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Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry (QCOR)
2016 Annual Report

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

Queensland Government

Acknowledgements

We would especially like to thank the Statewide Cardiac Clinical Network for their continued funding and support, the contribution of all Queensland Health participating cardiac services and the individual nurses, allied health professionals and clinicians who collect data and participate in the QCOR program.

We would also like to thank the staff of the Statewide Cardiac Clinical Informatics Unit (SCCIU) who provided clinical informatics support. The Health Statistics Unit and Statistics and Data Governance Branch for providing administrative data to QCOR, as well as the Queensland Ambulance Service for their contribution of data relating to pre-hospital processes.

Without these contributions, this report could not present credible analysis, or facilitate the assessment and monitoring of the standard of cardiac services in Queensland.

For Queensland Health employees, this report is available online at:

http://qheps.health.qld.gov.au/caru/networks/cardiac/

For external parties, electronic copies can be requested by contacting the SCCIU at the email address below.

Email: scciu@health.qld.gov.au

Contents

Figures

QCOR

Cardiac Surgery Audit

Heart Failure Support Services Audit

Interventional Cardiology Audit

Tables

QCOR

Cardiac Surgery Audit

Heart Failure Support Services Audit

Interventional Cardiology Audit

1 Message from the SCCN Chair

The 2016 report brings another important milestone for the Queensland Cardiac Outcomes Registry (QCOR), a structure established by the Statewide Cardiac Clinical Network in 2015 to track the quantity and quality of cardiac interventions in public patients in Queensland. In this report we expand on the initially established interventional cardiology database, to include information on patients undergoing cardiac surgical procedures and follow up and treatment for heart failure. The registry has also commenced data collection in the areas of cardiac electrophysiology and cardiac rehabilitation, and information profiling these interventions will be available in coming reports. The aim of the registry is to enable a more complete individual patient profile for all types of cardiac intervention as it is clear that many patients require a number of interventions over succeeding years, and the results of these multiple treatments are best viewed as a composite picture, rather than as individual isolated events. Importantly, the incorporation of heart failure represents a clear acknowledgement of the essential nature of adequate, comprehensive and sustained follow up (aftercare) to capitalise on the initial diagnostic and therapeutic intervention. It is clear that maintenance of appropriate medical treatment and control of risk factors following cardiac interventions remains paramount.

While these activities of the Statewide Cardiac Network and QCOR have not yet been universally embraced across the state, the accelerating participation of the broader cardiac community, now involving surgery, electrophysiology, imaging and rehabilitation continues to build on the momentum of this project. Important learnings include the difficulties of translation of “small” projects, to a much wider participation base. Issues of data quality and completeness have emerged as critical factors impacting on the ability of data to appropriately discriminate and benchmark individual programs within the registry. These learnings come at a time when even the national body is struggling with the willingness of individuals, and groups of individuals to contribute useful information to allow appropriate outcomes evaluation. QCOR fully recognises the need and responsibility to competently acquire, assess and analyse the data contributed by its members. The project however continues to build on the confidence demonstrated by its members in the necessity and appropriateness of these activities.

I wish to pay special mention to the administrative members of QCOR, without whose assistance this report would not have been possible. I also wish to pay tribute to the courage of the clinicians contributing to this program – at a time when there remains some individual concern about such contributions and personal attribution for the results of medical interventions, the contribution of units, individual physicians and surgeons to the deepening of our knowledge of the particulars of these cardiac interventions is worthy of praise.

Finally, it should be noted that there are rapidly developing teams of young, well trained staff forming new units in the far North, Central Queensland and Sunshine Coast. QCOR and the Cardiac Network is well placed to specifically document the impact of these teams over the coming years.

Dr Paul Garrahy
Chair
Statewide Cardiac Clinical Network (SCCN)

2 Introduction

The Statewide Cardiac Clinical Informatics Unit was established to enable the collation and analysis of clinical data collected in various electronic applications. Following the 2007, Adult Cardiac Service Quality Information Systems (ACQIS) project, focus was placed on understanding the experience of clinicians concerning their needs for quality clinical data relating to cardiac services in Queensland. Specifically, the undertaking focused on information management challenges facing cardiac service delivery.

Key priority areas were identified to improve the quality, safety and efficiency of cardiac care in Queensland. In 2009, the Statewide Cardiac Clinical Network (SCCN) mandated the establishment of a multi-year health informatics program, the Cardiac Information Solutions Program (CISP). Tasked with resolving information management barriers, CISP has assisted in the provision of applications developed to meet the need of an evolving workspace and maturing clinical needs.

To date, CISP has delivered across a number of cardiac specialties ranging from vendor point of care clinical applications to bespoke in-house applications. All systems provide the ability to allow clinical audit for cardiac service specialties, as well as assisting in point of care decision support where appropriate.

With statewide cardiac clinical systems in place, vast amounts of clinical data have been captured and consolidated. In addition to this, relevant administrative data is captured to complement existing clinical data collections. This information is sourced to reduce the requirement for capture of ancillary administrative data by clinicians.

Together these data are collectively known as the Queensland Cardiac Outcomes Registry (QCOR).

By providing a combination of comprehensive and rigorous reports, deep insights into the quality and safety of Cardiac Care across Queensland has been gained. QCOR provides clinicians valid and robust data with meaningful clinical indicators enabling adherence to and setting of benchmarks for evidence based practice.

QCOR is an exciting initiative supporting a clinician led and managed quality and safety Program. It also serves as a model for the establishment of other disease based registries within the public health sector environment.

This 2016 QCOR report now includes two new clinical audits, Cardiac Surgery and Heart Failure, with a total of three audits encompassing both cardiology and cardiothoracic surgery. It is with this continual development and evolution of clinical reporting maturity that QCOR hopes to further support cardiac informatics into the future.

3 Community profile

Cardiovascular disease was the leading cause of admitted patient hospital spending in Queensland in 2016 (11% total expenditure).[1] Until recently, cardiovascular disease was the leading cause of death for Queenslanders, reflecting the substantial gains that have been achieved in preventing and treating cardiovascular diseases over past decades. Despite these gains, cardiovascular disease and its long term consequences still represent significant financial and social burden.

The estimated resident population of Queensland in 2016 was 4,848,877 persons[2], representing approximately 20% of Australia's total population. Population growth was 1.5% which is consistent with the national average of 1.6%.[2] Two-thirds of the projected increase in the state population over the next 20 years is likely to occur in four Queensland Health Hospital and Health Services: Metro South, Metro North, West Moreton and Gold Coast.

Geographically, Queensland presents challenges to the provision of tertiary level cardiac services. Queensland is the world's 6th largest sub-national entity and home to ten of Australia's largest cities. Most of Queensland, (90% land mass) is classified as remote or very remote. Almost all the population (97%) is clustered in the coastal towns and the south east, though the population is decentralised with more than 50% of persons living outside the capital. 25% reside outside of the South East region. Indigenous Queenslanders constitute 4.3% (2014)[3] of the state population, with one quarter of the Indigenous Queenslander population living in two HHSs: Cairns and Hinterland, and Metro South[4].

Population densities also vary considerably across the state. The relatively low density of Mackay (15.5 persons/km^2) is in contrast to the average density of the Brisbane metropolitan area (882 persons/km^2).

In 2016, 12% of Queenslanders were smoking daily, more than one-third of the energy intake of Queenslanders was derived from food that provides little or no nutritional benefit and two-thirds of Queensland adults were either overweight or obese. About one-quarter of adults have high blood pressure and almost one-third have high cholesterol.[1]

It is with this in mind that cardiac services continue to form a priority for Queensland Hospital and Health Services.

1 Queensland Health. The health of Queenslanders 2016. Report of the Chief Health Officer Queensland. Queensland Government. Brisbane 2016.

2 Australian Bureau of Statistics, Regional Population Growth, Australia, Cat No. 3218.0 ABS: Canberra; 2016.

3 Australian Bureau of Statistics, Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016, Cat. No. 2071.0 ABS: Canberra; 2016.

4 Australian Bureau of Statistics, Population by age and sex, regions of Australia, Cat. No. 3235.0 ABS: Canberra; 2015.

4 QCOR

4.1 The Statewide Cardiac Clinical Network

The Statewide Cardiac Clinical Network (SCCN) acts in an overarching capacity under which three main areas of work fall:

- The Cardiac Information Solutions Program (CISP), responsible for system infrastructure to support data collection
- The Queensland Cardiac Outcomes Registry, supported by the Statewide Cardiac Clinical Informatics Unit (SCCIU)
- Statewide cardiac specialty groups.

Each of these groups and their roles under the SCCN are described in the following sections:

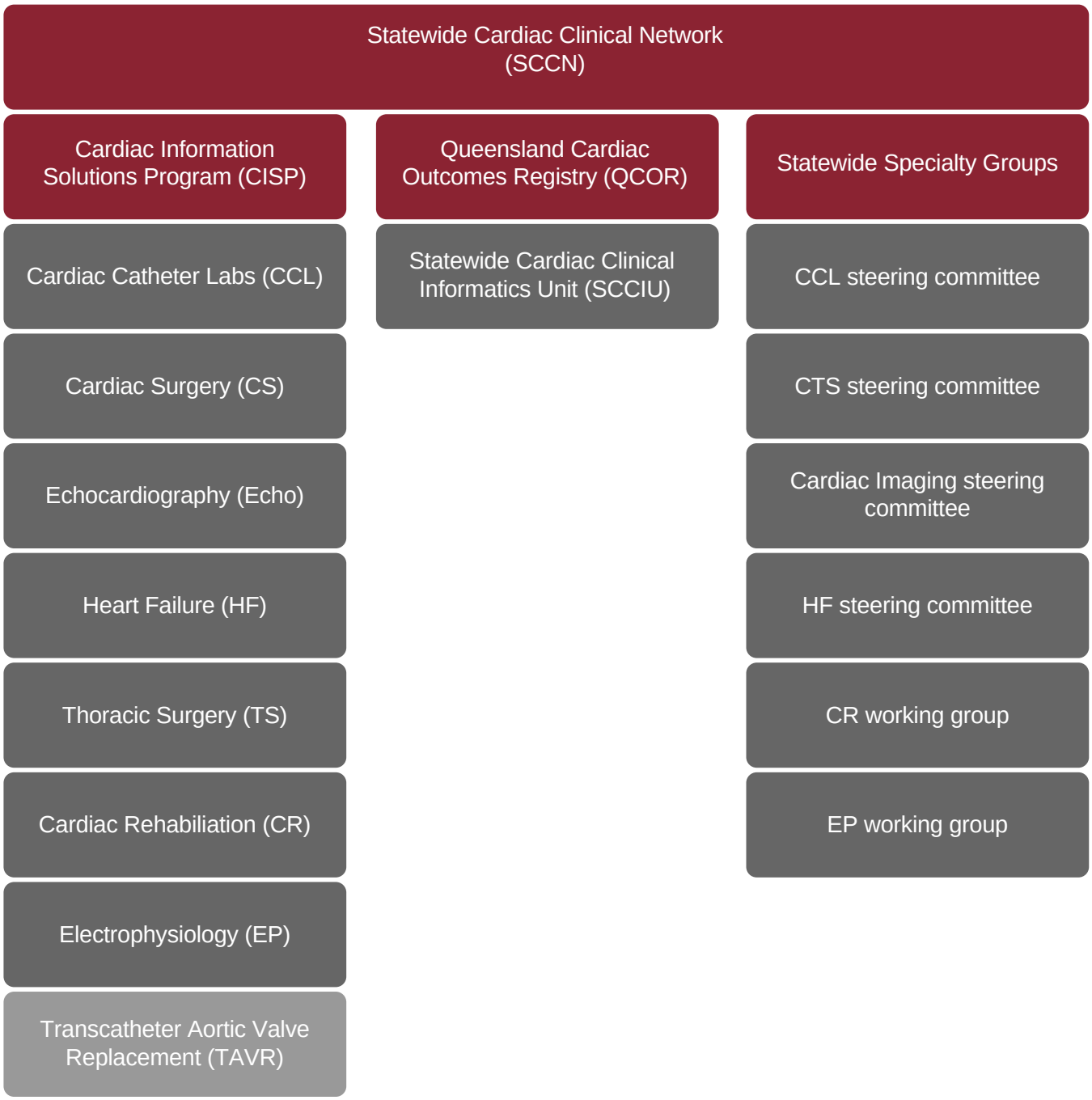

Figure 1: Statewide Cardiac Clinical Network

4.2 Data collection

Since 2012, the Queensland Cardiac Outcomes Registry has been prospectively collecting clinical data to support its quality and safety program across a number of cardiac specialties (see Table 1).

Table 1: Current QCOR data collections

Module	Module Name	Participating Sites (n)
1	Diagnostic and Interventional Cardiology	7
2	Cardiac Surgery	3
3	Heart Failure	24
4	Thoracic Surgery	4
5	Echocardiography	3
6	Electrophysiology, ICDs and ablations	8
7	Cardiac Rehabilitation	52

Table 2: Future QCOR data collections

Module	Module Name
1	TAVR

4.3 Clinical governance

Each specialty group participating in QCOR has its own steering committee/working group responsible for developing a clinical indicator program.

The SCCN is currently working to establish two approved Quality Assurance Committees. These committees are formed under Part 6, of the Hospital and Health Boards Act 2011 to facilitate the participation of clinicians and administrators who are responsible for the management and delivery of cardiac services. Furthermore, these groups are integral in the peer review of the safety and quality of cardiac services and any service improvement activities.

Once established, working group/steering committees undertake benchmarking activities to manage, evaluate, monitor and plan cardiac services.

4.4 Data governance

A cardiac service line-wide data governance model was initially developed by the Interventional Cardiology specialty group. After wider consultation with other specialty areas and ratified by the SCCN in 2014, the model was adopted as a service line-wide model encompassing all QCOR data collections.

All requests are recorded in a statewide register and audited by the relevant specialty group steering committee.

4.5 Operational unit

The Statewide Cardiac Clinical Informatics Unit (SCCIU) was established as a clinician-led clinical informatics unit utilising accurate and timely electronic health data resources to support all facets of clinical informatics. SCCIU provides greatest value in the transformation of QCOR data to clinically meaningful and practical information. This information is useful to support service planning and delivery as well as for audit and quality standards.

The SCCIU employs a mix of staff with varied backgrounds and skillsets. The unit utilises the expertise of clinical analysts, subject matter experts, database administrators, application developers and informatics professionals. The unit works closely with various specialty groups to remain engaged with the clinical service lines.

The SCCIU provides a suite of reports utilising QCOR data for a range of stakeholders including clinicians, administrators and external registries. These reports are broadly categorised into the following areas:

Table 3: SCCIU reporting catalogue

Report Type	Report Content
Operational	Monthly operational reports providing summary level detail for a variety of clinically relevant information
Clinical Indicators	Quarterly clinician developed clinical process and outcome measures
Morbidity and Mortality (M&M)	Quarterly reports detailing relevant information to support cardiac M&M meetings
Data audits	Monthly standardised audit reports for action by site based clinical informaticians and data managers
ANZSCTS	Australian and New Zealand Society for Cardio-Thoracic Surgeons National Clinical Quality Registry
ACOR	Australasian Cardiac Outcomes Registry – Device data
Compliance reporting (in development)	Australian Commission for Safety and Quality in Health Care; Acute Coronary Syndrome (ACS) Clinical Care Guidelines

4.6 Data quality

The success of the QCOR program relies on valid and accurate data. The ongoing responsibility of ensuring high quality data is a team effort between the SCCIU and site based personnel, which include two distinct roles, data managers or clinical quality improvement coordinators (cQIC), with sites choosing which role best suits their needs and resource allocation.

Data managers are responsible to review cases as appropriate, utilising weekly audit reports sent out by the SCCIU to resolve data quality issues. These roles are filled by both administrative staff and/or clinical staff depending on the hospital.

cQICs are designated clinical roles and are currently open to nursing and allied health professionals. These roles, whilst also reviewing clinical case data, play a vital role in identifying processes of care that may be improved, identifying strategies for improvement and implementing these strategies and also evaluating outcomes. All identified areas for development and enhancement are revised using quality improvement methodologies.

The SCCIU distributes weekly data audits to each site addressing the three clinical audit programs. The outstanding data points are actioned at site with the goal of completing all applicable key data points accurately and efficiently, whilst also encouraging ongoing quality data entry by all clinical staff.

5 Future plans

Since its inception, QCOR has continually evolved to encompass more specialty areas within multiple service lines across cardiology and cardiac surgery. Despite this progress, there still remain opportunities for improvement in data collection within some areas and specialty groups.

Data collection applications have been launched or are due to be launched in 2017 in the areas of cardiac electrophysiology including device implants, electrophysiology studies and ablation as well as a bespoke patient assessment tool for cardiac rehabilitation services across Queensland. These applications remain an opportunity for further refinement as well as a chance to further audit and analyse clinical processes and patient flow.

Future applications for development include the expansion of catheter laboratory based procedural reporting in the building of a dedicated TAVR data collection application that allows for collection of pre, post and intra-procedural data. This is due to be commenced in the latter part of 2017.

QCOR has striven to provide a means for contribution and participation in quality standard benchmarking activities. Although currently not collating data for all health institutions across the state of Queensland, QCOR is looking forward to including multiple private health providers in future audits. QCOR is also currently developing applications to provide tools for those sites to contribute their data to facilitate participation.

National registries which collate and analyse procedural and process data in the interest of patient outcomes are an important part of improving clinical practice. QCOR recognises the importance of such initiatives and currently contributes data in line with best practice. Moving forward, QCOR is seeking to consolidate statewide data and ensure that a firm foundation of data is laid before more proactive participation is commenced.

Clinical research is an important use of data which is collected within QCOR facilitated applications. With increased awareness of capabilities and a constant focus on quality, QCOR has a focus on supporting academic interests and encourages data requests through the established processes in place. With an expanding number of service lines, the level and detail of data is continuing to increase in volume and sophistication.

The dynamic nature of healthcare dictates that organisations must remain responsive to new initiatives and a constantly changing workspace. One of the primary objectives of QCOR is to support this change and as such it is always keen to discuss ways that clinical departments can benefit from QCOR's input and initiatives.

Cardiac Surgery Audit

Authors

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

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1 Message from the QCOR Cardiothoracic Steering Committee Chair

For many Queenslanders, cardiac surgery is a once off event for themselves or a loved one. For some, surgery is a planned event with time for considered thought. For others it is can be an emergency in the middle of the night. For yet others, cardiac surgery is something they face several times in their lives.

As surgeons, we take pride in the skills and services that we offer these Queenslanders. We aim to benefit as many people as we can, whilst knowing that our surgery carries risks that have significant effects on our patients and their families when they occur.

This is the first report of the QCOR project to report results in adult cardiac surgery in Queensland. For this report, there are three public adult cardiac surgical units who participated directly in the statewide database program in 2016. A fourth unit began direct entry in the database in 2017, and as new units are established we anticipate they will directly enter into the database. As the focus of this project is Queensland, the data is analysed on a statewide basis.

Each one of our cardiac surgical units is different, certainly no clone of each other. While tempting to assume we are all the same, we serve different patient populations in different parts of Queensland, with different kinds of people who have variations in the kinds of diseases they face. Part of looking at results and reporting is ensuring that despite the different challenges we face, our units are able to provide safe surgery to the patients they see.

Quality in surgery is made of several factors, and encompasses much more than simply the skills of the surgeon in the operating theatre. How a patient is discovered to need cardiac surgery, has tests performed, is sent to the appropriate hospital to receive treatment, then how that surgery is performed, how all the aspects of medical care for the entire hospital stay, and the outpatient clinic, are managed are all parts of quality in surgery. The entire experience of the patient as problems arise that need surgery, through to how they return to their life after surgery is part of quality in surgery, and goes far beyond the skill of an individual surgeon. It's the performance of the entire team that is being measured. For this reason, results are reported for the entire group of units that participate in the database, and are not reported for individual surgeons.

This report is the beginning of a Queensland-based project to ensure Queenslanders are being offered surgery when they would best benefit and then having that surgery performed and managed in the best way possible. This report has two sections. The first reports the characteristics of patients and the surgery they underwent in 2016. The second section is an analysis of the risks of that surgery using several risk prediction scores.

I hope that this report reassures Queenslanders that cardiac surgery is being provided safely to them and their loved ones, and serves to reinforce their trust in our cardiac surgical hospitals.

Dr Christopher Cole
Chair
Statewide Cardiothoracic Surgery Steering Committee

2 Executive summary

This inaugural Queensland Cardiothoracic Surgery audit describes baseline demographics, risk factors, surgeries performed and surgery outcomes for three of the four adult cardiac surgery units that contributed in the QCOR cardiac surgery database in 2016.

Key findings include:

- In 2016, 1,291 surgeries were performed across the three sites.
- The majority of patients were between 61 and 80 years of age (59%).
- Three-quarters of patients were male (76%).
- Three out of four patients were overweight or obese (75%).
- The proportion of Indigenous patients overall was 8%, however there was wide variation between Townsville in the north with 24% of patients classed as Indigenous.
- Smoking and hypertension were present in over half of patients and diabetes in around one-third of patients.
- 19% of patients were current smokers at the time of their operation.
- 56% of patients were elective admissions.
- Same day admission rates for elective surgery were around 26% for all surgery types.
- Approximately two thirds (67%) of all adult cardiac surgery procedures included a coronary artery bypass graft (CABG), and the remaining cases were predominately valve surgery procedures (28%).
- 77% of elective cases did not require blood products compared to 31% of emergency cases.
- Mitral valve repair (66%) was the most common form of valve repair surgery and aortic valve replacement (79%) the most frequently performed replacement surgery.
- The average number of bypass grafts used was 2.9. In multi-vessel CABG the mean number increased to 3.2.
- Calcific valve disease (53%) was the primary pathology for aortic valve replacement with myxomatous disease (31%) the most frequently encountered pathology leading to mitral valve intervention.
- The mortality rate after surgery is significantly less than expected, depending on the risk model used to evaluate this outcome.
- Major morbidities were evaluated using STS models with most results demonstrating that the observed rate of adverse events is within expectations.

3 Participating sites

In 2016, there were four public adult cardiac surgery units spread across metropolitan and regional Queensland. Three of these entered data directly into the Queensland Cardiac Outcomes Registry (QCOR) Cardiac Surgery database. The fourth site, The Prince Charles Hospital began direct entry in 2017.

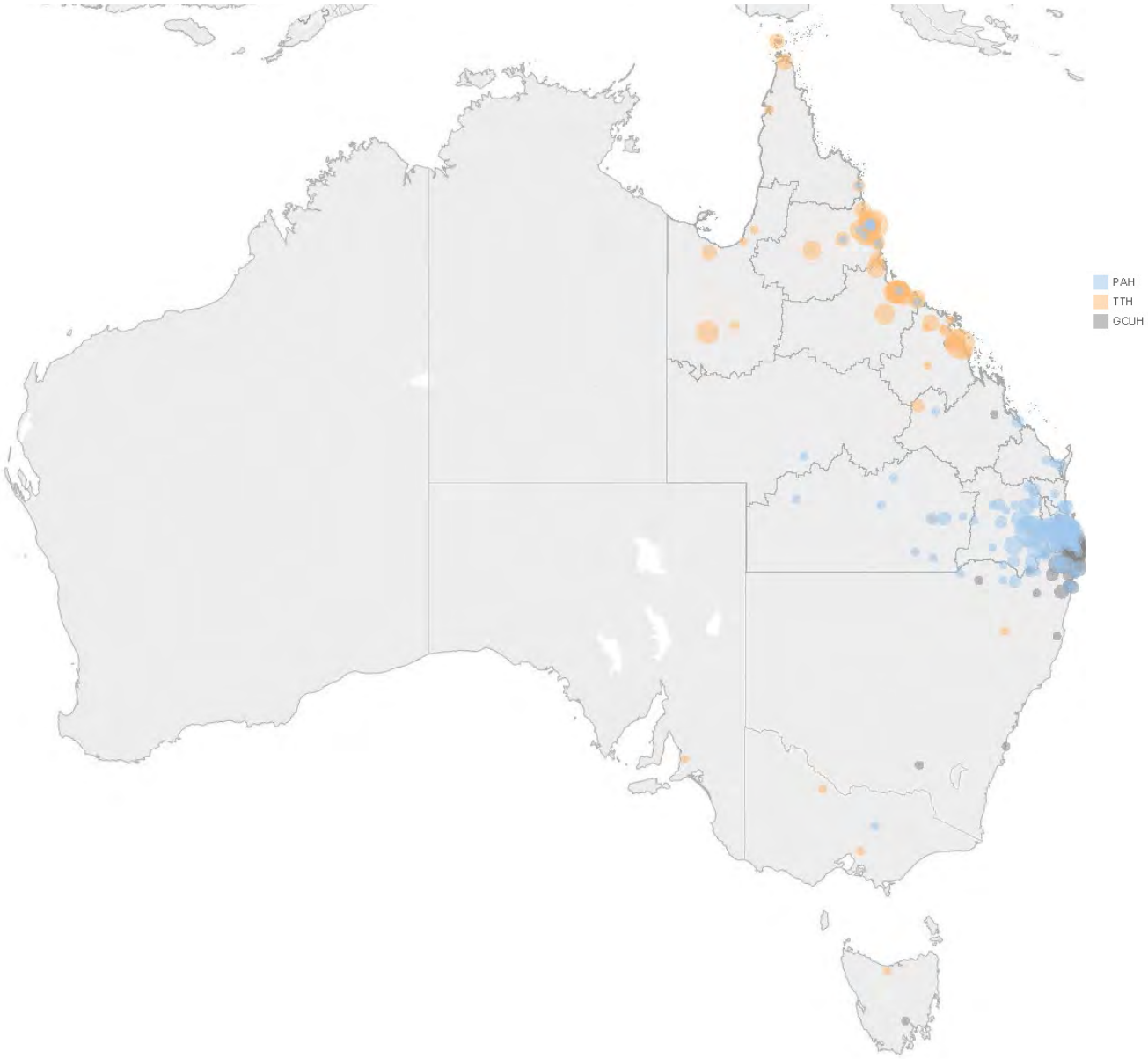


Figure 1: Cardiac Surgery cases by residential postcode

Table 1: Participating sites

SITE NUMBER	SITE NAME	LOCATION	ACRONYM
1	The Townsville Hospital	Regional	TTH
2	Princess Alexandra Hospital	Metropolitan	PAH
3	Gold Coast University Hospital	Metropolitan	GCUH

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

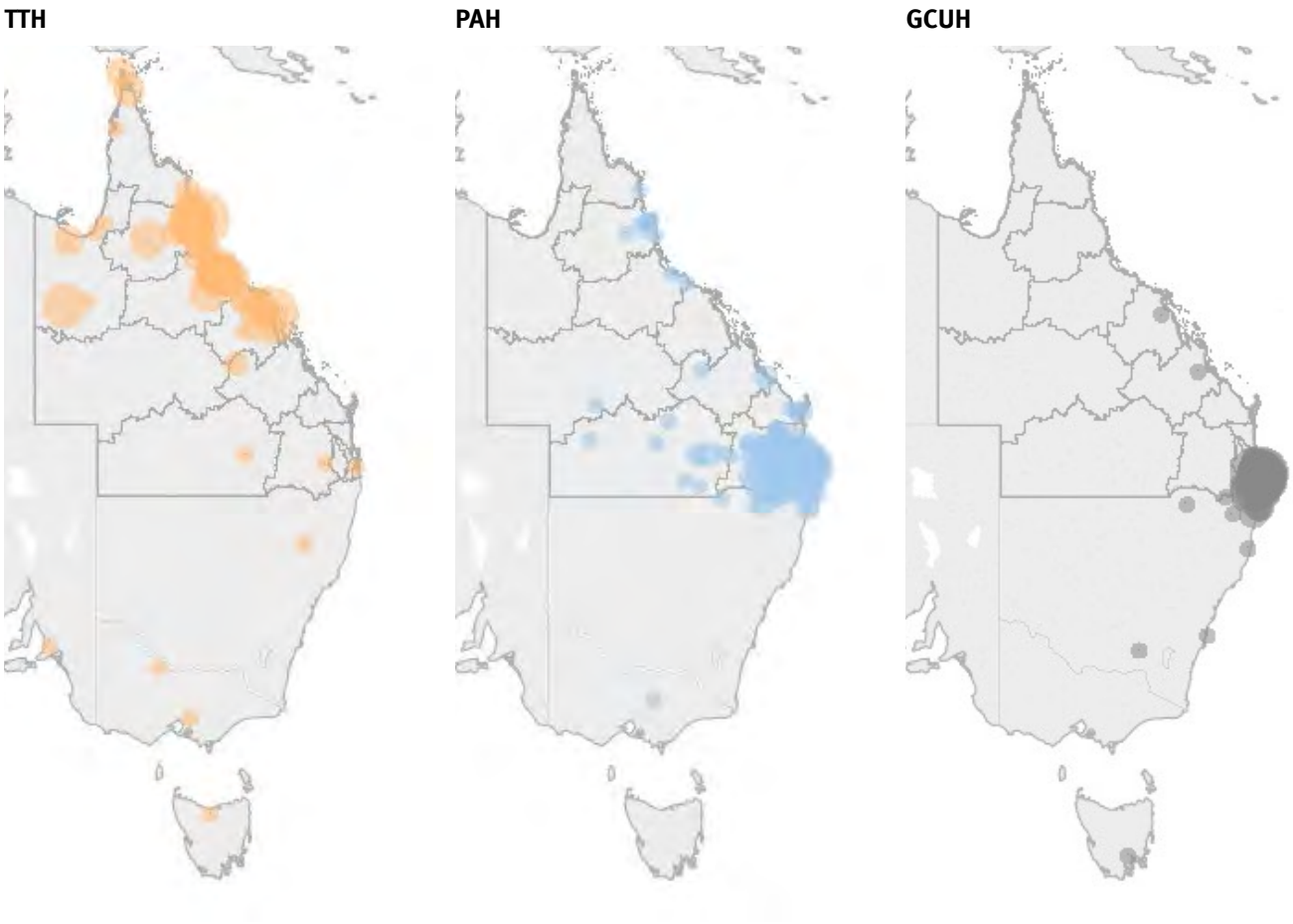


Figure 2: Cardiac Surgery cases by residential postcode and performing site

4 Case totals

4.1 Total cases

In 2016, 1,291 cardiac surgical procedures were performed across the state at the three public hospitals that directly entered data in the QCOR database. Each of the procedure combinations included in those cases have been allocated to a cardiac surgery procedure category to allow data analysis for the purpose of this report.

Table 2: Procedure counts and surgery category

Procedure combination	Count	Category*
Coronary artery bypass grafts (CABG)	733	CABG
CABG + other cardiac procedure	10	CABG
CABG + aortic procedure	5	CABG
CABG + other non-cardiac procedure	4	CABG
CABG + valve procedure	106	CABG + VALVE
CABG + valve + aortic procedure	11	CABG + VALVE
CABG + valve + other cardiac procedure	2	CABG + VALVE
Valve procedure†	287	VALVE
Valve + aortic procedure	52	VALVE
Valve + other cardiac procedure	21	VALVE
Valve + aortic + other cardiac procedure	1	VALVE
Valve + other non-cardiac procedures	1	VALVE
Aortic procedure	29	OTHER
Other cardiac procedure	23	OTHER
Aortic procedure + other non-cardiac procedure	3	OTHER
Aortic procedure + other cardiac procedure	2	OTHER
Other cardiac and other non-cardiac procedure	1	OTHER
TOTAL CASES	**1,291**	

Note, final column outlines allocation of procedures to surgery categories

* Category procedure combination allocated

† Includes TAVR procedures (n=16)

4.2 Cases by category

Approximately two-thirds (67%) of all cardiac surgery procedures involved coronary artery bypass grafting (CABG). Of these, 9% involved a simultaneous valve procedure while 58% did not.

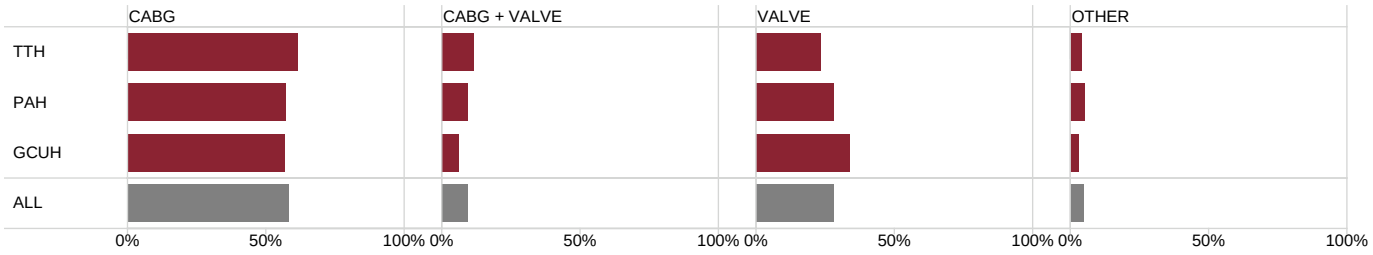


Figure 3: Proportion of cases by site and surgery category

Table 3: Proportion of cases by surgery category (n, %)

Site	CABG	CABG + VALVE	VALVE	OTHER	Total cases
TTH	211 (61%)	39 (11%)	80 (23%)	14 (4%)	344 (100%)
PAH	360 (57%)	60 (10%)	175 (28%)	34 (5%)	629 (100%)
GCUH	181 (57%)	20 (6%)	107 (34%)	10 (3%)	318 (100%)
ALL	**752 (58%)**	**119 (9%)**	**362 (28%)**	**58 (4%)**	**1,291 (100%)**

5 Patient characteristics

5.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. The majority of patients were aged between 61 and 80 (59%).

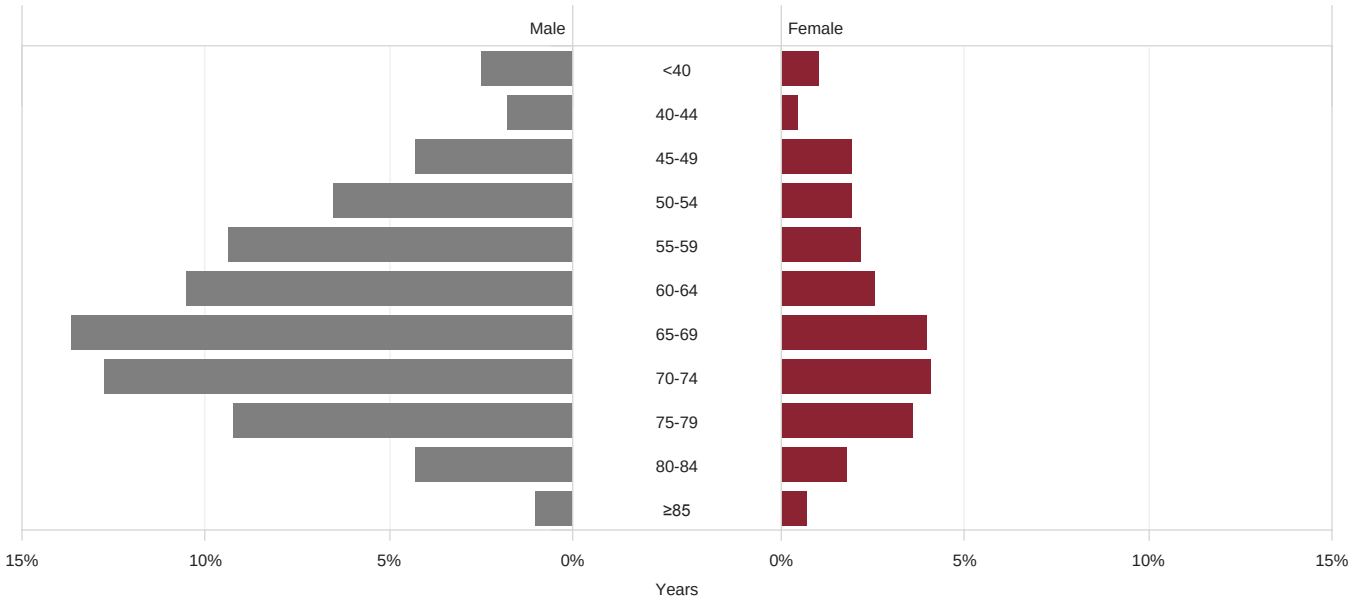


Figure 4: Proportion of all cases by age group and gender

The median age of all patients undergoing cardiac surgery was 66 years of age. The median age of males was lower also at 66 compared with females at 68.

