Annual Report 2023/24

Out of Hospital Cardiac Arrest & Prehospital ST Elevation Myocardial Infarction

Queensland Ambulance Service

Queensland Government

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ABOUT THIS REPORT

Research and evaluation is fundamental to continuously improving the care Queenslanders receive. At the Queensland Ambulance Service (QAS), research and evidence guide everything we do. The QAS supports and invests in research and evaluation as an important way of delivering the organisation's Strategic objective 1 – To continue to deliver excellent health care to Queenslanders.

The QAS has a well-established cardiac research program. Dedicated staff, coupled with national and international collaborations, have continued to support the organisation's growing cardiac research agenda for two important groups of cardiac patients attended by ambulance clinicians: out-of-hospital cardiac arrest (OHCA) and prehospital ST-segment elevation myocardial infarction (STEMI). Instrumental to cardiac research are our OHCA and STEMI data collections, which provide a comprehensive, population-level understanding of incident location, patient characteristics, community response, ambulance system performance, and patient outcomes. This in turn provides data-driven evidence necessary to identify opportunities for improvement. This report outlines key indicators of patient characteristics, bystander interventions, ambulance response and management, and outcomes of OHCA and STEMI patients attended by QAS paramedics in financial year (FY) 2023/24. Trends over the last six years (from FY 2018/19 to 2023/24) are also investigated, which demonstrate improvement in both patient cohorts across multiple elements, including bystander intervention rates, prehospital reperfusion rates and survival outcomes.

This report also features investigation of three distinct aspects of cardiac management:

01

The treatment of OHCA usually requires vascular access for drug administration. Gaining vascular access is well-established within the scope of practice of QAS paramedics. However, there is limited data on the competency of paramedics in obtaining vascular access during a cardiac arrest. This report evaluates the insertion patterns and success rates of QAS paramedics in performing IV and IO access during an arrest.

02

Cardiopulmonary resuscitation induced consciousness (CPRIC) is a phenomenon in which patients regain consciousness during cardiopulmonary resuscitation (CPR). Whilst rare, the occurrence of CPRIC is likely to continue to increase with an increased focus on high-quality CPR. Despite its increasing frequency and important clinical implications, there remains a scarcity of knowledge regarding CPRIC. Accordingly, there is a pressing need to improve our understanding of this growing phenomenon. Such knowledge is valuable to inform guideline development for the identification and management of CPRIC. This report extends to investigate the prevalence of CPRIC, patient characteristics and outcomes, and pharmacological management for this phenomenon among OHCA patients attended by QAS paramedics.

03

Underlying acute coronary disease (such as STEMI) and pulmonary embolism (PE) are responsible for around half of OHCA cases. As such, there is a biological rationale for selectively using fibrinolysis during cardiac arrest. However, evidence for the benefits of fibrinolytic therapy during a cardiac arrest remains inconclusive. Current guidelines recommend fibrinolytic drugs for cardiac arrest caused by suspected PE (weak recommendation, very low-certainty evidence);[1] whereas the benefits of intra-arrest fibrinolysis in cardiac arrests of suspected STEMI remain to be established. Within the QAS, intra-arrest fibrinolysis for arrest due to suspected PE or STEMI is considered on a case-by-case basis based on patient's clinical characteristics and with strict approval from the QAS on-call consultant physician. In this report, we investigate the epidemiology and survival outcomes of OHCA patients who receive prehospital intra-arrest fibrinolysis with tenecteplase.

OUT OF HOSPITAL CARDIAC ARREST

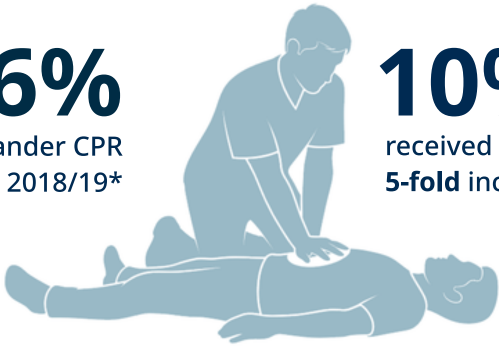
Key Statistics 2023/24

6787
cardiac arrests attended

38%
received resuscitation attempt

61%
presumed cardiac aetiology

79%
arrests occurred at home



86%
received bystander CPR
12% increase from 2018/19*

10%
received bystander defibrillation
5-fold increase from 2018/19*

***8.3** min*
median response time

64%
patients were attended by paramedics within 10 mins of 000 call

52%
patients survived event
(Utstein group)

