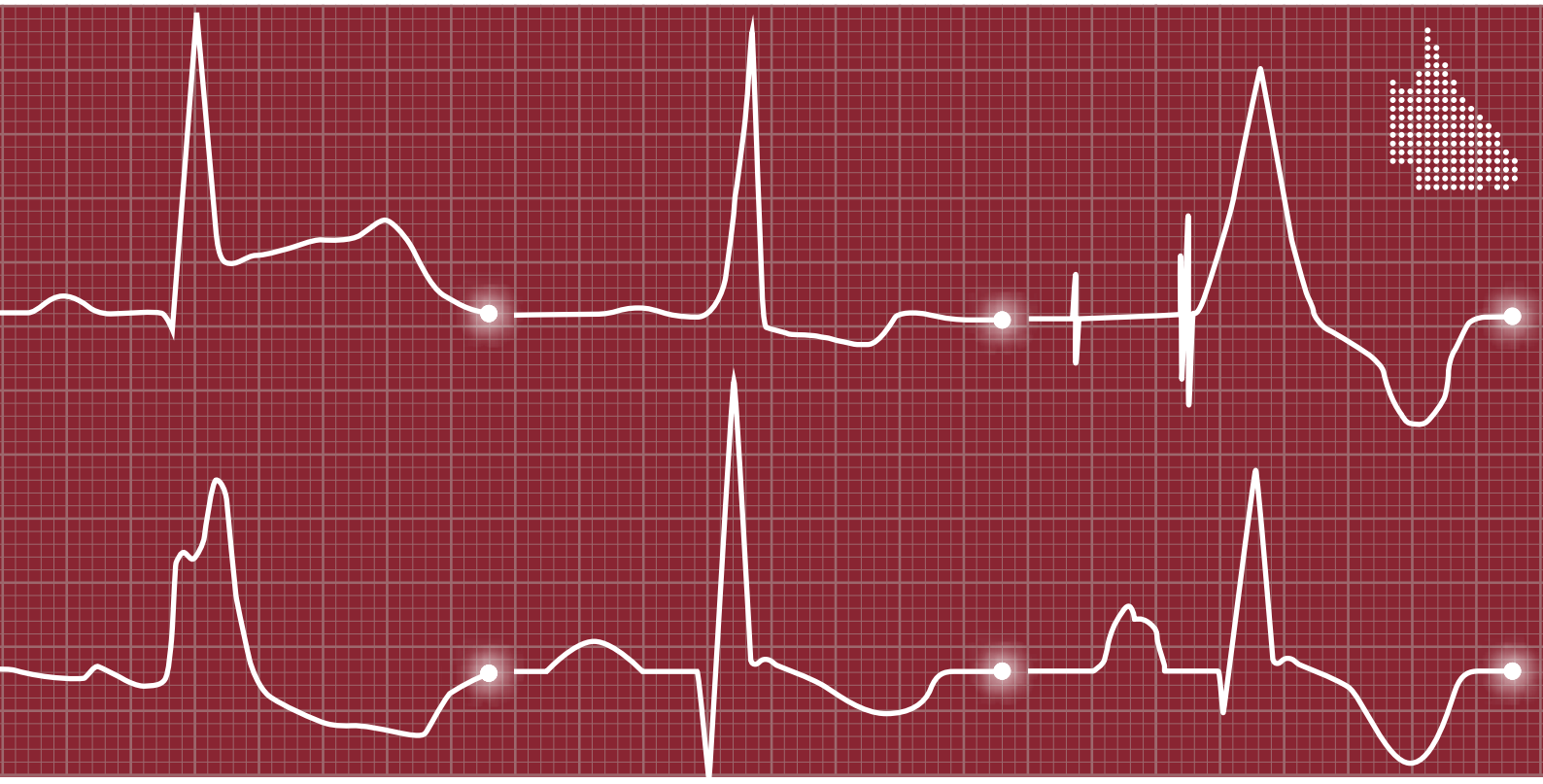
Statewide Cardiac Clinical Network

Queensland Cardiac Outcomes Registry

2019 Annual Report

Electrophysiology and Pacing Audit



Queensland Cardiac Outcomes Registry
2019 Annual Report

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1 Message from the SCCN Chair

We are pleased to present the 2019 Queensland Cardiac Outcomes Registry (QCOR) Annual Report, which marks five years of publication. Yet again, the Report documents the world-class quality of care offered by practitioners within the Queensland public health system. The QCOR program is driven by the passion of Queensland's clinicians to not only report on the quality, performance and outcomes of cardiac services delivered to Queenslanders, but to enable and provide a comprehensive platform to directly support frontline cardiac services and be a driving force for continuous improvement. The result has been collaboration on a statewide scale, with QCOR directly supporting the efforts of hundreds of clinicians across often incredible distances.

The breadth of QCOR is highlighted by the development of a new module to support cardiac outreach services, starting with the Far North Queensland outreach unit in late 2019. Outreach services are an important part of delivering quality care to patients for whom cardiac care is less accessible, due to their remoteness from traditional facility-based services. This initial reporting will be expanded as additional units are established or come online over following years. This Report also shines a spotlight on the new partnership between QCOR and the Queensland Rheumatic Heart Disease (RHD) Registry. Despite being in its infancy, this collaboration has already led to the identification and development of specialised care plans for almost two hundred Queenslanders suffering from RHD. These are outcomes which are seldom linked to traditional research-focused registries and reflect a far greater vision at the core of this clinician-led initiative.

Clinical quality has again continued to be a focus of this report, with several new clinical indicators having been added to these audits for the new year to align with ever-changing international guidelines for the management and treatment of patients. As such, the registry continues to evolve and clinical indicators across all areas of interest will continue to be reviewed and expand accordingly over future years. It is yet again reassuring to see performance of Queensland services strong when compared to these often optimistic benchmarks and targets.

Investment in the collection of clinical data is now recognised as a valuable means of returning on investment and identifying areas of efficiency that subsequently enable cost savings and redirection of health funding to areas of need or emerging clinical technologies. QCOR data has underpinned bulk purchase arrangements and continues to demonstrate the ability to negotiate strongly with industry via commercial processes and ensure that each health funding dollar is spent wisely and carefully. Future processes now have the potential to increase in scope which will drive further financial realisation on investment that compound and grow over time.

The tireless work of Queensland cardiac clinicians and administrative staff must be recognised, not only for delivering high quality clinical outcomes but for their engagement, understanding and enthusiasm for quality clinical processes that are supported by quality data, and we look forward to future expansion that seeks to apply a similar scope and high standard of reporting to echocardiography and structural heart disease.

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

2 Introduction

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

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

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

The SCCIU team consists of:

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

* Principal contact officer/QCOR program lead

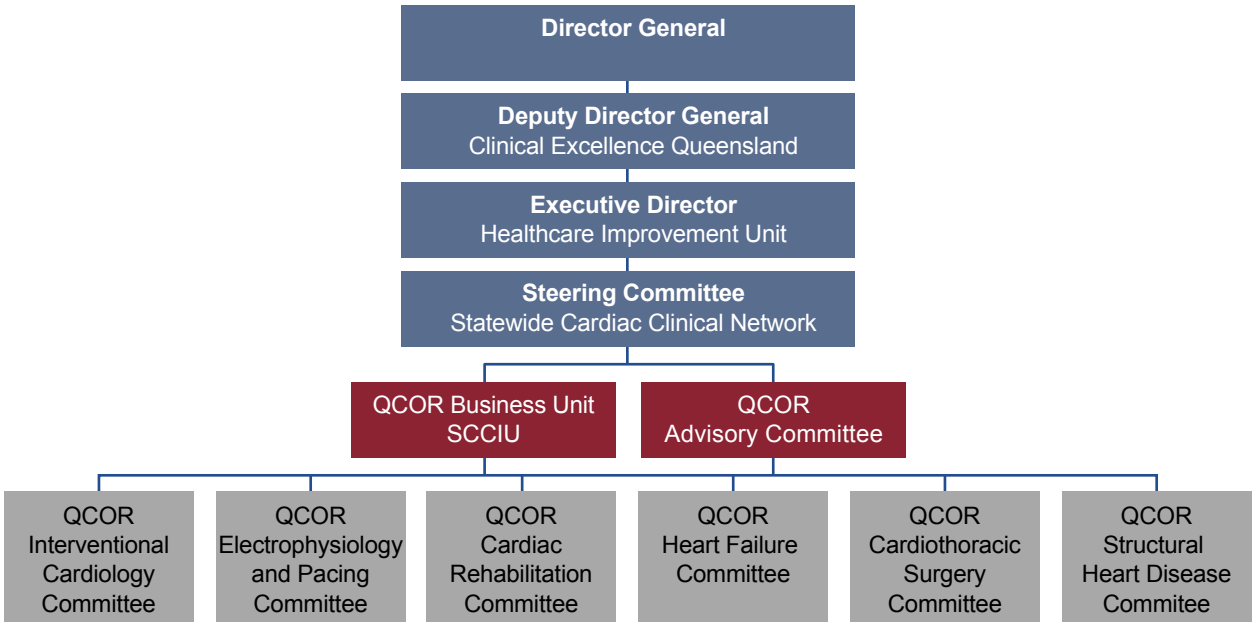
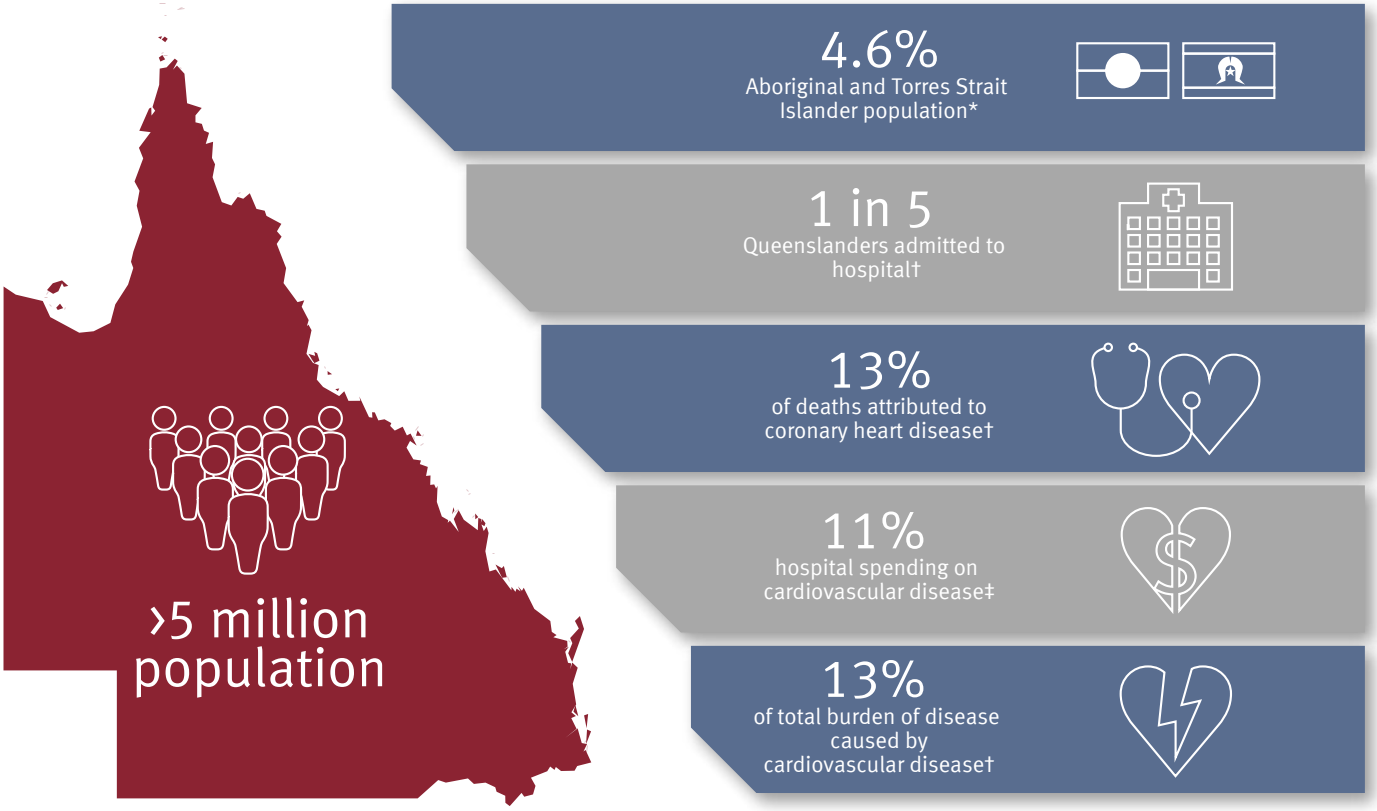


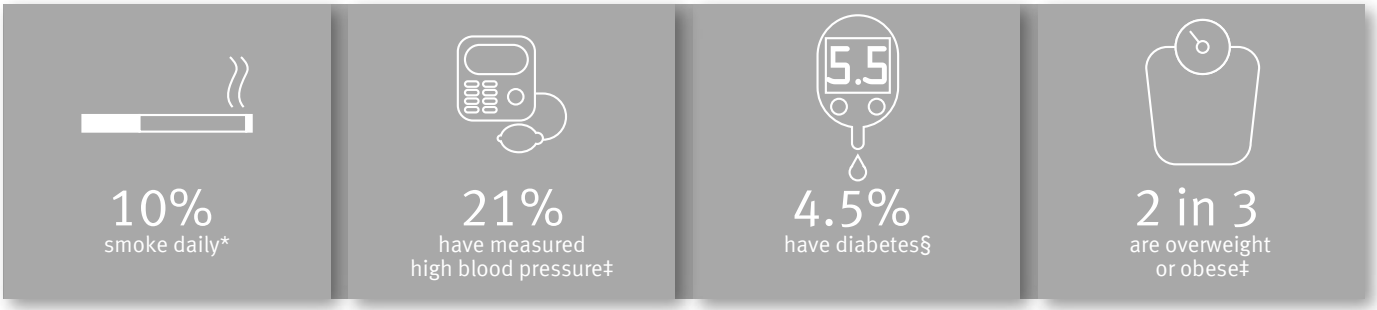
Figure 1: Governance structure

Queensland Cardiac Outcomes Registry

The Health of Queenslanders



Comorbidities



Mortality

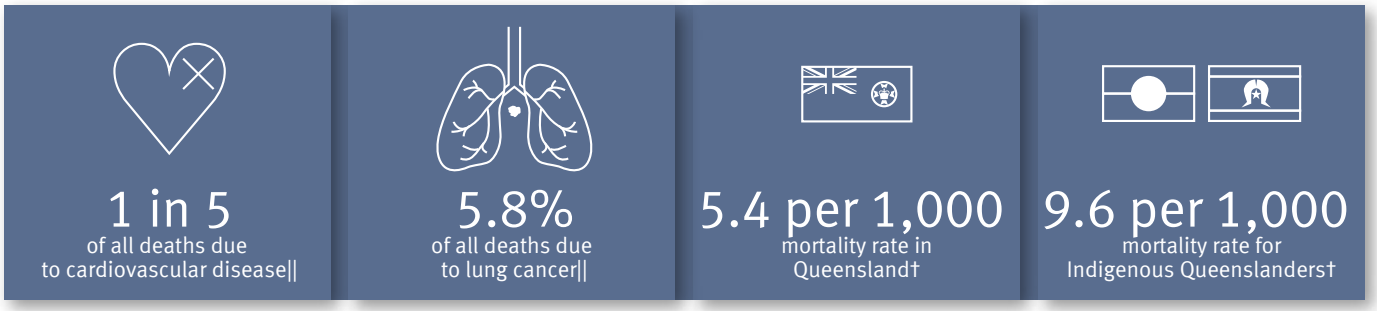


Figure 2: QCOR 2019 infographic

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

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

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

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

|| Australian Bureau of Statistics. (2019). *Deaths, Australia, 2018*. Cat. no. 3302.0. ABS: Canberra.

2019 Activity at a Glance

What's New?