Table 4: Median age by gender and surgery category

	Total cases (n)	Female (years)	Male (years)	ALL (years)
CABG	752	67	65	66
CABG + VALVE	119	70	72	71
VALVE	362	68	65	67
OTHER	58	64	61	62
ALL CASES	**1,291**	**66**	**68**	**66**

Overall, around three-quarters of patients were male (76%) with the largest proportion of females represented in the valve and other cardiac surgery categories (35% and 32% respectively). This reflects the increased risk of coronary artery disease in men.

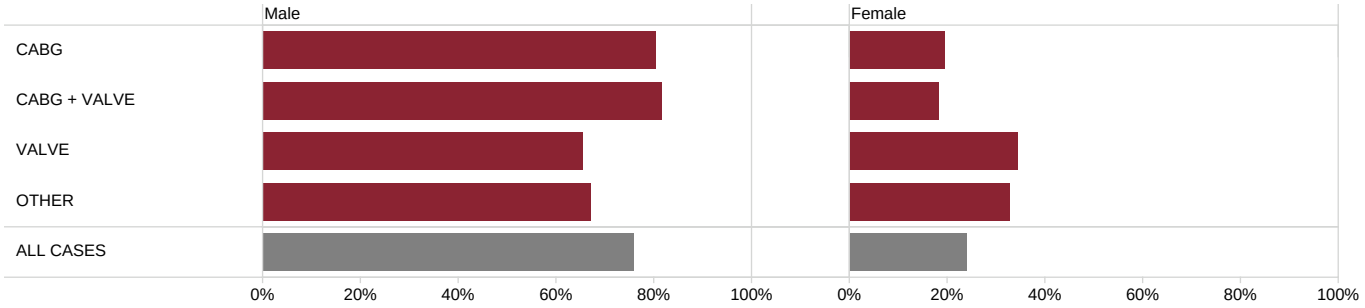


Figure 5: Proportion of cases by gender and surgery category

5.2 Body mass index

Patients classed as having a body mass index (BMI) category of overweight (36%), obese (35%) or morbidly obese (4%) represented around three quarters of cardiac surgery patients. Patients classed as underweight represented 1% of all cases, and 24% of patients were classed as being in the normal weight range.

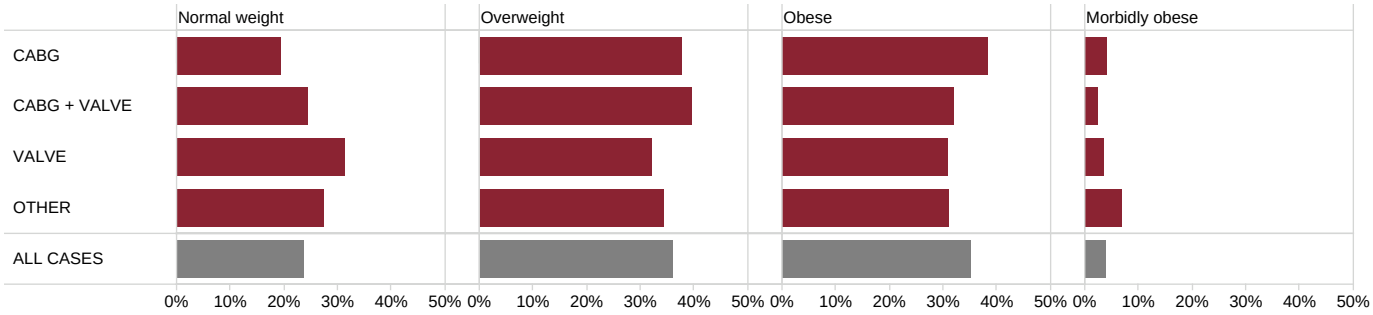


Figure 6: Proportion of cases by BMI and surgery category

Table 5: Proportion of cases by BMI and surgery category

	Underweight	Normal weight	Overweight	Obese	Morbidly obese
CABG	5 (1%)	146 (19%)	283 (38%)	288 (38%)	30 (4%)
CABG + VALVE	2 (2%)	29 (24%)	47 (39%)	38 (32%)	3 (3%)
VALVE	9 (2%)	113 (31%)	116 (32%)	111 (31%)	13 (4%)
OTHER	0 (0%)	16 (28%)	20 (34%)	18 (31%)	4 (7%)
ALL CASES	**16 (1%)**	**304 (24%)**	**466 (36%)**	**455 (35%)**	**50 (4%)**

5.3 Identified 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 population have a higher incidence and prevalence of coronary artery disease than other ethnicities.[1]

Overall the proportion of identified Aboriginal and Torres Strait Islander patients undergoing cardiac surgery was 8%, however there was large variation between the two metropolitan units and the Townsville Hospital in North Queensland across all surgery categories (2% and 24% respectively).

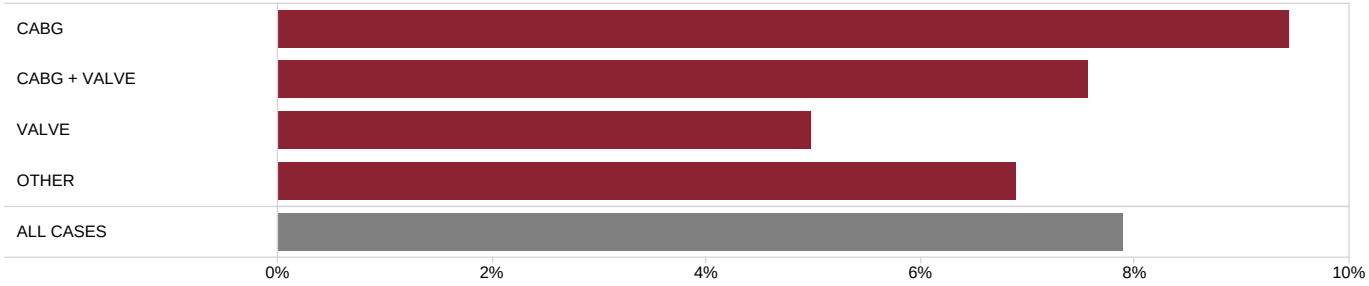


Figure 7: Proportion of cases by identified Aboriginal and Torres Strait islander status and surgery category

6 Risk factor profile

6.1 Smoking history

Overall, over half of patients had a history of tobacco use, including 19% being current smokers (defined as smoking within 30 days of the procedure) and 39% former smokers. The remaining 37% reported never having smoked and 5% had an unknown smoking history.

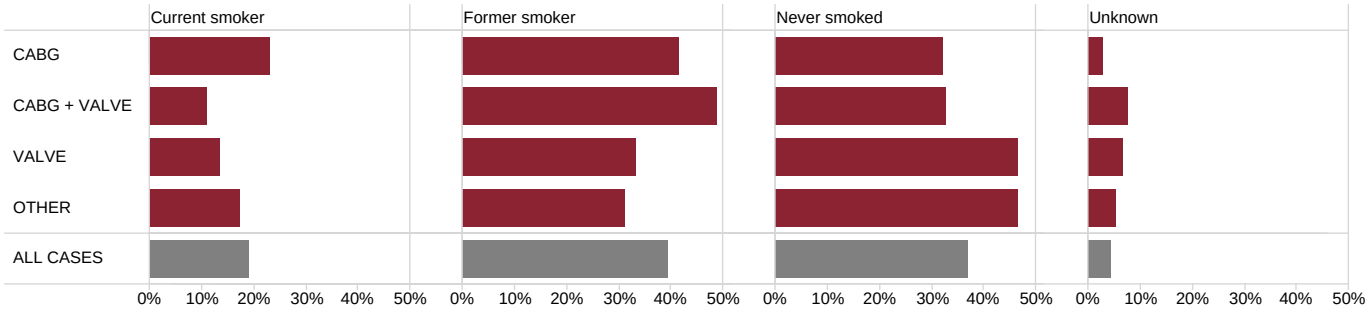


Figure 8: Proportion of cases by smoking status and surgery category

6.2 Diabetes

The prevalence of diabetes was highest in the CABG group, with 37% of patients known to be diabetic.

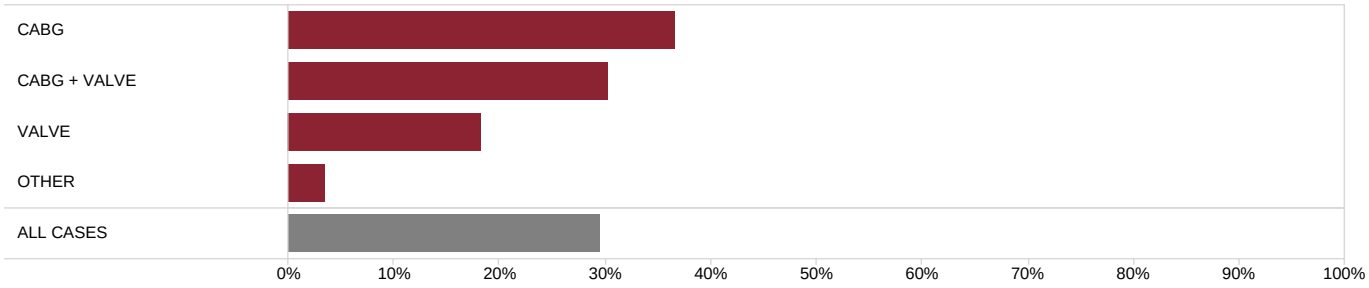


Figure 9: Proportion of cases by diabetes status and surgery category

6.3 Hypertension

Hypertension, defined as receiving antihypertensive medications at the time of surgery, was present in over half of patients irrespective of surgery type (range 56 to 87%)

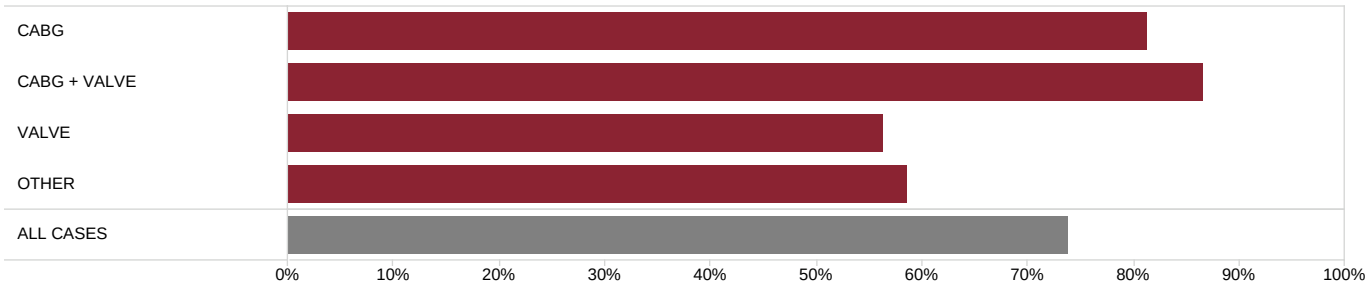


Figure 10: Proportion of cases by hypertension status and surgery category

6.4 Statin therapy

Overall, 67% of patients were treated with statins for abnormal cholesterol at the time of surgery, ranging from 81% in the CABG category to 33% in the other surgery category.

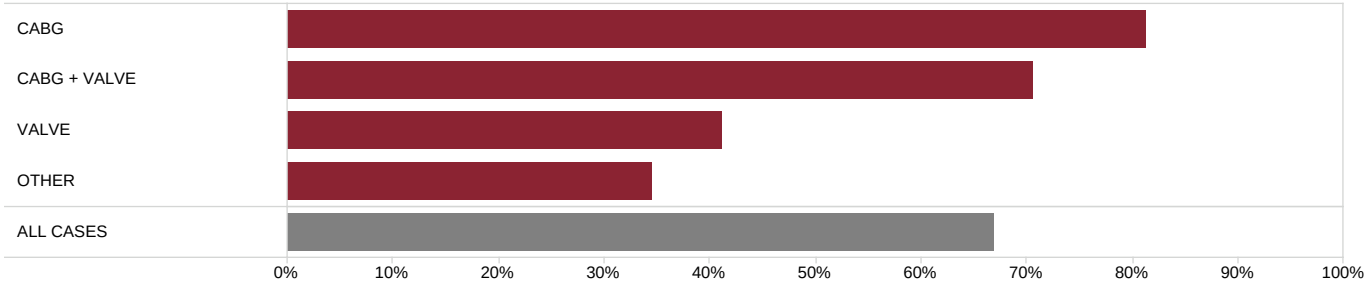


Figure 11: Proportion of cases by statin therapy status and surgery category

6.5 Renal impairment

There were 55% of all patients identified as having impaired renal function (eGFR ≤ 89 mL/min/1.73m^2) at the time of their surgery. Of these patients, the CABG and valve group had the highest incidence of renal impairment.

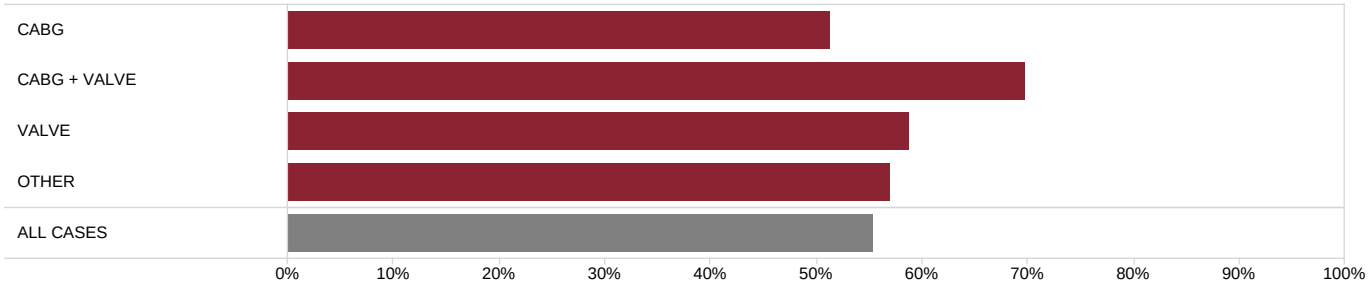


Figure 12: Proportion of cases by renal impairment status and surgery category

6.6 Severe renal dysfunction

Overall, 3% of patients were identified as having severe renal dysfunction (preoperative creatinine › 200µmol), ranging from 2% to 7% across surgery categories. This cut-off is used by the EuroSCORE for predicting risk.

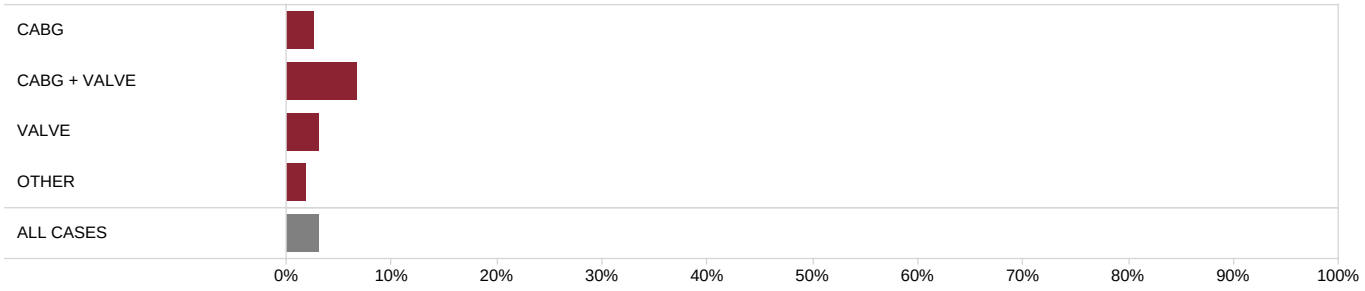


Figure 13: Proportion of cases by severe renal dysfunction status and surgery category

6.7 Left ventricular (LV) dysfunction

Left ventricular dysfunction was identified in 29% of all patients, including 20% with mild LV dysfunction (LVEF between 40-50%), 6% with moderate LV dysfunction (LVEF between 30-39%) and 3% with severe LV dysfunction (LVEF ‹30%).

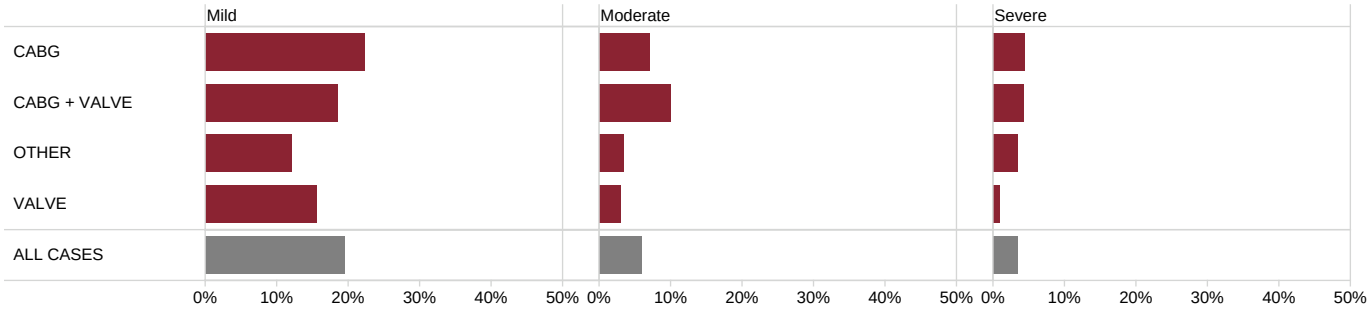


Figure 14: Proportion of cases by LV dysfunction category and surgery category

6.8 Summary

Table 6: Summary of risk factors by surgery category (n, %)

	CABG	CABG + VALVE	VALVE	OTHER	ALL CASES
Current smoker	173 (23%)	13 (12%)	49 (13%)	10 (17%)	245 (19%)
Former smoker	312 (41%)	58 (49%)	120 (33%)	18 (31%)	508 (39%)
BMI ≥ 30	318 (42%)	41 (34%)	124 (34%)	22 (38%)	505 (39%)
Diabetes	275 (37%)	36 (30%)	66 (18%)	2 (3%)	379 (29%)
Hypertension	611 (81%)	103 (87%)	204 (56%)	34 (60%)	952 (74%)
Statin therapy	611 (81%)	84 (71%)	149 (41%)	20 (34%)	864 (67%)
eGFR ≤ 89 mL/min/1.73m²	386 (51%)	83 (70%)	213 (59%)	33 (57%)	715 (55%)
Severe renal dysfunction	20 (3%)	8 (7%)	11 (3%)	1 (2%)	40 (3%)
LVEF 40-50%	168 (22%)	22 (18%)	56 (15%)	7 (12%)	253 (20%)
LVEF 30-39%	53 (7%)	12 (10%)	11 (3%)	2 (3%)	78 (6%)
LVEF <30%	34 (5%)	5 (4%)	3 (1%)	2 (3%)	44 (3%)

6.8.1 Combined risk factors

Table 7: Summary of combined risk factors by surgery category (n, %)

	CABG	CABG + VALVE	VALVE	OTHER	ALL CASES
Hypertension + Statin therapy	526 (70%)	74 (62%)	17 (29%)	116 (32%)	733 (57%)
Current/former smoker + Hypertension	392 (52%)	62 (52%)	16 (28%)	103 (28%)	573 (44%)
Current/former smoker + Hypertension + Statin therapy	293 (39%)	34 (29%)	8 (14%)	60 (17%)	395 (31%)
BMI ≥ 30 + Statin therapy	280 (37%)	29 (24%)	10 (17%)	67 (19%)	386 (30%)
Diabetes + Hypertension + Statin therapy	223 (30%)	26 (22%)	2 (3%)	42 (12%)	293 (23%)
Diabetes + eGFR ≤ 89 mL/min/1.73m²	133 (18%)	24 (20%)	1 (2%)	45 (12%)	203 (16%)
Current/former smoker + BMI ≥ 30 + Diabetes	99 (13%)	10 (8%)	1 (2%)	24 (7%)	134 (10%)

7 Care and treatment of patients

7.1 Admission status

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

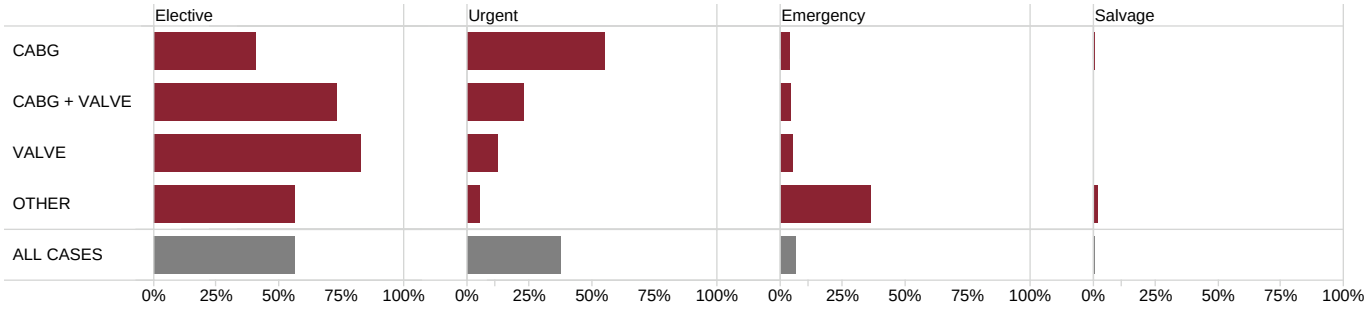


Figure 15: Proportion of cases by admission status and surgery category

Table 8: Proportion of cases by admission status and surgery category (n, %)

	Elective	Urgent	Emergency	Salvage
CABG	307 (41%)	413 (55%)	31 (4%)	1 (‹1%)
CABG + VALVE	87 (73%)	27 (23%)	5 (4%)	0 (0%)
VALVE	301 (83%)	43 (12%)	18 (5%)	0 (0%)
OTHER	33 (57%)	3 (5%)	21 (36%)	1 (2%)
ALL CASES	**728 (56%)**	**486 (38%)**	**75 (6%)**	**2 (‹1%)**

7.2 Day of surgery admission (DOSA)

Same day admission rates accounted for 26% of all elective cases, with minor variations observed across most surgery categories.

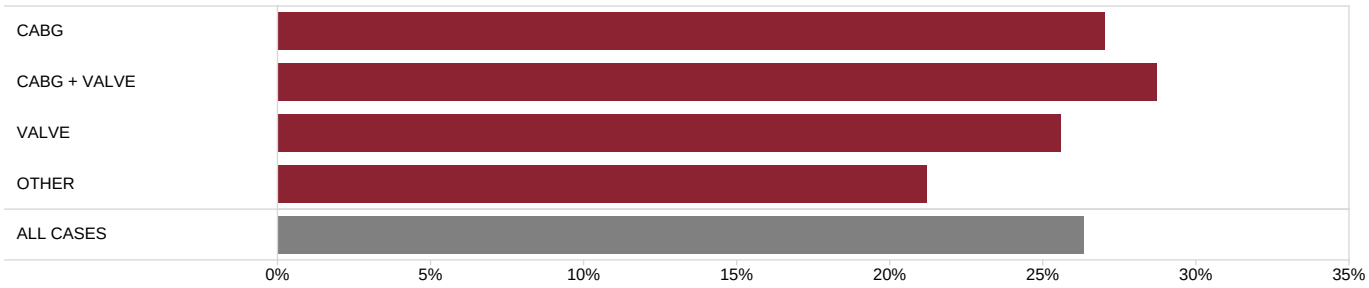


Figure 16: Proportion of elective cases for DOSA cases by surgery category

Table 9: Proportion of DOSA cases by surgery category (n, %)

	Total elective cases (n)	DOSA cases (n, %)
CABG	307	83 (27%)
CABG + VALVE	87	25 (29%)
VALVE	301	77 (26%)
OTHER	33	7 (21%)
ALL CASES	**728**	**192 (26%)**

7.3 Coronary artery bypass grafts (CABG)

7.3.1 Number of diseased vessels

In total, 871 patients had a CABG procedure. Of these, the majority (93%) had multi-vessel disease.

When CABG was performed in conjunction with a valve procedure, 71% of patients had multi-vessel disease compared to 96% when CABG was performed without a valve procedure.

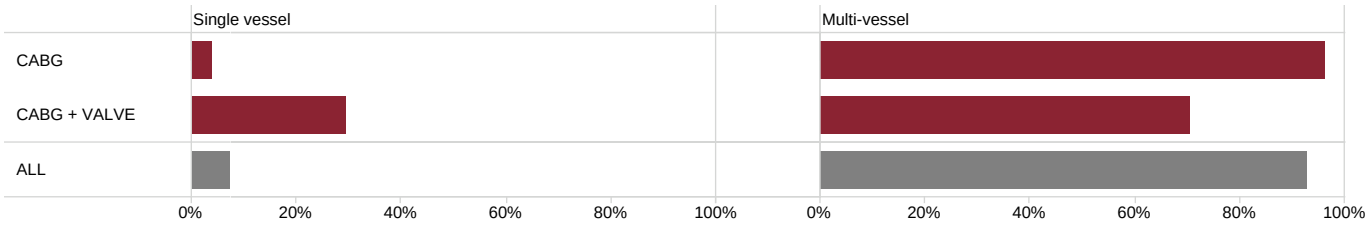


Figure 17: Number of diseased vessels

Table 10: Number of diseased vessels (n, %)

	Total cases	Single vessel	Multi vessel
CABG	752	29 (4%)	723 (96%)
CABG + VALVE	119	35 (29%)	84 (71%)
ALL CASES	**871**	**64 (7%)**	**807 (93%)**

7.3.2 Mean number of grafts

Overall the mean number of grafts performed was 2.9. In multi vessel CABG, the mean number of grafts was 3.2.

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

	Single vessel (mean)	Multi vessel (mean)	Multi vessel (median)	All (mean)
CABG	1.3	3.2	3	3.1
CABG + VALVE	1.1	2.4	2	2.0
ALL CASES	**1.2**	**3.1**	**3**	**2.9**

7.3.3 Conduits used

In all CABG, the most common form of revascularisation involved the use of a combination of an arterial and vein graft (75%). Total arterial revascularisation occurred in 14% of cases.

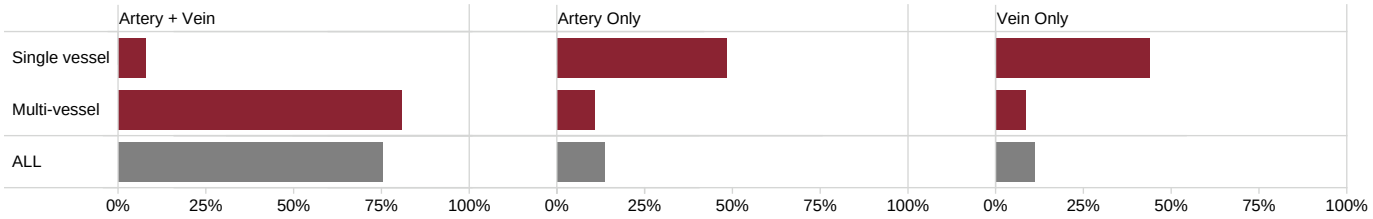


Figure 18: Conduits used by number of diseased vessels (%)

Table 12: Conduits used by number of diseased vessels (n, %)

	Artery + Vein	Artery Only	Vein Only
Single vessel	5 (8%)	31 (48%)	28 (44%)
Multi-vessel	652 (81%)	87 (11%)	68 (8%)
ALL	**657 (75%)**	**118 (14%)**	**96 (11%)**

7.3.4 Off pump CABG

Approximately 4% of isolated CABGs were performed off pump.

Table 13: Off pump CABG (n, %)

Isolated CABG Off Pump	27 (4%)
Isolated CABG On Pump	706 (96%)
ALL	**733 (100%)**

7.3.5 Y or T grafts

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

Table 14: Y or T graft used by procedure category (n, %)

	Y or T GRAFT
CABG	33 (4%)
CABG + VALVE	1 (1%)
ALL	**34 (4%)**

7.4 Aortic surgery

There were a total of 103 cases that included an aortic procedure (not including procedures conducted on the aortic valve).

The majority of aortic surgery procedures included replacement of the ascending aorta (60%).

Aortic aneurysm was the primary reason for aortic surgery (63%).

Table 15: Aortic surgery by procedure type (n, %)

Aortic surgery type	n (%)
Replacement	93 (90%)
Ascending	62 (60%)
Ascending + Arch	27 (26%)
Arch	2 (2%)
Ascending + Arch + Descending	1 (1%)
Aortoplasty	10 (10%)
Patch repair	9 (9%)
Endarterectomy	1 (1%)
Total	**103 (100%)**

7.4.1 Aortic pathology

Table 16: Aortic surgery cases by pathology type (n, %)

Aortic pathology type	n (%)
Aortic aneurysm	65 (63%)
Aortic dissection (≤ 2 weeks)	21 (20%)
Calcification	6 (6%)
Other	5 (5%)
Aortic dissection (› 2 weeks)	4 (4%)
Traumatic transection	2 (2%)
Total	**103 (100%)**

7.5 Valve surgery

In participating sites, valve surgery was performed in 481 patients during 2016. The aortic valve was the most commonly operated on valve either with or without other valves (72%). Mitral valve surgery accounted for the next most common valvular surgery (32%)

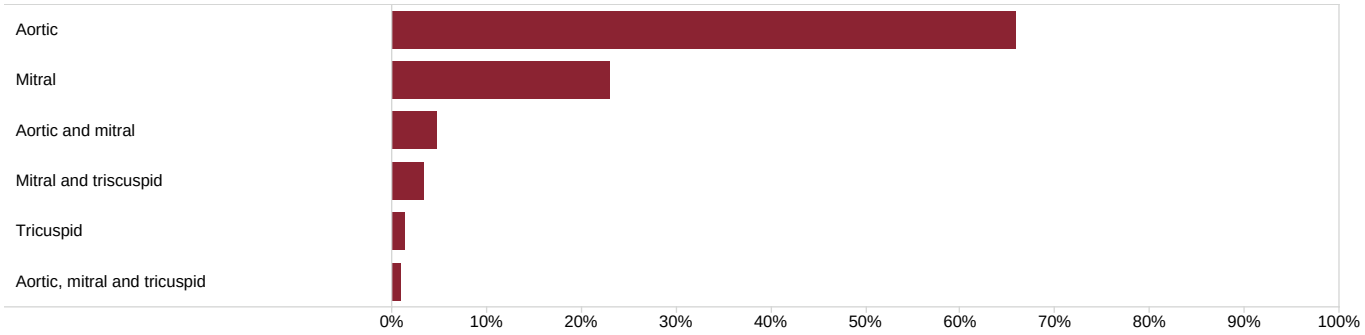


Figure 19: Valve surgery cases by valve (%)

Table 17: Valve surgery cases by valve (n, %)

Type of valve surgery	n (%)
Aortic*	317 (66%)
Mitral	111 (23%)
Aortic and mitral	23 (5%)
Mitral and tricuspid	16 (3%)
Tricuspid	7 (2%)
Aortic, mitral and tricuspid	5 (1%)
Pulmonary	1 (<1%)
Aortic and tricuspid	1 (<1%)
Total	**481 (100%)**

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

7.5.1 Valve pathology

The most common valve pathology across all valve types was calcific (37%), followed by myxomatous (10%). Furthermore, calcific aortic valve disease was the most common valve pathology encountered.

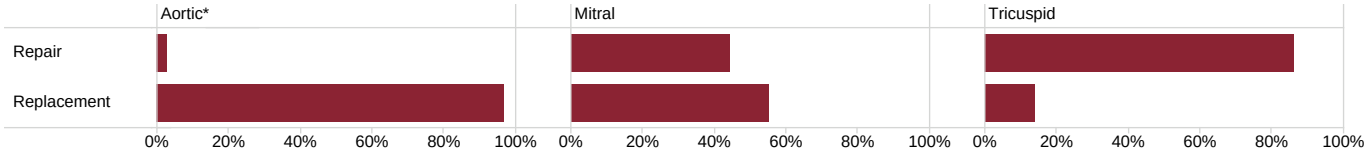
Table 18: Valve pathology by valve type (n, %)

	Aortic	Mitral	Tricuspid	Pulmonary	ALL
Calcific	184 (53%)	10 (6%)	1 (3%)	-	195 (37%)
Myxomatous	2 (1%)	48 (31%)	3 (10%)	-	53 (10%)
Rheumatic	19 (5%)	31 (20%)	2 (7%)	-	52 (10%)
Infection	24 (7%)	23 (15%)	4 (14%)	1 (100%)	52 (10%)
Congenital	47 (14%)	1 (1%)	1 (3%)	-	49 (9%)
Degenerative	22 (6%)	16 (10%)	3 (10%)	-	41 (8%)
Other	24 (7%)	10 (6%)	4 (14%)	-	38 (7%)
Ischaemic	-	11 (7%)	-	-	11 (2%)
Functional	-	1 (1%)	10 (34%)	-	11 (2%)
Dissection	9 (3%)	-	-	-	9 (2%)
Prosthesis failure	5 (1%)	4 (3%)	-	-	9 (2%)
Annuloaortic ectasia	9 (3%)	-	-	-	9 (2%)
Iatrogenic	-	-	1 (3%)	-	1 (<1%)
Inspection only	1 (<1%)	-	-	-	1 (<1%)
Total	**346 (100%)**	**155 (100%)**	**29 (100%)**	**1 (100%)**	**531 (100%)**

7.5.2 Types of valve surgery

The majority of valve surgery cases were conducted on the aortic valve (65%).

The most common aortic valve procedure was valve replacement surgery (97%). This was similar for the mitral valve where replacement was more frequent than repair (55 vs 45%).



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

Figure 20: Valve surgery category by valve (%)

Table 19: Valve surgery category by valve type (n, %)

	Aortic	Mitral	Tricuspid	Pulmonary
Repair	10 (3%)	69 (45%)	25 (86%)	0 (0%)
Replacement	335 (97%)	86 (55%)	4 (14%)	1 (100%)
Inspection only	1 (<1%)	-	-	-
Total	**346 (100%)**	**155 (100%)**	**29 (100%)**	**1 (100%)**

7.5.3 Valve repair surgery

The most common form of valve repair surgery was repair/reconstruction with annuloplasty (68%), followed by annuloplasty only (13%). Mitral valve repair/reconstruction with annuloplasty was the most common individual valve repair surgery.

Table 20: Valve repair surgery by valve type

	Aortic	Mitral	Tricuspid	Pulmonary	ALL
Repair/reconstruction with annuloplasty	-	61 (88%)	10 (40%)	-	71 (68%)
Annuloplasty only	-	4 (6%)	10 (40%)	-	14 (13%)
Root reconstruction with valve sparing	9 (90%)	-	-	-	9 (9%)
Repair/reconstruction without annuloplasty	-	3 (4%)	2 (8%)	-	5 (5%)
Commissurotomy with annuloplasty ring	-	1 (1%)	3(12%)	-	4 (4%)
Decalcification of valve only	1 (10%)	-	-	-	1 (1%)
Total	**10 (100%)**	**69 (100%)**	**25 (100%)**	**-**	**104 (100%)**

7.5.4 Valve replacement surgery

The most common form of valve implant prostheses used across all valve types were biological including bovine pericardial (59%) followed by porcine (25%).

Table 21: Types of valve prosthesis by valve type (n, %)

	Aortic	Mitral	Tricuspid	Pulmonary	ALL
Biological - Bovine pericardial	217 (64%)	33 (38%)	3 (75%)	-	253 (59%)
Biological - Porcine	72 (21%)	31 (36%)	1 (25%)	1 (100%)	105 (25%)
Mechanical	44 (13%)	22 (26%)	-	-	67 (16%)
Homograft/allograft	2 (1%)	-	-	-	2 (<1%)
Total	**335 (100%)**	**86 (100%)**	**4 (100%)**	**1 (100%)**	**427 (100%)**

7.6 Other cardiac surgery

The most common forms of other cardiac surgery were to repair an atrial septal defect (17%) or removal of a cardiac tumour (17%). These were often combined with CABG or Valve surgery.