40%
patients discharged alive
(Utstein group)

** bystander-witnessed, attempted-resuscitation*

Incidence & **Demographics**

In FY 2023/24, QAS ambulance clinicians attended a total of 6787 OHCA incidents. This equates to a crude incidence rate of 121 cases per 100,000 population, a 14% relative increase from FY 2018/19 (Figure 1). The incidence rate for OHCA was highest in Darling Downs and South West Region (176 cases per 100,000 population), followed by Far Northern Region (158) and Northern Region (152). The more densely populated Metro North (105), Metro South (107) and Gold Coast Regions (115) had the lowest incidence rates (Figure 2).

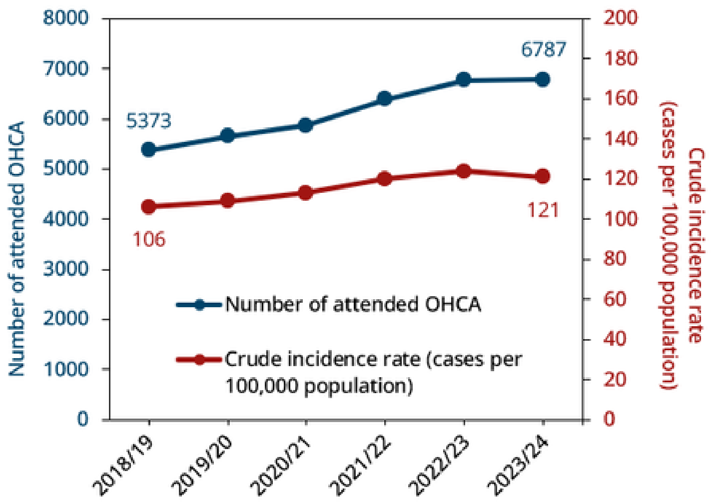


Figure 1. Number and incidence rate of paramedic-attended OHCA cases.

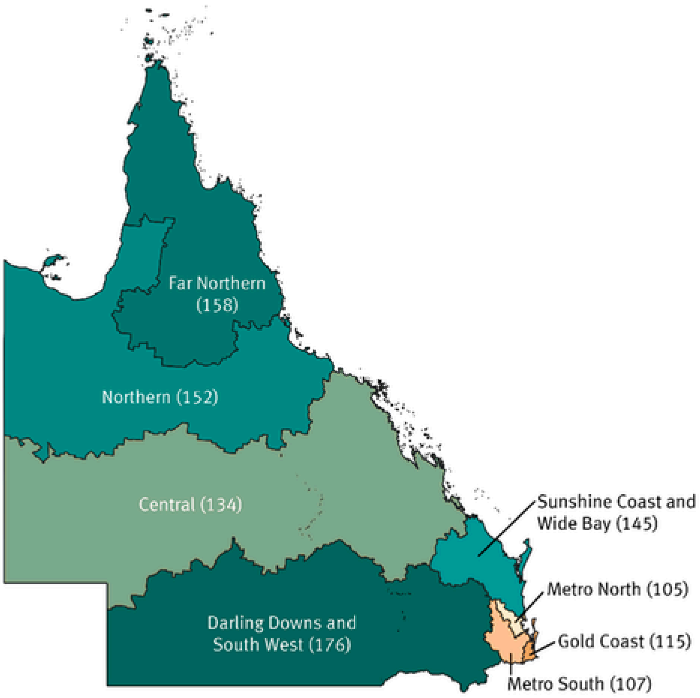


Figure 2. Incidence rate of paramedic-attended OHCA by QAS Region

More than half of OHCA incidents occurred in metropolitan areas (Figures 3 and 4). The patterns of rurality remain consistent over the years and reflect the patterns of population distribution in the state.