- Rheumatic heart disease, cardiac outreach and ECG Flash spotlights
- Expanded thrombolysis for STEMI analysis
- Cardiac surgery EuroSCORE II risk adjustment analysis
- Cardiac surgery remoteness investigation
- New timely non-acute assessments cardiac rehabilitation indicator
- New mineralocorticoid antagonist prescription heart failure indicator

Interventional Cardiology

5,002
percutaneous coronary interventions

477
structural heart disease interventions

249
transcatheter aortic valve replacements

15,615
all coronary procedures

Cardiothoracic Surgery

2,622
adult cardiac surgeries

1,042
adult thoracic surgeries

Electrophysiology & Pacing

4,654
electrophysiology and pacing procedures

3,189
cardiac implantable electronic device procedures

Heart Failure Support Services

5,304
heart failure support services referrals

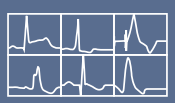
Cardiac Rehabilitation

11,547
cardiac rehabilitation referrals

Rheumatic Heart Disease

179
unknown RHD patients identified

Clinical Indicator Progress



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

0.3%
procedural tamponade rate for cardiac device and electrophysiology procedures

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

94%
of cardiac rehabilitation referrals within 3 days of discharge

1.0%
mortality rate for coronary artery bypass surgery at 30 days

QCOR Yearly Trends

Interventional Cardiology

15,615
cases in 2019
– up from 15,293 in 2017

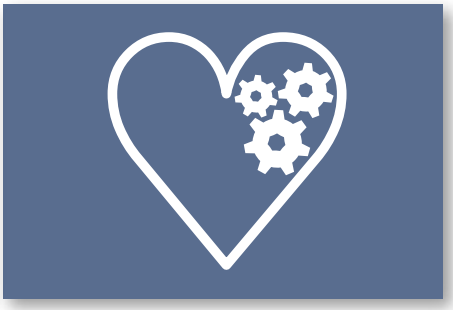
5,002
PCI cases in 2019
– up from 4,867 in 2018

3 minute
improvement in median time to reperfusion for STEMI PCI from 2017 to 2019

8%
increase in primary PCI cases meeting 90 minute target for timely reperfusion – 2017 to 2019

Cardiothoracic Surgery

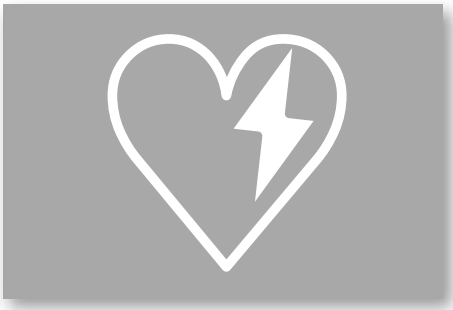
11%
increase in cardiac surgery cases
– 2017 to 2019



23%
increase in thoracic surgery cases
– 2018 to 2019

Electrophysiology & Pacing

4,654
cases in 2019
– up from 4,474 in 2018



22%
increase in complex EP cases
– 2018 to 2019

Outpatient Support Services

23,000+
cardiac rehabilitation referrals
– 2018 and 2019

17%
increase in new heart failure support services referrals
– 2017 to 2019

3 Acknowledgements

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

QCOR Interventional Cardiology Committee

- Dr Sugeet Baveja, Townsville University Hospital
- Dr Niranjan Gaikwad, The Prince Charles Hospital
- Dr Paul Garrahy, Princess Alexandra Hospital
- Dr Christopher Hammett, Royal Brisbane & Women's Hospital
- A/Prof Richard Lim, Princess Alexandra Hospital
- Dr Rohan Poulter, Sunshine Coast University Hospital
- A/Prof Atifur Rahman, Gold Coast University Hospital
- Dr Shantisagar Vaidya, Mackay Base Hospital
- Dr Gregory Starmer, Cairns Hospital (Chair)

QCOR Cardiothoracic Surgery Committee

- Dr Anil Prabhu, The Prince Charles Hospital
- Dr Pallav Shah, Townsville University Hospital
- Dr Andrie Stroebel, Gold Coast University Hospital
- Dr Morgan Windsor, Metro North Hospital and Health Service
- Dr Christopher Cole, Princess Alexandra Hospital (Chair)

QCOR Cardiac Rehabilitation Committee

- Ms Michelle Aust, Sunshine Coast University Hospital
- Ms Maura Barnden, Metro North Hospital and Health Service
- Ms Jacqueline Cairns, Cairns Hospital
- Ms Yvonne Martin, Chronic Disease Brisbane South
- Dr Johanne Neill, Ipswich Hospital
- Ms Samara Phillips, Statewide Cardiac Rehabilitation Coordinator
- Ms Madonna Prenzler, West Moreton Hospital and Health Service
- Ms Deborah Snow, Gold Coast Hospital and Health Service
- Ms Natalie Thomas, South West Hospital and Health Service
- Mr Gary Bennett, Health Contact Centre (Chair)

Statewide Cardiac Clinical Informatics Unit

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

QCOR Electrophysiology and Pacing Committee

- Mr John Betts, The Prince Charles Hospital
- Mr Anthony Brown, Sunshine Coast University Hospital
- Mr Andrew Claughton, Princess Alexandra Hospital
- Dr Naresh Dayananda, Sunshine Coast University Hospital
- Dr Russell Denman, The Prince Charles Hospital
- Mr Braden Dinham, Gold Coast University Hospital
- Ms Sanja Doneva, Princess Alexandra Hospital
- Mr Nathan Engstrom, Townsville University Hospital
- A/Prof John Hill, Princess Alexandra Hospital
- Dr Bobby John, Townsville University Hospital
- Dr Paul Martin, Royal Brisbane & Women's Hospital
- Ms Sonya Naumann, Royal Brisbane & Women's Hospital
- Dr Kevin Ng, Cairns Hospital
- Dr Robert Park, Gold Coast University Hospital

QCOR Heart Failure Support Services Committee

- Mr Ben Shea, Ipswich Hospital
- Ms Angie Sutcliffe, Cairns Hospital
- Ms Tina Ha, Princess Alexandra Hospital
- Ms Helen Hannan, Rockhampton Hospital
- Ms Annabel Hickey, Statewide Heart Failure Services Coordinator
- Dr Rita Hwang, PhD, Princess Alexandra Hospital
- Dr Kevin Ng, Cairns Hospital
- Ms Robyn Peters, Princess Alexandra Hospital
- Ms Serena Rofail, Royal Brisbane & Women's Hospital
- Dr Yee Weng Wong, The Prince Charles Hospital
- A/Prof John Atherton, Royal Brisbane & Women's Hospital (Chair)

Queensland Ambulance Service

- Dr Tan Doan, PhD
- Mr Brett Rogers

4 Executive summary

This report comprises an account for cases performed in the eight cardiac catheterisation laboratories (CCL) and nine electrophysiology and pacing (EP) facilities, along with five cardiothoracic surgery units operating across Queensland public hospitals in 2019. Referrals to the 21 heart failure support and 57 cardiac rehabilitation services for the management of heart disease have also been included in this Audit.

- 15,615 diagnostic or interventional cases were performed across the eight public CCL facilities in Queensland hospitals. Percutaneous coronary intervention (PCI) was performed in 5,002 of these cases.
- Patient outcomes following PCI remain encouraging. The 30 day mortality rate following PCI was 2.2%, and of the 108 deaths observed, 77% were classed as either salvage or emergency PCI.
- When analysing the ST segment elevation myocardial infarction (STEMI) patient cohort, the median time from first diagnostic electrocardiograph (ECG) to reperfusion and arrival at PCI facility to reperfusion was observed at 83 minutes and 42 minutes.
- Across the four sites with a cardiac surgery unit, a total of 2,622 cases were performed including 1,567 coronary artery bypass grafting (CABG) and 1,104 valve procedures.
- The observed rates for cardiac surgery mortality and morbidity are either within the expected range or better than expected, depending on the risk model used to evaluate these outcomes. This is consistent with the results of previous audits.
- Approximately 4% of all cardiac surgical patients resided in remote or very remote Australia.
- Patients in Outer Regional and Remote/Very Remote areas were two to four times more likely to have a postoperative length of stay >14 days (Outer Regional: OR 2.02, p<0.01), Remote/Very Remote: OR 4.05, p <0.001).
- Patients residing outside of a Major City of Australia had a higher likelihood of having a length of stay <6 days (Inner Regional: OR 1.61 p=0.009, Outer Regional: OR 1.45 p=0.044).
- A total of 1,042 thoracic surgery cases were performed across the five public hospitals providing thoracic surgery services in 2019. Almost a quarter (24%) of surgeries followed a preoperative diagnosis of primary lung cancer, whereas pleural disease accounted for nearly a third of all cases (32%).
- At the nine public Electrophysiology and Pacing (EP) sites, a total of 4,654 cases were performed, which included 3,189 cardiac device procedures and 1,058 electrophysiology procedures. This year's EP Audit sees the addition of Toowoomba Hospital, which began direct entry in November 2019.
- The EP clinical indicator audit identified a median wait time of 81 days for complex ablation procedures, and 32 days for elective implantable cardioverter defibrillator (ICD) implants. Meanwhile the median wait time for a standard ablation procedure was 117 days.
- There was a total of 11,547 referrals to one of the 57 public cardiac rehabilitation (CR) services in 2019. Almost three quarters of referrals (74%) followed an admission at a public hospital in Queensland.
- The vast majority of referrals to CR were created within three days of the patient being discharged from hospital (94%), while over half of patients went on to complete an initial assessment by CR within 28 days of discharge (56%). This performance measure is consistent with the data observed in 2018.
- There were 5,304 new referrals to a heart failure support service in 2019. Clinical indicator benchmarks were achieved for timely follow-up of referrals and appropriate medication prescriptions as per clinical guidelines for all medications except mineralocorticoid receptor antagonists.

5 Cardiac Outreach Spotlight

The development and implementation of the QCOR Cardiac Outreach module is an initiative of the Statewide Cardiac Clinical Network in partnership with the Healthcare Improvement Unit and the Health Minister's 'Rapid Results Program'.

People living in rural and remote locations (such as North Queensland) and Aboriginal and Torres Strait Islander people are admitted to hospital for cardiac related conditions at two to three times the rate of the broader Queensland population*. Equitable access to health care across Queensland can be a challenge due to its vast size and dispersed population, which can require patients to travel significant distances to access cardiac care. Furthermore, due to the vast distances this patient cohort need to travel to access tertiary care, their healthcare journey is often fragmented contributing to poorer access and health outcomes. The foundation of this model is based on a coordinated approach which supports the patient journey by linking to services. Through the outreach model, patients in a remote setting can access support from a team of practitioners much closer to home including a specialist cardiologist, cardiac scientists, nurses and health workers.

As well as seeing a cardiologist for initial consultation, review or follow-up, patients attending a cardiac outreach clinic can have specialised tests such as echocardiograms and stress tests, as well as the potential for referral to tertiary care for more complex procedures. Close links with other Queensland Health outpatient services such as cardiac rehabilitation programs or heart failure support services are also an advantage of this model of care. These services are further supplemented by telehealth and remote cardiac testing capabilities.

Through 2018–2019, the SCCIU and Rapid Results Program collaborated with staff and subject matter experts across the various Queensland Health cardiac outreach units to develop a new QCOR module specifically oriented towards this work. The new QCOR Outreach Module establishes a foundation for cardiac outreach care coordination across the health system, and a reporting platform which allows an unprecedented amount of information to be available for an area otherwise characterised by relative paucity of data.

The QCOR Outreach Module provides Queensland Health practitioners with:

- Patient-centric clinical case management – tailored towards the outreach setting,
- Improved follow up and activity-based reporting for outreach patients and services,
- Reporting of outreach-specialty clinical indicators and other key performance measures, and
- Potential for future integration with other Queensland Health and QCOR systems.

The new QCOR Outreach Module was deployed from 2019 as part of a staggered rollout, with the Far North Queensland Outreach Unit as the first site commencing in November 2019. Further units have been added to the system over the following year as either new outreach programs are established or existing services transition to the system.

Table 1: QCOR cardiac outreach module – participating outreach units

Cardiac outreach unit	Hub facility	Commenced date
Far North Queensland Cardiac Outreach	Cairns Hospital	November 2019
Townsville and North West Queensland Cardiac Outreach	Townsville University Hospital	January 2020
Princess Alexandra Hospital Cardiac Outreach	Princess Alexandra Hospital	July 2020
Toowoomba Hospital Cardiac Outreach	Toowoomba Hospital	August 2020
Ipswich Hospital Cardiac Outreach	Ipswich Hospital	November 2020

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

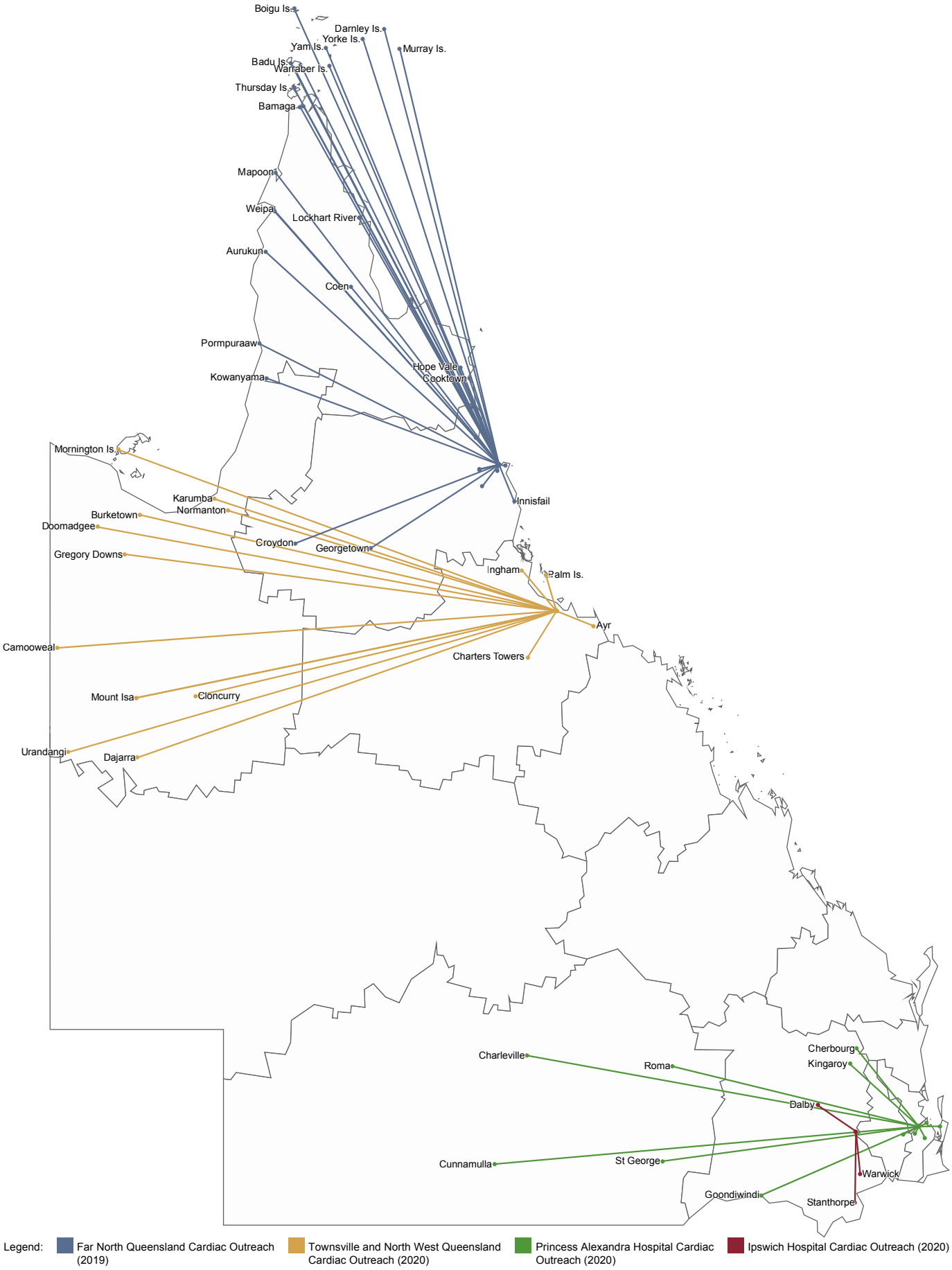


Figure 3: Cardiac outreach hub and spoke locations

6 ECG Flash Spotlight

ECG Flash, a Statewide Cardiac Clinical Network initiative, aims to give rural and remote clinicians 24/7 access to urgent specialist cardiology advice. When a patient presents at emergency and an ECG is taken, the system lets clinicians send time critical, difficult-to-interpret ECGs straight to an on call cardiologist for rapid analysis. The on call cardiologist receives a digital copy of the ECG to review and will call the treating clinician back to provide treatment advice. ECG Flash has been implemented to use a hub and spoke model of care where larger facilities with specialist staff cardiologists act as the hub to smaller regional and remote centres.