Table 22: Other cardiac procedures (n, %)

Procedure	n (%)
Atrial septal defect	10 (17%)
Cardiac tumour	10 (17%)
Atrial arrhythmia surgery	8 (13%)
Other congenital	6 (10%)
Ventricular septal defect	5 (8%)
Permanent LV epicardial lead	5 (8%)
Other	5 (8%)
Left atrial appendage closure	3 (5%)
Cardiac trauma	2 (3%)
LVOT myectomy	2 (3%)
Left ventricular aneurysm	1 (2%)
Pericardiectomy	1 (2%)
LV reconstruction	1 (2%)
Pulmonary embolectomy	1 (2%)
TOTAL	**60 (100%)**

7.7 Blood product usage

The majority of cases did not require blood product transfusion, either with red blood cells (RBC) or non-red blood cells (NRBC). Emergency and salvage cases had much higher transfusion rates.

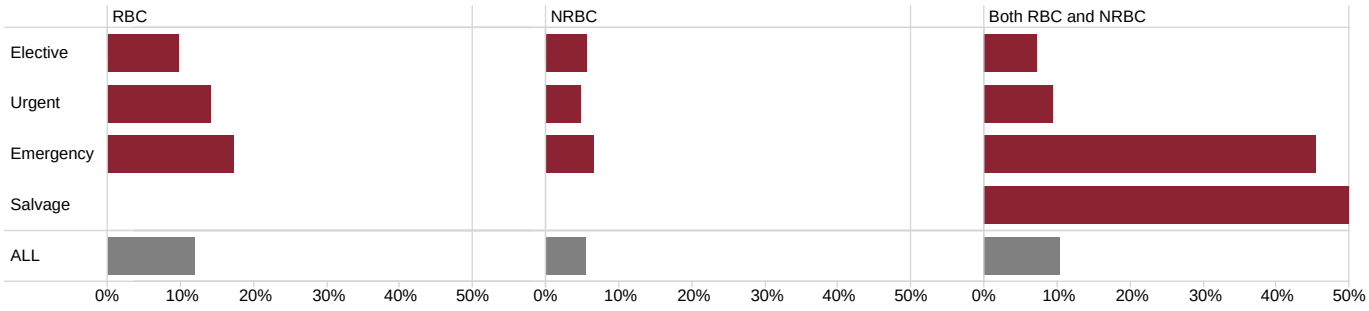


Figure 21: Blood products used by admission status (%)

Table 23: Blood products used by admission status (n, %)

	RBC	NRBC used	Both RBC and NRBC used	No blood products used
Elective	72 (10%)	41 (6%)	53 (7%)	562 (77%)
Urgent	69 (14%)	24 (5%)	46 (9%)	347 (71%)
Emergency	13 (17%)	5 (7%)	34 (45%)	23 (31%)
Salvage	0 (0%)	0 (0%)	1 (50%)	1 (50%)
ALL	**154 (12%)**	**70 (5%)**	**134 (10%)**	**933 (72%)**

8 Outcomes

There are two aspects of outcomes analysis for procedural related specialties: the risk of complications from procedures, and key targets for optimal procedural performance. This report focuses on the risk of complications from procedures. This section of the report compares the aggregated outcomes of the three adult cardiac surgical units with direct entry into the QCOR database in 2016 against calculated risk scores.

8.1 Risk prediction models

The data from the QCOR Cardiac Surgery database allows for an analysis of the risk of complications from surgery. Direct site by site comparison alone does not provide an outside standard with which to compare the risk of surgery in Queensland. The size and demographic differences between the units would not allow for development of acceptable standards within a single year of data. Thus, the committee decided to perform analysis comparing statewide aggregate numbers with validated risk scores.

Risk scores in cardiac surgery are based on a group of patients from a particular period in time and in a particular geographic area who undergo cardiac surgery. Patient and surgical factors are analysed, and factors that were associated with increased risk of surgery are then identified. This statistical analysis allows of calculation of the risk for patients with certain characteristics, who are undergoing various types of surgery. Most risk scores analyse for the risk of death after an operation. One risk score (the STS Score) calculates the risk of complications (morbidity) after an operation in addition to the risk of death. The risk models used are:

1. EuroSCORE
2. ANZSCTS General Score
3. AusSCORE
4. STS Score

The EuroSCORE[2] and the ANZSCTS General Score[3] evaluate deaths in all cardiac surgical cases. The AusSCORE model[4] evaluates deaths in CABG cases only. The STS Score calculates risks for mortality and morbidity for limited groups of cardiac surgery procedures. (CABG model: isolated coronary artery bypass only[5]. Valve model: isolated aortic valve replacement, isolated mitral valve replacement or isolated mitral valve repair[6]. Valve + CABG model: CABG plus one of aortic valve replacement, mitral valve replacement or isolated repair[7].)

EuroSCORE has over time become less calibrated with contemporary results in cardiac surgery, it retains its ability to discriminate risk. It is retained in this evaluation to provide a benchmark for comparison to historical performance. EuroSCORE II was not used because there were not data points for every element in the risk score in the QCOR dataset, prohibiting calculation of this score. Only one site calculates this score routinely as a separate data point.

The charts demonstrate the predicted rates of death or complications that are derived from each risk score compared with the actual observed rates in our units. When the observed rate falls within the 95% confidence intervals of the predicted rate, then the observed rate is considered to be statistically within expectations. Where the diamond is below or above the interval indicate that the observed event rate is statistically lower or higher than expected.

As mentioned in the opening remarks to this report, there is more to performance in surgery than simply the skill of the surgeon in the operating theatre. Several aspects of the patient's entire journey to disease and through treatment and recovery may combine to influence the outcome of surgery. Thus, there are five potential categories of differences between the predicted and observed results:

1. Data: issues of data quality and definition
2. Case mix: differences in patient characteristics
3. Structure of resources: issues to do with the equipment, facilities or organisational processes
4. Process of care: clinical pathways and standards of treatment
5. Carer: unit and/or individual clinician practice and treatment methods.

8.1.1 Mortality

The mortality rate of patients undergoing cardiac surgery has been evaluated using a range of applicable models. As the STS models are restricted to defined groups of procedures, it is important to note that the STS models have been used to evaluate outcomes only in the range of cases meeting the defined inclusion criteria. Cases that do not meet defined group criteria are excluded for the STS comparison analysis. The Total outcome chart for the STS models has been derived by pooling all results for the 3 individual models. Likewise, the AusSCORE model has been used for CABG only cases and is presented side-by-side with the other risk score predictions for CABG only cases.

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

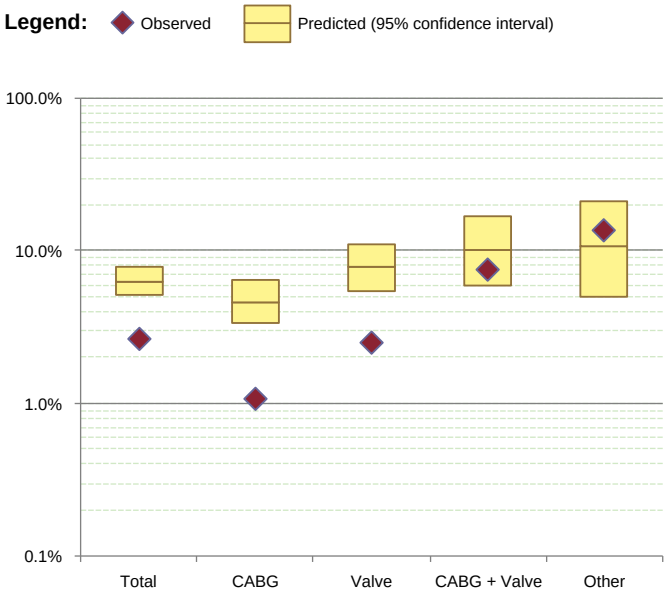


Figure 22: EuroSCORE

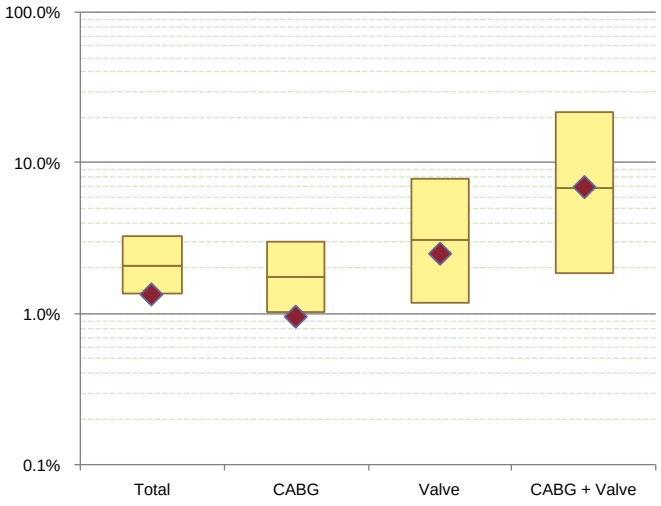


Figure 23: STS (Death)

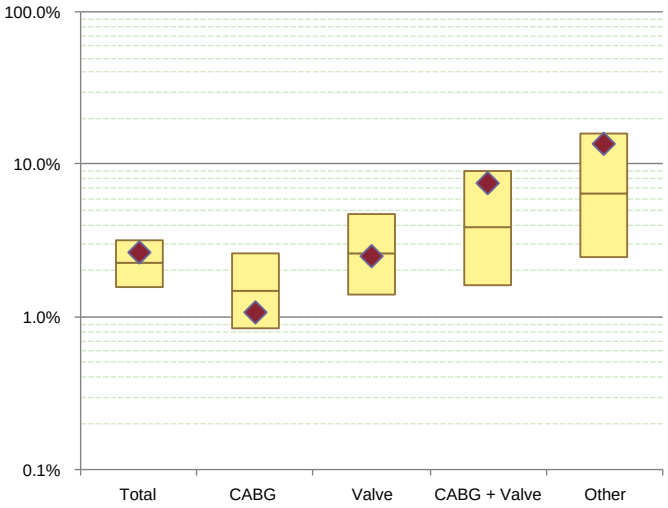


Figure 24: ANZSCTS (General)

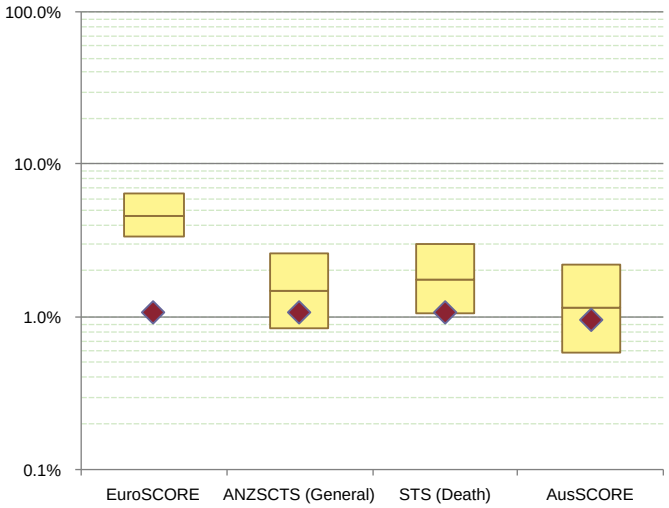


Figure 25: CABG

8.1.2 Morbidity

Apart from the risk of death, there is the risk of a complication (morbidity). The STS model predicts the risk of several morbidities. The observed rates have been compared to the rates predicted by the STS model. The STS models do not cover any cardiac surgical procedure, but instead are limited to three individual groups: CABG, CABG + Valve, and Valve only. The total outcome for each morbidity has been derived by pooling results for the three individual models and focuses on complications observed within 30 days of surgery.

The major morbidities chart represents the observed rate of cases involving at least one of the five morbidities (shown as a red diamond) plotted within the expected rate.

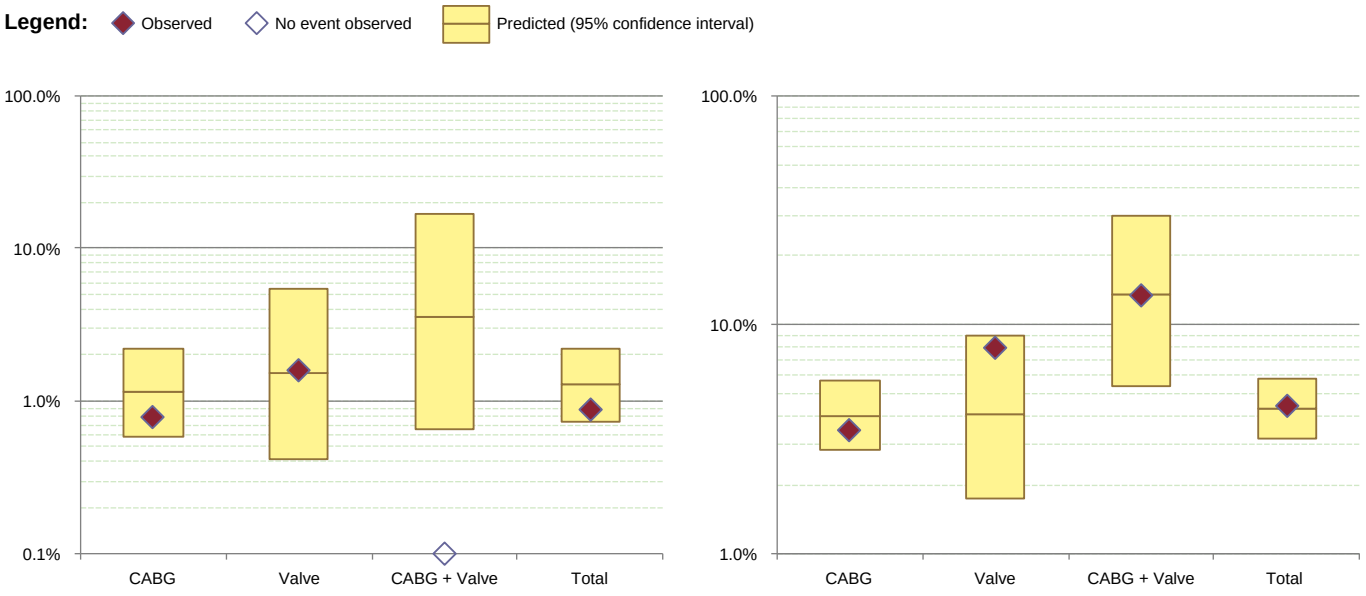


Figure 26: CVA

Figure 27: Renal failure

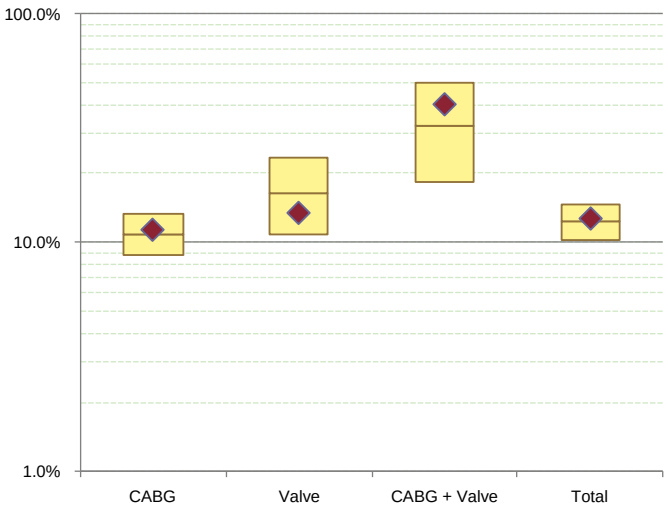


Figure 28: Ventilation › 24 hours

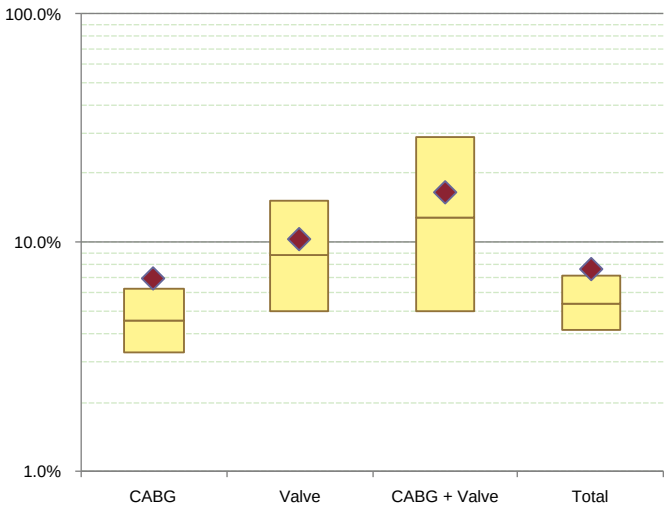


Figure 29: Reoperation

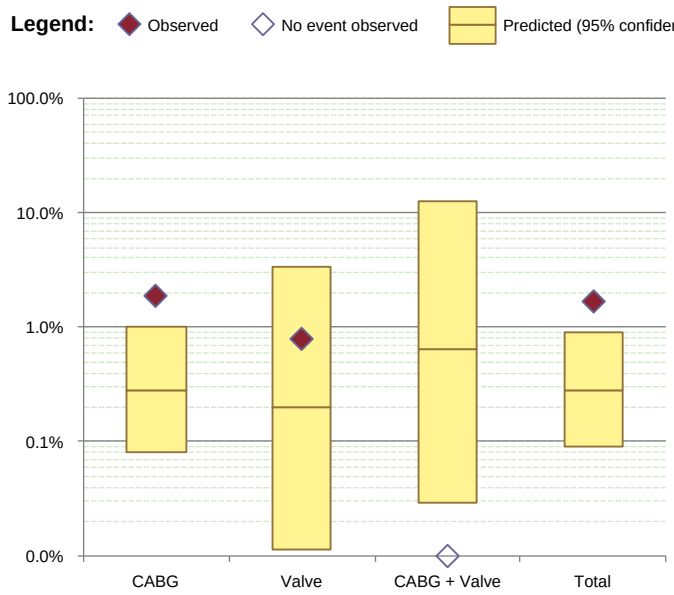


Figure 30: Deep sternal infection

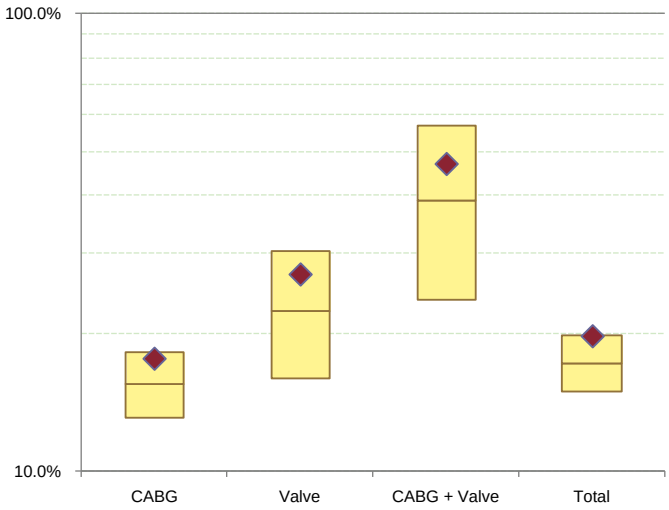


Figure 31: Major morbidity

In most of the comparisons with the risk scores, the observed rate of either mortality or morbidity is within expectation when evaluated using the risk models. The exception is deep sternal infection in CABG cases in which the event rate is significantly higher. This is a result that needs further investigation. The possible explanations may include differences in the definitions used in the risk scores and the database, clinical practice differences, a true variance or a combination of these factors. Other data sets that have investigated this difference have found that the STS score potentially underestimates deep sternal wound infection by a factor of up to four[8]. Applying this multiplier to our data would find the DSWI rate to be acceptable.

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

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

8.1.3 Measures of process

The following charts evaluate the length of stay of patients compared with that predicted by the STS score. A length of stay ‹6 days is a measure of processes that allow for elective weekly booking procedures. Length of stay ›14 days excludes the patients who may stay several days after the 6 day cut off for minor reasons, but instead are on a prolonged recovery pathway.

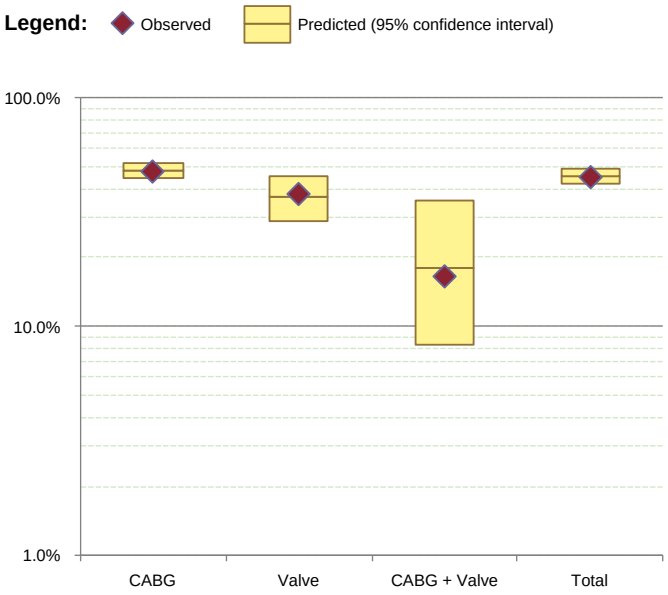


Figure 32: LOS ‹6 days

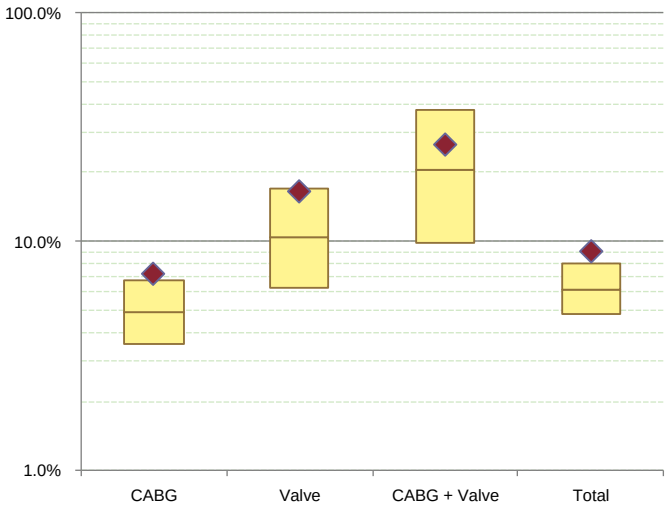


Figure 33: LOS ›14 days

This comparison suggests that although the observed proportion of cases staying less than 6 days (shown as a red diamond) is in line with that predicted by the relevant models, for CABG and valve cases, a greater proportion than expected are staying longer than expected. This needs further investigation and may represent a challenge unique to the geography of Queensland with the significant distance some patients have to travel prolonging their stay in hospital.

8.1.4 Failure to rescue

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

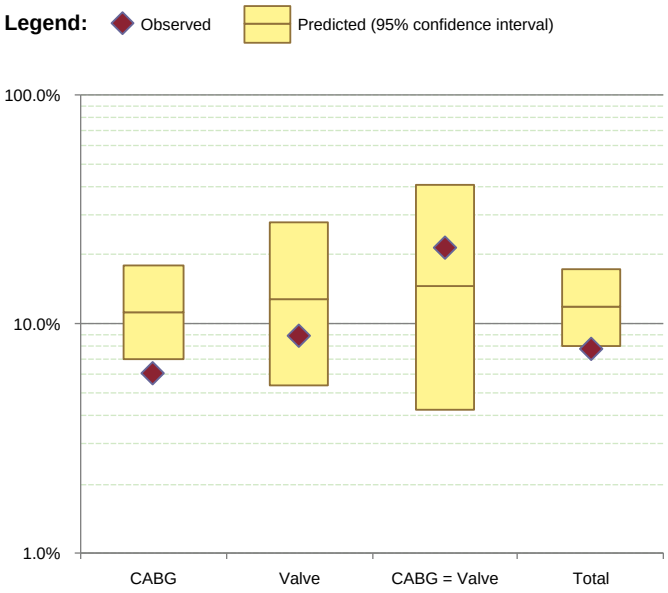


Figure 34: Failure to rescue

Based on this analysis, the failure to rescue observed rate for CABG cases (shown as a red diamond) is statistically better than predicted and the rate for valve, and combined CABG and valve cases is within the expected range. It is reasonable to conclude that hospital processes to deal with adverse events are functioning better than expected in the three units with direct entry in QCOR in 2016.

9 Conclusions

This is the first annual report from the QCOR cardiac surgery database, and reports statewide data from the sites with direct database entry in 2016.

Based on the demographics, the most common characteristics for a patient undergoing cardiac surgery is a 66 year old male with obesity and hypertension who is a current or former smoker, and needs coronary artery revascularisation for multi-vessel disease.

In contrast to this most common patient, there are patients at the extremes, patients in the 20s and 80s, underweight patients and those needing uncommon cardiac surgery not related to either coronary artery disease or valvular disease. Our adult cardiac surgical units care for both the common and the extreme.

A future focus will be to examine the role of significant obesity in cardiac surgery, in particular its effect on the risk of death and the risk of morbidity is not completely clear. The high rates of overweight, obese, and morbidly obese undergoing surgery and its effect on the safety of surgery is a source for investigation for the committee. With each successive year of data, the effect of obesity on the risk of surgery can be more clearly elucidated.

A second area for investigation is the treatment of at risk groups with statins. Whilst statin on admission is reasonably high as reported here, the duration of this treatment is not available from our database and needs to be researched. It is likely that a large proportion of patients are treated with statins only for a short period prior to surgery, meaning that an at risk group of Queenslanders is not receiving treatment with statins.

The analysis of activity cannot reach conclusions without inclusion of data from all public adult cardiac surgical units. This will be partially available for 2017, and is planned to be complete ongoing. Once this data is available, then analysis of per capita rates, regional variations and access can be analysed and discussed.

A key advantage of the QCOR cardiac surgery database distinct from other cardiac surgery databases is that it is part of the Statewide Cardiac Clinical Network, and can integrate the data and analysis with the entire spectrum of cardiac care in Queensland. A key question for the network is the rate of coronary surgery and its relationship to percutaneous coronary intervention.

Comparison with risk scores allows a benchmarking of sorts, a guide at best. From this analysis, the committee will now look into the higher than expected rate of deep sternal wound infections, and report on this in the next annual report. There are multiple issues to look into starting with the analysis itself, comparison with different data sets, and eventually concluding with individual cases analysis. The committee will undertake this work.

The discussion about what is relevant to report on in cardiac surgery is ongoing within the committee. The goal is to ensure that there are minimum levels of safety for patients in Queensland, and to continuously improve on these standards.

Heart Failure Support Services Audit

Authors

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

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1 Message from the Heart Failure Steering Committee Chairs

We are proud to be publishing the first annual report of clinical performance indicators for Heart Failure (HF) Support Services in Queensland Health. Collection and reporting of clinical indicators of chronic heart failure care in Australia is frequently ad hoc, and difficult to verify or benchmark with other services particularly as patients move between acute and community sectors[1].

Queensland has a HF Services steering committee that oversees 24 Support Services that have been operational since 2006. In 2015, the Queensland Cardiac Outcomes Registry (QCOR) developed a module to support the collection and reporting of clinical indicators. By 2016, nurses at all sites in the state were entering data into the Heart failure Evaluation and Reporting of Outcomes (HERO) clinical indicator reporting tool as part of routine practice.

Team leaders receive quarterly reports that benchmark individual Support Services to the state median, and provide details about exclusions and contraindications to inform clinical practice. High completion rates suggest that HERO is sustainable and engages clinicians. In the context of a coordinated statewide approach to HF Support Services (which includes data collection and review, education and clinical mentoring), HERO is a powerful tool for achieving best practice.

Associate Professor John Atherton and Ms Tracey Nunan
Co-chairs
Queensland HF Services Steering Committee of the SCCN

2 Executive summary

Introduction

Heart Failure (HF) Support Services help patients at high risk of hospitalisation with chronic heart failure. Support Services are comprised of nurses with specialist medical support. Some services include pharmacists, physiotherapists or exercise physiologists, and other allied health professionals. Queensland HF Support Services reported data on new referrals as part of routine practice from mid-2015.

Characteristics of patients

HF Support Services reported on 4,021 new referrals of which 83% were from South East Queensland. The majority of referrals were from inpatients (71%); male (67%); and had HF associated with a reduced left ventricular ejection fraction (below 50%) (HFrEF) (78%). The median age was 70 years with women 5 years older than men, and Aboriginal and Torres Strait Islanders 11 years younger than other patients. Aboriginal and Torres Strait Islander patients made up 4.1% of all referrals, with Cairns and Townsville reporting greater than 15%. The HFrEF median age was 8 years younger than those with HF associated with a preserved left ventricular ejection fraction (HFpEF) (50% or more) and a higher proportion of patients with HFpEF were female compared to HFrEF.

Clinical indicator results

Clinical indicator performance is shown for proportions of all eligible (ideal) patients who received specific interventions. Benchmarks were set at 80% for all indicators except one.

Benchmarks were achieved for:

- Follow-up of non-acute patients within 4 weeks (86%);
- Assessment of left ventricular ejection fraction within 2 years (94%);
- Angiotensin converting enzyme inhibitor (ACEI)/angiotensin receptor blocker (ARB) prescription at hospital discharge (92%);
- ACEI/ARB prescription at first clinical review (93%);
- Guideline recommended beta blocker prescription at hospital discharge (90%); and
- Guideline recommended beta blocker prescription at first clinical review (89%).

Several indicators failed to meet benchmarks. The follow-up of inpatient referrals within 2 weeks was 73% and beta blocker titration status review at 6 months post referral was 75%. The achievement of target dose for beta blockers was lower than the 50% benchmark (39%) while achievement of maximum tolerated dose was below the 80% benchmark (71%).

Conclusion and recommendations

Opportunities exist to improve follow-up times of new referrals, and beta blocker review and titration. While the proportion of HF Support Services achieving benchmarks should be interpreted with caution, there does appear to be variance between services. Data entry is reliant on nurses to complete as part of their daily work and it is likely that the data is incomplete due to varying workloads. Reporting of hospital utilisation (readmission and length of stay) and mortality rates would provide a context to clinical performance. Recommendations include:

- Audit missed referrals;
- Review variance between services;
- Provide incentives for continued data entry;
- Introduce new indicators for areas likely to be in need of improvement;
- Report on unplanned readmission, length of stay, and mortality rates; and
- Collect more covariates to allow risk-adjustment of outcomes measures.

3 Participating sites

Queensland Heart Failure Support Services are multidisciplinary teams that assist patients with heart failure to adhere to treatment and manage symptoms. These teams are comprised of HF nurses with specialist medical support. Some services may include pharmacists, physiotherapists or exercise physiologists, and other allied health professionals. Statewide coordination of these services provides training, and promotes an evidence-based and consistent approach in delivery of care across the state.

Heart Failure Support Services provide:

- Active case finding throughout the hospital with an opt-out approach;
- Patient and carer education during and post hospitalisation;
- Discharge coordination between the inpatient treating team, and primary care services, including GP;
- Heart failure multidisciplinary clinic and/or telephone-based follow-up or home visits or exercise program;
- Medical follow-up that may include Heart Failure, general cardiology or medical outpatient clinics depending on local resources and patient preferences.

Heart Failure nurses entered data on all patients referred to the HF Support Services as part of routine care, using a web-based system which allows reporting of patient characteristics and benchmarking on five clinical indicators. Nurses are provided with weekly reminders regarding fields that require completion and patients due for a review of medication titration status at six months post referral. Where patients are referred to another HF Support Service, the audit is completed only for the aspect of the journey of care delivered by the site.

Of the 24 Heart Failure Support Services in Queensland, 23 contributed data to this report.

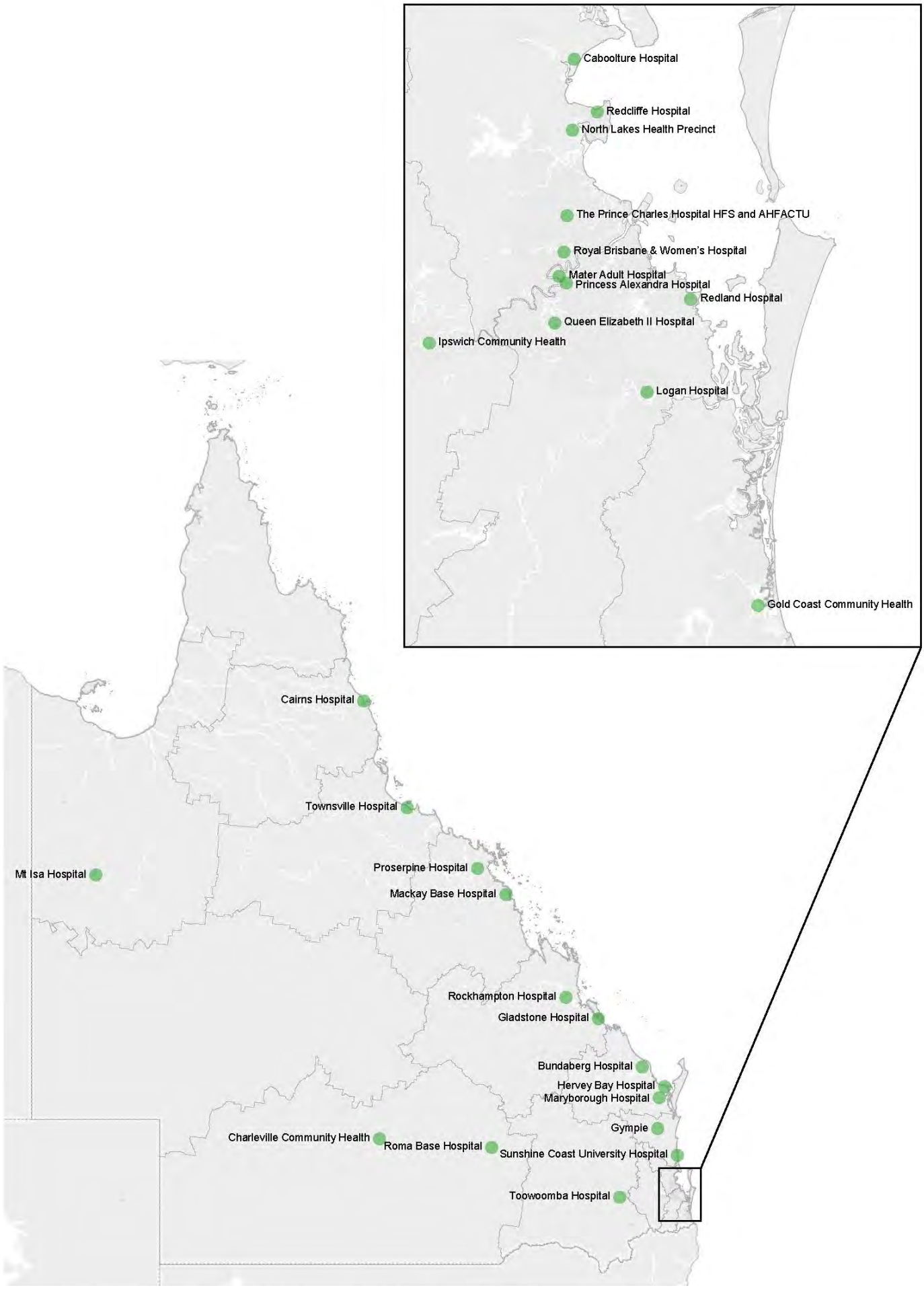


Figure 1: HFSSs locations

Table 1 shows the range of activities offered by Queensland Heart Failure Support Services in 2016. The activities of all Heart Failure Support Services included offering phone support.

