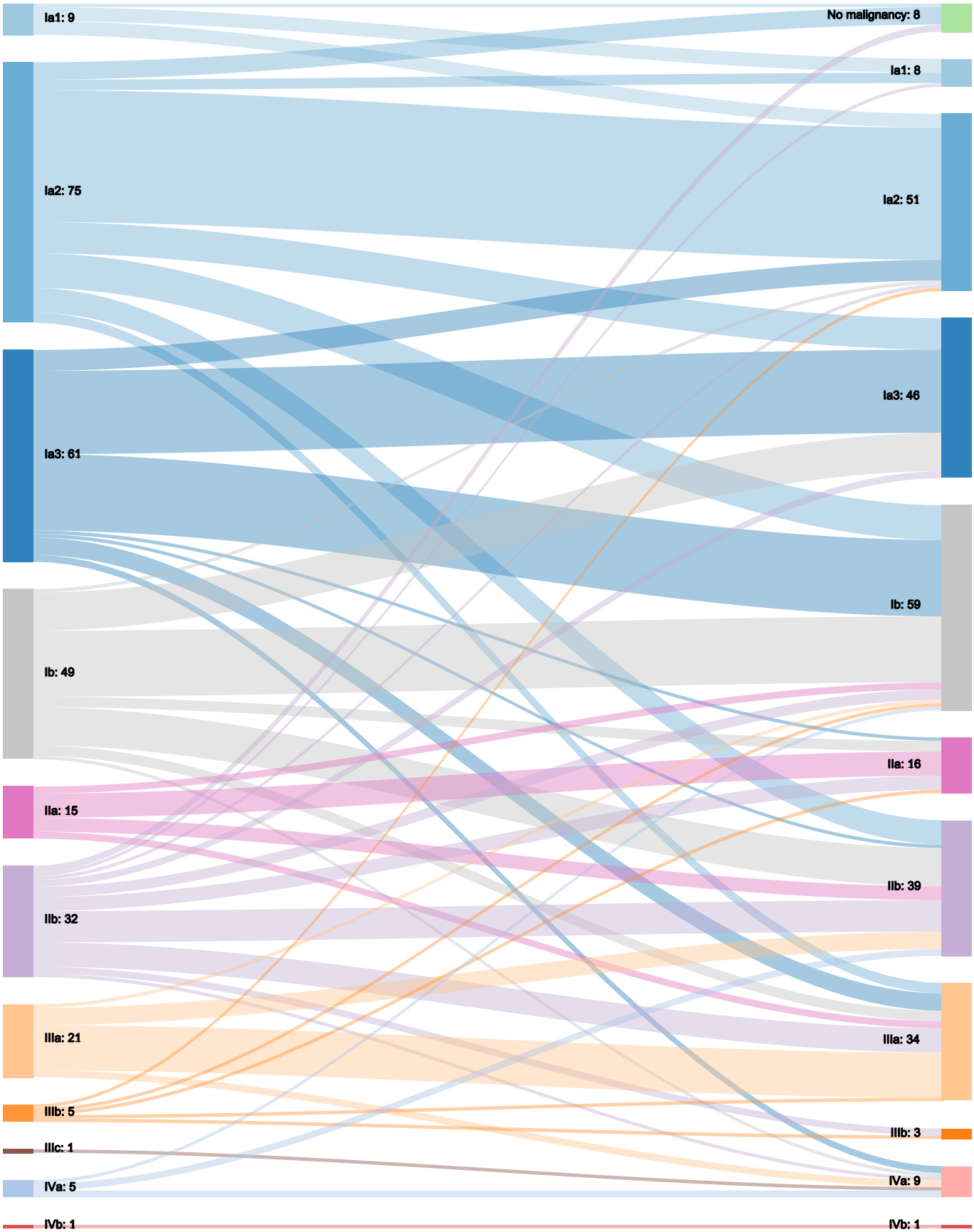


Figure 11: Primary lung cancer cases by clinical and pathological TNM classification

7.4 Unadjusted all-cause mortality

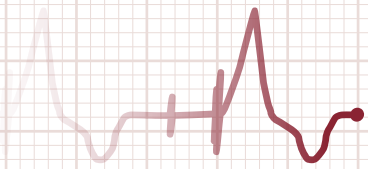
The unadjusted all-cause mortality rate within 30 days of all thoracic surgery was 1.1%, increasing to 2.2% at 90 days. Mortality rates at 90 days for surgery on other thoracic cancer are higher than the overall group, though caution should be used when interpreting these results due to small patient volumes in this cohort.

Survival following thoracic surgery is influenced by many factors which are not always directly related to the operation itself. In oncologic cases, outcomes are significantly influenced by the progression of disease at the time of surgery. Within this cohort, approximately 4% of primary lung cancers were classified as pathological stage IV postoperatively, a group known to carry a markedly elevated short-term mortality risk.

Table 25: All-cause unadjusted mortality up to 90 days post surgery

Category	Total cases n	Death in 30 days n (%)	Death in 90 days n (%)
Primary lung cancer	278	1 (0.4)	4 (1.4)
Other cancer	373	10 (2.4)	18 (4.8)
Pleural disease	348	0 (0.0)	1 (0.3)
Other	139	2 (1.4)	2 (1.4)
ALL	**1,138**	**13 (1.1)**	**25 (2.2)**

Electrophysiology and Pacing Audit



1 Key findings

This Electrophysiology and Pacing Audit describes baseline demographics, risk factors, procedures performed and outcomes for 2024.

Key findings include:

- Across Queensland, nine public sites contributed to the registry in 2024, with all sites providing a complete year of data.
- Of the 5,769 electrophysiology and pacing cases, 4,299 were device procedures and 1,470 were electrophysiology procedures.
- An increase of 1,163 device procedures and an additional 409 electrophysiology procedures was observed in 2024 over 2018 volumes.
- Almost three-quarters of patients were aged 60 years or over (73%) with a median age of 70 years.
- The vast majority of patients (72%) were classed as having an unhealthy body mass index (BMI) of greater than 30 kg/m^2.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 4.4%.
- There were 2,338 pacemaker implants or generator changes which represent the most frequently performed cardiac device intervention across all facilities.
- Combined totals for ICD, BiV ICD, and leadless pacemaker procedures was 944, indicating a substantial volume of complex device therapies being delivered statewide.
- Pulmonary vein isolation for atrial fibrillation cases increased from 290 in 2019 to 565 in 2024, representing a 95% increase over this time.
- Complex ablation procedures including intervention for atrial fibrillation and ventricular tachycardia accounted for 54% of all ablation procedures.
- Routine ablation for atrial flutter, atrioventricular node re-entry tachycardia, accessory pathways and AV node ablations accounted for 46% of all ablation cases.
- The reported complication rate for all device procedures was 0.7%, while electrophysiology procedures had a 1.3% complication rate.
- The statewide median wait time for complex ablation was 105 days with 69% of cases meeting the 180 day benchmark.
- There was a 0.2% procedural tamponade rate reported for all cases.
- The 12 month device system loss rate due to infection was 0.3%.

2 Participating sites

There were nine public electrophysiology and pacing units spread across Metropolitan and regional Queensland. All of these entered data directly into the Queensland Cardiac Outcomes Registry (QCOR) electrophysiology and pacing application.

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

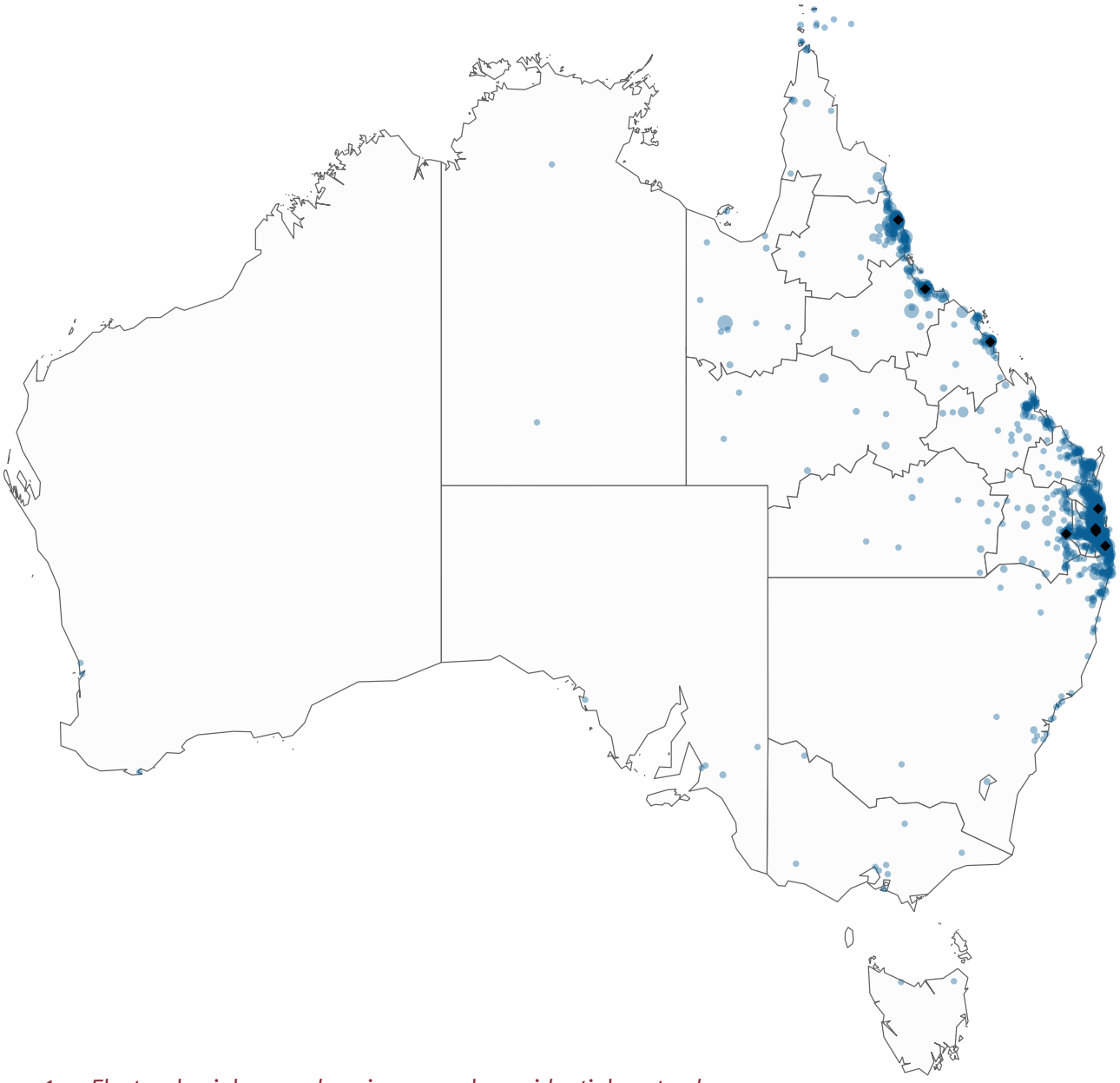


Figure 1: Electrophysiology and pacing cases by residential postcode

Table 1: Participating sites

Acronym	Site name
CH	Cairns Hospital
TUH	Townsville University Hospital
MBH	Mackay Base Hospital
SCUH	Sunshine Coast University Hospital
TPCH	The Prince Charles Hospital
RBWH	Royal Brisbane & Women's Hospital
PAH	Princess Alexandra Hospital
TWH	Toowoomba Hospital
GCUH	Gold Coast University Hospital

3 Case totals

3.1 Case volume

In 2024, were 6,181 electrophysiology and pacing procedures documented using the QCOR electrophysiology and pacing application. There were 31 cardiac device procedures undertaken in conjunction with electrophysiology or ablation procedures.

Table 2: Total cases by category

Procedure combination	Category	Total cases n (%)
Cardiac device procedure	Device	4,251 (68.8)
Cardiac device procedure + EP study		23 (0.4)
Cardiac device procedure + other procedure		11 (0.2)
Cardiac device procedure + EP study + ablation		4 (0.1)
Cardiac device procedure + EP study + drug challenge		4 (0.1)
Cardiac device procedure + cardioversion		2 (<0.1)
Cardiac device procedure + drug challenge		2 (<0.1)
Cardiac device procedure + pericardiocentesis		2 (<0.1)
EP study + ablation	EP	1,107 (17.9)
EP study		150 (2.4)
Ablation		101 (1.6)
EP study + ablation + cardioversion		90 (1.5)
EP study + cardioversion		5 (0.1)
EP study + drug challenge		4 (0.1)
Ablation + cardioversion		3 (<0.1)
EP study + ablation + drug challenge		3 (<0.1)
EP study + ablation + pericardiocentesis		2 (<0.1)
EP study + ablation + other procedure		1 (<0.1)
EP study + drug challenge + cardioversion		1 (<0.1)
EP study + other procedure		1 (<0.1)
EP study + pericardiocentesis		1 (<0.1)
Cardioversion	Other	365 (5.9)
Other procedure		23 (0.4)
Drug challenge		20 (0.3)
Cardioversion + other procedure		2 (<0.1)
Pericardiocentesis		2 (<0.1)
ALL		**6,181 (100.0)**

3.2 Cases by category

The majority of cases performed were cardiac device procedures accounting for over two-thirds (69%) of documented procedures. The rest of the cases were electrophysiology and ablation procedures (24%), with the remainder categorised as 'other' procedures (7%).

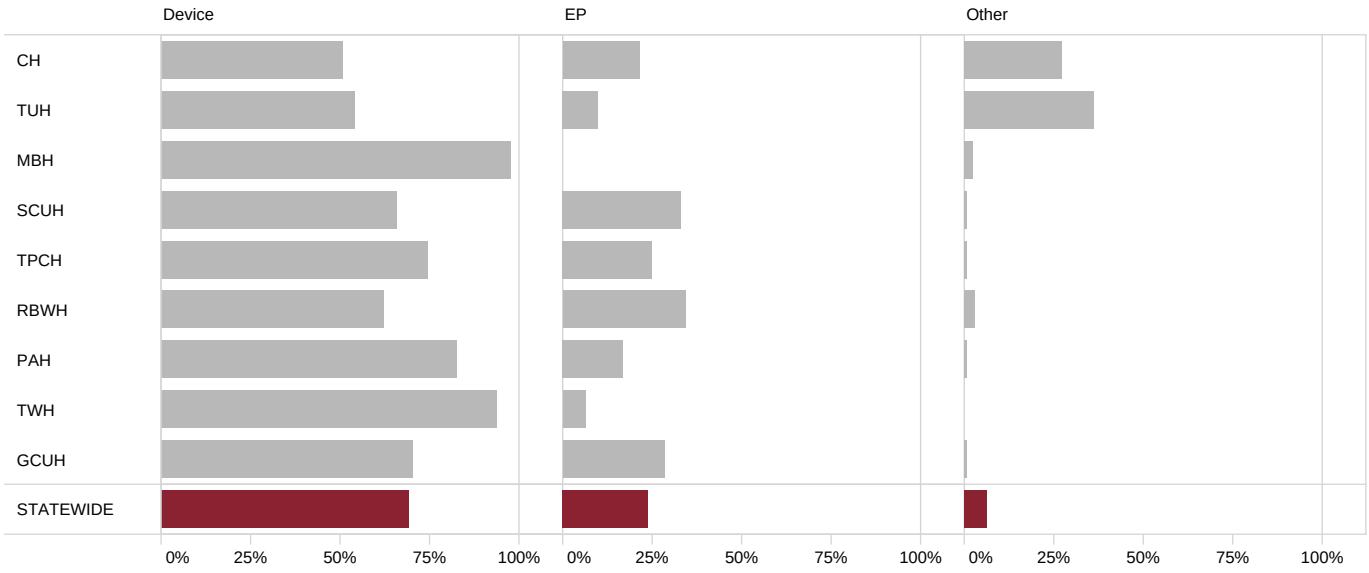


Figure 2: Proportion of cases by site and category

Table 3: Cases by case category

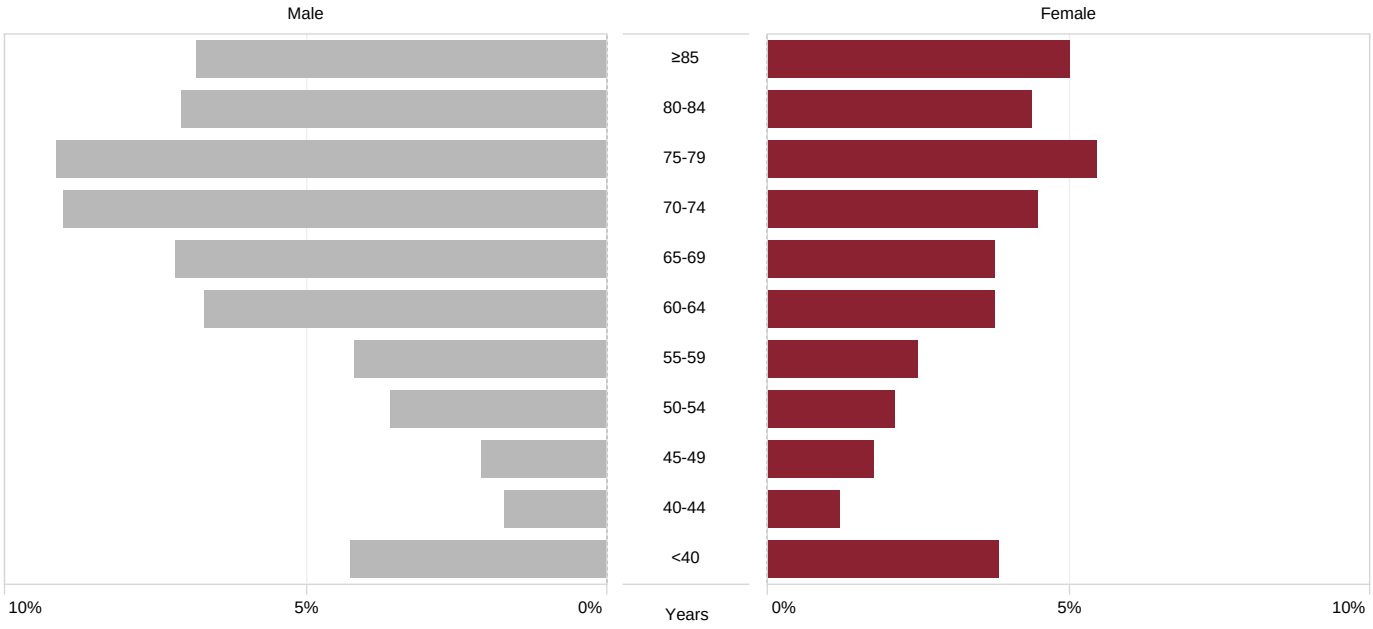
Site	Device n (%)	EP n (%)	Other n (%)	Total n (%)
CH	360 (8.4)	154 (10.5)	194 (47.0)	708 (11.5)
TUH	262 (6.1)	48 (3.3)	174 (42.1)	484 (7.8)
MBH	129 (3.0)	–	3 (0.7)	132 (2.1)
SCUH	511 (11.9)	257 (17.5)	5 (1.2)	773 (12.5)
TPCH	1,017 (23.7)	341 (23.2)	9 (2.2)	1,367 (22.1)
RBWH	443 (10.3)	245 (16.7)	19 (4.6)	707 (11.4)
PAH	926 (21.5)	192 (13.1)	3 (0.7)	1,121 (18.1)
TWH	89 (2.1)	6 (0.4)	–	95 (1.5)
GCUH	562 (13.1)	226 (15.4)	6 (1.5)	794 (12.8)
STATEWIDE	**4,299 (69.6)**	**1,469 (23.8)**	**413 (6.7)**	**6,181 (100.0)**

4 Patient characteristics

4.1 Age and gender

Age is an important risk factor for developing cardiovascular disease with the majority of patients in this cohort aged 60 years and above (73%). The median age of the overall electrophysiology and pacing patient cohort was 70 years of age. Males between the age of 75 and 79 comprised the largest proportion by age and gender.

The median age of both males and females was 70 years. Median patient age differed considerably by procedure category with the median age of patients undergoing electrophysiology procedures being 60 years compared to 74 years for cardiac device procedures.



% of total (n=6,181)

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

Table 4: Median age by gender and case category

	Total cases n	Male years	Female years	ALL years
Device	4,299	74	74	74
EP	1,470	61	57	60
Other	412	64	65	65
Total	**6,181**	**70**	**70**	**70**

Overall, 62% of patients were male with a similar distribution across all procedure categories. The largest proportion of females was represented in the electrophysiology category (41%).

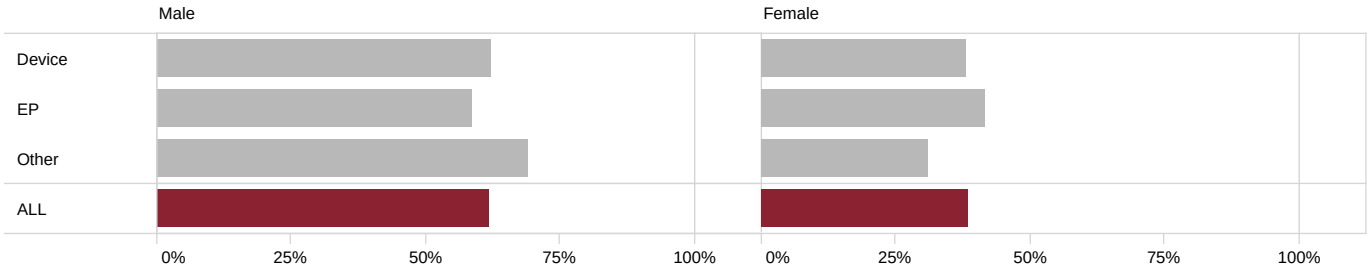


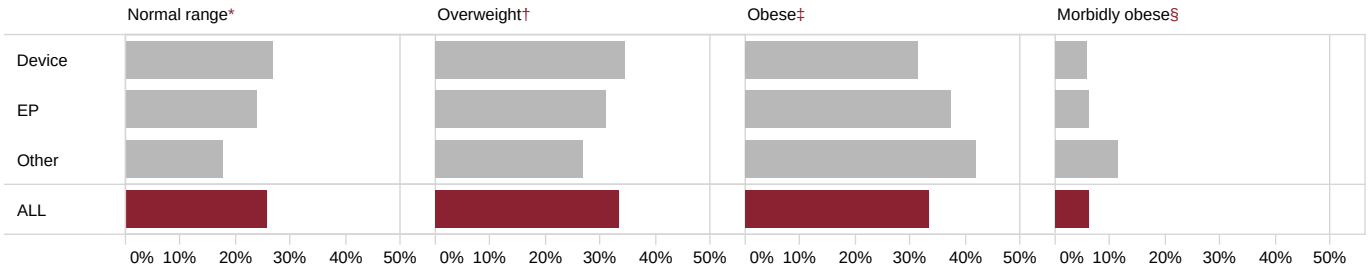
Figure 4: Proportion of cases by gender and category

Table 5: Proportion of cases by gender and category

	Total cases n	Male n (%)	Female n (%)
Device	4,299	2,666 (62.0)	1,633 (38.0)
EP	1,469	862 (58.7)	607 (41.3)
Other	413	285 (69.0)	128 (31.0)
ALL	**6,181**	**3,812 (61.7)**	**2,368 (38.3)**

4.2 Body mass index

Patients classed as having a body mass index (BMI) category of overweight (33%), obese (33%) or morbidly obese (6%) represented almost three-quarters of all electrophysiology and pacing patients. Patients classed as underweight represented less than 2% of all cases.



* 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 5: Proportion of cases by BMI and case category

4.3 Aboriginal and Torres Strait Islander status

Overall, the proportion of identified Aboriginal and Torres Strait Islander patients undergoing electrophysiology and pacing procedures was 4.4%. This correlates with the estimated proportion of Aboriginal and Torres Strait Islander peoples within Queensland (4.6%).[2] There was large variation between units, with the North Queensland sites seeing a larger proportion of Aboriginal and Torres Strait Islander patients.

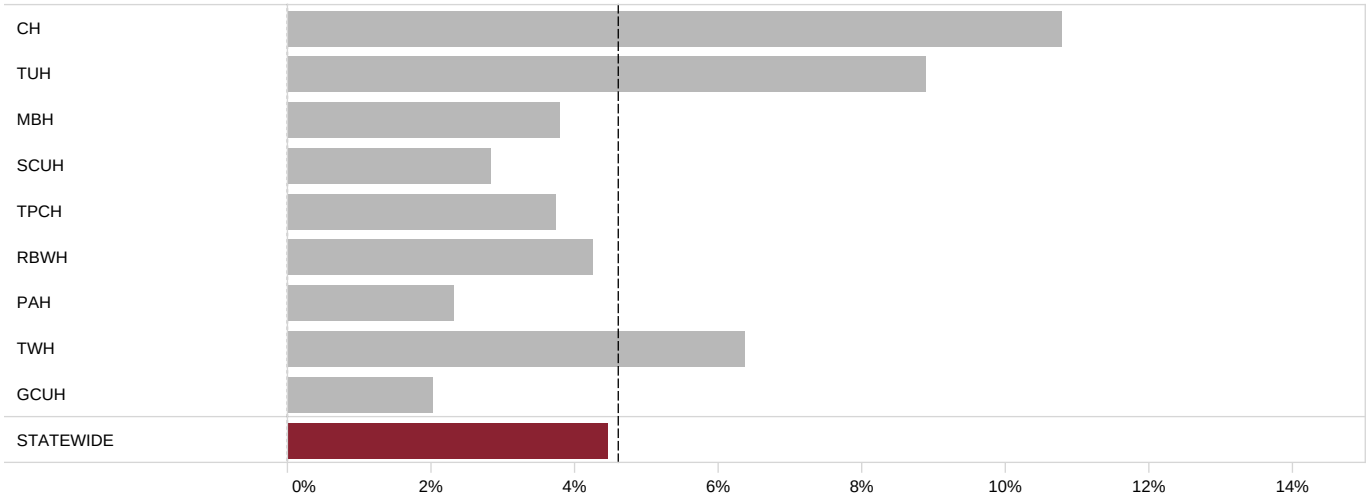


Figure 6: Proportion of cases by identified Aboriginal and Torres Strait Islander status and site

4.4 Device procedures

Case types and procedure combinations varied across the state and is driven primarily by services offered at individual sites. Single and dual chamber pacemaker implants/generator changes accounted for the majority of cases. All sites across the state offered biventricular (BiV) pacemaker/ implantable cardioverter defibrillator insertion, with six sites providing leadless pacemaker implants.

Table 6: Cardiac device case types by site

Procedure type	CH	TUH	MBH	SCUH	TPCH	RBWH	PAH	TWH	GCUH
	n	n	n	n	n	n	n	n	n
Pacemaker procedure*	171	156	52	233	539	210	596	62	319
Loop recorder implant/explant	96	21	62	146	101	105	65	10	61
ICD procedure*	40	35	4	59	148	60	120	5	81
BiV ICD procedure*	20	17	4	32	98	28	53	9	50
Lead revision/replacement/pocket revision	15	5	3	13	32	16	22	1	23
BiV pacemaker procedure*	7	9	1	13	24	3	18	2	14
Device explant	1	–	1	5	63	4	5	–	3
Leadless pacemaker implant	4	19	–	7	9	10	28	–	4
Temporary pacing system	6	–	2	3	1	7	16	–	7
Defibrillation threshold testing	–	–	–	–	1	–	2	–	–
Insertion of epicardial pacing system	–	–	–	–	1	–	–	–	–
Insertion of epicardial lead	–	–	–	–	–	–	1	–	–
ALL	**360**	**262**	**129**	**511**	**1,017**	**443**	**926**	**89**	**562**

* Implant/generator change/upgrade

4.5 Electrophysiology studies/ablations

Electrophysiology studies involving radiofrequency ablation were the most common individual procedure performed across all sites, ranging from 50% of case volume at Cairns Hospital to 75% at PAH. Pulsed field ablation was performed at seven sites in 2024, with 243 cases using this technology. This represents a 52% increase from the previous year, where pulsed field ablation was utilised for 159 cases by three sites.

Table 7: Electrophysiology study/ablation types by site

Site	Procedure type	Complex EP n (%)	Standard EP n (%)	Case n (%)
CH	Radiofrequency ablation	26 (16.7)	86 (55.1)	112 (71.8)
	Electrophysiology study	–	18 (11.5)	18 (11.5)
	Pulsed field ablation	17 (10.9)	–	17 (10.9)
	Cryotherapy ablation	7 (4.5)	2 (1.3)	9 (5.8)
TUH	Radiofrequency ablation	12 (24.5)	17 (34.7)	29 (59.2)
	Cryotherapy ablation	8 (16.3)	–	8 (16.3)
	Pulsed field ablation	6 (12.2)	–	6 (12.2)
	Electrophysiology study	–	4 (8.2)	4 (8.2)
	Radiofrequency and cryotherapy ablation	1 (2.0)	–	1 (2.0)
	Radiofrequency and pulsed field ablation	1 (2.0)	–	1 (2.0)
SCUH	Radiofrequency ablation	57 (21.7)	110 (41.8)	167 (63.5)
	Cryotherapy ablation	41 (15.6)	7 (2.7)	48 (18.3)
	Electrophysiology study	–	37 (14.1)	37 (14.1)
	Pulsed field ablation	9 (3.4)	–	9 (3.4)
	Radiofrequency and cryotherapy ablation	2 (0.8)	–	2 (0.8)
TPCH	Radiofrequency ablation	81 (23.5)	118 (34.2)	199 (57.7)
	Pulsed field ablation	92 (26.7)	1 (0.3)	93 (27.0)
	Electrophysiology study	–	48 (13.9)	48 (13.9)
	Cryotherapy ablation	4 (1.2)	–	4 (1.2)
	Radiofrequency and pulsed field ablation	1 (0.3)	–	1 (0.3)
RBWH	Radiofrequency ablation	44 (17.3)	89 (34.9)	133 (52.2)
	Cryotherapy ablation	42 (16.5)	3 (1.2)	45 (17.6)
	Pulsed field ablation	37 (14.5)	–	37 (14.5)
	Electrophysiology study	–	34 (13.3)	34 (13.3)
	Radiofrequency and cryotherapy ablation	6 (2.4)	–	6 (2.4)
PAH	Radiofrequency ablation	59 (29.6)	78 (39.2)	137 (68.8)
	Electrophysiology study	–	30 (15.1)	30 (15.1)
	Pulsed field ablation	28 (14.1)	–	28 (14.1)
	Radiofrequency and pulsed field ablation	4 (2.0)	–	4 (2.0)
TWH	Radiofrequency ablation	–	3 (50.0)	3 (50.0)
	Electrophysiology study	–	3 (50.0)	3 (50.0)
GCUH	Radiofrequency ablation	81 (35.7)	83 (36.6)	164 (72.2)
	Pulsed field ablation	42 (18.5)	1 (0.4)	43 (18.9)
	Electrophysiology study	–	15 (6.6)	15 (6.6)
	Radiofrequency and pulsed field ablation	3 (1.3)	1 (0.4)	4 (1.8)
	Cryotherapy ablation	–	1 (0.4)	1 (0.4)
STATEWIDE		**711 (47.4)**	**711 (47.4)**	**789 (52.6)**

4.5.1 Ablation type/arrhythmia

The most frequently ablated clinical arrhythmia was atrial fibrillation (pulmonary vein isolation), which accounted for 43% of ablations across all sites. This was followed by atrioventricular nodal re–entry tachycardias (AVNRT) (20%) and atrial flutter (14%).

Age and gender varied depending on the arrythmia ablated. Patients undergoing accessory pathway ablation had a lower median age than those who underwent pulmonary vein isolation or AV node ablation. Furthermore, over two-thirds of patients undergoing pulmonary vein isolation were male (70%) which contrasts with the AVNRT and SVT cohort which is predominately a female group.

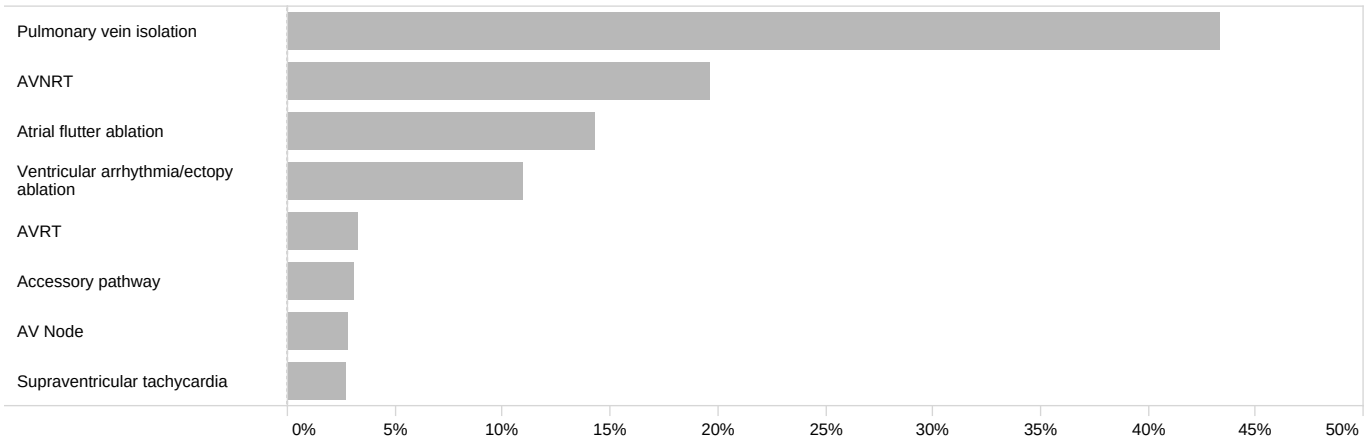


Figure 7: Proportion of arrhythmias ablated

Table 8: Median age and gender by ablation type

Ablation type	Gender	Total cases n (%)	Median age years
Pulmonary vein isolation	Male	384 (70.1)	61
	Female	184 (29.9)	65
AVNRT	Male	80 (33.8)	57
	Female	179 (66.2)	49
Atrial flutter	Male	143 (80.1)	67
	Female	44 (19.9)	68
Ventricular arrhythmia/ectopy	Male	92 (64.7)	62
	Female	51 (35.3)	54
Accessory pathway	Male	28 (55.6)	32
	Female	12 (44.4)	28
AVRT	Male	22 (50.7)	35
	Female	21 (49.3)	54
AV node	Male	11 (42.4)	76
	Female	25 (57.6)	81
Supraventricular tachycardia	Male	18 (32.3)	49
	Female	17 (67.7)	52
ALL		**1,311 (100.0)**	**61**

Table 9: Arrhythmia type by site

Site	Ablation type	Count n (%)
CH	AVNRT	43 (31.2)
	Pulmonary vein isolation	42 (30.4)
	Atrial flutter ablation	26 (18.8)
	Ventricular arrhythmia/ectopy ablation	8 (5.8)
	Supraventricular tachycardia	6 (4.3)
	AVRT	5 (3.6)
	AV Node	5 (3.6)
	Accessory pathway	3 (2.2)
TUH	Pulmonary vein isolation	21 (46.7)
	AVNRT	11 (24.4)
	Ventricular arrhythmia/ectopy ablation	7 (15.6)
	Accessory pathway	4 (8.9)
	Atrial flutter ablation	2 (4.4)
SCUH	Pulmonary vein isolation	91 (40.3)
	Atrial flutter ablation	43 (19.0)
	AVNRT	42 (18.6)
	Ventricular arrhythmia/ectopy ablation	18 (8.0)
	AV Node	15 (6.6)
	AVRT	6 (2.7)
	Supraventricular tachycardia	6 (2.7)
	Accessory pathway	5 (2.2)
TPCH	Pulmonary vein isolation	134 (45.1)
	AVNRT	55 (18.5)
	Ventricular arrhythmia/ectopy ablation	44 (14.8)
	Atrial flutter ablation	41 (13.8)
	AVRT	9 (3.0)
	Accessory pathway	7 (2.4)
	Supraventricular tachycardia	7 (2.4)
RBWH	Pulmonary vein isolation	108 (48.9)
	AVNRT	45 (20.4)
	Atrial flutter ablation	30 (13.6)
	Ventricular arrhythmia/ectopy ablation	21 (9.5)
	AVRT	7 (3.2)
	Accessory pathway	5 (2.3)
	Supraventricular tachycardia	3 (1.4)
	AV Node	2 (0.9)
PAH	Pulmonary vein isolation	69 (40.8)
	AVNRT	28 (16.6)
	Atrial flutter ablation	24 (14.2)
	Ventricular arrhythmia/ectopy ablation	22 (13.0)
	AVRT	12 (7.1)
	Accessory pathway	7 (4.1)
	Supraventricular tachycardia	4 (2.4)
	AV Node	3 (1.8)
TWH	AVNRT	1 (33.3)
	Atrial flutter ablation	1 (33.3)
	AV Node	1 (33.3)
GCUH	Pulmonary vein isolation	103 (48.6)
	AVNRT	34 (16.0)
	Ventricular arrhythmia/ectopy ablation	23 (10.8)
	Atrial flutter ablation	20 (9.4)
	AV Node	10 (4.7)
	Accessory pathway	9 (4.2)
	Supraventricular tachycardia	9 (4.2)
	AVRT	4 (1.9)
STATEWIDE		**1,311 (100.0)**

4.6 Other procedures

There were 545 miscellaneous procedures performed independently of a concurrent cardiac device or electrophysiology procedure, and a further 114 in conjunction with these procedures. The most common other procedure was cardioversion (82%). Variations in clinical practice across sites can be observed here with not all cardioversions performed at sites being carried out in the electrophysiology laboratory environment or documented using the QCOR module.

Table 10: Other procedures

	Total n	Cardioversion n (%)	Drug challenge n (%)	Other procedure n (%)	Pericardiocentesis n (%)
CH	199	185 (93.0)	7 (3.5)	7 (3.5)	–
TUH	175	172 (98.3)	–	3 (1.7)	–
MBH	4	3 (75.0)	–	1 (25.0)	–
SCUH	24	15 (62.5)	6 (25.0)	2 (8.3)	1 (4.2)
TPCH	43	29 (67.4)	5 (11.6)	8 (18.6)	1 (2.3)
RBWH	76	57 (75.0)	7 (9.2)	10 (13.2)	2 (2.6)
PAH	9	3 (33.3)	4 (44.4)	2 (22.2)	–
GCUH	15	4 (26.7)	5 (33.3)	3 (20.0)	3 (20.0)
STATEWIDE	**545**	**468 (85.9)**	**34 (6.2)**	**36 (6.6)**	**7 (1.3)**

5 Procedural complications

Complications are a well recognised, albeit infrequent, outcome following medical procedures or interventions. While some complications may be minor and self-limiting, others can be more severe, requiring a broad spectrum of management strategies. The summary of complications presented below reflects events that occurred during or immediately following the procedure, providing insight into peri- and post-procedural risks.

Within the QCOR Electrophysiology application, the primary focus is on procedural detail reporting. Consequently, the documentation of complications that arise during or after the procedure is the responsibility of site-based practitioners. This ensures that the data captured is both timely and clinically accurate.

Complication rates are expressed as a proportion of the total number of device and electrophysiology procedures performed, allowing for meaningful comparison and trend analysis. In rare instances, the emergence of an intraprocedural complication—such as coronary sinus dissection—may necessitate a change in the planned procedure type. For example, a biventricular implant or upgrade may be converted to a non BiV device procedure. In such cases, complications are attributed to the final procedure type, ensuring consistency in reporting and interpretation.

The overall device procedure complication rate was 0.7%, while electrophysiology procedures had a 1.3% complication rate.

Table 11: Cardiac device procedure intra procedure complications

Procedure type	Complication	Total n (%)
Pacemaker procedure	Pericardial effusion with tamponade	4 (0.2)
	Conduction block	1 (<0.1)
	Drug reaction	1 (<0.1)
	Haemodynamic instability	1 (<0.1)
	Lead dislodgement	1 (<0.1)
	Pneumothorax	1 (<0.1)
	Pericardial effusion without tamponade	1 (<0.1)
	Other	4 (0.2)
ICD procedure	Pericardial effusion with tamponade	1 (0.2)
	Pneumothorax	1 (0.2)
	Cardiac arrest	1 (0.2)
	Pericardial effusion without tamponade	1 (0.2)
BiV ICD procedure	Coronary sinus dissection	2 (0.6)
	Cardiac arrest	2 (0.6)
BiV pacemaker procedure	Coronary sinus dissection	1 (1.1)
	Drug reaction	1 (1.1)
	Other	1 (1.1)
	Pericardial effusion without tamponade	1 (1.1)
Leadless pacemaker implant	Drug reaction	1 (1.2)
	Pericardial effusion without tamponade	1 (1.2)
Temporary pacing system	Cardiac arrest	1 (2.4)
ALL		**29 (0.7)**

Table 12: Electrophysiology procedure intra procedure complications by case type and complexity

Procedure type	Complexity	Complication	Total n (%)
EP Study	Standard	Cardiac arrest	1 (0.5)
		Conduction block	1 (0.5)
		Pericardial effusion with tamponade	1 (0.5)
Ablation – radiofrequency	Complex	Pericardial effusion with tamponade	3 (0.8)
		Bleeding	2 (0.6)
		Haemodynamic instability	1 (0.3)
		Conduction block	2 (0.6)
Ablation – cryotherapy	Complex	Pericardial effusion without tamponade	4 (3.9)
		Phrenic nerve injury	1 (1.0)
Ablation – pulsed field	Complex	Pericardial effusion with tamponade	4 (1.7)
ALL			**20 (1.3)**

6 Clinical indicators

Clinical indicators are important measures of the clinical management and outcomes of patient care. An indicator that is clinically relevant and useful should highlight specific issues that may require attention or signal areas for improvement. Rate-based indicators typically identify the rate of occurrence of an event, such as complications, readmissions, or adverse outcomes, and are instrumental in tracking performance over time. These indicators not only provide insight into the effectiveness and safety of care but also support benchmarking across services and institutions.