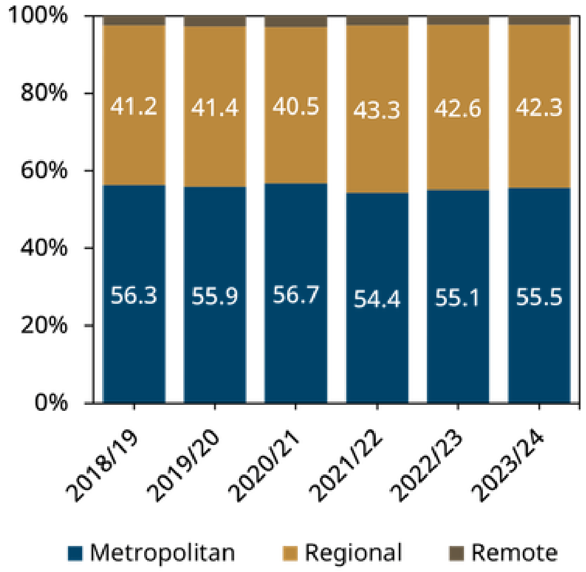


Figure 3. Rurality of OHCA incidents based on incident location.
Rurality is categorised according to The Australian Statistical Geography Standard Edition 3 Remoteness Structure

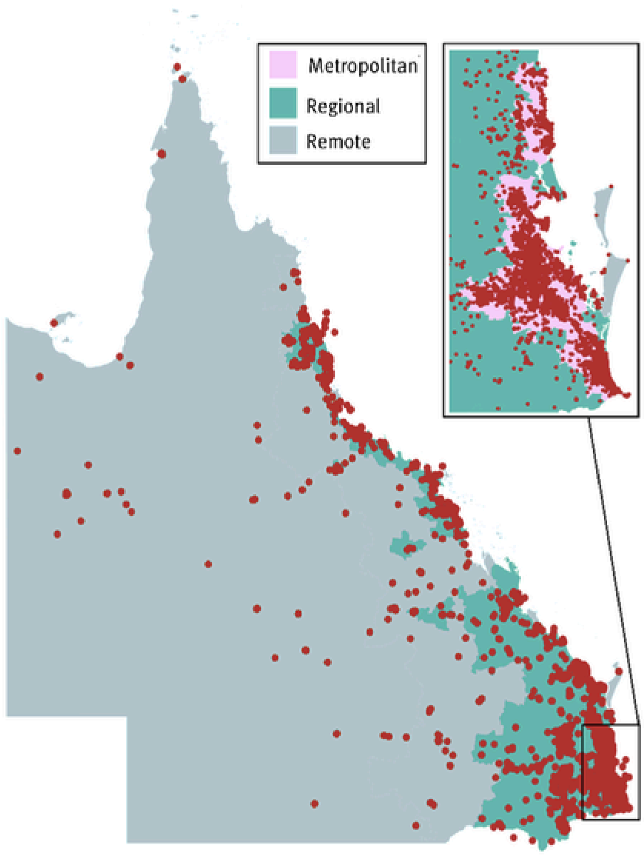


Figure 4. Spatial locations of OHCA incidents with each dot representing a case

In FY 2023/24, adults (⩾ 16 years of age) accounted for the majority of OHCA cases attended by paramedics (98.5%). Two-thirds (65.8%) of cardiac arrests were male. The overall median age was 67 years, with female (median 72 years) being an average of seven years older than male (median 65 years). In both sexes, the proportion of patients aged 76 years or older has modestly increased over the years (Figure 5).