Table 1: Activities offered by Queensland HFSSs in 2016

HHS*	Heart Failure Support Service	Inpatient support	Pharmacy review	Exercise therapist	Group rehab	Nurse led clinics	Home visits	NP†	Specialist medical review onsite‡
Cairns and Hinterland	Cairns Hospital	Y	-	Y	Y	Y	Y	Y	Y
Central Queensland	Gladstone Hospital	-	-	Y	Y	Y	Y	-	Telehealth
	Rockhampton Hospital	Y	Y	Y	Y	Y	Y	Y	Y
Darling Downs	Toowoomba Hospital	Y	-	Y	-	Y	Y	-	Y
Gold Coast	Gold Coast Community Health	Y	Y	Y	Y	Y	Y	-	Y
Mackay	Mackay Base Hospital	Y	-	Y	Y	Y	Y	-	Y
	Proserpine Hospital	Y	-	Y	Y	-	Y	-	Outreach
Metro North	Caboolture Hospital	-	Y	-	-	Y	-	-	Y
	AHFACTU§	Y	Y	Y	Y	Y	-	Y	Y
	Redcliffe Hospital	Y	-	-	-	-	Y	-	Y
	RBWH‖	Y	Y	Y	Y	Y	-	-	Y
	TPCH#	Y	Y	Y	Y	Y	Y	Y	Y
Metro South	Logan Hospital	Y	Y	Y	Y	Y	Y	Y	Y
	Mater Adult Hospital	Y	-	-	-	Y	Y	Y	Y
	PAH**	Y	Y	Y	Y	Y	Y	Y	Y
	QE II††	Y	Y	-	-	Y	Y	Y	Y
	Redland Hospital	Y	-	Y	Y	Y	Y	Y	Y
North West	Mt Isa Hospital	Y	-	-	-	-	Y	Y	Outreach
Sunshine Coast	Gympie Hospital	Y	-	Y	Y	Y	Y	Y	Outreach
	Nambour Hospital	Y	-	-	-	Y	Y	Y	Y
Townsville	Townsville Hospital	Y	Y	Y	-	Y	Y	Y	Y
West Moreton	Ipswich Community Health	Y	Y	Y	Y	Y	Y	Y	Y
Wide Bay	Bundaberg	Y	-	Y	Y	Y	-	Y	Y
	Hervey Bay Hospital	Y	-	Y	Y	Y	Y	Y	Telehealth
Statewide		**92%**	**46%**	**75%**	**67%**	**88%**	**83%**	**63%**	**79%**

* Hospital and Health Service

† Nurse practitioner who can prescribe medications

‡ Review by cardiologist or general physician with interest in heart failure

§ Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

‖ Royal Brisbane & Women's Hospital

\# The Prince Charles Hospital

** Princess Alexandra Hospital

†† Queen Elizabeth II Hospital

4 New referrals

Across Queensland, 4,021 new referrals were reported by 23 public sector HF Support Services in 2016. Patients readmitted to hospital whilst being monitored by a HF Support Service are not counted as a new referral. Most patients are monitored for at least 6 months to review medication titration achievement.

4.1 Location of referrals

The majority of referrals (83%) are reported by HF Support Services in South East Queensland.

Table 2: Distribution of new referrals by Hospital and Health Service and HFSS locations

HHS	Heart Failure Support Service	n	%
Cairns and Hinterland	Cairns Hospital	100	2.5%
Central Queensland	Gladstone Hospital	27	0.7%
	Rockhampton Hospital	209	5.2%
Darling Downs	Toowoomba Hospital	9	0.2%
Gold Coast	Gold Coast Community Health	381	9.5%
Mackay	Mackay Base Hospital	91	2.3%
	Proserpine Hospital	3	0.1%
Metro North	Caboolture Hospital	7	0.2%
	AHFACTU*	97	2.4%
	Redcliffe Hospital	53	1.3%
	Royal Brisbane and Women's Hospital	301	7.5%
	The Prince Charles Hospital	498	12.4%
Metro South	Logan Hospital	390	9.7%
	Mater Adult Hospital	103	2.6%
	Princess Alexandra Hospital	620	15.4%
	Queen Elizabeth II Hospital	138	3.4%
	Redland Hospital	139	3.5%
North West	Mt Isa Hospital	23	0.6%
Sunshine Coast	Gympie Hospital	91	2.3%
	Nambour General Hospital	286	7.1%
Townsville	Townsville Hospital	148	3.7%
West Moreton	Ipswich Community Health	239	5.9%
Wide Bay	Hervey Bay Hospital	68	1.7%
Statewide		**4,021**	**100.0%**

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

Table 3: Regional distribution of new referrals

Area of Queensland	Heart Failure Support Service	n	%
South East	Caboolture Hospital	7	
	Gold Coast Community Health	381	
	Gympie Hospital	91	
	Ipswich Community Health	239	
	Logan Hospital	390	
	Mater Adult Hospital	103	
	Nambour General Hospital	286	
	Princess Alexandra Hospital	620	
	AHFACTU*	97	
	Queen Elizabeth II Hospital	138	
	Redcliffe Hospital	53	
	Redland Hospital	139	
	Royal Brisbane and Women's Hospital	301	
	The Prince Charles Hospital	498	
	Toowoomba Hospital	9	
South East Total		**3,352**	**83%**
Other	Cairns Hospital	100	
	Gladstone Hospital	27	
	Hervey Bay Hospital	68	
	Mackay Base Hospital	91	
	Mt Isa Hospital	23	
	Proserpine Hospital	3	
	Rockhampton Hospital	209	
	Townsville Hospital	148	
Other Total		**669**	**17%**
Statewide		**4,021**	

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

4.2 Referral source

Of all referrals, 2,855 (71%) come from an inpatient setting. Few non-acute referrals came directly from primary care; this may be due to flow of GP referrals to specialty outpatient clinics for diagnosis and treatment optimisation prior to referral to a HF Support Service.

Table 4: Proportion by referral source

HHS	Heart Failure Support Service	Inpatient n (%)	Outpatient n (%)	Another HFSS n (%)	Primary care n (%)
Cairns and Hinterland	Cairns Hospital	48 (48.0)	52 (52.0)	0 (0.0)	0 (0.0)
Central Queensland	Gladstone Hospital	9 (33.3)	1 (3.7)	16 (59.3)	1 (3.7)
	Rockhampton Hospital	102 (48.8)	46 (22.0)	35 (16.7)	26 (12.4)
Darling Downs	Toowoomba Hospital	5 (55.6)	2 (22.2)	1 (11.1)	1 (11.1)
Gold Coast	Gold Coast Community Health	238 (62.5)	118 (31.0)	12 (3.1)	13 (3.4)
Mackay	Mackay Base Hospital	50 (54.9)	31 (34.1)	7 (7.7)	3 (3.3)
	Proserpine Hospital	2 (66.7)	0 (0.0)	1 (33.3)	0 (0.0)
Metro North	Caboolture Hospital	6 (85.7)	0 (0.0)	0 (0.0)	1 (14.3)
	AHFACTU*	52 (53.6)	41 (42.3)	0 (0.0)	4 (4.1)
	Redcliffe Hospital	52 (98.1)	1 (1.9)	0 (0.0)	0 (0.0)
	Royal Brisbane & Women's Hospital	248 (82.4)	52 (17.3)	1 (0.3)	0 (0.0)
	The Prince Charles Hospital	472 (94.8)	23 (4.6)	3 (0.6)	0 (0.0)
Metro South	Logan Hospital	299 (76.7)	33 (8.5)	58 (14.9)	0 (0.0)
	Mater Adult Hospital	71 (68.9)	31 (30.1)	1 (1.0)	0 (0.0)
	Princess Alexandra Hospital	559 (90.2)	51 (8.2)	10 (1.6)	0 (0.0)
	Queen Elizabeth II Hospital	83 (60.1)	31 (22.5)	24 (17.4)	0 (0.0)
	Redland Hospital	69 (49.6)	22 (15.8)	47 (33.8)	1 (0.7)
North West	Mt Isa Hospital	1 (4.3)	20 (87.0)	0 (0.0)	2 (8.7)
Sunshine Coast	Gympie Hospital	45 (49.5)	15 (16.5)	29 (31.9)	2 (2.2)
	Nambour General Hospital	226 (79.0)	50 (17.5)	9 (3.1)	1 (0.3)
Townsville	Townsville Hospital	96 (64.9)	38 (25.7)	3 (2.0)	11 (7.4)
West Moreton	Ipswich Community Health	119 (49.8)	64 (26.8)	53 (22.2)	3 (1.3)
Wide Bay	Hervey Bay Hospital	16 (23.5)	14 (20.6)	33 (48.5)	5 (7.4)
Statewide		**2,868 (71.3)**	**736 (18.3)**	**343 (8.5)**	**74 (1.8)**

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

5 Patient characteristics

5.1 Age

The statewide median age of patients managed by a HF Support Service was 70 years. The median age of women (74 years) was five years older than for men. There were 24% of patients 80 years of age and older. The Qld Advanced Heart Failure and Cardiac Transplantation Unit reported the youngest median age of 56 years and Redcliffe Hospital had the oldest median age of 80 years.

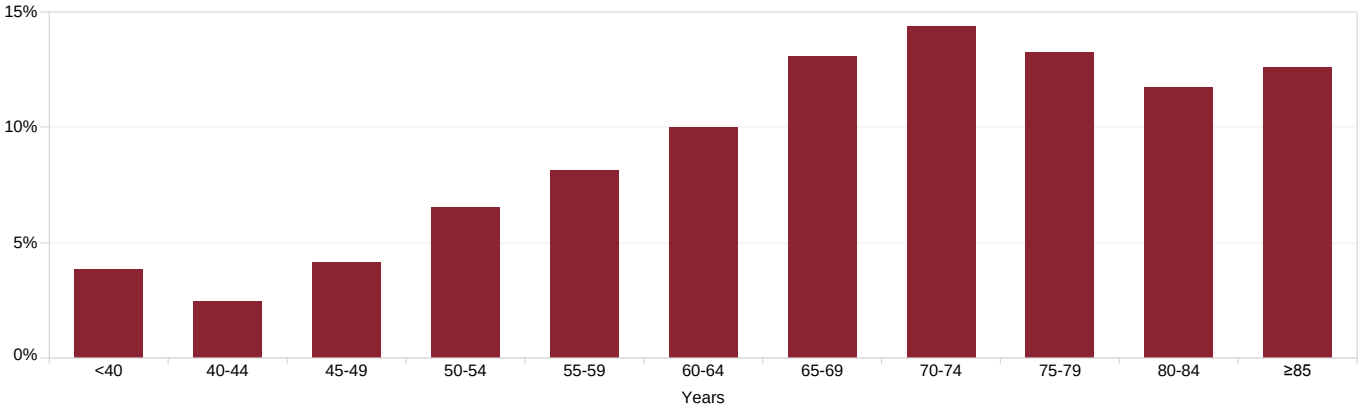


Figure 2: Age groups at referral to a HFSS

Table 5: Median age (years) of referrals by gender

HHS	Heart Failure Support Service	Male	Female	ALL
Cairns and Hinterland	Cairns Hospital	64	61	63
Central Queensland	Gladstone Hospital	69	80	70
	Rockhampton Hospital	68	74	69
Darling Downs	Toowoomba Hospital	69	71	69
Gold Coast	Gold Coast Community Health	71	76	72
Mackay	Mackay Base Hospital	64	72	68
	Proserpine Hospital	64	-	64
Metro North	Caboolture Hospital	73	67	67
	AHFACTU*	57	54	56
	Redcliffe Hospital	76	82	80
	Royal Brisbane & Women's Hospital	69	75	70
	The Prince Charles Hospital	71	76	73
Metro South	Logan Hospital	70	75	71
	Mater Adult Hospital	70	73	72
	Princess Alexandra Hospital	67	72	68
	Queen Elizabeth II Hospital	69	76	70
	Redland Hospital	70	74	72
North West	Mt Isa Hospital	68	64	67
Sunshine Coast	Gympie Hospital	76	80	78
	Nambour General Hospital	70	73	71
Townsville	Townsville Hospital	65	67	65
West Moreton	Ipswich Community Health	66	76	69
Wide Bay	Hervey Bay Hospital	69	75	71
Statewide		**69**	**74**	**70**

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

5.2 Gender

The majority (67%) of referrals were males.

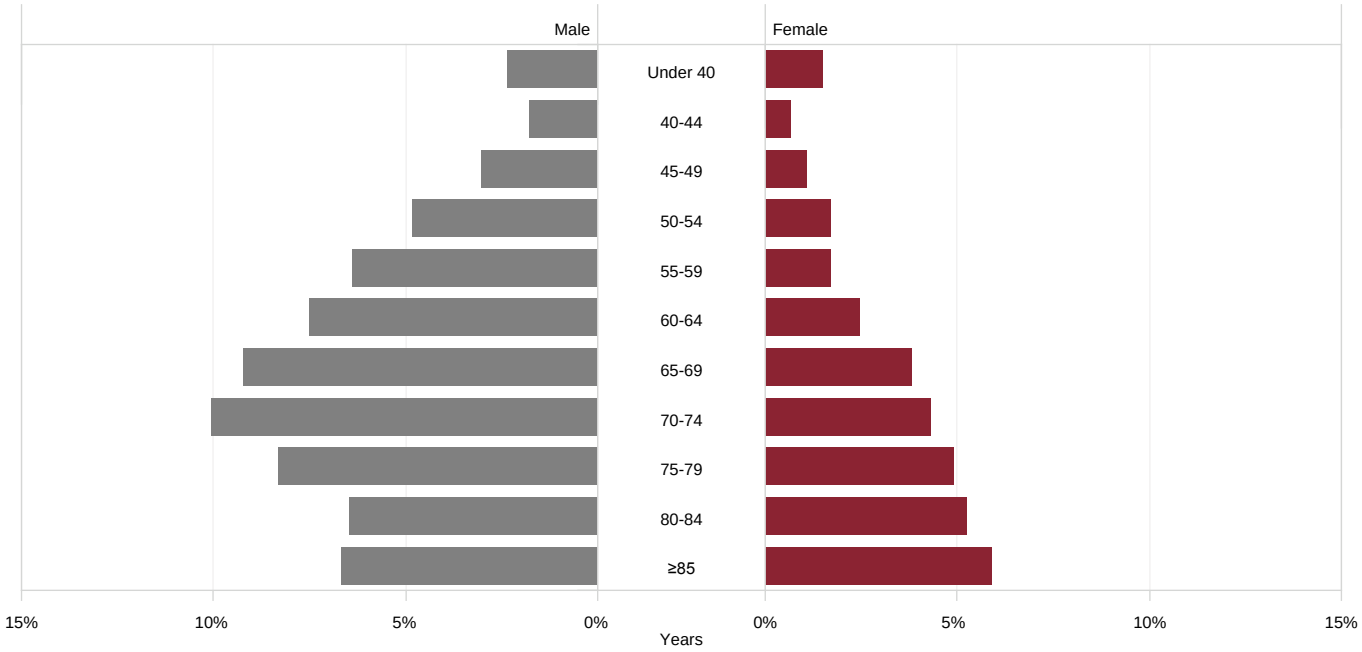
Table 6: Proportion of referrals to HFSSs by gender

HHS	Heart Failure Support Service	Male n(%)	Female n(%)
Cairns and Hinterland	Cairns Hospital	76 (76.0)	24 (24.0)
Central Queensland	Gladstone Hospital	22 (81.5)	5 (18.5)
	Rockhampton Hospital	139 (66.5)	70 (33.5)
Darling Downs	Toowoomba Hospital	8 (88.9)	1 (11.1)
Gold Coast	Gold Coast Community Health	248 (65.1)	133 (34.9)
Mackay	Mackay Base Hospital	60 (65.9)	31 (34.1)
	Proserpine Hospital	3 (100.0)	0 (0.0)
Metro North	Caboolture Hospital	4 (57.1)	3 (42.9)
	AHFACTU*	68 (70.1)	29 (29.9)
	Redcliffe Hospital	26 (49.1)	27 (50.9)
	Royal Brisbane & Women's Hospital	198 (65.8)	103 (34.2)
	The Prince Charles Hospital	328 (65.9)	170 (34.1)
Metro South	Logan Hospital	253 (64.9)	137 (35.1)
	Mater Adult Hospital	48 (46.6)	55 (53.4)
	Princess Alexandra Hospital	438 (70.6)	182 (29.4)
	Queen Elizabeth II Hospital	98 (71.0)	40 (29.0)
	Redland Hospital	87 (62.6)	52 (37.4)
North West	Mt Isa Hospital	19 (82.6)	4 (17.4)
Sunshine Coast	Gympie Hospital	58 (63.7)	33 (36.3)
	Nambour General Hospital	203 (71.0)	83 (29.0)
Townsville	Townsville Hospital	100 (67.6)	48 (32.4)
West Moreton	Ipswich Community Health	153 (64.0)	86 (36.0)
Wide Bay	Hervey Bay Hospital	47 (69.1)	21 (30.9)
Statewide		**2,684 (66.7)**	**1,337 (33.3)**

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

5.2.1 Gender by age group

The age distribution of referrals differed for gender. The highest proportion of referrals for males was in the 70 to 74 years age group (10%), and for females was in the over 85 years age group (6%).



% of total n (4,021)

Figure 3: Proportion of referrals to HFSSs by gender and age group

5.3 Identified 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 known that in the Aboriginal and Torres Strait Islander populations there is a higher age-adjusted incidence and prevalence of hypertension, coronary artery disease, and rheumatic heart disease, which are well-recognised pathological precursors for the pathogenesis of symptomatic HF.[2]

Aboriginal and Torres Strait Islander patients made up 4% of all referrals. Cairns and Townsville reported greater than 15% of case load as being Aboriginal and Torres Strait Islander. The Princess Alexandra reported the largest number (n=28) of referrals for Aboriginal and Torres Strait Islander patients.

The median age of Aboriginal and Torres Strait Islander patients was 11 years younger than other patients (median age 60 compared to 71).

Table 7: Proportions of Aboriginal and Torres Strait Islander patients referred to HFSSs

HHS	Heart Failure Support Service	n	%
Cairns and Hinterland	Cairns Hospital	22	22.0%
Central Queensland	Gladstone Hospital	1	3.7%
	Rockhampton Hospital	13	6.2%
Darling Downs	Toowoomba Hospital	0	0.0%
Gold Coast	Gold Coast Community Health	3	0.8%
Mackay	Mackay Base Hospital	5	5.5%
	Proserpine Hospital	0	0.0%
Metro North	Caboolture Hospital	0	0.0%
	AHFACTU*	5	5.2%
	Redcliffe Hospital	0	0.0%
	Royal Brisbane & Women's Hospital	8	2.7%
	The Prince Charles Hospital	9	1.8%
Metro South	Logan Hospital	12	3.1%
	Mater Adult Hospital	5	4.9%
	Princess Alexandra Hospital	28	4.5%
	Queen Elizabeth II Hospital	1	0.7%
	Redland Hospital	4	2.9%
North West	Mt Isa Hospital	3	13.0%
Sunshine Coast	Gympie Hospital	4	4.4%
	Nambour General Hospital	5	1.7%
Townsville	Townsville Hospital	24	16.2%
West Moreton	Ipswich Community Health	9	3.8%
Wide Bay	Hervey Bay Hospital	2	2.9%
Statewide		**163**	**4.1%**

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

5.4 Classification of heart failure by left ventricular ejection fraction

Heart Failure with reduced left ventricular ejection fraction (HFrEF) was defined as patients with an ejection fraction less than 50% at time of diagnosis. Some patients may return to a normal ejection fraction (greater than 50%) but still require ongoing medications to manage HFrEF.[3,4,5]

The majority (78%) of patients seen by Heart Failure Support Services had HFrEF at the time of diagnosis. Patients with HFrEF tended to be younger with a median age of 69 years compared to patients with HF associated with a preserved left ventricular ejection fraction (HFpEF) who had a median age of 77 years. A higher proportion of patients with HFpEF were female (53%) and a higher proportion of patients with HFrEF were male (72%).

Table 8: Proportion of patients by heart failure type referred to HFSSs

HHS	Heart Failure Support Service	HFrEF* n (%)	HFpEF† n (%)	Missing/unsure n (%)
Cairns and Hinterland	Cairns Hospital	99 (99.0)	1 (1.0)	0 (0.0)
Central Queensland	Gladstone Hospital	26 (96.3)	1 (3.7)	0 (0.0)
	Rockhampton Hospital	182 (87.1)	21 (10.0)	6 (2.9)
Darling Downs	Toowoomba Hospital	9 (100.0)	0 (0.0)	0 (0.0)
Gold Coast	Gold Coast Community Health	269 (70.6)	91 (23.9)	21 (5.5)
Mackay	Mackay Base Hospital	84 (92.3)	7 (7.7)	0 (0.0)
	Proserpine Hospital	2 (66.7)	1 (33.3)	0 (0.0)
Metro North	Caboolture Hospital	7 (100.0)	0 (0.0)	0 (0.0)
	AHFACTU‡	66 (68.0)	22 (22.7)	9 (9.3)
	Redcliffe Hospital	9 (17.0)	16 (30.2)	28 (52.8)
	Royal Brisbane & Women's Hospital	236 (78.4)	59 (19.6)	6 (2.0)
	The Prince Charles Hospital	366 (73.5)	102 (20.5)	30 (6.0)
Metro South	Logan Hospital	272 (69.7)	100 (25.6)	18 (4.6)
	Mater Adult Hospital	71 (68.9)	20 (19.4)	12 (11.7)
	Princess Alexandra Hospital	542 (87.4)	67 (10.8)	11 (1.8)
	Queen Elizabeth II Hospital	102 (73.9)	31 (22.5)	5 (3.6)
	Redland Hospital	96 (69.1)	26 (18.7)	17 (12.2)
North West	Mt Isa Hospital	20 (87.0)	3 (13.0)	0 (0.0)
Sunshine Coast	Gympie Hospital	67 (73.6)	22 (24.2)	2 (2.2)
	Nambour General Hospital	248 (86.7)	37 (12.9)	1 (0.3)
Townsville	Townsville Hospital	129 (87.2)	15 (10.1)	4 (2.7)
West Moreton	Ipswich Community Health	186 (77.8)	48 (20.1)	5 (2.1)
Wide Bay	Hervey Bay Hospital	52 (76.5)	16 (23.5)	0 (0.0)
Statewide		**3,140 (78.1)**	**706 (17.6)**	**175 (4.4)**

* Heart failure with reduced ejection fraction

† Heart failure with preserved ejection fraction

‡ Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

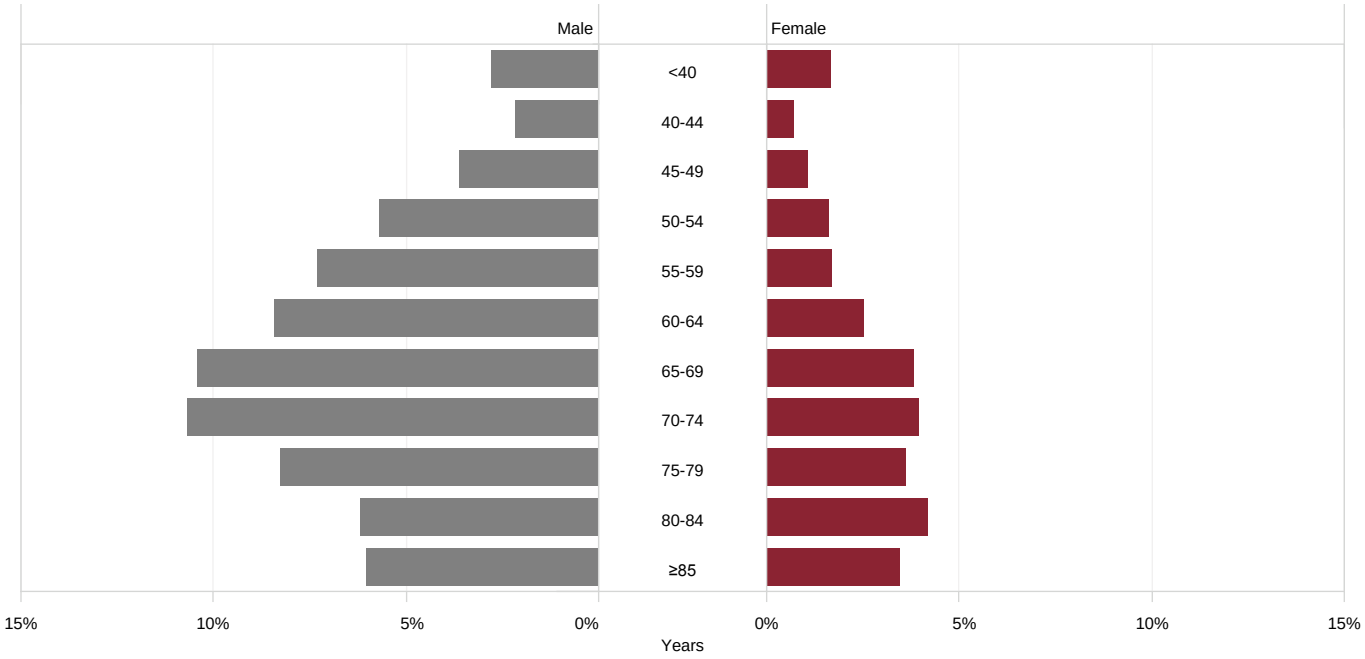
Table 9: Type of heart failure by age, gender, and Aboriginal and Torres Strait Islander status

	HFrEF*	HFpEF†
Number	3,140	706
Age (median years)	69	77
% male	72%	48%
% A&TSI	4%	3%

Excluding missing data (4.1%)

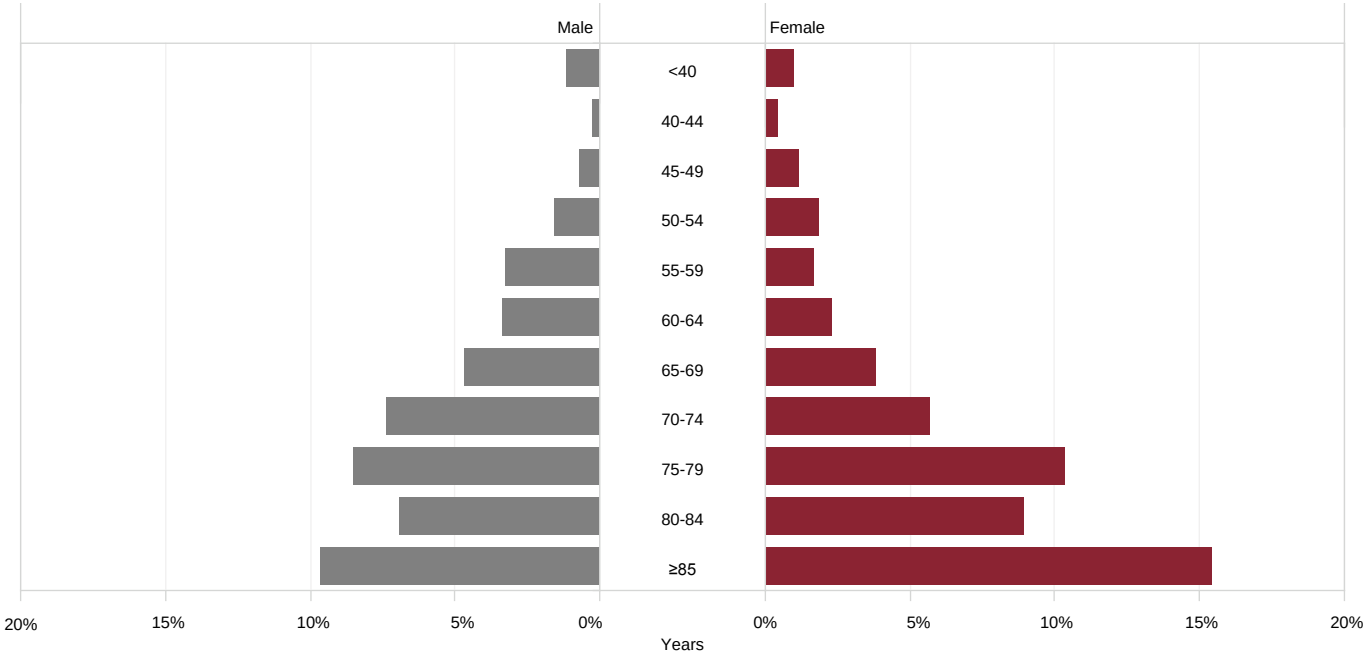
* Heart failure with reduced ejection fraction

† Heart failure with preserved ejection fraction



% of total with HFrEF (n=3,140)

Figure 4: Proportion of referrals to HFSSs by gender and age group for heart failure with reduced ejection fraction



% of total with HFpEF (n=706)

Figure 5: Proportion of referrals to HFSSs by gender and age group for heart failure with preserved ejection fraction

5.5 Summary of patient characteristics

Patient characteristics are summarised below.

Table 10: Summary of patient characteristics referred to a HFSS

Characteristic	HF Support Services
New referrals to a HFSS*	4,021
Referrals from South East Queensland	83%
Referral source:	
Inpatient	71%
Outpatient	18%
Another HFSS	9%
Primary care	2%
Age (median years):	
All (median, range by service)	70 (53-80) years
Women vs Men	74 vs 69 years
A&TSI† vs other	60 vs 71 years
Over 80 year	24%
Males	67%
A&TSI†	4%
HFrEF‡	78% (72% male, median age 69 years)
HFpEF§	22% (48% male, median age 77 years)

* Heart Failure Support Service

† Identified Aboriginal and Torres Strait Islander

‡ Heart failure with reduced ejection fraction

§ Heart failure with preserved ejection fraction

6 Clinical indicators

The number of indicators collected was intentionally limited to allow pragmatic data entry as part of routine clinical practice. Consensus on the content and methods of collecting data was reached following a Delphi method involving all HF Support Services in Queensland.

Five process indicators were agreed upon.

The management of all patients regardless of the type of heart failure including:

1. Timely follow-up by a HF Support Service for inpatient and outpatient referrals
2. Assessment of left ventricular function within the last 2 years

The management of patients with a diagnosis of HFrEF measured medication prescribing and titration practices including:

3. Prescription of angiotensin-converting-enzyme inhibitor (ACEI) or angiotensin II receptor blockers (ARB) at hospital discharge and/or at the time of first clinical review
4. Prescription of guideline recommended beta blockers (Bisoprolol, Carvedilol, Metoprolol sustained release, or Nebivolol) at hospital discharge and/or at the time of first clinical review
5. Guideline recommended beta blocker review and titration status at 6 months post referral to a HF Support Service

The target optimal standard for most indicators was set at 80%, with the exception of beta blocker titration to clinical guideline target dose at 6 months which was set at 50% based upon reviews of real world practice[6].

6.1 First clinical review

A review is defined as a clinical (rather than administrative) intervention and can be conducted by phone, clinic, or home visit. Patients were excluded if they died, were referred to another HF Support Service, declined follow-up or could not be contacted.

1a First clinical review by HFSS within 2 weeks of hospital discharge or date of referral if after discharge (for inpatient referrals).

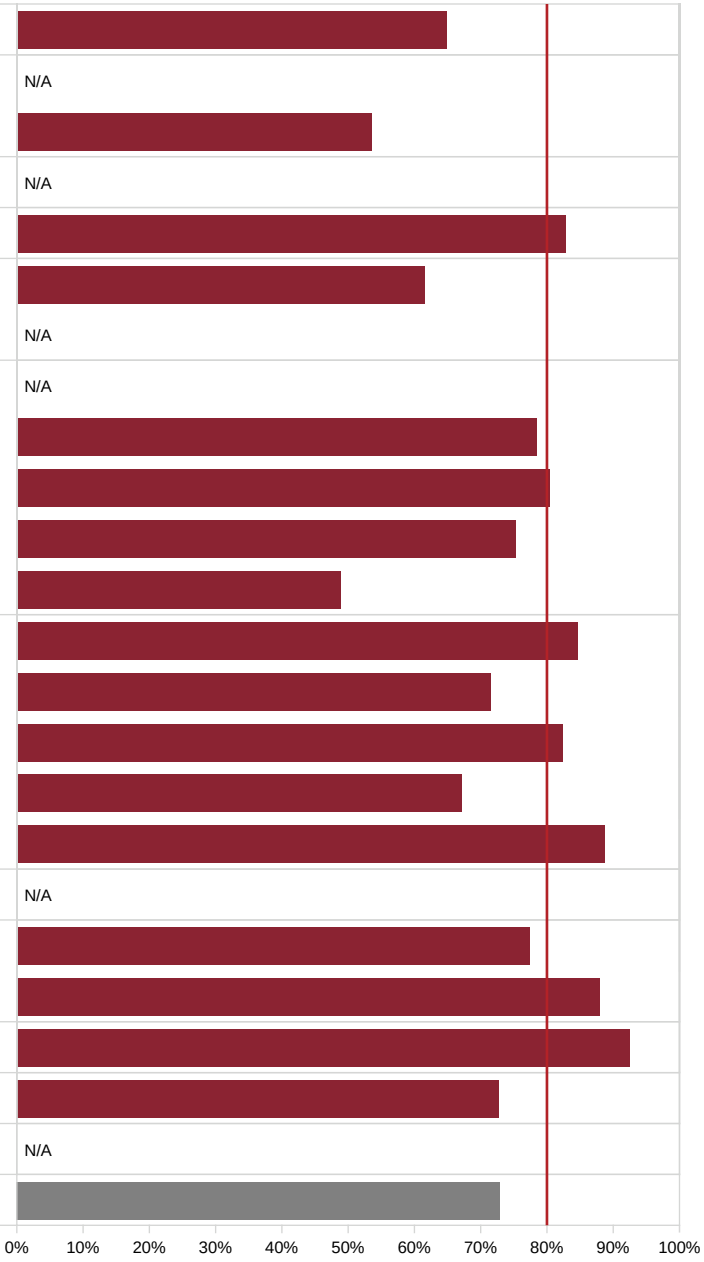
Early post discharge follow up is recommended for patients with HF to monitor symptoms, provide education and support self-management principles. The appropriate timeframe chosen for this intervention was review within two weeks of hospital discharge or date of referral after recent hospitalisation.

Of patients referred from an inpatient setting, 73% received a clinical review by a HF Support Service within two weeks of hospital discharge. The desired benchmark of 80% was achieved by 7/17 (41%) of HF Support Services that had more than 20 cases eligible for analysis. Six services had insufficient data for benchmarking.

Table 11: Inpatients receiving first HFSSs clinical review within 2 weeks of hospital discharge

	n
Eligible for analysis	1,958
Achieved benchmark	1,429
Benchmark not achieved	529
Ineligible	910
Referred to another HFSS	567
Patient declined service	128
Other reason	111
Patient could not be contacted	71
Patient deceased	33
Total acute patients	**2,868**

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	40
Central Queensland	Gladstone Hospital	9
	Rockhampton Hospital	99
Darling Downs	Toowoomba Hospital	3
Gold Coast	Gold Coast Community Health	189
Mackay	Mackay Base Hospital	47
	Proserpine Hospital	2
Metro North	Caboolture Hospital	4
	AHFACTU*	42
	Redcliffe Hospital	41
	Royal Brisbane & Women's Hospital	163
	The Prince Charles Hospital	354
Metro South	Logan Hospital	231
	Mater Adult Hospital	46
	Princess Alexandra Hospital	143
	Queen Elizabeth II Hospital	73
	Redland Hospital	53
North West	Mt Isa Hospital	1
Sunshine Coast	Gympie Hospital	40
	Nambour General Hospital	178
Townsville	Townsville Hospital	81
West Moreton	Ipswich Community Health	103
Wide Bay	Hervey Bay Hospital	16
STATEWIDE		



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

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

Figure 6: Proportion of inpatients who received first HFSS clinical review within 2 weeks of hospital discharge by site.

1b First HFSS clinical review conducted within 4 weeks of referral (non-acute patients)

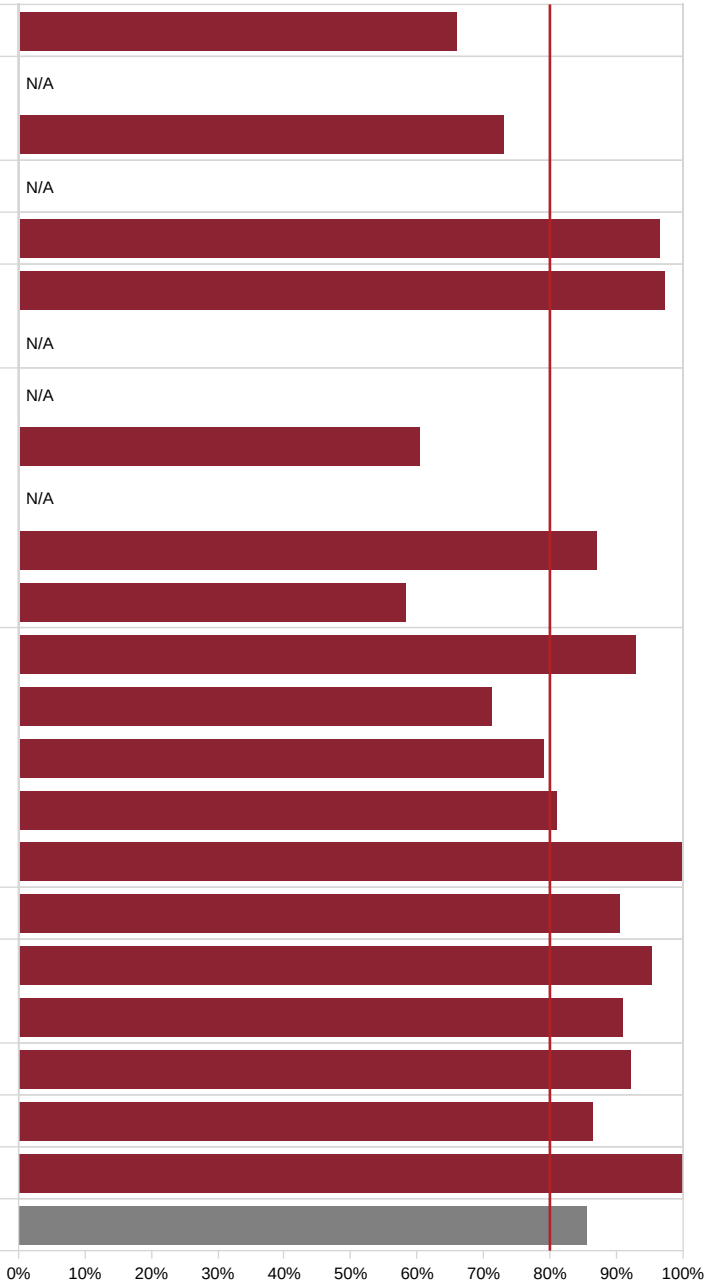
For non-acute patients, the Statewide HF Steering Committee determined four weeks following referral to be the recommended time frame for first clinical review.