Regional and remote sites (spoke sites) use a digitally enabled ECG cart which automatically transmits all ECGs taken to an enterprise clinical data storage application. This digital storage solution for ECGs is available at each site and from there clinicians can selectively transmit time critical, difficult-to-interpret ECGs directly to the on call cardiologist at their referring tertiary hospital (hub site). They are also able to access ECGs taken at other participating hospitals within their HHS, allowing them to have access to patients' ECGs across multiple facilities.

In 2019, there were 30 rural sites utilising the ECG Flash solution and they sent 252 ECGs through to five receiving cardiology departments.

Implementation at an additional 51 rural sites and 3 hub sites is planned for 2020. Further use of ECG Flash data to complement existing QCOR data collections will be the focus for future work.

Table 2: ECG Flash – participating hub sites

ECG Flash hub	Commenced date	Number of spoke sites 2019	Number of spoke sites 2020
Princess Alexandra Hospital	August 2018	9	9
Cairns Hospital	September 2018	10	19
Mackay Base Hospital	February 2019	7	7
Townsville University Hospital	June 2019	4	6
Bundaberg Hospital	February 2020	–	8

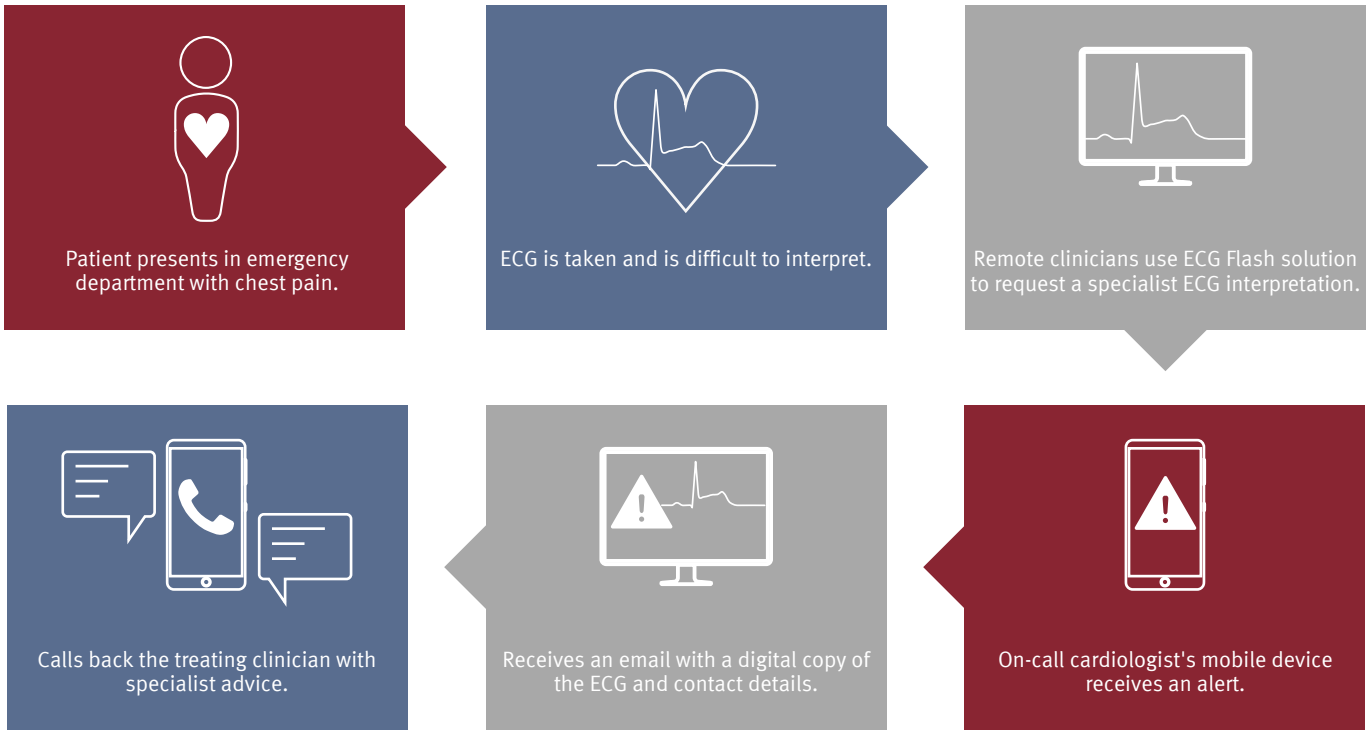


Figure 4: ECG Flash process flow

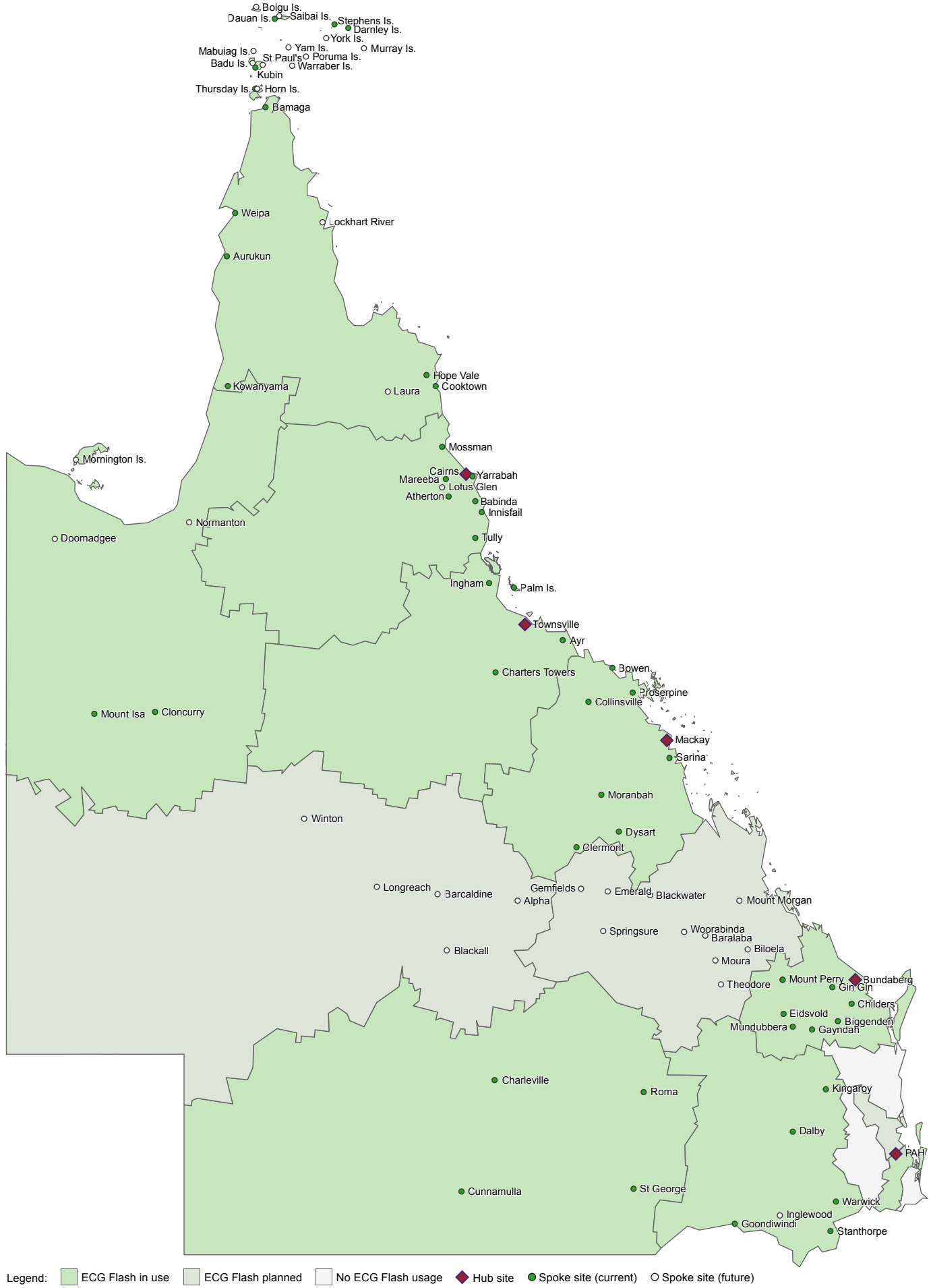


Figure 5: ECG Flash hub and spoke locations as at November 2020

7 RHD Spotlight

7.1 Background

The Queensland rheumatic heart disease register and control program (RHD Program) was established in 2009 to address rheumatic heart disease (RHD) as the leading cause of cardiovascular disparity between Aboriginal and Torres Strait Islander peoples and Australians of other descent. The program supports existing healthcare services with client care by maintaining a skilled health workforce, promoting culturally appropriate care, supporting education and health promotion for patients and communities, and working with patients and primary health care staff to optimise timely delivery of secondary prophylaxis.

The program further advocates for and supports activities aimed at preventing, identifying, managing and treating acute rheumatic fever (ARF) and RHD, and promotes primordial, primary and secondary prevention aimed at preventing initial episodes of ARF and development of RHD. This includes the development and distribution of ARF/RHD education and health promotion-focused resources such as client and family educational material to improve health literacy, and information on diversionary therapy aids and reward/incentive products.

Additional strategies are being undertaken to enhance the quality of support the program provides including, creation and distribution of reports for outreach clinics, HHS, service providers and health service planning managers. Individual client information and clinical advice is being provided to healthcare providers including, diagnostic criteria, notification process, treatment and follow-up requirements (point of care information).

The World Health Organization recommends a coordinated, public health approach in areas where there are substantial populations with ARF or RHD. The Australian Guideline for prevention, diagnosis and management of ARF and RHD (3rd edition)* states that 'Comprehensive RHD control programs which span action in the social and environmental determinants of health and primary and secondary prevention of ARF, can provide an effective approach to reducing the burden of RHD.' It is with this structure and suggested methodology that the Queensland RHD Program has been established.

7.2 The disease

ARF is an acute illness causing a generalised, autoimmune inflammatory response following repeated exposure to and infection with Group A Streptococcal bacteria. The inflammatory response occurs predominantly in the heart, joints, brain and skin. Clients typically present with a history of a sore throat and/or infected skin sores, pain and swelling in one or more joints, fever, malaise, a skin rash, chorea (jerky, uncoordinated movements of the hands, feet, tongue and face) and sometimes chest pain. Clinical investigations may identify prolonged atrioventricular junctional arrhythmias on an electrocardiogram, a heart murmur or carditis.

Once the initial acute illness has resolved, ARF leaves no lasting damage to the joints or skin however, any remaining damage to the brain can cause ongoing mental health and neurological issues. Similarly, anatomical changes occur affecting the heart valves with the ensuing clinical sequalae known as RHD. Repeated episodes of ARF inevitably lead to the development or worsening of RHD.

Severe RHD usually requires surgical intervention in the form of valve repair and/or replacement. Individuals receiving mechanical valves require lifelong anticoagulation. Every year, RHD kills people and devastates lives, particularly those of young Aboriginal and Torres Strait Islander Queenslanders. The disease process begins with symptoms as modest as a sore throat or skin infection which can be easily treated with common antibiotics, however if left untreated, it can lead to stroke and valve disease requiring cardiac surgery, often in an adolescent population. Efforts to prevent ARF and RHD currently centre on primary prevention (of the sore throat or skin infection), and secondary prevention via delivery of secondary prophylactic antibiotics to prevent recurrent episodes.

7.3 Disease demographics

Across Australia, sustained improvements to the conditions in which we are born, grow, live and work have permanently reduced the rates of preventable infectious diseases. Unfortunately, this progress is inequitable and Aboriginal and Torres Strait Islander people have not benefitted from the same improvements in health and living outcomes as the rest of Australia. Household disadvantage, poor-quality living conditions, poverty and overcrowding all contribute to health inequalities in at-risk populations.

ARF and RHD are diseases that exemplify the 'gap' between Aboriginal and Torres Strait Islander peoples and Australians of other descent. In 2017, there was a rate of 111 ARF cases per 100,000 Aboriginal and Torres Strait Islander Australians whereas for Australians of other descent the rate was 1 per 100,000. (Australian Institute of Health and Welfare (AIHW) 2019).† Between the ages of 5 years to 24 years, Aboriginal and Torres Strait Islander peoples are three times more likely to die from RHD than Australians of other descent.

7.4 The costs of ARF and RHD

Eliminating RHD means preventing all new cases of ARF. Preventing ARF is as simple as early diagnosis and treatment of a Streptococcal infection. This cost is negligible in comparison to the long term management of what would become chronic disease.

ARF and RHD contribute to increased death and disability in Queensland. RHD accrues early in life, with 20% of people on the Queensland RHD Register under 18 years of age and 26% of all ARF and RHD clients having had or will require valvular surgery.

The estimated financial costs of ARF and RHD diagnosis and management are outlined in Table 1.‡

Table 3: Costs of diagnosis and management of ARF and RHD

	Child $	Adult $
Management of Acute disease requiring hospitalisation		
ARF – Inpatient	12,075	12,912
RHD – Non-Surgical	11,798	9,787
RHD – Surgical	74,915	72,042
ARF/RHD Management (per year)		
ARF with/without mild RHD	2,048	2,048
Severe RHD	3,920	3,920

7.5 Disease prevention

Interventions to eradicate ARF and RHD in Australia require strategies that target the underlying economic, social and environmental conditions. These are structural and health system considerations that include moving away from a silo-based culture and transitioning towards functional multiagency, multidisciplinary teams. By actioning disparities in the environmental, social, cultural and economic determinants of health, primary and secondary prevention strategies for ARF and RHD can be developed. These then lend themselves to effective tertiary care which provides clients with high-quality medical and surgical management of their RHD.

* RHD Australia (ARF/RHD writing group) (2020). *The 2020 Australian guideline for prevention, diagnosis and management of acute rheumatic fever and rheumatic heart disease* (3rd edition). Retrieved from https://www.rhdaustralia.org.au/arf-rhd-guideline

† Australian Institute of Health and Welfare (2020). *Acute rheumatic fever and rheumatic heart disease in Australia, 2014–2018.* Retrieved from https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/acute-rheumatic-fever/contents/summary

‡ Wyber, R., Noonan, K., Halkon, C., Enkel, S., Ralph, A., … Carapetis, J. (2020.). *The RHD Endgame Strategy: A Snapshot. The blueprint to eliminate rheumatic heart disease in Australia by 2031*. Perth: The END RHD Centre of Research Excellence, Telethon Kids Institute

7.6 Queensland RHD Program and QCOR

In September 2018, RHD became a notifiable condition in Queensland. Since April 2019, QCOR and the RHD program have collaborated to enhance the reporting of all RHD-identified echocardiograms to the RHD register for Cairns, Townsville, Mackay and Rockhampton hospitals. Interaction between the RHD Register and QCOR acts as a supporting notification mechanism, assisting to identify those patients who have not previously been or were escalated for notification of RHD at the time of their clinical encounter.

Through QCOR, reporting of positive RHD findings by echocardiography has resulted in 172 previously unknown clients with RHD being added to the Register.

Table 4: QCOR echocardiography module RHD notifications

	Positive RHD findings n	Unknown RHD clients identified n
Cairns	494	66
Townsville	150	62
Mackay	47	26
Rockhampton	28	18
Total	**719**	**172**

Through the QCOR cardiac surgery RHD notification reports, seven previously unknown clients requiring surgery for their RHD have been added to the RHD register since October 2019.