There is emerging recognition that the capacity to evaluate and report on quality is a critical building block for system-wide improvement of healthcare delivery and patient outcomes. Robust indicator frameworks enable health services to identify variation, monitor trends, and implement targeted interventions. Furthermore, integrating clinical indicators into routine reporting fosters transparency, accountability, and a culture of continuous improvement. As healthcare systems evolve, the strategic use of indicators will be essential in guiding policy, informing clinical practice, and ultimately enhancing patient care across the continuum.

The quality and safety indicators which have been nominated by the QCOR Electrophysiology and Pacing Committee are outlined below.

Table 13: Electrophysiology and pacing clinical indicators

Clinical indicator	Description
1	Waiting time from booking date to procedure by case category
2	Procedural tamponade rates
3	Reintervention within one year of procedure date due to cardiac device lead dislodgement
4	Rehospitalisation within one year of procedure due to infection resulting in loss of the device
5	12 month all-cause mortality for cardiac device procedures

6.1 Waiting time from referral date to procedure by case category

Waiting times for clinical interventions and investigations are an important metric for monitoring service provision and identifying potential unmet need. This clinical indicator examines the waiting time for various cardiac device procedure types. Specifically, the median wait time from the date the procedure was referred to the date of the case. For the purpose of this indicator, procedures classed as elective (not performed as part of an acute admission) are examined.

The adverse consequences of treatment delay are well known and include deterioration in the condition for which treatment is awaited, the loss of utility from delay (especially if treatment can relieve significant disability), a rise in the costs of total treatment, accumulation of any loss of income from work, and, as an extreme outcome, death.

An important distinction exists between the waiting time of the patients booked for their procedure and those who are referred for specialist opinion and subsequent treatment. As this indicator examines the wait time from booking date to case date, it is reflective of system performance that is specifically focused on electrophysiology and pacing demand and need.

6.1.1 Elective pacemaker

Examination of the waiting time for elective pacemaker procedures is below. Of the 284 cases with complete data, the median wait time was 21 days.

Table 14: Elective pacemaker wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days
STATEWIDE	407	284	21	1–58

6.1.2 Elective ICD wait time and proportion within 28 days

This analysis examines the waiting time for elective ICD procedures and the proportion adhering to the benchmark of 28 days or less.

Table 15: Elective ICD wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days	Met target %
STATEWIDE	213	149	37	1–75	47.0

6.1.3 Standard ablation

Waiting times for standard ablation procedures are presented below. Of the 361 cases eligible for analysis, the median wait time was 97 days.

Table 16: Elective standard ablation wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days
STATEWIDE	506	361	97	42–151

6.1.4 Complex ablation with proportion within 180 days or less

Complex ablations are defined as cases involving ventricular arrhythmias or pulmonary vein isolation. This indicator examines the waiting time for these procedures and the proportion adhering to the benchmark of 180 days or less.

A median wait time of 105 days was observed, with a large interquartile range demonstrating there are a number of patients with considerably long waits.

Table 17: Elective complex ablation wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days	Met target %
STATEWIDE	410	295	105	47–220	68.5

6.2 Procedural tamponade rates

Cardiac tamponade is a known complication of cardiac device and electrophysiology procedures. This indicator examines the rate of procedural pericardial tamponade in these procedure categories. As pericardial tamponade is a clinical diagnosis, this indicator explicitly reports those patients with this specific diagnosis and does not include those patients with the diagnosis or finding of pericardial effusion. Inclusion criteria is those patients with a noted complication of pericardial tamponade or a concurrent pericardiocentesis performed during or within 24 hours of the index procedure.

Table 18: Procedural tamponade analysis

Procedure category	Total cases analysed n	Tamponade observed <24 hours n	Tamponade rate %
Device	4,299	5	0.1
EP	1,470	8	0.5
ALL	**5,769**	**13**	**0.2**

6.3 Reintervention within one year of procedure date due to cardiac device lead dislodgement

This indicator identifies the number of cases where one or more lead dislodgements were observed within one year of lead insertion. The cases included in this indicator were all new device implants or upgrades where a new lead/s had been implanted and a lead revision or replacement was subsequently required due to dislodgement. Index implant procedures were cases performed within Queensland Health implanting facilities in the 2023 calendar year.

Out of the 64 cases requiring reintervention within 12 months of the index procedure, right atrial lead dislodgements accounted for the largest proportion with 31 cases (49%), followed closely by right ventricular lead dislodgements with 29 cases (45%). Left ventricular lead dislodgements were comparatively rare, comprising 4 cases (6%). This distribution highlights that the majority of reintervention cases were associated with right-sided lead dislodgements, which together represented 94% of all such events.

These results compare similarly with international cohorts, where observed dislodgement rates for pacemaker system implants vary from 1.0 to 2.7%.[44]

Table 19: Reintervention due to lead dislodgement analysis

	Cases analysed n	12 month lead dislodgement n	12 month lead dislodgement rate %	Median time to dislodgement days	Interquartile range days
Eligible 2023 device cases	2,519	64	2.5	3	2–53

6.4 Rehospitalisation within one year of procedure due to infection resulting in loss of the device system

One of the most serious long-term complications related to mortality and morbidity for patients with cardiac implantable electronic devices is infection. Complete removal of all hardware is the recommended treatment for patients with established device infection because infection relapse rates due to retained hardware are high. For this indicator, implant cases where new devices or leads were implanted form the cohort.

A system loss rate of 0.3% was observed at 12 months post procedure. This is reassuring when compared to international literature which suggests infection rates necessitating explant of approximately 2.4%.[45]

Table 20: Rehospitalisation with device loss analysis

	Cases analysed n	12 month system loss due to infection n	12 month system loss rate %
Eligible 2023 device cases	3,123	8	0.3

6.5 12 month all-cause mortality for cardiac device procedures

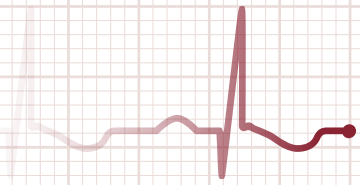
To ensure complete 12 month follow-up, mortality outcomes are reported for patients who underwent cardiac device procedures during 2023. The overall unadjusted all-cause mortality rate across all device types was 5.3%.

Importantly, individuals receiving cardiac devices are typically older adults, with a median age at procedure of 83 years (IQR: 76–88 years). Many present with advanced cardiac conditions, such as heart failure, and often carry a significant burden of comorbidities and risk factors.

Table 21: 12 month all-cause unadjusted mortality for cardiac device procedures

	Cases analysed n	12 month mortality observed n	12 month mortality rate %	Median age at procedure years	Interquartile range years
Any BiV procedure	346	17	4.9	74	67–79
ICD procedure	581	14	2.4	75	68–83
Pacemaker procedures	2,390	145	6.1	84	79–89
ALL 2023 device cases	**3,317**	**176**	**5.3**	**83**	**76–88**

Cardiac Rehabilitation Audit



1 Key findings

This eighth Cardiac Rehabilitation (CR) Audit examines the characteristics and outcomes for patients referred to and assessed by public CR services in Queensland. It also outlines clinical indicator performance for participating services.

- There were 59 public cardiac rehabilitation (CR) sites that contributed data to QCOR.
- A total of 9,773 referrals were made to public CR programs across Queensland. A further 1,219 referrals were declined, unsuitable or referred outside of Queensland Health at the point of first contact.
- Approximately 69% of referrals originated from an inpatient setting, while 15% of referrals originated from outside of Queensland Health.
- There were 7,041 referrals (72%) which proceeded to a pre assessment. The most common reasons that the pre assessment did not take place was that the patient declined, was medically unsuitable or inappropriate, had been uncontactable or failed to attend the appointment.
- Male patients accounted for 69% of all CR referrals.
- The median age of patients was 67 years, with three-quarters of patients aged 57 years and above. There was considerable variation in median age between Aboriginal and Torres Strait Islander patients (57 years) and patients of other descent (67 years).
- The total proportion of Aboriginal and Torres Strait Islander patients was 7.0%. Large geographical variance was noted, with sites in North Queensland having a significantly higher proportion of Aboriginal and Torres Strait Islander patients.
- Overall, 63% of referrals had a pre assessment diagnosis of ischaemic heart disease.
- The most common procedure undergone by patients who attended a CR pre assessment was a percutaneous coronary intervention, which had been performed for 42% of patients. There were 16% of patients who had undergone coronary artery bypass grafting.
- Only 39% of patients were recorded as being sufficiently active at pre assessment.
- 53% of patients who completed a pre assessment continued CR to the completion of a post assessment.
- Where a six minute walk test was undertaken, 76% patients demonstrated an improved result from pre to post assessment, with 55% recording an increase of greater than 50 metres.
- When measured using the AQoL-4D instrument, 54% of patients demonstrated an improved quality of life score after CR intervention. When quality of life was measured using other metrics, 53% of participants reported a feeling of improved health following completion of CR, 47% of patients reported an improved mood at post assessment compared to pre assessment, and 54% of patients reported that their fitness had improved following completion of the program.
- 41% of patients had an improved self reported activity level at completion of the program.
- Completion of a timely referral for Queensland Health inpatients (within 3 days of discharge from hospital) was achieved in 92% of cases.
- A timely overall journey occurred in 67% of cases (Queensland Health inpatients assessed by CR program within 28 days of discharge).

2 Participating sites

Table 1: Participating CR sites

Legend: ✓ Engaged and contributing ◑ Partially contributing (<50% of referrals) ○ Not contributing

HHS/ Organisation	CR program	Locations	2022	2023	2024
Cairns and Hinterland	Cairns Outpatient CR Program	Cairns	✓	✓	✓
	Cassowary Area CR	Innisfail, Tully	✓	✓	✓
	Tablelands CR	Atherton, Mareeba	✓	✓	✓
	Mossman CR and Prevention Program	Mossman	✓	✓	✓
Central Queensland	Community Health CR	Gladstone	✓	✓	✓
	Biloela CR Program	Biloela	✓	N/A	N/A
	CR Outpatient Program	Rockhampton, Capricorn Coast	✓	✓	✓
	Mount Morgan CR	Mount Morgan	✓	✓	✓
Central West	Longreach and Central West CR Program	Longreach	✓	✓	✓
		Blackall	✓	✓	✓
		Tambo	✓	✓	✓
		Winton	✓	✓	✓
		Barcaldine	✓	✓	✓
Darling Downs	Toowoomba Hospital Heart Care	Toowoomba	✓	✓	✓
	Warwick CR Service	Warwick	✓	✓	✓
	Chinchilla-Miles CR Service	Chinchilla, Miles	✓	✓	✓
	Dalby-Tara CR Service	Dalby, Tara	✓	✓	✓
	Kingaroy Hospital South Burnett CR	Kingaroy	✓	✓	✓
	Goondiwindi CR	Goondiwindi	✓	✓	✓
Gold Coast	Gold Coast Heart Health Service	Robina	✓	✓	✓
HCC*	SMoCC†	Health Contact Centre	✓	✓	✓
Mackay	Mackay Heart Health Service	Mackay	✓	✓	✓
	Mackay Rural District CR	Proserpine, Bowen	◑	✓	◑
Metro North	Complex Chronic Disease	Caboolture, Chermside, North Lakes, Redcliffe	✓	✓	✓
Metro South	PAH Heart Recovery Program	Princess Alexandra Hospital	✓	✓	✓
	Bayside CR Program	Redland	✓	✓	✓
	Brisbane South CR Service	Eight Mile Plains, Inala	✓	✓	✓
	Logan-Beaudesert CR Service	Browns Plains	✓	✓	✓
North West	North West CR Program	Mount Isa	✓	✓	✓
South West	South West HHS CR Services	Charleville, Roma	✓	✓	✓
		St George	✓	✓	✓
Sunshine Coast	Sunshine Coast HHS Cardiac Rehab	Caloundra, Gympie, Maroochydore, Nambour, Noosa	✓	✓	✓
Townsville	Townsville CR Outpatient Program	Townsville	✓	✓	✓
	Ingham CR Outpatient Program	Ingham	◑	○	◑
	Ayr Health Service	Ayr	○	○	○
West Moreton	Ipswich and West Moreton CR	Ipswich, Boonah, Esk, Gatton, Laidley	✓	✓	✓
Wide Bay	Fraser Coast CR	Hervey Bay, Maryborough	✓	✓	✓
	Wide Bay Rural and Allied Health*	Biggenden, Eidsvold, Gayndah, Mundubbera	✓	✓	✓

N/A Existing service ceased operations in 2023

* Health Contact Centre

† Self-Management of Chronic Conditions (delivering the COACH program)

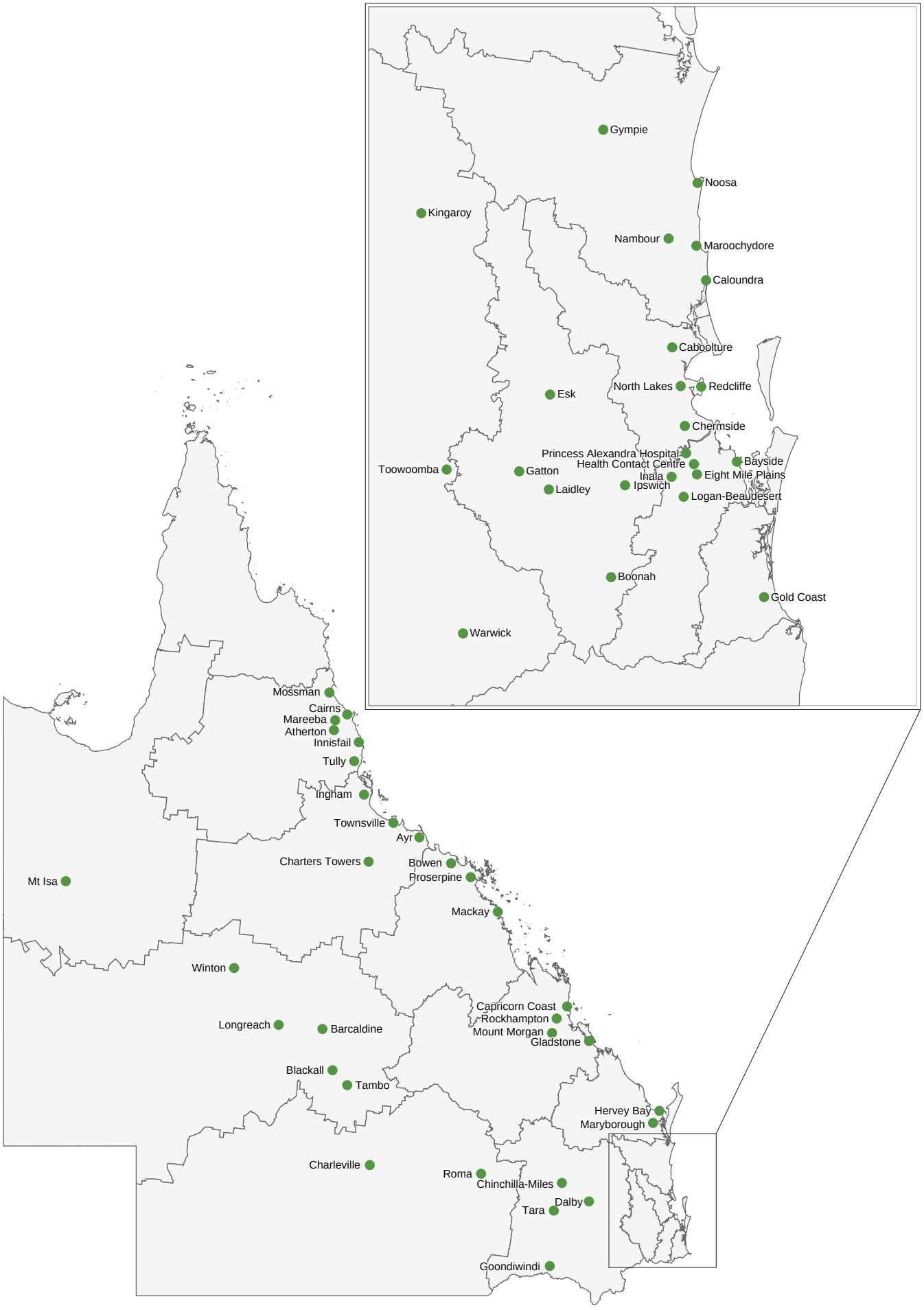


Figure 1: Map of Queensland public CR sites

3 Total referrals

3.1 Statewide

The volume of cardiac rehabilitation (CR) referrals entered into the QCOR clinical application expanded through 2024 to include an additional 9,773 new referrals for the calendar year. This brings the overall total to approximately 80,000 referrals since data collection commenced in July 2017.

Clinicians at 59 Queensland CR sites have incorporated data entry into their daily practices. A smaller number of sites deliver public outpatient CR but contribute to the database inconsistently or not at all. This can be a result of various factors such as resource availability. These sites remain a focus for engagement and involvement.

The QCOR module allows cases where the patient declined a CR referral or was considered unsuitable to participate in CR during the acute inpatient period (phase 1) to be recorded in the system, allowing the reasons that these patient did not participate to be examined.

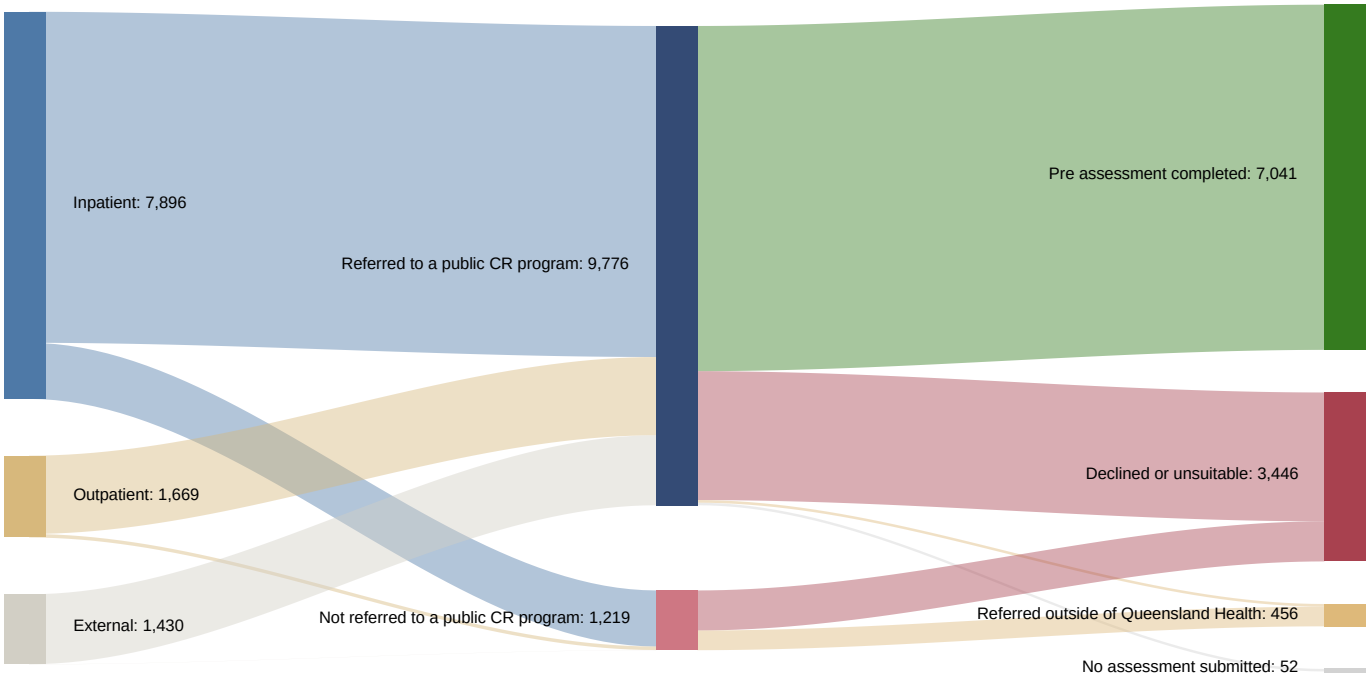


Figure 2: Statewide cardiac rehabilitation referrals flow

Patients were located across a wide geographical area with the majority residing in population centres along the Eastern Seaboard (Figure 3).

It is important to note that referrals for patients residing interstate or overseas are not generally accepted by Queensland public CR programs. The inclusion of these data is reflective of local site processes and may also vary based on available resources.

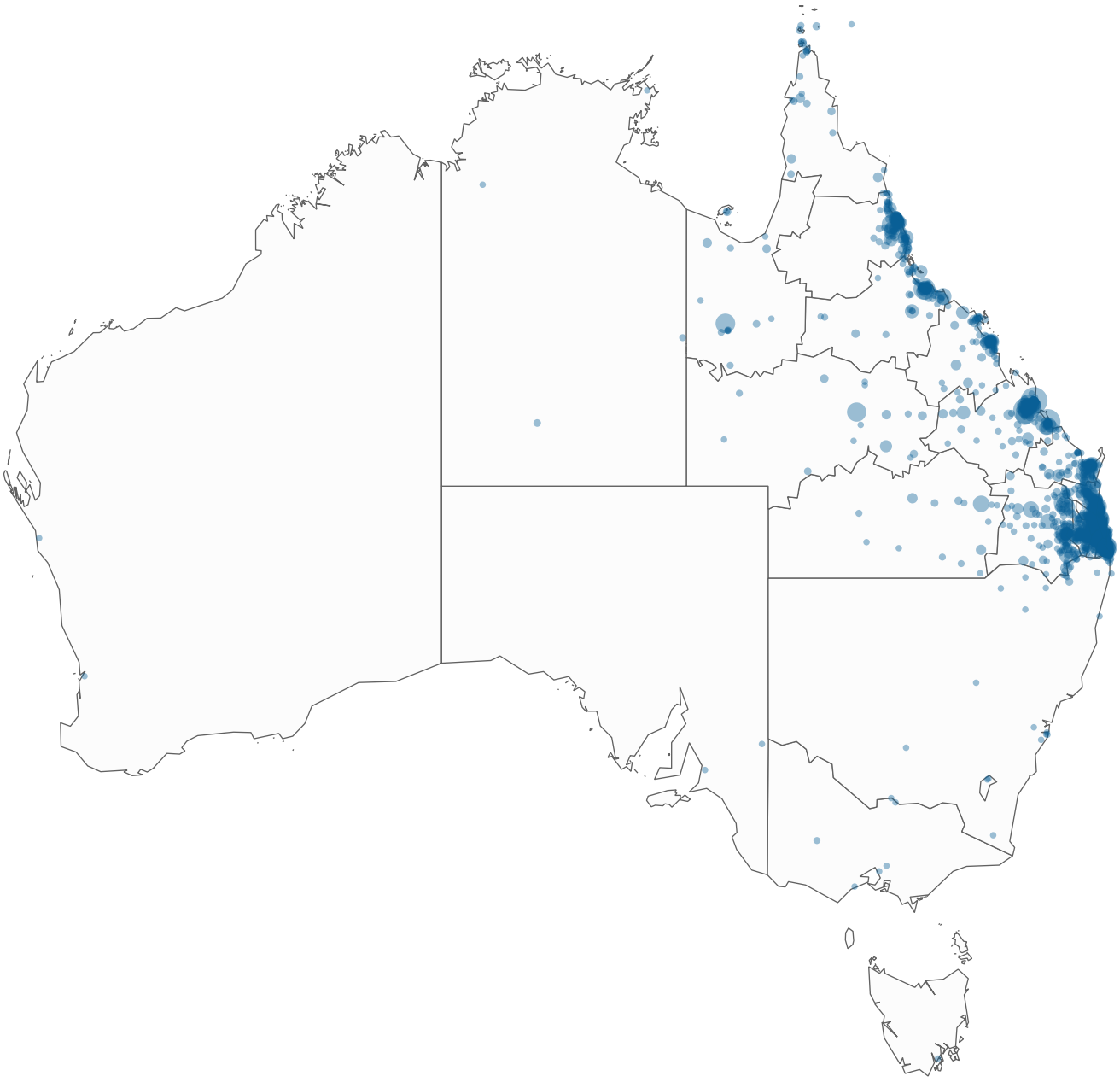


Figure 3: Distribution of CR referrals by usual place of residence

Table 2: Proportion of CR referrals by remoteness classification

Remoteness area*	%
Major Cities of Australia	51.3
Inner Regional Australia	27.9
Outer Regional Australia	16.4
Remote Australia	1.6
Very Remote Australia	2.7
ALL	**100.0**

Excludes missing data (0.3%)

* Classified by Australian Statistical Geography Standard remoteness area

3.2 Origin of referrals

Most referrals (69%) originated from an inpatient setting, with smaller proportions of referrals flowing to CR from an outpatient setting (16%) and outside of Queensland Health (15%).

There was considerable variation across participating CR programs in the proportion of referrals from external sources, which ranged from 2% to 32%. It is possible that not all sites are entering referrals received from general practitioners, private hospitals or external specialists, or that local access management strategies are in place where public referrals are prioritised entry into the program, or that local services are unaware that a CR program exists within the area.

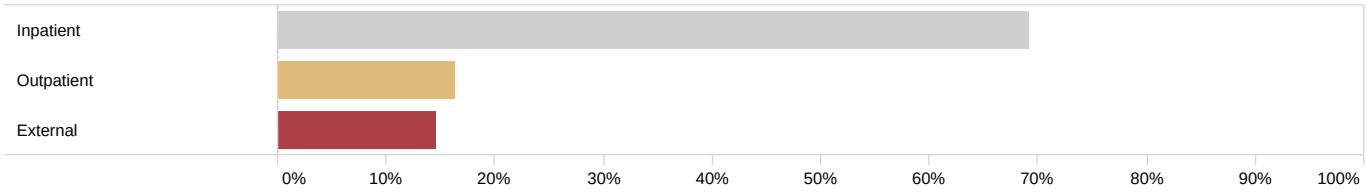


Figure 4: Proportion of referrals by referral source

Table 3: Referral sources by outpatient program HHS

HHS/division	Total referrals n	Inpatient* n (%)	Outpatient* n (%)	External n (%)
Cairns and Hinterland	680	550 (80.9)	66 (9.7)	64 (9.4)
Central Queensland	906	432 (47.7)	308 (34.0)	166 (18.3)
Central West	70	7 (10.0)	57 (81.4)	6 (8.6)
Darling Downs	551	358 (65.0)	58 (10.5)	135 (24.5)
Gold Coast	977	739 (75.6)	131 (13.4)	107 (11.0)
Health Contact Centre	1,108	875 (79.0)	205 (18.5)	28 (2.5)
Mackay	286	184 (64.3)	97 (33.9)	5 (1.7)
Metro North	1,399	847 (60.5)	254 (18.2)	298 (21.3)
Metro South	1,469	1,091 (74.3)	90 (6.1)	288 (19.6)
North West	51	30 (58.8)	20 (39.2)	1 (2.0)
South West	65	34 (52.3)	21 (32.3)	10 (15.4)
Sunshine Coast	768	629 (81.9)	59 (7.7)	80 (10.4)
Townsville	449	297 (66.1)	132 (29.4)	20 (4.5)
West Moreton	657	482 (73.4)	62 (9.4)	113 (17.2)
Wide Bay	337	194 (57.6)	36 (10.7)	107 (31.8)
Statewide	**9,773**	**6,749 (69.1)**	**1,596 (16.3)**	**1,428 (14.6)**

* Includes referrals from a Queensland Health public facility

More than half of all patients were residing in major cities (51%), and the remainder in regional and remote areas of Queensland. This is consistent with the decentralised distribution of the population within the state.

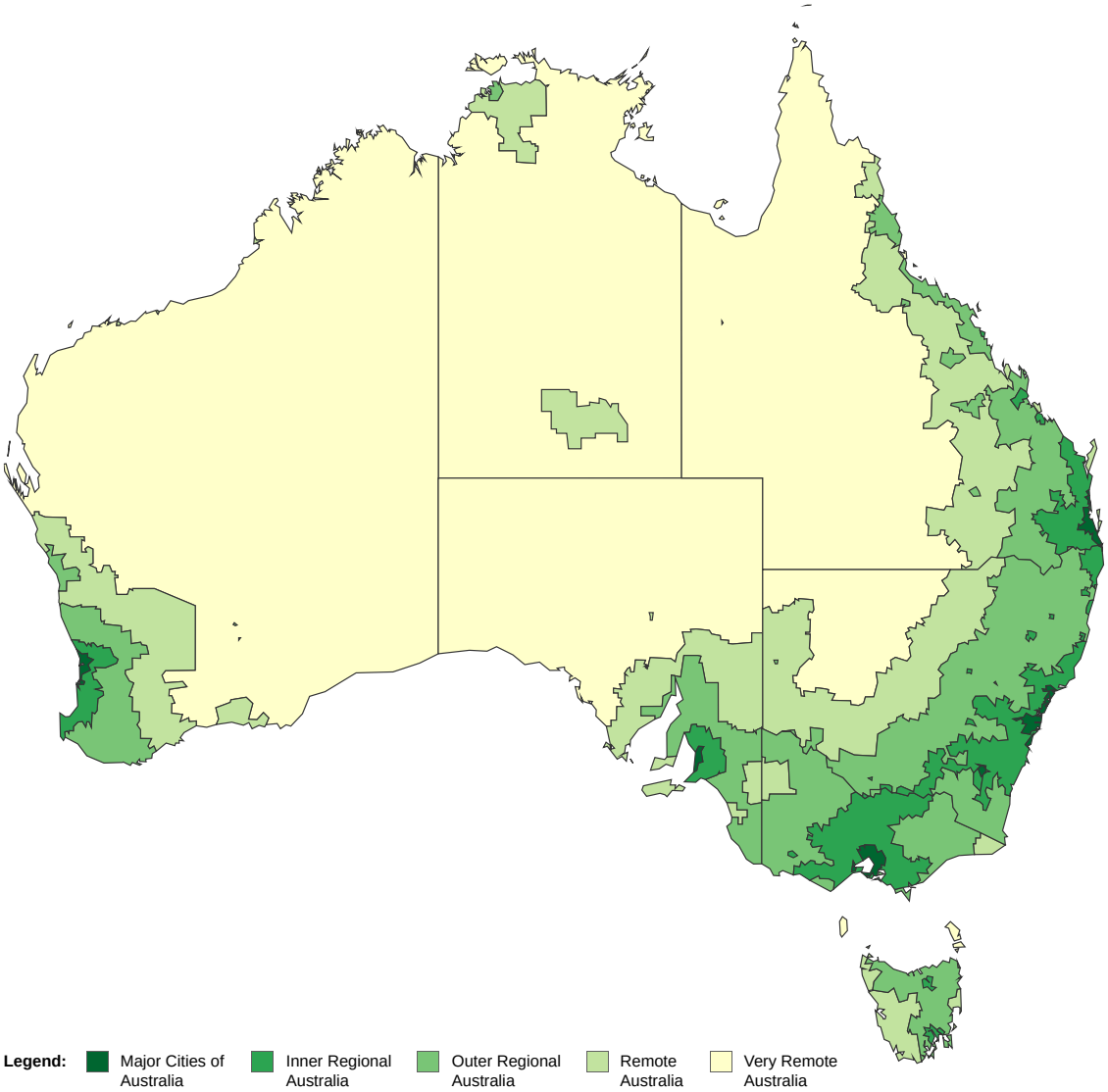


Figure 5: Australian Statistical Geography Standard remoteness areas

Table 4: CR referrals by outpatient HHS and patient remoteness classification

HHS/division	Major Cities n (%)	Inner Regional n (%)	Outer Regional n (%)	Remote n (%)	Very Remote n (%)
Cairns and Hinterland	4 (0.6)	5 (0.7)	592 (87.3)	35 (5.2)	42 (6.2)
Central Queensland	3 (0.3)	827 (91.4)	64 (7.1)	11 (1.2)	–
Central West	–	–	–	–	70 (100.0)
Darling Downs	8 (1.5)	401 (72.9)	136 (24.7)	5 (0.9)	–
Gold Coast	933 (96.0)	35 (3.6)	1 (0.1)	–	3 (0.3)
Health Contact Centre	557 (50.5)	227 (20.6)	177 (16.1)	58 (5.3)	83 (7.5)
Mackay	2 (0.7)	155 (54.8)	115 (40.6)	9 (3.2)	2 (0.7)
Metro North	1,253 (89.6)	144 (10.3)	2 (0.1)	–	–
Metro South	1,355 (92.9)	91 (6.2)	8 (0.5)	4 (0.3)	1 (0.1)
North West	1 (2.0)	–	3 (5.9)	4 (7.8)	43 (84.3)
South West	2 (3.1)	2 (3.1)	29 (44.6)	16 (24.6)	16 (24.6)
Sunshine Coast	446 (58.1)	316 (41.2)	5 (0.7)	–	–
Townsville	6 (1.3)	4 (0.9)	421 (94.0)	12 (2.7)	5 (1.1)
West Moreton	428 (65.2)	227 (34.6)	1 (0.2)	–	–
Wide Bay	3 (0.9)	288 (85.7)	45 (13.4)	–	–
Statewide	**5,001 (51.3)**	**2,722 (27.9)**	**1,599 (16.4)**	**154 (1.6)**	**265 (2.7)**

Excludes missing data (0.3%)

3.3 Inpatient referrals

For referrals originating from an inpatient setting, the largest referrer was Metro North HHS which accounted for almost one-third (29%) of these referrals. The largest proportion of inpatient referrals was received by Metro South HHS (16%).

Table 5: CR inpatient referrals by source and destination HHS

HHS/organisation	Outgoing inpatient referrals n (%)	Incoming inpatient referrals n (%)
Cairns and Hinterland	471 (7.0)	550 (8.1)
Central Queensland	194 (2.9)	432 (6.4)
Central West	–	7 (0.1)
Darling Downs	77 (1.1)	358 (5.3)
Gold Coast	730 (10.8)	739 (10.9)
Health Contact Centre	–	875 (13.0)
Mackay	141 (2.1)	184 (2.7)
Mater Health Services	91 (1.3)	–
Metro North	1,958 (29.0)	847 (12.6)
Metro South	1,681 (24.9)	1,091 (16.2)
North West	–	30 (0.4)
South West	1 (<0.1)	34 (0.5)
Sunshine Coast	538 (8.0)	629 (9.3)
Townsville	540 (8.0)	297 (4.4)
West Moreton	317 (4.7)	482 (7.1)
Wide Bay	10 (0.1)	194 (2.9)
Statewide	**6,749 (100.0)**	**6,749 (100.0)**

The flow of inpatient referrals from the originating HHS or organisation (acute site) to the CR outpatient program HHS is illustrated in Figure 6. Most inpatient referrals remained within the originating HHS, though there was some variation noted.

It should be highlighted that there are no outpatient programs for Mater Health Services, and conversely the Health Contact Centre provides an outpatient (telephone based) service only.

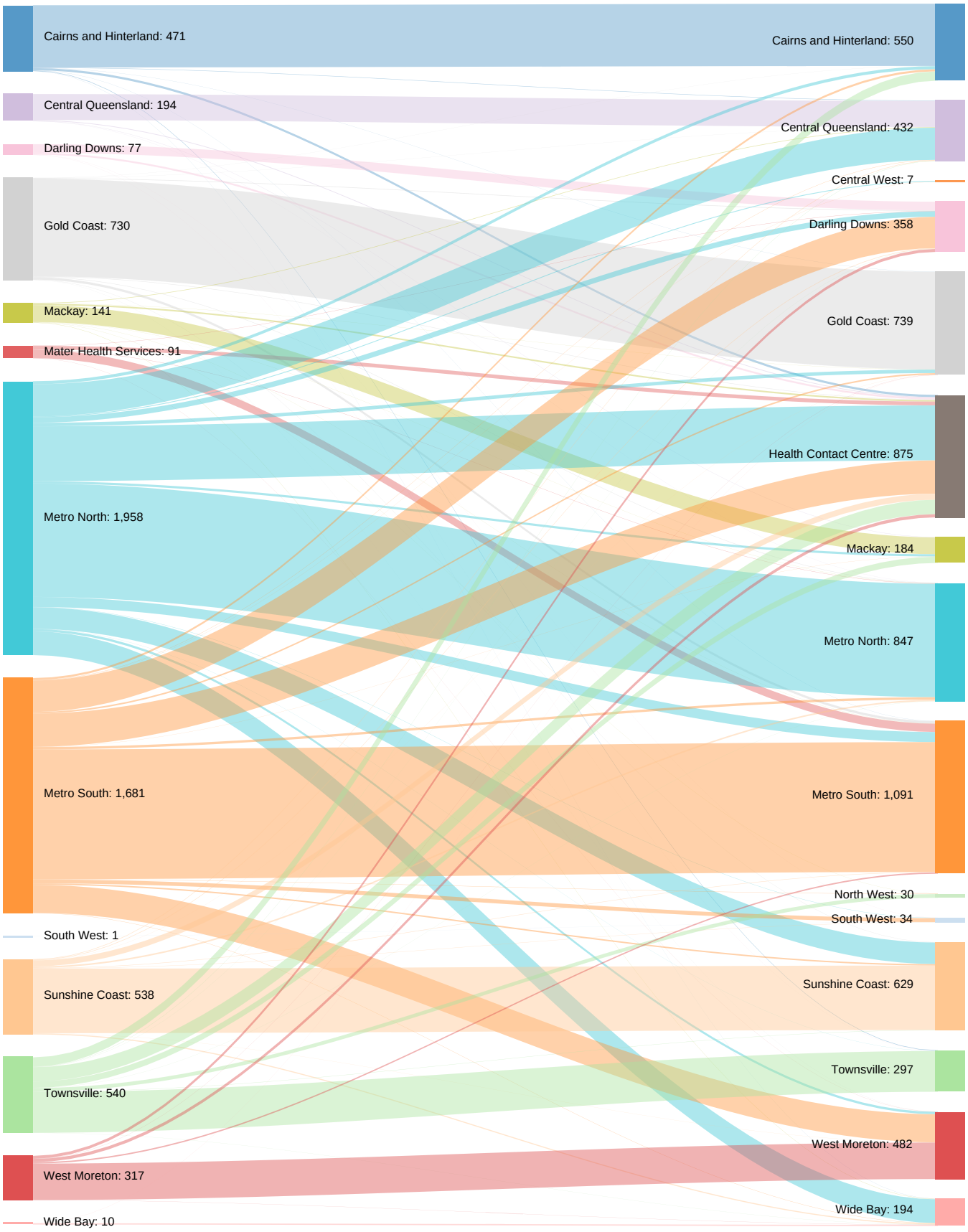


Figure 6: CR inpatient referrals by source and destination HHS

4 Program participation

4.1 Pre assessment stage

The assessment of a patient attending CR comprises a comprehensive cardiovascular disease risk factor review. This extends beyond a patient's presenting medical and social history to encompass overall health, physical well-being, psychological factors, availability of social support and patient-reported quality of life.

An assessment within outpatient CR is generally conducted in two stages which occur before and after a patient attends the CR program. These stages are referred to as the pre assessment and post assessment. The pre assessment signifies the successful enlistment of a patient onto the CR program. Assessments may be undertaken via telehealth or face-to-face.

The proportion of total referrals which proceeded to a pre assessment within any timeframe was 72%. This is a limited metric which should be interpreted with caution due to varying processes across the state for patients refusing or not interested in attending CR, and for patients residing overseas and interstate.

Capacity for service delivery is also a contributing factor for referrals not proceeding to pre assessment, these issues are explored later in the report.