Referrals for 1,153 of patients came from non-acute services of which 86% received a clinical review within 4 weeks of referral. The desired benchmark of 80% was achieved by 12 out of 18 (67%) of HF Support Services that had more than 20 cases eligible for analysis. Five services had insufficient data for benchmarking.

Table 12: Non-acute patients receiving first HFSSs clinical review within 4 weeks of referral

	n
Eligible for analysis	1,044
Achieved benchmark	893
Benchmark not achieved	151
Ineligible	109
Patient declined service	44
Other reason	23
Patient could not be contacted	21
Referred to another HFSS	16
Patient deceased	5
Total non-acute patients	**1,153**

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	50
Central Queensland	Gladstone Hospital	17
	Rockhampton Hospital	104
Darling Downs	Toowoomba Hospital	4
Gold Coast	Gold Coast Community Health	113
Mackay	Mackay Base Hospital	40
	Proserpine Hospital	1
Metro North	Caboolture Hospital	1
	AHFACTU*	43
	Redcliffe Hospital	1
	Royal Brisbane & Women's Hospital	47
	The Prince Charles Hospital	24
Metro South	Logan Hospital	84
	Mater Adult Hospital	28
	Princess Alexandra Hospital	53
	Queen Elizabeth II Hospital	48
	Redland Hospital	52
North West	Mt Isa Hospital	21
Sunshine Coast	Gympie Hospital	43
	Nambour General Hospital	55
Townsville	Townsville Hospital	52
West Moreton	Ipswich Community Health	111
Wide Bay	Hervey Bay Hospital	52
STATEWIDE		



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

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

Figure 7: Proportion of non-acute patients who received first HFSS clinical review within 4 weeks of referral

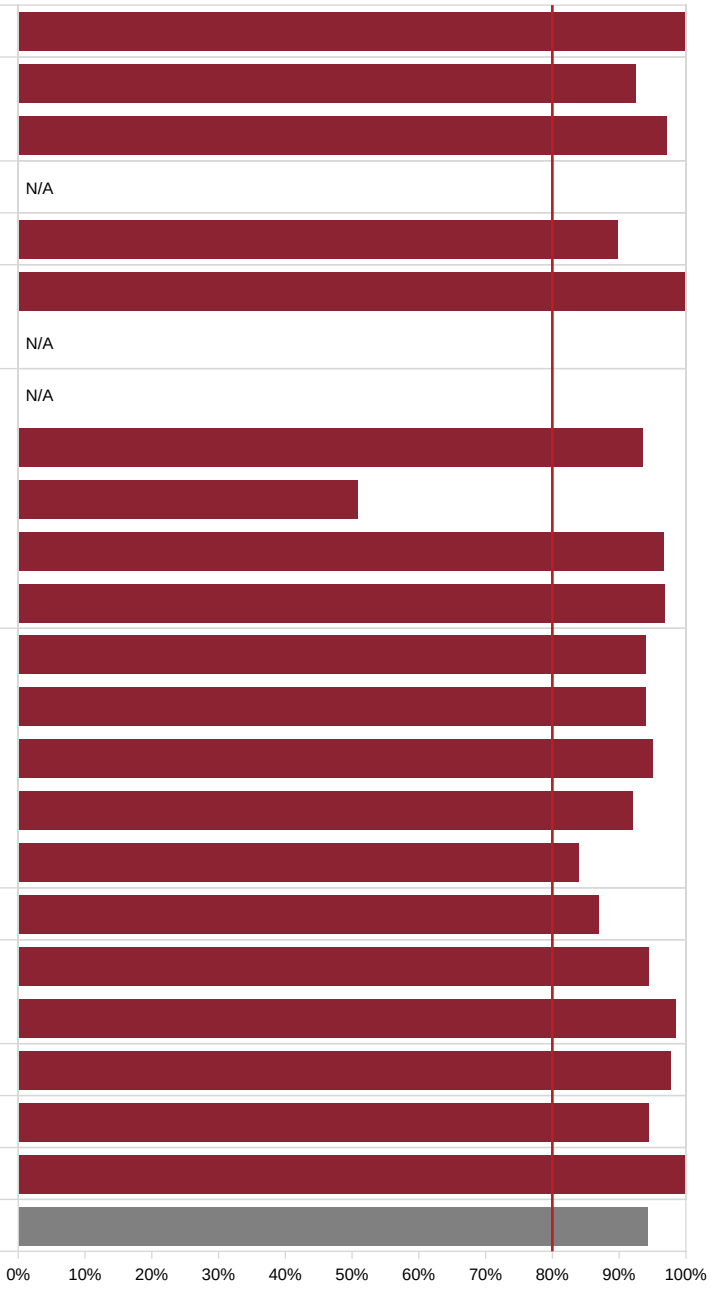
6.2 Left ventricular ejection fraction (LVEF) assessment

Clinical guidelines recommend that all people with HF should have an assessment of left ventricular function.[3,4,5] In 94% of cases LVEF was assessed within 2 years of referral to a HF Support Service. The benchmark of 80% was achieved by 19 out of 20 (95%) of HF Support Services that had more than 20 cases eligible for analysis. Three services had insufficient data for benchmarking.

Table 13: Patients who had LVEF assessed within 2 years of referral

	n
Eligible for analysis	4,000
Achieved benchmark	3,777
Benchmark not achieved	223
Ineligible	N/A
Incomplete data	21
Total referrals	**4,021**

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	100
Central Queensland	Gladstone Hospital	27
	Rockhampton Hospital	209
Darling Downs	Toowoomba Hospital	9
Gold Coast	Gold Coast Community Health	381
Mackay	Mackay Base Hospital	91
	Proserpine Hospital	3
Metro North	Caboolture Hospital	7
	AHFACTU*	95
	Redcliffe Hospital	51
	Royal Brisbane & Women's Hospital	301
	The Prince Charles Hospital	482
Metro South	Logan Hospital	390
	Mater Adult Hospital	102
	Princess Alexandra Hospital	620
	Queen Elizabeth II Hospital	138
	Redland Hospital	139
North West	Mt Isa Hospital	23
Sunshine Coast	Gympie Hospital	91
	Nambour General Hospital	286
Townsville	Townsville Hospital	148
West Moreton	Ipswich Community Health	239
Wide Bay	Hervey Bay Hospital	68
STATEWIDE		



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

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

Figure 8: Proportion of all patients who had LVEF assessed within 2 years of referral to HFSSs by site

6.3 Prescription of ACEI or ARB

Angiotensin-converting-enzyme inhibitor (ACEI) or angiotensin II receptor blockers (ARB) have been shown to reduce mortality and morbidity in patients with HF with reduced ejection fraction (HFrEF) and are recommended for all symptomatic patients unless contraindicated or not tolerated.[3,4,5]

3a ACEI or ARB prescription for HFrEF at hospital discharge

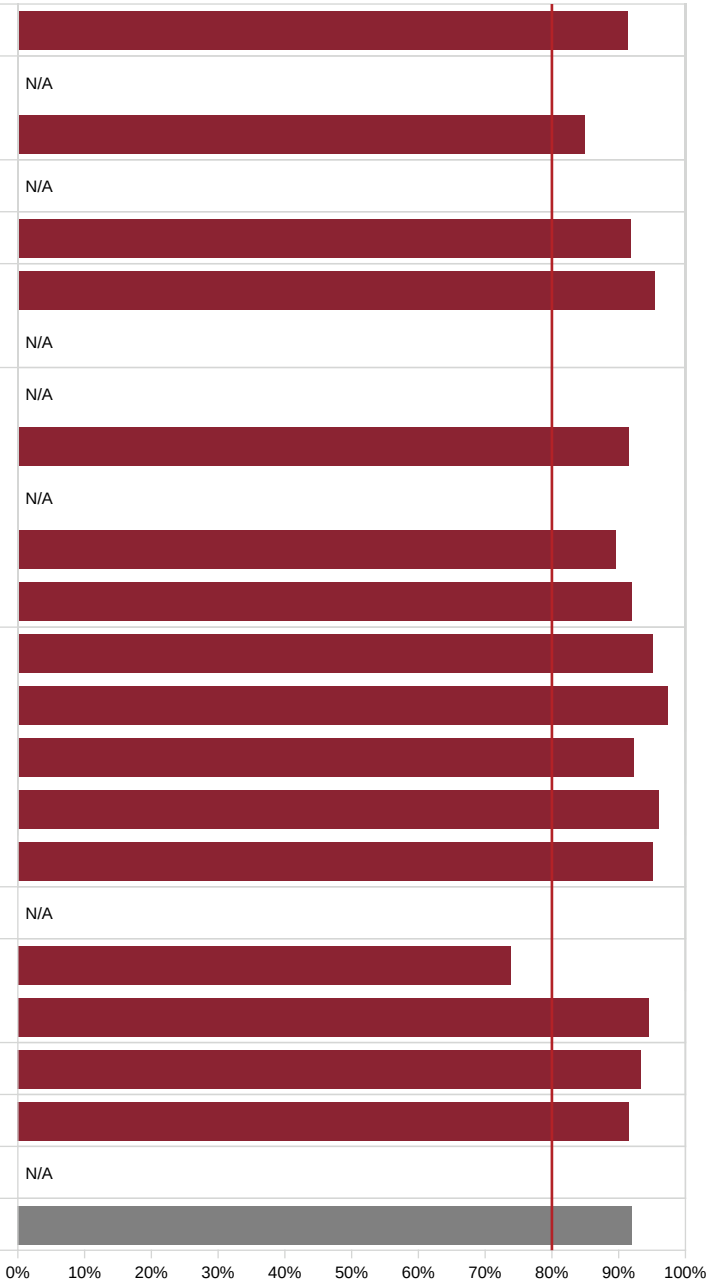
In 2016, 92% of patients referred to a HF Support Service were prescribed an ACEI or ARB therapy on hospital discharge. The benchmark of 80% was achieved by 15/16 (88%) of HF Support Services that had more than 20 cases eligible for analysis. Seven services had insufficient data for benchmarking.

Table 14: Inpatients on ACEI or ARB at time of hospital discharge

	n
Eligible for analysis	2,033
Achieved benchmark	1,873
Benchmark not achieved	160
Ineligible	785
Not HFrEF	562
Documented contraindication*	126
LV Function assessment not available	97
Incomplete data	50
Total acute patients	**2,868**

* Adverse reaction to ACEI or ARB, palliative intent to treatment, pregnancy, eGFR ‹ 30 mL/min, severe aortic stenosis, renal artery stenosis, serum potassium › 5.5 mmol/L, symptomatic hypotension.

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	47
Central Queensland	Gladstone Hospital	6
	Rockhampton Hospital	73
Darling Downs	Toowoomba Hospital	5
Gold Coast	Gold Coast Community Health	158
Mackay	Mackay Base Hospital	44
	Proserpine Hospital	2
Metro North	Caboolture Hospital	5
	AHFACTU*	36
	Redcliffe Hospital	6
	Royal Brisbane & Women's Hospital	185
	The Prince Charles Hospital	303
Metro South	Logan Hospital	191
	Mater Adult Hospital	38
	Princess Alexandra Hospital	461
	Queen Elizabeth II Hospital	52
	Redland Hospital	41
North West	Mt Isa Hospital	0
Sunshine Coast	Gympie Hospital	23
	Nambour General Hospital	185
Townsville	Townsville Hospital	76
West Moreton	Ipswich Community Health	84
Wide Bay	Hervey Bay Hospital	12
STATEWIDE		



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

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

Figure 9: Proportion of patients on an ACEI or ARB at time of hospital discharge by site

3b ACEI or ARB prescription for HFrEF at time of first HFSS clinical review

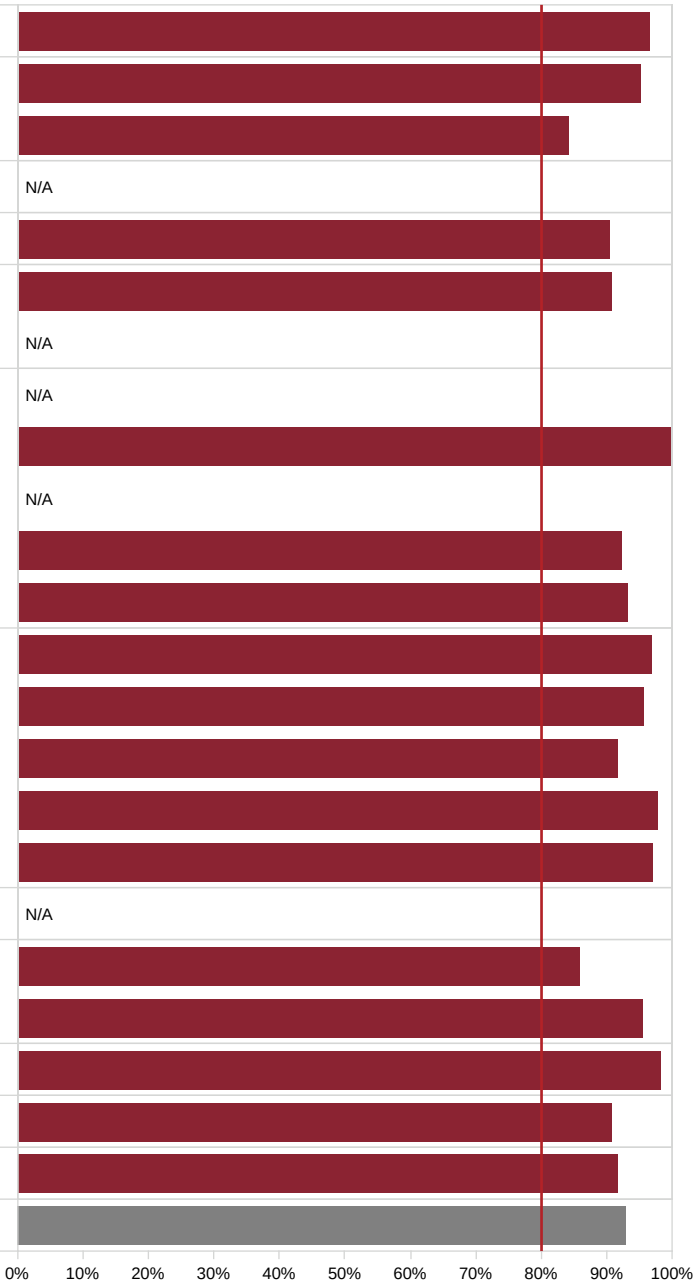
At the time of first clinical review, the target for prescription of ACEI or ARB was met for 93% of patients. The benchmark of 80% was achieved by 18 out of 18 (100%) of HF Support Services that had more than 20 cases eligible for analysis. Five services had insufficient data for benchmarking.

Table 15: Patients on an ACEI or ARB at first clinical review

	n
Eligible for analysis	2,156
Achieved benchmark	2,004
Benchmark not achieved	152
Ineligible	1,787
Referred to another HFSS	583
Not HFrEF	574
Patient declined service	172
Other reason	134
Documented contraindication*	112
Patient could not be contacted	92
LV Function assessment not available	82
Patient deceased	38
Incomplete data	78
Total referrals	**4,021**

* Adverse reaction to ACEI or ARB, palliative intent to treatment, pregnancy, eGFR ‹ 30 mL/min, severe aortic stenosis, renal artery stenosis, serum potassium › 5.5 mmol/L, symptomatic hypotension.

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	89
Central Queensland	Gladstone Hospital	21
	Rockhampton Hospital	165
Darling Downs	Toowoomba Hospital	4
Gold Coast	Gold Coast Community Health	209
Mackay	Mackay Base Hospital	76
	Proserpine Hospital	2
Metro North	Caboolture Hospital	4
	AHFACTU*	52
	Redcliffe Hospital	5
	Royal Brisbane & Women's Hospital	144
	The Prince Charles Hospital	208
Metro South	Logan Hospital	214
	Mater Adult Hospital	47
	Princess Alexandra Hospital	167
	Queen Elizabeth II Hospital	86
	Redland Hospital	70
North West	Mt Isa Hospital	18
Sunshine Coast	Gympie Hospital	57
	Nambour General Hospital	197
Townsville	Townsville Hospital	110
West Moreton	Ipswich Community Health	163
Wide Bay	Hervey Bay Hospital	48
STATEWIDE		



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

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

Figure 10: Proportion of patients on ACEI or ARB therapy at time of first clinical review by site

6.4 Prescription of guideline recommended beta blockers

Guideline recommended beta blockers have been shown to reduce mortality and morbidity in patients with HFrEF and are recommended for all symptomatic patients unless contraindicated or not tolerated.[3,4,5] Guideline recommended beta blockers include: Bisoprolol, Carvedilol, Metoprolol sustained release, or Nebivolol. Results pertain only to these beta blocker medications.

4a Beta blocker prescription for HFrEF at time of hospital discharge

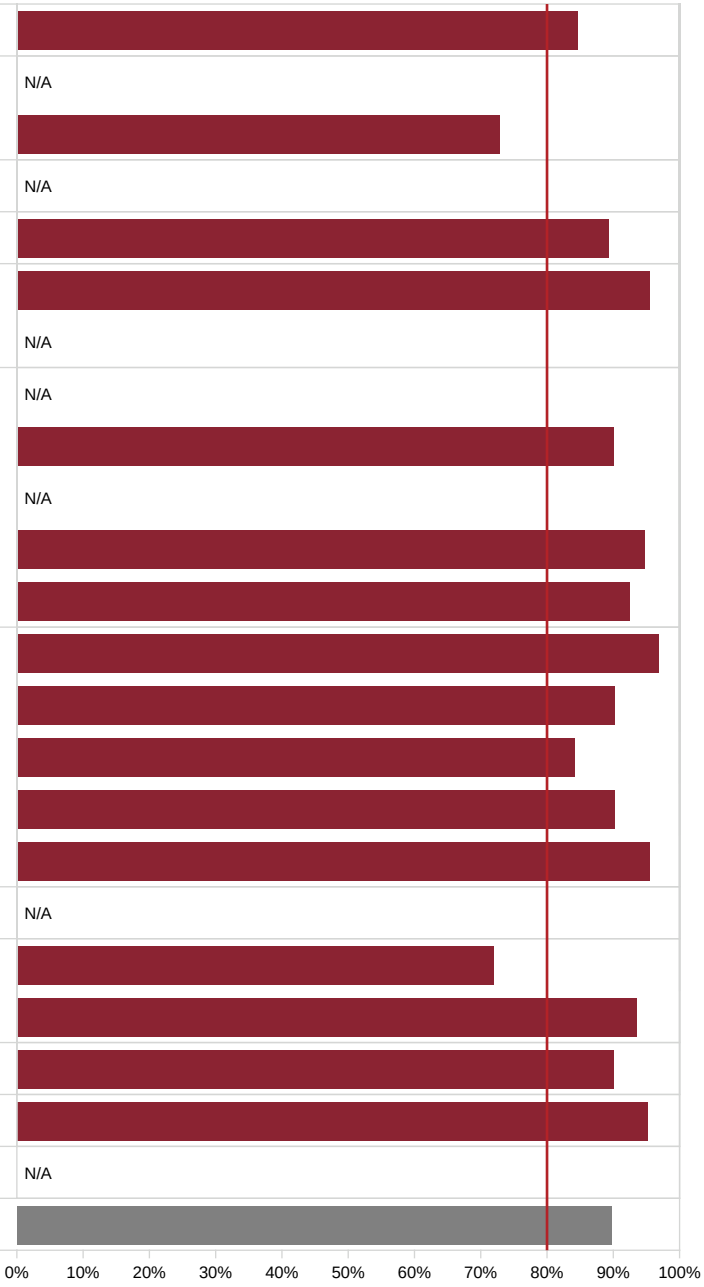
In 2016, 90% of referrals were reported to be on a guideline recommended beta blocker at the time of discharge from hospital. The benchmark of 80% was achieved by 14 out of 16 (88%) of HF Support Services that had more than 20 cases eligible for analysis. Seven services had insufficient data for benchmarking.

Table 16: Patients on guideline recommended beta blocker at hospital discharge

	n
Eligible for analysis	2,111
Achieved benchmark	1,899
Benchmark not achieved	212
Ineligible	707
Not HFrEF	562
LV Function assessment not available	97
Documented contraindication*	48
Incomplete data	50
Total acute patients	**2,868**

* adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR <50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	46
Central Queensland	Gladstone Hospital	8
	Rockhampton Hospital	78
Darling Downs	Toowoomba Hospital	5
Gold Coast	Gold Coast Community Health	160
Mackay	Mackay Base Hospital	46
	Proserpine Hospital	2
Metro North	Caboolture Hospital	6
	AHFACTU*	40
	Redcliffe Hospital	6
	Royal Brisbane & Women's Hospital	193
	The Prince Charles Hospital	322
Metro South	Logan Hospital	196
	Mater Adult Hospital	41
	Princess Alexandra Hospital	477
	Queen Elizabeth II Hospital	52
	Redland Hospital	45
North West	Mt Isa Hospital	0
Sunshine Coast	Gympie Hospital	25
	Nambour General Hospital	186
Townsville	Townsville Hospital	81
West Moreton	Ipswich Community Health	85
Wide Bay	Hervey Bay Hospital	11
STATEWIDE		



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

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

Figure 11: Proportion of patients on guideline recommended beta blocker at hospital discharge by site

4b Beta blocker prescription for HFREF at time of first HFSS clinical review

In 2016, 89% of referrals to HF Support Services were reported to be on a guideline recommended beta blocker at the time of first clinical review. The desired benchmark of 80% was achieved by 17 out of 18 (94%) of HF Support Services that had more than 20 cases eligible for analysis. Five services had insufficient data for benchmarking.

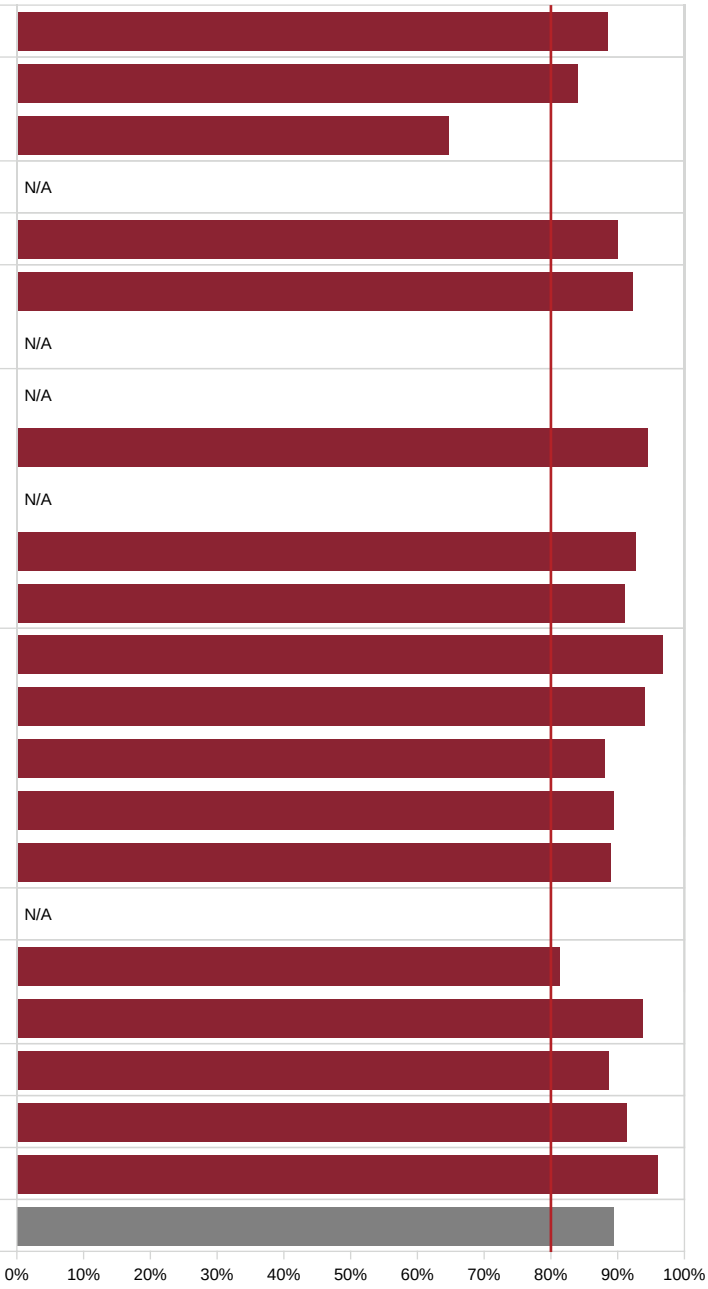
Eighty-nine percent of referrals to HF Services were reported to be on HF beta blocker therapy at the time of first clinical review. Target was achieved in all but one service for this indicator.

Table 17: Patients on guideline recommended beta blocker at first clinical review

	n
Eligible for analysis	2,209
Achieved benchmark	1,976
Benchmark not achieved	233
Ineligible	1,731
Referred to another HFSS	583
Not HFrEF	574
Patient declined service	172
Other reason	134
Patient could not be contacted	92
LV Function assessment not available	82
Documented contraindication*	56
Patient deceased	38
Incomplete data	81
Total referrals	**4,021**

* adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR <50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	88
Central Queensland	Gladstone Hospital	25
	Rockhampton Hospital	173
Darling Downs	Toowoomba Hospital	4
Gold Coast	Gold Coast Community Health	204
Mackay	Mackay Base Hospital	79
	Proserpine Hospital	2
Metro North	Caboolture Hospital	5
	AHFACTU*	55
	Redcliffe Hospital	5
	Royal Brisbane & Women's Hospital	152
	The Prince Charles Hospital	217
Metro South	Logan Hospital	217
	Mater Adult Hospital	50
	Princess Alexandra Hospital	169
	Queen Elizabeth II Hospital	85
	Redland Hospital	72
North West	Mt Isa Hospital	19
Sunshine Coast	Gympie Hospital	59
	Nambour General Hospital	198
Townsville	Townsville Hospital	116
West Moreton	Ipswich Community Health	165
Wide Bay	Hervey Bay Hospital	50
STATEWIDE		



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

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

Figure 12: Proportion of patients on guideline recommended beta blocker therapy at first clinical review by site

6.5 Beta blocker titration

This indicator looks at the progress of titration of guideline recommended beta blockers at 6 months following hospital discharge or when deactivated from the HF Support Service, whichever is sooner. The time frame is taken from the first clinical review by the Heart Failure Support Service (usually at 4 weeks from referral or hospital discharge).

The indicator measures 3 components of beta blocker titration at 6 months, including:

a) Review of titration status undertaken,

b) Achievement of target dose, and

c) Achievement of target or maximum tolerated dose.

5a Beta blocker titration review conducted within 6 months of first HFSS clinical review

Patients who received a beta-blocker titration review at 6 months from referral or at the time of deactivation from the HF Support Service (whichever is sooner).

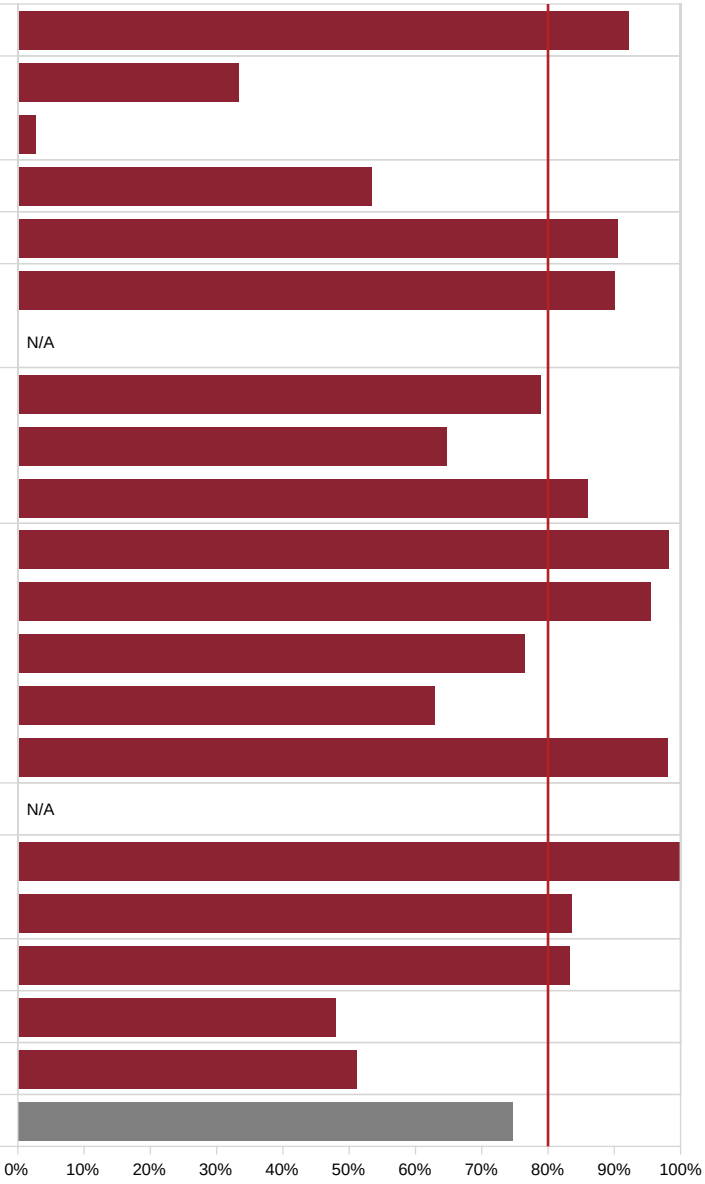
In 2016, 75% of patients received a beta-blocker titration review at 6 months from referral or at the time of deactivation from the HF Support Service (whichever was sooner). The benchmark of 80% was achieved by 10 out of 17 (59%) of HF Support Services that had more than 20 cases eligible for analysis. Six services had insufficient data for benchmarking.

Table 18: Patients who had a beta blocker titration review within 6 months

	n
Eligible for analysis	1,579
Achieved benchmark	1,179
Benchmark not achieved	400
Ineligible	1,442
Not HFrEF	579
Other reason	312
Patient on target dose at the time of referral	130
Patient declined service	107
Documented contraindication*	75
LV function assessment not available	75
Patient deceased	56
Referred to another HFSS	55
Patient could not be contacted	53
Incomplete data	146
Cases due for beta blocker review	**3,167**

* adverse reaction to beta blocker, palliative intent to treatment, pregnancy, bradycardia (HR <50bpm), symptomatic hypotension, severe COPD, asthma/reversible airways disease

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	52
Central Queensland	Gladstone Hospital	12
	Rockhampton Hospital	111
Darling Downs	Toowoomba Hospital	15
Gold Coast	Gold Coast Community Health	149
Mackay	Mackay Base Hospital	101
	Proserpine Hospital	1
Metro North*	AHFACTU†	57
	Royal Brisbane & Women's Hospital	108
	The Prince Charles Hospital	122
Metro South	Logan Hospital	113
	Mater Adult Hospital	47
	Princess Alexandra Hospital	115
	Queen Elizabeth II Hospital	46
	Redland Hospital	53
North West	Mt Isa Hospital	6
Sunshine Coast	Gympie Hospital	43
	Nambour General Hospital	160
Townsville	Townsville Hospital	90
West Moreton	Ipswich Community Health	133
Wide Bay	Hervey Bay Hospital	45
STATEWIDE		



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

† Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

* Caboolture Hospital and Redcliffe Hospital are not displayed due to having no cases eligible for analysis

Figure 13: Proportion of patients who had a beta blocker titration review conducted within 6 months by site

5b Beta blocker clinical guideline target dose achieved at time of titration review

Target total daily dose:

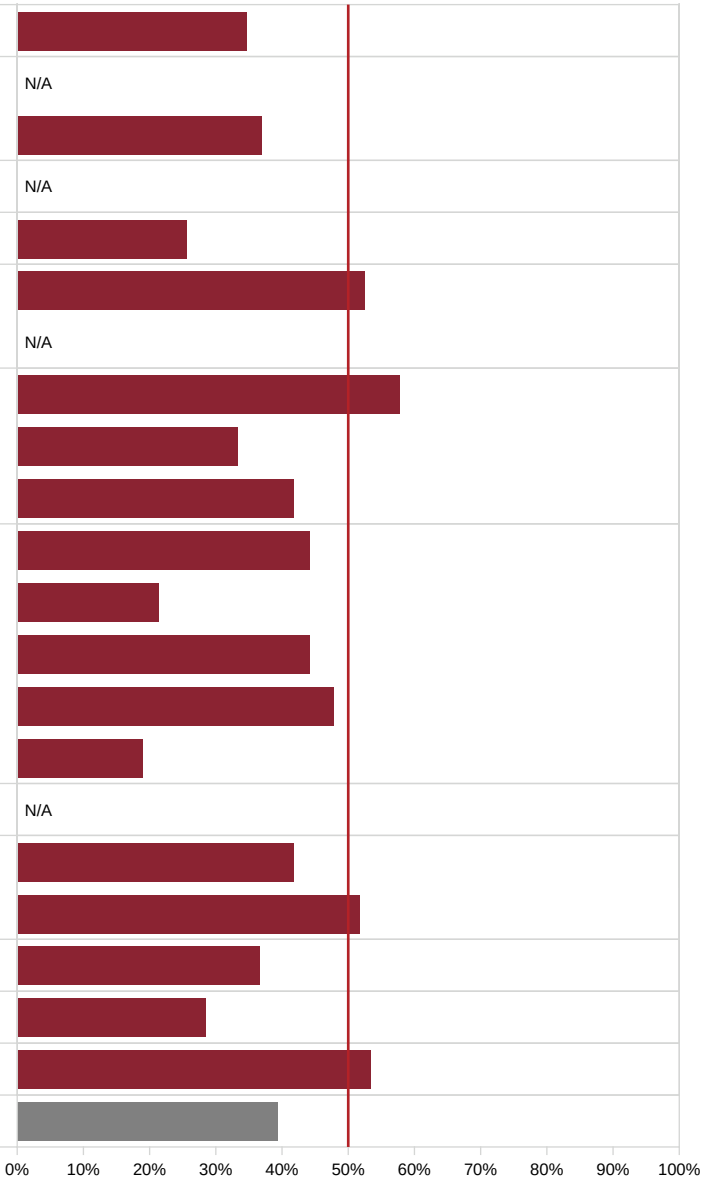
- Carvedilol 50-100 mg
- Metoprolol sustained release 190 mg
- Bisoprolol 10 mg
- Nebivolol 10 mg

Only 39% of referrals achieved target dose for guideline recommended beta blocker medication by the time of titration review at 6 months. The benchmark of 50% was achieved by 4 out of 17 (24%) of HF Support Services that had more than 20 cases eligible for analysis. Six services had insufficient data for benchmarking.