Table 5: QCOR cardiac surgery module RHD notifications

	Positive RHD findings n	Unknown RHD clients identified n
Statewide cardiac surgery	14	7

8 Facility profiles

8.1 Cairns Hospital

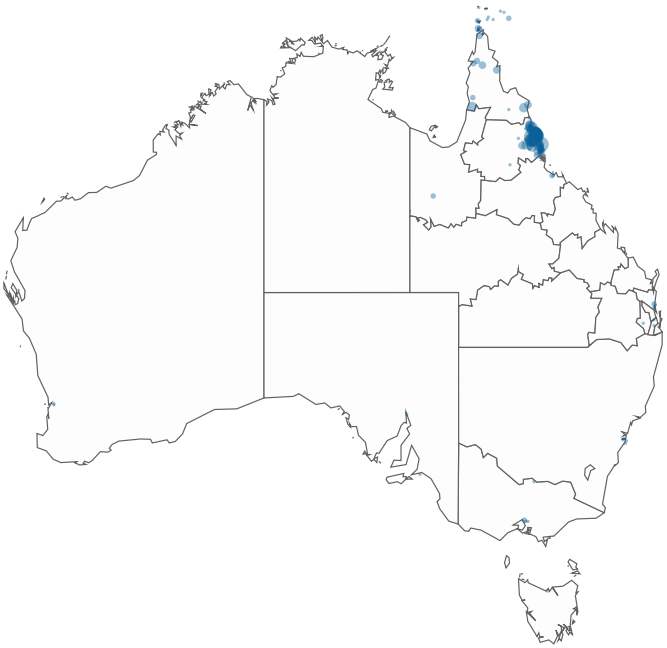


Figure 6: Cairns Hospital

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

8.2 Townsville University Hospital

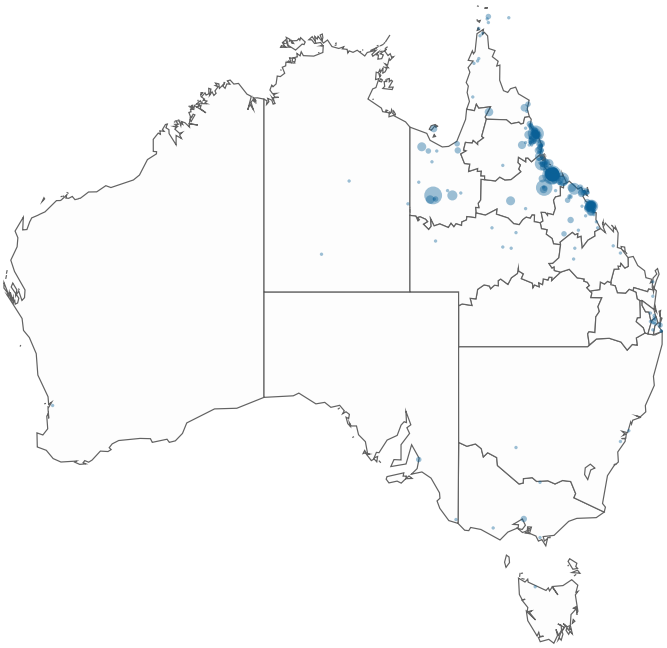


Figure 7: Townsville University Hospital

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

8.3 Mackay Base Hospital

Figure 8: Mackay Base Hospital

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

8.4 Sunshine Coast University Hospital

Figure 9: Sunshine Coast University Hospital

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

8.5 The Prince Charles Hospital

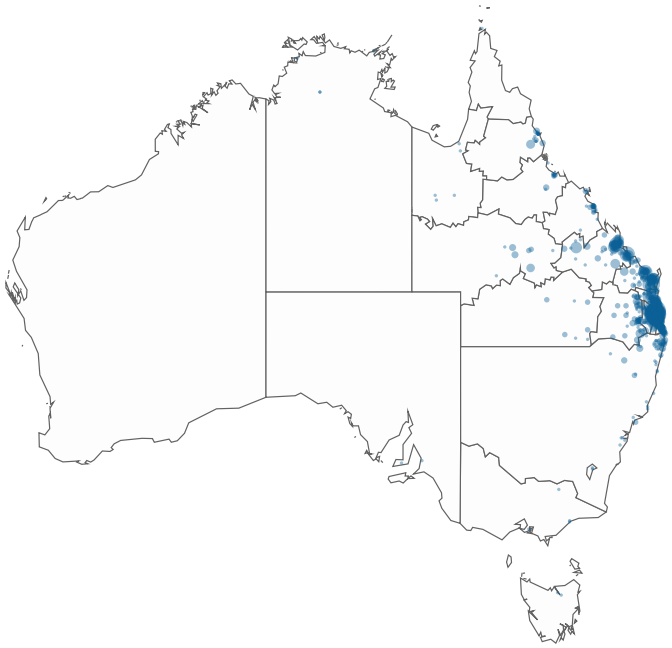


Figure 10: The Prince Charles Hospital

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

8.6 Royal Brisbane & Women's Hospital

Figure 11: Royal Brisbane & Women's Hospital

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

8.7 Princess Alexandra Hospital

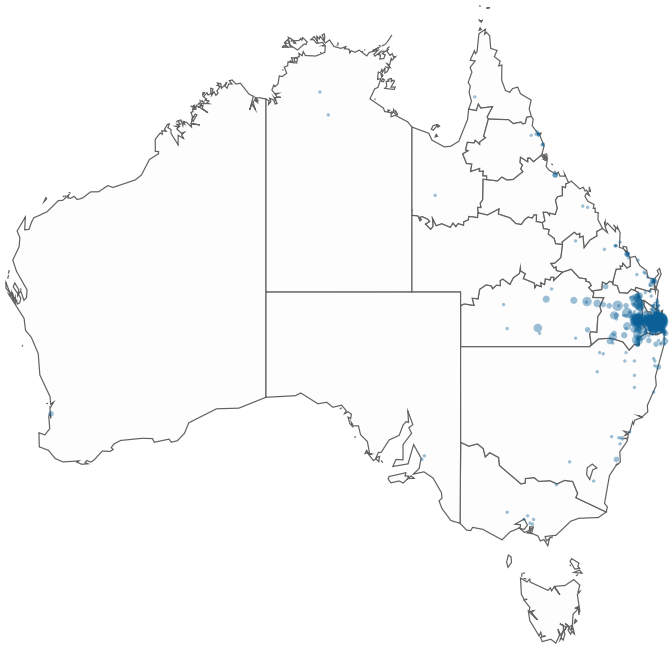


Figure 12: Princess Alexandra Hospital

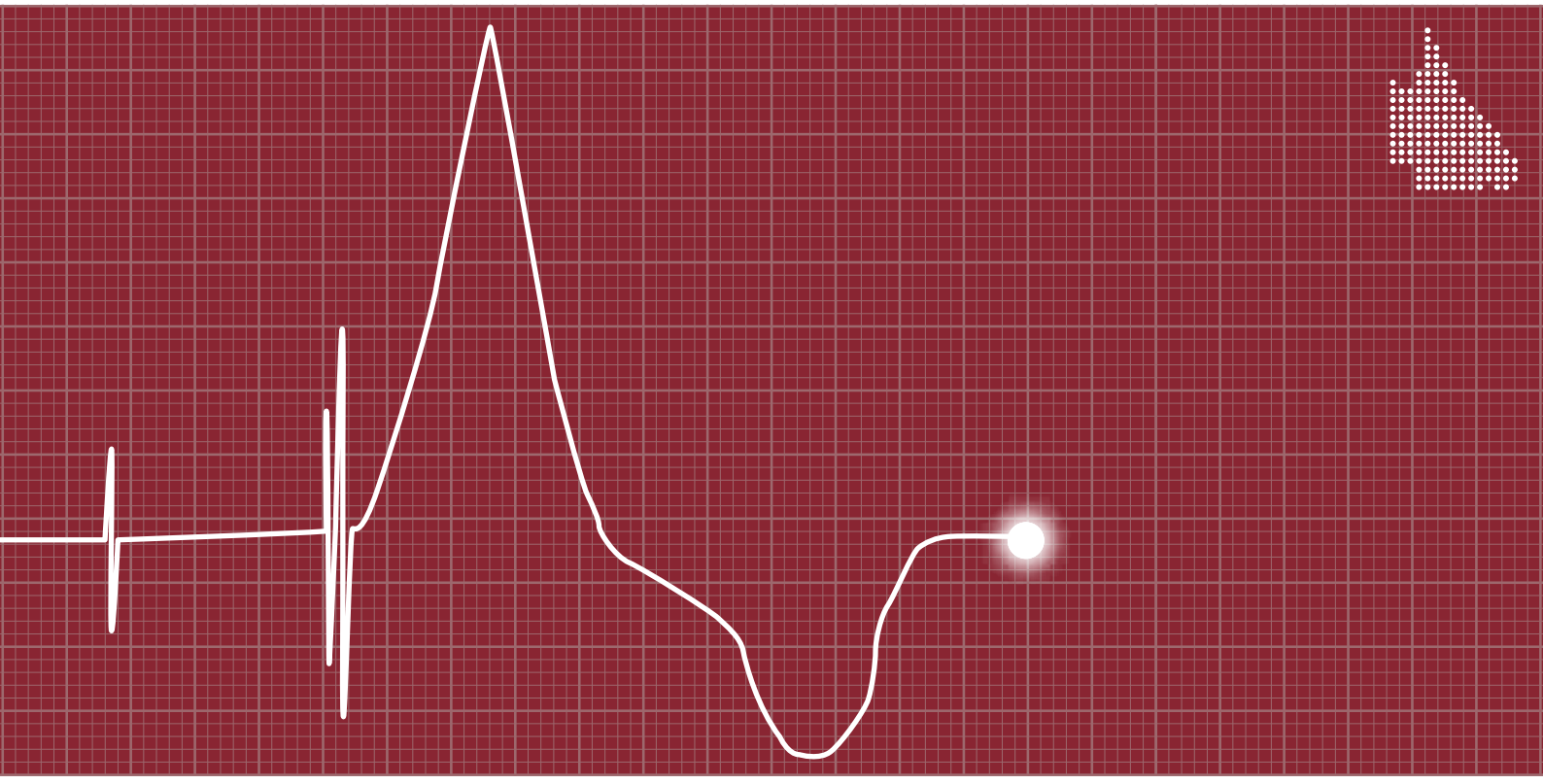
- Referral hospital for Metro South and South West Hospital and Health Services, serving a population of approximately 1,000,000
- Public tertiary level invasive cardiac services provided at the Princess Alexandra Hospital include:
  - Coronary angiography
  - Percutaneous coronary intervention
  - Structural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

8.8 Gold Coast University Hospital

Figure 13: Gold Coast University Hospital

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

Electrophysiology and Pacing Audit



1 Introduction

This 2019 QCOR Electrophysiology and Pacing Audit builds on the foundations of work performed in earlier years to document the activity and quality of electrophysiology and pacing work performed across the state. The content of this report relates to procedures and interventions that ultimately enhance the quality of life and reduce the burden of disease for the community. It seeks to examine the experience of Queenslanders who undergo these procedures and ensure that public hospital electrophysiology and pacing services are functioning safely.

The report characterises the patients that have been treated, the often complex and chronic diseases they face, and the procedures they have had. Sometimes these are multiple, owing to the nature of the pathology and status of the patient. As the background population continues to age and the incidence of cardiovascular diseases such as atrial fibrillation and heart failure, so too does the need for more complex treatment and a highly trained and specialised workforce. Commensurate with this increase in procedural complexity is an increase in time taken to complete this work, which negatively affects wait times. Again, it is noted that long wait times point to clear deficiencies in service provision, and these are often longstanding and increasing. Without further resources to attempt to alleviate these confounding issues, case volumes will likely continue to stay steady with services at saturation point.

QCOR data has again assisted with securing competitive market arrangements for implantable devices with the effect of ensuring all funding for these invaluable services is spent in the most efficacious way possible. Further processes of this kind are hoped to expand on this work.

As the QCOR dataset continues to increase in size and scope, so too does the ability to follow patient cohorts over time and investigate their interactions with the health care system. Intra-registry linkage with other QCOR data collections presents opportunities, especially in the heart failure cohort. Further work will enhance the breadth of reporting and quality assurance activities that is possible from this dataset. The efforts of clinicians in compiling this quality data must be acknowledged.

On behalf of the
QCOR Electrophysiology and Pacing Committee

2 Key findings

This Electrophysiology and Pacing Audit describes baseline demographics, risk factors, procedures performed and outcomes for 2019.

Key findings include:

- Across Queensland, nine public sites contributed to the registry with eight sites contributing a complete year of data. Toowoomba Hospital began direct data entry in November 2019.
- Of the 4,654 electrophysiology and pacing cases, 3,189 were device procedures and 1,058 were electrophysiology procedures.
- The majority of all patients were aged over 60 years (70%) with a median age of 69 years.
- The overall proportion of Aboriginal and Torres Strait Islander patients was 3.9%.
- The vast majority of patients (73%) were classed as having an unhealthy body mass index (BMI) of greater than 30 kg/m^2.
- High-urgency procedures that are clinically indicated within 30 days accounted for the majority of procedures (57%).
- Outpatient procedures accounted for 53% of all cases.
- Complex electrophysiology procedures which utilise three-dimensional mapping technology involve pulmonary vein isolation or ventricular arrhythmias, and accounted for 64% of this case cohort.
- Radiofrequency ablation was the energy source utilised in the vast majority of ablation cases (88%).
- Atrial flutter, pulmonary vein isolation (atrial fibrillation) and atrioventricular node re-entry tachycardia ablations accounted for 72% of all ablation cases.
- The reported complication rate for all device procedures was 1.3%, while electrophysiology procedures had a 1.1% complication rate.
- The statewide median wait time for complex ablation was 65 days with 79% of cases meeting the 180 day benchmark.
- There was a 0.3% procedural tamponade rate reported for all cases.
- The 12 month device system loss rate due to infection was 0.7%.

3 Participating sites

There were nine public electrophysiology and pacing units spread across Metropolitan and regional Queensland. Eight of these entered data directly into the Queensland Cardiac Outcomes Registry (QCOR) electrophysiology and pacing application. The ninth site, Toowoomba Hospital, began direct entry in November 2019.