Table 6: Total pre assessments completed by outpatient HHS/division

Outpatient HHS/division	Pre assessment completed n (%)	Declined/not assessed n (%)	No assessment submitted n (%)
Cairns and Hinterland	506 (74.4)	174 (25.6)	–
Central Queensland	686 (75.7)	220 (24.3)	–
Central West	51 (72.9)	19 (27.1)	–
Darling Downs	368 (66.8)	183 (33.2)	–
Gold Coast	739 (75.6)	238 (24.4)	–
Health Contact Centre	699 (63.1)	409 (36.9)	–
Mackay	194 (67.8)	61 (21.3)	31 (10.8)
Metro North	943 (67.4)	456 (32.6)	–
Metro South	1,173 (79.9)	296 (20.1)	–
North West	41 (80.4)	10 (19.6)	–
South West	58 (89.2)	4 (6.2)	3 (4.6)
Sunshine Coast	548 (71.4)	220 (28.6)	–
Townsville	296 (65.9)	153 (34.1)	–
West Moreton	470 (71.5)	172 (26.2)	15 (2.3)
Wide Bay	269 (79.8)	68 (20.2)	–
Statewide	**7,041 (72.0)**	**2,683 (27.5)**	**49 (0.5)**

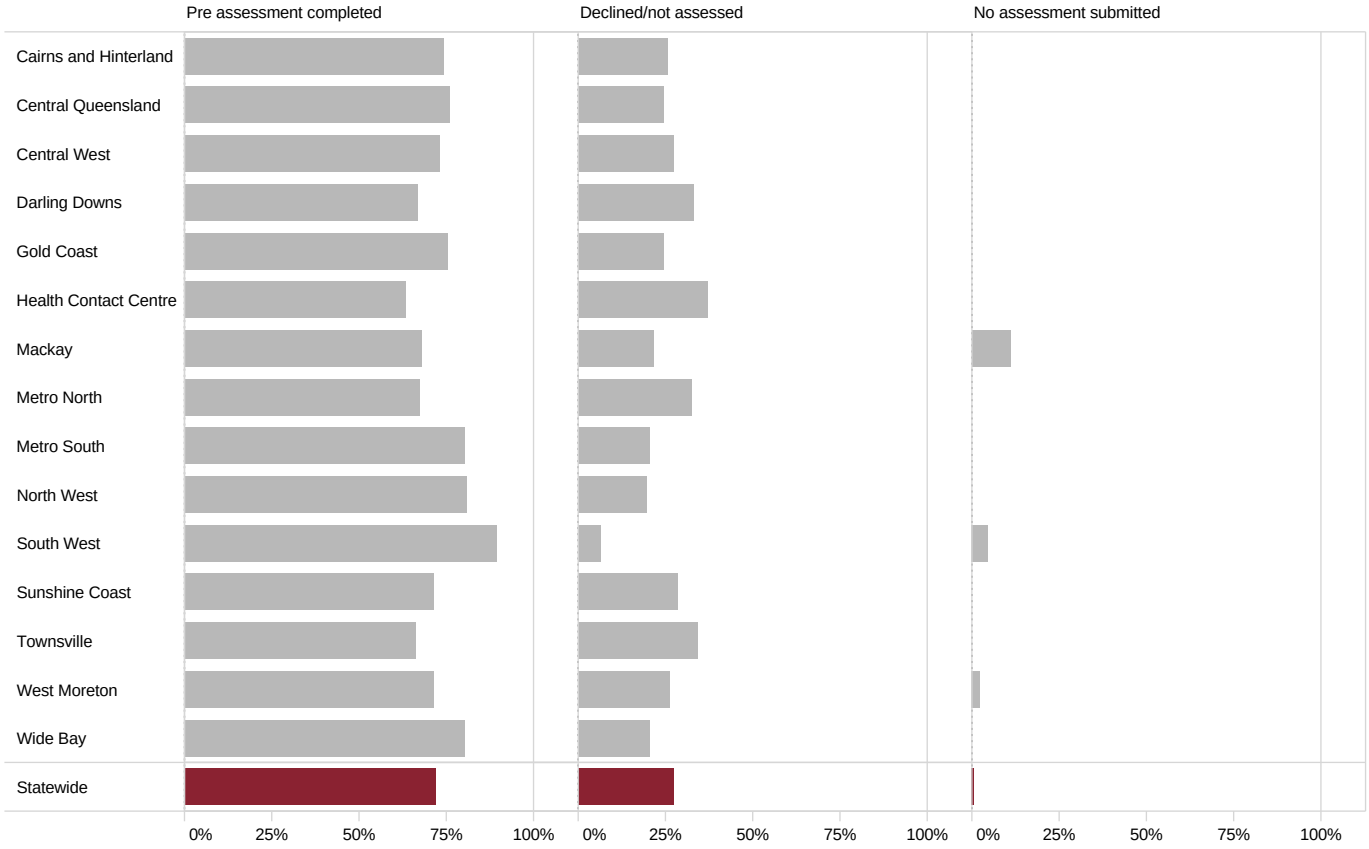


Figure 7: Proportion of CR referrals proceeding to pre assessment by outpatient HHS/division

4.2 Post assessment stage

In most cases, the post assessment is representative of completion and graduation from the specialist CR outpatient program. This provides an opportunity for the patient and clinician to reflect upon the targets defined at the pre assessment and discuss the impact of the program. Of 7,041 completed pre assessments, approximately half (53%) proceeded to post assessment.

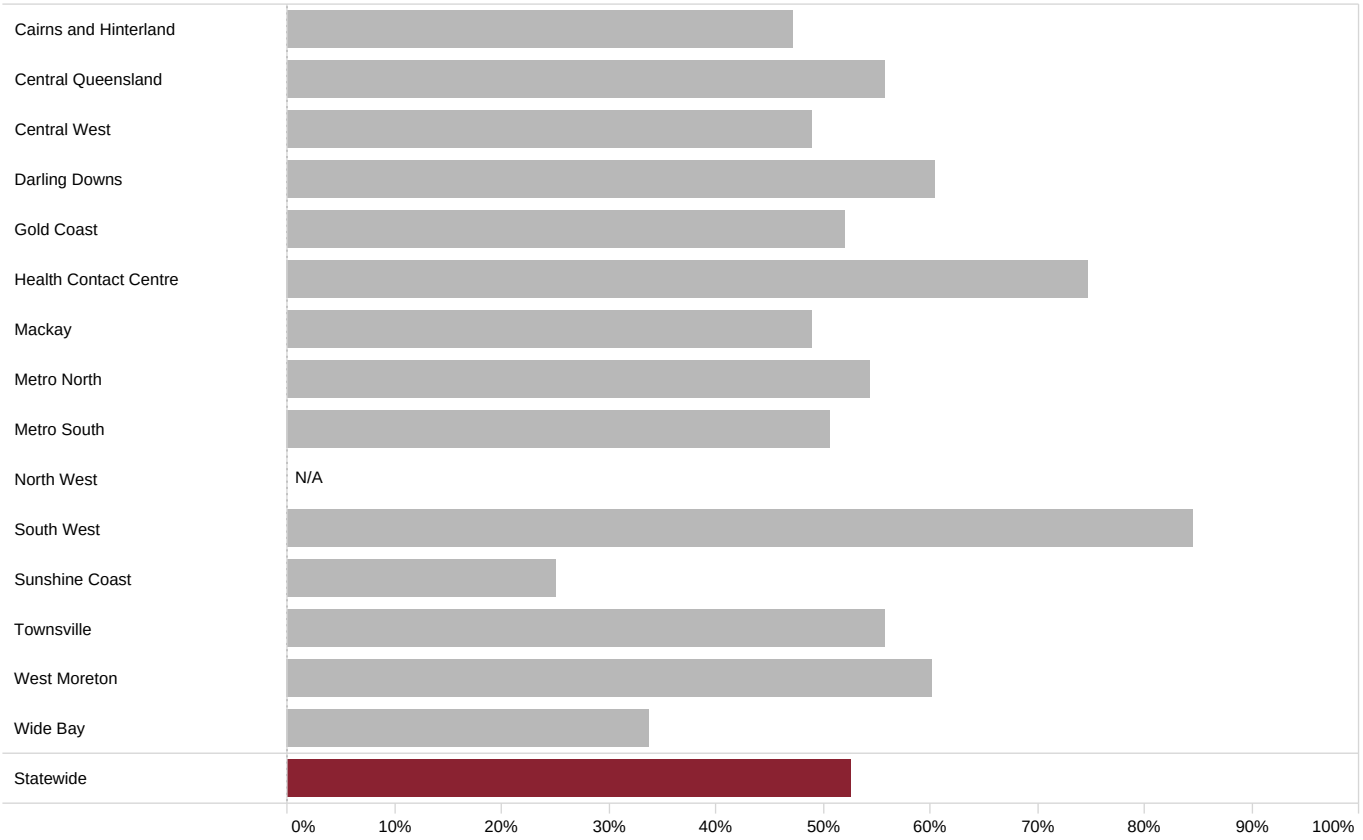
Completion rates and median time interval from pre assessment to post assessment varied considerably by HHS. The median time from pre assessment to post assessment was 76 days, with a range of 50 days to 132 days across outpatient HHS. There was considerable variation in the proportion of cases where a post assessment was completed, suggesting the model of care and data entry vary at a local level. A range of issues can contribute to completion of the post assessment which may include timing, patient availability or other factors outside the control of the program.

Data reported in this section uses a six month cut-off period for post assessment completion.

Table 7: Total post assessments completed by HHS

Outpatient HHS/division	Post assessment completed n (%)	Median time to post assessment days
Cairns and Hinterland	239 (47.2)	62
Central Queensland	382 (55.7)	74
Central West	25 (49.0)	102
Darling Downs	222 (60.3)	63
Gold Coast	385 (52.1)	51
Health Contact Centre	523 (74.8)	126
Mackay	95 (49.0)	81
Metro North	513 (54.4)	72
Metro South	595 (50.7)	76
North West	4 (9.8)	N/A
South West	49 (84.5)	71
Sunshine Coast	137 (25.0)	94
Townsville	165 (55.7)	132
West Moreton	283 (60.2)	59
Wide Bay	91 (33.8)	50
Statewide	**3,708 (52.7)**	**76**

N/A Not displayed due to <20 post assessments for analysis



N/A Not displayed due to <20 post assessments for analysis

Figure 8: Proportion of CR assessments proceeding to post assessment

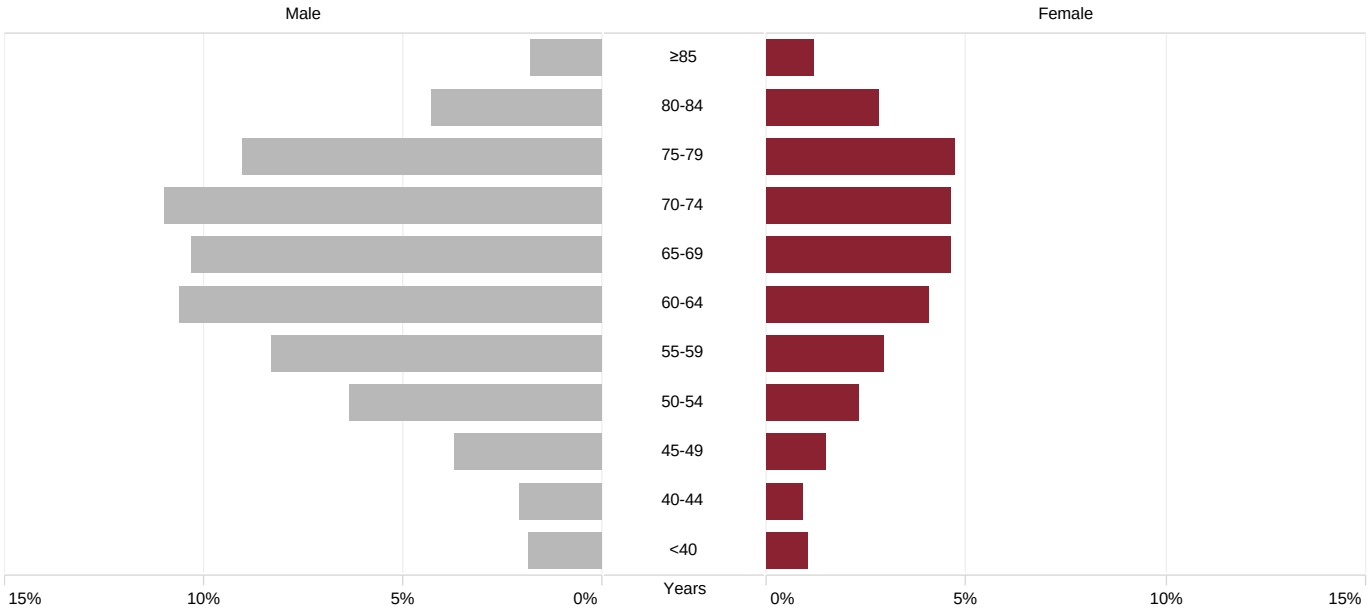
5 Patient characteristics

The following analysis examines the characteristics of the 9,733 patients who were referred to a public CR program. Largely these characteristics are similar to those reported over previous years.

5.1 Age and gender

Development of cardiovascular disease is related to age. Overall, 69% of patients were male and 31% female. The age distribution of referrals was similar for genders, though the median age for males was slightly lower than for females (66 years vs 68 years).

Overall, three-quarters of patients were 57 years of age or older (interquartile range 57 years to 74 years).



% of total referrals (n=9,733)

Figure 9: Referrals by patient gender and age group

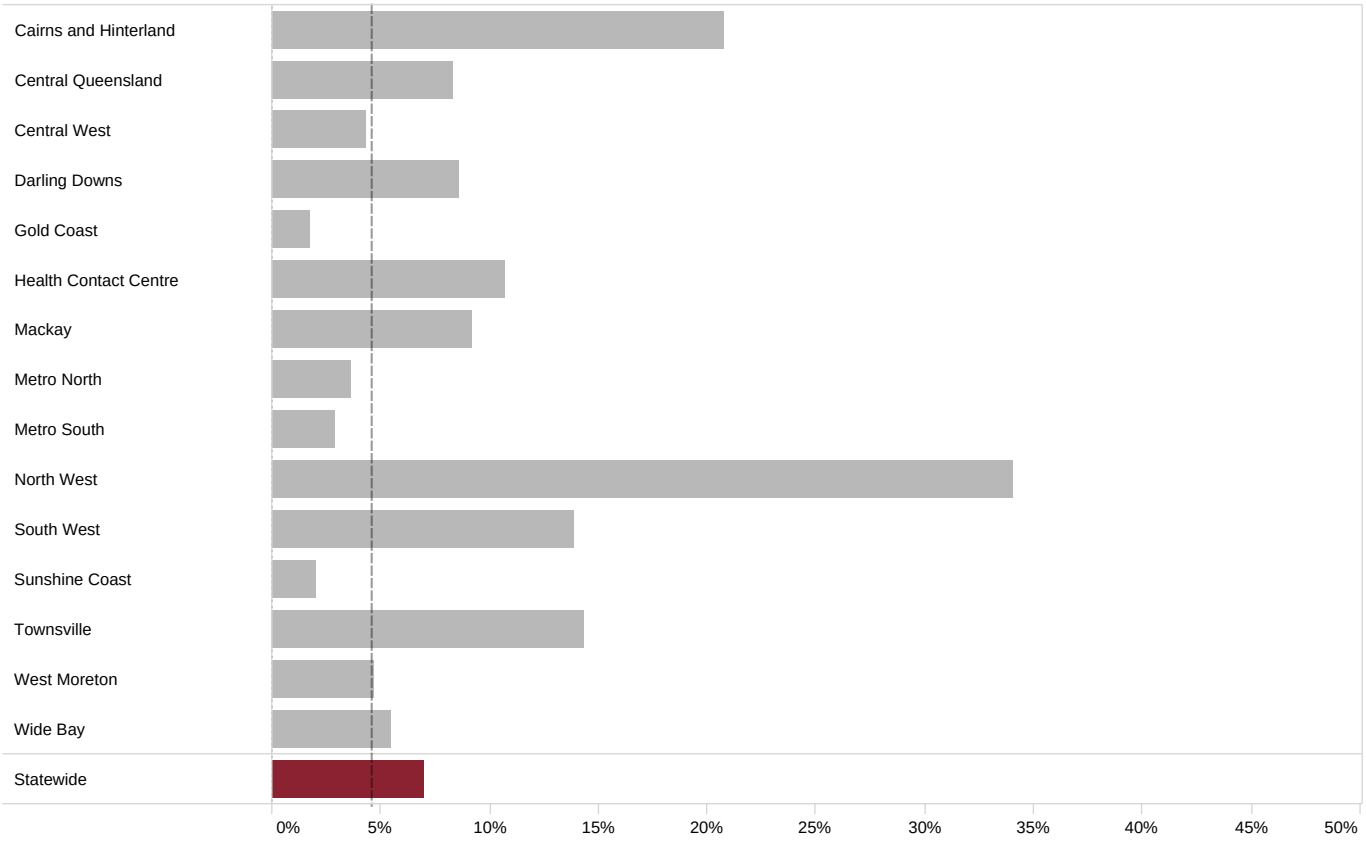
Table 8: Median patient age by gender and HHS

Outpatient HHS/division	Male years	Female years	ALL years
Cairns and Hinterland	64	68	66
Central Queensland	67	68	67
Central West	69	73	71
Darling Downs	67	68	67
Gold Coast	66	68	67
Health Contact Centre	65	68	66
Mackay	66	69	67
Metro North	66	68	67
Metro South	64	68	65
North West	61	58	59
South West	69	69	69
Sunshine Coast	68	70	68
Townsville	64	64	64
West Moreton	65	64	65
Wide Bay	72	69	71
Statewide	**66**	**68**	**67**

5.2 Aboriginal and Torres Strait Islander status

It is recognised that the Aboriginal and Torres Strait Islander population has a higher incidence and prevalence of coronary artery disease with ischaemic heart disease identified as the leading cause of death among Indigenous Australians in 2020.[1]

In this cohort, Aboriginal and Torres Strait Islander patients represent 7.0% of all statewide referrals with considerable variation observed across CR programs. By comparison, the estimated overall proportion of the Aboriginal and Torres Strait Islander population in Queensland is 4.6%.[2]

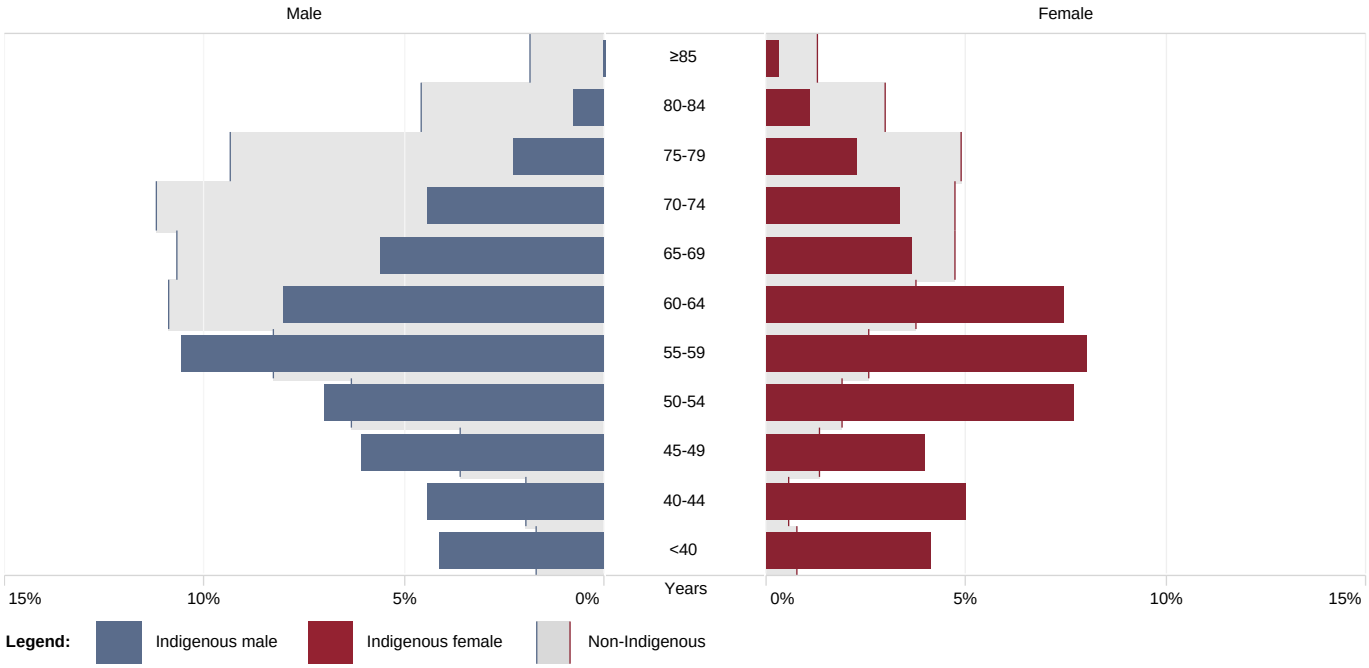


Excludes missing data (3.1%)

Figure 10: Proportion of identified Aboriginal and Torres Strait Islander patients by outpatient HHS

The proportion of Aboriginal and Torres Strait Islander patients referred to CR had a median age considerably lower than other patients (57 years vs 67 years respectively).

The rate of cardiovascular disease among Aboriginal and Torres Strait Islander patients is largely different to that seen among other Australians. The disparity in median age and proportionate numbers of Aboriginal and Torres Strait Islander patients undertaking CR is consistent with chronic diseases occurring more often and at a younger age compared to non-Indigenous Australians.



Excludes missing data (3.1%)

Figure 11: Proportion of all CR referrals by age group and Indigenous status

Table 9: Median patient age by gender and Indigenous status

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

Excludes missing data 3.1%

6 Clinical presentation

6.1 Diagnosis

For the following analysis, patients attending a CR pre assessment have been grouped into a diagnosis category based on clinical patient information obtained through the course of referral and pre assessment.

The majority of pre assessments (63%) followed a previous diagnosis of ischaemic heart disease (IHD).

Table 10: Pre assessments by diagnosis category

Diagnosis category	n	%
Ischaemic heart disease*	4,420	62.8
Valvular disease	733	10.4
Other†	1,888	26.8
ALL	**7,041**	**100.0**

* STEMI, NSTEMI and angina

† Typically includes arrhythmia, congestive heart failure and any other diagnosis

6.2 Most recent procedure

The most common procedure preceding a referral to CR was percutaneous coronary intervention (PCI). This was documented for 42% of all referrals and 61% of referrals for patients with IHD.

There were approximately 12% of cases where the most recent procedure had not been identified. These cases can be attributed to missing data, or to patients being conservatively managed and thus having no previous invasive cardiac procedure at the time of program commencement.

Table 11: Most recent procedure noted at pre assessment by diagnosis category

Most recent procedure	Ischaemic heart disease n (%)	Valvular disease n (%)	Other n (%)	ALL n (%)
PCI	2,686 (60.8)	2 (0.3)	254 (13.5)	2,942 (41.8)
CABG*	745 (16.9)	69 (9.4)	294 (15.6)	1,108 (15.7)
Coronary angiogram	639 (14.5)	17 (2.3)	296 (15.7)	952 (13.5)
Valve procedure	23 (0.5)	579 (79.0)	174 (9.2)	776 (11.0)
Other	36 (0.8)	23 (3.1)	245 (13.0)	304 (4.3)
Device procedure	6 (0.1)	6 (0.8)	118 (6.3)	130 (1.8)
CABG* + valve procedure	1 (<0.1)	–	–	1 (<0.1)
Not specified	284 (6.4)	37 (5.0)	507 (26.9)	828 (11.8)

* Coronary artery bypass graft

6.3 Risk factors and comorbidities

The following risk factors and comorbidities are discussed with the patient through the assessment phase and are generally self reported by the patient. With all self reporting instances, it is important to note that sometimes responses are not accurately conveyed while the patient and clinician are in the establishment phase of their relationship. As a result, some of the risk factor metrics may be understated.

At the time of the pre assessment:

- Most patients (90%) had a history of abnormal cholesterol levels or had been prescribed lipid lowering therapy at the time of assessment. This ranged from 70% to 97% across diagnosis categories.
- Only 39% of patients met the physical activity guidelines for their age and were sufficiently active. Furthermore, 18% of patients were classed as inactive, which is defined as only undertaking activities associated with daily living.
- The majority of patients were identified as having an unhealthy body mass index (BMI) with approximately one fifth (21%) of patients having a BMI within the normal range.
- Overall, 27% of patients had diabetes as a comorbidity with some variation observed between diagnosis categories.
- Almost half (46%) of patients had a family history of cardiovascular disease.
- Overall, there were 20% of patients assessed by outpatient CR who were documented as having heart failure.
- Of the patients documented to have heart failure, 87% had a reduced ejection fraction (LVEF ‹50%).
- Over one quarter (28%) of patients had a documented history of depression.
- More than half of patients (61%) were identified as having a history of hypertension.
- There were 14% of patients identified as current smokers (defined as smoking within 30 days), while 46% were classed as former smokers. Patients with ischaemic heart disease were those with the highest rate of current smoking.

Table 12: Summary of risk factors by diagnosis category

Risk factor	Ischaemic heart disease %	Valvular disease %	Other %	ALL %
Abnormal cholesterol*	96.9	70.0	79.6	89.4
Activity level				
Sufficiently active	40.7	35.9	36.3	38.9
Insufficiently active	42.4	43.9	43.9	43.0
Inactive	16.9	20.1	19.9	18.1
Body mass index				
Normal range†	20.4	26.6	18.7	20.6
Overweight‡	38.7	34.2	32.2	36.5
Obese§	34.9	33.5	39.8	36.1
Morbidly obese‖	5.2	4.7	8.3	6.0
Diabetes	28.9	21.7	26.3	27.4
Family history of CVD#	49.1	34.8	43.6	46.1
Heart failure	17.3	13.1	28.8	20.0
Heart failure, LVEF**				
≥50%	5.9	23.4	22.3	13.4
40–49%	44.2	24.5	26.5	36.0
30–39%	37.6	34.0	29.0	34.0
<30%	12.4	18.1	22.3	16.6
History of depression	28.1	26.2	29.4	28.3
Hypertension	60.1	57.6	65.6	61.3
Smoking status				
Current smoker††	17.6	5.8	9.4	14.2
Former smoker	45.6	45.1	46.8	45.9
Never smoked	36.8	49.1	43.8	40.0

% from total complete data per case category

* Total cholesterol >4.0 mmol/L, HDL <1.0 mmol/L, LDL >2.0 mmol/L or triglycerides >2.0 mmol/L

† 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

\# Cardiovascular disease

** Left ventricular ejection fraction

†† Within 30 days

6.4 Current medications

Over three-quarters of patients were being treated with aspirin (82%) and lipid lowering medications (84%). As expected, there was variation in medication across diagnosis categories. Patients with IHD tended to use antiplatelet and sublingual nitrate medications more than patients with valvular disease. This is consistent with the different disease processes and respective treatment regimes.

Although these measures are not directly influenced by CR practitioners, these data are important to note for the overall care and treatment of cardiac disease.

Table 13: Current medications by diagnosis category

Medications	IHD %	Valvular disease %	Other %	ALL %
Aspirin	90.7	65.5	65.8	81.5
ACEI/ARB*	65.4	41.4	54.4	60.0
Antiplatelet	72.3	12.5	26.6	53.9
Anticoagulant	18.2	44.4	33.4	24.9
Beta blocker	68.0	54.7	64.2	65.6
Diabetic medications	26.7	18.9	25.6	25.6
Dual antiplatelet	66.9	7.0	21.0	48.4
Lipid lowering	92.7	60.5	72.6	84.0
Sublingual nitrate	61.2	5.5	20.0	44.4
Other	68.3	80.4	72.9	70.8

* Angiotensin converting enzyme inhibitor/angiotensin receptor blocker

7 Program outcomes

The following outcome measures use paired observations from the pre assessment and post assessment stages to identify changes in health status for patients participating in CR. Measures included in this analysis relate to patient reported outcome measures (PROMS) and other functional or pathological investigations.

A limiting factor for this analysis is availability of data for the post assessment stage. Specifically, the availability of updated pathology and other investigations as well as the model of care employed by the CR program. This may result in limited data from which conclusions can be drawn and is a focus for future reporting and enhancements to data collection.

Table 14: Summary of program outcome measures

Program outcome	Category	Measure
1	Pathology	Lipid profile
2	Functional	Six minute walk test
3	PROMS	Patient Health Questionnaire
4	PROMS	Assessment of Quality of Life
5	PROMS	Other patient reported quality of life
6	PROMS	Other patient reported outcomes

7.1 Lipid profile

Data for lipid values such as total cholesterol was available for a smaller proportion of patients completing CR. A barrier to reporting this outcome is that updated pathology results are not always available for the post assessment stage. It is hoped that this limitation may be reduced with increased availability of data and linkage with other Queensland Health data collections.

Overall, a reduction in the mean total cholesterol was observed as was a reduction in triglycerides and LDL-C levels. This may be attributable to the impact of CR and adherence with pharmacotherapy.

Table 15: Summary of lipid values

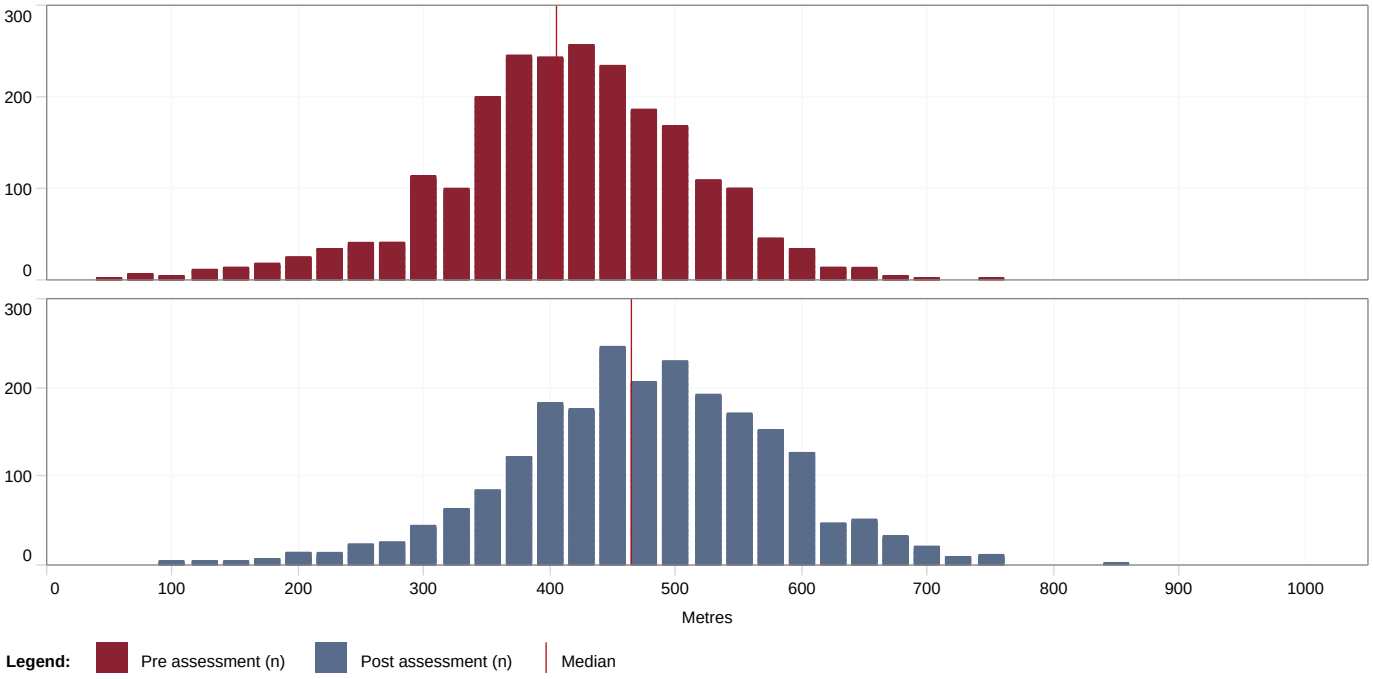
	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Total cholesterol (mmol/L)	494	4.4 ± 1.4	3.3 ± 1.0	-1.1 ± 1.5
Triglycerides (mmol/L)	468	1.7 ± 1.0	1.4 ± 0.7	-0.3 ± 0.8
HDL-C (mmol/L)	414	1.3 ± 0.9	1.1 ± 0.4	-0.1 ± 0.8
LDL-C (mmol/L)	410	2.6 ± 1.3	1.6 ± 0.8	-1.0 ± 1.3

7.2 Six minute walk test

A functional measure is commonly utilised prior to implementing an exercise program in order to determine exercise prescription and enable changes to be measured. The six minute walk test (6MWT) is a standardised investigation of submaximal exercise capacity that is often used in patients with cardiopulmonary disease. Changes in the six minute walk distance are useful in assessing functional capacity and the efficacy of therapeutic interventions such as pharmacotherapy and CR.[46]

The 6MWT is not always feasible due to the different models of care that exist, with some programs not offering an exercise component. There were 2,275 cases where the patient completed a 6MWT at the pre assessment and post assessment stages, which is a slight increase from the 2,095 referrals available for analysis for 2023.

The majority of patients (76%) had a clinically significant improvement in 6MWT distance of greater than 25 metres with 55% recording an increase of greater than 50 metres (Table 17).



Results rounded to 25 metres

Figure 12: Comparison of pre assessment and post assessment six minute walk test results

Table 16: Summary of six minute walk test results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Distance travelled (metres)	2,275	401.8 ± 99.4	464.2 ± 106.7	62.4 ± 58.5

Table 17: Change in six minute walk test results

	n (%)
Improved ≥50 metres	1,250 (54.9)
Improved 26–49 metres	490 (21.5)
No change (±25 metres)	455 (20.0)
Worsened >25 metres	80 (3.5)
ALL	**2,275 (100.0)**

7.3 Patient reported outcome measures

Patient Health Questionnaire

The CR assessment often includes a brief screening for anxiety and depressive disorders. Both are significant risk factors for patients suffering coronary artery disease and are associated with adverse cardiovascular outcomes independent of other risk factors.

The Patient Health Questionnaire-4 (PHQ-4) is a validated tool for screening anxiety and depressive disorders.[47] This instrument is a four item composite measure derived from the Generalized Anxiety Disorder-7 scale (GAD-7) and the Patient Health Questionnaire-9 (PHQ-9). Each of the four items on the PHQ-4 is scored using a four point scale:

- high psychological distress being scored 9–12 points
- mild psychological distress scoring between 3–5 points
- minimal depression and anxiety scoring between 0–2 points.

A total of 2,681 paired data were available for analysis. One third of patients (33%) demonstrated an improved PHQ-4 score at post assessment while 52% recorded no change to their PHQ-4 score. Given a large proportion of patients reported minimal depression and anxiety at the pre assessment there is often no scope for improvement via this metric.

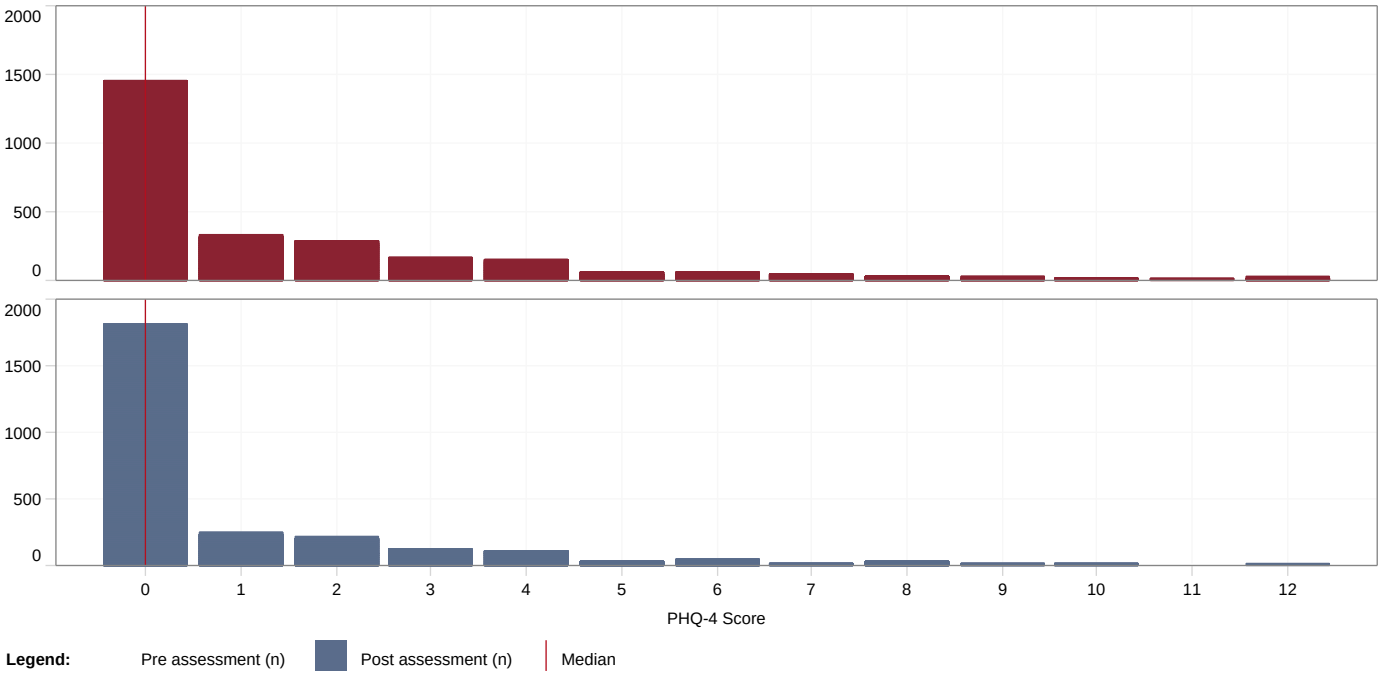


Figure 13: Comparison of pre assessment and post assessment PHQ-4 results

Table 18: Summary of PHQ-4 results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Depression score (PHQ-2)	2,681	0.7 ± 1.3	0.5 ± 1.0	-0.2 ± 1.3
Anxiety score (GAD-2)	2,681	0.9 ± 1.4	0.6 ± 1.2	-0.3 ± 1.4
Overall score	**2,681**	**1.5 ± 2.4**	**1.0 ± 2.0**	**-0.5 ± 2.3**

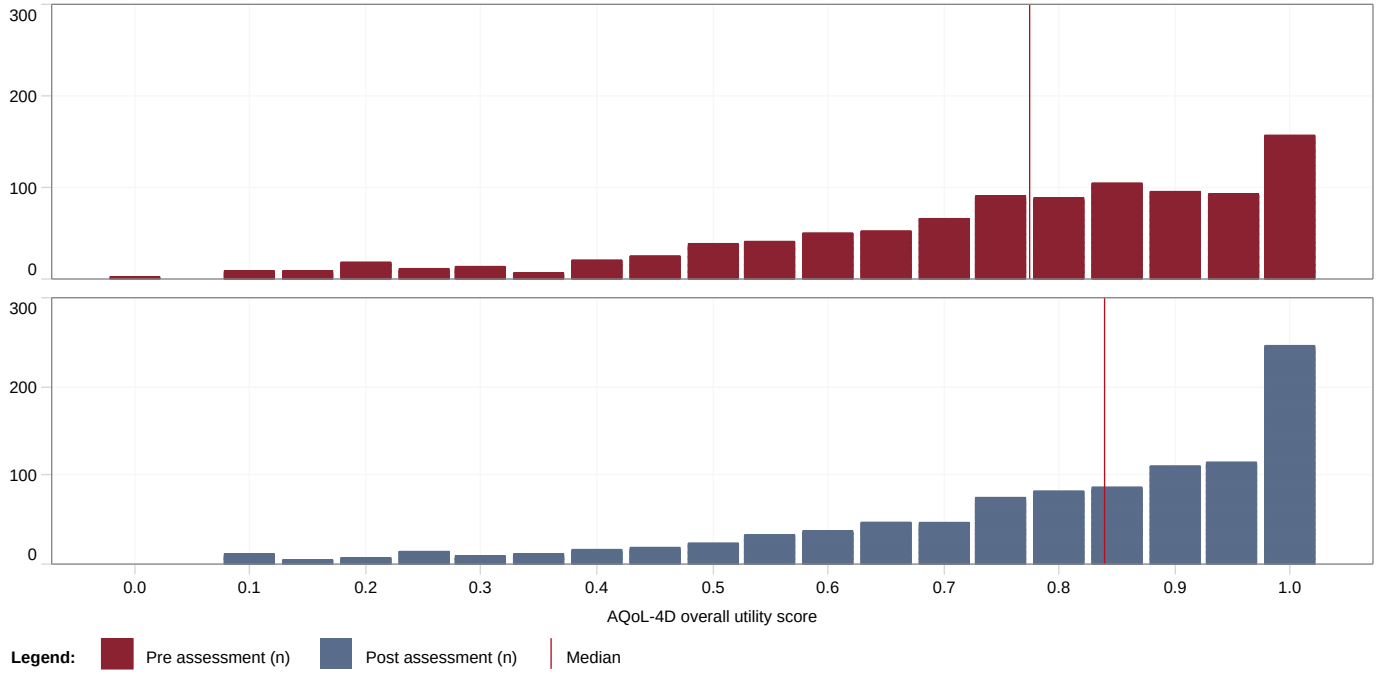
Table 19: Change in PHQ-4 results

	n (%)
Any improvement	893 (33.3)
No change	1,385 (51.7)
Any worse result	403 (15.0)
ALL	**2,681 (100.0)**

Assessment of Quality of Life

The Assessment of Quality of Life (AQoL-4D) is a multi-attribute utility instrument developed to assess health-related quality of life. It measures PROMS across four domains of health, scored individually, as well as providing an overall score. Overall AQoL-4D utility score ranges from 0.00–1.00, with scores closer to 1.00 indicating higher satisfaction of patients reporting the status of their own health.