Table 19: Patients who achieved target beta blocker dose at time of titration review

	n
Eligible for analysis	1,572
Achieved benchmark	622
Benchmark not achieved	950
Ineligible	N/A
Incomplete data	7
Total titration reviews conducted	**1,579**

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	52
Central Queensland	Gladstone Hospital	12
	Rockhampton Hospital	111
Darling Downs	Toowoomba Hospital	14
Gold Coast	Gold Coast Community Health	149
Mackay	Mackay Base Hospital	100
	Proserpine Hospital	1
Metro North*	AHFACTU†	57
	Royal Brisbane & Women's Hospital	107
	The Prince Charles Hospital	122
Metro South	Logan Hospital	113
	Mater Adult Hospital	47
	Princess Alexandra Hospital	115
	Queen Elizabeth II Hospital	45
	Redland Hospital	53
North West	Mt Isa Hospital	6
Sunshine Coast	Gympie Hospital	43
	Nambour General Hospital	158
Townsville	Townsville Hospital	90
West Moreton	Ipswich Community Health	132
Wide Bay	Hervey Bay Hospital	45
STATEWIDE		



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

† Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

* Caboolture Hospital and Redcliffe Hospital are not displayed due to having no cases eligible for analysis

Figure 14: Proportion of patients who achieved target beta blocker dose at time of titration review by site

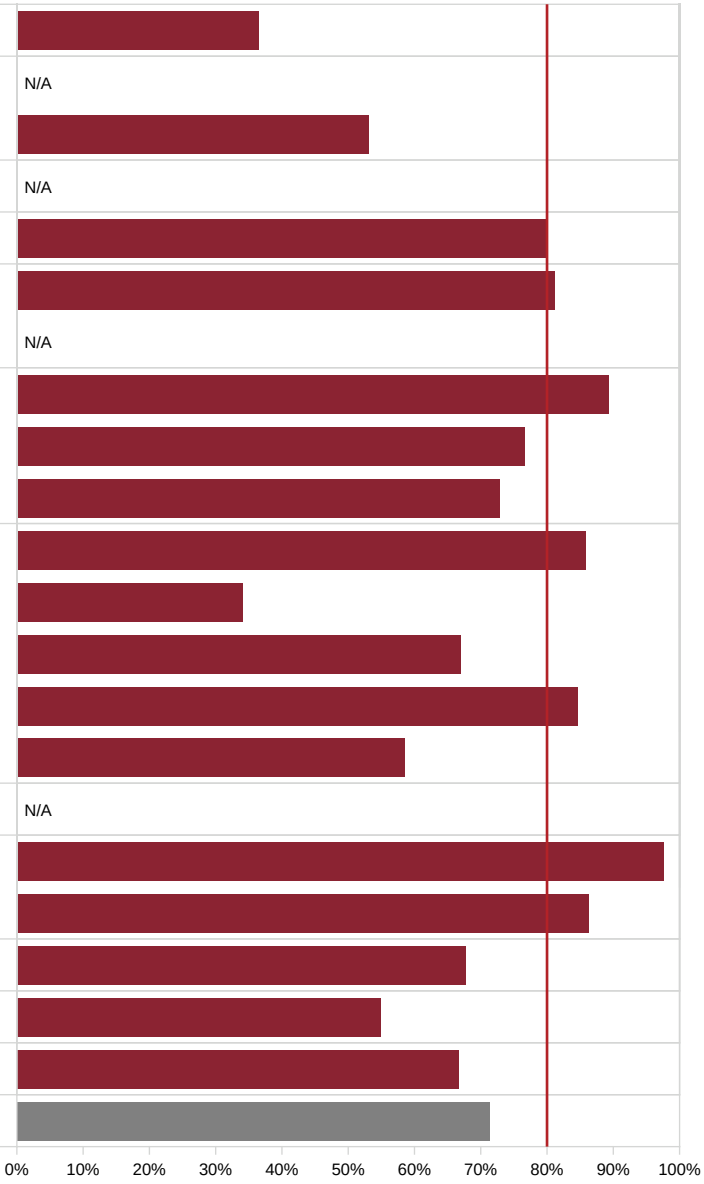
5c Beta blocker titration clinical guideline target or maximum tolerated dose achieved at time of titration review

The number of patients reaching the target dose or maximum tolerated dose of guideline recommended beta blocker medication by the time of titration review at 6 months was 71%. The benchmark of 80% was achieved by 6 out of 17 (35%) of HF Support Services that had more than 20 cases eligible for analysis. Six services had insufficient data for benchmarking.

Table 20: Patients who achieved target or maximum tolerated beta blocker dose at time of titration review

	n
Eligible for analysis	1,577
Achieved benchmark	1,127
Benchmark not achieved	450
Ineligible	N/A
Incomplete data	2
Total titration reviews conducted	**1,579**

HHS	Heart Failure Support Service	n
Cairns and Hinterland	Cairns Hospital	52
Central Queensland	Gladstone Hospital	12
	Rockhampton Hospital	111
Darling Downs	Toowoomba Hospital	14
Gold Coast	Gold Coast Community Health	149
Mackay	Mackay Base Hospital	101
	Proserpine Hospital	1
Metro North*	AHFACTU†	57
	Royal Brisbane & Women's Hospital	108
	The Prince Charles Hospital	122
Metro South	Logan Hospital	113
	Mater Adult Hospital	47
	Princess Alexandra Hospital	115
	Queen Elizabeth II Hospital	46
	Redland Hospital	53
North West	Mt Isa Hospital	6
Sunshine Coast	Gympie Hospital	43
	Nambour General Hospital	160
Townsville	Townsville Hospital	90
West Moreton	Ipswich Community Health	132
Wide Bay	Hervey Bay Hospital	45
STATEWIDE		



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

† Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

* Caboolture Hospital and Redcliffe Hospital are not displayed due to having no cases eligible for analysis

Figure 15: Proportion of patients who achieved target beta blocker dose or maximum tolerated dose at time of titration review by site

6.6 Summary of clinical indicator performance

The performance on clinical indicators (CI) is summarised in the figure below showing the proportions of all eligible (ideal) patients who received specific interventions. Benchmarks were set at 80% for all indicators except CI 5b) Titration of beta blockers to clinical guideline target dose, which was 50%.

Benchmarks were achieved for CI 1b (follow-up of non-acute patients in 4 weeks); CI 2 (LVEF assessment within 2 year); CI 3: (ACEI/ARB prescription at hospital discharge and at first clinical review); and CI 4 (beta blocker prescription at hospital discharge and at first clinical review). Areas in need of improvement were CI 1a (follow-up of inpatients in 2 weeks); and CI 5a, b, & c (beta blocker review and titration).

Table 21: Summary of clinical indicator performance

		Clinical Indicator achievement %									
HHS	**Heart Failure Support Service**	**1a**	**1b**	**2**	**3a**	**3b**	**4a**	**4b**	**5a**	**5b**	**5c**
Cairns and Hinterland	Cairns Hospital	65	66	100	91	97	85	89	92	35	37
Central Queensland	Gladstone Hospital	-	-	93	-	95	-	84	-	-	-
	Rockhampton Hospital	54	73	97	85	84	73	65	3	37	53
Darling Downs	Toowoomba Hospital	-	-	-	-	-	-	-	-	-	-
Gold Coast	Gold Coast Community Health	83	96	90	92	90	89	90	91	26	80
Mackay	Mackay Base Hospital	62	98	100	95	91	96	92	90	52	81
	Proserpine Hospital	-	-	-	-	-	-	-	-	-	-
Metro North	Caboolture Hospital	-	-	-	-	-	-	-	-	-	-
	AHFACTU*	79	60	94	92	100	90	95	79	58	89
	Redcliffe Hospital	80	-	51	-	-	-	-	-	-	-
	Royal Brisbane & Women's Hospital	75	87	97	90	92	95	93	65	33	77
	The Prince Charles Hospital	49	58	97	92	93	93	91	86	42	73
Metro South	Logan Hospital	85	93	94	95	97	97	97	98	44	86
	Mater Adult Hospital	72	71	94	97	96	90	94	96	21	34
	Princess Alexandra Hospital	83	79	95	92	92	84	88	77	44	67
	Queen Elizabeth II Hospital	67	81	92	96	98	90	89	63	48	85
	Redland Hospital	89	100	84	95	97	96	89	98	19	58
North West	Mt Isa Hospital	-	90	87	-	-	-	-	-	-	-
Sunshine Coast	Gympie Hospital	78	95	95	74	86	72	81	100	42	98
	Nambour General Hospital	88	91	99	95	95	94	94	84	52	86
Townsville	Townsville Hospital	93	92	98	93	98	90	89	83	37	68
West Moreton	Ipswich Community Health	73	86	95	92	91	95	92	48	29	55
Wide Bay	Hervey Bay Hospital	-	100	100	-	92	-	96	51	53	67
Statewide		**73**	**86**	**94**	**92**	**93**	**90**	**89**	**75**	**39**	**71**

* Advanced HF & Cardiac Transplant Unit (a quaternary unit for Queensland at The Prince Charles Hospital)

7 Conclusions

This report captures information on 4,021 patient referrals to 23 Queensland Heart Failure services in 2016, providing a comprehensive data set of the characteristics and treatment for patients seen by Heart Failure Support Services in Queensland. While the statewide figures provide an overview of clinical performance, data from individual services should be treated with caution; where under reporting or small patient numbers may not accurately reflect performance.

South East Queensland comprised 83% of referrals, consistent with population distribution. The low number of referrals from primary care (1.8%) reflects the referral processes for most of the Heart Failure Support Services, with primary care referrals initially being evaluated in specialist clinics. Comparisons with a recent large UK Heart Failure audit demonstrates that Queensland Heart Failure Support Service patients are younger with a higher proportion of males and a higher proportion having HFrEF[7]. It is possible that Queensland Heart Failure Support Services are missing referrals of older female patients with HFpEF or it may be that these patients are suitably managed by generalist health services. Furthermore, some Heart Failure Support Services do not accept referrals of patients with HFpEF due to limited capacity.

Aboriginals and Torres Strait Islanders are estimated to comprise 4.2% of the Queensland population and are known to have higher rates of cardiovascular disease[8,9]. It is difficult to interpret the significance of the Aboriginal and Torres Strait Islander referral rate of 4.1% as to whether cases are being missed. In the Cairns and Townsville Heart Failure Support Services, referral rates of Aboriginal and Torres Strait Islander patients is >15% of caseload. The median age of Aboriginal and Torres Strait Islander patients is 11 years younger than non-Aboriginal and Torres Strait Islander patients and therefore Heart Failure is more likely to present in Aboriginal and Torres Strait Islander people of working or child bearing age.

The high rate of assessment of LVEF within 2 years (94% all patients) is not surprising given that patients referred to the Heart Failure Support Services are required to have the diagnosis confirmed.

The time taken to follow-up new referrals is below the desired level. While there is no hard evidence on the best time to review new referrals, patients recently discharged from hospital with chronic heart failure have high 30-day hospital readmissions rates. The two week benchmark for inpatient referrals and four week benchmark for outpatient referrals reflect the likely risk of hospitalisation of these two groups while acknowledging that some patients with complex medical or social factors may require immediate follow-up, while others may manage well at home with minimal support.

While overall rates were high for ACEI/ARB and beta blocker prescription, a few sites were below the benchmark for prescribing at hospital discharge, which improved at the time of the first clinical review with only one site below the 80% benchmark highlighting the benefits of specialist multidisciplinary teams monitoring patients in the community.

The beta blocker target dose achievement rate of 39% while higher than many other real-world studies falls short of doses achieved in the clinical trials that demonstrated the benefits of these therapies, representing opportunities for improvement.[6] The reporting of whether a patient has reached the *maximum tolerated dose*, although a clinical judgement, demonstrates that beta blocker titration was not overlooked. The high proportion of individual services not attaining benchmarks related to beta blocker review and titration highlights the challenges faced in supporting medication titration over extended periods of time and across acute and primary care sectors. The routine measurement of beta blocker titration achievement is a unique data set rarely collected in routine clinical practice and should provide valuable information for informing quality improvement activities in this area.

Trends in hospital utilisation such as readmission and length of stay as well as mortality rates are not yet linked to this data set, but will provide a valuable context to the clinical indicators.

8 Recommendations

1. HF Support Services to review local hospital discharge data with a primary diagnosis of heart failure to audit potential missed referrals.
2. HF Support Services who do not achieve benchmarks for particular indicators to review practices and establish the reason for non-attainment with support from the statewide heart failure coordinator.
3. Provide incentives for data completion by introducing elements that assist with patient management such as production of referrals letters.
4. Introduce new indicators that are likely to require improvement such as prescribing of mineralocorticoid receptor antagonists (MRA).
5. Report on unplanned readmissions, length or stay, and mortality rates.
6. Consider collecting other covariates to allow risk-adjustment of outcomes measure (e.g. eGFR, serum sodium, serum potassium, haemoglobin, iron studies, and comorbidities).

Interventional Cardiology Audit

Authors

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

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1 Message from the Interventional Cardiology Steering Committee Chair

Despite a steady decline over the last 20 years, ischaemic heart disease remains the leading cause of death in Australia. In Queensland, the rate is 8% higher than the national average. Most Queenslanders have therefore in some way been affected by heart disease, either personally, or by association with a family member, or close friend being impacted. The ramifications of this life-altering disease highlight the need for ongoing efforts to improve cardiac outcomes.

This 2nd annual Queensland interventional cardiology report details both the safety, and outcomes of key clinical indicators at 7 public interventional cardiology facilities across Queensland – 2 tertiary metropolitan, and 5 large regional centres. Since the inaugural report was published last year, refinements in data collection have led to the ability to expand the reported demographic and performance data, and the data analysis has been more extensive.

At a pivotal time, with global transparency in health care no longer just desirable, but expected, this clinician-led registry builds on the key themes of equity, and cross-institution cooperation to measure performance, and ultimately improve cardiac care for all Queenslanders. With maturation of this cardiac outcomes registry, the collaborative alliance that underpins a publication such as this has made significant strides in delivering transparency that transcends traditional geographic boundaries, and this achievement is certainly worth acknowledging.

Dr Greg Starmer
Chair
Interventional Cardiology Steering Committee

2 Executive summary

This second Queensland interventional cardiology audit describes key aspects of the care and treatment of cardiac patients receiving percutaneous coronary interventions (PCI) at seven out of the eight public cardiac catheter laboratories across Queensland during 2016.

Key findings include:

- Queensland presents challenges to the provision of tertiary level cardiac services, with more than 50% of the population living outside the capital, and 25% living outside the south east region.
- In 2016, 11,334 diagnostic or interventional cases were performed. Of these, 3,563 were PCI.
- The proportion of patients identified as Aboriginal and Torres Strait islander illustrates a stepwise gradient based on geographical area with the highest proportions found in the north of the state and the lowest in the south east corner.
- A large proportion of PCI patients (38%) were classed as obese, highlighting the temporal trend for increasing body mass index in the population.
- The majority of PCI cases (77%) were non-elective, highlighting the acute and often unstable patient cohort.
- Radial access was used in 53% of PCI cases, but there is large variation across facilities.
- Drug eluting stents were used in 78% of cases with a range between 55 and 92% across sites.
- PCI for non-ST elevation myocardial infarction (NSTEMI) represented 28% of all cases, with the median time to angiography of 51 hours. Patients presenting to a non PCI capable facility have a median wait to coronary angiography 29 hours longer than those who present directly to a PCI capable facility (68 vs 39).
- There were 1,253 PCI cases following presentation with ST elevation myocardial infarction (STEMI) in 2016, of which 56% were managed by primary PCI.
- During 2016, there were 35 deaths in STEMI patients, the majority (n=27) occurring during the index admission. There were no in lab deaths of STEMI patients in 2016.
- Median door to device time for STEMI patients presenting within six hours of symptom onset was 51 mins (range 38 to 60 across sites).
- Median time to reperfusion for STEMI patients presenting within six hours of symptom onset was 93 mins (range 73 to 103 across sites).
- Observed risk adjusted 30-day all cause PCI mortality was 1.8%.
- Of all cases, 0.56% recorded a major adverse cardiac event. Coronary artery perforation accounted for the majority (0.3%) of these events.
- Radiation doses were found to be under the safe radiation level in 97.7% of PCI cases across all sites and 99.8% of diagnostic procedures.

3 Participating sites

During 2016, there were eight public hospitals offering cardiac catheter laboratory services across both metropolitan and regional Queensland. Seven of these hospitals participate in the Queensland Cardiology Outcomes Registry, Interventional Cardiology Audit.

The Prince Charles Hospital does not contribute to the Statewide Interventional Cardiology Quality and Safety program.

Table 1: Participating sites

Site number	Site name	Location	Acronym
1	Cairns Hospital	Regional	CH
2	The Townsville Hospital	Regional	TTH
3	Mackay Base Hospital	Regional	MBH
4	Nambour General Hospital	Regional	NGH
5	Royal Brisbane and Women's Hospital	Metropolitan	RBWH
6	Princess Alexandra Hospital	Metropolitan	PAH
7	Gold Coast University Hospital	Metropolitan	GCUH

3.1 Statewide

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

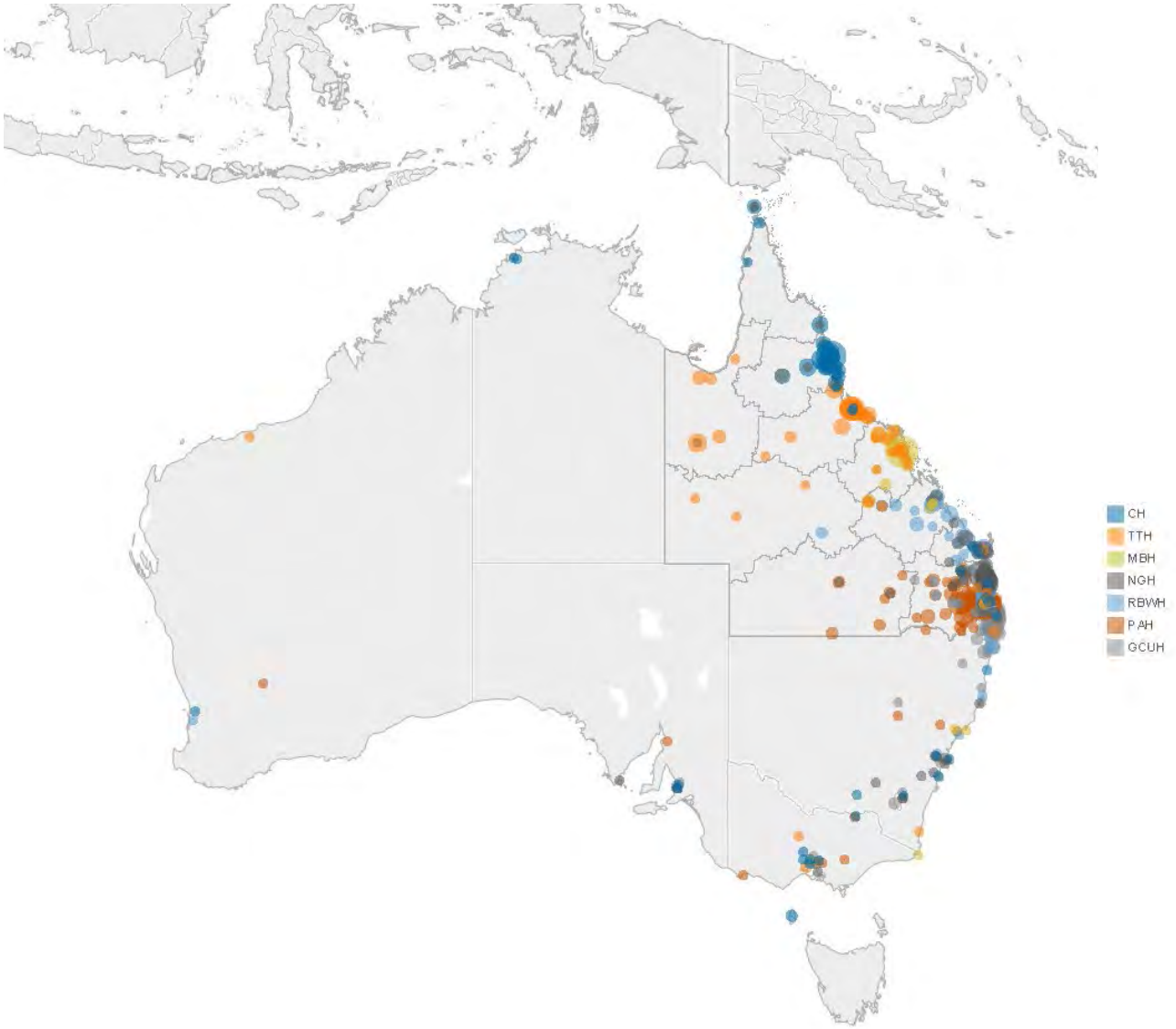


Figure 1: PCI cases by residential postcode

With the exception of the Royal Brisbane and Women's Hospital, more than half of all patients were seen at their local Hospital and Health Service (HHS).

Total cases included 25 patients from overseas, accounting for 0.7% of all PCI cases across all sites.

Table 2: Proportion of cases with patient residential postcodes within the treating Hospital and Health Service (HHS) boundaries

	Within HHS (%)
Cairns Hospital	84
The Townsville Hospital	75
Mackay Base Hospital	94
Nambour General Hospital	79
Royal Brisbane and Women's Hospital	48
Princess Alexandra Hospital	56
Gold Coast University Hospital	72

3.2 Cairns Hospital

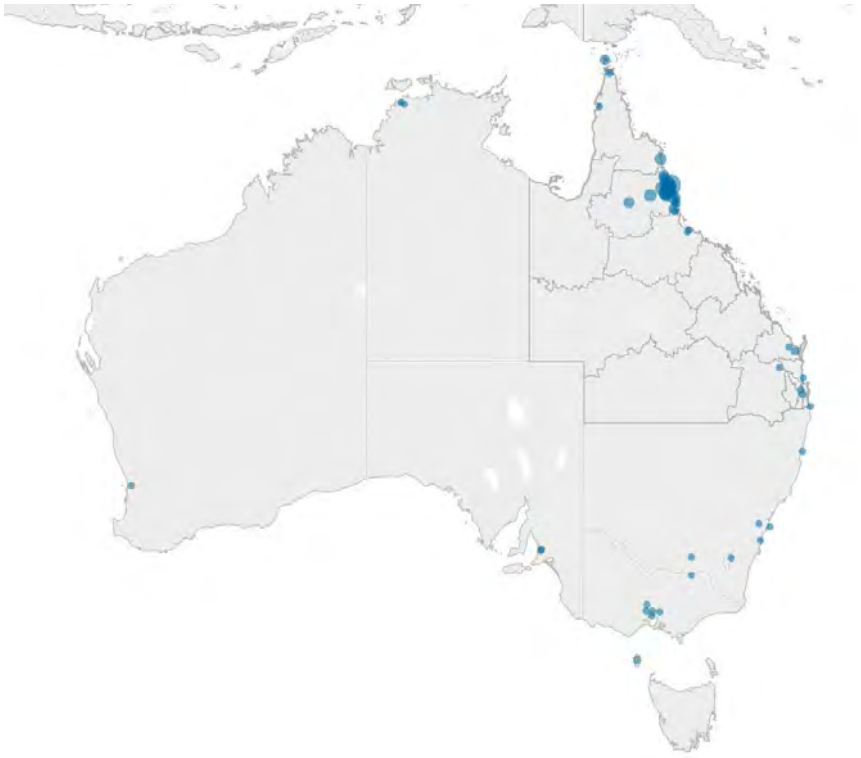


Figure 2: Cairns Hospital

- Referral hospital for Cairns and Hinterland and Torres and Cape Hospital and Health Services, serving a population of approximately 300,000
- Large population of tourists and Aboriginal and Torres Strait Islander peoples
- Public tertiary level cardiac services provided at Cairns Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Pacemaker implantations
- One cardiac catheter laboratory with a dedicated service commencing in 2010
- 24/7 PCI service available since April 2015
- 5.4 FTE consultant cardiologists

3.3 The Townsville Hospital

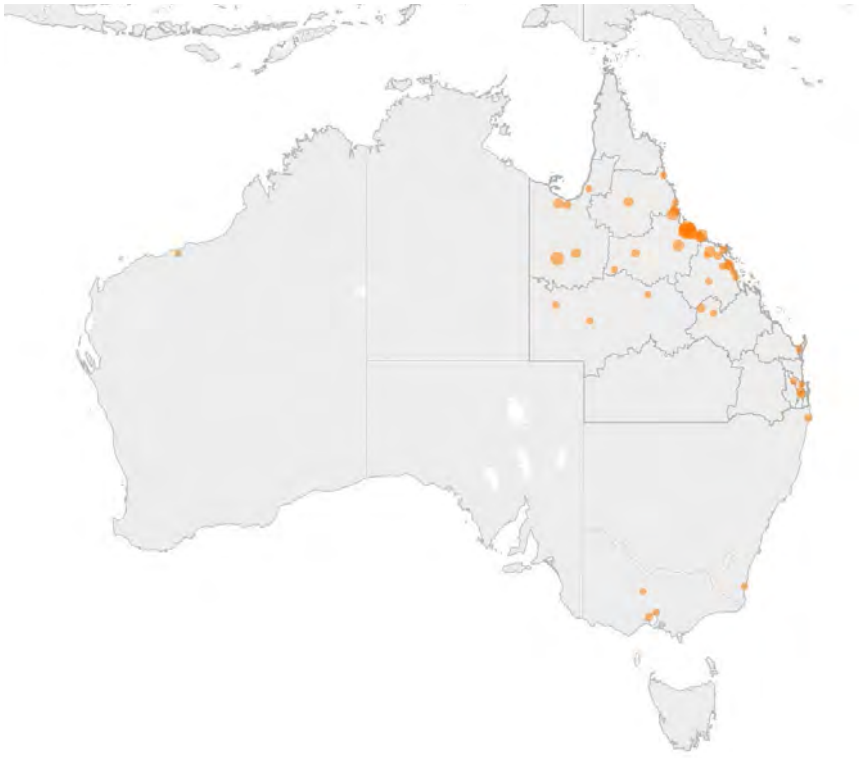


Figure 3: The Townsville Hospital

- Referral hospital for Townsville and North West Hospital and Health Services, serving a population of approximately 295,000
- Public tertiary level cardiac services provided at The Townsville Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiac surgery
- Two cardiac catheter laboratories with a dedicated service commencing in 1994
- 24/7 PCI service available since March 2016
- 8.0 FTE consultant cardiologists

3.4 Mackay Base Hospital

- Referral hospital for Mackay and Whitsunday regions, serving a population of approximately 182,000
- Public tertiary level cardiac services provided at Mackay Base Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - ICD and pacemaker implantation
- One cardiac catheter laboratory with a dedicated service commencing in 2014
- 2.6 FTE consultant cardiologists

Figure 4: Mackay Base Hospital

3.5 Nambour General Hospital

- Referral hospital for Sunshine Coast and Wide Bay Hospital and Health Services, serving a population of approximately 563,000
- Public tertiary level cardiac services provided at Nambour General Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart disease intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
- One cardiac catheter laboratory with a dedicated service commencing in 2012
- 24/7 PCI service available since August 2012
- 9.1 FTE consultant cardiologists

Figure 5: Nambour General Hospital

3.6 The Royal Brisbane and Women's Hospital

Figure 6: The Royal Brisbane and Women's Hospital

- Referral hospital for Metro North, Wide Bay and Central Queensland Hospital and Health Services, serving a population of approximately 900,000 (shared referral base with the Prince Charles Hospital)
- Public tertiary level cardiac services provided at The Royal Brisbane and Women's Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
- Two cardiac catheter laboratories with a dedicated service commencing in 1997
- 24/7 PCI service available since 1997
- 11 FTE consultant cardiologists

3.7 Princess Alexandra Hospital

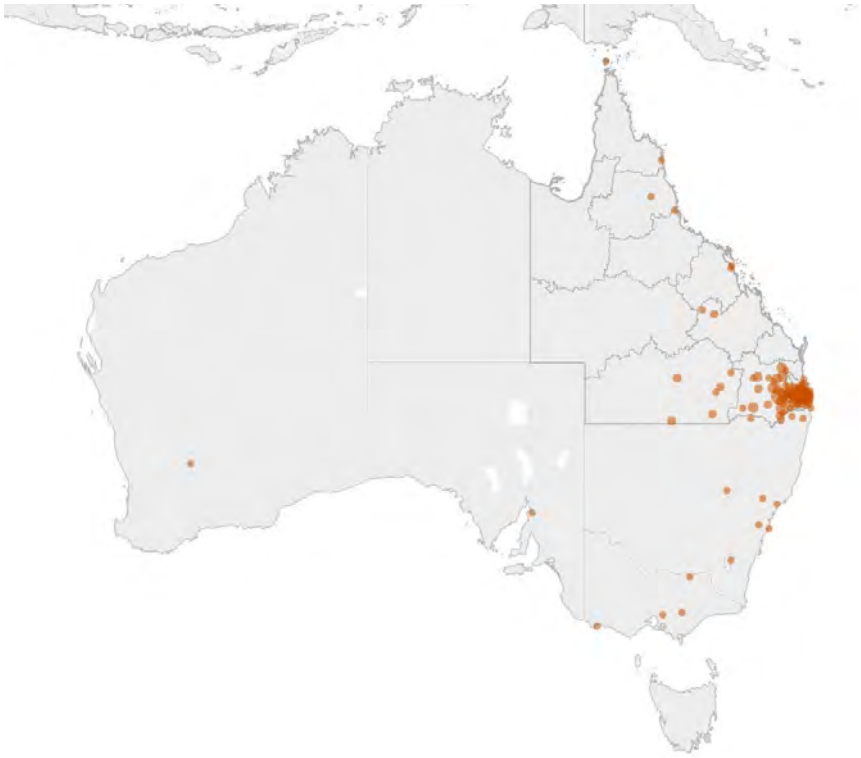


Figure 7: Princess Alexandra Hospital

- Referral hospital for Metro South and South West Hospital and Health Services, serving a population of approximately 1,000,000
- Public tertiary level cardiac services provided at the Princess Alexandra Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural heart intervention
  - Electrophysiology
  - ICD, CRT and pacemaker implantation
  - Cardiac surgery
- Three cardiac catheter laboratories with a dedicated service commencing in 1998
- 24/7 PCI service available since November, 1998
- 11.5 FTE consultant cardiologists

3.8 Gold Coast University Hospital

Figure 8: Gold Coast University Hospital

- Referral hospital for Gold Coast and northern New South Wales regions, serving a population of approximately 700,000
- Public tertiary level 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
  - Cardiac surgery
- 24/7 PCI service available since 2006
- 8.25 FTE consultant cardiologists

4 Total cases

4.1 Total cases by category

In 2016, 11,334 diagnostic and interventional cardiology cases were performed across the seven participating public cardiac catheter laboratories (see Table 1 for details of participating sites). This represents a 2% increase from the previous year where total cases numbered 11,113.

Of the total cases, 3,563 (31%) involved percutaneous coronary interventions (PCI), with these cases the subject of this report.

Table 3: Total number of cases by type

SITE	PCI cases (n)	Total cases (n)	PCI cases (%)
Cairns Hospital	432	1,376	31%
The Townsville Hospital	383	1,408	27%
Mackay Base Hospital	233	850	27%
Nambour General Hospital	470	1,315	36%
Royal Brisbane and Women's Hospital	404	1,289	31%
Princess Alexandra Hospital	961	3,005	32%
Gold Coast University Hospital	680	2,091	33%
ALL	**3,563**	**11,334**	**31%**

5 Patient characteristics

5.1 PCI cases

Age is an important risk factor for developing cardiovascular disease. The median age of patients undergoing PCI was 64 years of age and ranged from 61 to 67 across HHSs.

The majority of (76%) of patients undergoing PCI were male. The median age for females was higher than males, with proportionally less patients below 55 years age and a greater proportion over 80 years age.

Table 4: Median age (years) by gender for all PCI cases

	Male (years)	Female (years)	All (years)
CH	62	65	63
TTH	62	65	63
MBH	65	70	66
NGH	66	68	67
RBWH	61	61	61
PAH	62	67	62
GCUH	64	70	65
ALL	**63**	**67**	**64**

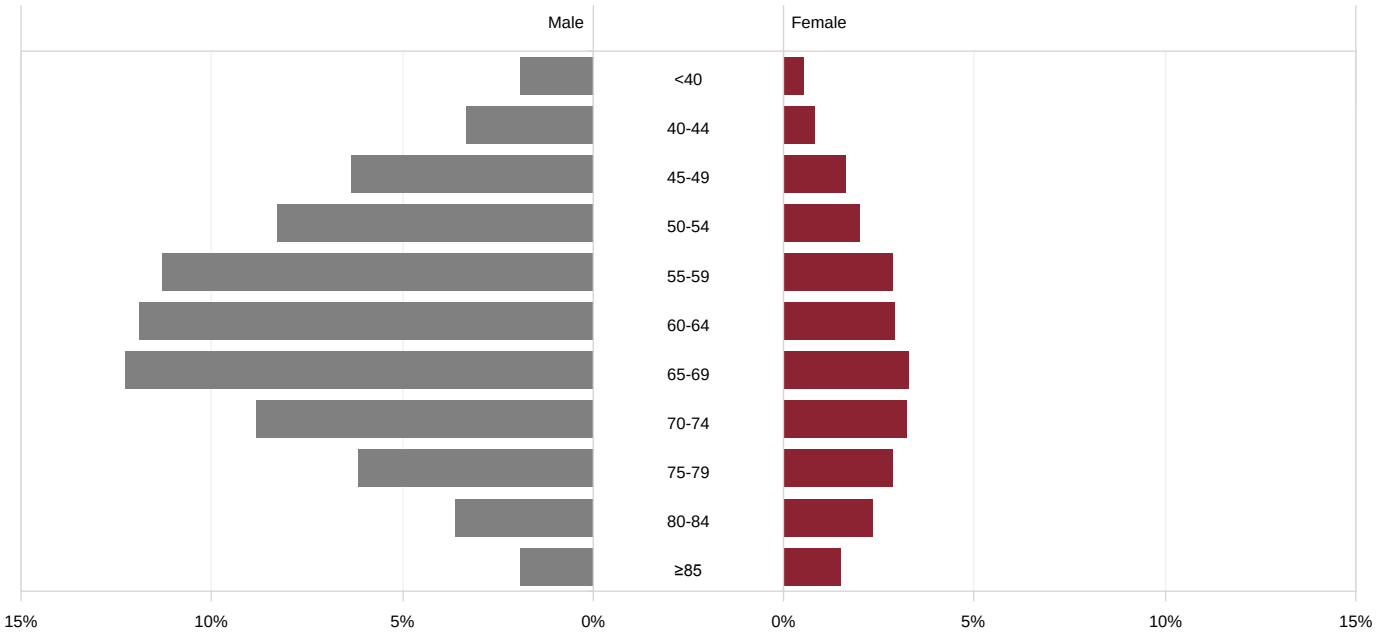


Figure 9: Proportion of all PCI cases by gender and age group

5.1.2 Body mass index

It is recognised there is temporal trend for increasing body mass index (BMI) within our population. Patients across all sites displayed similar trends in obesity, with around one-quarter of patients (22%) in the normal BMI range and 39%, 33% and 5% classified as overweight, obese and morbidly obese respectively. 1% of cases were classified as underweight. These analyses compare similarly with 2015 data.

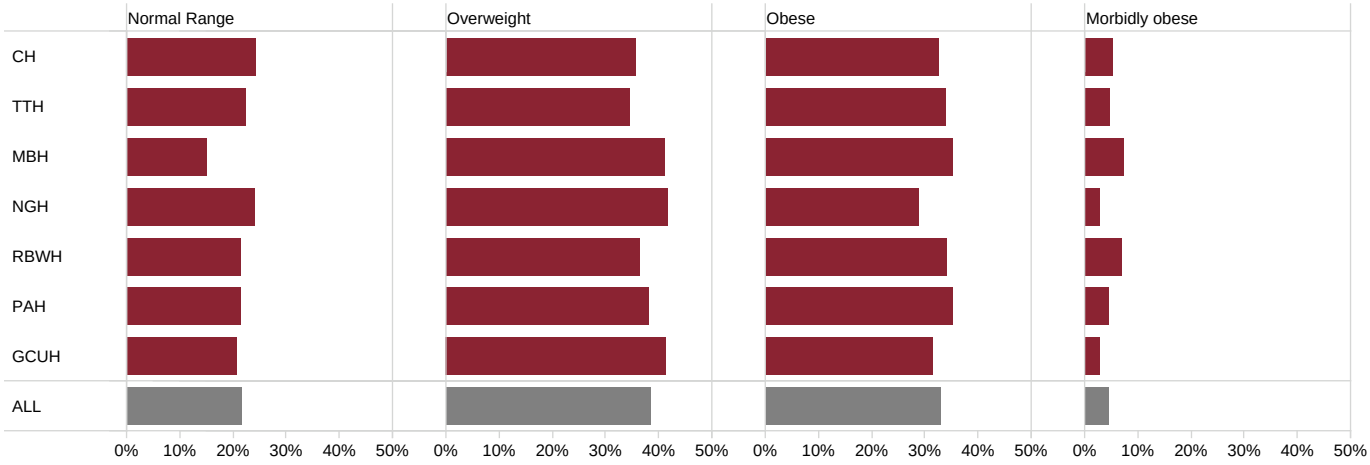


Figure 10: Proportion of all PCI cases by body mass index category

5.1.3 Identified Aboriginal and Torres Strait Islander status

Ethnicity is an important determinant of health with a particular impact on the development of cardiovascular disease. It's recognised that the Aboriginal and Torres Strait Islander population have a higher incidence and prevalence of coronary artery disease.