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

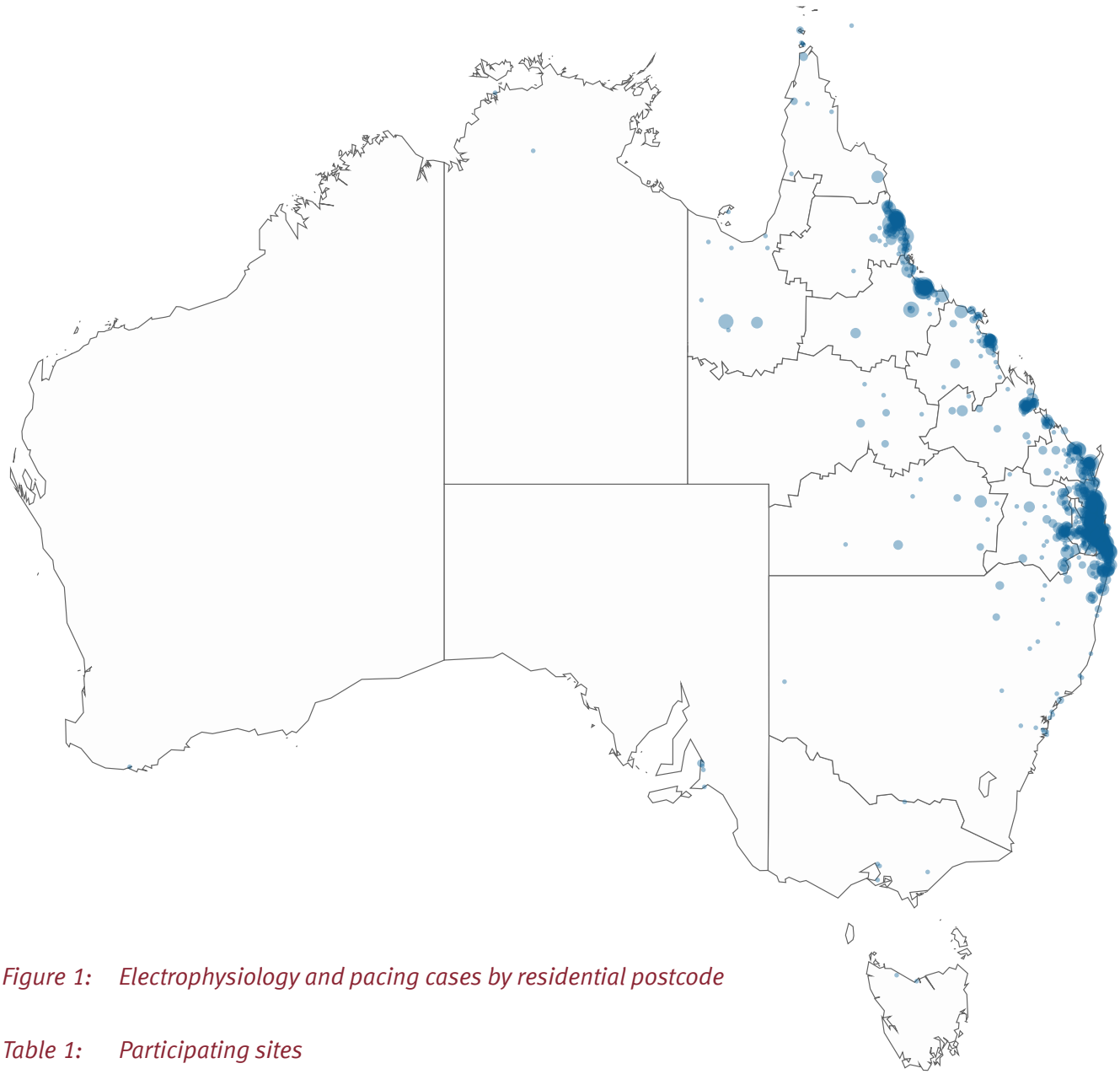


Figure 1: Electrophysiology and pacing cases by residential postcode

Table 1: Participating sites

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

Toowoomba Hospital commenced data entry 6 November 2019

Figure 2: Cairns Hospital

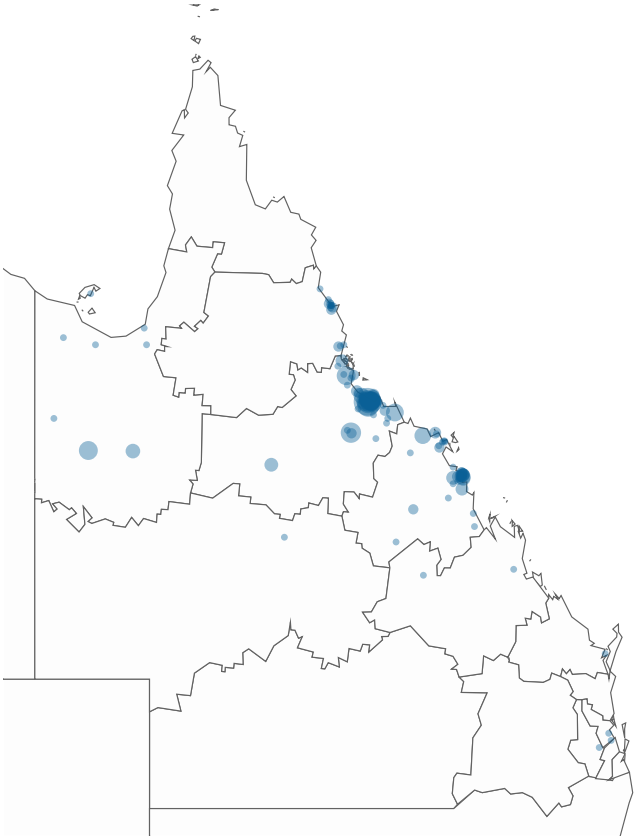


Figure 3: Townsville University Hospital

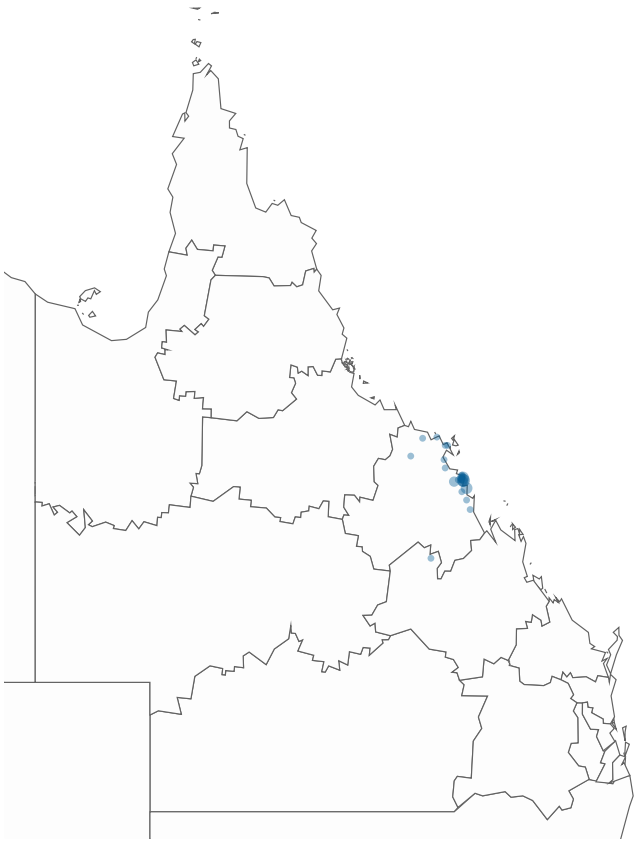


Figure 4: Mackay Base Hospital

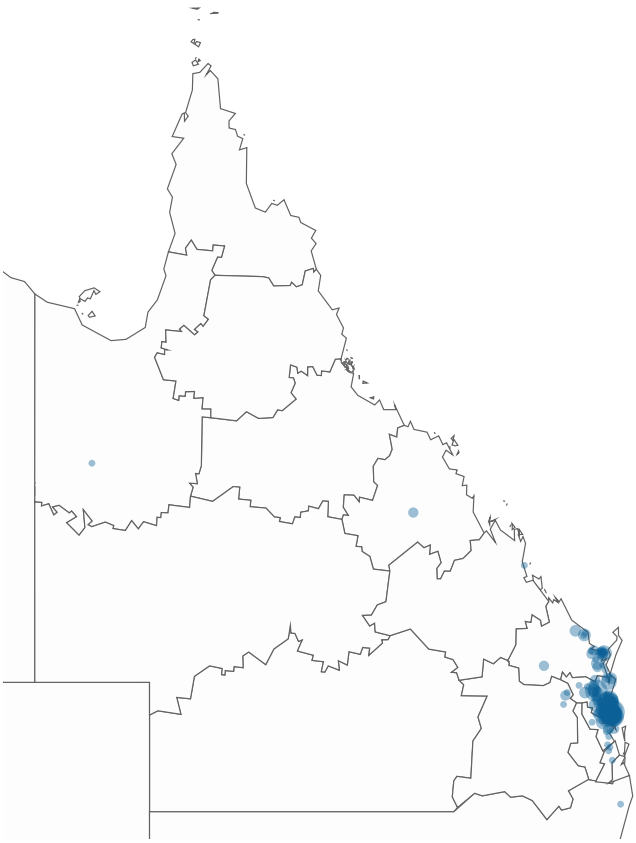


Figure 5: Sunshine Coast University Hospital

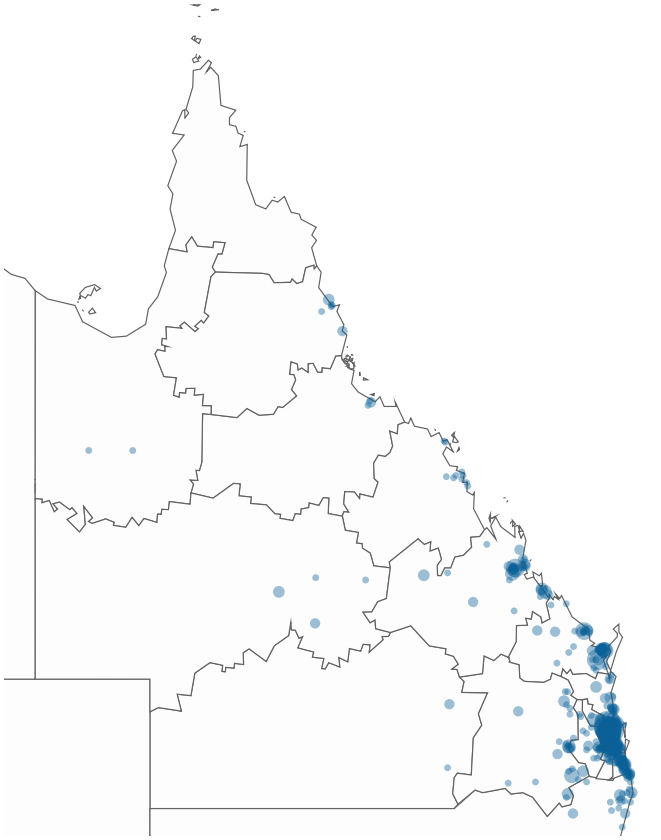


Figure 6: The Prince Charles Hospital

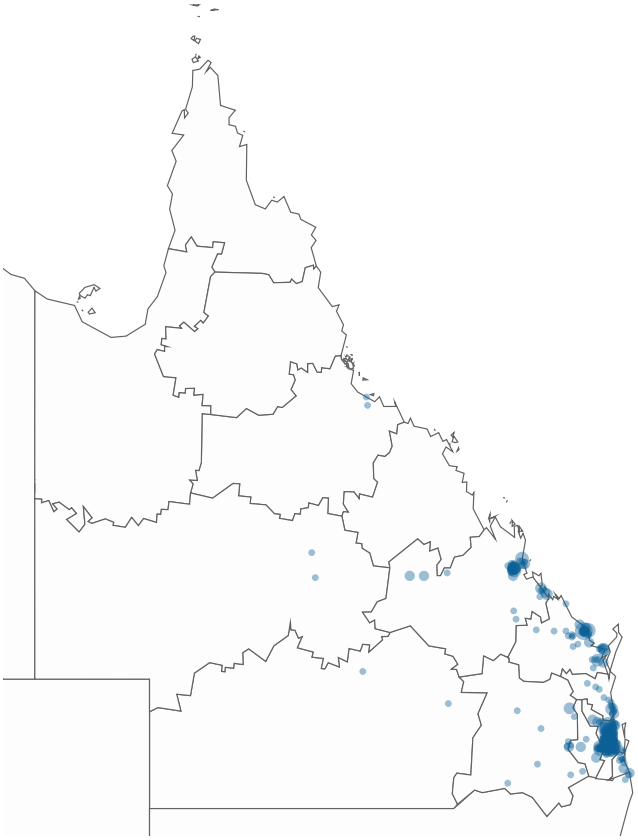


Figure 7: Royal Brisbane & Women's Hospital

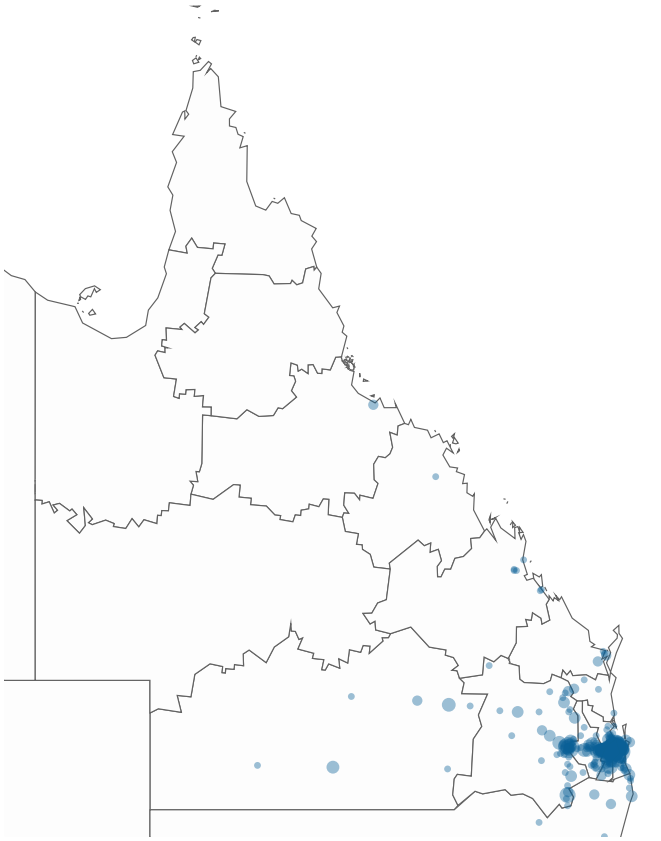


Figure 8: Princess Alexandra Hospital

Figure 9: Gold Coast University Hospital

4 Case totals

4.1 Case volume

There were 4,654 electrophysiology and pacing procedures documented using the QCOR electrophysiology and pacing application.

Table 2: Total cases by category

Procedure combination	Category	Total cases n (%)
Cardiac device procedure	Device	3,146 (67.6)
Cardiac device procedure + EP study		19 (0.4)
Cardiac device procedure + other procedure		15 (0.3)
Cardiac device procedure + EP study + ablation		4 (0.1)
Cardiac device procedure + cardioversion		3 (0.1)
Cardiac device procedure + drug challenge		1 (<0.1)
Cardiac device procedure + EP study + drug challenge		1 (<0.1)
EP study + ablation	EP	866 (18.6)
EP study		136 (2.9)
EP study + ablation + cardioversion		38 (0.8)
EP study + drug challenge		6 (0.1)
EP study + cardioversion		5 (0.1)
EP study + ablation + other procedure		4 (0.1)
EP study + ablation + cardioversion + other procedure		2 (<0.1)
EP study + other procedure		1 (<0.1)
Cardioversion	Other	360 (7.7)
Other procedure		24 (0.5)
Drug challenge		21 (0.5)
Cardioversion + other procedure		2 (<0.1)
ALL		**4,654 (100.0)**

Case totals do not reflect all activity due to incomplete year of data acquisition

4.2 Cases by category

The majority of cases performed were cardiac device procedures accounting for over two thirds (69%) of documented procedures. The remainder of cases were electrophysiology and ablation procedures (23%), with the remainder categorised as 'other' procedures (9%).