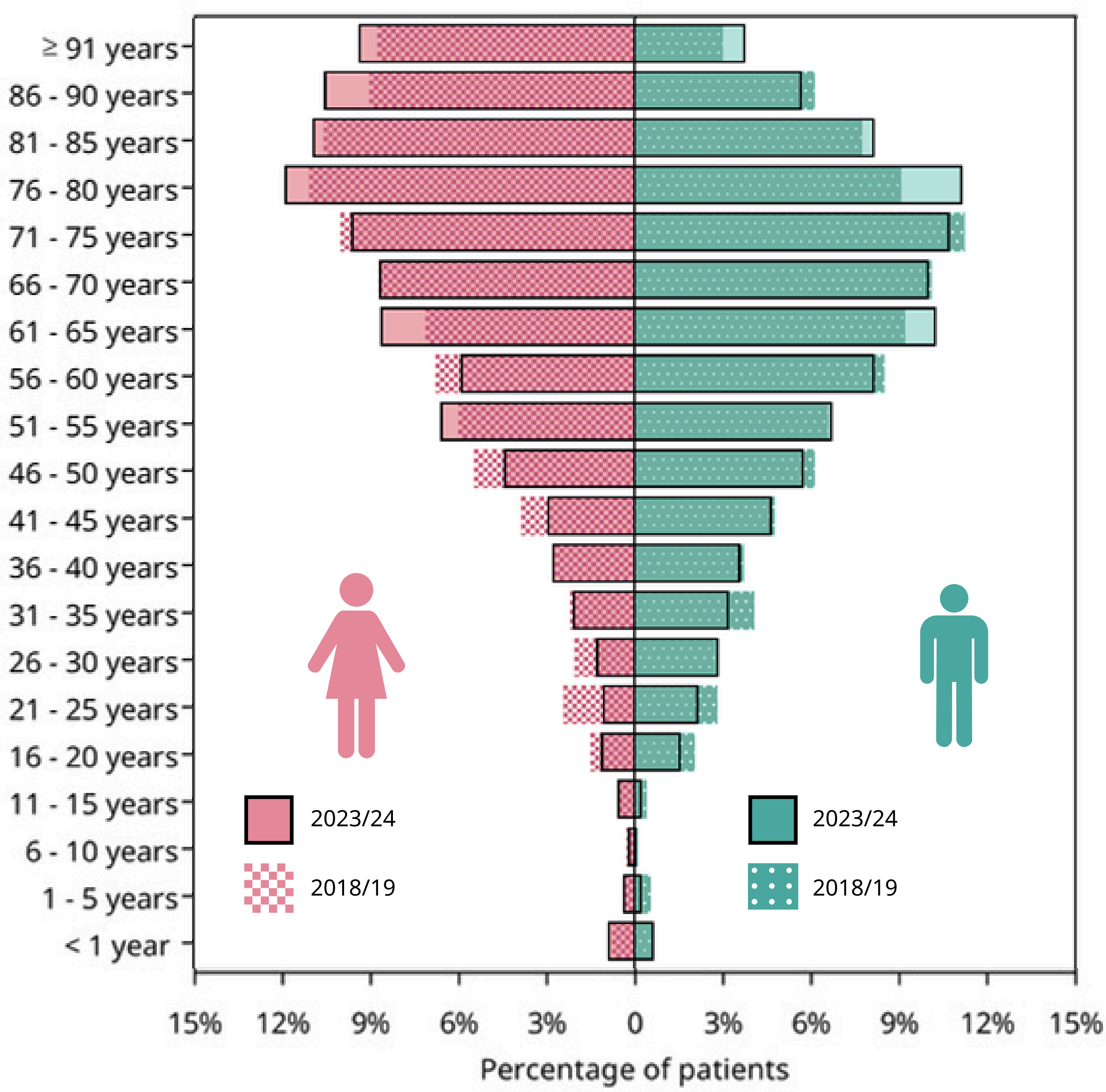


Figure 5. Percentage of patients in different age groups with comparison between FY 2023/24 and 2018/19, stratified by sex.

Patient &
Arrest Characteristics

In FY 2023/24, 79.2% of arrests occurred at a private residence (Figure 6). This proportion is similar across the years, except for FY 2020/21 when a slightly higher proportion of arrests in the home was observed, which was likely due to restrictions regarding leaving home during the COVID-19 pandemic.

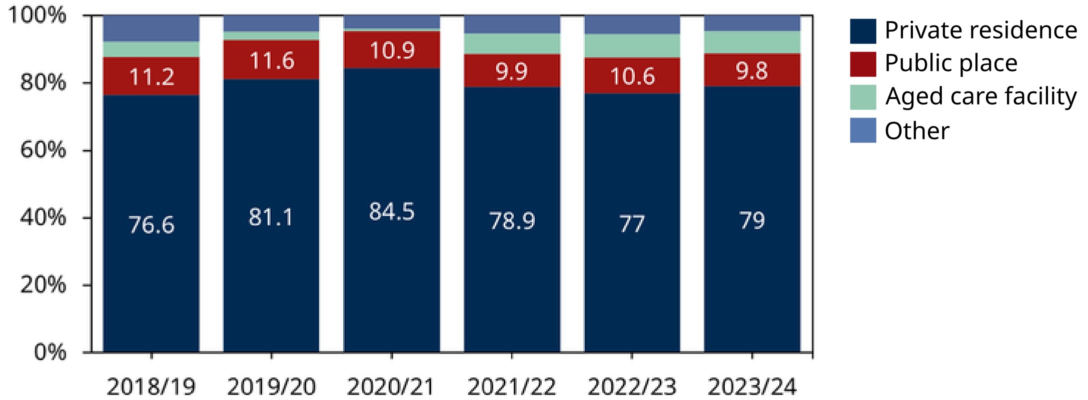


Figure 6. Location types of arrests.