For the 992 records available at the pre and post CR timeframes, the mean overall pre assessment AQoL-4D utility score was 0.73 which compares similarly to expected results for patients with a cardiovascular diagnosis.[48] This utility score improved to 0.78 at the post assessment stage, where 54% of patients demonstrated an improved overall utility score after CR intervention (Table 20 and Table 21).



Results rounded to 0.05 utility score

Figure 14: Comparison of pre assessment and post assessment AQoL-4D results

Table 20: Summary of AQoL-4D results

	Total analysed n	Pre assessment Mean ± SD	Post assessment Mean ± SD	Change in value Mean ± SD
Independent living	992	0.89 ± 0.17	0.95 ± 0.12	0.05 ± 0.15
Relationships	992	0.92 ± 0.15	0.93 ± 0.14	‹0.01 ± 0.14
Senses	992	0.95 ± 0.08	0.95 ± 0.08	‹0.01 ± 0.09
Mental health	992	0.90 ± 0.11	0.91 ± 0.11	0.01 ± 0.11
Overall score	**992**	**0.73 ± 0.22**	**0.78 ± 0.22**	**0.05 ± 0.21**

Table 21: Change in AQoL-4D results

	n (%)
Any improvement	539 (54.3)
No change	101 (10.2)
Any worse result	352 (35.5)
ALL	**992 (100.0)**

Other patient reported quality of life

Any assessment by a CR clinician includes a component assessing for quality of life (QOL). However, the use of a long-form questionnaire (such as AQoL-4D) is often impractical or unwarranted. The assessment of patient reported QOL takes the form of an abbreviated questionnaire allowing patients to self report their health-related status across three domains.

The questions asked include:

- In general, how would you describe your health at present?
- In general, how would you describe your mood at present?
- How fit are you now compared with 6 months ago?

The abbreviated questionnaire often provides a gauge to whether the CR practitioner may need to apply a more detailed QOL assessment to better understand the status and needs of the individual patient.

Paired data on the condensed QOL survey were available for 2,136 assessments.

Self reported health

There were 48% of patients reporting a health status of very good or excellent at post assessment, compared with 17% at the pre assessment phase. Over half (53%) reported a feeling of improved health. Reductions in the numbers of patients reporting fair or poor health were observed, with only 2% of patients reporting poor health at post assessment.

Decreases in self reported health status were reported by 9% of patients, however caution should be exercised when interpreting this result as there are many confounding factors which may affect the health status of a patient with what is often a newly diagnosed complex chronic disease.

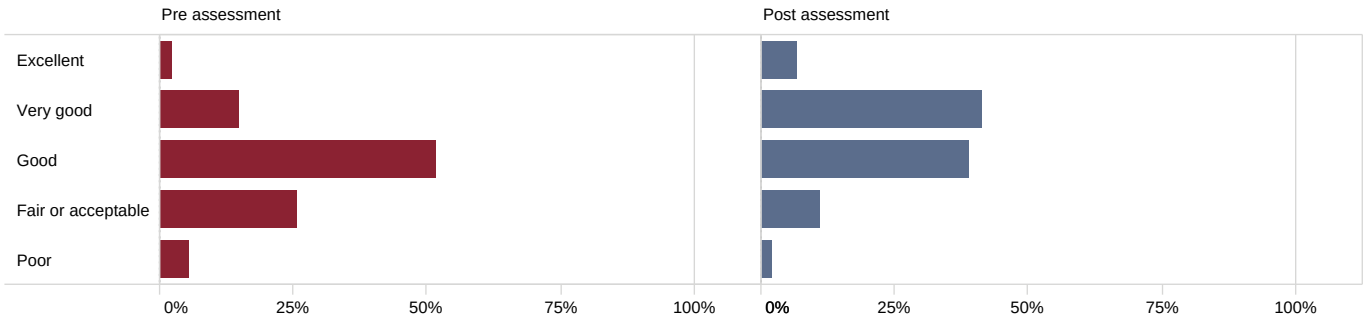


Figure 15: Comparison of patient reported health status at pre and post assessment

Table 22: Change in patient reported health status at pre and post assessment

	n (%)
Any improvement	1,125 (52.7)
No change	820 (38.4)
Any worse result	191 (8.9)
ALL	**2,136 (100.0)**

Self reported mood

Almost half of patients (47%) reported an improved mood compared to the pre assessment stage. The proportion of patients reporting excellent mood scores at post assessment increased from 5% to 10%, while those with very good mood scores increased from 18% to 41%.

There were 10% of patients who reported a decrease in mood, however it is reassuring to note an overall decrease in the proportion of patients reporting fair or poor mood.

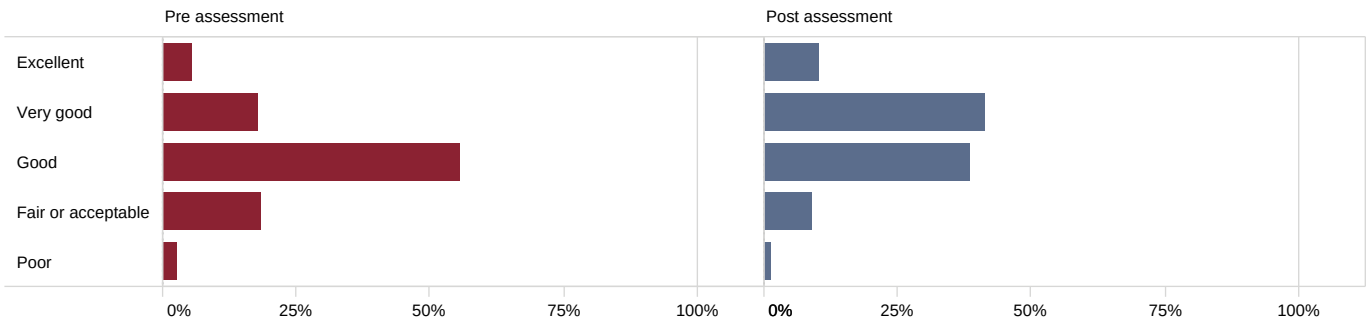


Figure 16: Comparison of patient reported mood at pre and post assessment

Table 23: Change in patient reported mood at pre and post assessment

	n (%)
Any improvement	994 (46.5)
No change	936 (43.8)
Any worse result	206 (9.6)
ALL	**2,136 (100.0)**

Self reported fitness

When asked to compare fitness level to the period six months prior to completing a CR program, 54% of patients reported that their fitness had improved. Decreases in fitness were reported by 18% of patients.

Issues such as the development of significant cardiac dysfunction as a result of myocardial infarction may explain a decline in fitness. Given the result is compared to a baseline six months prior to completing CR, the patient's index cardiac event may also have occurred in this time and therefore regression may not be unexpected.

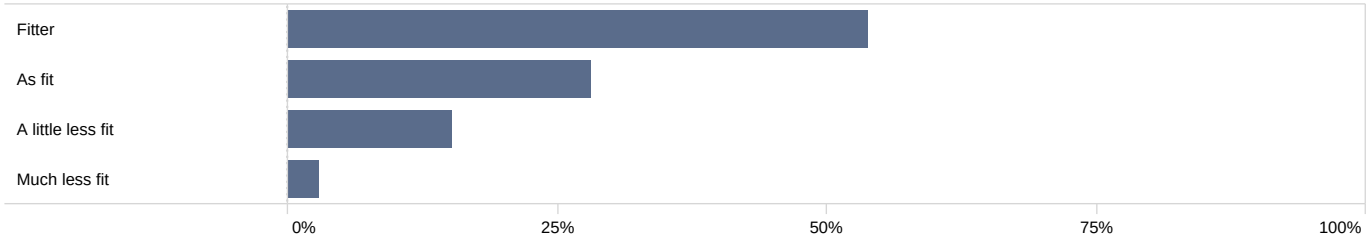


Figure 17: Patient reported change in fitness at post assessment

Table 24: Patient reported change in fitness at post assessment

	n (%)
Fitter	1,149 (53.8)
As fit	600 (28.1)
A little less fit	324 (15.2)
Much less fit	63 (2.9)
ALL	**2,136 (100.0)**

Smoking

There were 3,686 patients where smoking status at pre assessment and post assessment was available for analysis. For the vast majority of patients (95%), smoking status was unchanged over the course of the CR program. However, there was a slight decrease in the proportion of patients reported as current smokers (defined as smoking within the last 30 days), with 10% of patients identified as current smokers at the time of the pre assessment decreasing to 7% at the time of the post assessment.

The change in current smoking status represents approximately 4% of patients who reported having ceased smoking between the CR pre assessment and post assessment (Table 25). However, conversely, there were some former smokers at pre assessment who reported having relapsed by the time the post assessment was conducted (0.8%).

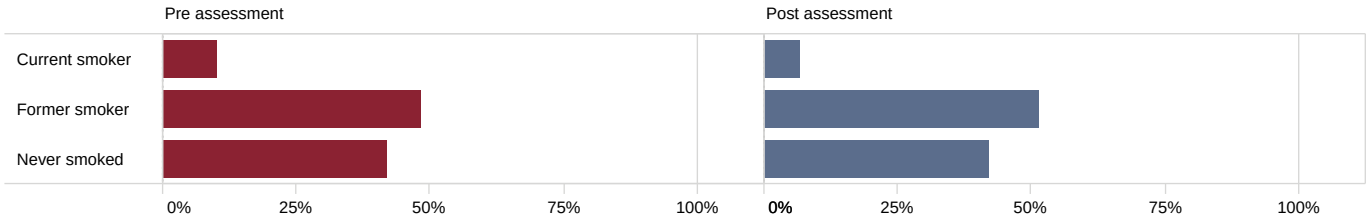


Figure 18: Patient reported smoking status at pre and post assessment

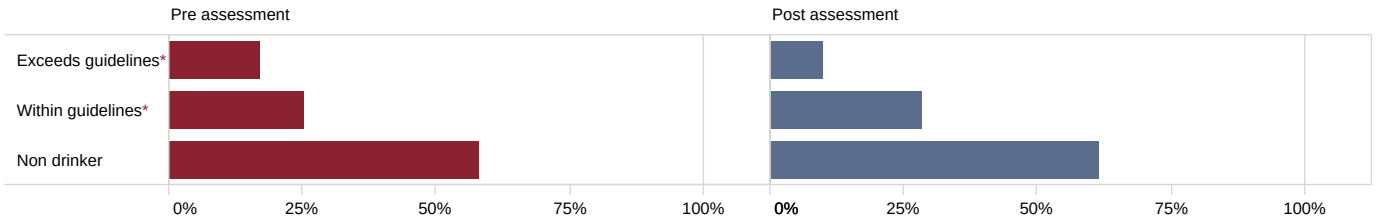
Table 25: Change in patient reported smoking status at pre and post assessment

	n (%)
Ceased smoking	151 (4.1)
No change to smoking status	3,504 (95.1)
Relapsed smoker	31 (0.8)
ALL	**3,686 (100.0)**

Alcohol consumption

Patient reported alcohol consumption was available for comparison between 3,214 pre and post assessments. Almost one fifth (17%) reported unhealthy levels of alcohol consumption (exceeding 10 standard drinks per week or more than 4 standard drinks on any single day)[49] at the time of the pre assessment, which had reduced to 10% at the time of the post assessment.

A greater proportion of the cohort were within guidelines at post assessment compared to pre assessment.



* No more than 10 standard drinks per week, and no more than 4 standard drinks any single day of the week

Figure 19: Patient reported alcohol consumption at pre and post assessment

Table 26: Patient reported alcohol consumption at pre and post assessment

	Pre assessment n (%)	Post assessment n (%)
Exceeds guideline	546 (17.0)	315 (9.8)
Within guideline	809 (25.2)	918 (28.6)
Non drinker	1,859 (57.8)	1,981 (61.6)
ALL	**3,214 (100.0)**	**3,214 (100.0)**

Activity level

There were 3,212 patients for whom self reported activity level could be compared between the pre and post assessment. Over two-fifths (41%) reported an increased activity level following the completion of their CR program, with almost three-quarters (71%) reporting sufficient levels of physical activity at the post assessment compared to 40% at the pre assessment.

The proportion of patients reported as inactive decreased from 15% at the pre assessment to 2% at the post assessment.

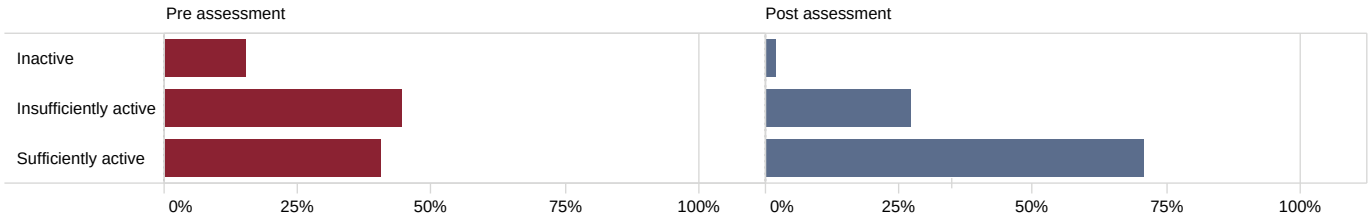


Figure 20: Patient reported activity level at pre and post assessment

Table 27: Change in patient reported activity level at pre and post assessment

	n (%)
Improved	1,330 (41.4)
No change	1,768 (55.0)
Worsened	114 (3.5)
ALL	**3,212 (100.0)**

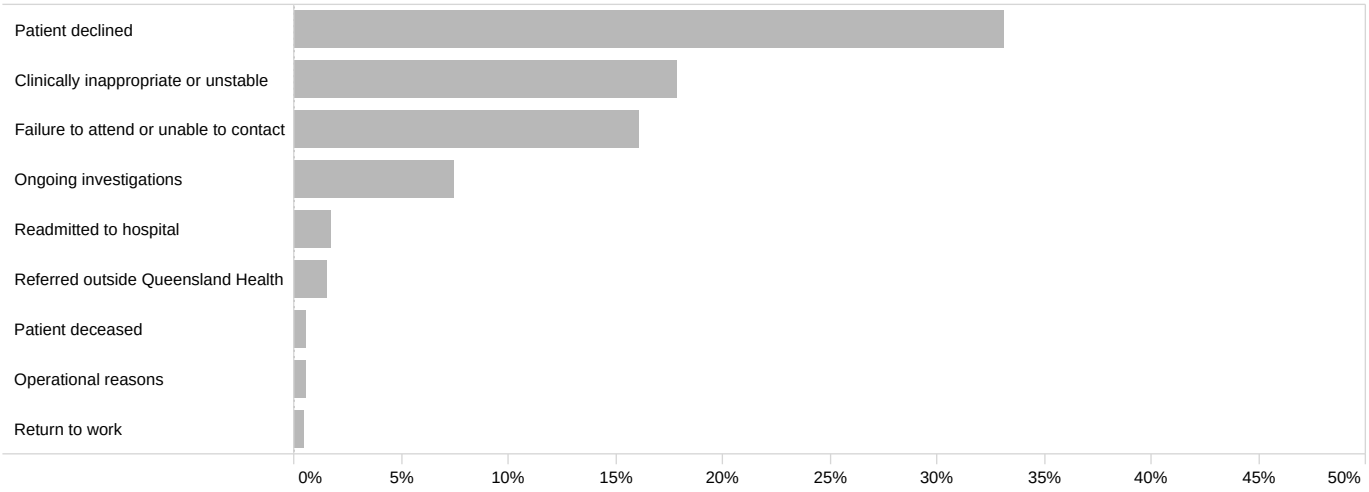
7.4 Failure to participate

There are many reasons a patient may not participate in a CR program. In this cohort, which includes patients who declined or were unsuitable during phase 1 and phase 2, the most common reason for not participating in a CR program was that the patient had declined (33%). Eighteen percent were medically inappropriate to participate, while 16% had been uncontactable or failed to attend.

An ongoing initiative has been to further define the subset of patients who did not participate in CR. The aim is to increase the level of detail available to describe the barriers to participation, identify common themes and opportunities to improve patient participation rates.

In some of these instances, the clinician may still provide opportunistic education and advice to these patients, however this is difficult to incorporate into reporting.

A limiting factor for this analysis is the amount of data available to describe this cohort, as this is limited to the information included on the initial referral only.



Not displaying other reasons (20%)

Figure 21: Reasons for no pre assessment being conducted

7.4.1 Age and gender

There was considerable variation in patient age when comparing patients who participated in CR as opposed to patients who declined or were not interested and patients who were medically unsuitable. Patients who participated in CR had a median age of 66 years, while patients who declined or were medically unsuitable had a median age five years older and three years older respectively.

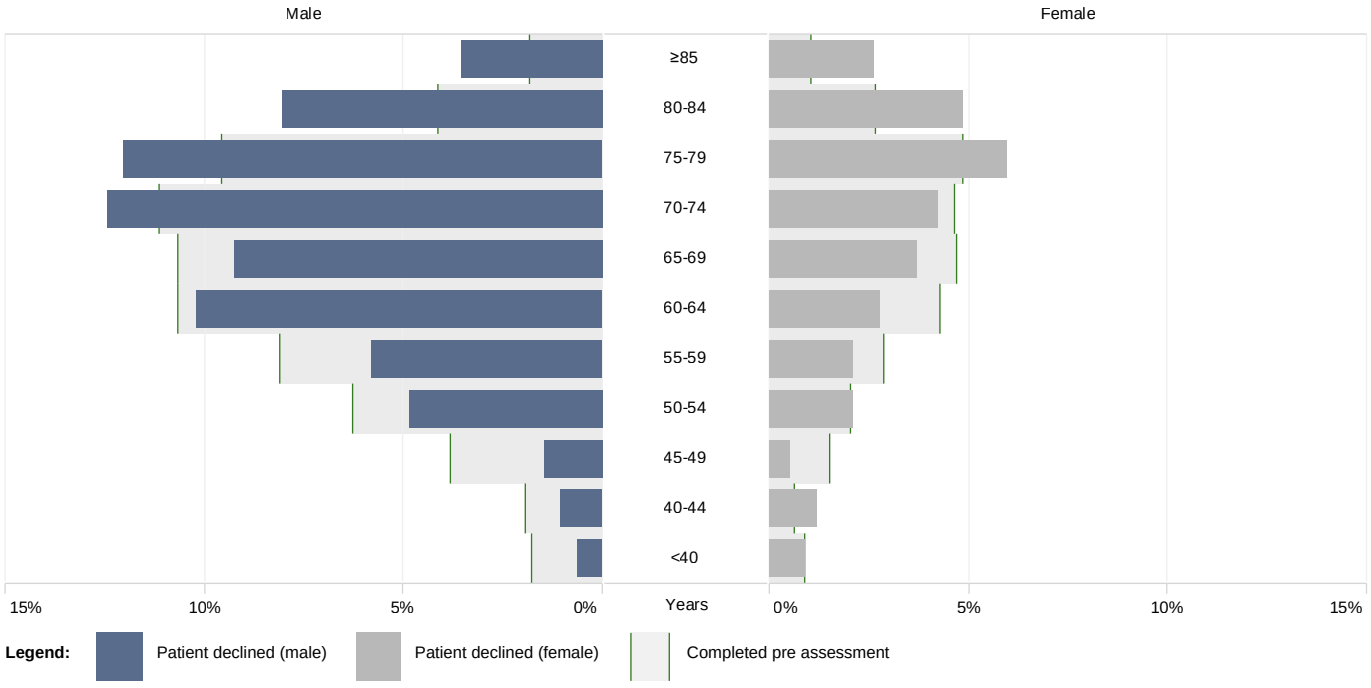


Figure 22: Patient age group and gender, patient declined vs completed pre assessment

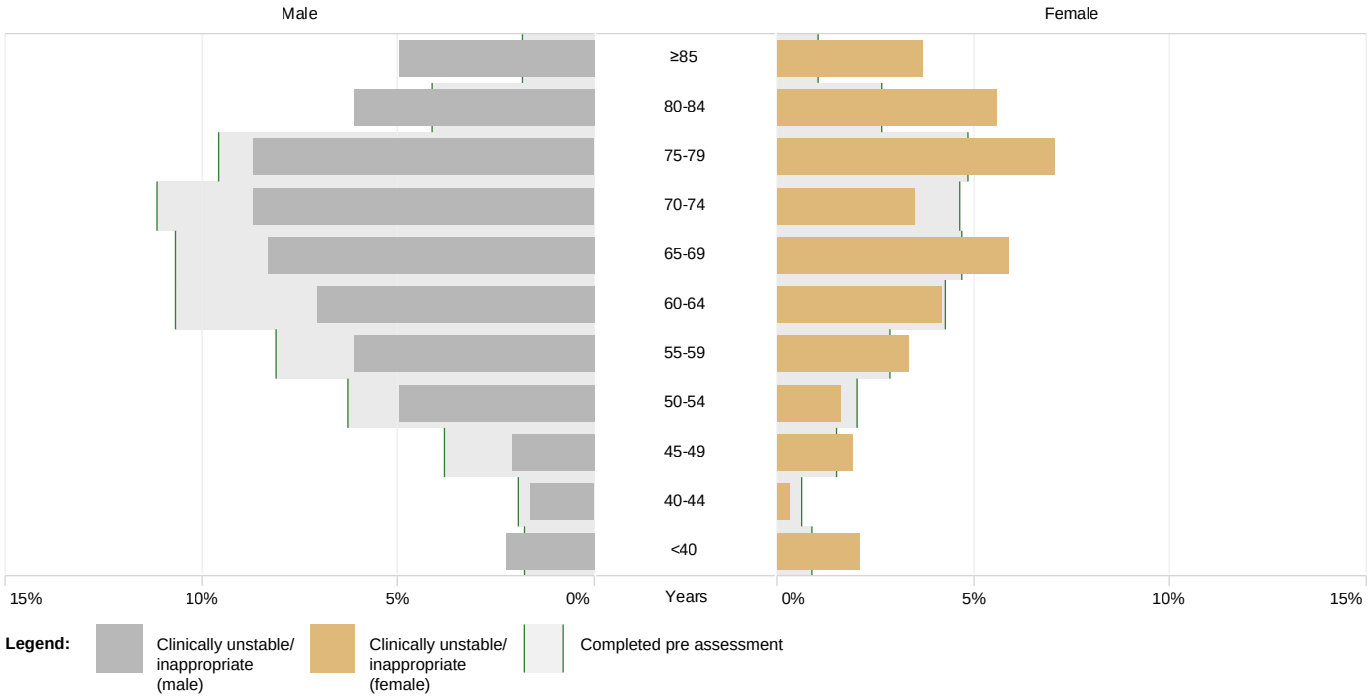


Figure 23: Patient age group and gender, clinically unstable/inappropriate vs completed pre assessment

Table 28: Patient age (years) by program participation status

Program participation status	Male Median (IQR)	Female Median (IQR)	ALL Median (IQR)
Pre assessment completed	66 (57–74)	67 (59–76)	66 (57–74)
Patient declined	70 (61–77)	72 (62–79)	71 (61–78)
Clinically unstable or inappropriate	68 (59–77)	70 (60–79)	69 (59–78)
Other reason not assessed	65 (56–74)	66 (55–75)	65 (56–74)

Table 29: Patient gender by program participation status

Gender	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
Male	4,914 (65.1)	801 (10.6)	379 (5.0)	1,453 (19.3)
Female	2,127 (63.6)	357 (10.7)	245 (7.3)	613 (18.3)
ALL	**7,041 (64.7)**	**1,158 (10.6)**	**624 (5.7)**	**2,066 (19.0)**

7.4.2 Diagnosis category

Of the patients who declined, 47% had a diagnosis of ischaemic heart disease and 5% had valvular disease while the remainder had another diagnosis. By comparison, patients who had completed an initial assessment via CR were more likely to have a diagnosis of ischaemic heart disease or valvular heart disease (63% and 10% respectively).

Patients without IHD or valvular disease were least likely to commence a CR program, with 15% of these referrals declined by the patient and 9% declined by the service as they were not appropriate for cardiac rehabilitation.

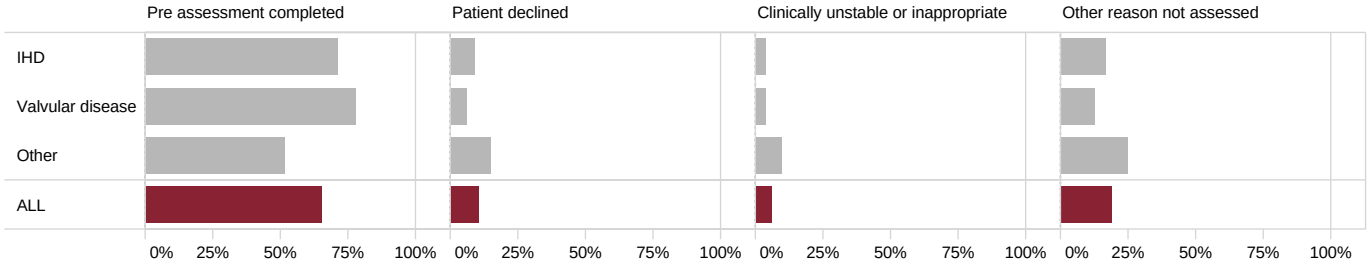


Figure 24: Proportion of cases by diagnosis category and program participation status

Table 30: Diagnosis category by program participation status

Diagnosis category	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
IHD	4,420 (70.8)	550 (8.8)	240 (3.8)	1,037 (16.6)
Valvular disease	733 (77.4)	60 (6.3)	35 (3.7)	119 (12.6)
Other	1,888 (51.1)	548 (14.8)	349 (9.4)	910 (24.6)
ALL	**7,041 (64.7)**	**1,158 (10.6)**	**624 (5.7)**	**2,066 (19.0)**

7.4.3 Most recent procedure

For the cohort that proceeded to assessment, their most recent procedure was closely related to their participation status. 74% of patients who had a PCI procedure and 81% of patients who underwent CABG completed a pre assessment. This suggests that patients who have undergone an invasive cardiac procedure are more likely to have participated in a CR program.

Approximately two-fifths (41%) of patients who declined CR had no recent procedure specified. Furthermore, 29% of patients that elected not to participate in CR were recorded as having undergone PCI, while approximately 6% had undergone CABG.

Care should be taken when interpreting these findings as this data element is not always completed at the time of referral. Therefore, it may not fully reflect the patient's medical history.

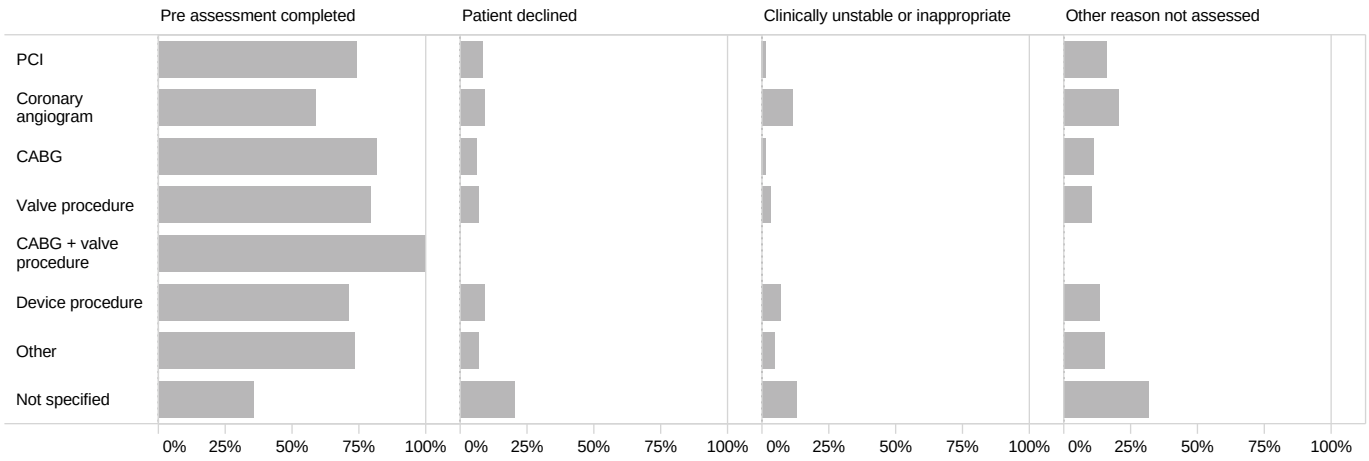


Figure 25: Proportion of referrals by most recent procedure and program participation status

Table 31: Most recent procedure by program participation status

Most recent procedure	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
PCI	2,942 (74.0)	339 (8.5)	64 (1.6)	631 (15.9)
Coronary angiogram	952 (58.9)	151 (9.3)	184 (11.4)	330 (20.4)
CABG	1,108 (81.2)	82 (6.0)	18 (1.3)	157 (11.5)
Valve procedure	776 (79.4)	63 (6.4)	32 (3.3)	106 (10.8)
CABG + valve procedure	1 (100.0)	–	–	–
Device procedure	130 (70.7)	16 (8.7)	13 (7.1)	25 (13.6)
Other	304 (73.6)	29 (7.0)	19 (4.6)	61 (14.8)
Not specified	828 (35.1)	478 (20.3)	294 (12.5)	756 (32.1)
ALL	**7,041 (64.7)**	**1,158 (10.6)**	**624 (5.7)**	**2,066 (19.0)**

7.4.4 Place of residence

There was some variation in patient participation in CR based on place of residence, with higher proportions of patients who did not attend CR residing in regional and remote areas of Queensland.

While there are many reasons a patient may not participate in CR, this trend toward lower participation rates for patients in regional areas should be noted for service planning and model of care selection. These figures should be interpreted with caution due to the small numbers residing in the remote areas.

Table 32: Remoteness classification by program participation status

Remoteness area*	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
Major cities	3,660 (67.9)	587 (10.9)	223 (4.1)	923 (17.1)
Inner regional	1,979 (65.7)	350 (11.6)	139 (4.6)	546 (18.1)
Outer regional	1,121 (57.8)	172 (8.9)	207 (10.7)	438 (22.6)
Remote	89 (49.4)	21 (11.7)	22 (12.2)	48 (26.7)
Very remote	177 (58.4)	24 (7.9)	27 (8.9)	75 (24.8)
ALL	**7,026 (64.9)**	**1,154 (10.7)**	**618 (5.7)**	**2,030 (18.7)**

Excludes missing data (0.6%)

* Classified by Australian Statistical Geography Standard remoteness area

7.4.5 Indigenous status

Considerable variation in program participation was observed for Aboriginal and Torres Strait Islander patients when compared to patients of other descent. Half (50%) of Aboriginal and Torres Strait Islander patients participated in the initial CR pre assessment, compared to 66% of other patients.

This finding should be noted and considered as a potential focus for future service improvement activities.

Table 33: Program participation by Indigenous status

Indigenous status	Pre assessment completed n (%)	Patient declined n (%)	Clinically unstable or inappropriate n (%)	Other reason not assessed n (%)
Indigenous	400 (50.3)	57 (7.2)	82 (10.3)	256 (32.2)
Non-Indigenous	6,424 (65.6)	1,066 (10.9)	529 (5.4)	1,774 (18.1)
ALL	**6,824 (64.5)**	**1,123 (10.6)**	**611 (5.8)**	**2,030 (19.2)**

Excludes missing data (2.8%)

8 Clinical indicators

The CR clinical indicator program has been focused towards the timely provision of CR to admitted patients discharged from public hospitals. This requires collaboration between the acute and outpatient services, with each having their own targets (clinical indicators 1 and 2a respectively).

Overall system performance is measured through clinical indicator 3, which requires the acute and outpatient services to both meet their respective targets. For the purpose of this indicator any referrals crossing between HHSs are counted under both the referring and receiving HHS/organisation.

For the 2023 reporting period and onwards, clinical indicators 2 and 3 were amended to ensure that CR programs receiving untimely referrals (more than three days post discharge) were not penalised in cases where they were nonetheless able to complete their pre assessment within 28 days. Further changes to the indicator criteria were made to ensure that all patients with an unplanned hospital readmission within 28 days of discharge are automatically excluded from the calculation. These changes have been implemented to ensure a consistent approach to measuring performance across services.

Table 34: Cardiac rehabilitation clinical indicators

#	Clinical indicator	Description
1	Timely referral – inpatients	Documented referral to CR within three days of discharge
2a	Timely assessment – inpatients	Initial CR pre assessment completed within 28 days of discharge
2b	Timely assessment – non acute patients	Initial CR pre assessment completed within 28 days of referral date
3	Timely journey – inpatients	Composite of timely referral and assessment

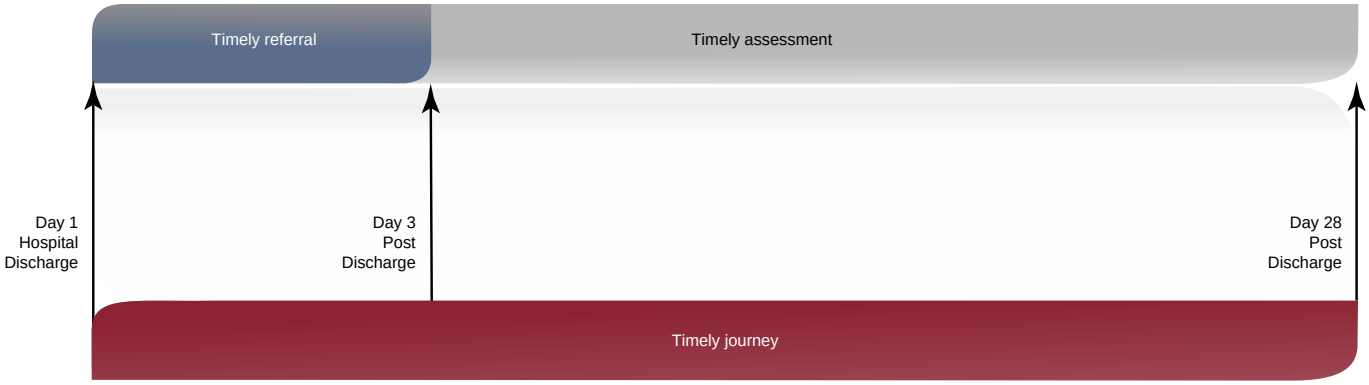


Figure 26: Timely referral, assessment and overall journey for inpatient referrals

8.1 Timely referral

This indicator examines the proportion of inpatient referrals to CR originating from a public hospital which had been provided to the CR program in a timely manner (within 3 days of referral). This requires the referral to be submitted to the outpatient program within three days of the patient being discharged from hospital.

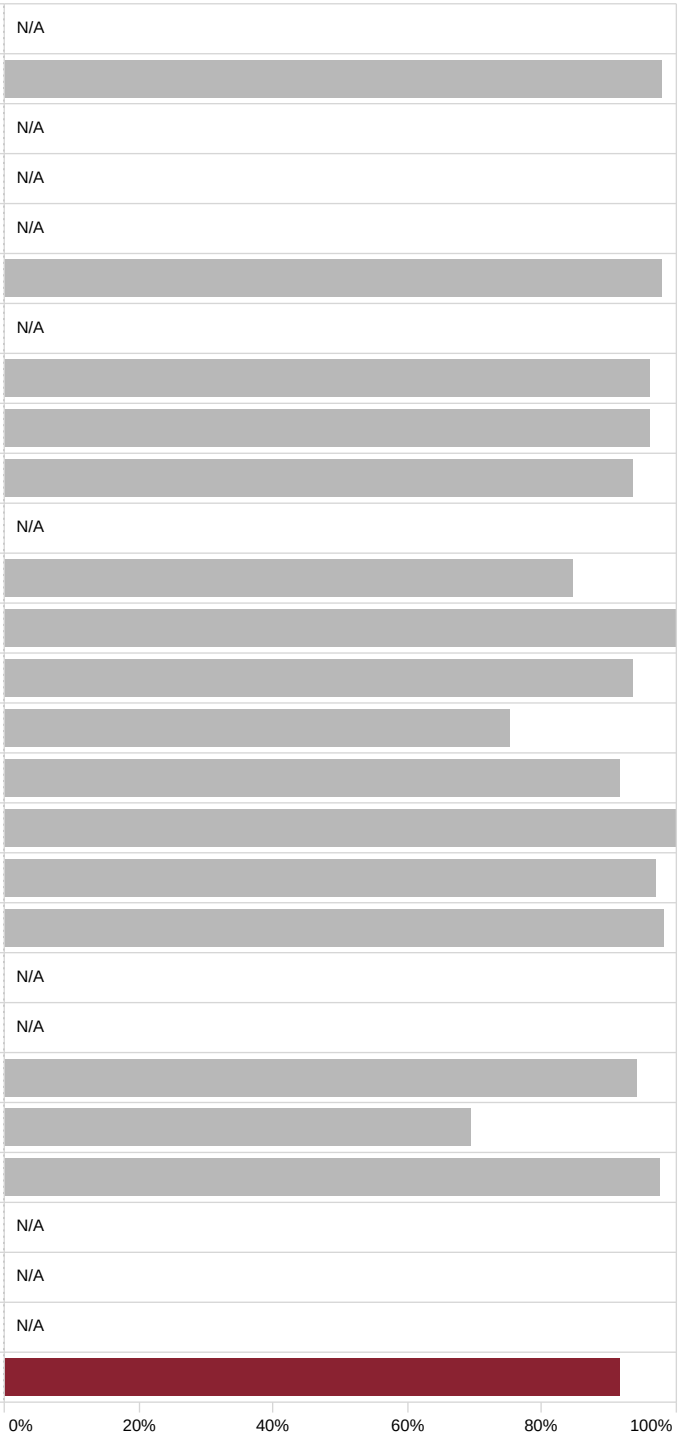
Overall, performance is high with 92% of referrals contributed to QCOR being submitted within three days of discharge.

Table 35: Timely referrals by referring HHS

Referring HHS/organisation	Total inpatient referrals n	Total eligible for analysis n	Target met n (%)
Cairns and Hinterland	471	466	456 (97.9)
Central Queensland	194	177	173 (97.7)
Darling Downs	77	75	72 (96.0)
Gold Coast	730	727	698 (96.0)
Mackay	141	141	132 (93.6)
Mater Health Services	91	91	77 (84.6)
Metro North	1,958	1,928	1,699 (88.1)
Metro South	1,681	1,655	1,603 (96.9)
South West	1	1	N/A
Sunshine Coast	538	503	473 (94.0)
Townsville	540	530	368 (69.4)
West Moreton	317	293	286 (97.6)
Wide Bay	10	10	N/A
Statewide	**6,749**	**6,597**	**6,045 (91.6)**

N/A Not displayed due to <20 referrals eligible for analysis

Referred by HHS	Referred by hospital	Total analysed, n
Cairns and Hinterland	Atherton Hospital	1
	Cairns Hospital	463
	Innisfail Hospital	2
Central Queensland	Capricorn Coast Hospital	1
	Gladstone Hospital	1
	Rockhampton Hospital	175
Darling Downs	Oakey Hospital	1
	Toowoomba Hospital	74
Gold Coast	Gold Cost University Hospital	727
Mackay	Mackay Base Hospital	140
	Proserpine Hospital	1
Mater Health Services	Mater Hospital Brisbane	91
Metro North	Caboolture Hospital	37
	Redcliffe Hospital	46
	Royal Brisbane & Women's Hospital	444
	The Prince Charles Hospital	1,401
Metro South	Logan Hospital	55
	Princess Alexandra Hospital	1,538
	Queen Elizabeth II Jubilee Hospital	57
	Redland Hospital	5
South West	Roma Hospital	1
Sunshine Coast	Sunshine Coast University Hospital	503
Townsville	Townsville University Hospital	530
West Moreton	Ipswich Hospital	293
Wide Bay	Bundaberg Base Hospital	3
	Hervey Bay Hospital	6
	Maryborough Hospital	1
Statewide		



N/A Not displayed due to <20 referrals eligible for analysis

Figure 27: Timely referrals by referring hospital

8.2 Timely assessment – inpatients

This indicator examines the proportion of referrals to CR which proceed to an assessment within 28 days of discharge. Referrals which are not eligible for this indicator are outlined in Table 36. The exclusions are applied where information is available and has been documented in the application.

Overall, approximately two thirds of patients (67%) are being assessed in a timely manner, however there was some variation across health services.