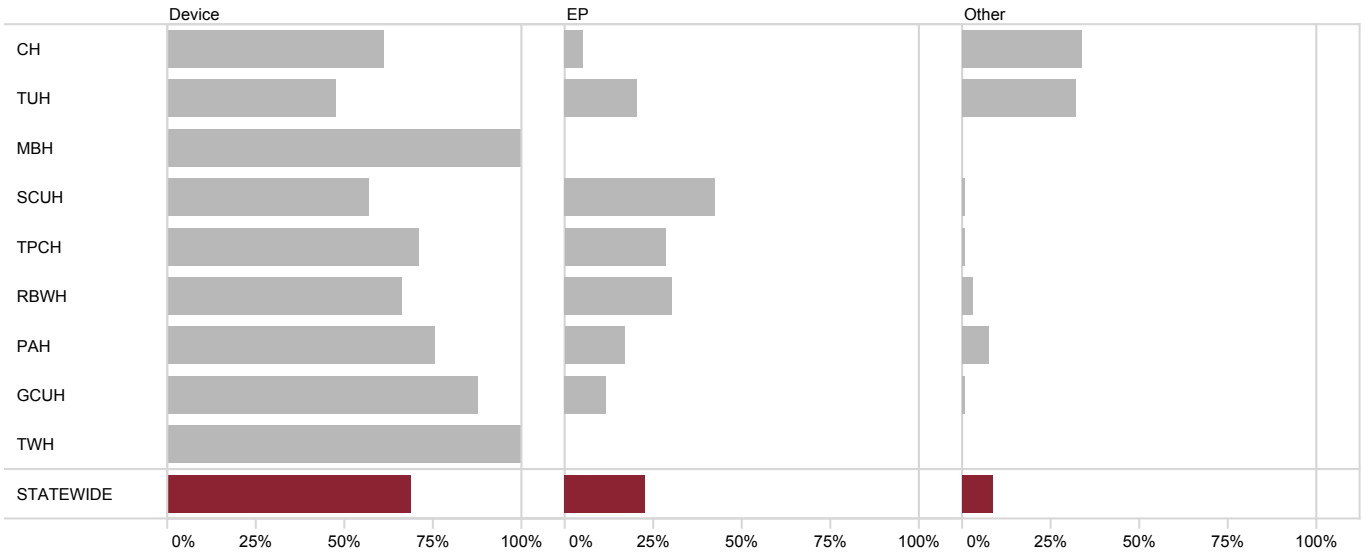


Figure 10: Proportion of cases by site and category

Table 3: Cases by case category

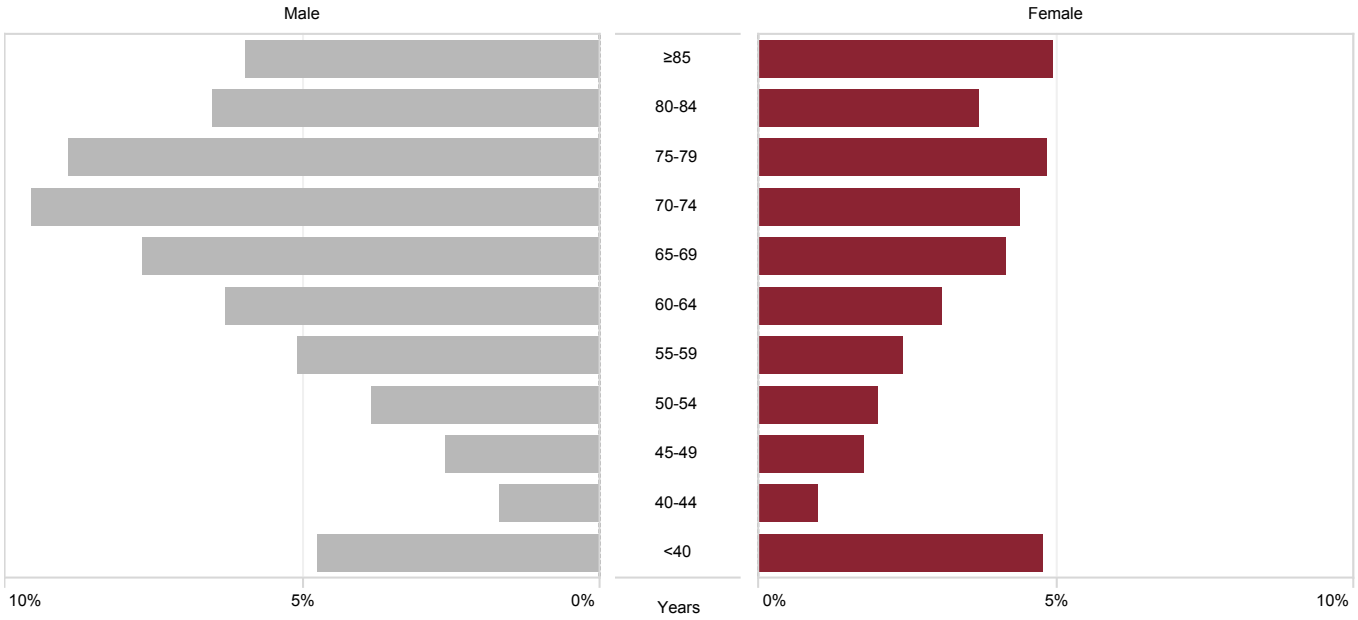
Site	Device n (%)	EP n (%)	Other n (%)	Total n (%)
CH	257 (8.1)	21 (2.0)	143 (35.1)	421 (9.0)
TUH	248 (7.8)	105 (9.9)	168 (41.3)	522 (11.2)
MBH	37 (1.2)	–	–	37 (0.8)
SCUH	305 (9.6)	227 (21.5)	4 (1.0)	536 (11.5)
TPCH	839 (26.3)	336 (31.8)	7 (1.7)	1182 (25.4)
RBWH	342 (10.7)	156 (14.7)	16 (3.9)	514 (11.0)
PAH	672 (21.1)	150 (14.2)	68 (16.7)	890 (19.1)
TWH	8 (0.3)	–	–	8 (0.2)
GCUH	481 (15.1)	63 (6.0)	1 (0.2)	545 (11.7)
STATEWIDE	**3,189 (68.5)**	**1,058 (22.7)**	**407 (8.8)**	**4,654 (100.0)**

5 Patient characteristics

5.1 Age and gender

Age is an important risk factor for developing cardiovascular disease. The majority of patients were aged 60 years and above (70%). The median age of the overall electrophysiology and pacing patient cohort was 69 years of age.

The median age of males and females was 69 years. Patient age differed greatly by procedure category with the median age of patients undergoing electrophysiology procedures being 58 years compared to 73 years for cardiac device procedures.



% of total (n=4,654)

Figure 11: Proportion of all cases by age group and gender

Table 4: Median age by gender and case category

	Total cases n	Male years	Female years	ALL years
Device	3,189	72	74	73
EP	1,058	60	54	58
Other	407	64	69	66
ALL	**4,654**	**69**	**69**	**69**

Overall, 63% of patients were male with a similar distribution across all procedure categories. The largest proportion of females was represented in the electrophysiology category (43%).

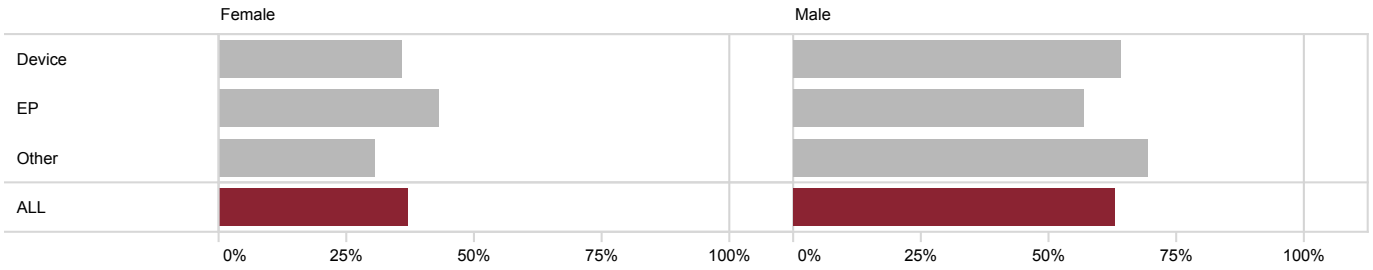


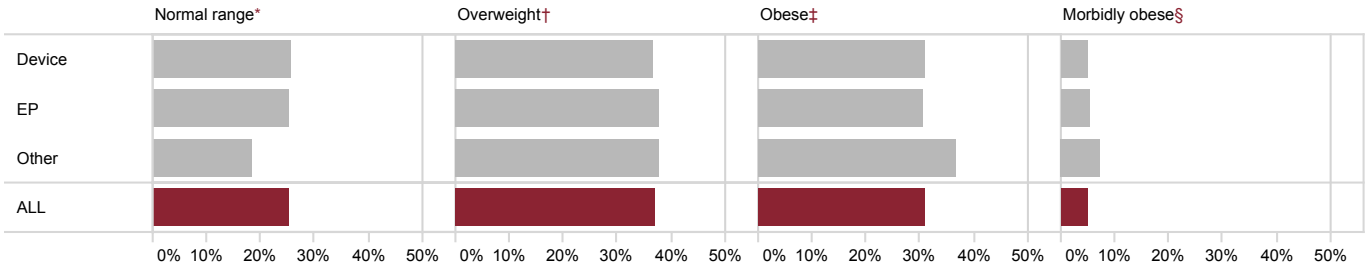
Figure 12: Proportion of cases by gender and category

Table 5: Proportion of cases by gender and category

	Total cases n	Male n (%)	Female n (%)
Device	3,189	2,040 (64.0)	1,149 (36.0)
EP	1,058	603 (57.0)	455 (43.0)
Other	407	282 (69.3)	125 (30.7)
ALL	**4,654**	**2,925 (62.8)**	**1,729 (37.2)**

5.2 Body mass index

Patients classed as having a body mass index (BMI) category of overweight (37%), obese (31%) or morbidly obese (5%) represented almost three quarters of all electrophysiology and pacing patients. Patients classed as underweight represented 2% of all cases.



* BMI 18.5–24.9 kg/m^2

† BMI 25.0–29.9 kg/m^2

‡ BMI 30.0–39.9 kg/m^2

§ BMI ≥40.0 kg/m^2

Figure 13: Proportion of cases by BMI and case category

5.3 Aboriginal and Torres Strait Islander status

Overall, the proportion of identified Aboriginal and Torres Strait Islander patients undergoing electrophysiology and pacing procedures was 3.9%. This correlates closely to the estimated proportion of Aboriginal and Torres Strait Islander peoples within Queensland (4.6%).[2] There was large variation between units, with the North Queensland sites seeing a larger proportion of Aboriginal and Torres Strait Islander patients (Figure 14).

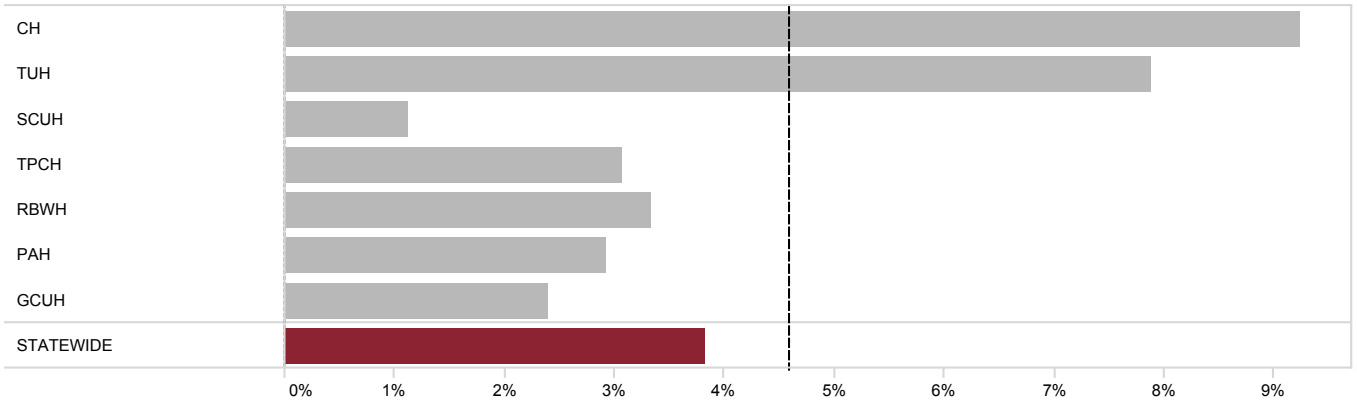


Figure 14: Proportion of cases by identified Aboriginal and Torres Strait Islander status and site

6 Risk factors and comorbidities

Heart rhythm disorders can affect any individual, though they are more commonly developed in those who have other cardiac disease. Risk factors that may increase an individual's likelihood of developing a heart rhythm disorder are outlined below. Hypertension and a history of atrial arrhythmia are the most common comorbidities documented. There are also notable differences between some risk factors and comorbidities within the device and EP categories.

Table 6: Risk factor incidence by case category

	Device %	EP %	Other %	All %
Anticoagulation	22.3	28.3	28.5	24.1
Atrial arrhythmia history	26.3	31.9	31.5	28.0
Coronary artery disease	26.7	13.9	6.1	22.0
Diabetes	18.9	8.0	3.9	15.1
Dyslipidaemia	31.8	16.8	13.3	26.8
Family history of sudden cardiac death	4.1	2.9	2.7	3.7
Heart failure	12.9	5.7	8.4	10.8
Hypertension	43.5	25.1	16.2	37.0
Other cardiovascular disease or co-morbidity	4.1	3.2	3.9	3.9
Smoking history	27.9	22.2	10.4	25.1
Valvular heart disease	18.2	10.7	8.6	15.7

7 Care and treatment of patients

7.1 Urgency category

Urgency categories are based on the time frame which the procedure is clinically indicated. Categorisation is judged by the individual treating clinician.

Across the state, category one cases formed the majority of procedures undertaken. Urgency category ranged widely between sites with category one cases varying from 37% to 100%. Further disparity was noted within category three, with these cases accounting for 1% to 36% of case volumes by site.

Table 7: Proportion of all cases by urgency category and site

	Total cases n	Category 1* n (%)	Category 2† n (%)	Category 3‡ n (%)
CH	421	332 (78.9)	72 (17.1)	6 (1.4)
TUH	521	193 (37.0)	62 (11.9)	6 (1.2)
MBH	37	16 (43.2)	19 (51.4)	2 (5.4)
SCUH	536	176 (32.8)	199 (37.1)	111 (20.7)
TPCH	1,182	812 (68.7)	284 (24.0)	84 (7.1)
RBWH	514	238 (46.3)	92 (17.9)	184 (35.8)
PAH	890	403 (45.3)	345 (38.8)	140 (15.7)
TWH	8	8 (100.0)	–	–
GCUH	545	458 (84.0)	70 (12.8)	15 (2.8)
STATEWIDE	**4,654**	**2,636 (56.6)**	**1,143 (24.6)**	**548 (11.8)**

Includes missing data 7.1%

* Procedures that are clinically indicated within 30 days

† Procedures that are clinically indicated within 90 days

‡ Procedures that are clinically indicated within 365 days

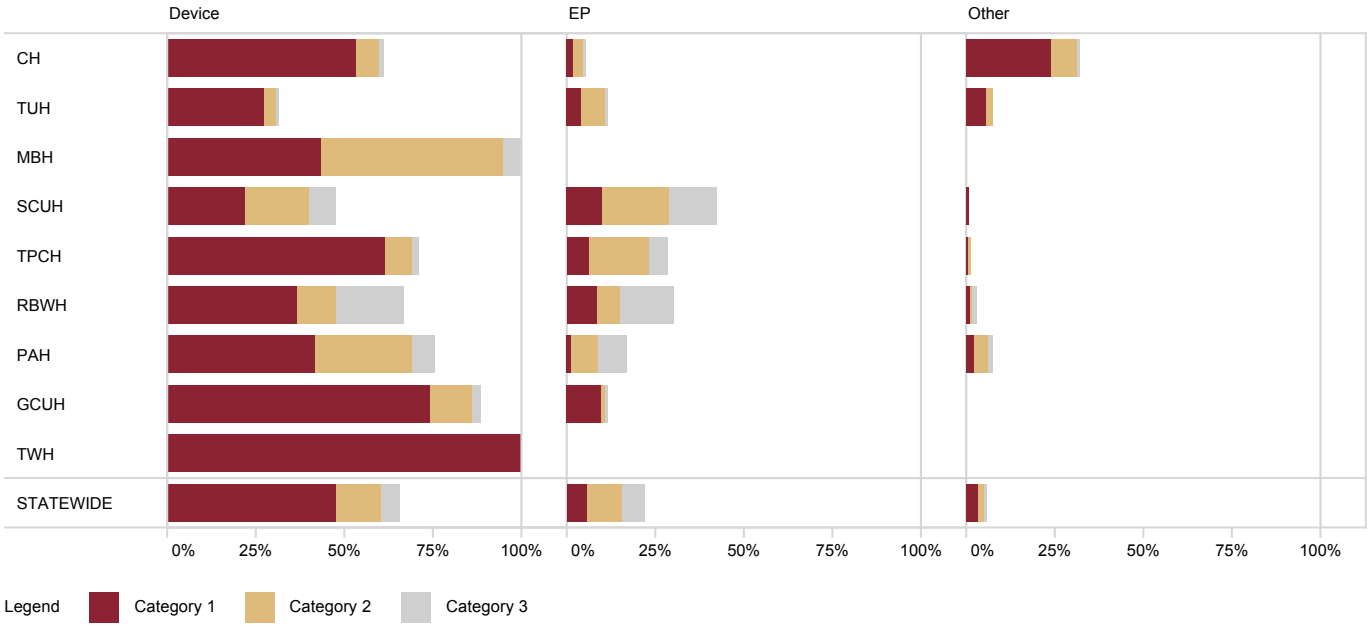
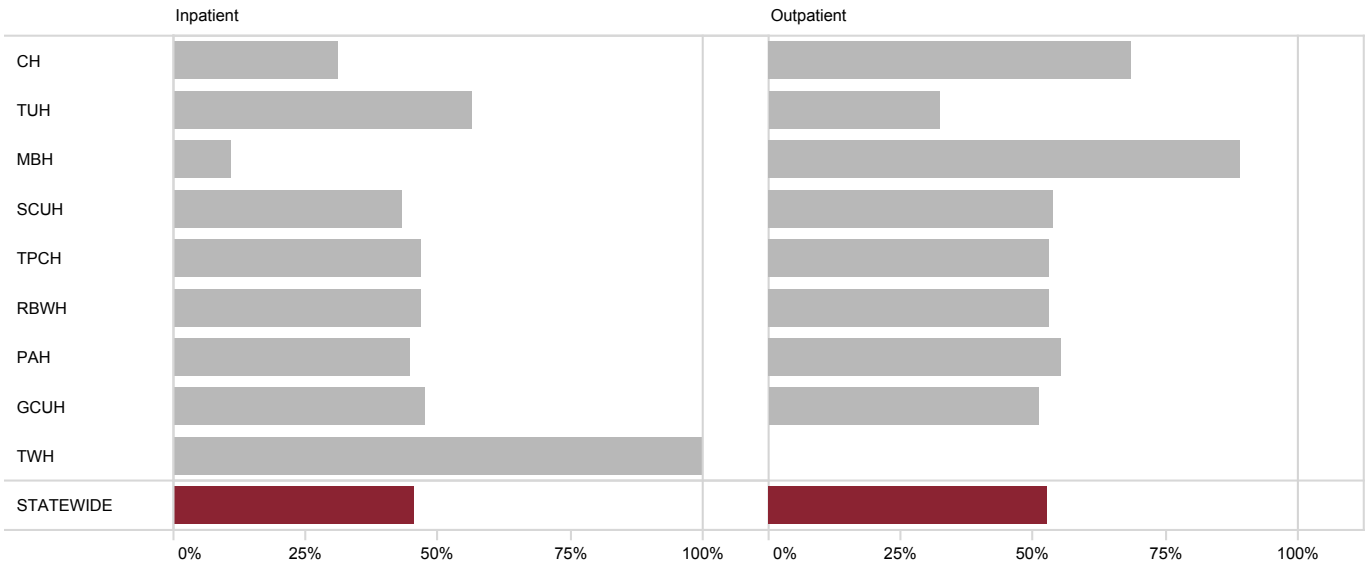


Figure 15: Proportion of all cases by urgency category, procedure category and site

7.2 Admission source

The majority of all cases were performed on patients classed as outpatients (53%). Inpatient cases accounted for 45% of cases and non-admitted, interhospital transfers made up less than 1% of all case volume.