Noncardiac medical causes were the most common causes of cardiac arrest in children, accounting for around one-third (34.3%) of cases in this age group in FY 2023/24 (Figure 7). Presumed cardiac aetiology was the most common cause of cardiac arrest in adults with the proportion of presentations due to presumed cardiac cause increasing with age. In adults aged 16-65 years, presumed cardiac cause was responsible for 52.6% of cardiac arrests. This increased to 65.1% in the 66-75 years age group, and further increased to 70.2% in > 75 years adults. Traumatic arrest was more common in children and younger adults.

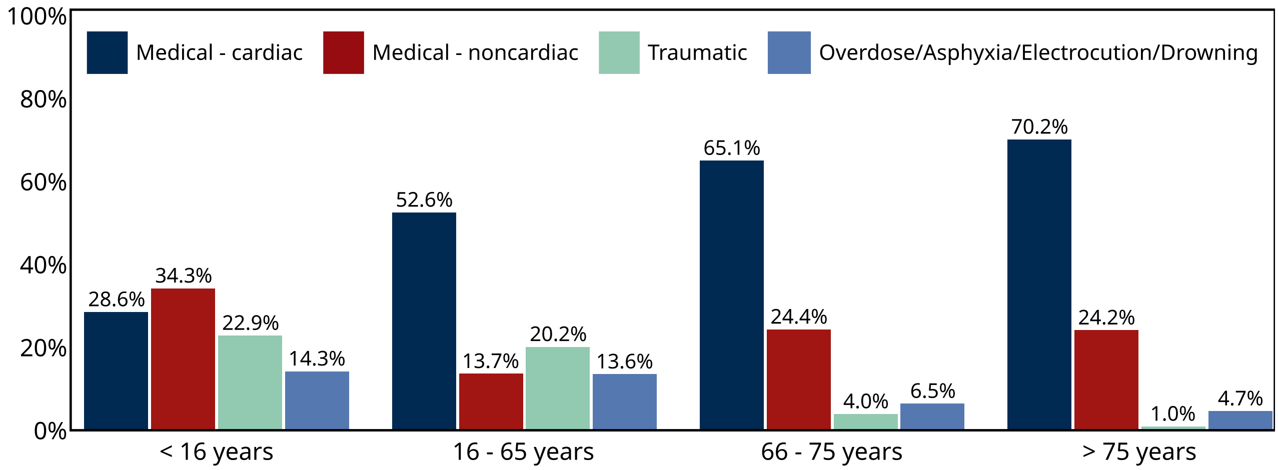


Figure 7. Aetiology of arrest by age group in FY 2023/24.
Unknown cause was allocated to presumed cardiac in accordance with the 2024 Utstein template.[2]

Presumed cardiac aetiology as a cause of cardiac arrest has decreased over time, from 68.0% in FY 2018/19 to 60.6% in FY 2023/24 (Figure 8) for all ages combined. In contrast, noncardiac medical causes have almost doubled during this period, from 10.7% to 19.6%, some of this may be attributable to improvement in documentation around pre-existing medical conditions and prehospital diagnosis.