Table 36: Summary of referrals ineligible for timely assessment clinical indicator – inpatients

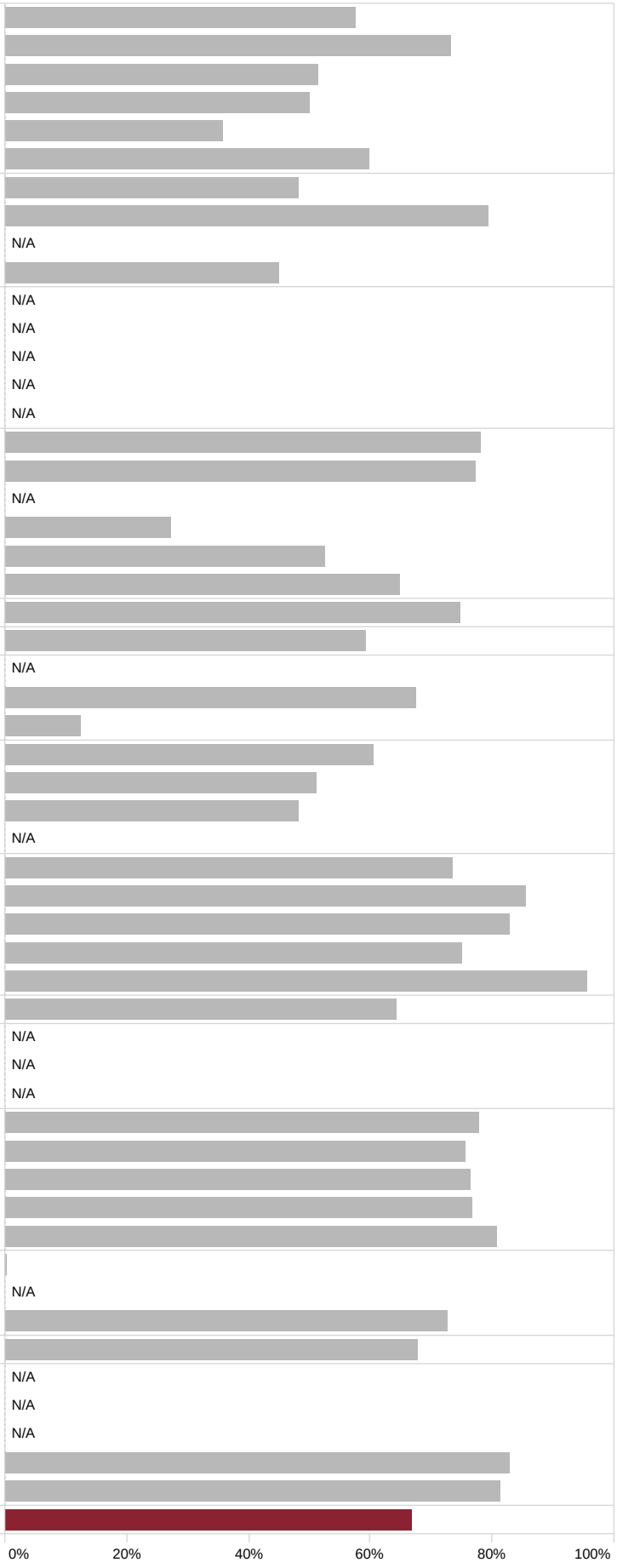
Summary	n
Patient readmitted to hospital	402
Same day admission	152
Clinically unstable/inappropriate	78
Referred outside of Queensland Health	35
Patient accepted onto existing program	34
Patient deceased	17
Total ineligible	**718**

Table 37: Timely assessment indicator by outpatient HHS – inpatients

Outpatient HHS/division	Total inpatient referrals n	Total eligible for analysis n	Target met n (%)
Cairns and Hinterland	550	488	320 (65.6)
Central Queensland	432	354	188 (53.1)
Central West	7	7	N/A
Darling Downs	358	311	165 (53.1)
Gold Coast	739	691	517 (74.8)
Health Contact Centre	875	779	461 (59.2)
Mackay	184	173	97 (56.1)
Metro North	847	744	393 (52.8)
Metro South	1,091	1,012	816 (80.6)
North West	30	28	18 (64.3)
South West	34	33	23 (69.7)
Sunshine Coast	629	549	425 (77.4)
Townsville	297	274	172 (62.8)
West Moreton	482	420	285 (67.9)
Wide Bay	194	168	139 (82.7)
Statewide	**6,749**	**6,031**	**4,024 (66.7)**

N/A Not displayed due to <20 referrals eligible for analysis

Outpatient HHS/division	Outpatient program	Total analysed, n
Cairns and Hinterland	Atherton	65
	Cairns	348
	Innisfail	43
	Mareeba	38
	Mossman	28
	Tully	24
Central Queensland	Capricorn Coast	67
	Gladstone	85
	Mount Morgan	11
	Rockhampton	248
Central West	Barcaldine	1
	Blackall	2
	Longreach	2
	Tambo	1
	Winton	1
Darling Downs	Chinchilla-Miles	24
	Dalby-Tara	29
	Goondiwindi	5
	Kingaroy	74
	Toowoomba	154
	Warwick	66
Gold Coast	Gold Coast	736
Health Contact Centre	SMoCC	862
Mackay	Bowen	3
	Mackay	146
	Proserpine	35
Metro North	Caboolture	232
	Chermside	284
	North Lakes	304
	Redcliffe	12
Metro South	Bayside	215
	Eight Mile Plains	149
	Inala	89
	Logan-Beaudesert	432
	Princess Alexandra Hospital	188
North West	Mt Isa	30
South West	Charleville	6
	Roma	18
	St George	10
Sunshine Coast	Caloundra	165
	Gympie	122
	Maroochydore	115
	Nambour	98
	Noosa	95
Townsville	Ayr	39
	Ingham	8
	Townsville	239
West Moreton	Ipswich	458
Wide Bay	Biggenden	1
	Eidsvold	1
	Gayndah	3
	Hervey Bay	130
	Maryborough	56
Statewide		



N/A Not displayed due to <20 referrals eligible for analysis

Figure 28: Timely assessment by outpatient program – inpatients

8.3 Timely assessment – non acute patients

This indicator examines the proportion of referrals from the non acute setting which proceed to an assessment within 28 days of referral. The majority of non acute patients (63%) are being assessed in a timely manner, with some notable variation between health services.

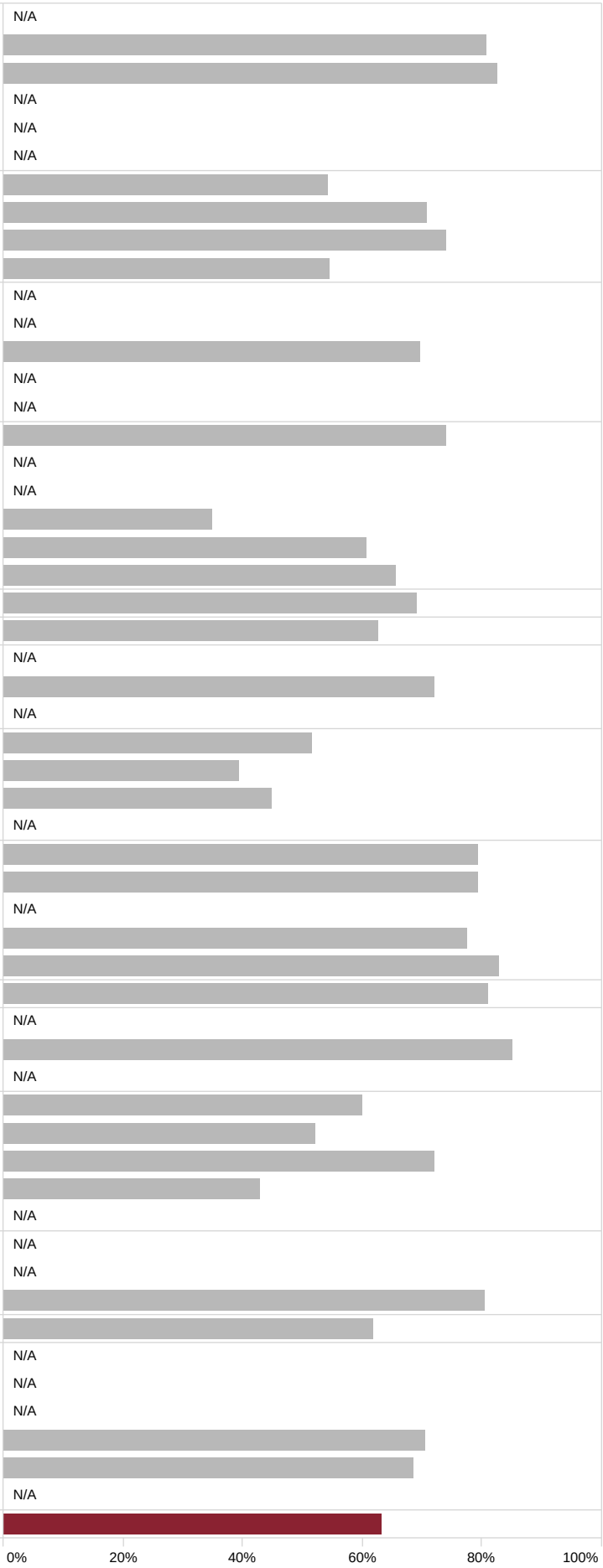
Table 38: Summary of referrals ineligible for timely assessment clinical indicator – non acute patients

Summary	n
Clinically unstable/inappropriate	27
Patient accepted onto an existing program	22
Referred outside of Queensland Health	19
Patient readmitted to hospital	12
Patient deceased	5
Total ineligible	**85**

Table 39: Timely assessment indicator by outpatient HHS – non acute patients

Outpatient HHS/division	Total non acute referrals n	Total eligible for analysis n	Target met n (%)
Cairns and Hinterland	130	126	101 (80.2)
Central Queensland	474	455	269 (59.1)
Central West	63	57	41 (71.9)
Darling Downs	193	185	108 (58.4)
Gold Coast	238	230	159 (69.1)
Health Contact Centre	233	225	141 (62.7)
Mackay	102	99	64 (64.6)
Metro North	552	543	246 (45.3)
Metro South	378	370	296 (80.0)
North West	21	21	17 (81.0)
South West	31	30	24 (80.0)
Sunshine Coast	139	131	78 (59.5)
Townsville	152	151	103 (68.2)
West Moreton	175	175	108 (61.7)
Wide Bay	143	141	104 (73.8)
Statewide	**3,024**	**2,939**	**1,859 (63.3)**

Outpatient HHS/division	Outpatient program	Total analysed, n
Cairns and Hinterland	Atherton	12
	Cairns	62
	Innisfail	23
	Mareeba	13
	Mossman	9
	Tully	7
Central Queensland	Capricorn Coast	103
	Gladstone	96
	Mount Morgan	27
	Rockhampton	229
Central West	Barcaldine	1
	Blackall	7
	Longreach	46
	Muttaburra	1
	Winton	2
Darling Downs	Chinchilla-Miles	23
	Dalby-Tara	14
	Goondiwindi	2
	Kingaroy	40
	Toowoomba	71
	Warwick	35
Gold Coast	Gold Coast	230
Health Contact Centre	SMoCC	225
Mackay	Bowen	1
	Mackay	86
	Proserpine	12
Metro North	Caboolture	128
	Chermside	99
	North Lakes	312
	Redcliffe	4
Metro South	Bayside	125
	Eight Mile Plains	58
	Inala	18
	Logan-Beaudesert	134
	Princess Alexandra Hospital	35
North West	Mt Isa	21
South West	Charleville	5
	Roma	20
	St George	5
Sunshine Coast	Caloundra	45
	Gympie	23
	Maroochydore	32
	Nambour	21
	Noosa	10
Townsville	Ayr	12
	Ingham	11
	Townsville	128
West Moreton	Ipswich	175
Wide Bay	Biggenden	9
	Eidsvold	6
	Gayndah	14
	Hervey Bay	51
	Maryborough	51
	Mundubbera	10
Statewide		



N/A Not displayed due to <20 referrals eligible for analysis

Figure 29: Timely assessment by outpatient program – non acute patients

8.4 Timely journey

This patient-centric measure of overall system performance requires strong coordination and links between the referring acute and outpatient CR sites. It measures the proportion of eligible inpatient referrals which have a pre assessment by CR completed within 28 days of discharge.

Referrals are excluded from the analysis for the reasons outlined in Table 40. The exclusions are applied where information is available and has been documented in the application.

It is important to note that for the purpose of this indicator, any referral which crosses between HHSs is counted for both participating services.

Table 40: Summary of referrals ineligible for timely journey clinical indicator – inpatients

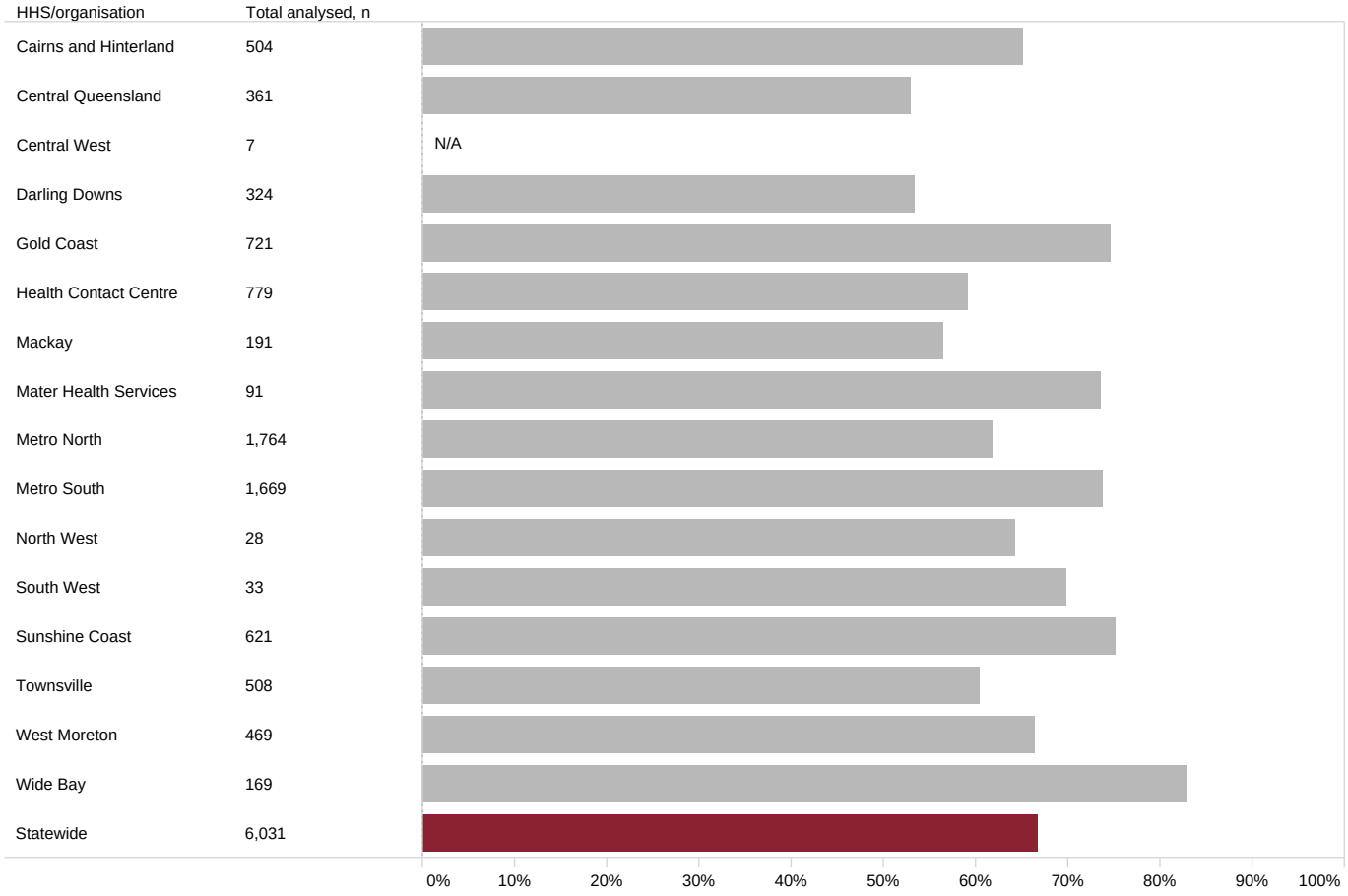
Summary	n
Patient readmitted to hospital	402
Same day admission	152
Clinically unstable/inappropriate	78
Referred outside of Queensland Health	35
Patient accepted onto existing program	34
Patient deceased	17
Total ineligible	**718**

Table 41: Timely journey indicator by participating HHS – inpatients

Participating HHS/ organisation	Total inpatient referrals* n	Total eligible for analysis* n	Target met n (%)
Cairns and Hinterland	576	504	328 (65.1)
Central Queensland	440	361	191 (52.9)
Central West	7	7	N/A
Darling Downs	373	324	173 (53.4)
Gold Coast	771	721	539 (74.8)
Health Contact Centre	875	779	461 (59.2)
Mackay	205	191	108 (56.5)
Mater Health Services	91	91	67 (73.6)
Metro North	1,994	1,764	1,090 (61.8)
Metro South	1,844	1,669	1,230 (73.7)
North West	30	28	18 (64.3)
South West	34	33	23 (69.7)
Sunshine Coast	706	621	466 (75.0)
Townsville	546	508	307 (60.4)
West Moreton	538	469	312 (66.5)
Wide Bay	195	169	140 (82.8)
Statewide	**6,749**	**6,031**	**4,024 (66.7)**

N/A Not displayed due to <20 referrals eligible for analysis

* Includes both incoming and outgoing referrals



N/A Not displayed due to <20 referrals eligible for analysis

Figure 30: Timely journey indicator by participating HHS – inpatients

9 Supplement: Cardiac rehabilitation model of care

9.1 Introduction

CR is a cornerstone of secondary prevention for individuals recovering from acute cardiac events or managing chronic cardiovascular conditions.

Globally, CR programs vary significantly in structure, delivery models, and accessibility. Traditional centre-based programs remain the most common, particularly in high-income countries, offering supervised exercise, education, and psychosocial support. However, alternative models which include home-based, community-based, and electronic programs, have emerged to address barriers such as geographic distance, cost, and workforce limitations.[50]

A global survey revealed that CR is available in 55% of countries. Among these, 77% offer supervised programs. Home-based CR is accessible in 34% of countries, though typically underutilised, with a median of just 3 sessions. Community-based CR is available in 23% of countries, offering a median of 20 sessions. Additionally, 64% of programs incorporate electronic CR, highlighting the growing adoption of digital health solutions.[50] An Australian survey identified that 81% CR programs were delivered from an outpatient setting, with limited home or alternate community settings used. Additionally, few sites used technology or novel delivery methods, and only for delivery of support or education.[51]

Notwithstanding these innovations, capacity remains a challenge, especially in low- and middle-income countries, where CR programs often lack sufficient funding and staffing. In these countries, patients frequently bear the cost of CR, unlike in high-income countries where government funding is more common.[52] Despite government funding, CR program dosage is variable across countries with European and American countries often providing double the quantity Australian programs provide, possibly described by differences in funding and healthcare models.[51] Recommendations also differ between program length.

Peak bodies, including the International Council of Cardiovascular Prevention and Rehabilitation and the Australian Cardiovascular Rehabilitation Association have established core standards and components to guide the delivery of CR.[53] These standards typically encompass comprehensive patient assessment and risk stratification, structured exercise training, nutritional counselling, psychosocial support, medical risk factor management, and strategies aimed at promoting long-term behaviour change. Together, these elements form the foundation of effective CR programs, ensuring holistic care and improved cardiovascular outcomes.[54]

In Queensland, the delivery of CR services is guided by the standardised *Queensland Health Cardiac Rehabilitation Services: Model of Care Document*.[55] This guideline ensures consistency, equity, and evidence-based practice across the state's public health system. All recognised CR programs contribute data to QCOR, enabling comprehensive monitoring of service performance, patient outcomes, and adherence to clinical standards. This report outlines the current models of care for CR in Queensland, drawing on QCOR findings to highlight service delivery trends, variations of models in use and potential opportunities for improvement.

9.2 Queensland Health models of care

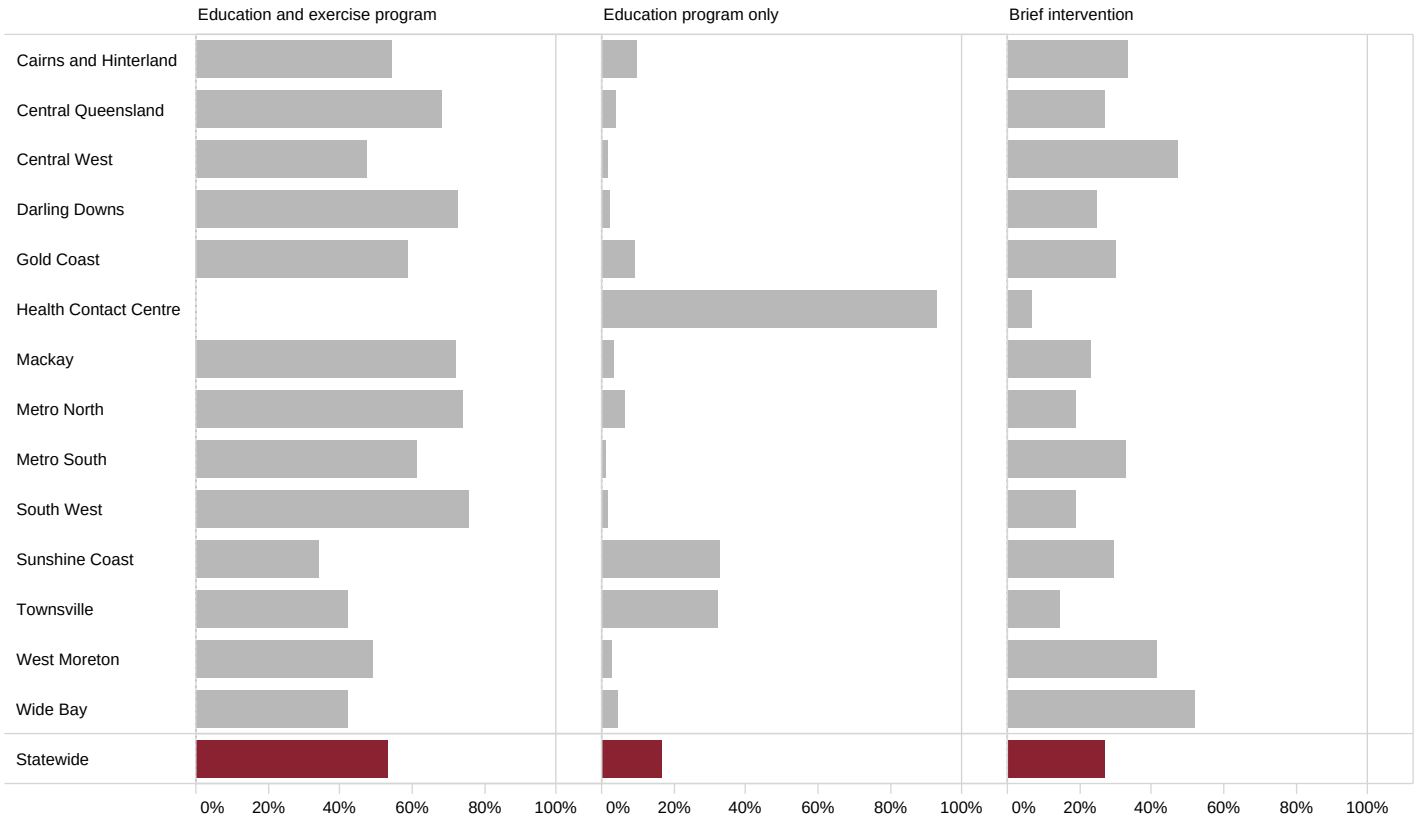
Complete model of care data were available for 97% of the 7,041 patients who completed a CR pre assessment in 2024 (Table 42). Over half (55%) of all patients were enrolled into a model of care that included an education and exercise component, while 17% participated in a structured education program with no exercise component. Approximately one quarter (28%) of patients did not participate in a structured education or exercise program and received only a brief intervention at the time of the pre assessment.

The proportion of patients receiving a structured exercise program varied considerably across the state, ranging from 79% to 35% across participating HHSs (excluding the Health Contact Centre, which offers a telephone based program that does not include an exercise component).

Table 42: Statewide CR model of care type

Model of care type	n (%)
Education and exercise program	3,723 (54.5)
Education program only	1,187 (17.4)
Brief intervention	1,918 (28.1)
Total	**6,828 (100.0)**

Excludes missing data (n=213)



Excludes missing data (3.0%)

North West HHS not displayed due to ›40% missing data

Figure 31: CR models of care types by outpatient HHS

The model of care type varied considerably based on patient remoteness classification. Patients located in Metropolitan areas were far more likely to participate in an education and exercise program (58%) compared to patients in remote and very remote areas of Queensland (30% and 29% respectively).

Table 43: CR model of care type by patient remoteness classification

Remoteness classification	Education and exercise program %	Education program only %	Brief intervention %
Major cities	57.6	16.0	26.4
Inner regional	53.3	15.1	31.6
Outer regional	52.7	21.8	25.5
Remote	29.9	40.2	29.9
Very remote	28.7	31.2	40.1
Total	**54.5**	**17.4**	**28.1**

Excludes missing data (3.0%)

9.2.1 Education programs

Education in cardiac rehabilitation is a core component aimed at improving patient knowledge, self-management skills, and confidence in adopting heart-healthy behaviours. Contemporary CR practice emphasises flexible, patient-centred delivery, using a mix of in-person, telehealth, and self-directed options to accommodate diverse needs and preferences. Education may cover topics such as medication adherence, risk factor management, nutrition, and psychosocial wellbeing. Programs can be delivered as standalone interventions or integrated with exercise sessions, ensuring accessibility and continuity of care.

A total of 6,828 patients participated in an education program. The brief intervention model accounted for the largest proportion of activity (41%) and among structured programs, the centre-based model remained the dominant mode (34%), with telerehabilitation (10%) and hybrid programs (10%) contributing smaller volumes. Self-directed education represented only 5%, suggesting limited uptake of unsupported models.

When examining duration and intensity, distinct differences emerged across models of care. Centre-based programs delivered a relatively short and consistent intervention (median 5 weeks, 5 sessions), aligning with traditional supervised schedules. In contrast, telerehabilitation programs were markedly longer (median 18 weeks) but involved fewer sessions, reflecting their extended follow-up model. Hybrid programs sat between these approaches, offering a moderate program length (median 9 weeks) but the highest session counts, indicating increased touchpoints when combining supervised and remote components. Collectively, structured education programs delivered a median of 7 weeks and 5 sessions, demonstrating considerable variability by model.

Program timeliness also differed substantially. Median time from referral to program commencement was shortest for telerehabilitation (13 days), compared with 31–33 days for centre-based and hybrid pathways. Telerehabilitation and hybrid programs also demonstrated immediate initiation following assessment (median 0 days), highlighting streamlined processes or same-day onboarding. Compliance with the recommended ≤35 day referral-to-start timeframe was highest for telerehabilitation (93%), while centre-based and hybrid programs achieved 56% and 58%, respectively. Overall compliance across structured models was 63%, suggesting that workforce capacity, scheduling constraints, and site-level processes may continue to influence timely access to education.

Table 44: Education program mode of delivery descriptors

Mode	Description
Brief intervention	One-off education at assessment, no follow-up—used when Phase II CR is declined.
Centre-based program	In-person education at health/community centre, individually or in groups, over multiple sessions or a single fast-track day.
Telerehabilitation	Real-time education via video or phone call, individually or in groups, with flexible scheduling.
Hybrid program	Combines two or more modes (e.g. centre-based and telerehabilitation), either concurrently or sequentially.
Self directed	Patient accesses clinician-directed resources (e.g. web platform or emailed videos) independently. Does not include *My Heart My Life* program (standard at initial assessment).

Table 45: Education program volume per model of care

Model of care	n (%)
Brief intervention	2,819 (41.3)
Centre-based program	2,336 (34.2)
Telerehabilitation	687 (10.1)
Hybrid program	657 (9.6)
Self directed	329 (4.8)
Total	**6,828 (100.0)**

Table 46: Education program duration and volumes

Model of care	n	Median duration weeks	Mean duration weeks	Median sessions n	Mean sessions n
Centre based program	2,336	5	7	5	5
Telerehabilitation program	687	18	18	4	4
Hybrid program	657	9	9	12	10
Total	**3,680**	**7**	**9**	**5**	**6**

Excludes brief intervention and self directed education

Table 47: Education program commencement timeframe and compliance by model of care

Model of care	n	Median referral to start of education program days	Median assessment to start of education program days	Referral to start of education program ≤35 days %
Centre based program	2,336	33	14	56.0
Telerehabilitation program	687	13	0	93.2
Hybrid program	657	31	0	57.8
Total	**3,680**	**28**	**8**	**63.3**

Excludes brief intervention and self directed education

9.2.2 Exercise programs

If a CR clinician determines that an exercise program is appropriate, a range of delivery modes may be utilised depending on local resources and patient needs. Where relevant, a scheduled commencement date should be documented. In some instances, Queensland Health programs may refer patients to external exercise providers. These referrals, along with relevant details, can be recorded during the exercise triage process but are otherwise outside of scope of reporting.

Table 48: Exercise program mode of delivery descriptors

Mode	Description
Brief intervention	A single interaction providing advice on physical activity and reducing sedentary behaviour, with no follow-up. Used when patient already meets activity guidelines.
Centre-based program	Structured exercise delivered in-person at a health or community centre, individually or in groups, with clinician present.
Telerehabilitation	Real-time exercise sessions via video call, 1:1 or group, following a structured plan.
Hybrid program	Combines two or more delivery modes, either concurrently (eg centre-based and telerehab) or sequentially (eg. centre-based then home program).
Home program only	Exercise managed at home with clinician support via phone or visits; may be self-directed or guided with regular follow-up.

Of the 6,828 patients, nearly half (49%) engaged in a centre-based exercise program, making it the dominant model of care. A substantial proportion (46%) did not participate in any exercise program, highlighting a significant gap in uptake. Home-based programs accounted for only 4%, while hybrid and telerehabilitation models were rare, representing just 1% and 0.6% of activity respectively. This distribution suggests that exercise delivery remains heavily reliant on traditional centre-based pathways, with minimal adoption of remote or blended approaches.

Among structured exercise programs (n=3,723), the median duration was eight weeks, with a median of six sessions, indicating a relatively consistent intervention length across models. Centre-based programs mirrored this overall pattern (median eight weeks, six sessions), while home-only programs were shorter (median four weeks) but maintained similar session counts. Hybrid and telerehabilitation programs offered comparable durations (eight weeks) but slightly higher session frequencies, particularly hybrid models (median eight sessions), suggesting increased engagement when combining supervised and remote components.

Program commencement timelines varied, with home-only programs achieving the shortest referral-to-start interval (median 26 days) and the highest compliance with the ≤35 day benchmark (70%). Centre-based programs were slower to initiate (median 36 days) and demonstrated lower compliance (49%), while hybrid and telerehabilitation models performed similarly (median 34–36 days, compliance 50–58%). Overall compliance across structured exercise programs was just 51%, indicating persistent challenges in meeting recommended timeframes, likely driven by workforce and scheduling constraints.

Table 49: Exercise program volume per model of care

Model of care	n (%)
Centre based program	3,345 (49.0)
Home program only	272 (4.0)
Hybrid program	66 (1.0)
Telerehabilitation program	40 (0.6)
No exercise program	3,105 (45.5)
Total	**6,828 (100.0)**

Table 50: Exercise program duration and volumes

Model of care	n (%)	Median duration weeks	Mean duration weeks	Median sessions n	Mean sessions n
Centre-based program	3,345 (89.8)	8	8	6	7
Home program only	272 (7.3)	4	5	6	7
Hybrid program	66 (1.8)	8	8	8	11
Telerehabilitation	40 (1.1)	8	8	9	10
Total	**3,723 (100.0)**	**8**	**8**	**6**	**7**

Table 51: Exercise program commencement timeframe and compliance by model of care

Model of care	n	Median referral to start of exercise program days	Median assessment to start of exercise program days	Referral to start of exercise program ≤35 days %
Centre-based program	3,345	36	16	49.1
Home program only	272	26	8	69.9
Hybrid program	66	34	14	57.6
Telerehabilitation	40	36	22	50.0
Total	**3,723**	**35**	**15**	**50.7**

9.2.3 Program completion

To assess whether CR programs are completed as intended, a post-program assessment is encouraged once a patient has finished their program. This assessment helps determine patient outcomes and evaluate the delivery of care. It is typically conducted on the final day of program attendance to maximise participation, though it may occur up to four weeks post-completion.

Before submitting the post-program assessment, CR clinicians must confirm the attended model of care. This step is critical for accurately reporting whether the CR program was delivered as planned. It enables outcome reporting and service performance evaluation across different models of care, supporting quality improvement initiatives.

The proportion of referrals where a post assessment was completed varied considerably based on the model of care type (Table 52). Over three quarters (76%) of patients undergoing a combined education and exercise program completed a post assessment compared to 53% and 9% for patients receiving an education only program or brief intervention respectively.

Table 52: Post assessment completion by model of care type

Model of care type	n	Completing post assessment n (%)	Median time from pre assessment to post assessment days
Education and exercise program	3,723	2846 (76.4)	70
Education program only	1,187	623 (52.5)	126
Brief intervention	1,918	165 (8.6)	62
Total	**6,828**	**3634 (53.2)**	**76**

9.3 Discussion

Queensland's CR service delivery reflects the structured, multi-modal approach outlined in the Queensland Health *Cardiac Rehabilitation Services: Model of Care Document*.[55] Consistent with global trends, centre-based programs remain the dominant mode for both education and exercise, accounting for 34% and 49% of respective program volumes. This mirrors international findings that supervised, facility-based CR is the most common model in high-income countries. Notably, nearly half of patients (46%) did not participate in any exercise program, highlighting a significant gap in CR uptake and a key opportunity for targeted interventions.

However, the data highlights Queensland's adoption of alternative models to improve accessibility. Hybrid programs and home-based exercise represent smaller but notable proportions, while telerehabilitation – though still underutilised—shows promise, particularly for education delivery via video and telephone. This is evident in telerehabilitation programs, which demonstrate the most timely performance, with 93% of patients commencing within 35 days of referral compared to 56% for centre-based education. Similarly, home-based exercise programs achieve faster initiation (median 26 days) and higher compliance (70%) than centre-based exercise (49%).

Program duration and intensity vary significantly across models. Centre-based education typically spans seven weeks with a median of five sessions, while telerehabilitation extends to 18 weeks with four sessions, reflecting its longitudinal support structure. Exercise programs are generally longer, with centre-based delivery averaging eight weeks and six sessions. Hybrid and telerehabilitation models mirror these patterns but offer greater flexibility for patients unable to attend in person. Exercise programs generally span eight weeks across all models, but session frequency varies, with hybrid and telerehabilitation offering more interactions compared to centre-based delivery.

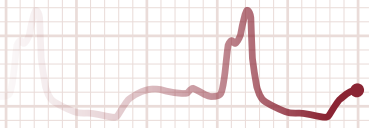
Despite recent innovations, challenges in achieving timely access persist. Across all models, only 63% of education programs and 51% of exercise programs commence within 35 days of referral. These delays likely reflect structural constraints such as workforce capacity, facility limitations, and scheduling practices (e.g. block versus rolling intake). Addressing these barriers is critical given international standards emphasising early CR initiation to optimise outcomes.

Key opportunities for improvement include:

- Expanding telehealth and hybrid programs to address geographic inequities and improve access for rural and remote communities.
- Streamlining referral and assessment processes to align with international standards for early CR initiation.
- Enhancing capacity through digital health solutions to mitigate workforce shortages and support service delivery across Queensland's large catchment areas.

By prioritising these strategies, Queensland Health can strengthen CR service delivery, ensuring consistent, evidence-based care and improved cardiovascular outcomes across a geographically diverse state.

Heart Failure Support Services Audit



1 Key findings

Key findings include:

- 7,442 new referrals were made to 21 participating Heart Failure Support Services (HFSS) in 2024, with 59% of referrals originating from the acute setting.
- 67% of referred patients were male, and 85% had heart failure with reduced ejection fraction (HFrEF).
- Aboriginal and Torres Strait Islander patients represented 5.9% of referrals and had a median age which was 13 years younger than non-Indigenous patients (56 vs 69 years).
- Male patients presented younger than females (67 vs 71 years), while patients with HFrEF were younger than patients with a heart failure with preserved ejection fraction (HFpEF) (67 vs 76 years).
- One third of patients (33%) were aged 75 years or older, highlighting the significant burden of heart failure in older populations.
- 76% of acute patients were followed up within 2 weeks of referral to HFSS.
- 84% of non acute patients received follow-up within 4 weeks, meeting the benchmark.
- 98% of patients had an assessment of left ventricular ejection fraction within 2 years of referral, exceeding the benchmark.
- 91% of patients with HFrEF were prescribed ACEI, ARB or ARNI at the time of first clinical review, meeting the benchmark.
- 91% of patients with HFrEF were prescribed a beta blocker at the time of first clinical review, meeting the benchmark.
- 65% of patients with HFrEF were prescribed a mineralocorticoid receptor antagonist (MRA) at the time of first HFSS clinical review. This is below the benchmark but showing year-on-year improvement (43% in 2019).
- 67% of patients with HFrEF were prescribed an SGLT2 inhibitor at their first HFSS clinical review, a significant increase from previous years (40% in 2022 and 58% in 2023).
- 67% of patients had their beta blocker titration status reviewed at six months post-referral.
- 25% of patients achieved guideline-recommended beta blocker target dosages, which is below the 50% benchmark.
- 78% of patients achieved either the guideline-recommended target dose or their maximum tolerated dose of beta blocker.
- 50% of patients with HFpEF were prescribed an SGLT2 inhibitor at their first HFSS clinical review, compared to 30% in 2023 and 13% in 2022.
- Patient outcomes following hospital referral showed 10.7% mortality at 12 months, and 50% experienced death or rehospitalisation within a year.
- Among 3,721 eligible patients, 106,943 days were lost due to death or hospitalisation over 12 months, with a median of 365 days alive and out of hospital (IQR: 356–365). Over half of patients survived the full year out of hospital, while one quarter of patients spent nine or more days in hospital or passed away during the year.

2 Participating sites

Heart Failure Support Services (HFSS) consists of teams of specialised nurses, with medical support and allied health professionals. There are 21 services which contributed data to this year's Annual Report and the locations and services offered are shown in Figure 1 and Table 2 respectively.

Table 1: Queensland Heart Failure Support Services (HFSS) facilities and acronyms

Hospital and Health Service (HHS)	HFSS Facility	Acronym
Cairns and Hinterland	Cairns Hospital	CH
Central Queensland	Gladstone Hospital*	GLH
	Rockhampton Hospital	RKH
Darling Downs	Toowoomba Hospital	TWH
Gold Coast	Gold Coast Community Health	GCCH
Mackay	Mackay Base Hospital	MKH
Metro North	Caboolture Hospital	CBH
	Redcliffe Hospital	RDH
	Royal Brisbane & Women's Hospital	RBWH
	The Prince Charles Hospital	TPCH
Metro South	Logan Hospital	LGH
	Princess Alexandra Hospital	PAH
	Queen Elizabeth II Hospital	QEII
	Redland Hospital	RLH
North West	Mt Isa Hospital	MIH
South West	Roma Hospital	RMH
Sunshine Coast	Gympie Hospital	GYH
	Sunshine Coast University Hospital	SCUH
Townsville	Townsville Hospital	TTH
West Moreton	Ipswich Community Health	IPCH
Wide Bay	Bundaberg Hospital	BNH
	Hervey Bay Hospital (includes Maryborough)	HBH

* Did not contribute data to 2024 Audit

Figure 1: Heart Failure Support Service (HFSS) locations

Table 2: Components of Queensland Heart Failure Support Services (HFSS)

		HFSS disciplines				Modes of service				
HHS	**Facility**	**Nurse**	**NP***	**Pharm†**	**Physio or AEP‡**	**Inpatient**	**Nurse or MD clinics**	**Home visits**	**Group rehab**	**Medical mentor§**
Cairns and Hinterland	CH	✓	✓	–	✓	✓	✓	✓	✓	✓
Central Queensland	GLH	✓	✓VC	–	✓	–	–	–	✓	–
	RKH	✓	✓	–	✓	✓	✓	–	✓	✓
Darling Downs	TWH	✓	–	–	R	✓	✓	✓	✓	✓
Gold Coast	GCCH	✓	–	✓	✓	✓	✓	✓	✓	✓
Mackay	MKH	✓	–	–	✓	✓	✓	–	✓	✓
Metro North	CBH	✓	–	✓	–	–	✓	–	–	✓
	RDH	✓	✓	–	–	✓	✓	✓	–	✓
	RBWH	✓	–	✓	✓	✓	✓	–	✓	✓
	TPCH	✓	✓	✓	✓	✓	✓	–	✓	✓
Metro South	LGH	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PAH	✓	✓	✓	✓	✓	✓	✓	✓	✓
	QEII	✓	✓	✓	R	✓	✓	✓	–	✓
	RLH	✓	✓	–	✓	✓	✓	✓	✓	✓
North West	MIH	✓	–	✓	R	✓	✓	✓	–	Outreach
South West	RMH	✓	–	–	✓	✓	✓	✓	✓	Video clinic
Sunshine Coast	GYH	✓	✓VC	–	–	✓	✓	✓	–	✓
	SCUH	✓	✓	–	R	✓	✓	✓	–	✓
Townsville	TTH	✓	✓	✓	R	✓	✓	✓	–	✓
West Moreton	IPCH	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wide Bay	BNH	✓	✓	–	R	✓	✓	✓	–	✓
	HBH	✓	✓	–	✓	✓	✓	✓	✓	Video clinic

* Nurse practitioner who can prescribe medications

† Pharmacist

‡ Physiotherapist or accredited exercise physiologist

§ The HFSS has a cardiologist or general physician mentor

R Referral for exercise that is routinely accepted by another program such as cardiac or pulmonary rehabilitation

VC Videoconference service is provided by an NP elsewhere in the HHS

3 New referrals

There were 7,442 new referrals reported by the 21 participating HFSS, with Metropolitan sites comprising 54% of all referrals. Nine year trends in referral to HFSS can be seen in the figure below. Between 2016 and 2024 referral volumes increased by 85%.