Non-admitted interhospital transfers not displayed (<1%)

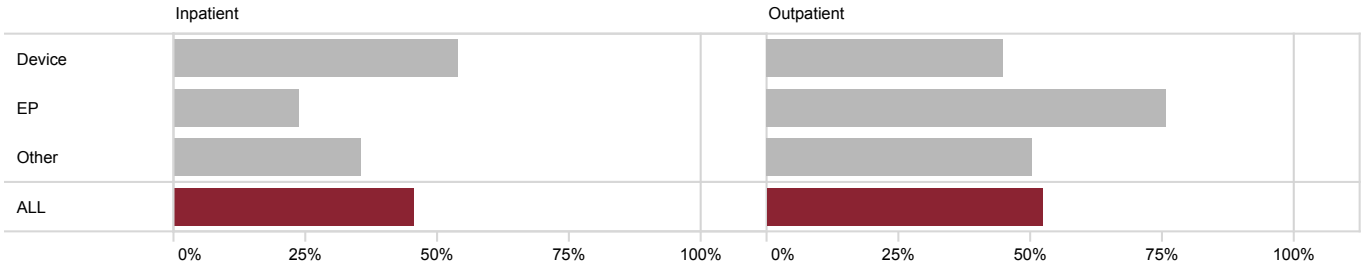
Includes missing data (1.7%)

Figure 16: Admission source by site

Table 8: Admission source by site

	Total cases n*	Inpatient n (%)	Outpatient n (%)	Non-admitted interhospital transfer n (%)
CH	421	131 (31.1)	288 (68.4)	2 (0.5)
TUH	521	294 (56.3)	168 (32.2)	–
MBH	37	4 (10.8)	33 (89.2)	–
SCUH	539	232 (43.3)	288 (53.7)	–
TPCH	1,182	554 (46.9)	627 (53.0)	1 (0.1)
RBWH	514	240 (46.7)	272 (52.9)	2 (0.4)
PAH	890	397 (44.6)	491 (55.2)	1 (0.1)
TWH	8	8 (100.0)	–	–
GCUH	549	258 (47.3)	278 (51.0)	8 (1.5)
STATEWIDE	**4,654**	**2,445 (52.5)**	**2,118 (45.5)**	**14 (0.3)**

* Includes missing data (1.7%)



Non-admitted interhospital transfers not displayed (<1%)

Includes missing data (1.7%)

Figure 17: Admission source by case category

7.3 Admission source and urgency category

Category one procedures accounted for the highest proportion of inpatient and outpatient cases. There was a marked increase in proportions for inpatient procedures with category one cases accounting for over three quarters of cases (86%). Outpatient procedures demonstrated a more even distribution across the three categories.

Table 9: Outpatient cases by urgency category

Outpatient site	Total cases n*	Category 1 n (%)	Category 2 n (%)	Category 3 n (%)
CH	288	203 (70.5)	70 (24.3)	5 (1.7)
TUH	168	50 (29.8)	38 (22.6)	5 (3.0)
MBH	33	13 (39.4)	18 (54.5)	2 (6.1)
SCUH	290	34 (11.8)	136 (47.2)	102 (35.4)
TPCH	627	280 (44.7)	267 (42.6)	78 (12.4)
RBWH	272	23 (8.5)	77 (28.3)	172 (63.2)
PAH	491	82 (16.7)	297 (60.5)	112 (22.8)
GCUH	278	230 (82.7)	34 (12.2)	13 (4.7)
STATEWIDE	**2,445**	**915 (37.4)**	**937 (38.3)**	**489 (20.0)**

* Includes missing data (4.3%)

Table 10: Inpatient cases by urgency category

Inpatient site	Total cases n*	Category 1 n (%)	Category 2 n (%)	Category 3 n (%)
CH	131	127 (96.9)	2 (1.5)	1 (0.8)
TUH	294	142 (48.3)	24 (8.2)	1 (0.3)
MBH	4	3 (75.0)	1 (25.0)	–
SCUH	232	142 (61.2)	63 (27.2)	8 (3.4)
TPCH	554	532 (96.0)	17 (3.1)	5 (0.9)
RBWH	240	213 (88.8)	15 (6.3)	12 (5.0)
PAH	397	320 (80.6)	48 (12.1)	28 (7.1)
TWH	8	8 (100.0)	–	–
GCUH	258	219 (84.9)	36 (14.0)	2 (0.8)
STATEWIDE	**2,118**	**1,706 (80.5)**	**206 (9.7)**	**57 (2.7)**

* Includes missing data (7.0%)

7.4 Device procedures

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

Table 11: Cardiac device case types by site

Procedure type	CH	TUH	MBH	SCUH	TPCH	RBWH	PAH	TWH	GCUH
	n	n	n	n	n	n	n	n	n
Pacemaker procedure*	98	137	4	172	409	129	416	7	280
ICD procedure*	52	49	4	43	122	72	99	–	91
Loop recorder implant/explant	82	14	28	40	80	82	51	–	45
BiV ICD procedure*	10	21	–	20	68	25	40	–	21
Lead revision/replacement/pocket revision	6	4	–	9	19	11	16	–	25
Device explant	3	2	–	3	77	1	5	–	8
BiV pacemaker procedure*	3	13	–	14	33	11	11	–	3
Temporary pacing system	2	2	1	4	8	5	16	1	3
Leadless pacemaker implant	1	6	–	–	14	5	4	–	5
Defibrillation threshold testing	–	–	–	–	6	1	13	–	–
Insertion of epicardial pacing system	–	–	–	–	2	–	–	–	–
Insertion of epicardial lead	–	–	–	–	–	–	1	–	–
ALL	**257**	**248**	**37**	**305**	**838**	**342**	**672**	**8**	**481**

* Includes implant/generator change/upgrade

7.5 Electrophysiology studies/ablations

Electrophysiology studies including radiofrequency ablation were the most common individual procedure performed across all sites, ranging from 62% of case volume at SCUH to 79% at TUH.

Table 12: Electrophysiology study/ablation types by site

Site	Procedure type	Case n (%)
CH	Radiofrequency ablation	16 (72.7)
	Electrophysiology study	6 (27.3)
TUH	Radiofrequency ablation	85 (79.4)
	Cryotherapy ablation	10 (9.3)
	Electrophysiology study	10 (9.3)
	Radiofrequency and cryotherapy ablation	2 (1.9)
SCUH	Radiofrequency ablation	142 (62.3)
	Cryotherapy ablation	52 (22.8)
	Electrophysiology study	30 (13.2)
	Radiofrequency and cryotherapy ablation	3 (1.3)
	Cryotherapy ablation and drug challenge	1 (0.4)
TPCH	Radiofrequency ablation	265 (77.0)
	Electrophysiology study	43 (12.5)
	Cryotherapy ablation	30 (8.7)
	Electrophysiology study and drug challenge	6 (1.7)
RBWH	Radiofrequency ablation	122 (75.3)
	Electrophysiology study	24 (14.8)
	Cryotherapy ablation	14 (8.6)
	Radiofrequency and cryotherapy ablation	2 (1.2)
PAH	Radiofrequency ablation	121 (78.6)
	Electrophysiology study	27 (17.5)
	Cryotherapy ablation	5 (3.2)
	Electrophysiology study and drug challenge	1 (0.6)
GCUH	Radiofrequency ablation	46 (70.8)
	Electrophysiology study	19 (29.2)
STATEWIDE		**1,082**

7.5.1 Standard vs. complex electrophysiology

Complex electrophysiology cases involving three-dimensional mapping technology, ventricular arrhythmias or pulmonary vein isolation accounted for 64% of all electrophysiology cases.

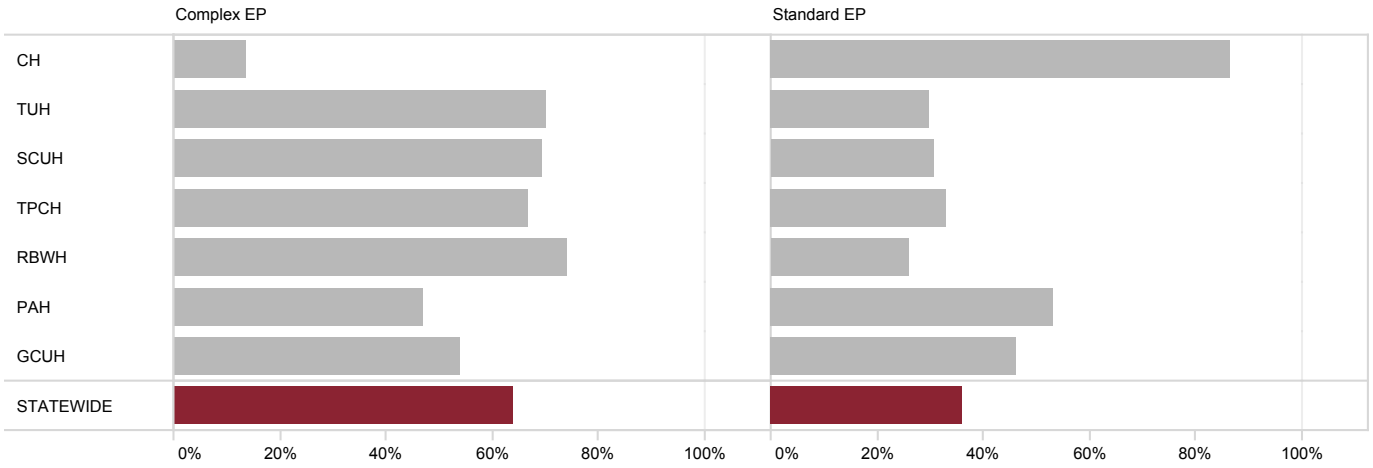


Figure 18: Complexity of electrophysiology procedures by site

Table 13: Proportion of standard and complex electrophysiology procedures by site

Site	Procedure type	Total n	Complex EP n	Standard EP n
CH	Radiofrequency ablation	16	–	16
	Electrophysiology study	6	3	3
TUH	Radiofrequency ablation	85	59	26
	Cryotherapy ablation	10	10	–
	Electrophysiology study	10	4	6
	Radiofrequency and cryotherapy ablation	2	2	–
SCUH	Radiofrequency ablation	142	95	47
	Electrophysiology study	30	17	13
	Cryotherapy ablation	52	43	9
	Radiofrequency and cryotherapy ablation	3	3	–
	Cryotherapy ablation with drug challenge	1	–	1
TPCH	Radiofrequency ablation	265	172	93
	Electrophysiology study	43	26	17
	Cryotherapy ablation	30	29	1
	Electrophysiology study with drug challenge	6	3	3
RBWH	Radiofrequency ablation	122	96	26
	Electrophysiology study	24	10	14
	Cryotherapy ablation	14	14	–
	Radiofrequency and cryotherapy ablation	2	–	2
PAH	Radiofrequency ablation	121	63	58
	Electrophysiology study	27	9	18
	Cryotherapy ablation	5	–	5
	Electrophysiology study with drug challenge	1	–	1
GCUH	Radiofrequency ablation	46	27	19
	Electrophysiology study	19	8	11
STATEWIDE		**1,082**	**693**	**389**

7.5.2 Three-dimensional mapping system

The total proportion of electrophysiology cases utilising three-dimensional mapping systems across sites, and distribution across vendors is shown in Table 14. Two vendors accounted for 75% of all three-dimensional mapping systems used.

Table 14: Three-dimensional mapping system type by site

	Total cases n	Vendor 1 n (%)	Vendor 2 n (%)	Vendor 3 n (%)	Vendor 3 + other n (%)
TUH	67	34 (50.7)	32 (47.8)	–	1 (1.5)
SCUH	126	1 (0.8)	46 (36.5)	79 (62.7)	–
TPCH	191	27 (14.1)	163 (85.3)	1 (0.5)	–
RBWH	103	8 (7.8)	95 (92.2)	–	–
PAH	66	32 (48.5)	34 (51.5)	–	–
GCUH	31	22 (71.0)	9 (29.0)	–	–
STATEWIDE	**584**	**124 (21.2)**	**379 (64.9)**	**80 (13.7)**	**1 (0.2)**

7.6 Ablation type

Radiofrequency ablation is the principal method across all sites, with 87% of all cases utilising this energy. There was variation in the proportionate use between sites with some more likely to use multiple types which is possibly a function of equipment availability. A small proportion of cases (1%) utilised two energy types.

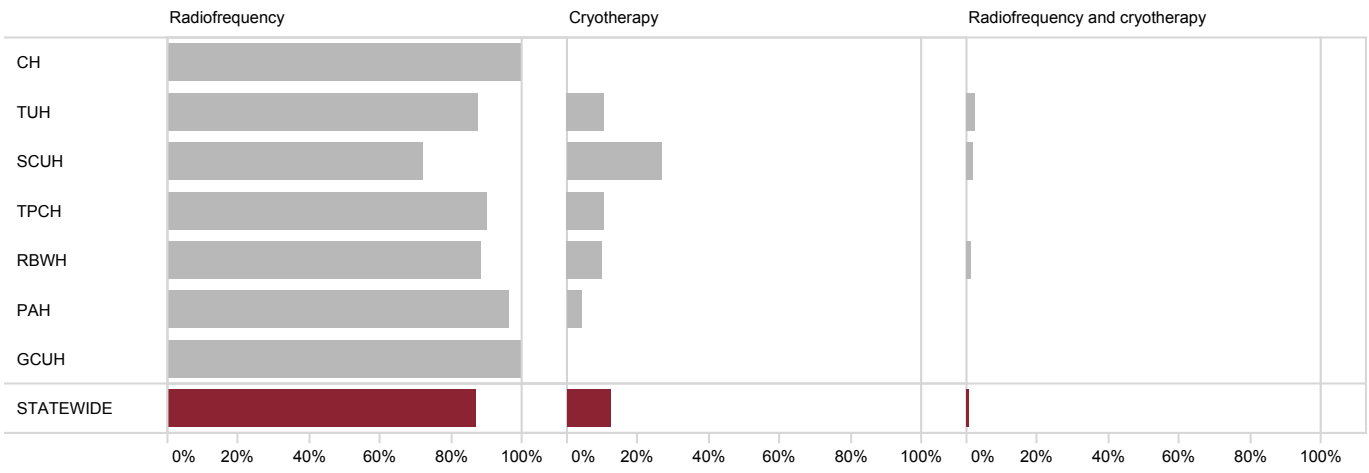


Figure 19: Proportion of case by ablation type and site

Table 15: Ablation type by site

	Total cases n	Radiofrequency n (%)	Cryotherapy n (%)	Radiofrequency + cryotherapy n (%)
CH	16	16 (100.0)	–	–
TUH	97	85 (87.6)	10 (10.3)	2 (2.1)
SCUH	198	142 (71.7)	53 (26.8)	3 (1.5)
TPCH	294	264 (89.8)	30 (10.2)	–
RBWH	138	122 (88.4)	14 (10.1)	2 (1.4)
PAH	126	121 (96.0)	5 (4.0)	–
GCUH	45	45 (100.0)	–	–
STATEWIDE	**914**	**795 (87.0)**	**112 (12.2)**	**7 (0.8)**

7.6.1 Ablation type/arrhythmia

The most frequently ablated clinical arrhythmia was atrial fibrillation (pulmonary vein isolation), which accounted for 32% of ablations across all sites. This was followed by atrioventricular nodal re-entry tachycardias (AVNRT) (23%) and atrial flutter (17%).