The increased proportion of identified Aboriginal and Torres Strait Islander patients in the northern HHS's (CH, 17.6% and TTH, 15.1%) reflects the resident population within these areas and should be noted for future service provision and planning.

The proportion of identified Aboriginal and Torres Strait Islander patients requiring a PCI procedure across all sites (6.7%) exceeds the estimated proportion of Aboriginal and Torres Strait Islander persons within Queensland (4.0%).*

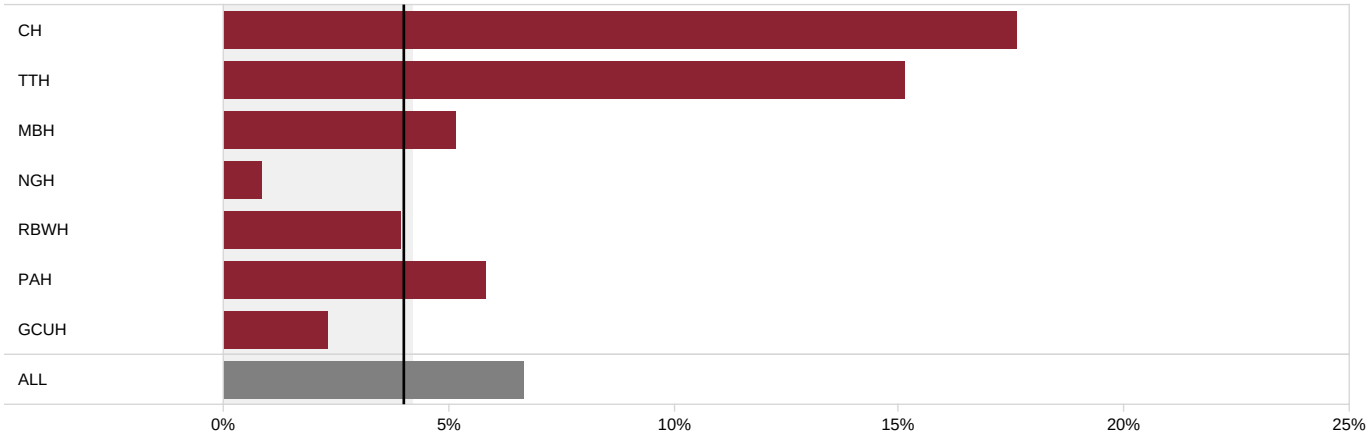


Figure 11: Proportion of all PCI cases by identified Aboriginal and Torres Strait Islander status

* Australian Bureau of Statistics, Census of Population and Housing, 2016, Cat. No. 2071.0 ABS: Canberra; 2016.

5.2 NSTEMI cases

5.2.1 Age and gender

The median age of non-ST elevation myocardial infarction (NSTEMI) cases was similar across HHSs. The median age for females was higher at 67 compared to males at 64 years of age.

Table 5: NSTEMI cases median age by gender

	Male (years)	Female (years)	All (years)
CH	63	64	63
TTH	61	68	63
MBH	66	70	68
NGH	69	70	69
RBWH	63	67	64
PAH	63	65	64
GCUH	65	68	67
ALL	**64**	**67**	**65**

Overall, the proportion of males was slightly lower in the NSTEMI cohort compared to the PCI cohort (69% and 76% respectively).

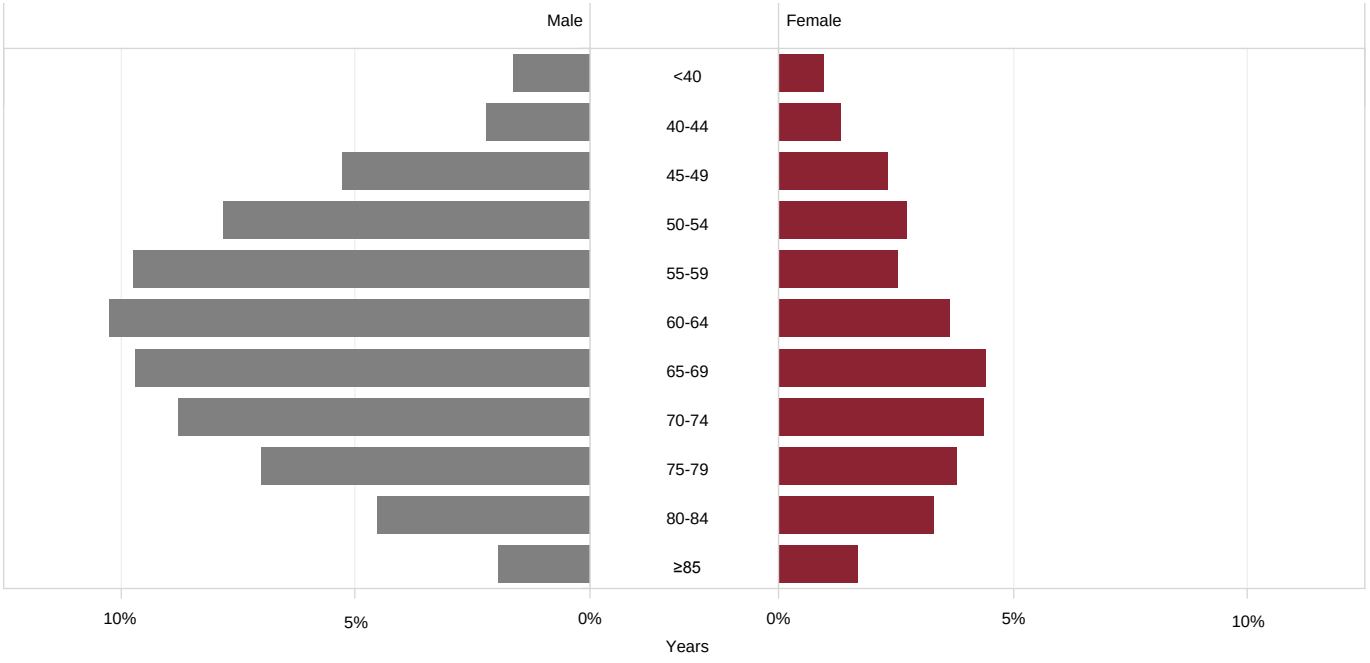


Figure 12: Proportion of NSTEMI cases by age group and gender

5.2.2 Identified Aboriginal and Torres Strait Islander status

As observed in the overall cohort, there was a geographical gradient down the Queensland coastline in the percentage of identified Aboriginal and Torres Strait Islander patients presenting with NSTEMI.

It is evident that three out of seven sites treated a higher ratio of Aboriginal and Torres Strait Islander patients than the estimated proportional population of Aboriginal and Torres Strait Islander persons in Queensland (4.0%).*

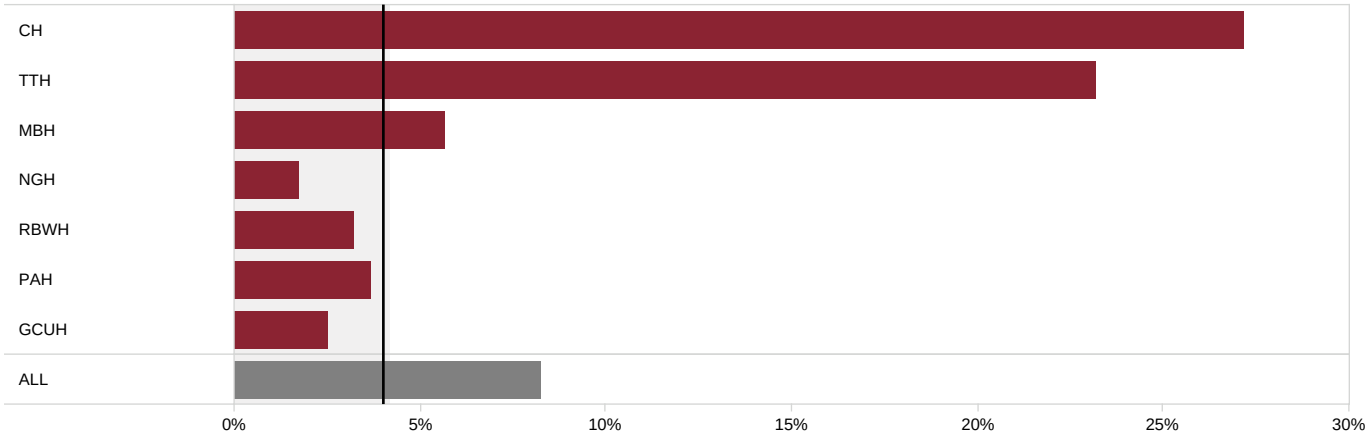


Figure 13: Proportion of identified Aboriginal and Torres Strait Islander patients presenting with NSTEMI

* Australian Bureau of Statistics, Census of Population and Housing, 2016, Cat. No. 2071.0 ABS: Canberra; 2016.

5.3 STEMI cases

5.3.1 Age and gender

The median age of ST elevation myocardial infarction (STEMI) ranged from 58 to 64 years of age across HHSs. The median age for females was higher at 65 compared to males at 60 years of age.

Table 6: STEMI cases median age by gender

	Male (years)	Female (years)	All (years)
CH	61	65	61
TTH	59	52	58
MBH	61	57	60
NGH	63	67	64
RBWH	58	58	58
PAH	59	66	60
GCUH	63	74	64
ALL	**60**	**65**	**61**

Figure 14: Proportion of STEMI cases by gender and age group

5.3.2 Identified Aboriginal and Torres Strait Islander status

As evidenced across all analyses, the proportion of identified Aboriginal and Torres Strait Islander patients presenting with STEMI is highest in the north of Queensland with a subsequent reduction towards the south east corner.

It is evident that five out of seven sites treated a higher ratio of Aboriginal and Torres Strait Islander patients than the estimated proportion of Aboriginal and Torres Strait Islander persons residing in Queensland (4.0%).*

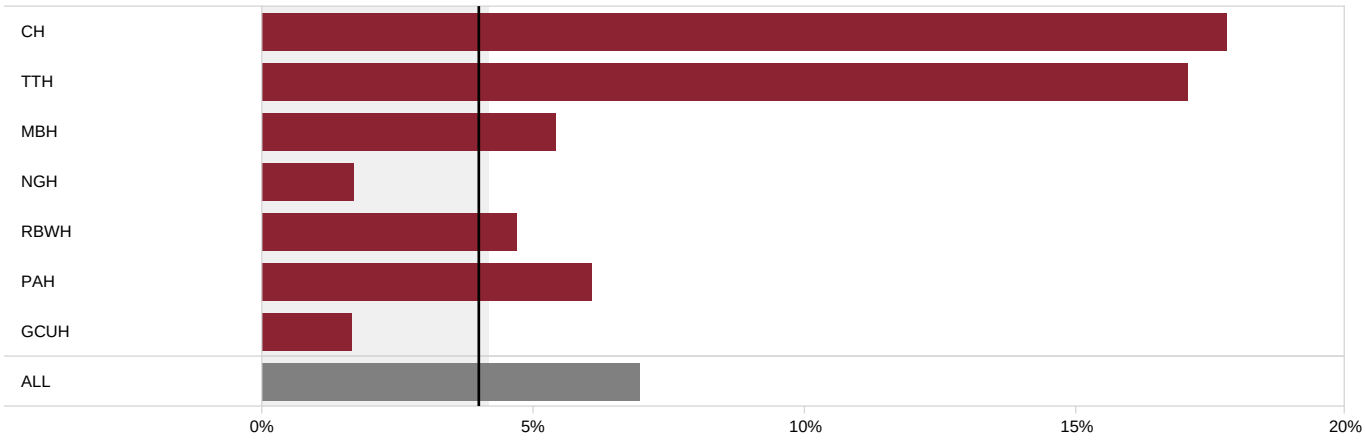


Figure 15: Proportion of STEMI cases by identified Aboriginal and Torres Strait Islander status

* Australian Bureau of Statistics, Census of Population and Housing, 2016, Cat. No. 2071.0 ABS: Canberra; 2016.

6 Care and treatment of PCI patients

6.1 Admission status

A total of 3,563 PCI procedures were performed in 2016 by the seven contributing cardiology centres across Queensland. This represents a 2% increase in case volumes over that observed in 2015 (n=3,484).

The annual case volume varied significantly between facilities, with Mackay Base Hospital performing 233 PCI cases and The Princess Alexandra Hospital performing 961 PCI cases.

Patients were classified into admission status defined by the National Cardiovascular Data Registry (NCDR) as follows[1]:

Table 7: 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 ischemia, 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 ischemia 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 a last resort. The patient is in cardiogenic shock at the start of the procedure. Within the last ten minutes prior to the start of the procedure the patient has also received chest compressions for a total of at least sixty seconds or has been on unanticipated extracorporeal circulatory support (e.g. extracorporeal membrane oxygenation, cardiopulmonary support)

* Typically includes NSTEMI

† Typically includes STEMI

‡ Haemodynamically unstable

The majority of PCI cases (77%) detailed in this report were classed as urgent, emergent or salvage PCI. This reflects the acute and often complex case mix draining to Queensland public hospitals.

Despite published definitions, the percentage distribution varied considerably between institutions as classification of cases is often operator-dependent.

Services provided by contributing sites vary with not all centres offering primary PCI. Mackay Base Hospital commenced its PCI service in 2015 and continues to refer its complex PCI cases outside of the HHS for treatment.

Table 8: Admission status (n, %)

	Total cases (n)	Elective (%)	Urgent (%)	Emergent (%)	Salvage (%)
CH	432	24%	52%	22%	2%
TTH	383	22%	60%	17%	1%
MBH	233	50%	44%	6%	0%
NGH	470	19%	46%	35%	1%
RBWH	404	14%	63%	21%	2%
PAH	961	17%	56%	26%	1%
GCUH	680	31%	41%	27%	1%
ALL	**3,563**	**23%**	**52%**	**24%**	**1%**

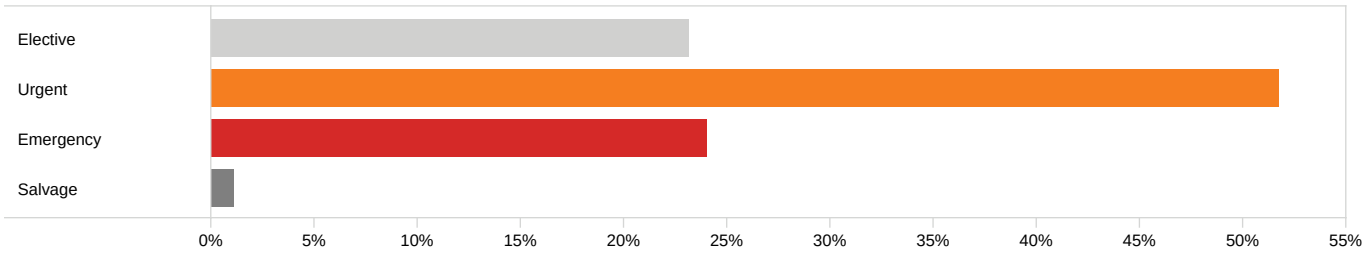


Figure 16: PCI cases by admission status (%)

6.2 Access route

Across all sites, 53% of PCI were via the radial approach, 44% femoral, 3% used both radial and femoral access and 0.2% coded as other access route, such as brachial or ulnar.

The use of the radial approach varies between different PCI centres (20% to 76%).

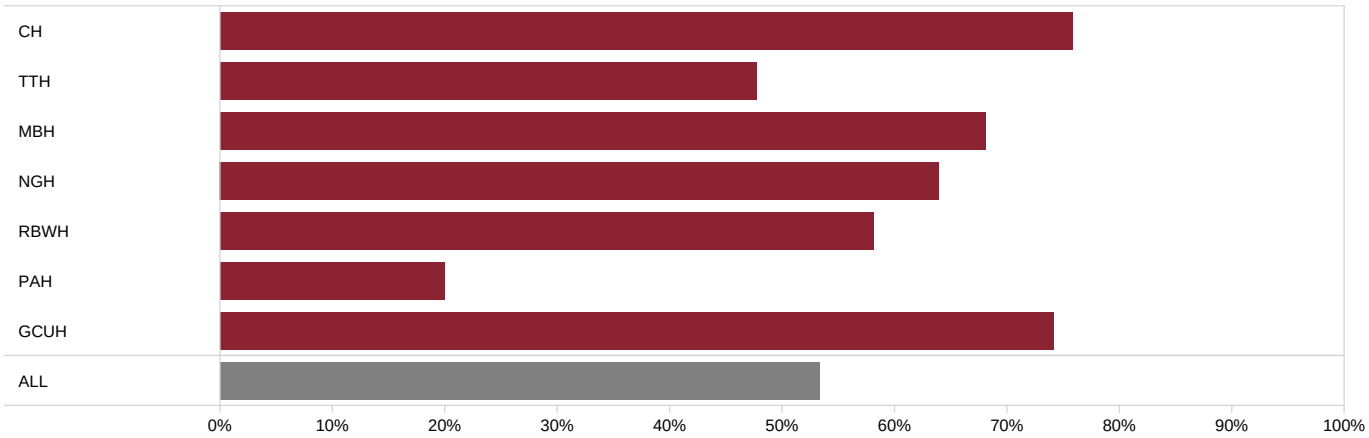


Figure 17: Access route – Radial approach (%)

Table 9: Access route (%)

	Radial (%)	Femoral (%)	Dual Approach (%)	Other (%)
CH	76%	20%	4%	0%
TTH	48%	50%	2%	0%
MBH	68%	28%	4%	0%
NGH	64%	34%	2%	0%
RBWH	58%	34%	7%	1%
PAH	20%	79%	1%	0%
GCUH	74%	23%	2%	0%
ALL	**53%**	**44%**	**3%**	**0%**

6.3 Vessels treated

Of all native vessels or grafts treated by PCI, the majority were native vessels with only 3% of PCIs being performed on grafts.

Of the native vessels treated, 44% involved the left anterior descending coronary artery (LAD), followed by the right coronary artery (RCA) at 36%, the circumflex coronary artery (LCx) at 24% and the left main coronary artery (LMCA) at 2%.

Table 10: Vessels treated (%)

	LAD %	LMCA %	LCx %	RCA %	GRAFT %
CH	46%	2%	23%	38%	3%
TTH	43%	2%	22%	37%	5%
MBH	46%	0%	25%	28%	5%
NGH	44%	3%	22%	36%	4%
RBWH	45%	2%	20%	41%	2%
PAH	43%	2%	25%	36%	2%
GCUH	43%	1%	26%	36%	2%
ALL	**44%**	**2%**	**24%**	**36%**	**3%**

6.4 Stent type

Stents are grouped into one of four different types – drug-eluting stents (DES), bare metal stents (BMS), bioresorbable vascular scaffolds (BVS) and covered stents.

In 2016 drug eluting stents were used in 76% of cases (up from 68% in 2015), ranging by centre between 58 – 94%, BMS 22%, and BVS 0%.

Across all centres on average, 1.5 stents were used per PCI case which involved stent deployment (Table 11).

Table 11: Stent type by PCI cases including at least one stent deployed (%)

	Total (n)	DES (%)	BMS (%)	BVS (%)	Stents per case (mean)
CH	402	91%	8%	1%	1.6
TTH	365	92%	8%	0%	1.6
MBH	207	92%	7%	1%	1.3
NGH	447	84%	14%	2%	1.4
RBWH	371	94%	6%	0%	1.5
PAH	921	58%	42%	0%	1.5
GCUH	628	74%	26%	0%	1.3
ALL	**3,341**	**78%**	**22%**	**0%**	**1.5**

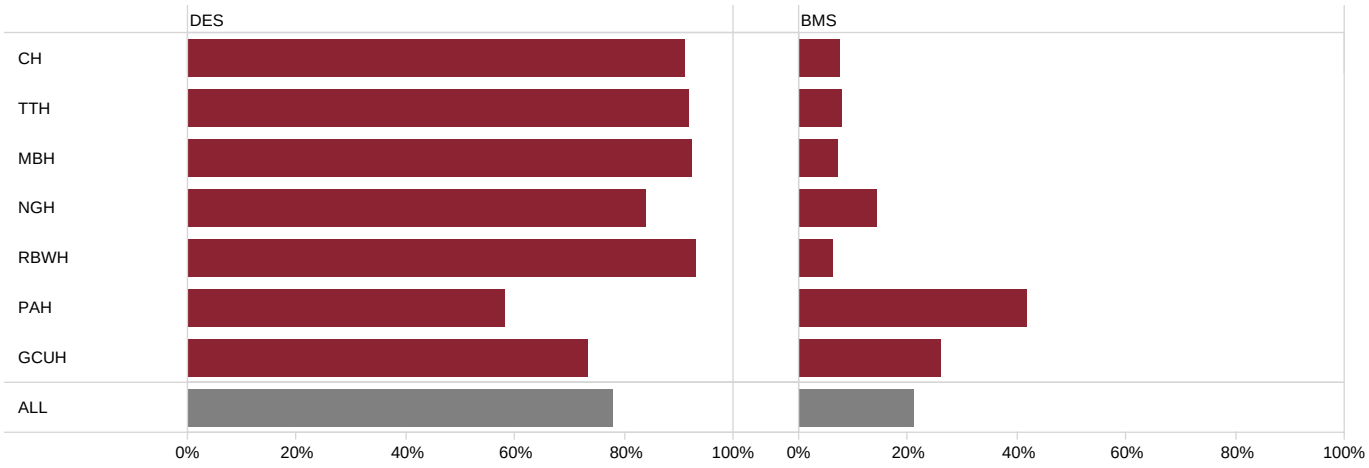


Figure 18: Proportion of cases using DES and BMS stents

6.5 NSTEMI

6.5.1 Case load

Of all cases performed in cardiac catheter suites during 2016, 2,165 (19%) cases were coded with a procedural indication of NSTEMI.

NSTEMI cases accounted for 28% of all PCI cases across all sites, with site variation ranging from 18 to 41%.

Table 12: NSTEMI cases (n)

	Total NSTEMI cases (n)	NSTEMI PCI cases (n)	NSTEMI receiving a PCI (%)	% of PCI cases
CH	261	139	54%	32%
TTH	233	68	31%	19%
MBH	124	46	37%	20%
NGH	346	118	36%	27%
RBWH	310	153	53%	41%
PAH	655	276	48%	33%
GCUH	236	118	50%	18%
ALL	**2,165**	**918**	**45%**	**28%**

6.5.2 Admission source

Overall there were more NSTEMI cases where the patient was transferred from another facility than those presenting directly to the PCI capable facility (57% and 43% respectively).

There are observed differences between sites, with the number of interhospital transfers for NSTEMI ranging from 38% to 71%.

Table 13: Admission source to treating facility (n, %)

	Case Count (n)	Direct to treating facility (%)	Interhospital transfer (%)
CH	261	54%	46%
TTH	233	58%	42%
MBH	124	62%	38%
NGH	346	55%	45%
RBWH	310	29%	71%
PAH	655	29%	71%
GCUH	236	48%	52%
ALL	**2,165**	**43%**	**57%**

6.5.3 Hospital performance – Time to angiography

Time to coronary angiography for patients presenting to hospital with a NSTEMI continues to be a key clinical quality indicator for QCOR.

National and international guidelines remain unchanged since the 2015 report with recommendations stating coronary angiography should be offered and performed within 72 hours of diagnosis[2].

A major barrier often cited in achieving this target is the time taken to transfer patients from non-PCI capable facilities to the accepting facility. There are multiple reasons delays can occur including capacity constraints and transfer logistics. The overall outcome of this indicator is presented later.

Compared with patients presenting directly to a PCI capable facility, patients arriving from another facility to a non-PCI capable facility have a median wait to coronary angiography of 29 hours longer (39 vs 68 hours) and are less likely to have angiography performed within the target timeframe of 72 hours (77% vs 54%).

Analysis was only possible in a proportion of NSTEMI cases as records were excluded due to missing data, which accounts for the mismatch between total and analysed cases.

Table 14: Median time to angiography – direct to PCI facility (hours)

SITE	Total cases (n)	Total analysed (n)	Median (hours)	Interquartile range (hours)	Met 72 hour target (%)
CH	142	131	52	68	66%
TTH	135	129	43	48	78%
MBH	77	77	42	39	82%
NGH	190	188	29	34	84%
RBWH	89	79	29	38	85%
PAH	193	154	36	57	71%
GCUH	113	92	42	52	74%
ALL	**939**	**850**	**39**	**49**	**77%**

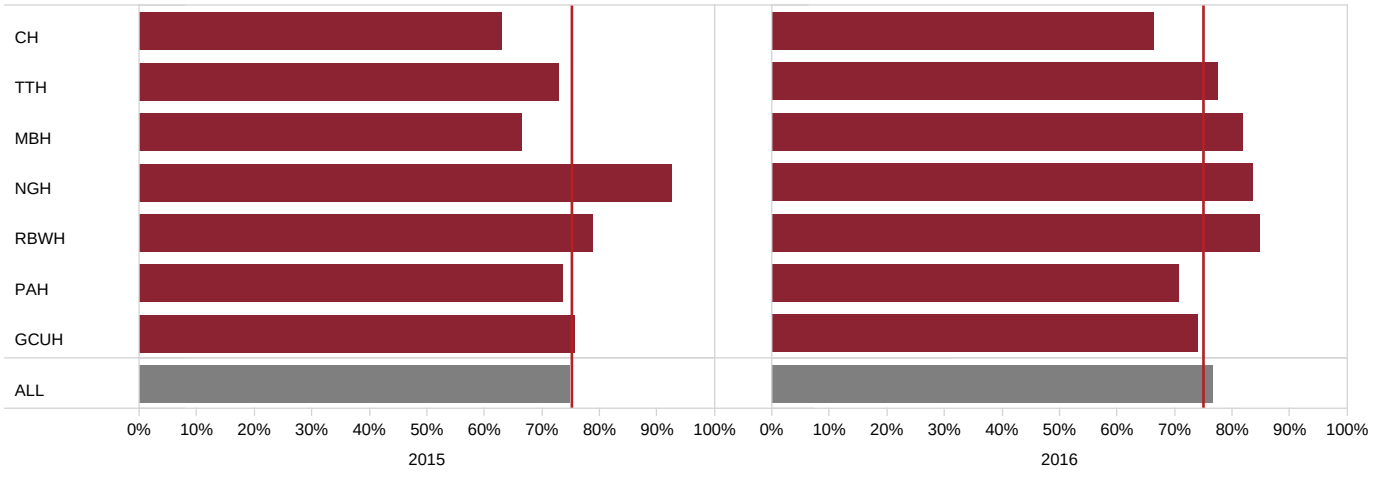


Figure 19: Proportion of NSTEMI direct presenters meeting target of 72 hours, 2015 vs 2016

Table 15: Median time to angiography – interhospital transfers (hours)

SITE	Total cases (n)	Total analysed (n)	Median (hours)	Interquartile range (hours)	Met 72 hour target (%)
CH	119	112	65	69	54%
TTH	98	89	71	67	51%
MBH	47	31	53	31	68%
NGH	156	144	36	41	80%
RBWH	221	210	71	54	52%
PAH	462	446	76	66	46%
GCUH	123	57	49	52	65%
ALL	**1,226**	**1,089**	**68**	**59**	**54%**

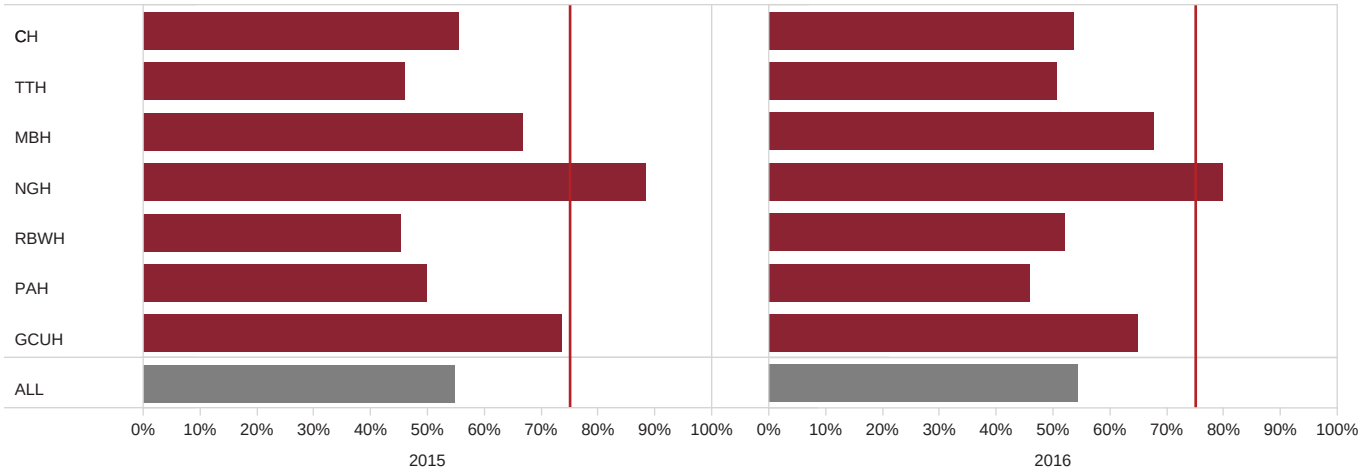


Figure 20: Proportion of NSTEMI IHT presenters meeting target of 72 hours, 2015 vs 2016

These data are similar to those observed in 2015, highlighting the continued need for overall system improvement and a statewide strategy for referring and transferring patients who require coronary angiography following a NSTEMI.

6.6 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 outcomes. PCI capable hospitals have therefore developed rapid triage and transfer systems to fast-track STEMI patients into the cardiac catheter laboratory for rapid reperfusion (primary PCI).

Decision-making for the method of reperfusion depends on many factors. Timeliness of treatment and patient characteristics indicate which treatment method is appropriate and applicable. If the patient is in a location that allows for timely transportation to a PCI capable hospital, primary PCI is the preferred treatment choice. If the patient is not able to be transported in a timely manner, fibrinolytic therapy is preferable.

Given the time-critical nature of this presentation type, ongoing refinement 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 large proportion of STEMI patients who do not present to hospital and are not treated with any form of reperfusion therapy, however this element of care is outside the scope of this registry.

6.6.1 First medical contact

Across all sites, 64% of patients presented with a STEMI via the Queensland Ambulance Service (QAS). A smaller proportion of patients presented to the emergency department (DEM) of either a PCI or non-PCI capable (satellite DEM) facility (10% and 20% respectively). The remaining 6% presented to other facilities, such as GP clinics or community health facilities.

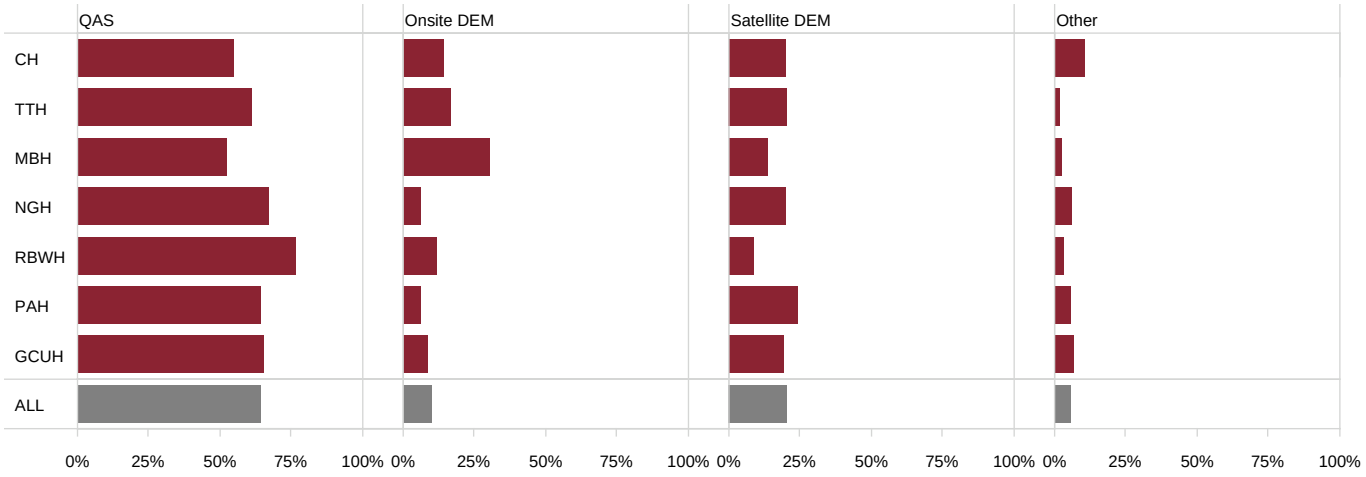


Figure 21: STEMI cases by first medical contact (%)

6.6.2 Clinical presentation

In 2016, there were 1,253 documented STEMI cases with just over half (56%) presenting as primary PCI cases, 14% presenting after 12 hours (late presenters). 27% of reperfusion-eligible patients received fibrinolysis (lysis); of these, 23% required rescue PCI because fibrinolysis was unsuccessful.

Table 16: Number of cases by STEMI presentation (n)

SITE	Case count	Transient STEMI (n)	< 6 hrs (n)	6-12 hrs (n)	Late Presentation (n)	Post successful lysis (n)	Rescue (failed lysis) (n)
CH	146	12	51	8	27	36	12
TTH	123	2	47	6	20	43	5
MBH	37	0	13	1	7	14	2
NGH	236	0	137	12	20	54	13
RBWH	106	1	68	2	9	21	5
PAH	426	25	183	27	72	84	35
GCUH	179	1	131	14	16	12	5
ALL	**1,253**	**41**	**630**	**70**	**171**	**264**	**77**

6.6.3 Mortality

Of the 1,253 documented STEMI cases in 2016, 1,024 (81.7%) patients underwent a PCI intervention and are the subject of the following outcomes analyses.

6.6.3.1 All STEMIS

Table 17: STEMI mortality in patients who underwent primary PCI (n)

SITE	Total cases (n)	In Lab (n)	In Hospital (n)	Post discharge to 30 days (n)	TOTAL (n, %)
CH	124	0	1	2	3 (2.4%)
TTH	92	0	1	1	2 (2.2%)
MBH	27	0	1	0	1 (3.7%)
NGH	193	0	6	2	8 (4.1%)
RBWH	89	0	2	0	2 (2.2%)
PAH	334	0	9	3	12 (3.6%)
GCUH	165	0	7	0	7 (4.2%)
ALL	**1,024**	**0**	**27**	**8**	**35 (3.4%)**

6.6.3.2 STEMI presentation within 6 hours from symptom onset

Table 18: STEMI mortality for patients presenting within six hours of symptom onset who underwent a primary PCI (n)

SITE	Total cases (n)	In Lab (n)	In Hospital (n)	Post discharge to 30 days (n)	TOTAL (n, %)
CH	47	0	1	0	1 (2.1%)
TTH	43	0	1	0	1 (2.3%)
MBH	11	0	0	0	0 (0%)
NGH	124	0	3	1	4 (3.2%)
RBWH	63	0	2	0	2 (3.2%)
PAH	166	0	6	1	7 (4.2%)
GCUH	124	0	4	0	4 (3.2%)
ALL	**578**	**0**	**17**	**2**	**19 (3.3%)**

6.6.4 Length of stay

Clinical coding is applied to each patient case according to a DRG (diagnosis-related group). Interventional coronary procedures performed for patients presenting with acute myocardial infarction may be coded as being with or without complications (DRG of F10A or F10B).

For patients presenting with STEMI within six hours of symptom onset, the median length of stay for an uncomplicated admission was 3.1 days and 4.4 days for an admission with complications.