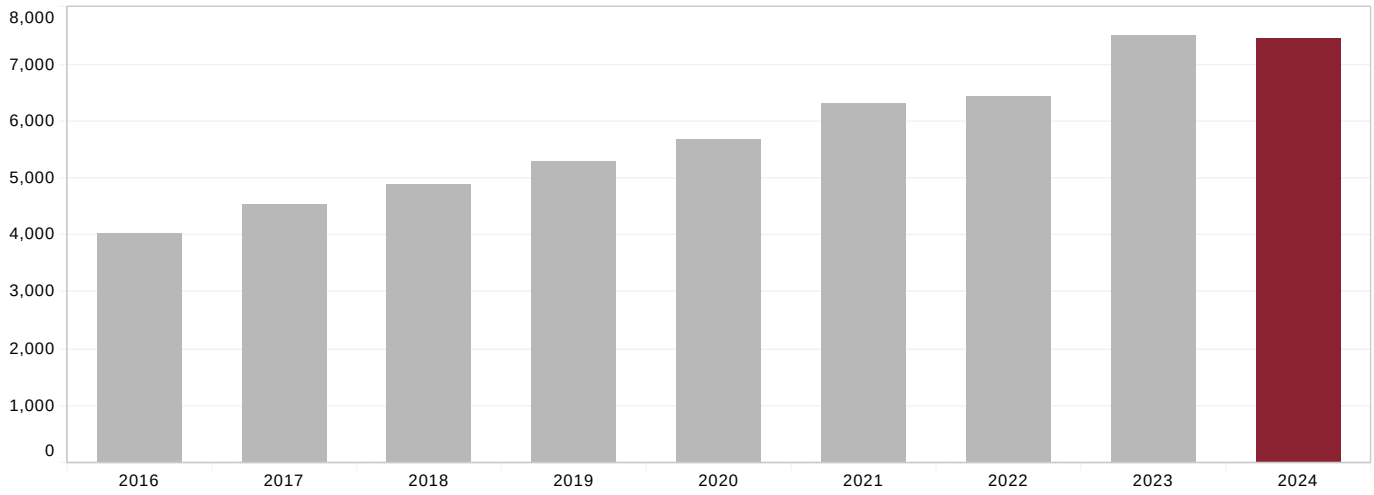


Figure 2: Total yearly HF referrals, 2016–2024

Table 3: Yearly HF referral volume, 2016–2024

	2016 n	2017 n	2018 n	2019 n	2020 n	2021 n	2022 n	2023 n	2024 n
Yearly referrals	4,021	4,528	4,878	5,304	5,664	6,326	6,438	7,514	7,442

3.1 Location of referrals

Table 4: Distribution of new referrals by HFSS location

HHS	n (%)	HFSS	n (%)
Cairns and Hinterland	268 (3.6)	Cairns Hospital	268 (3.6)
Central Queensland	333 (4.5)	Rockhampton Hospital	333 (4.5)
Darling Downs	194 (2.6)	Toowoomba Hospital	194 (2.6)
Gold Coast	488 (6.6)	Gold Coast Community Health	488 (6.6)
Mackay	184 (2.5)	Mackay Base Hospital	184 (2.5)
Metro North	2,045 (27.5)	Caboolture Hospital	367 (4.9)
		Redcliffe Hospital	349 (4.7)
		Royal Brisbane & Women's Hospital	411 (5.5)
		The Prince Charles Hospital HFS	918 (12.3)
Metro South	1,945 (26.1)	Logan Hospital	702 (9.4)
		Princess Alexandra Hospital	659 (8.9)
		Queen Elizabeth II Hospital	348 (4.7)
		Redland Hospital	236 (3.2)
North West	115 (1.5)	Mt Isa Hospital	115 (1.5)
South West	3 (<0.1)	Roma Hospital	3 (<0.1)
Sunshine Coast	630 (8.5)	Gympie Hospital	144 (1.9)
		Sunshine Coast University Hospital	486 (6.5)
Townsville	315 (4.2)	Townsville Hospital	315 (4.2)
West Moreton	400 (5.4)	Ipswich Community Health	400 (5.4)
Wide Bay	522 (7.0)	Bundaberg Hospital	291 (3.9)
		Hervey Bay Hospital	231 (3.1)
Statewide			**7,442 (100.0)**

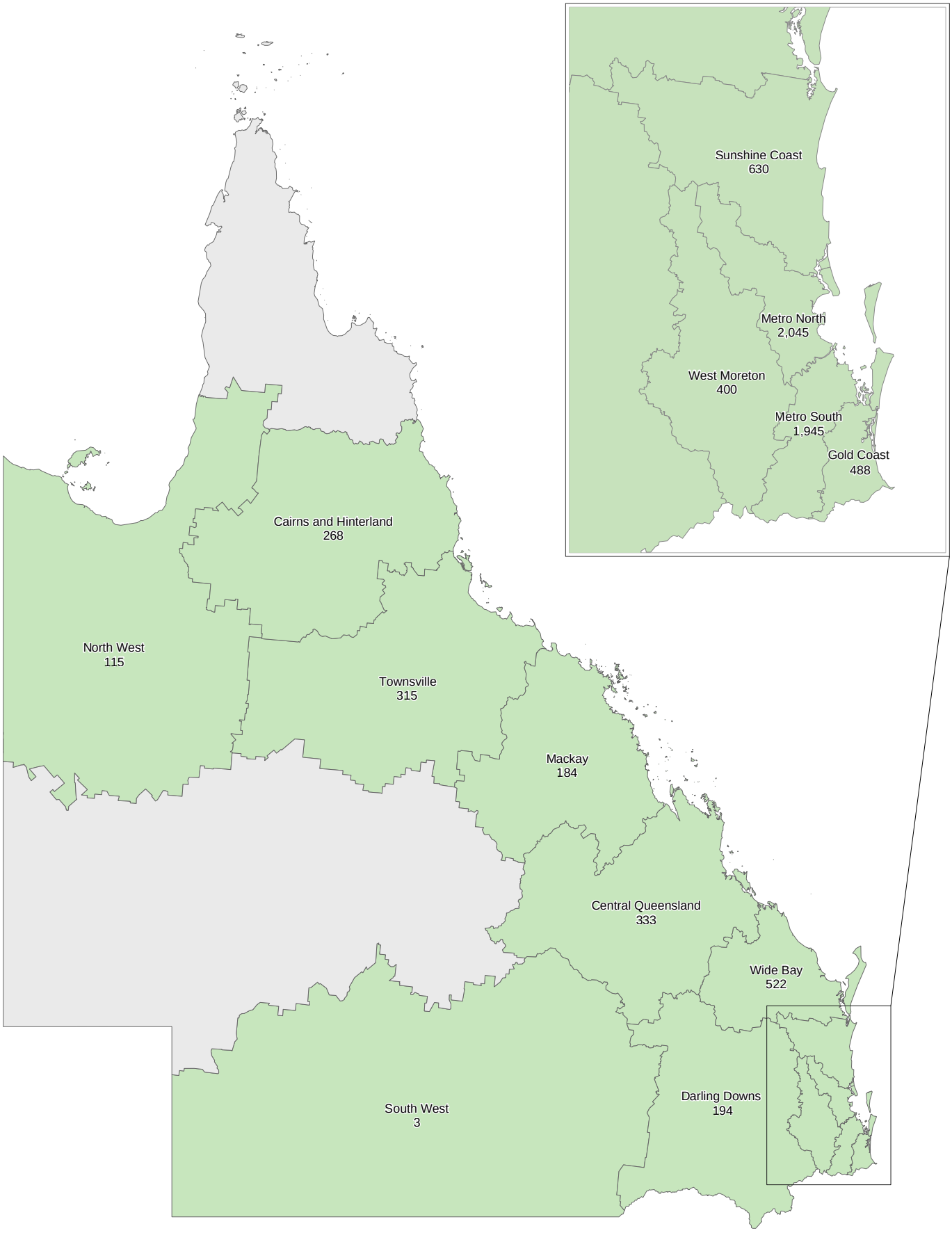


Figure 3: Regional distribution of new referrals

3.2 Referral source

Most referrals originated from an inpatient setting (59%), with smaller proportions originating from an outpatient setting (29%) or as a transfer from another service (11%).

Few referrals came directly from primary care (2%), which is expected as most referrals flow to specialty outpatient clinics for diagnosis and treatment optimisation prior to referral to a HFSS.

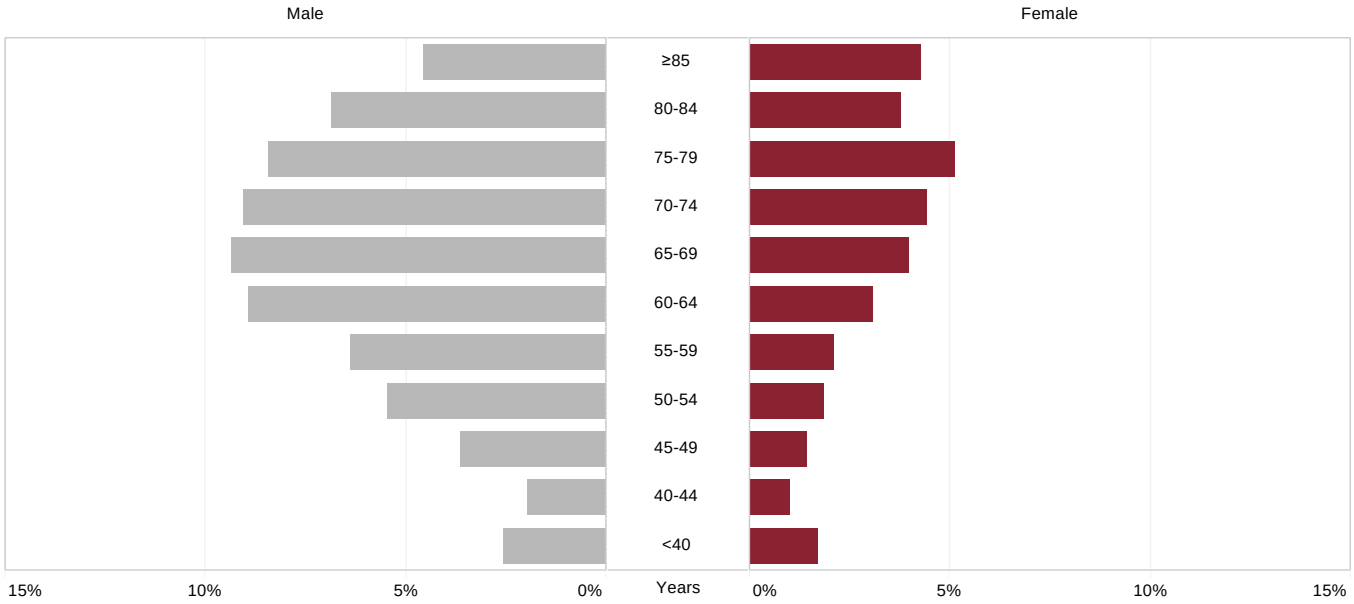
Table 5: Source of HFSS referral

HHS	HFSS	Inpatient n (%)	Outpatient n (%)	Another HFSS n (%)	Primary care n (%)
Cairns and Hinterland	Cairns Hospital	205 (76.5)	62 (23.1)	1 (0.4)	–
Central Queensland	Rockhampton Hospital	183 (55.0)	98 (29.4)	37 (11.1)	15 (4.5)
Darling Downs	Toowoomba Hospital	126 (64.9)	63 (32.5)	5 (2.6)	–
Gold Coast	Gold Coast Community Health	316 (64.8)	132 (27.0)	22 (4.5)	18 (3.7)
Mackay	Mackay Base Hospital	105 (57.1)	70 (38.0)	9 (4.9)	–
Metro North	Caboolture Hospital	128 (34.9)	98 (26.7)	128 (34.9)	13 (3.5)
	Redcliffe Hospital	116 (33.2)	101 (28.9)	124 (35.5)	8 (2.3)
	Royal Brisbane & Women's Hospital	330 (80.3)	76 (18.5)	3 (0.7)	2 (0.5)
	The Prince Charles Hospital HFS	681 (74.2)	221 (24.1)	14 (1.5)	2 (0.2)
Metro South	Logan Hospital	443 (63.1)	137 (19.5)	121 (17.2)	1 (0.1)
	Princess Alexandra Hospital	595 (90.3)	55 (8.3)	9 (1.4)	–
	Queen Elizabeth II Hospital	228 (65.5)	88 (25.3)	32 (9.2)	–
	Redland Hospital	56 (23.7)	92 (39.0)	87 (36.9)	1 (0.4)
North West	Mt Isa Hospital	11 (9.6)	88 (76.5)	16 (13.9)	–
South West	Roma Hospital	2 (66.7)	1 (33.3)	–	–
Sunshine Coast	Gympie Hospital	67 (46.5)	34 (23.6)	42 (29.2)	1 (0.7)
	Sunshine Coast University Hospital	296 (60.9)	171 (35.2)	19 (3.9)	–
Townsville	Townsville Hospital	188 (59.7)	125 (39.7)	2 (0.6)	–
West Moreton	Ipswich Community Health	57 (14.2)	306 (76.5)	36 (9.0)	1 (0.3)
Wide Bay	Bundaberg Hospital	182 (62.5)	43 (14.8)	23 (7.9)	43 (14.8)
	Hervey Bay Hospital	101 (43.7)	66 (28.6)	52 (22.5)	12 (5.2)
Statewide		**4,416 (59.3)**	**2,127 (28.6)**	**782 (10.5)**	**117 (1.6)**

4 Patient characteristics

4.1 Age and gender

The statewide median age of patients managed by an HFSS was 68 years. The median age of females (71 years) was four years older than males. One-third of patients (33%) were 75 years of age and older.



% of total (n=7,442)

Figure 4: Proportion of all referrals by gender and age group

Table 6: Median age in years by gender and HFSS

HHS	HFSS	Male years	Female years	ALL years
Cairns and Hinterland	Cairns Hospital	67	69	68
Central Queensland	Rockhampton Hospital	67	69	68
Darling Downs	Toowoomba Hospital	67	65	67
Gold Coast	Gold Coast Community Health	65	71	67
Mackay	Mackay Base Hospital	62	69	64
Metro North	Caboolture Hospital	68	72	69
	Redcliffe Hospital	70	74	72
	Royal Brisbane & Women's Hospital	68	70	68
	The Prince Charles Hospital HFS	67	73	69
Metro South	Logan Hospital	65	69	66
	Princess Alexandra Hospital	65	69	67
	Queen Elizabeth II Hospital	69	75	72
	Redland Hospital	68	73	69
North West	Mt Isa Hospital	65	56	63
South West	Roma Hospital	46	61	51
Sunshine Coast	Gympie Hospital	71	77	73
	Sunshine Coast University Hospital	69	72	70
Townsville	Townsville Hospital	63	69	64
West Moreton	Ipswich Community Health	65	70	66
Wide Bay	Bundaberg Hospital	70	74	71
	Hervey Bay Hospital	72	72	72
Statewide		**67**	**71**	**68**

4.2 Gender

The majority of patients were male (67%), ranging from 59% to 72% across participating sites.

Table 7: Referrals by gender and HFSS

HHS	HFSS	Male n (%)	Female n (%)
Cairns and Hinterland	Cairns Hospital	191 (71.3)	77 (28.7)
Central Queensland	Rockhampton Hospital	227 (68.2)	106 (31.8)
Darling Downs	Toowoomba Hospital	137 (70.6)	57 (29.4)
Gold Coast	Gold Coast Community Health	353 (72.3)	135 (27.7)
Mackay	Mackay Base Hospital	125 (67.9)	59 (32.1)
Metro North	Caboolture Hospital	225 (61.3)	142 (38.7)
	Redcliffe Hospital	217 (62.2)	132 (37.8)
	Royal Brisbane & Women's Hospital	290 (70.6)	121 (29.4)
	The Prince Charles Hospital HFS	597 (65.0)	321 (35.0)
Metro South	Logan Hospital	474 (67.5)	228 (32.5)
	Princess Alexandra Hospital	466 (70.7)	193 (29.3)
	Queen Elizabeth II Hospital	205 (58.9)	143 (41.1)
	Redland Hospital	162 (68.6)	74 (31.4)
North West	Mt Isa Hospital	70 (60.9)	45 (39.1)
South West	Roma Hospital	2 (66.7)	1 (33.3)
Sunshine Coast	Gympie Hospital	94 (65.3)	50 (34.7)
	Sunshine Coast University Hospital	331 (68.1)	155 (31.9)
Townsville	Townsville Hospital	217 (68.9)	98 (31.1)
West Moreton	Ipswich Community Health	263 (65.8)	137 (34.3)
Wide Bay	Bundaberg Hospital	208 (71.5)	83 (28.5)
	Hervey Bay Hospital	145 (62.8)	86 (37.2)
Statewide		**4,999 (67.2)**	**2,443 (32.8)**

4.3 Aboriginal and Torres Strait Islander status

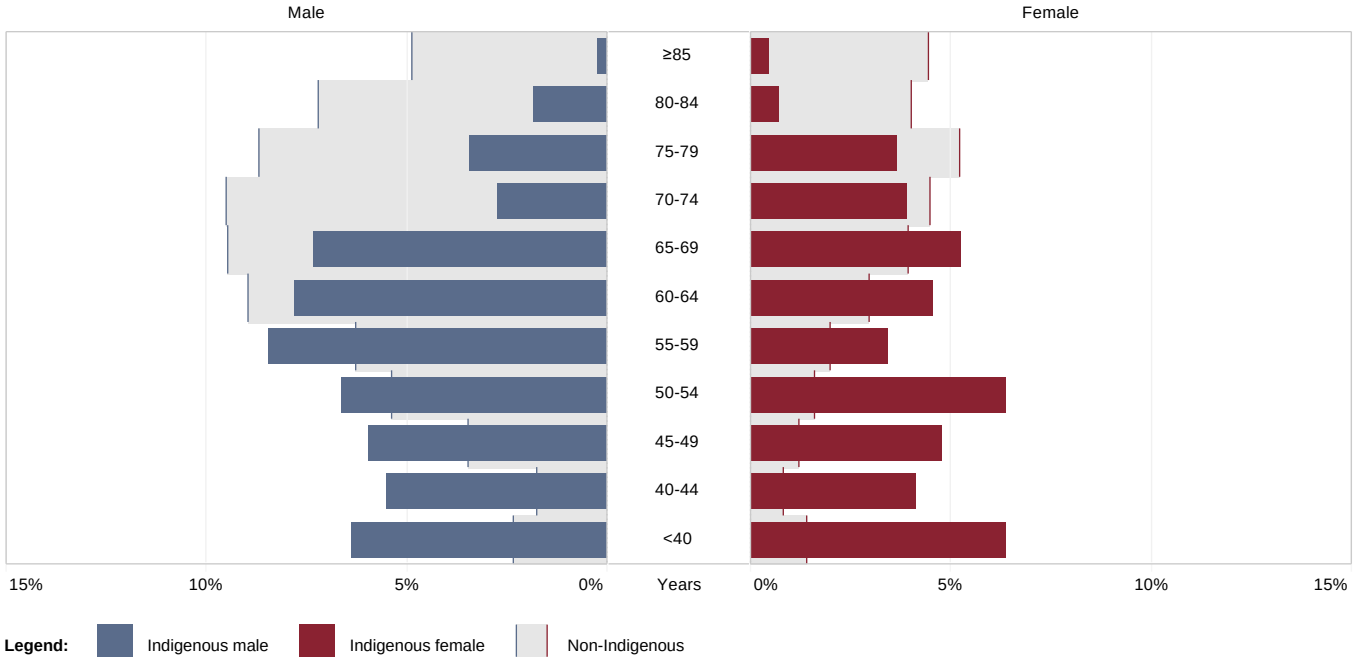
Patients of identified Aboriginal and Torres Strait Islander status made up 6% of all referrals. The number of referrals (n=437) was similar to the previous year (n=463). Aboriginal and Torres Strait Islander patients were significantly younger than other Queenslanders (median age of 56 years vs 69 years). The proportion of caseload of Aboriginal and Torres Strait Islander patients was highest in Mount Isa (47%), followed by Cairns (23%) and Townsville (16%).

The number of Aboriginal and Torres Strait Islander referrals in the Greater Brisbane area (Metro North HHS and Metro South HHS) was 140 (32% of referrals statewide for Indigenous Australians).

Table 8: Aboriginal and Torres Strait Islander HFSS referrals as a proportion of caseload

HHS	HFSS	Indigenous n (%)	Non Indigenous n (%)	Not stated / unknown n (%)
Cairns and Hinterland	Cairns Hospital	62 (23.1)	204 (76.1)	2 (0.7)
Central Queensland	Rockhampton Hospital	37 (11.1)	291 (87.4)	5 (1.5)
Darling Downs	Toowoomba Hospital	9 (4.6)	180 (92.8)	5 (2.6)
Gold Coast	Gold Coast Community Health	7 (1.4)	473 (96.9)	8 (1.6)
Mackay	Mackay Base Hospital	18 (9.8)	164 (89.1)	2 (1.1)
Metro North	Caboolture Hospital	12 (3.3)	344 (93.7)	11 (3.0)
	Redcliffe Hospital	10 (2.9)	336 (96.3)	3 (0.9)
	Royal Brisbane & Women's Hospital	11 (2.7)	396 (96.4)	4 (1.0)
	The Prince Charles Hospital HFS	48 (5.2)	865 (94.2)	5 (0.5)
Metro South	Logan Hospital	30 (4.3)	665 (94.7)	7 (1.0)
	Princess Alexandra Hospital	11 (1.7)	643 (97.6)	5 (0.8)
	Queen Elizabeth II Hospital	12 (3.4)	334 (96.0)	2 (0.6)
	Redland Hospital	6 (2.5)	227 (96.2)	3 (1.3)
North West	Mt Isa Hospital	54 (47.0)	60 (52.2)	1 (0.8)
South West	Roma Hospital	N/A	N/A	N/A
Sunshine Coast	Gympie Hospital	2 (1.4)	140 (97.2)	2 (1.4)
	Sunshine Coast University Hospital	11 (2.3)	463 (95.3)	12 (2.5)
Townsville	Townsville Hospital	51 (16.2)	256 (81.3)	8 (2.5)
West Moreton	Ipswich Community Health	19 (4.8)	380 (95.0)	1 (0.3)
Wide Bay	Bundaberg Hospital	14 (4.8)	274 (94.2)	3 (1.0)
	Hervey Bay Hospital	11 (4.8)	191 (82.7)	29 (12.6)
Statewide		**437 (5.9)**	**6,887 (92.5)**	**118 (1.6)**

N/A: Not displayed due to <20 cases eligible for analysis



% of total Indigenous (n=437) vs total non-Indigenous (n=6,887)

Excludes missing data (1.6%)

Figure 5: Proportion of all referrals by age group and identified Aboriginal and Torres Strait Islander status

Table 9: Median patient age by gender and Indigenous status

	Total referrals* n	Male years	Female years	ALL years
Aboriginal and Torres Strait Islander	437	56	55	56
Non Aboriginal and Torres Strait Islander	6,887	68	72	69
ALL	**7,324**	**67**	**71**	**68**

* Excludes missing data (1.6%)

4.4 Phenotype of heart failure

The table below shows rates of different HF phenotypes referred to each HFSS, these include:

- HFrEF: heart failure with reduced ejection fraction, where the left ventricular ejection fraction is less than 50% at time of diagnosis,
- HFpEF: heart failure with preserved ejection fraction, where the left ventricular ejection fraction is 50% or greater at time of diagnosis,
- Primary right heart failure, for example cor pulmonale.

The most common referral to a HFSS was for HFrEF (85%). The median age for HFrEF was nine years younger than for patients with HFpEF (67 vs 76 years respectively). A higher proportion of patients with HFrEF were male than female (71% male), whereas HFpEF did not have a significant gender difference.

Table 10: Proportion of patients by heart failure phenotype

HHS	HFSS	HFrEF* n (%)	HFpEF† n (%)	Primary right HF n (%)	Unsure/ unknown n (%)
Cairns and Hinterland	Cairns Hospital	256 (95.5)	10 (3.7)	–	2 (0.7)
Central Queensland	Rockhampton Hospital	278 (83.5)	47 (14.1)	5 (1.5)	3 (0.9)
Darling Downs	Toowoomba Hospital	191 (98.5)	2 (1.0)	–	1 (0.5)
Gold Coast	Gold Coast Community Health	429 (87.9)	46 (9.4)	2 (0.4)	11 (2.3)
Mackay	Mackay Base Hospital	166 (90.2)	15 (8.2)	1 (0.5)	2 (1.1)
Metro North	Caboolture Hospital	263 (71.7)	79 (21.5)	5 (1.4)	20 (5.4)
	Redcliffe Hospital	282 (80.8)	58 (16.6)	3 (0.9)	6 (1.7)
	Royal Brisbane & Women's Hospital	360 (87.6)	43 (10.5)	1 (0.2)	7 (1.7)
	The Prince Charles Hospital HFS	694 (75.6)	204 (22.2)	5 (0.5)	15 (1.6)
Metro South	Logan Hospital	582 (82.9)	99 (14.1)	8 (1.1)	13 (1.9)
	Princess Alexandra Hospital	615 (93.3)	35 (5.3)	7 (1.1)	2 (0.3)
	Queen Elizabeth II Hospital	262 (75.3)	80 (23.0)	4 (1.1)	2 (0.6)
	Redland Hospital	200 (84.7)	17 (7.2)	–	19 (8.1)
North West	Mt Isa Hospital	76 (66.1)	19 (16.5)	3 (2.6)	17 (14.8)
South West	Roma Hospital	3 (100.0)	–	–	–
Sunshine Coast	Gympie Hospital	110 (76.4)	19 (13.2)	11 (7.6)	4 (2.8)
	Sunshine Coast University Hospital	445 (91.6)	35 (7.2)	4 (0.8)	2 (0.4)
Townsville	Townsville Hospital	309 (98.1)	5 (1.6)	–	1 (0.3)
West Moreton	Ipswich Community Health	342 (85.5)	50 (12.5)	7 (1.8)	1 (0.3)
Wide Bay	Bundaberg Hospital	262 (90.0)	23 (7.9)	4 (1.4)	2 (0.7)
	Hervey Bay Hospital	169 (73.2)	48 (20.8)	12 (5.2)	2 (0.9)
Statewide		**6,294 (84.6)**	**934 (12.6)**	**82 (1.1)**	**132 (1.8)**

* Heart failure with reduced ejection fraction (LVEF <50%)

† Heart failure with preserved ejection fraction (LVEF ≥50%)

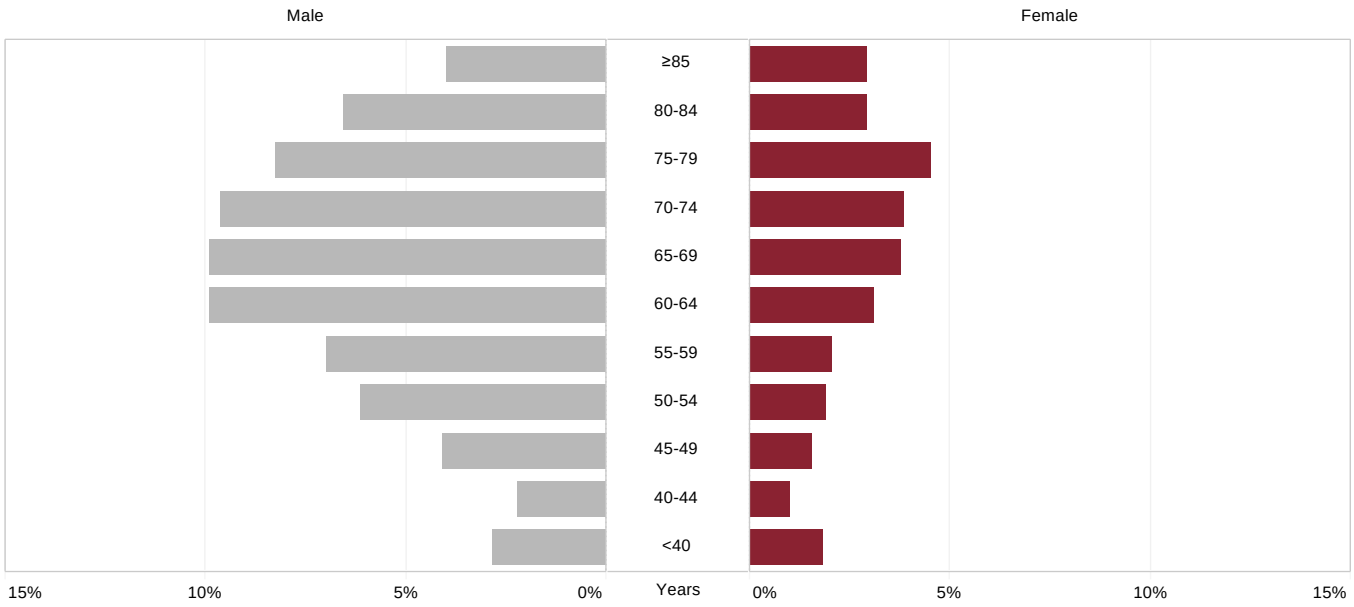
Table 11: Summary of patient age, gender and Indigenous status by heart failure phenotype

	HFrEF*	HFpEF†	Primary right HF
Number	6,294	934	82
Age (median years)	67	76	72
% male	70.5%	46.7%	58.5%
% Aboriginal and Torres Strait Islander	5.9%	5.1%	7.3%

Excludes unsure/unknown HF phenotype (1.8%)

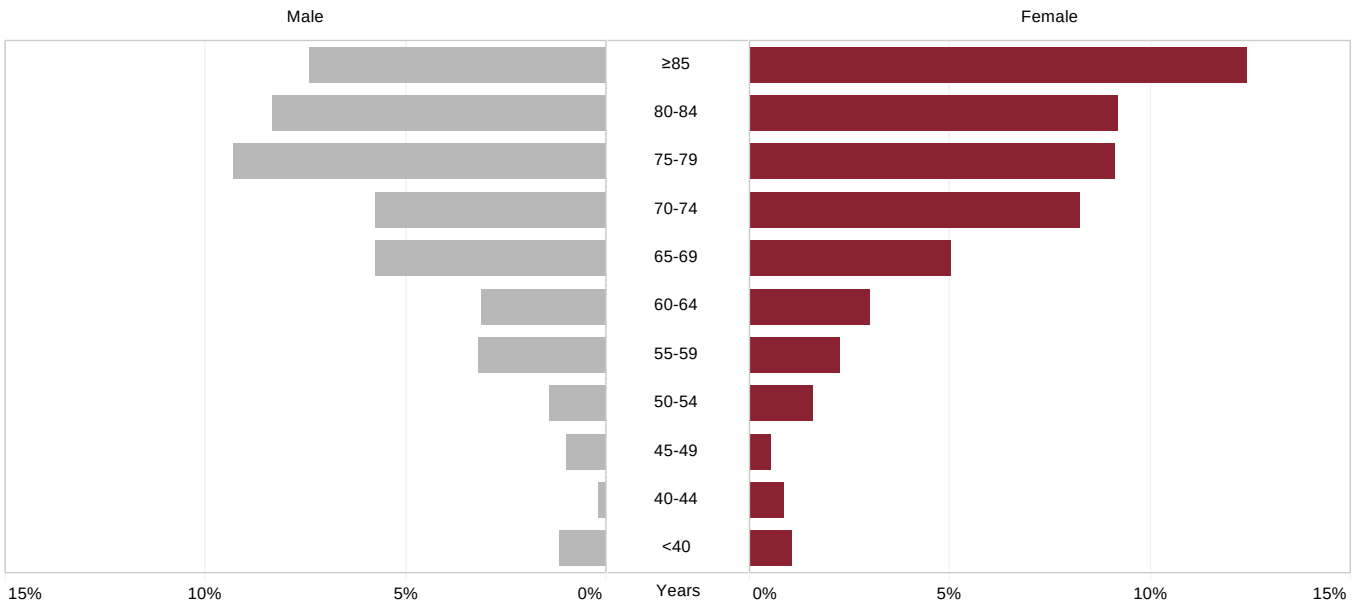
* Heart failure with reduced ejection fraction (LVEF ‹50%)

† Heart failure with preserved ejection fraction (LVEF ≥50%)



% of total with HFrEF (n=6,294)

Figure 6: Proportion of HFrEF referrals by gender and age group



% of total with HFpEF (n=934)

Figure 7: Proportion of HFpEF referrals by gender and age group

4.5 Summary of patient characteristics

A summary of patient characteristics from all referrals to an HFSS are shown below.

Table 12: Summary of patient characteristics

Characteristic	Summary
Participating HFSS	21
New referrals	7,442
Referrals from South East Queensland	74%
Referral source:	
Inpatient	59.3%
Outpatient	28.6%
Another HFSS	10.5%
Primary care	1.6%
Age (median years):	
All (median, range by service)	68 (51–73) years
Male vs Female	67 vs 71 years
Indigenous vs non-Indigenous	56 vs 69 years
HFrEF* vs HFpEF†	67 vs 76 years
Age group:	
75 years and over	33.0%
Males	67.2%
Aboriginal and Torres Strait Islander patients	5.9%
Heart failure phenotype:	
HFrEF*	84.6%
HFpEF†	12.6%
Primary right HF	1.1%
Unsure/unknown	1.8%

* Heart failure with reduced ejection fraction (LVEF <50%)

† Heart failure with preserved ejection fraction (LVEF ≥50%)

5 Clinical indicators

The number of clinical indicators is limited so that data entry is sustainable and part of routine clinical practice. The clinical indicators selected are shown in Table 13.

The target benchmark for all indicators was set at 80%, except for 7b (beta blocker titration to clinical guideline target dose at six months) where the benchmark was set at 50%. The lower benchmark of 50% acknowledges that target doses derived from clinical trials may be inappropriate in clinical practice where patients are often older with greater disease severity and associated comorbidities compared to patients recruited to large drug trials.[56]

Table 13: Clinical process indicators

Indicator #	Process measures
1	**Timely follow-up and first clinical review** 1a) First clinical review within two weeks for inpatient referrals 1b) First clinical review within four weeks for non acute referrals
2	**Left ventricular ejection fraction (LVEF) assessed within 2 years of referral to HFSS**
3	**Prescription of angiotensin-converting-enzyme inhibitor (ACEI), angiotensin II receptor blockers (ARB) or angiotensin receptor neprilysin inhibitor (ARNI) for HFrEF**
4	**Prescription of guideline recommended beta blockers (bisoprolol, carvedilol, metoprolol sustained release or nebivolol) for HFrEF**
5	**Prescription of mineralocorticoid receptor antagonists (MRA) for patients with HFrEF**
6	**Prescription of sodium-glucose cotransporter-2 (SGLT2) inhibitors for HFrEF**
7	**Beta blocker review and titration** 7a) Titration review conducted within 6 months of first clinical review 7b) Guideline target dose achieved at time of titration review 7c) Either target or maximum dose achieved at time of titration review
8	**Prescription of sodium-glucose cotransporter-2 (SGLT2) inhibitors for HFpEF**

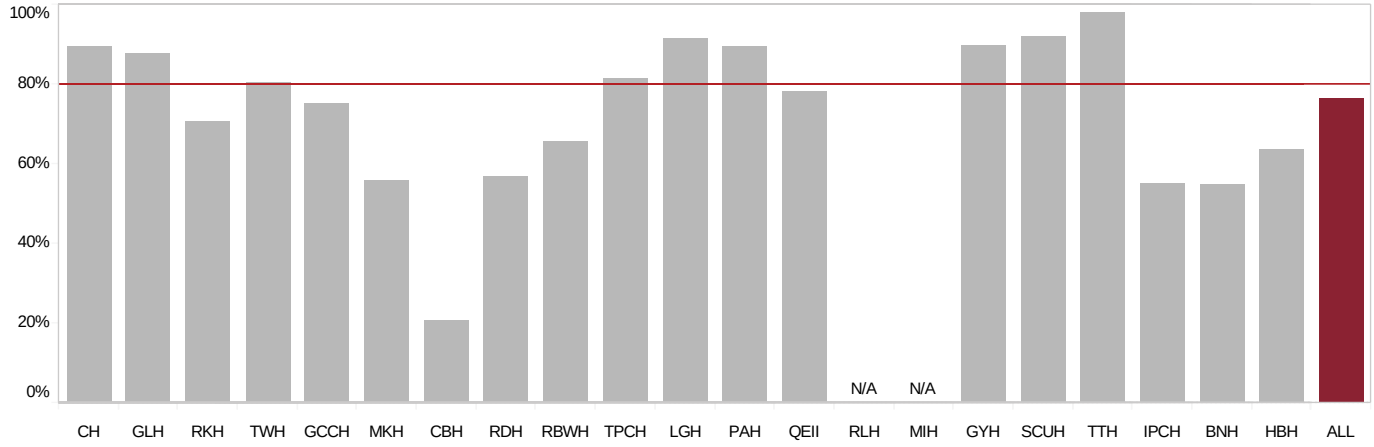
5.1 First clinical review

The HFSS review is defined as a clinical (rather than administrative) intervention and can be conducted face to face (clinic, gym or home visit) or virtually (phone, videoconference). Patients were excluded if they died, were referred to another HFSS, declined follow-up or could not be contacted.

1a First clinical review by Heart Failure Support Service within two weeks of hospital discharge (for inpatient referrals)

Early post discharge follow-up is recommended for patients with HF to monitor symptoms, provide education and support self-management principles. The review timeframe chosen for this intervention is within two weeks of hospital discharge or date of referral after recent hospitalisation.

Of the 4,416 patients referred from an acute setting, 76% of the cases eligible for analysis received a clinical review by an HFSS within two weeks of hospital discharge. Variation in performance was observed between services and is demonstrated in the figure below.



N/A: Eligible referrals <20

Figure 8: Inpatients who received first HFSS clinical review within two weeks of hospital discharge

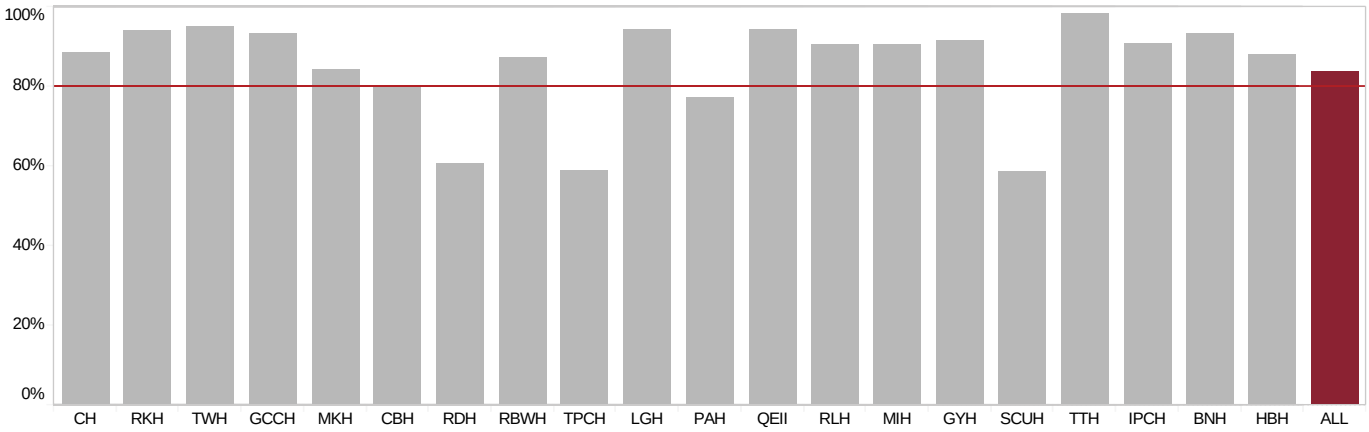
Table 14: Inclusion details for clinical indicator 1a: Inpatients receiving first HFSS clinical review within two weeks of hospital discharge

	n	%
Eligible for analysis	2,906	
Achieved benchmark	2,219	76.4
Benchmark not achieved	687	23.6
Ineligible	1,502	
Referred to another HFSS	828	
Declined service, could not be contacted, out of area, repeated FTA	290	
Referred to another service such as CR or community nursing	108	
HF no longer prime issue (e.g. palliative care, high care nursing home)	105	
Other reason	65	
Patient deceased	57	
Medical management with no support service (not advised)	27	
Multiple referrals for the same patient	22	
Total inpatient referrals	**4,416**	

1b First Heart Failure Support Service clinical review within four weeks for non acute referrals

For non acute referrals, clinical follow-up should be within four weeks of the referral date.