Age and gender varied depending on the arrythmia ablated. Patients undergoing accessory pathway ablation had a lower median age than those who underwent pulmonary vein isolation or AV node ablation. Furthermore, two thirds of patients undergoing pulmonary vein isolation were male which contrasts with the AVNRT cohort which is predominately a female group. These details are further expanded in Table 16.

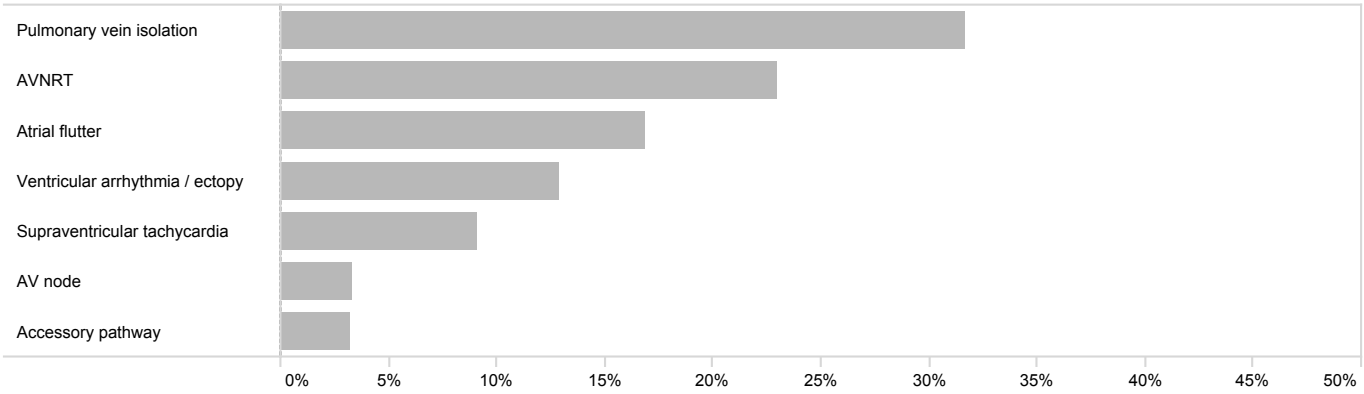


Figure 20: Proportion of arrhythmias ablated

Table 16: Median age and gender by ablation type

Ablation type	Gender	Total cases n (%)	Median age years
Pulmonary vein isolation	Male	192 (66.2)	59
	Female	98 (33.8)	63
AVNRT	Male	65 (31.0)	59
	Female	145 (69.0)	50
Atrial flutter ablation	Male	116 (75.3)	67
	Female	38 (24.7)	64
Ventricular arrhythmia/ectopy ablation	Male	77 (65.3)	68
	Female	41 (34.7)	49
Supraventricular tachycardia	Male	37 (44.6)	37
	Female	46 (55.4)	30
AV node	Male	12 (40.0)	72
	Female	18 (60.0)	74
Accessory pathway	Male	17 (58.6)	29
	Female	12 (41.4)	25
ALL		**914 (100.0)**	**59**

Table 17: Arrhythmia type by site

Site	Ablation type	Count n (%)
CH	AVNRT	8 (0.9)
	Atrial flutter ablation	6 (0.7)
	AV node	2 (0.2)
TUH	AVNRT	28 (3.1)
	Pulmonary vein isolation	25 (2.7)
	Ventricular arrhythmia/ectopy ablation	23 (2.5)
	Atrial flutter ablation	10 (1.1)
	Supraventricular tachycardia	6 (0.7)
	Accessory pathway	4 (0.4)
	AV node	1 (0.1)
SCUH	Pulmonary vein isolation	89 (9.8)
	Atrial flutter ablation	46 (5.0)
	AVNRT	32 (3.5)
	Ventricular arrhythmia/ectopy ablation	12 (1.3)
	Accessory pathway	8 (0.9)
	AV node	7 (0.8)
	Supraventricular tachycardia	4 (0.4)
TPCH	Pulmonary vein isolation	80 (8.8)
	AVNRT	76 (8.3)
	Ventricular arrhythmia/ectopy ablation	57 (6.2)
	Atrial flutter ablation	32 (3.5)
	Supraventricular tachycardia	31 (3.4)
	AV node	11 (1.2)
	Accessory pathway	7 (0.8)
RBWH	Pulmonary vein isolation	43 (4.7)
	Atrial flutter ablation	34 (3.7)
	AVNRT	21 (2.3)
	Supraventricular tachycardia	21 (2.3)
	Ventricular arrhythmia/ectopy ablation	13 (1.4)
	Accessory pathway	3 (0.3)
	AV node	3 (0.3)
PAH	Pulmonary vein isolation	41 (4.5)
	AVNRT	41 (4.5)
	Atrial flutter ablation	14 (1.5)
	Supraventricular tachycardia	13 (1.4)
	Ventricular arrhythmia/ectopy ablation	8 (0.9)
	Accessory pathway	5 (0.5)
	AV node	4 (0.4)
GCUH	Pulmonary vein isolation	12 (1.3)
	Atrial flutter ablation	12 (1.3)
	Supraventricular tachycardia	8 (0.9)
	Ventricular arrhythmia/ectopy ablation	5 (0.5)
	AVNRT	4 (0.4)
	Accessory pathway	2 (0.2)
	AV node	2 (0.2)
STATEWIDE		**914**

7.7 Other procedures

The most common other procedure was cardioversion (89%). Variations in clinical practice across sites can be observed here with not all cardioversions performed being carried out in the electrophysiology laboratory environment or documented using the QCOR module.

Table 18: Other procedures

	Total n	Cardioversion n (%)	Drug challenge n (%)	Other procedure n (%)
CH	143	131 (91.6)	6 (4.2)	6 (4.2)
TUH	168	155 (92.3)	4 (2.4)	9 (5.4)
SCUH	4	–	2 (50.0)	2 (50.0)
TPCH	7	3 (42.9)	1 (14.3)	3 (42.9)
RBWH	16	8 (50.0)	5 (31.3)	3 (18.8)
PAH	68	65 (95.6)	3 (4.4)	–
GCUH	1	–	–	1 (100.0)
STATEWIDE	**407**	**362 (88.9)**	**21 (5.2)**	**24 (5.9)**

8 Procedural complications

Lead complications were the most frequently encountered complication for device procedures, and pericardial effusions were the most commonly observed complication across electrophysiology procedures. The summary of complications below denotes events observed during and post procedure. The QCOR electrophysiology application is predominantly utilised for procedural detail reporting and as such, documentation of peri and post-procedural complications is the responsibility of site practitioners.

The complication rates for procedures in Tables 19 and 20 are reflected as the proportion of the total number of device and electrophysiology procedures respectively. On some rare occasions, the development of an intraprocedural complication such as coronary sinus dissection necessitated a change of procedure type from BiV implant/upgrade to a non-BiV device procedure. In these instances, complications are reported against the final procedure type.

The overall device procedure complication rate was 1.3%, while electrophysiology procedures had a 1.1% complication rate.

Table 19: Cardiac device procedure complications

Procedure type	Complication	Total n (%)
Pacemaker implant/generator change	Lead complication	5 (0.2)
	Haemodynamic instability	3 (<0.1)
	Coronary sinus dissection	3 (<0.1)
	Other	3 (<0.1)
	Pericardial effusion with tamponade	2 (<0.1)
	Vascular injury	2 (<0.1)
	Pericardial effusion without tamponade	1 (<0.1)
	Pneumothorax	1 (<0.1)
ICD implant/generator change/upgrade	Other	3 (<0.1)
	Coronary sinus dissection	1 (<0.1)
	Pericardial effusion with tamponade	1 (<0.1)
	Lead complication	1 (<0.1)
BIV ICD implant/generator change/upgrade	Coronary sinus dissection	3 (<0.1)
	Conduction block	1 (<0.1)
	Haematoma	1 (<0.1)
	Pericardial effusion with tamponade	1 (<0.1)
Lead revision/replacement/pocket revision	Lead complication	1 (<0.1)
	Cardiac arrest	1 (<0.1)
	Other	1 (<0.1)
BiV pacemaker implant/generator change/upgrade	Pericardial effusion without tamponade	1 (<0.1)
Device explant	Vascular injury	2 (<0.1)
	Pericardial effusion with tamponade	1 (<0.1)
	Lead complication	1 (<0.1)
ALL		**40 (1.3)**

Table 20: Electrophysiology procedure complications by study type and complexity

Procedure type	Complexity	Complication	Total n (%)
Electrophysiology study	Standard EP	Vascular injury	1 (<0.1)
	Complex EP	Haematoma	1 (<0.1)
Radiofrequency ablation	Standard EP	Atrial arrhythmia requiring DCCV	1 (<0.1)
		Vascular injury	1 (<0.1)
		Pericardial effusion without tamponade	1 (<0.1)
		Conduction block	1 (<0.1)
	Complex EP	Vascular injury	1 (<0.1)
		Conduction block	1 (<0.1)
		Haematuria	1 (<0.1)
		Pericardial effusion without tamponade	1 (<0.1)
Cryotherapy ablation	Complex EP	Phrenic nerve injury	2 (<0.1)
ALL			**12 (1.1)**

9 Clinical indicators

Clinical indicators are important measures of the clinical management and outcomes of patient care. An indicator that is clinically relevant and useful should highlight specific issues that may require attention or signal areas for improvement. Usually, rate-based indicators identify the rate of occurrence of an event. There is emerging recognition that a capacity to evaluate and report on quality is a critical building block for system-wide improvement of healthcare delivery and patient outcomes.

The quality and safety indicators which have been nominated by the QCOR Electrophysiology Committee are outlined in Table 21.

Table 21: Electrophysiology and pacing clinical indicators

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

9.1 Waiting time from referral date to procedure by case category

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

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

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

9.1.1 Elective pacemaker

Examination of the waiting time for elective pacemaker procedures is below. Of the 193 cases with complete data, the median wait time was 21 days.

Table 22: Elective pacemaker wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days
STATEWIDE	335	193	21	3–169

9.1.2 Elective ICD wait time and proportion within 28 days

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

Table 23: Elective ICD wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days	Met target %
STATEWIDE	234	130	32	14–267	45.4

9.1.3 Standard ablation

Waiting times for standard ablation procedures are presented below. Of the 182 cases eligible for analysis, the median wait time was 117 days. More than one quarter of patients had a wait time of 159 days or more.

Table 24: Elective standard ablation wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days
STATEWIDE	251	182	117	44–737

9.1.4 Complex ablation with proportion within 180 days or less

Complex ablations are defined as cases using three-dimensional mapping technology or involving ventricular arrhythmia or pulmonary vein isolation. This indicator examines the waiting time for these procedures and the proportion adhering to the benchmark of 180 days or less.

A median wait time of 65 days was observed, with a large interquartile range demonstrating there are a number of patients with considerably long waits.

Table 25: Elective complex ablation wait time analysis

	Total cases n	Total cases analysed n	Median wait time days	Interquartile range days	Met target %
STATEWIDE	457	364	65	25–681	78.6

9.2 Procedural tamponade rates

Cardiac tamponade is a known complication of cardiac device and electrophysiology procedures. This indicator examines the rate of procedural pericardial tamponade. As pericardial tamponade is a clinical diagnosis, this indicator explicitly reports those patients with this specific diagnosis and does not include those patients with the diagnosis or finding of pericardial effusion.

Table 26: Procedural tamponade analysis

Procedure category	Total cases analysed n	Procedural tamponade observed n	Procedural tamponade rate %
Device	3,189	7	0.2
EP	1,058	6	0.6
ALL	**4,247**	**13**	**0.3**

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

This indicator identifies the number of cases where lead dislodgement was observed within one year of lead insertion. The cases included in this indicator were all new device implants or upgrades where a new lead/s had been implanted and a lead revision or replacement was subsequently required due to dislodgement. Index implant procedures were cases performed within Queensland Health implanting facilities in the 2018 calendar year.

The analysis showed 41 cases (1.9%) where reintervention was required within 12 months of the index procedure. Higher rates of reintervention were noted in the biventricular device category which may reflect the greater complexity of these systems.

These results compare favourably with international cohorts, where observed dislodgement rates for pacemaker system implants vary from 1.0 to 2.7%.[23]

Table 27: Reintervention due to lead dislodgement analysis

	Cases analysed n	Atrial lead n	Ventricular lead n	12 month lead dislodgement n	12 month lead dislodgement rate %
Pacemaker implant	1,510	16	19	35	2.3
Any BiV implant	234	1	4	5	2.1
ICD implant	435	1	0	1	0.2
Eligible 2018 device cases	**2,179**	**18**	**23**	**41**	**1.9**

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

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

A 0.7% system loss rate was observed at 12 months post procedure, which is reassuring when compared to international literature which suggests infection rates necessitating explant of approximately 2.4%.[24]

Table 28: Rehospitalisation with device loss analysis

	Cases analysed n	12 month system loss due to infection n	12 month system loss rate %
Eligible 2018 device cases	2,642	19	0.7

9.5 12 month all-cause mortality for cardiac device procedures

The rate of 12 month all-cause mortality is examined for patients with cardiac devices procedures in 2018. It is important to note that patients undergoing these procedures are often of an advanced age, have advanced symptomatology (advanced heart failure in patients with biventricular pacing) and often have multiple comorbidities and risk factors.

Table 29: 12 month all-cause unadjusted mortality for cardiac device procedures

	Cases analysed n	12 month mortality observed n	12 month mortality rate %	Median age at procedure years	Interquartile range years
Any BiV procedure	290	15	5.2	70	57–88
ICD procedure	599	17	2.8	68	61–85
Pacemaker procedures	2,232	129	5.8	82	74–97
All 2018 device cases	**3,121**	**161**	**5.2**	**79**	**70–97**

10 Conclusions

This 2019 QCOR Annual Report has built on the significant advances in the analytic capacity for electrophysiology and pacing. Improvement and enhancement in the reporting of clinical quality indicators relevant to clinical practice and have also examined further the unmet demand for ablation procedures in Queensland. This is exemplified through considerable wait times for diagnosis and intervention.

While overall case volumes have remained essentially unchanged from previous years, a 12% increase in the proportion of cases categorised as complex electrophysiology (52% vs. 64%) has been noted since the 2018 Audit. Pulmonary vein isolation remains the most frequently performed ablation procedure while increases in the case volumes of ventricular arrhythmia ablation were also noted. There was a corresponding increase in the usage of three-dimensional mapping systems use, which further underlines the intricacy of the work undertaken at Queensland public EP units. It is once again reassuring to see that aggregated performance for device loss and lead dislodgement compare favourably to internationally reported rates.

Secondary use of QCOR data has also supported the implementation of more cost-effective procurement framework for implantable devices, resulting in significant cost-savings, and allowing funding to be redirected to other areas of need. It is also reassuring that QCOR data has been applied to the prospective service planning and capability discussions within Queensland Health. Without this critical contextualised information provided by QCOR, informed guidance and decision-making would be considerably limited.

With continued clinical input and focus, QCOR data and reporting will be able to inform clinicians not only of performance and quality but offering as well unprecedented levels of insight into electrophysiology and pacing service capacity and throughput rarely available to clinicians both nationally and internationally. Indeed, the current level of detail contained within this registry stands Queensland in good stead for future use and as a case study for what is possible with an engaged clinical group.

These initiatives have underscored the importance of quality data capture and the indispensable nature of clinical input to inform useful and relevant reporting. With a further focus on data completeness and integrity, it is anticipated that the power of the QCOR electrophysiology registry will grow to underpin service provision and delivery of quality clinical care for the people of Queensland.

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Glossary

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

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