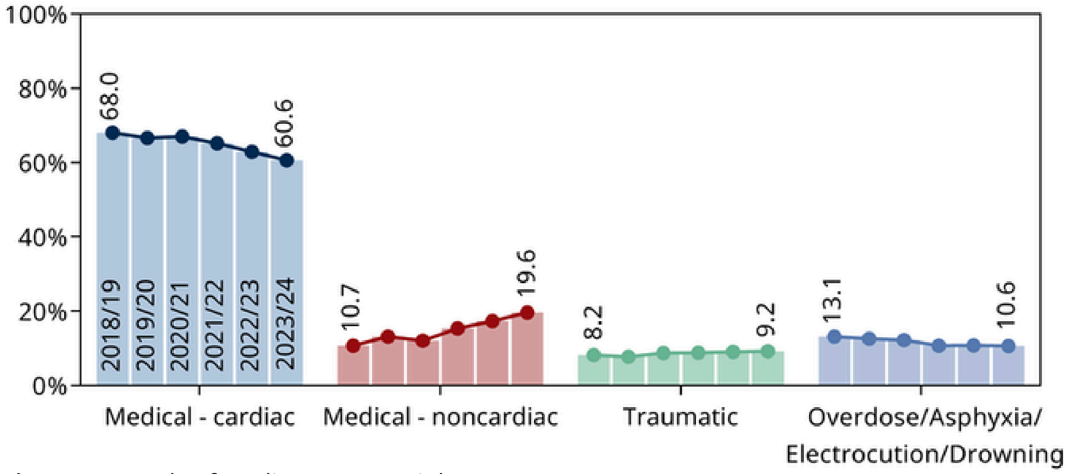


Figure 8. Trends of cardiac arrest aetiology.
Unknown cause was allocated to presumed cardiac in accordance with the 2024 Utstein template.[2]

In FY 2023/24, 37.9% of all patients received a resuscitation attempt by paramedics, with rates of attempted resuscitation higher in children (73.3%) than in adults (37.4%) (Figure 9). The proportion of patients receiving a resuscitation attempt by paramedics has increased over time in children and slightly decreased in older adults (Figure 10).

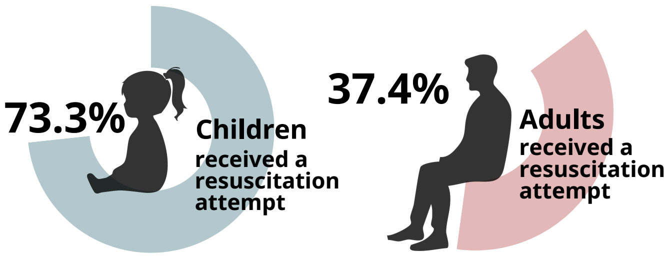


Figure 9. Proportion of children and adult OHCA patients receiving a resuscitation attempt by paramedics.

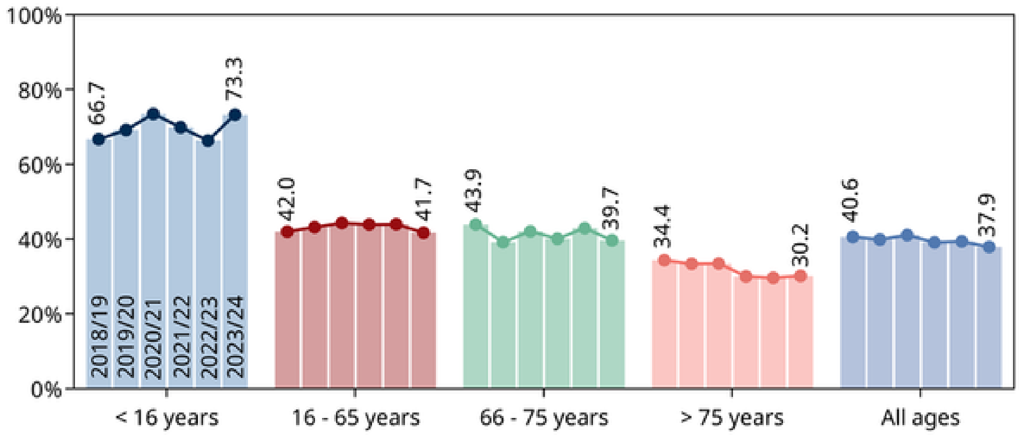


Figure 10. Trends of percentage of cardiac arrest patients receiving a resuscitation attempt by paramedics, by age group.

In FY 2023/24, a quarter (25.9%) of attempted-resuscitation patients presented in a shockable rhythm, being 2.6% in children and 26.6% among adults. The percentage of patients with initial shockable rhythm was stable over the years.

Bystander interventions

The percentage of all attended OHCA patients in FY 2023/24 (regardless of resuscitation attempt by paramedics) who received bystander CPR prior to the arrival of paramedics was 65.5% among bystander-witnessed arrests, and 27.7% among unwitnessed cardiac arrest cases. (Figure 11A).