Referrals for 3,026 patients came from non acute services, of which 84% of the cases eligible for analysis received a clinical review within four weeks of referral. Variation in performance amongst services was observed and is outlined below.



N/A Eligible referrals <20

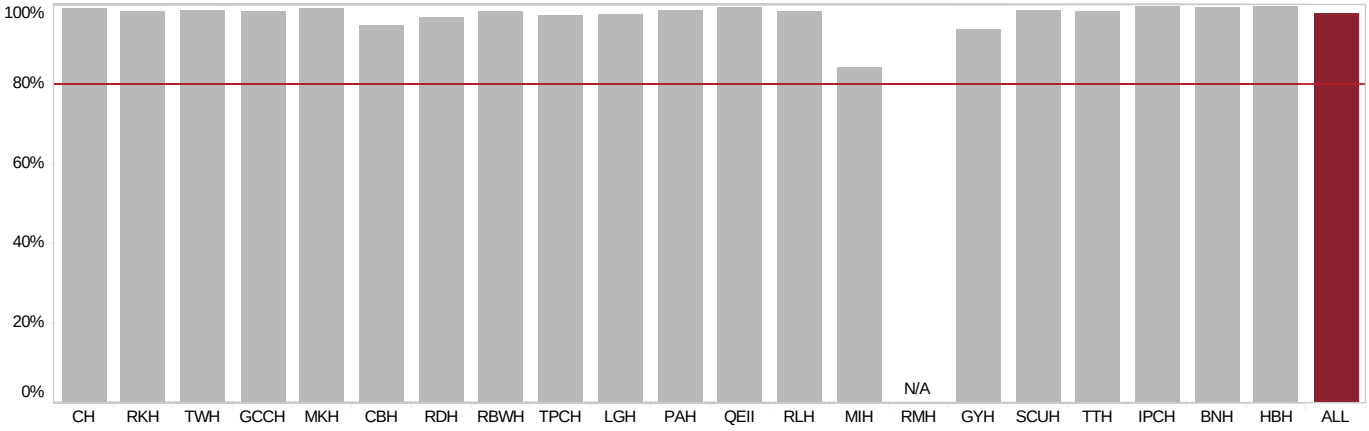
Figure 9: Proportion of non acute patients who received first HFSS clinical review within four weeks of referral

Table 15: Inclusion details for clinical indicator 1b: Non acute patients receiving first HFSS clinical review within four weeks of referral

	n	%
Eligible for analysis	2,572	
Achieved benchmark	2,161	84.0
Benchmark not achieved	411	16.0
Ineligible	433	
Declined service, could not be contacted, out of area, repeated FTA	197	
Referred to another HFSS	91	
HF no longer prime issue (e.g. palliative care, high care nursing home)	45	
Other reason	39	
Referred to another service such as CR or community nursing	25	
Patient deceased	19	
Multiple referrals for the same patient	17	
Total non acute patients	**3,026**	

5.2 Left ventricular ejection fraction (LVEF) assessed within two years of referral to HFSS

Australian clinical guidelines recommend that all patients with heart failure should have an assessment of left ventricular function.[58] In 98% of cases, LVEF was assessed within two years of referral to an HFSS. Little variation in performance was observed and is demonstrated in the analysis below.



N/A Eligible referrals <20

Figure 10: Proportion of all patients who had LVEF assessed within two years of referral to HFSS

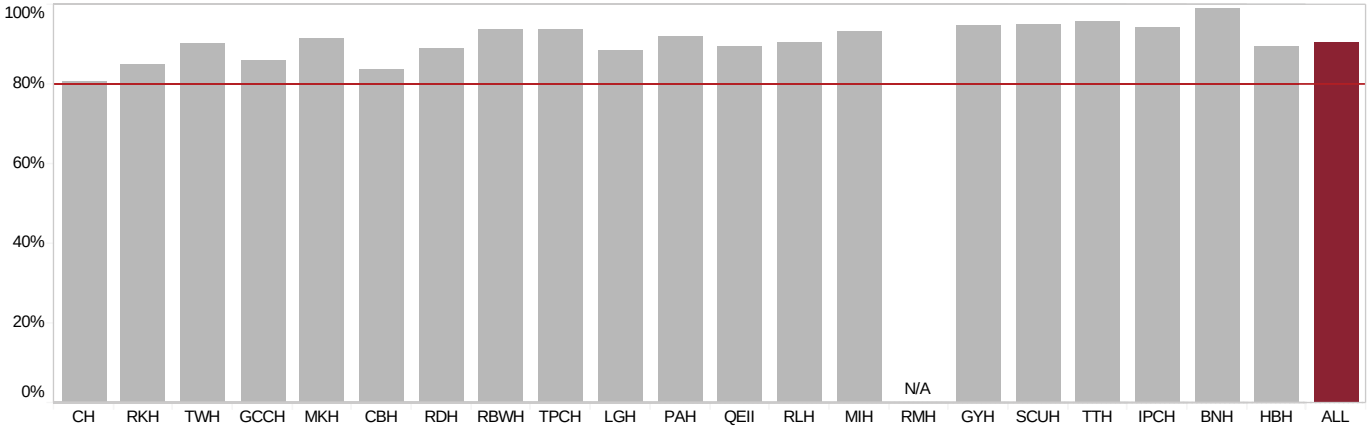
Table 16: Inclusion details for clinical indicator 2: Patients who had LVEF assessed within two years of referral

	n	%
Eligible for analysis	7,396	
Achieved benchmark	7,235	97.8
Benchmark not achieved	161	2.2
Missing data	46	
Total referrals	**7,442**	

5.3 Prescription of ACEI, ARB or ARNI for patients with HFrEF at time of first HFSS clinical review

Angiotensin-converting-enzyme inhibitor (ACEI), angiotensin II receptor blockers (ARB) or angiotensin receptor neprilysin inhibitor (ARNI) have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all patients unless contraindicated or not tolerated.[58]

At the time of first clinical review, the target for prescription of ACEI, ARB or ARNI was met for 91% of eligible patients. Of these patients there were 65% of patients who were prescribed an ACEI/ARB and the remaining 35% were prescribed ARNI.



N/A Eligible referrals <20

Figure 11: Proportion of patients on ACEI, ARB or ARNI at time of first clinical review by site

Table 17: Inclusion details for clinical indicator 3: Patients on ACEI, ARB or ARNI at first clinical review

	n	%
Eligible for analysis	4,473	
Achieved benchmark	4,050	90.5
Benchmark not achieved	423	9.5
Ineligible		
Documented contraindication*	114	
Missing data	69	
Total inpatient referrals analysed	**4,656**	

* Adverse reaction to ACEI/ARB or ARNI, palliative intent to treatment, pregnancy, eGFR <20mL/min/1.73m² (ACEI/ARB) or <30mL/min/1.73m² (ARNI), severe aortic stenosis, renal artery stenosis, serum potassium >5.5 mmol/L, symptomatic hypotension

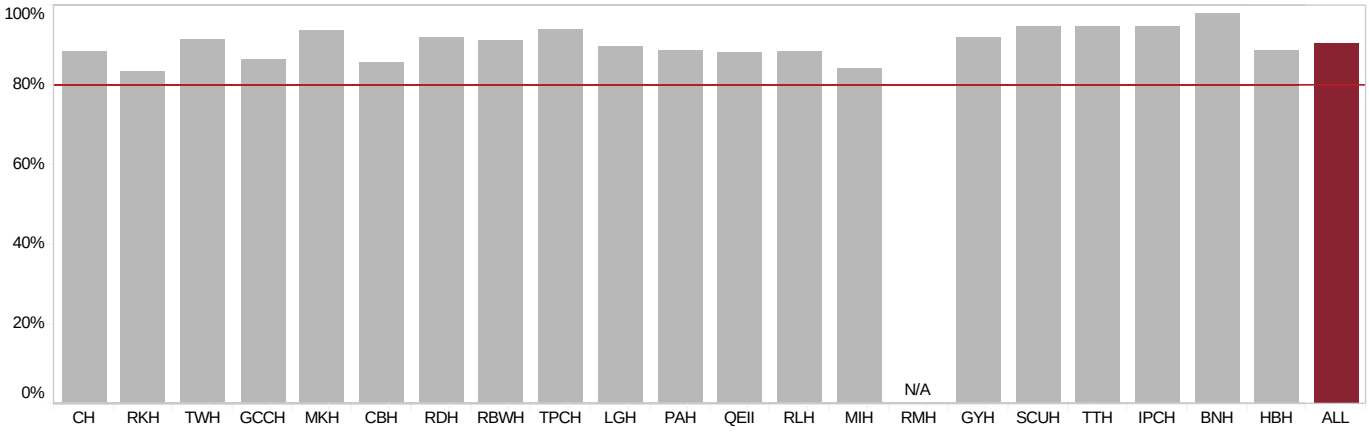
5.4 Prescription of guideline recommended beta blockers for HFrEF at time of first HFSS clinical review

Guideline recommended beta blockers have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all patients unless contraindicated or not tolerated.[57,58] Guideline recommended beta blockers include bisoprolol, carvedilol, metoprolol sustained release or nebivolol. Results pertain only to these beta blocker medications.

At the first clinical review, 91% of eligible referrals to HFSS were reported to be on a guideline recommended beta blocker. Of these patients there were 86%, 7%, 4% and 3% of patients who were prescribed bisoprolol, metoprolol sustained release, carvedilol, and nebivolol respectively.

4a Beta blocker prescription for HFrEF at time of hospital discharge

At hospital discharge, 91% of eligible patients were prescribed guideline recommended beta blockers. Of these patients there were 85%, 7%, 5% and 3% of patients who were prescribed bisoprolol, metoprolol sustained release, carvedilol, and nebivolol respectively.



N/A Eligible referrals <20

Figure 12: Proportion of patients on guideline recommended beta blocker therapy at first clinical review by site

Table 18: Inclusion details for clinical indicator 4: Patients on guideline recommended beta blocker at first clinical review

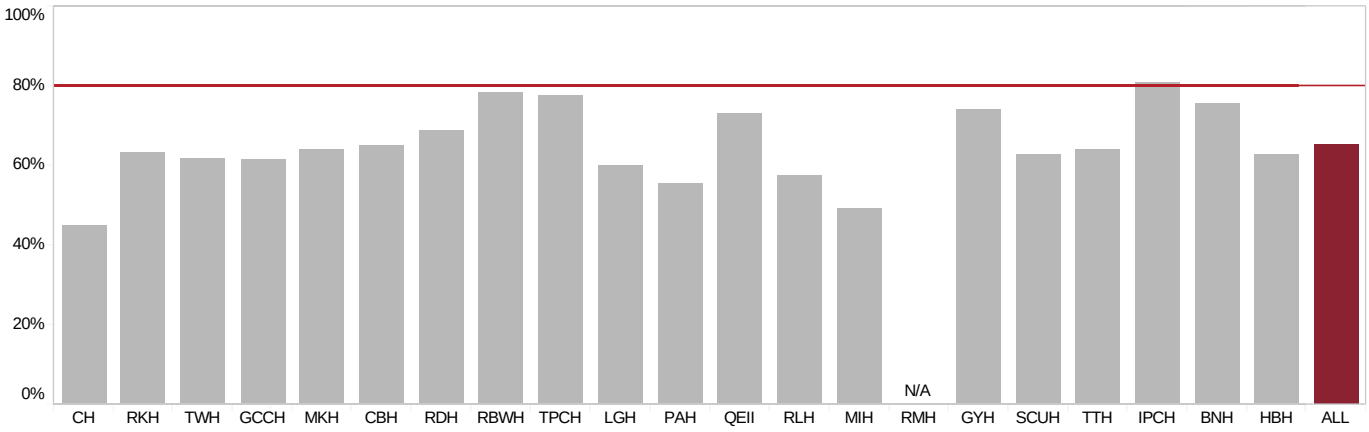
	n	%
Eligible for analysis	4,519	
Achieved benchmark	4,098	90.7
Benchmark not achieved	421	9.3
Ineligible		
Documented contraindication*	68	
Missing data	69	
Total inpatient referrals analysed	**4,656**	

* Adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR <50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

5.5 Prescription of mineralocorticoid receptor antagonists (MRA) for patients with HFrEF at time of first HFSS clinical review

Guideline recommended mineralocorticoid receptor antagonists have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all patients unless contraindicated or not tolerated.[57,58] Guideline recommended MRAs include eplerenone and spironolactone. Most sites were below the benchmark.

At the time of first clinical review, 65% of eligible referrals to an HFSS were reported to be on a guideline recommended MRA. Of these patients there were 86% prescribed spironolactone and 14% who were prescribed eplerenone.



N/A Eligible referrals <20

Figure 13: Proportion of patients on guideline recommended MRA at first clinical review by site

Table 19: Inclusion details for clinical indicator 5: Patients on guideline recommended MRA at first clinical review

	n	%
Eligible for analysis	4,305	
Achieved benchmark	2,810	65.3
Benchmark not achieved	1,495	34.7
Ineligible		
Documented contraindication*	282	
Missing data	69	
Total inpatient referrals analysed	**4,656**	

* Adverse reaction to MRA, palliative intent to treatment, serum potassium >5 mmol/L, pregnancy, eGFR <30mL/min/1.73m², previous gynaecomastia, Addison's disease, symptomatic hypotension or LVEF returned to >50%

5.6 Prescription of sodium-glucose cotransporter-2 (SGLT2) inhibitors for HFrEF at time of first HFSS clinical review

Guideline recommended sodium-glucose cotransporter-2 (SGLT2) inhibitors have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all patients unless contraindicated or not tolerated. Guideline recommended SGLT2 inhibitors include dapagliflozin and empagliflozin.[59,60,61]

At the time of first clinical review, 67% of eligible referrals to an HFSS were reported to be on a guideline recommended SGLT2 inhibitor for HFrEF. All sites were below the benchmark.

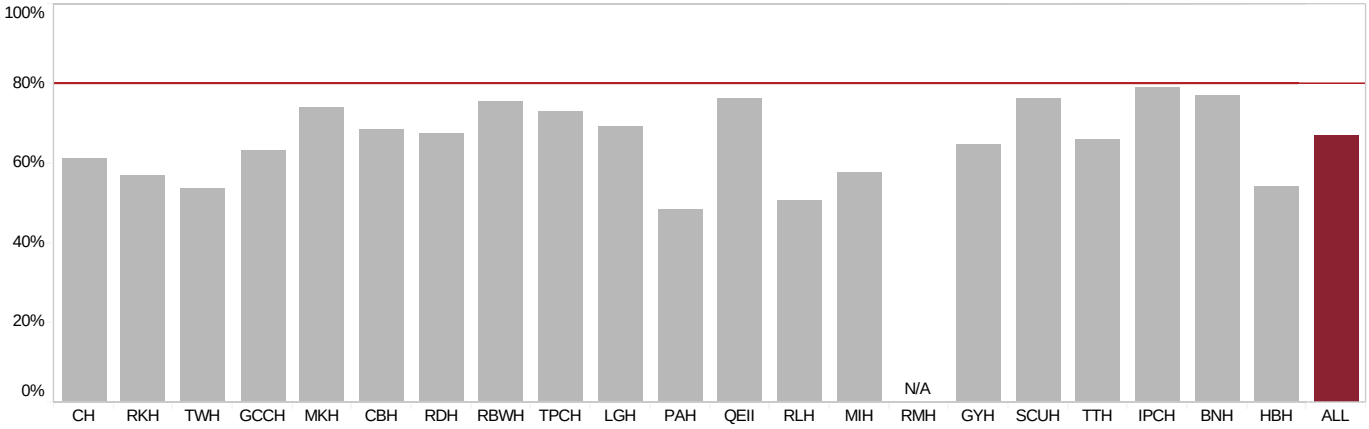


Figure 14: Proportion of HFrEF patients on guideline recommended SGLT2 inhibitor at first clinical review by site

Table 20: Inclusion details for clinical indicator 6: HFrEF patients on guideline recommended SGLT2 inhibitor at first clinical review

	n	%
Eligible for analysis	4,352	
Achieved benchmark	2,911	66.9
Benchmark not achieved	1,441	33.1
Ineligible		
Documented contraindication*	237	
Missing data	67	
Total referrals analysed	**4,656**	

* SGLT2 inhibitor adverse reaction, type 1 diabetes mellitus, previous ketoacidosis, palliative intent to treatment, pregnancy, eGFR <20mL/min/1.73m², or symptomatic hypotension

5.7 Beta blocker titration

This indicator looks at the progress of titration of guideline recommended beta blockers at six months following hospital discharge or when deactivated from the HFSS, whichever is sooner. The timeframe is taken from the first clinical review by HFSS (usually at four weeks from referral or hospital discharge).

The indicator measures three components of beta blocker titration at six months, including:

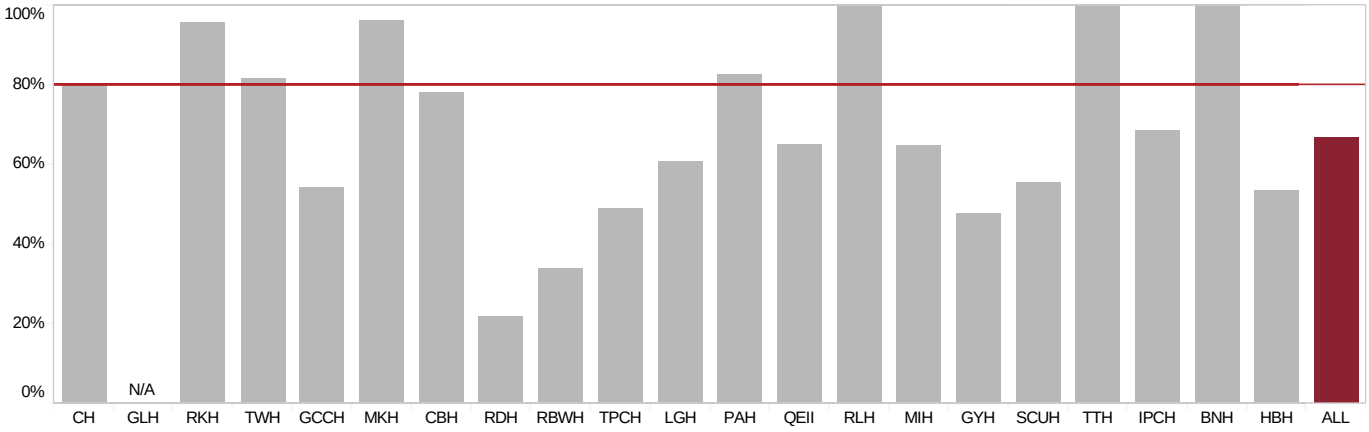
a) Review of titration status undertaken,

b) Achievement of target dose, and

c) Achievement of target or maximum tolerated dose.

7a Beta blocker titration review conducted within six months of first HFSS clinical review

At six months from first clinical review or at the time of deactivation from the HFSS (whichever was sooner), 67% of patients received a beta blocker titration review which is below the benchmark. Variation in performance amongst services was observed and is demonstrated in the figure below.



N/A Eligible referrals <20

Figure 15: Proportion of patients who had a beta blocker titration review conducted within six months by site

Table 21: Inclusion details for clinical indicator 7a: Patients who had a beta blocker titration review within six months

	n	%
Eligible for analysis	2,651	
Achieved benchmark	1,770	66.8
Benchmark not achieved	881	33.2
Ineligible		
Patient on target dose at the time of referral	812	
Other reason	324	
Patient could not be contacted, moved or lives out of area, or repeated FTA	224	
Patient declined service	156	
Documented contraindication*	144	
Patient deceased	122	
Referred to another HFSS	86	
HF no longer prime issue (e.g. palliative care, high care nursing home)	65	
Referred to another service such as CR or community nursing	50	
Incomplete data	9	
Total analysed	**4,643**	

* Adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR <50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

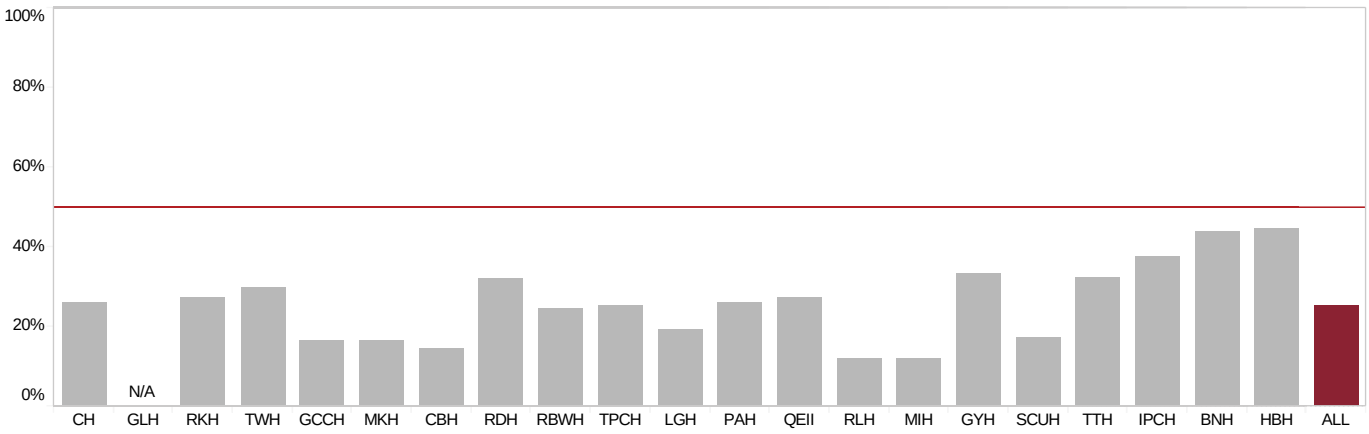
7b Beta blocker clinical guideline target dose achieved at time of titration review

The benchmark for target dose beta blocker titration was set lower than the other indicators at 50%. This lower benchmark is to accommodate differences in patients recruited to clinical trials compared to patients presenting in clinical practice who are older with more comorbidities.

Guideline recommended target dose was achieved for 25% of referrals within six months or at deactivation. All sites were below the benchmark (see Figure 16).

Daily target doses are:

- Carvedilol 50–100 mg
- Metoprolol sustained release 190 mg
- Bisoprolol 10 mg
- Nebivolol 10 mg



N/A Eligible referrals <20

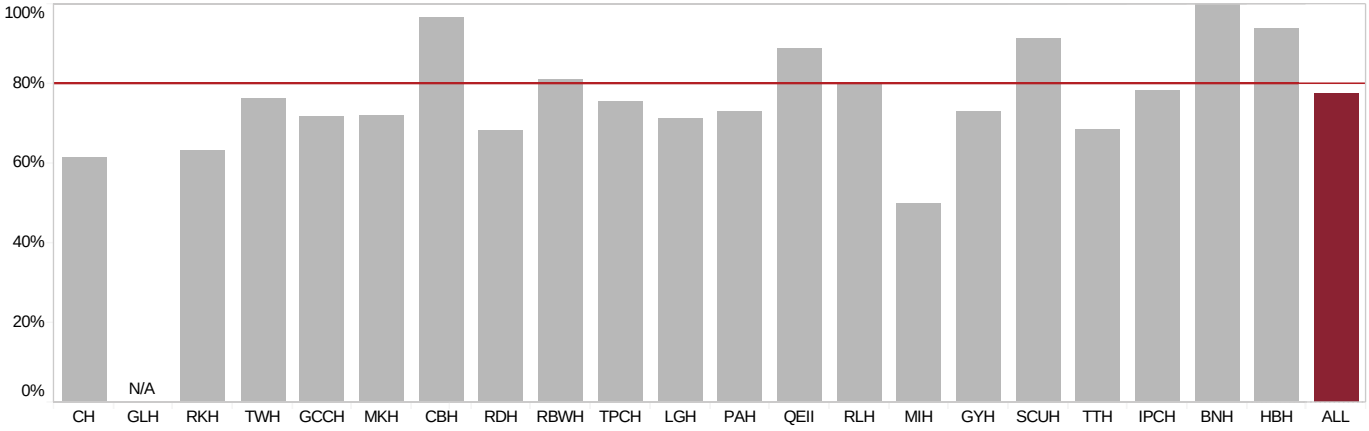
Figure 16: Proportion of patients who achieved target beta blocker dose at time of titration review by site

Table 22: Inclusion details for clinical indicator 7b: Patients who achieved target beta blocker dose at time of titration review

	n	%
Eligible for analysis	2,651	
Achieved benchmark	673	25.4
Benchmark not achieved	1,978	74.6
Ineligible	N/A	
Total titration reviews conducted	**2,651**	

7c Beta blocker titration clinical guideline target or maximum tolerated dose achieved at time of titration review

Maximum tolerated dose of beta blockers is based on a clinical judgement balancing the harm and benefit of up-titration. The proportion of patients reaching the target dose or maximum tolerated dose of guideline recommended beta blocker medication by the time of the titration review was 78%.



N/A Eligible referrals <20

Figure 17: Proportion of patients who achieved target beta blocker dose or maximum tolerated dose at time of titration review

Table 23: Inclusion details for clinical indicator 7c: Patients who achieved target or maximum tolerated beta blocker dose at time of titration review

	n	%
Eligible for analysis	2,651	
Achieved benchmark	2,056	77.6
Benchmark not achieved	595	22.4
Ineligible	N/A	
Total titration reviews conducted	**2,651**	

5.8 Prescription of sodium-glucose cotransporter-2 (SGLT2) inhibitors for HFpEF at time of first HFSS clinical review

Guideline recommended sodium-glucose cotransporter-2 (SGLT2) have been shown to reduce cardiovascular death or HF hospitalisations in patients with HFpEF and are recommended for all patients unless contraindicated or not tolerated. Guideline recommended SGLT2 inhibitors for HFpEF include dapagliflozin and empagliflozin.[59,61]

At the time of first clinical review, 50% of eligible referrals to an HFSS were reported to be on a guideline recommended SGLT2 inhibitor for HFpEF.

8a Prescription of SGLT2 inhibitor for HFpEF at time of hospital discharge

At the time of discharge from hospital, 25% of eligible referrals to an HFSS were reported to be on a guideline recommended SGLT2 inhibitor for HFpEF. All sites were below the benchmark.

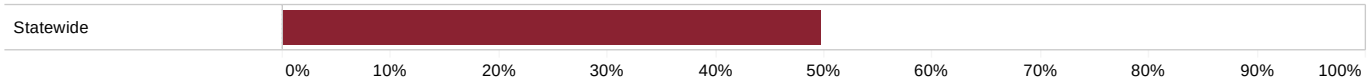


Figure 18: Proportion of HFpEF patients on guideline recommended SGLT2 inhibitor at first clinical review by site

Table 24: Inclusion details for clinical indicator 8: HFpEF patients on guideline recommended SGLT2 inhibitor at first clinical review

	n	%
Eligible for analysis	535	
Achieved benchmark	266	49.7
Benchmark not achieved	269	50.3
Ineligible		
Documented contraindication*	40	
Total referrals analysed	**575**	

* SGLT2 inhibitor adverse reaction, type 1 diabetes mellitus, previous ketoacidosis, palliative intent to treatment, pregnancy, eGFR <20mL/min/1.73m², or symptomatic hypotension

5.9 Summary of clinical indicators

Table 25: Summary of clinical process indicator performance by site

	Clinical indicator achievement (%)									
HFSS	**1a**	**1b**	**2**	**3**	**4a**	**5a**	**6a**	**7a**	**7b**	**7c**
Cairns Hospital	89	89	99	81	88	45	61	80	26	61
Rockhampton Hospital	88	94	98	85	84	63	57	95	27	63
Toowoomba Hospital	71	95	98	90	92	62	54	81	30	76
Gold Coast Community Health	80	93	98	86	86	62	63	54	16	71
Mackay Base Hospital	75	84	99	92	94	64	74	96	17	72
Caboolture Hospital	56	80	95	84	86	65	68	78	14	97
Redcliffe Hospital	21	61	97	89	92	69	67	22	32	68
Royal Brisbane & Women's Hospital	57	87	98	94	91	78	76	34	25	81
The Prince Charles Hospital HFS	65	59	97	94	94	78	73	49	25	75
Logan Hospital	81	94	98	88	90	60	69	61	19	71
Princess Alexandra Hospital	92	77	98	92	89	55	48	82	26	73
Queen Elizabeth II Hospital	90	94	99	90	88	73	76	65	27	89
Redland Hospital	78	91	98	90	88	58	51	100	12	80
Mt Isa Hospital	–	91	84	93	84	49	57	65	12	50
Roma Hospital	–	–	–	–	–	–	–	–	–	–
Gympie Hospital	90	92	94	95	92	74	65	48	33	73
Sunshine Coast University Hospital	92	58	99	95	95	63	76	55	17	91
Townsville Hospital	98	98	98	96	95	64	66	100	32	68
Ipswich Community Health	55	91	99	94	95	81	79	68	38	78
Bundaberg Hospital	55	93	99	99	98	75	77	100	44	100
Hervey Bay Hospital	64	88	100	90	89	63	54	53	45	94
Statewide	**76**	**84**	**98**	**91**	**91**	**65**	**67**	**67**	**25**	**78**

Legend:

1a Follow-up of acute patients within two weeks (Benchmark: 80%)

1b Follow-up of non acute patients within four weeks (Benchmark: 80%)

2 Assessment of left ventricular ejection fraction within two years (Benchmark: 80%)

3 ACEI, ARB or ARNI prescription at first clinical review (Benchmark: 80%)

4 Guideline recommended beta blocker prescription at first clinical review (Benchmark: 80%)

5 Guideline recommended MRA prescription at first clinical review (Benchmark: 80%)

6 Guideline recommended SGLT2 inhibitor prescription for HFrEF at first clinical review (Benchmark: 80%)

7a Beta blocker titration status review at six months post referral (Benchmark: 80%)

7b Beta blockers achievement of guideline recommended target dose (Benchmark: 50%)

7c Beta blockers achievement of guideline recommended target dose or maximum tolerated dose (Benchmark: 80%)

6 Patient outcomes

Chronic heart failure is associated with recurrent hospitalisation and increased mortality. Support from multidisciplinary HF disease management programmes (such as an HFSS) and adherence to recommended therapies are associated with improved outcomes.

6.1 Methods

This analysis used the previously reported 2023 patient cohort to examine the early (30 day) and one year clinical outcomes (rehospitalisation and mortality) among patients referred to HFSS. This was performed using data linkage with the Queensland Hospital Admitted Patient Data Collection (QHAPDC) and Queensland Registry of Births, Deaths and Marriages.

For this report, only HFSS referrals initiated during an inpatient encounter for 2023 were included. The earliest admission of the calendar year was considered the index admission (which may not be the first time that a patient has been hospitalised with heart failure).

Eligibility criteria for the mortality and readmission analysis cohort were applied at the time of the index admission. The eligibility status for days alive and out of hospital (DAOH) analysis was reviewed at all subsequent admissions over 12 months to exclude patients who were transferred to private hospitals or interstate.

The patient outcome indicators of interest are summarised in Table 26. Survival curves were constructed using the Kaplan–Meier method and cumulative incidence function was used to estimate the risk of all-cause and HF-related rehospitalisation to account for the competing risk of death.

DAOH was calculated to reflect the burden of recurrent hospitalisation, hospital length of stay and death, and was expressed as both median values, interquartile range, and mean values. Categorical variables were summarised as frequencies and percentages.

Table 26: Patient outcome indicators

Indicator #	Measure
1	All-cause mortality within one year after index hospitalisation discharge
2	Rehospitalisation within one year after index hospitalisation discharge a) All-cause rehospitalisation b) Heart failure rehospitalisation*
3	Composite of all-cause hospitalisation or all-cause mortality within one year after index hospitalisation discharge
4	Days alive and out of hospital within one year of index hospital discharge date

* ICD10AM codes: E87.7, I13.0, I13.2, I25.5, I42.0, I42.1, I42.2, I42.5, I42.6, I42.7, I42.8, I42.9, I46.0, I46.1, I46.9, I50, J81, J90, R18, R57.0, R60.1

6.2 Findings

There were 4,445 inpatient referrals of which 94% were successfully linked with the QHAPDC data. There were 660 patients who were ineligible for readmission and mortality analysis for the reasons shown in Table 27. A further 64 patients (1.4%) did not have complete follow up over one year to allow DAOH to be calculated.

Table 27: Eligibility criteria for patient outcome indicators

	n	%
Total 2023 inpatient referrals	**4,445**	**100**
Ineligible at index admission:		
Duplicate patient record	186	4.2
Not a Queensland resident	94	2.1
Transferred to private hospital	59	1.3
Died during index admission	34	0.8
Index admission is not overnight	23	0.5
No linkage data available	264	5.9
Included in readmission and mortality analysis	**3,785**	**84.8**
Ineligible at subsequent admission over 1 year		
Transferred to private hospital	64	1.4
Included in days alive and out of hospital analysis	**3,721**	**83.7**

6.2.1 All-cause mortality

Among patients referred to HFSS during an inpatient encounter, the 30 day and one year unadjusted all-cause mortality rates were 1.2% and 10.7%. The Kaplan-Meier survival analyses below (Figures 19 to 21) suggest that older age was associated with increased mortality rates at all time points and particularly at 12 months.

Table 28: Cumulative all-cause unadjusted mortality rate from 30 to 365 days after discharge

	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Total deaths identified	47 (1.2)	131 (3.5)	221 (5.8)	404 (10.7)
Died during subsequent admission*	24 (0.6)	76 (2.0)	131 (3.5)	235 (6.2)
All other deaths	23 (0.6)	55 (1.5)	90 (2.4)	169 (4.5)
Total at risk	**3,738 (98.8)**	**3,654 (96.5)**	**3,564 (94.2)**	**3,381 (89.3)**

* Data available for Queensland public hospitals only

Table 29: Cumulative all-cause unadjusted mortality by patient characteristic

Characteristic	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	2,499	33 (1.3)	87 (3.5)	145 (5.8)	259 (10.4)
Female	1,286	14 (1.1)	44 (3.4)	76 (5.9)	145 (11.3)
Age group					
<65 years	1535	7 (0.5)	17 (1.1)	40 (2.6)	73 (4.8)
65–74 years	967	8 (0.8)	33 (3.4)	51 (5.3)	95 (9.8)
≥75 years	1283	32 (2.5)	81 (6.3)	130 (10.1)	236 (18.4)
Heart failure phenotype					
HFrEF	3,243	38 (1.2)	105 (3.2)	170 (5.2)	315 (9.7)
HFpEF	457	8 (1.8)	23 (5.0)	42 (9.2)	74 (16.2)
Primary right HF	38	1 (2.6)	1 (2.6)	5 (13.2)	8 (21.1)
Missing/unsure	47	(0.0)	2 (4.3)	4 (8.5)	7 (14.9)
ALL	**3,785**	**47 (1.2)**	**131 (3.5)**	**221 (5.8)**	**404 (10.7)**

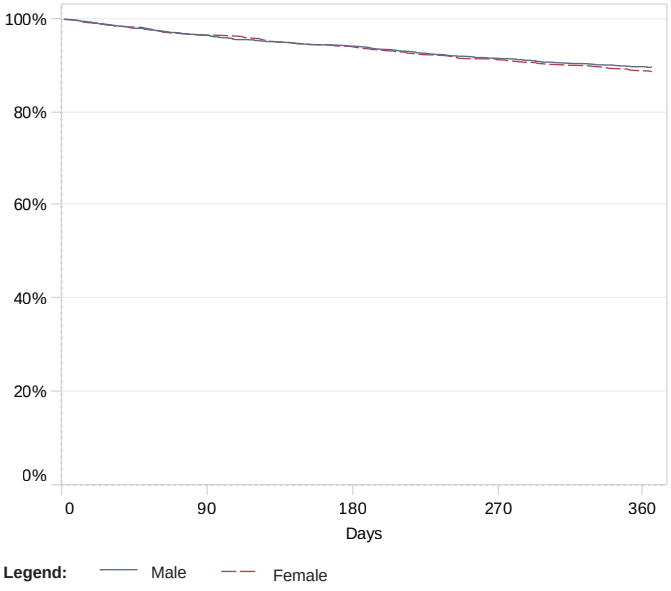


Figure 19: Heart failure survival by gender

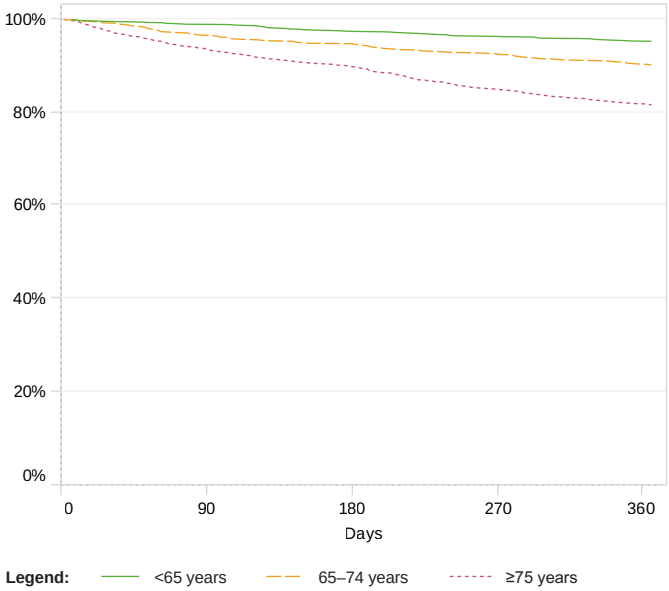


Figure 20: Heart failure survival by age group

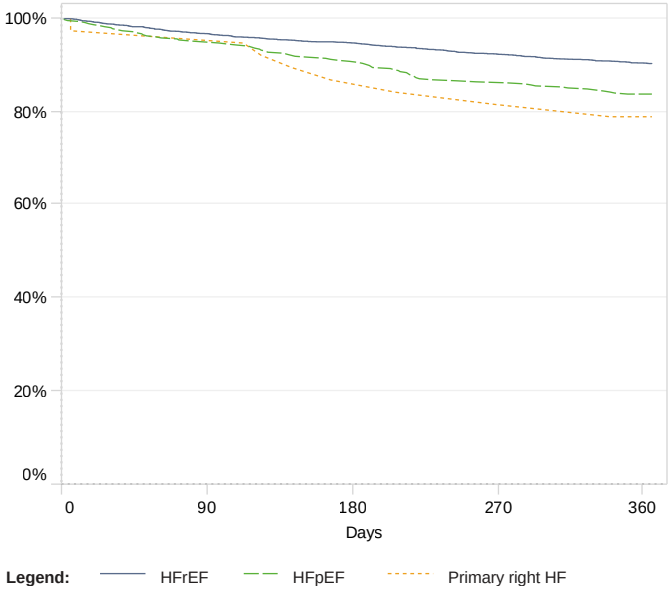


Figure 21: Heart failure survival by phenotype

7.2.2 All-cause and heart failure rehospitalisation

Cumulative incidence curves for all-cause and HF hospitalisation are shown in Figures 22 and 23. Of the 3,785 eligible patients referred to HFSS during 2023, the unadjusted rate of all-cause hospitalisation was 15.2% at 30 days, increasing to 48.7% at one year. Hospitalisations relating to HF (as identified by discharge diagnosis coding) were 4.0% and 15.9% at 30 days and one year respectively.

The overall risk of hospitalisation or death within 12 months post the index admission was 49.7% (Figure 24). Approximately one-quarter of patients referred to an HFSS were rehospitalised two or more times in the subsequent 12 months (Table 30).