Table 19: STEMI median length of stay for STEMI patients presenting within six hours of symptom onset (days)

	Complications (days)	No complications (days)
CH	6.1	2.8
TTH	3.3	3.2
MBH	N/A	3.9
NGH	4.0	2.8
RBWH	5.1	3.9
PAH	4.2	3.0
GCUH	5.5	3.8
ALL	**4.4**	**3.1**

7 Outcomes

7.1 Clinical quality indicators

The Clinical Quality Indicator program is a valuable focus of QCOR. The clinical quality indicators outlined in this document have been selected after considering international PCI and STEMI treatment guidelines and are in line with current best practice. Many key guidelines advise the use of defined and validated quality indicators as a means to measure and improve patient care.

The Clinical Quality Indicators reported by QCOR are:

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 NSTEMI patients who received angiography within 72 hours of first hospital admission.

4 Proportion of major in-lab events post PCI (perforation requiring intervention, death, tamponade, emergency coronary artery bypass graft or cerebrovascular accident-stroke).

5 Proportion of cases where total entrance dose exceeded the high dose threshold (HDT) (5Gy).

7.2 Risk adjusted 30-day all cause PCI mortality

Analysis of survival of patients undergoing PCI procedures at hospitals included in the QCOR analysis for 2016 indicates an unadjusted overall mortality rate at 30 days post procedure of 2.0%. This result compares more than favourably with the 30-day mortality rate of 2.8% presented by the British Cardiovascular Interventional Society (BCIS) in their review of 2014 PCI outcomes[3]. The observed rate at each hospital participating in the QCOR program is detailed in Table 20. All hospitals participating in this analysis achieve mortality rates of less than 2.8%.

Continuous quality improvement is a shared goal of both manufacturing and healthcare. Factors characteristic to the patient that are known to impact upon their outcome have a large bearing on the application of statistics to clinical practice. To account for these factors, QCOR has been exploring the use of risk adjustment algorithms. In adjusting for risk and confounding factors that are beyond the control of the clinician or service being monitored, controls can be applied to the analysis. This allows for retention of focus on performance measurement of the process under scrutiny.

Unfortunately, unlike many other medical specialties, there are very few universally accepted risk models in interventional cardiology. Three models that show promise are those used for risk adjustment of 30-day mortality by the BCIS[3], American College of Cardiology (ACC) CathPCI registry[4] and the Victorian Cardiac Outcomes Registry (VCOR)[5].

However, 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.

A current issue with the QCOR data set is the level of incomplete data, particularly with regards the factors required by the various risk adjustment algorithms. To address the matter of incomplete data, statistical imputation has been applied to substitute for missing information.

Future focus for improvement in the monitoring of outcomes in PCI will target improving the completeness of the datasets. One particular challenge is the availability of suitable clinical data to facilitate participation in risk adjustment modelling. Clinical and pathological investigations are not always feasible in time critical scenarios such as acute myocardial infarction.

This will enable a more thorough evaluation of the available risk models (BCIS, ACC and VCOR) and lead to the potential for adaptation through recalibration of one of these models or development of a locally relevant model.

The work on adapting these models for contemporary local practice is required due to the evolving nature of clinical practice in PCI. The outcomes presented in the 2014 BCIS review[3] clearly demonstrate a trend to using PCI in technically and clinically more complex cases, with a consequent drift to higher mortality rates. Reliance on older models therefore runs the risk that the weighting of factors in these models may mean they no longer retain their relevance for current practice.

Data appearing in Table 20 is shown for all-cause 30 day mortality post PCI broken down via admission status. A graphical representation of the evaluation of outcomes across the sites under review is shown in Figure 22 where the observed mortality rates are represented by a red diamond. This analysis used an imputed data set where records have been compiled to account for missing data.

Table 20: All-cause unadjusted 30-day mortality post PCI by admission status (% of total cases)

	Case count	Elective (%)	Urgent (%)	Emergency (%)	Salvage (%)	Total deaths (n)
CH	432	1.0%	1.3%	2.2%	33.3%	8
TTH	383	0.0%	2.2%	4.7%	0.0%	8
MBH	233	0.0%	0.0%	6.7%	0.0%	1
NGH	470	0.0%	2.3%	4.3%	66.7%	12
RBWH	404	0.0%	0.4%	1.2%	62.5%	7
PAH	961	0.0%	0.7%	6.3%	42.9%	23
GCUH	680	0.5%	0.7%	3.8%	42.9%	13
ALL	**3,563**	**0.2%**	**1.1%**	**4.3%**	**41.0%**	**72**

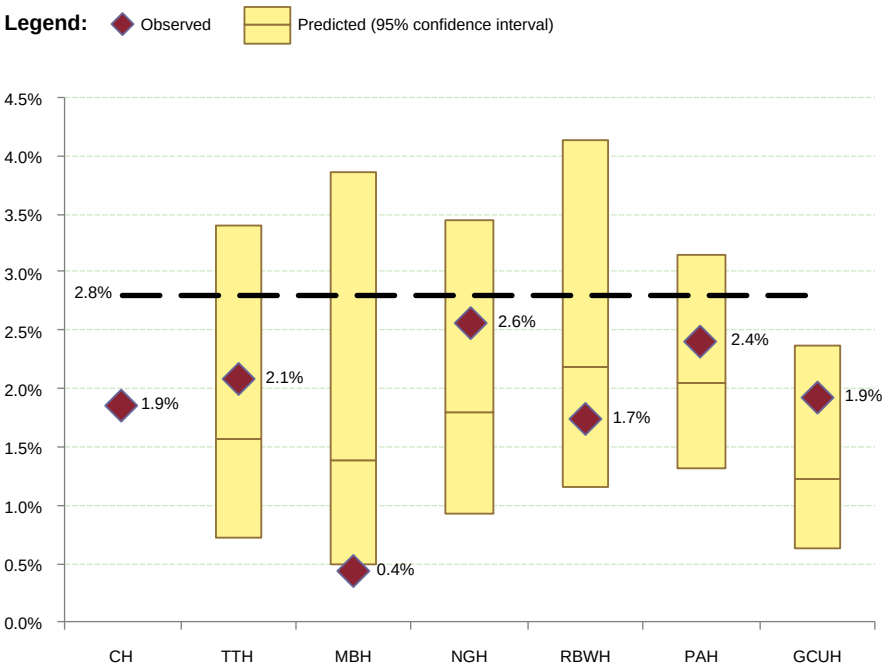


Figure 22: Comparison of observed vs. predicted mortality rates

No expected rate for CBH has been shown as analysis of the distribution of cases suggests a bias in the nature of missingness. This analysis compared the standardised mortality ratio (SMR) derived for cases with imputed data with the SMR for cases with complete data. If this analysis achieved statistical significance it was taken as an indication of bias in the nature of the missingness.

7.3 STEMI ‹ 6 hours from symptom onset – time to reperfusion

The most critical factor influencing outcome for patients who experience a STEMI is the total ischaemic time 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.[6]

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.

Definition: 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.

Definition: 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 etc)

If the lesion cannot be crossed with a guidewire or device (and thus none of the above applies), use the time of guidewire introduction. If there is already TIMI 3 flow observed on initial angiography, that timestamp is used instead of first device time.

Both the European and American STEMI guidelines recommend a target FdECG-to-device time ‹ 90 minutes. For patients who present initially to a non-PCI hospital then transfer to a PCI facility (inter-hospital transfer), the accepted FdECG-to-device target is ‹ 120 minutes[6,7]. It is widely recognised that these targets are ambitious and difficult to achieve in real-world practice as primary PCI becomes more available to larger catchment populations.

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.

In total, there were 630 discrete STEMI cases presenting within six hours of symptom onset, with 578 of these coded as primary PCI cases. Of these, 88 cases were excluded per the criteria below:

- Out of hospital cardiac arrest
- Intubation
- Shock/acute pulmonary oedema
- Salvage
- Thrombolysis contraindicated
- Significant non-cardiac comorbidity
- Previous coronary artery bypass graft surgery

Of the 490 eligible cases, 20 cases were excluded due to incomplete or invalid time stamps required to measure time to reperfusion.

Overall (n=470), the all-site median time to reperfusion was 93 minutes, with individual site times ranging from 73 to 103 minutes (Table 21). These results indicate that overall Queensland public facilities are approaching the ambitious benchmark of 90 minutes from time of first diagnostic ECG to device.

Considerable variation was observed depending on the admission pathway to the treating facility.

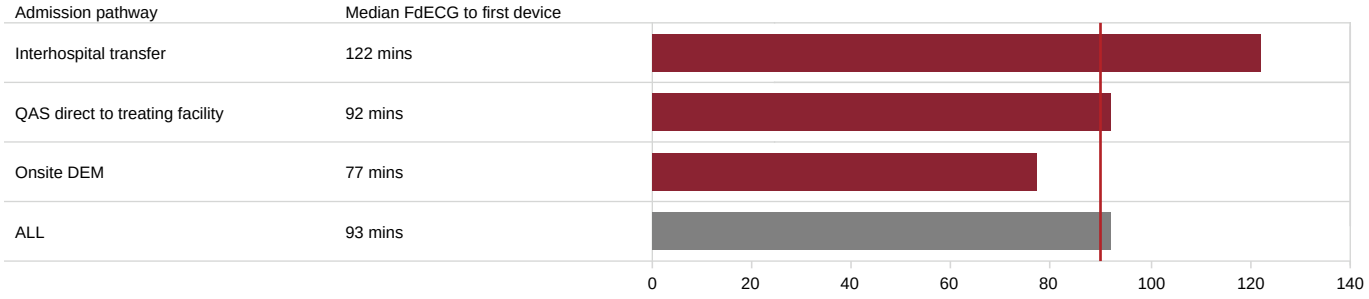


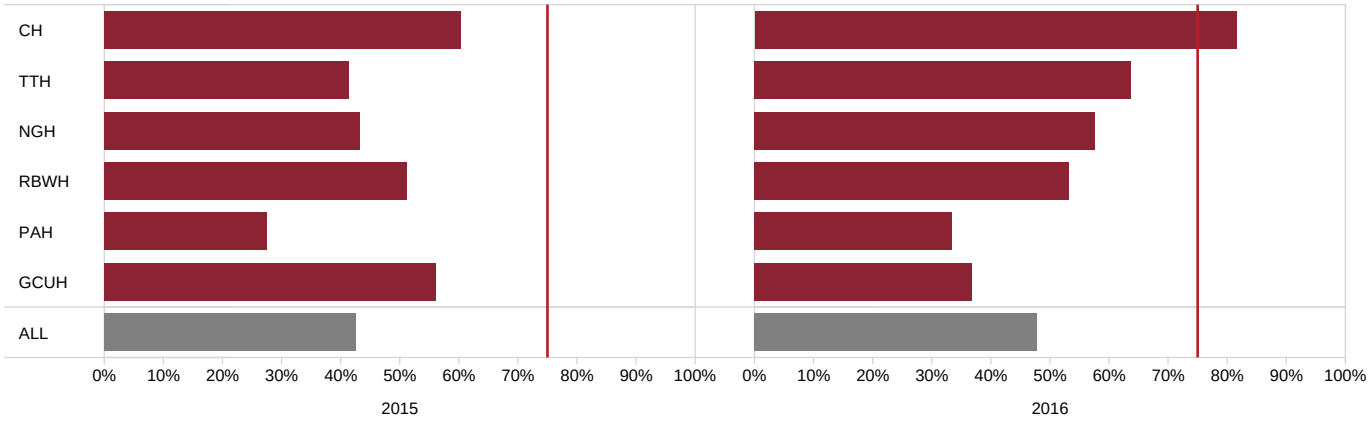
Figure 23: Median first diagnostic ECG to first device time by admission pathway (minutes)

Table 21: Median time from first diagnostic ECG to reperfusion for STEMI patients presenting within six hours of symptom onset (minutes)

SITE	Total cases (n)	Total analysed (n)	Median (minutes)	Interquartile range (minutes)	Met 90 min target (%)
CH	47	38	73	24	82%
TTH	43	33	81	34	64%
MBH	11	5	–	–	–
NGH	124	106	87	31	58%
RBWH	63	47	89	29	53%
PAH	166	138	103	36	33%
GCUH	124	103	100	37	37%
ALL	**578**	**470**	**93**	**39**	**48%**

The steering committee established the benchmark targeting 75% of patients to receive timely reperfusion measured from first diagnostic ECG to reperfusion as well as from arrival at PCI facility to reperfusion.

That only 48% of patients presenting to analysed Queensland facilities receive timely reperfusion per current guidelines (fdECG to reperfusion[6]) supports the view that the current target is optimistic. This is currently the focus of international review as more achievable objectives are explored. Nonetheless, the metric 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.



* Note MBH is not displayed due to less than 20 cases eligible for analysis.

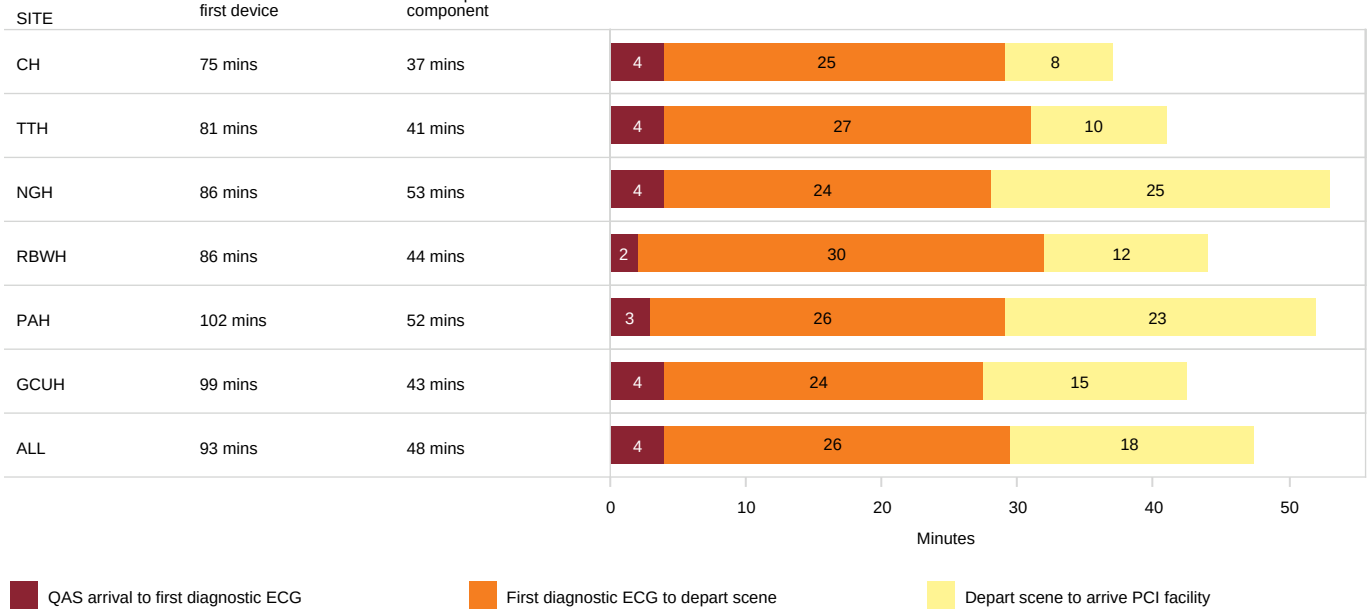
Figure 24: Proportion of cases where time from first diagnostic ECG to reperfusion met 90 min target 2015 vs 2016

1. Pre-hospital notification processes

On recognition of STEMI meeting criteria for primary PCI by a QAS paramedic trained in reperfusion, direct contact via a dedicated referral line is made with the on-call interventional cardiologist of the receiving hospital. A pre-hospital treatment plan is agreed and the cardiac catheter lab is activated. However, this referral could not occur if a QAS paramedic trained in reperfusion was not available to attend the patient.

Since 2008, Critical Care Paramedics have always been trained in reperfusion and more recently, QAS has introduced a strategy to provide this training to all Advanced Care Paramedics to promote faster activation of the lab for more STEMI patients. It is likely that as this strategy takes effect, more STEMI patients will be referred earlier.

SITE	Median FdECG to first device	Pre hospital component
CH	75 mins	37 mins
TTH	81 mins	41 mins
NGH	86 mins	53 mins
RBWH	86 mins	44 mins
PAH	102 mins	52 mins
GCUH	99 mins	43 mins
ALL	93 mins	48 mins



* Note MBH is not displayed due to less than 20 cases eligible for analysis.

Figure 25: STEMI under 6 hours pre-hospital component breakdown – QAS direct to PCI facility

2. Hospital processes

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 Emergency Department.

Although differing processes may explain some variation, this would appear to have minimal impact: when exploring door to device times in the following section, all sites were similar in the time taken to treat patients once they arrived at the PCI capable facility.

7.3.1 Door to Device – STEMI presentation within 6 hours of symptom onset

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 ‹ 90 minutes, although more recent guidelines have shortened this target time to ‹ 60 minutes [5,6].

Results demonstrate that for over half of cases (61%), participating PCI facilities are meeting a target door-to-device time of ‹ 60 minutes, with an overall all-site median time of 51 mins (range 38 to 62 mins).

Table 22: Median time from arrival at hospital to device for STEMI patients presenting within six hours of symptom onset (minutes)

SITE	Total cases	Total analysed (n)	Median (minutes)	Interquartile range (minutes)	Met 60 min target (%)
CH	47	38	56	51	58%
TTH	43	33	60	40	53%
MBH	11	5	–	–	–
NGH	124	106	38	36	75%
RBWH	63	47	53	43	60%
PAH	166	138	50	36	60%
GCUH	124	103	59	51	52%
ALL	**578**	**470**	**51**	**43**	**61%**

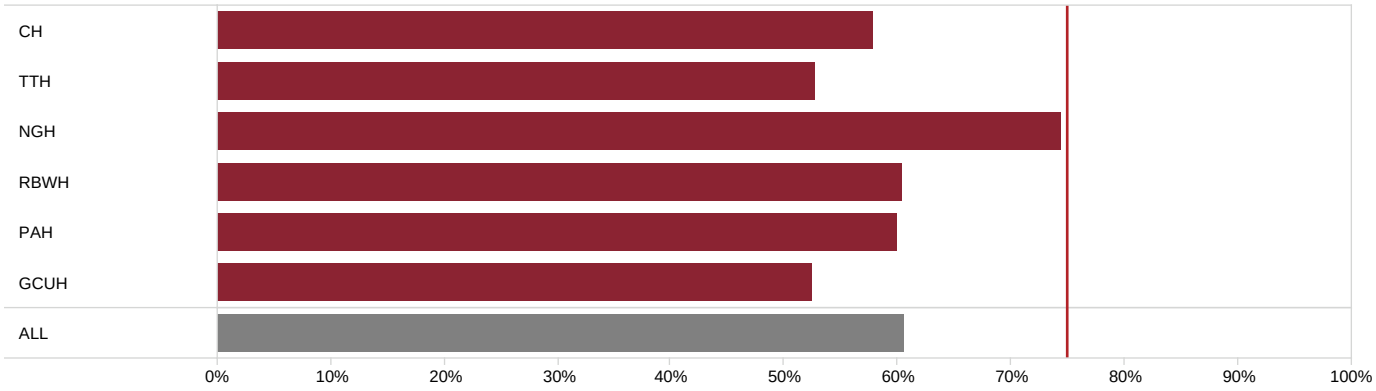


Figure 26: Proportion of cases where door to device ≤ 60 mins was met

7.4 NSTEMI – time to angiography

Coronary angiography is important in determining the extent and severity of coronary disease with both quality of life and prognostic implications for patients presenting with non-ST elevation acute coronary syndromes.

National and international guidelines recommend that coronary angiography should be offered and performed within 72 hours of diagnosis[2]. This duration is reduced to 24 hours for those deemed to be at high risk (as predicted by a validated risk score) of recurrent events.

For this indicator, the consensus of the steering committee was that the recommended treatment timeframe for analysis should be 72 hours for all non-ST elevation acute coronary syndromes as a universal risk prediction score has not been applied.

Table 23: Time to angiography

SITE	Total NSTEMI cases (n)	Total analysed (n)	Total interhospital transfers (%)	Median (hours)	Interquartile range (hours)	Met 72 hour target (%)
CH	261	243	45%	58	69	61%
TTH	233	218	41%	51	66	67%
MBH	124	108	38%	47	42	78%
NGH	346	332	44%	30	38	82%
RBWH	310	289	69%	59	61	61%
PAH	655	600	67%	70	63	52%
GCUH	236	149	52%	45	54	71%
ALL	**2,165**	**1,939**	**55%**	**51**	**63**	**64%**

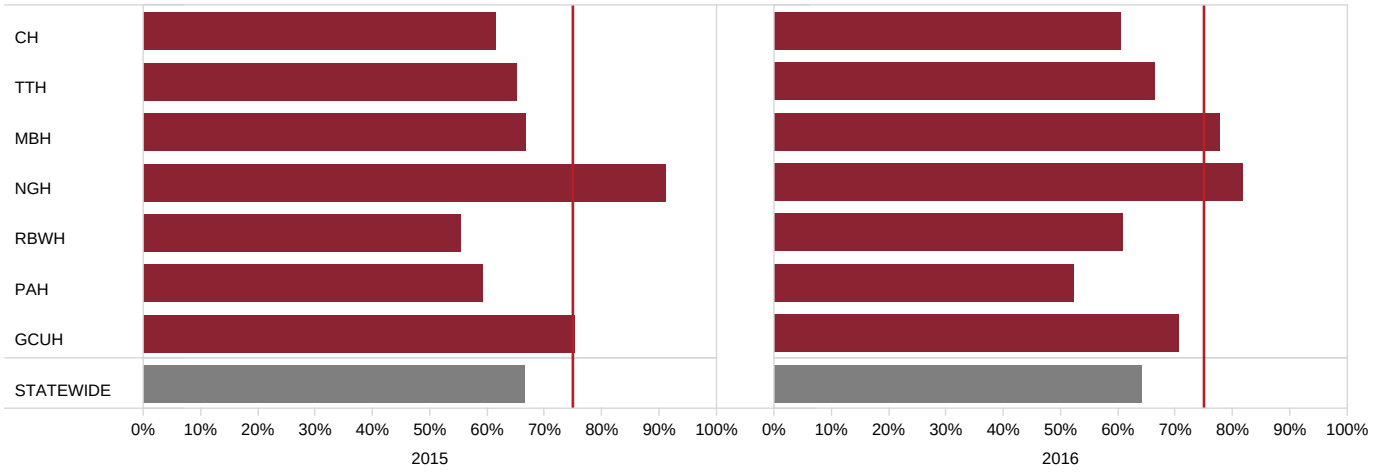


Figure 27: Proportion meeting time to angiography target of 72 hours, 2015 vs 2016

7.5 Major adverse cardiac events

Analysed as both a composite end-point and as individual events, this indicator examines intra-procedural, in lab complications which include coronary artery perforation, cerebrovascular event, emergency CABG, tamponade, and in lab death.

In 2016, 20 cases (0.56%) recorded a major adverse cardiac event (MACE).

Table 24: MACE type by case (n,%)

MACE type	Count	%
Coronary artery perforation	12	0.34
In lab death	5	0.14
Cerebrovascular event	2	0.06
Emergency CABG	1	0.03
No MACE	3,543	99.44
Total	**3,563**	

Whilst these figures provide reassurance about the safety of cardiac catheter laboratory procedures in Queensland in 2016, caution must be applied before extrapolating this safety data to non-participating sites as a participation bias may exist.

The seven participating sites represent less than 50% of hospitals with cardiac catheter labs in all of Queensland (public and private) and with this perspective, the reassuring safety data reported here may not be applicable to all sites with cardiac catheter laboratories, particularly those that do not participate in any formal data registry.

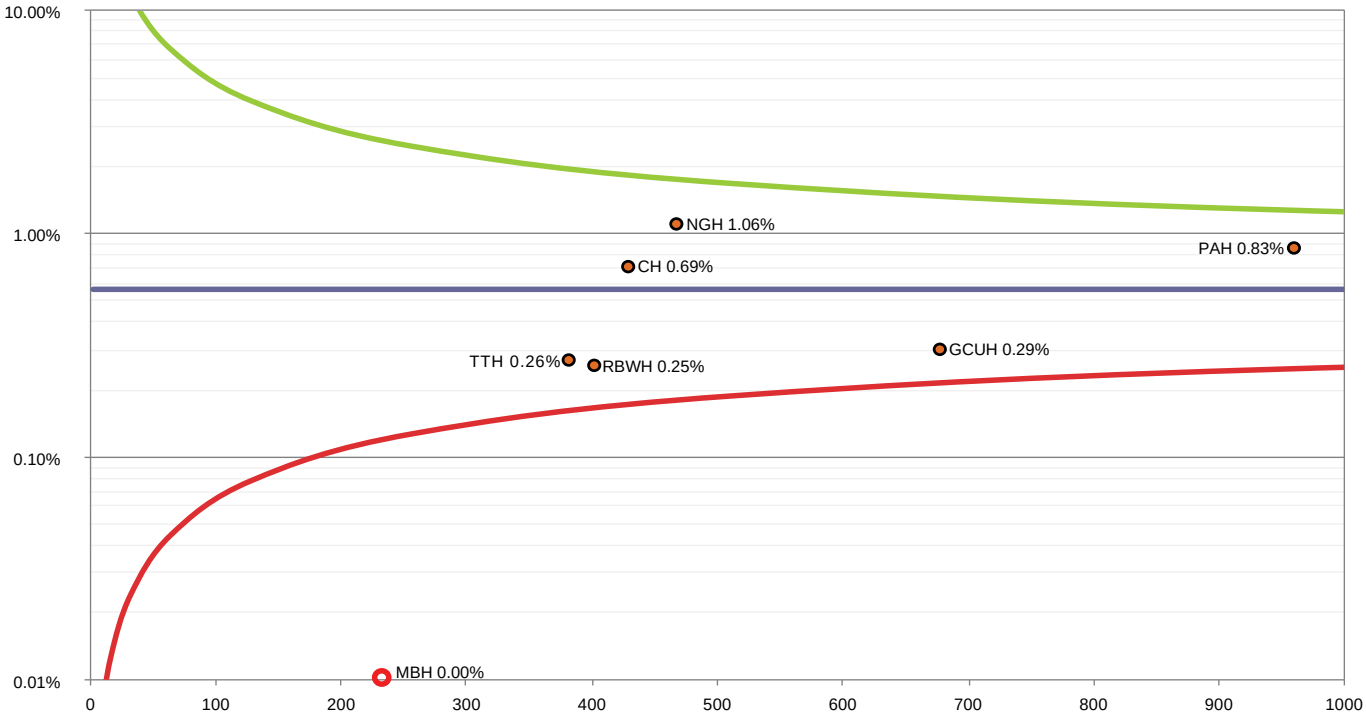


Figure 28: Major adverse cardiac events

7.6 Safe radiation doses

Staff and patients are exposed to ionizing radiation during almost all procedures performed in the cardiac catheter laboratory. Whilst ionizing radiation is known to cause both delayed and deterministic (non-delayed) effects, the probability of effect is thought to be dose-related.

Fortunately conservative thresholds are applied and monitored throughout Queensland; however as the complexity of procedural work undertaken by interventional cardiologists increases, along with the increase in patients with a large body weight, it is increasingly important to remain vigilant with radiation safety. This indicator examines the proportion of cases exceeding the high dose threshold of 5Gy.

Table 25: Proportion of cases meeting the safe dose threshold by case type (%)

	Diagnostic procedures (%)	PCI procedures (%)
CH	100.0%	99.8%
TTH	99.9%	97.9%
MBH	100.0%	99.6%
NGH	99.9%	99.4%
RBWH	99.9%	97.3%
PAH	99.6%	94.1%
GCUH	99.9%	99.7%
ALL	**99.8%**	**97.7%**

8 Supplement: Structural heart disease

Highlights from the structural heart disease (SHD) program are detailed below. The reporting of these procedures will be expanded in the 2017 annual report. One private institution based in Queensland has also contributed SHD procedure data to the QCOR Structural Heart Disease initiative.

8.1 Participating sites

In 2016, there were six participating cardiac catheter laboratories, performing a total of 116 SHD procedures. These included 47 device closure procedures and 69 valvuloplasty procedures.

Table 26: SHD procedures by category and participating site (n)

Site	Device closure	Valvuloplasty	Total
Cairns Hospital	4	7	11
The Townsville Hospital	9	6	15
Nambour General Hospital	9	6	15
Princess Alexandra Hospital	24	25	49
Gold Coast University Hospital	1	1	2
Other Institution	0	24	24
ALL	**47**	**69**	**116**

8.2 Patient characteristics

Patients undergoing SHD procedures were almost evenly distributed between male and female (53 to 47%), with the majority of patients aged 70 years and above.

Table 27: SHD procedures by gender and age group (n, %)

Age group	Male	Female	ALL
<30	2 (2%)	4 (3%)	6 (5%)
30-39	5 (4%)	7 (6%)	12 (10%)
40-49	5 (4%)	11 (9%)	16 (14%)
50-59	4 (3%)	5 (4%)	9 (8%)
60-69	8 (7%)	0 (0%)	8 (7%)
70-79	12 (10%)	9 (8%)	21 (18%)
80-89	18 (16%)	15 (13%)	33 (28%)
90+	7 (6%)	4 (3%)	11 (9%)
Total	**61 (53%)**	**55 (47%)**	**116 (100%)**

8.3 Procedure counts

8.3.1 Device closures

There were a total of 47 device closure procedures undertaken across all participating sites. These included two paravalvular leak closures for dysfunctional valvular prostheses.

Table 28: Device closure procedures by participating site (n)

Site	Paravalvular leak closure	ASD*	VSD†	PFO‡	Total
Cairns Hospital	0	2	0	2	4
The Townsville Hospital	0	4	2	3	9
Nambour General Hospital	0	4	0	5	9
Princess Alexandra Hospital	2	6	0	16	24
Gold Coast University Hospital	0	1	0	0	1
Other Institution	0	0	0	0	0
ALL	**2**	**17**	**2**	**26**	**47**

* Atrial septal defect

† Ventricular septal defect

‡ Patent foramen ovale

8.3.2 Valvuloplasty

The most common form of valvuloplasty procedure involved transcatheter aortic valve replacement (TAVR), followed by balloon aortic valvuloplasty cases.

Table 29: Valvuloplasty procedures by participating site (n)

Site	Balloon aortic valvuloplasty	TAVR	Balloon mitral valvuloplasty	Balloon pulmonary valvuloplasty	Total
Cairns Hospital	7	0	0	0	7
The Townsville Hospital	4	0	1	1	6
Nambour General Hospital	6	0	0	0	6
Princess Alexandra Hospital	6	16	3	0	25
Gold Coast University Hospital	1	0	0	0	1
Other Institution	0	24	0	0	24
ALL	**24**	**40**	**4**	**1**	**69**

9 Conclusion

This second report which details the workload and varied mix of patients encountered at seven of the eight public hospital cardiac catheter laboratory sites, continues to show positive results. Of the participating sites it is evident that there is reassuring mortality and morbidity information with no signs of elevated incidences of complications or sites with outlying negative outcomes.

Following detailed analysis of the data available, it is evident that there is opportunities for improvement in some areas of data collection. One particular challenge is the availability of suitable clinical data to facilitate participation in risk adjustment modelling. Clinical and pathological investigations are not always feasible in time critical scenarios such as acute myocardial infarction, which leads inevitably to incomplete datasets and an inability to unambiguously participate in benchmarking activities. It will equally be important to extend the reporting scope of QCOR to all public and private institutions to develop a true profile of cardiac interventional services in Queensland.

International clinical guidelines regarding the care and treatment of patients with cardiovascular disease are ongoing in development and evolution. Reports such as these and the indicators that clinical registries employ to encourage quality in this setting need to be dynamic and contemporary in nature. With the platform that has been built through clinical registries such as QCOR, clinicians can be confident that the care and treatment of patients in Queensland is of an international standard.

10 Recommendations

With the ongoing maturity of contributions and analysis of interventional cardiology data contained in QCOR, clinicians are able to access quality and timely reports and information. This information is constantly being moulded by changes to international guidelines and evolving practices prompted by contemporary research.

The interventional cardiology steering committee acknowledges these changes to current practice and is committed to ensuring the group remain in touch with these changing benchmarks and recommendations. This is particularly important when the group re-assess clinical indicators and the associated benchmarks that are set as targets for practice.

Furthermore, the steering committee are looking forward to progressing the development of a bespoke structural heart disease application with the key driver being the increased uptake of transcatheter valvular intervention. Such an application is vital for the capture of procedural data as well as the many pre and post intervention data points that are integral in the decision making processes and outcomes for these patients.

The steering committee also have an interest in the support of clinical research and audit and as such back any initiative that drives constructive change in practice and patient care. With the addition of more QCOR managed applications, the committee are keen to explore the future possibilities that this presents.

Data quality and the continued focus on excellence in data collection remain a key priority for the steering committee. Through the work of the steering committee and relevant departmental staff, contributions to and outputs from QCOR will continue to develop and play a far more pivotal role in guiding everyday practice and decision support.

Glossary

A&TSI	Aboriginal and Torres Strait Islander
ACEI	Angiotensin Converting Enzyme Inhibitor
ACOR	Australasian Cardiac Outcomes Registry
ACQIS	Adult Cardiac Service Quality Informations System
ACS	Acute Coronary Syndromes
ANZSCTS	Australian and New Zealand Society of Cardiac and Thoracic Surgeons
ARB	Angiotensin Receptor Blocker
BMI	Body Mass Index
BMS	Bare Metal Stent
CABG	Coronary Artery Bypass Graft
CCL	Cardiac Catheter Laboratory
CH	Cairns Hospital
CI	Clinical Indicator
CISP	Cardiac Information Solutions Program
cQIC	Clinical Quality Improvement Coordinator
CRT	Cardiac Resynchronisation Therapy
CV	Cardiovascular
CVA	Cerebrovascular Accident
DEM	Department of Emergency Medicine
DES	Drug Eluting Stent
DOSA	Day Of Surgery Admission
DSWI	Deep Sternal Wound Infection
ECG	12 lead electrocardiograph
eGFR	Estimated Glomerular Filtration Rate
ERP	Estimated Resident Population
FFR	Fractional Flow Reserve
FMC	First Medical Contact
FTE	Full Time Equivalent
GCHHS	Gold Coast Health and Hospital Service
GCUH	Gold Coast University Hospital
GP	General Practitioner
HDT	High Dose Threshold
HERO	Heart Failure Evaluation and Reporting of Outcomes
HF	Heart Failure
HFpEF	Heart Failure With Preserved Ejection Fraction
HFrEF	Heart Failure With Reduced Ejection Fraction
HFS	Heart Failure Service
HFSS	Heart Failure Support Service
HHS	Hospital and Health Service
ICD	Implantable Cardiac Defibrillator
KPI	Key Performance Indicator
LAD	Left Anterior Descending Artery
LV	Left Ventricle
LVEF	Left Ventricular Ejection Fraction
MACE	Major Adverse Cardiac Event
MBH	Mackay Base Hospital
MHHS	Mackay Hospital and Health Service
MI	Myocardial Infarction
MNHHS	Metro North Health and Hospital Service
MRA	Mineralocorticoid Receptor Antagonist
MSHHS	Metro South Health and Hospital Service
NCDR	The National Cardiovascular Data Registry
NGH	Nambour General Hospital
NP	Nurse Practitioner
NSTEMI	Non ST-Elevation Myocardial Infarction
OCT	Optical Coherence Tomography
PAH	The Princess Alexandra Hospital
PCI	Percutaneous Coronary Intervention
QAS	Queensland Ambulance Service
QCOR	Queensland Cardiac Outcomes Registry
QE II	Queen Elizabeth II Hospital
QI	Quality Improvement
RBWH	The Royal Women's and Brisbane Hospital
RCA	Right Coronary Artery
RFI	Request for Information
SCCIU	Statewide Cardiac Clinical Informatics Unit
SCCN	Statewide Cardiac Clinical Network
SCHHS	Sunshine Coast Health and Hospital Service
STEMI	ST-Elevation Myocardial Infarction
STS	Society of Thoracic Surgery
TAVR	Transcatheter Aortic Valve Replacement
TPCH	The Prince Charles Hospital
TTH	The Townsville Hospital
VCOR	Victorian Cardiac Outcomes Registry
VMO	Visiting Medical Officer

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