Table 30: Number of rehospitalisations per patient in the year post initial discharge

Total in one year	All-cause n (%)	Heart failure n (%)
0	1,975 (52.2)	3,222 (85.1)
1	881 (23.3)	365 (9.6)
2	427 (11.3)	122 (3.2)
3	220 (5.8)	40 (1.1)
4	112 (3.0)	15 (0.4)
≥5	170 (4.5)	21 (0.6)

Table 31: Cumulative incidence of all-cause rehospitalisation from 30 to 365 days post discharge

Characteristic	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	2,499	358 (14.4)	646 (26.2)	849 (34.4)	1136 (46.3)
Female	1,286	212 (16.6)	388 (30.4)	529 (41.6)	674 (53.4)
Age group					
<65 years	1,535	191 (12.5)	349 (22.8)	480 (31.5)	633 (41.6)
65–74 years	967	149 (15.5)	250 (26.2)	326 (34.1)	434 (45.7)
≥75 years	1,283	230 (18.1)	435 (34.5)	572 (45.5)	743 (59.7)
Heart failure phenotype					
HFrEF	3,243	480 (14.9)	847 (26.4)	1,126 (35.1)	1,485 (46.6)
HFpEF	457	80 (17.7)	155 (34.6)	213 (47.8)	276 (62.4)
Primary right HF	38	7 (18.9)	14 (37.8)	18 (48.6)	21 (56.8)
Missing/unsure	47	3 (6.4)	18 (38.3)	21 (44.7)	28 (60.9)
ALL	**3,785**	**570 (15.2)**	**1,034 (27.6)**	**1,378 (36.9)**	**1,810 (48.7)**

Table 32: Cumulative incidence of heart failure rehospitalisation from 30 to 365 days post discharge

Characteristic	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	2,499	93 (3.8)	177 (7.3)	234 (9.7)	340 (14.5)
Female	1,286	57 (4.5)	110 (8.8)	164 (13.3)	223 (18.7)
Age group					
<65 years	1,535	53 (3.5)	100 (6.6)	142 (9.4)	192 (12.9)
65–74 years	967	32 (3.3)	64 (6.8)	79 (8.5)	117 (12.9)
≥75 years	1,283	65 (5.2)	123 (10.0)	177 (14.8)	254 (22.4)
Heart failure phenotype					
HFrEF	3,243	121 (3.8)	225 (7.1)	307 (9.8)	424 (13.9)
HFpEF	457	27 (6.0)	54 (12.3)	80 (18.5)	121 (28.9)
Primary right HF	38	2 (5.4)	4 (10.8)	7 (20.6)	9 (28.1)
Missing/unsure	47	0 (0.0)	4 (8.7)	4 (9.1)	9 (22.0)
ALL	**3,785**	**150 (4.0)**	**287 (7.8)**	**398 (10.9)**	**563 (15.9)**

Table 33: Cumulative incidence of all-cause rehospitalisation or death from 30 to 365 days post discharge

Characteristic	Total patients n	30 days n (%)	90 days n (%)	180 days n (%)	365 days n (%)
Gender					
Male	2,499	375 (15.0)	675 (27.0)	881 (35.3)	1,183 (47.3)
Female	1,286	218 (17.0)	398 (30.9)	544 (42.3)	698 (54.3)
Age group					
<65 years	1,535	196 (12.8)	355 (23.1)	490 (31.9)	647 (42.1)
65–74 years	967	154 (15.9)	261 (27.0)	337 (34.9)	452 (46.7)
≥75 years	1,283	243 (18.9)	457 (35.6)	598 (46.6)	782 (61.0)
Heart failure phenotype					
HFrEF	3,243	497 (15.3)	876 (27.0)	1,161 (35.8)	1,539 (47.5)
HFpEF	457	85 (18.6)	164 (35.9)	224 (49.0)	291 (63.7)
Primary right HF	38	8 (21.1)	15 (39.5)	19 (50.0)	22 (57.9)
Missing/unsure	47	3 (6.4)	18 (38.3)	21 (44.7)	29 (61.7)
ALL	**3,785**	**593 (15.7)**	**1,073 (28.3)**	**1,425 (37.6)**	**1,881 (49.7)**

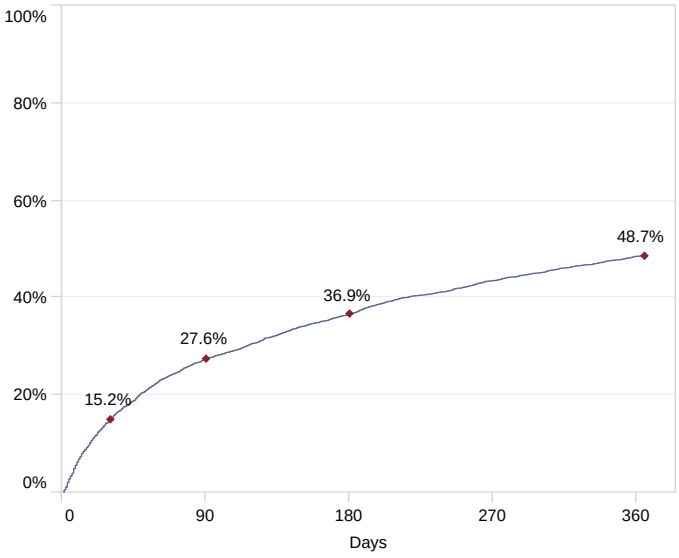


Figure 22: Cumulative incidence of all-cause rehospitalisation

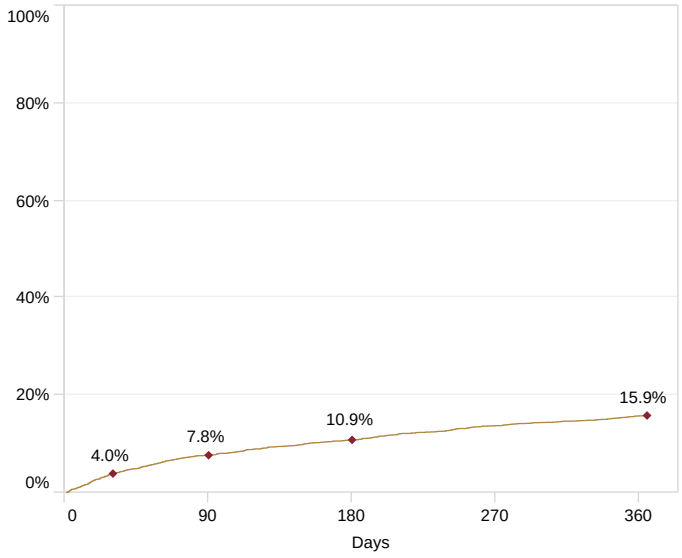


Figure 23: Cumulative incidence of heart failure rehospitalisation

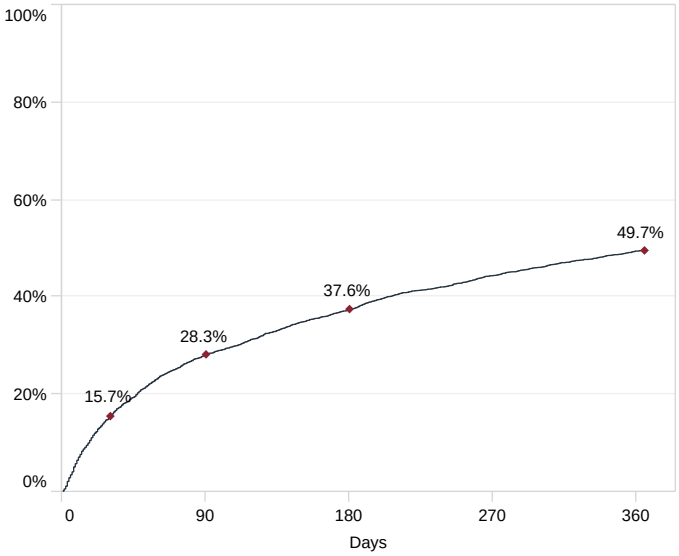


Figure 24: Cumulative incidence of all-cause rehospitalisation or death

7.2.3 Days alive and out of hospital

Days alive and out of hospital (DAOH) incorporates mortality and all hospitalisations (including length of hospital stay) within one year of discharge. This single measure demonstrates the post discharge time alive and not in hospital as a combined measure.

Almost 51% of patients survived more than a year without rehospitalisation, with a median of 365 days for the whole group. The mean days alive and out of hospital was 336 days, with 106,943 days lost due to death or hospitalisation over 12 months in 3,721 patients.

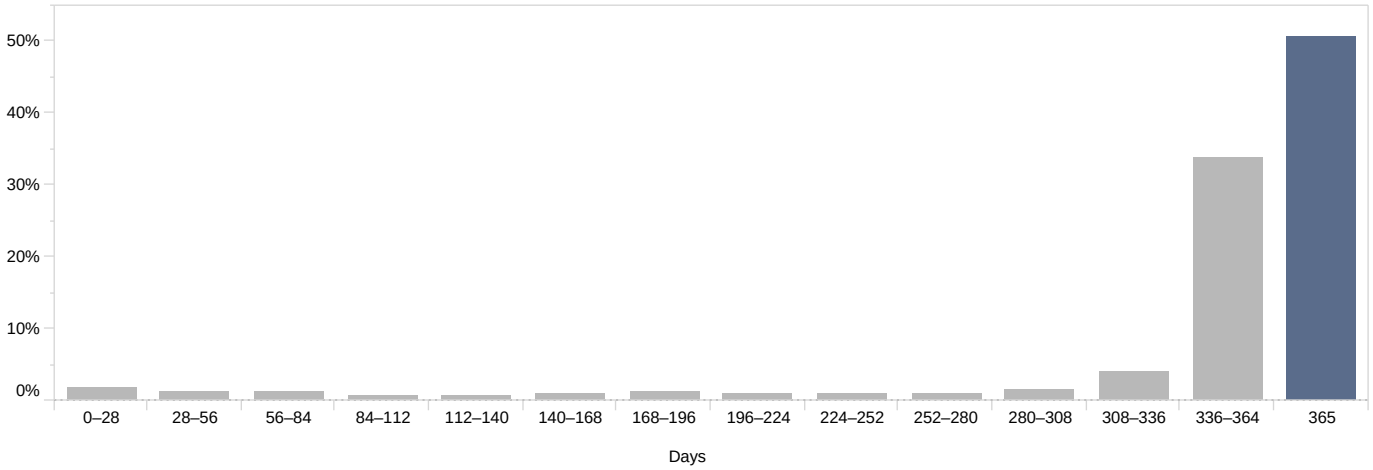
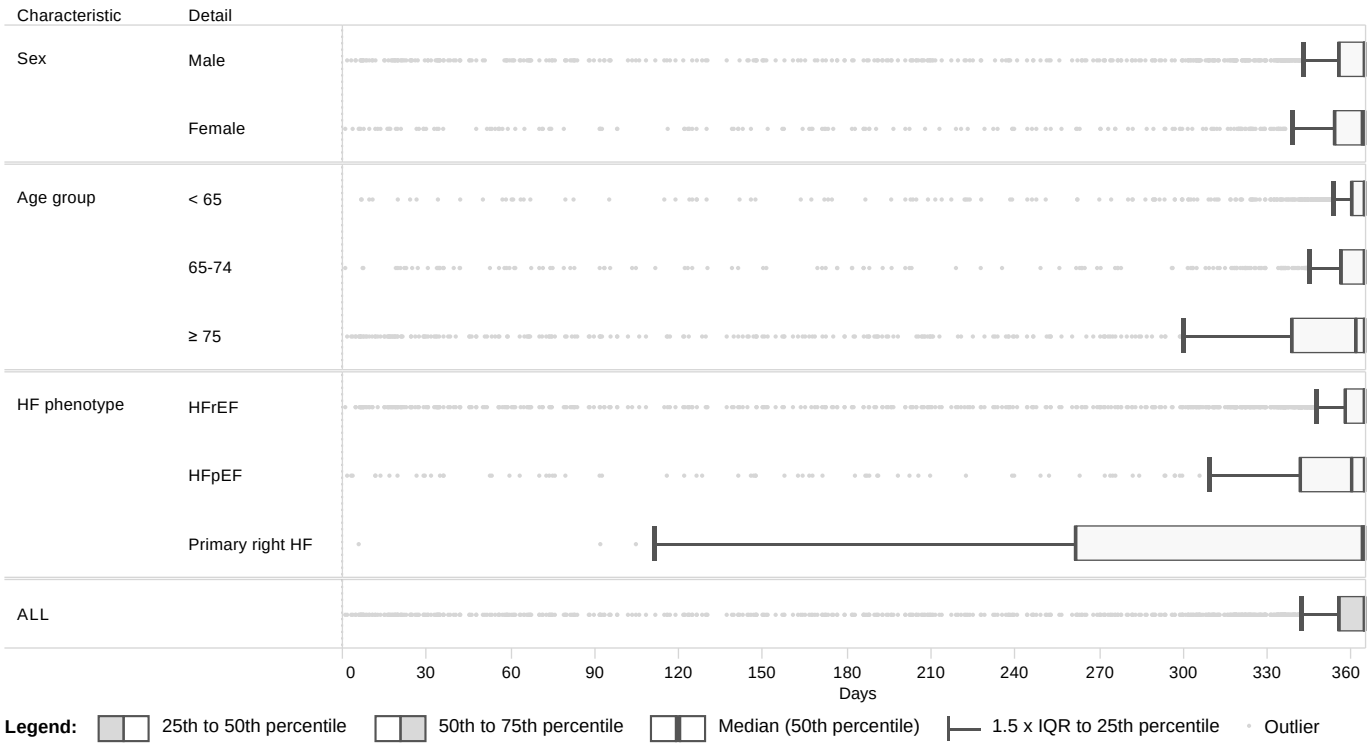


Figure 25: Days alive and out of hospital within one year after hospital discharge

Table 34: Days alive and out of hospital within one year of discharge by patient characteristic

Characteristic	Detail	n	Mean days	Median (IQR) days
Sex	Male	2,463	336.4	365 (356–365)
	Female	1,258	335.9	364 (354–365)
Age group	<65	1,518	350.6	365 (360–365)
	65–74	956	338.7	365 (357–365)
	≥75	1,247	316.9	362 (338–365)
HF phenotype	HFrEF	3,193	339.0	365 (358–365)
	HFpEF	446	320.8	361 (341–365)
	Primary right HF	36	303.6	364 (295–365)
	Missing/unsure	46	323.6	362 (336–365)
ALL		**3,721**	**336.3**	**365 (356–365)**

The box and whisker plots in Figure 26 illustrate the distribution of DAOH for different characteristics. The median DAOH is close to 365 days for most categories (the box shows the middle 50% of scores). The whiskers stretching to the left illustrate that many patients spent subsequent time in hospital or died. The DAOH was much lower for patients who were over 75 years old.



Mean, median and interquartile range (IQR) are given in days

Figure 26: Days alive and out of hospital within one year of discharge by patient characteristic

References

Interventional Cardiology Audit

1 Australian Bureau of Statistics. (2022). Causes of Death, Australia, ABS. Canberra. https://www.abs.gov.au/statistics/health/causes-death/causes-death-australia/latest-release#leading-causes-of-death-in-aboriginal-and-torres-strait-islander-people

2 Australian Bureau of Statistics. (2021). *Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians*. ABS. https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/census-population-and-housing-counts-aboriginal-and-torres-strait-islander-australians/2021#queensland

3 National Cardiovascular Data Registry. (2011, January 5). *CathPCI Data Coder's Dictionary*. https://www.ncdr.com/webncdr/cathpci/home/datacollection

4 Baran, D. A., Grines, C. L., Bailey, S., Burkhoff, D., Hall, S. A., Henry, T. D., Hollenberg, S. M., Kapur, N. K., O'Neill, W., Ornato, J. P., Stelling, K., Thiele, H., Diepen, S., & Naidu, S. S. (2019). SCAI clinical expert consensus statement on the classification of Cardiogenic Shock. *Catheterization and Cardiovascular Interventions*. https://doi.org/10.1002/ccd.28329

5 Shroff, A., Kupfer, J., Gilchrist, I. C., Caputo, R. P., Goyal, A., & Seto, A. H. (2016). Same-day discharge after percutaneous coronary intervention: Current perspectives and strategies for implementation. *JAMA Cardiology*, *1*(2), 216–223. https://doi.org/10.1001/jamacardio.2016.0148

6 Writing Committee, Rao, S. V., Vidovich, M. I., Gilchrist, I. C., Gulati, R., Gutierrez, J. A., Hess, C. N., Kaul, P., Martinez, S. C., & Rymer, J. (2021). 2021 ACC Expert Consensus Decision Pathway on Same-Day Discharge After Percutaneous Coronary Intervention: A Report of the American College of Cardiology Solution Set Oversight Committee. *Journal of the American College of Cardiology*, *77*(6), 811–825. https://doi.org/10.1016/j.jacc.2020.11.013

7 Bourdillon, M., Charitakis, K., & Boudoulas, K. D. (2024, February 8). *Implementing a same-day discharge pathway after a PCI*. Society for Cardiovascular Angiography & Interventions. https://scai.org/quality-improvement-tools/qi-tips/implementing-same-day-discharge-pathway-after-pci

8 Nguyen, N. H., Le, T. N., Thu Nguyen, H. T., Pham, T. M., & Nguyen, D. V. (2025). Same-day Discharge Following Percutaneous Coronary Intervention: A Systematic Review and Meta-analysis of Randomised Controlled Trials. *European Cardiology*, *20*, e19. https://doi.org/10.15420/ecr.2025.21

9 Chen, Y., Smith, I., Wu, C. J., Hattingh, L., Howes, L., Jayasinghe, R., Poulter, R., Rahman, A., Starmer, G., Singbal, Y., Yadav, R., & Marshall, A. P. (2025). Prevalence, trends, and outcomes of same-day discharge following elective percutaneous coronary intervention: a retrospective observational cohort study using routinely collected health data. *European Journal of Cardiovascular Nursing*, *24*(1), 104–113. https://doi.org/10.1093/eurjcn/zvae125

10 Lefkovits, J., Brennan, A., Dinh, D., Carruthers, H., Doyle, J., Lucas, M., Stub, D., & Reid, C. M. (2024). VCOR 2024 annual report. Victorian Cardiac Outcomes Registry (VCOR). Retrieved from https://www.monash.edu/__data/assets/pdf_file/0007/4117651/vcor-2024-annual-report.pdf

11 McAllister, K. S. L., Ludman, P. F., Hulme, W., de Belder, M. A., Stables, R., Chowdhary, S., Mamas, M. A., Sperrin, M., & Buchan, I. E. (2016). A contemporary risk model for predicting 30-day mortality following percutaneous coronary intervention in England and Wales. *International Journal of Cardiology*, *210*, 125–132. https://doi.org/10.1016/j.ijcard.2016.02.085

12 Andrianopoulos, N., Chan, W., Reid, C., Brennan, A. L., Yan, B., Yip, T., Clark, D. J., New, G., Ajani, A. E., & Duffy, S. J. (2014). PW245 Australia's first PCI registry-derived logistic and additive risk score calculations predicting post-procedural adverse outcomes. *Global Heart*, *9*(1). https//doi.org/10.1016/j.gheart.2014.03.2340

13 Hannan, E. L., Farrell, L. S., Walford, G., Jacobs, A. K., Berger, P. B., Holmes, D. R., Stamato, N. J., Sharma, S., & King, S. B. (2013). The New York State Risk Score for predicting in-hospital/30-day mortality following percutaneous coronary intervention. *JACC: Cardiovascular Interventions*, *6*(6), 614–622. https://doi.org/10.1016/j.jcin.2013.02.015

14 Beck, B., Bray, J., Cameron, P., Smith, K., Walker, T., Grantham, H., Hein, C., Thorrowgood, M., Smith, A., Inoue, M., Smith, T., Dicker, B., Swain, A., Bosley, E., Pemberton, K., McKay, M., Johnston-Leek, M., Perkins, G. D., Nichol, G., & Finn, J. (2018). Regional variation in the characteristics, incidence and outcomes of out-of-hospital cardiac arrest in Australia and New Zealand: Results from the Aus-ROC Epistry. *Resuscitation*, *126*, 49–57. https://doi.org/10.1016/j.resuscitation.2018.02.029

15 Rao, S. V., O'Donoghue, M. L., Ruel, M., Rab, T., Tamis-Holland, J. E., Alexander, J. H., Baber, U., Baker, H., Cohen, M. G., Cruz-Ruiz, M., Davis, L. L., de Lemos, J. A., DeWald, T. A., Elgendy, I. Y., Feldman, D. N., Goyal, A., Isiadinso, I., Menon, V., Morrow, D. A., … Williams, M. S. (2025). 2025 ACC/AHA/ACEP/NAEMSP/SCAI guideline for the management of patients with acute coronary syndromes: A report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*, *151*, e771–e862. https://doi.org/10.1161/CIR.0000000000001309

16 Byrne, R. A., Rossello, X., Coughlan, J. J., Barbato, E., Berry, C., Chieffo, A., Claeys, M. J., Dan, G.-A., Dweck, M. R., Galbraith, M., Gilard, M., Hinterbuchner, L., Jankowska, E. A., Jüni, P., Kimura, T., Kunadian, V., Leosdottir, M., Lorusso, R., Pedretti, R. F. E., … ESC Scientific Document Group. (2023). 2023 ESC Guidelines for the management of acute coronary syndromes: Developed by the task force on the management of acute coronary syndromes of the European Society of Cardiology (ESC). *European Heart Journal*, *44*(38), 3720–3826. https://doi.org/10.1093/eurheartj/ehad191

17 Chesebro, J. H., Knatterud, G., Roberts, R., Borer, J., Cohen, L. S., Dalen, J., Dodge, H. T., Francis, C. K., Hillis, D., & Ludbrook, P. (1987). Thrombolysis in myocardial infarction (TIMI) trial, phase I: A comparison between intravenous tissue plasminogen activator and intravenous streptokinase. clinical findings through hospital discharge. *Circulation*, *76*(1), 142–154. https://doi.org/10.1161/01.cir.76.1.142

18 Doan, T. N., Prior, M., Vollbon, W., Rogers, B., Rashford, S., & Bosley, E. (2021). Survival after resuscitated out-of-hospital cardiac arrest in patients with paramedic-identified ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention. *Prehospital Emergency Care*, *26*(6), 764–771. https://doi.org/10.1080/10903127.2021.1992054

19 Savage, M. L., Hay, K., Vollbon, W., Doan, T., Murdoch, D. J., Hammett, C., Poulter, R., Walters, D. L., Denman, R., Ranasinghe, I., & Raffel, O. C. (2023). Prehospital Activation of the Cardiac Catheterization Laboratory in ST-Segment-Elevation Myocardial Infarction for Primary Percutaneous Coronary Intervention. *Journal of the American Heart Association*, *12*(14), e029346. https://doi.org/10.1161/JAHA.122.029346

20 Chew, D. P., Scott, I. A., Cullen, L., French, J. K., Briffa, T. G., Tideman, P. A., Woodruffe, S., Kerr, A., Branagan, M., & Aylward, P. E. G. (2017). Corrigendum to 'National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand: Australian clinical guidelines for the management of Acute Coronary Syndromes 2016' Heart Lung and Circulation volume 25, (2016) 898 - 952. *Heart, Lung and Circulation*, *26*(10), 1117. https://doi.org/10.1016/j.hlc.2017.08.004.

Supplement: Structural heart disease

21 Makkar, R. R., Thourani, V. H., Mack, M. J., Kodali, S. K., Kapadia, S., Webb, J. G., Yoon, S.-H., Trento, A., Svensson, L. G., Herrmann, H. C., Szeto, W. Y., Miller, D. C., Satler, L., Cohen, D. J., Dewey, T. M., Babaliaros, V., Williams, M. R., Kereiakes, D. J., Zajarias, A., … Leon, M. B. (2020). Five-year outcomes of transcatheter or surgical aortic-valve replacement. *New England Journal of Medicine*, *382*(9), 799–809. https://doi.org/10.1056/nejmoa1910555

22 Arnold, S. V., Chinnakondepalli, K. M., Magnuson, E. A., Reardon, M. J., Deeb, G. M., Gleason, T., Yakubov, S. J., & Cohen, D. J. (2020). Five-year health status after self-expanding transcatheter or surgical aortic valve replacement in high-risk patients with severe aortic stenosis. *JAMA Cardiology*. https://doi.org/10.1001/jamacardio.2020.4397

23 Jørgensen, T. H., Thyregod, H. G., Ihlemann, N., Nissen, H., Petursson, P., Kjeldsen, B. J., Steinbrüchel, D. A., Olsen, P. S., & Søndergaard, L. (2021). Eight-year outcomes for patients with aortic valve stenosis at low surgical risk randomized to transcatheter vs. surgical aortic valve replacement. *European Heart Journal*, *42*(30), 2912–2919. https://doi.org/10.1093/eurheartj/ehab375

24 Burrage, M., Moore, P., Cole, C., Cox, S., Lo, W. C., Rafter, A., Garlick, B., Garrahy, P., Mundy, J., & Camuglia, A. (2017). Transcatheter aortic valve replacement is associated with comparable clinical outcomes to open aortic valve surgery but with a reduced length of in-patient hospital stay: A systematic review and meta-analysis of Randomised Trials. *Heart, Lung and Circulation*, *26*(3), 285–295. https://doi.org/10.1016/j.hlc.2016.07.011

25 Vahanian, A., Beyersdorf, F., Praz, F., Milojevic, M., Baldus, S., Bauersachs, J., Capodanno, D., Conradi, L., De Bonis, M., De Paulis, R., Delgado, V., Freemantle, N., Gilard, M., Haugaa, K. H., Jeppsson, A., Jüni, P., Pierard, L., Prendergast, B. D., Sádaba, J. R., … Sharipov, I. (2021). 2021 ESC/EACTS Guidelines for the management of Valvular Heart Disease. *European Heart Journal*, *43*(7), 561–632. https://doi.org/10.1093/eurheartj/ehab395

26 Dauerman, H. L., Deeb, G. M., O'Hair, D. P., Waksman, R., Yakubov, S. J., Kleiman, N. S., Chetcuti, S. J., Hermiller, J. B., Bajwa, T., Khabbaz, K., de Marchena, E., Salerno, T., Dries-Devlin, J. L., Li, S., Popma, J. J., & Reardon, M. J. (2019). Durability and clinical outcomes of transcatheter aortic valve replacement for failed surgical bioprostheses. *Circulation: Cardiovascular Interventions*, *12*(10). https://doi.org/10.1161/circinterventions.119.008155

27 Reardon, M. J., Van Mieghem, N. M., Popma, J. J., Kleiman, N. S., Søndergaard, L., Mumtaz, M., Adams, D. H., Deeb, G. M., Maini, B., Gada, H., Chetcuti, S., Gleason, T., Heiser, J., Lange, R., Merhi, W., Oh, J. K., Olsen, P. S., Piazza, N., Williams, M., … Kappetein, A. P. (2017). Surgical or transcatheter aortic-valve replacement in intermediate-risk patients. *New England Journal of Medicine*, *376*(14), 1321–1331. https://doi.org/10.1056/nejmoa1700456

28 Bekeredjian, R., Szabo, G., Balaban, Ü., Bleiziffer, S., Bauer, T., Ensminger, S., Frerker, C., Herrmann, E., Beyersdorf, F., Hamm, C., Beckmann, A., Möllmann, H., Karck, M., Katus, H. A., & Walther, T. (2018). Patients at low surgical risk as defined by the society of thoracic surgeons score undergoing isolated interventional or surgical aortic valve implantation: In-hospital data and 1-year results from the German Aortic Valve Registry (GARY). *European Heart Journal*, *40*(17), 1323–1330. https://doi.org/10.1093/eurheartj/ehy699

29 Leon, M. B., Smith, C. R., Mack, M. J., Makkar, R. R., Svensson, L. G., Kodali, S. K., Thourani, V. H., Tuzcu, E. M., Miller, D. C., Herrmann, H. C., Doshi, D., Cohen, D. J., Pichard, A. D., Kapadia, S., Dewey, T., Babaliaros, V., Szeto, W. Y., Williams, M. R., Kereiakes, D., … Webb, J. G. (2016). Transcatheter or surgical aortic-valve replacement in intermediate-risk patients. *New England Journal of Medicine*, *374*(17), 1609–1620. https://doi.org/10.1056/nejmoa1514616

Cardiac Surgery Audit

1 Australian Bureau of Statistics. (2022). Causes of death, Australia, ABS. Canberra. https://www.abs.gov.au/statistics/health/causes-death/causes-death-australia/latest-release#leading-causes-of-death-in-aboriginal-and-torres-strait-islander-people

2 Australian Bureau of Statistics. (2021). *Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians*. ABS. https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/census-population-and-housing-counts-aboriginal-and-torres-strait-islander-australians/2021#queensland

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

31 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

32 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

33 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

34 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

35 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

[36] 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

[37] 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

Supplement: Queensland cardiothoracic surgery quality assurance committee

[31] 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

[34] 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

[35] 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

[36] 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

[32] 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

[38] Smith, I. R., Garlick, B., Gardner, M. A., Brighouse, R. D., Foster, K. A., & Rivers, J. T. (2013). Use of graphical statistical process control tools to monitor and improve outcomes in cardiac surgery. *Heart, Lung & Circulation*, *22*(2), 92–99. https://doi.org/10.1016/j.hlc.2012.08.060

[39] Roberts, S. W. (2000). Control Chart Tests Based on Geometric Moving Averages. *Technometrics*, *42*(1), 97–101. https://doi.org/10.1080/00401706.2000.10485986

[40] Cook, D. A., Coory, M., & Webster, R. A. (2011). Exponentially weighted moving average charts to compare observed and expected values for monitoring risk-adjusted hospital indicators. *BMJ quality & safety*, *20*(6), 469–474. https://doi.org/10.1136/bmjqs.2008.031831

[41] Montgomery, D. C. (2020). Introduction to statistical quality control (8th ed.). John Wiley & Sons. ISBN 1119723094, 9781119723097.

Thoracic Surgery Audit

42 Queensland Government. (2020, July). Queensland Lung Cancer Quality Index: Indicators of safe, quality cancer care, lung cancer care in public and private hospitals, 2011–2016 (ISBN 978-0-6481487-9-1). Queensland Health. https://cancerallianceqld.health.qld.gov.au/media/1904/queensland-lung-cancer-quality-index-2011-2016.pdf

43 Detterbeck, F. C., Boffa, D. J., Kim, A. W., & Tanoue L. T. (2017). The eighth edition lung cancer stage classification. *Chest*. *151*(1), 193–203. https://doi.org/10.1016/j.jtcvs.2017.08.138

Electrophysiology and Pacing Audit

2 Australian Bureau of Statistics. (2021). *Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians*. ABS. https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/census-population-and-housing-counts-aboriginal-and-torres-strait-islander-australians/2021#queensland

44 Wang, Y., Hou, W., Zhou, C., Yin, Y., Lu, S., Liu, G., … Zhang, H.-J. (2018). Meta-analysis of the incidence of lead dislodgement with conventional and leadless pacemaker systems. *Pacing and Clinical Electrophysiology*, *41*(10), 1365–1371. https://doi.org/10.1111/pace.13458

45 Greenspon, A. J., Patel, J. D., Lau, E., Ochoa, J. A., Frisch, D. R., Ho, R. T., … Kurtz, S. M. (2011). 16-year trends in the infection burden for pacemakers and implantable cardioverter-defibrillators in the United States. *Journal of the American College of Cardiology*, *58*(10), 1001–1006. https://doi.org/10.1016/j.jacc.2011.04.033

Cardiac Rehabilitation Audit

1 Australian Bureau of Statistics. (2022). Causes of death, Australia, ABS. Canberra. https://www.abs.gov.au/statistics/health/causes-death/causes-death-australia/latest-release#leading-causes-of-death-in-aboriginal-and-torres-strait-islander-people

2 Australian Bureau of Statistics. (2021). *Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians*. ABS. https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/census-population-and-housing-counts-aboriginal-and-torres-strait-islander-australians/2021#queensland

46 Gremeaux, V., Troisgros, O., Benaïm, S., Hannequin, A., Laurent, Y., Casillas, J.-M., & Benaïm, C. (2011). Determining the minimal clinically important difference for the six-minute walk test and the 200-meter fast-walk test during cardiac rehabilitation program in coronary artery disease patients after acute coronary syndrome. *Archives of Physical Medicine and Rehabilitation*, *92*(4), 611–619. https://doi.org/10.1016/j.apmr.2010.11.023

47 Kroenke, K., Spitzer, R. L., Williams, J. B. W., & Löwe, B. (2009). An ultra-brief screening scale for anxiety and depression: The PHQ-4. *Psychosomatics*, *50*(6), 613–621. https://doi.org/10.1016/S0033-3182(09)70864-3

48 Hawthorne, G., Korn, S., & Richardson, J. (2013). Population norms for the AQOL derived from the 2007 Australian National Survey of Mental Health and Wellbeing. *Australian and New Zealand Journal of Public Health*, *37*(1), 7–16. https://doi.org/10.1111/1753-6405.12004

49 National Health and Medical Research Council. (2020). *Australian guidelines to reduce health risks from drinking alcohol*. Commonwealth of Australia. https://www.nhmrc.gov.au/about-us/publications/australian-guidelines-reduce-health-risks-drinking-alcohol

Supplement: Cardiac rehabilitation model of care

50 Lima de Melo Ghisi, G., Pesah, E., Turk-Adawi, K., Supervia, M., Lopez Jimenez, F., & Grace, S. L. (2018). Cardiac Rehabilitation Models around the Globe. *Journal of Clinical Medicine*, *7*(9), 260. https://doi.org/10.3390/jcm7090260

51 Abell, B., Glasziou, P., Briffa, T., & Hoffmann, T. (2016). Exercise training characteristics in cardiac rehabilitation programmes: a cross-sectional survey of Australian practice. *Open Heart*, *3*(1), e000374. https://doi.org/10.1136/openhrt-2015-000374

52 Pesah, E., Turk-Adawi, K., Supervia, M., Lopez-Jimenez, F., Britto, R., Ding, R., Babu, A., Sadeghi, M., Sarrafzadegan, N., Cuenza, L., Anchique Santos, C., Heine, M., Derman, W., Oh, P., & Grace, S. L. (2019). Cardiac rehabilitation delivery in low/middle-income countries. *Heart (British Cardiac Society)*, *105*(23), 1806–1812. https://doi.org/10.1136/heartjnl-2018-314486

53 Woodruffe, S., Neubeck, L., Clark, R. A., Gray, K., Ferry, C., Finan, J., Sanderson, S., & Briffa, T. G. (2015). Australian Cardiovascular Health and Rehabilitation Association (ACRA) core components of cardiovascular disease secondary prevention and cardiac rehabilitation 2014. *Heart, Lung & Circulation*, *24*(5), 430–441. https://doi.org/10.1016/j.hlc.2014.12.008

54 Brown, T. M., Pack, Q. R., Aberegg, E., Brewer, L. C., Ford, Y. R., Forman, D. E., Gathright, E. C., Khadanga, S., Ozemek, C., Thomas, R. J., & American Heart Association Exercise, Cardiac Rehabilitation and Secondary Prevention Committee of the Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council on Lifestyle and Cardiometabolic Health; and Council on Quality of Care and Outcomes Research (2024). Core Components of Cardiac Rehabilitation Programs: 2024 Update: A Scientific Statement From the American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation. *Circulation*, *150*(18), e328–e347. https://doi.org/10.1161/CIR.0000000000001289

55 Queensland Health. (2023, August). *Queensland Health cardiac rehabilitation services: Model of care document* [PDF]. State of Queensland (Queensland Health). https://www.health.qld.gov.au/__data/assets/pdf_file/0013/1371001/QH-CR-Services_MoC-document-final.pdf

56 Atherton, J. J., & Hickey, A. (2017). Expert comment: Is medication titration in heart failure too complex? *Cardiac Failure Review*, *03*(01), 25. https://doi.org/10.15420/cfr.2017:1:2

57 Yancy, C. W., Jessup, M., Bozkurt, B., Butler, J., Casey, D. E., Drazner, M. H., Fonarow, G. C., Geraci, S. A., Horwich, T., Januzzi, J. L., Johnson, M. R., Kasper, E. K., Levy, W. C., Masoudi, F. A., McBride, P. E., McMurray, J. J. V., Mitchell, J. E., Peterson, P. N., Riegel, B., … Wilkoff, B. L. (2013). 2013 ACCF/AHA guideline for the management of heart failure. *Circulation*, *128*(16). https://doi.org/10.1161/cir.0b013e31829e8776

58 Atherton, J., Branagan, M., Sindone, A., Abhayaratna, W., Driscoll, A., De Pasquale, C., Hopper, I., MacDonald, P., Kistler, P., Newton, P., Audehm, R., Briffa, T., Wong, J., O'Loughlin, J., & Thomas, L. (2018). The National Heart Foundation of Australia and Cardiac Society of Australia and New Zealand guidelines for the prevention, detection, and management of chronic heart failure in Australia 2018. *Heart, Lung and Circulation*, *27*(10), 1123–1208. https://doi.org/10.1016/j.hlc.2018.06.214

59 McDonagh, T. A., Metra, M., Adamo, M., Gardner, R. S., Baumbach, A., Böhm, M., Burri, H., Butler, J., Čelutkienė, J., Chioncel, O., Cleland, J. G. F., Coats, A. J. S., Crespo-Leiro, M. G., Farmakis, D., Gilard, M., Heymans, S., Hoes, A. W., Jaarsma, T., Jankowska, E. A., Lainscak, M., Lam, C. S. P., Lyon, A. R., McMurray, J. J. V., Mebazaa, A., Mindham, R., Muneretto, C., Piepoli, M. F., Price, S., Rosano, G. M. C., Ruschitzka, F., & Skibelund, A. K. (2021). 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: Developed by the Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC) With the special contribution of the Heart Failure Association (HFA) of the ESC. *European Heart Journal*, *42*(36), 3599–3726. https://doi.org/10.1093/eurheartj/ehab368

60 Sindone, A. P., De Pasquale, C., Amerena, J., Burdeniuk, C., Chan, A., Coats, A., Hare, D. L., Macdonald, P., Sverdlov, A., & Atherton, J. J. (2022). Consensus statement on the current pharmacological prevention and management of heart failure. *Medical Journal of Australia*, *217*(4), 212–217. https://doi.org/10.5694/mja2.51656

61 Heidenreich, P. A., Bozkurt, B., Aguilar, D., Allen, L. A., Byun, J. J., Colvin, M. M., Deswal, A., Drazner, M. H., Dunlay, S. M., Evers, L. R., Fang, J. C., Fedson, S. E., Fonarow, G. C., Hayek, S. S., Hernandez, A. F., Khazanie, P., Kittleson, M. M., Lee, C. S., Link, M. S., … Yancy, C. W. (2022). 2022 AHA/ACC/HFSA guideline for the management of heart failure. *Journal of the American College of Cardiology*, *79*(17), e263–e421. https://doi.org/10.1016/j.jacc.2021.12.012

Glossary

6MWT	Six Minute Walk Test
ACC	American College of Cardiology
ACEI	Angiotensin Converting Enzyme Inhibitor
ACP	Advanced Care Paramedic
ACS	Acute Coronary Syndromes
AEP	Accredited Exercise Physiologist
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
ARC	Academic Research Consortium
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
CPB	Cardiopulmonary Bypass
CR	Cardiac Rehabilitation
CRT	Cardiac Resynchronisation Therapy
CS	Cardiac Surgery
CTS	Cardiothoracic 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	Generalized Anxiety Disorder
GCCH	Gold Coast Community Health
GCS	Glasgow Coma Scale
GCUH	Gold Coast University Hospital
GLH	Gladstone Hospital
GP	General Practitioner
GYH	Gympie Hospital
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
HHB	Hospital and Health Boards
HHS	Hospital and Health Service
HOCM	Hypertrophic Obstructive Cardiomyopathy
IABP	Intra-Aortic Balloon Pump
IC	Interventional Cardiology
ICD	Implantable Cardioverter Defibrillator
IE	Infective Endocarditis
IHD	Ischaemic Heart Disease
IHT	Inter Hospital Transfer
IPCH	Ipswich Community Health
IPH	Ipswich Hospital
IQR	Inter Quartile Range
IVL	Intra-Coronary Lithotripsy
IVDU	Intravenous Drug Use
IVUS	Intravascular Ultrasound
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
M&M	Morbidity and Mortality
MBH	Mackay Base Hospital
MI	Myocardial Infarction
MIH	Mt Isa Hospital
MKH	Mackay Base Hospital

MoC	Model of Care
MRA	Mineralocorticoid Receptor Antagonists
MRSA	Methicillin Resistant Staphylococcus aureus
MSSA	Methicillin Susceptible Staphylococcus Aureus
NCDR	National Cardiovascular Data Registry
NCS	Networked Cardiac Services
NP	Nurse Practitioner
NRBC	Non-Red Blood Cells
NSTEMI	Non-ST segment Elevation Myocardial Infarction
NYHA	New York Heart Association
OCT	Optical Coherence Tomography
OOHCA	Out Of Hospital Cardiac Arrest
ORIF	Open Reduction Internal Fixation
PAH	Princess Alexandra Hospital
PAPVD	Partial Anomalous Pulmonary Venous Drainage
PCI	Percutaneous Coronary Intervention
PDA	Patent Ductus Arteriosus
PFO	Patent Foramen Ovale
PHQ	Patient Health Questionnaire
PICU	Paediatric Intensive Care Unit
PROMS	Patient Reported Outcome Measures
PTCRA	Percutaneous Transluminal Coronary Rotational Atherectomy
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
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
SCAI	Society for Cardiovascular Angiography and Interventions
SCCIU	Statewide Cardiac Clinical Informatics Unit
SCUH	Sunshine Coast University Hospital
SDD	Same Day Discharge
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
TS	Thoracic Surgery
TTVR	Transcatheter Tricuspid Valve Replacement
TUH	Townsville University Hospital
TWH	Toowoomba Hospital
VAD	Ventricular Assist Device
VATS	Video Assisted Thoracic Surgery
VCOR	Victorian Cardiac Outcomes Registry
VF	Ventricular Fibrillation
VSD	Ventricular Septal Defect

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