The percentage of attempted-resuscitation patients in FY 2023/24 who received bystander CPR prior to paramedic arrival was 85.9% among bystander-witnessed cardiac arrests, and 76.4% among unwitnessed cardiac arrest cases (Figure 11B). Bystander CPR rates varied between QAS regions, ranging from 79.2% (Northern Region) to 92.0% (Far Northern Region) in FY 2023/24 for bystander-witnessed cardiac arrest cases receiving a resuscitation attempt by paramedics (Figure 12).

There has been a significant improvement in the rates of bystander CPR and bystander defibrillation over the years amongst bystander-witnessed cardiac arrests that subsequently receive a resuscitation attempt by paramedics. Bystander CPR rates increased from 76.6% in 2018/19 to 85.9% in 2023/24, a relative 12% increase (Figure 11B).

Similarly in the same period, bystander defibrillation has increased 5-fold, from 1.8% to 9.5% (Figure 11B).

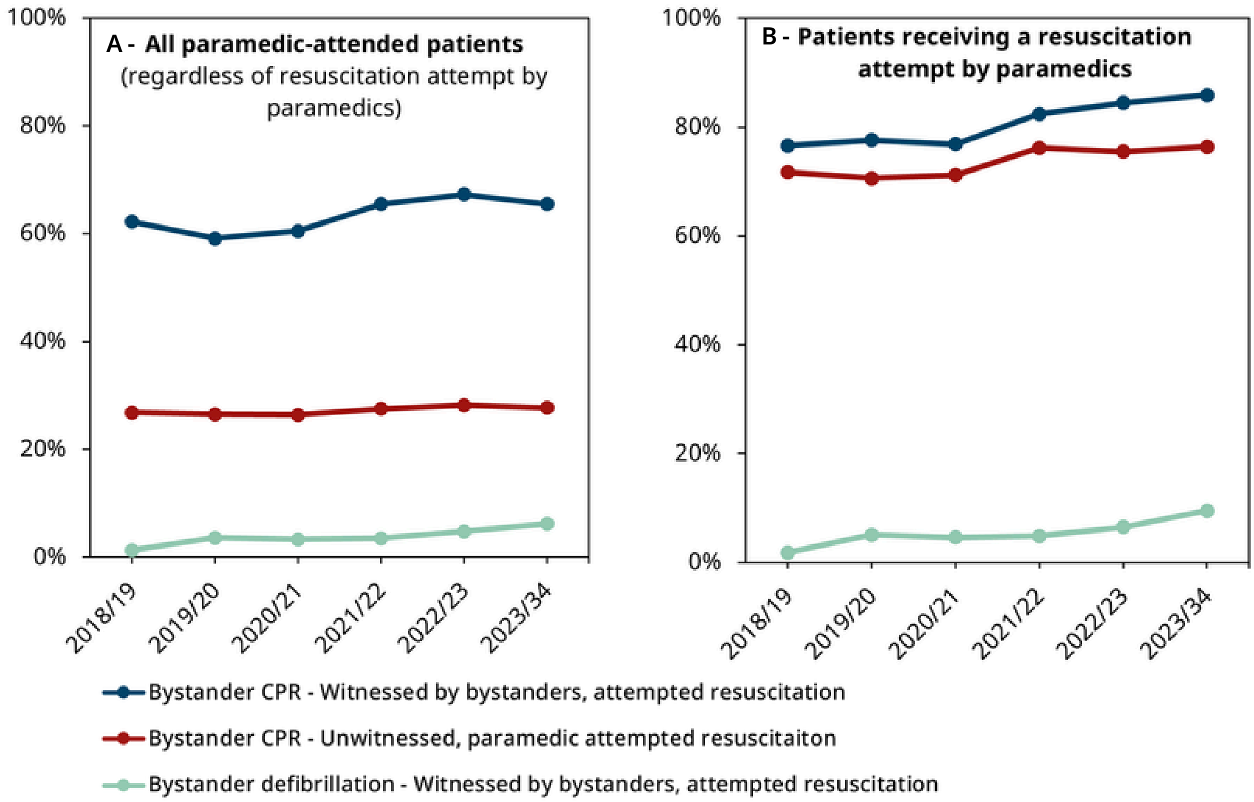


Figure 11. Rates of bystander interventions.

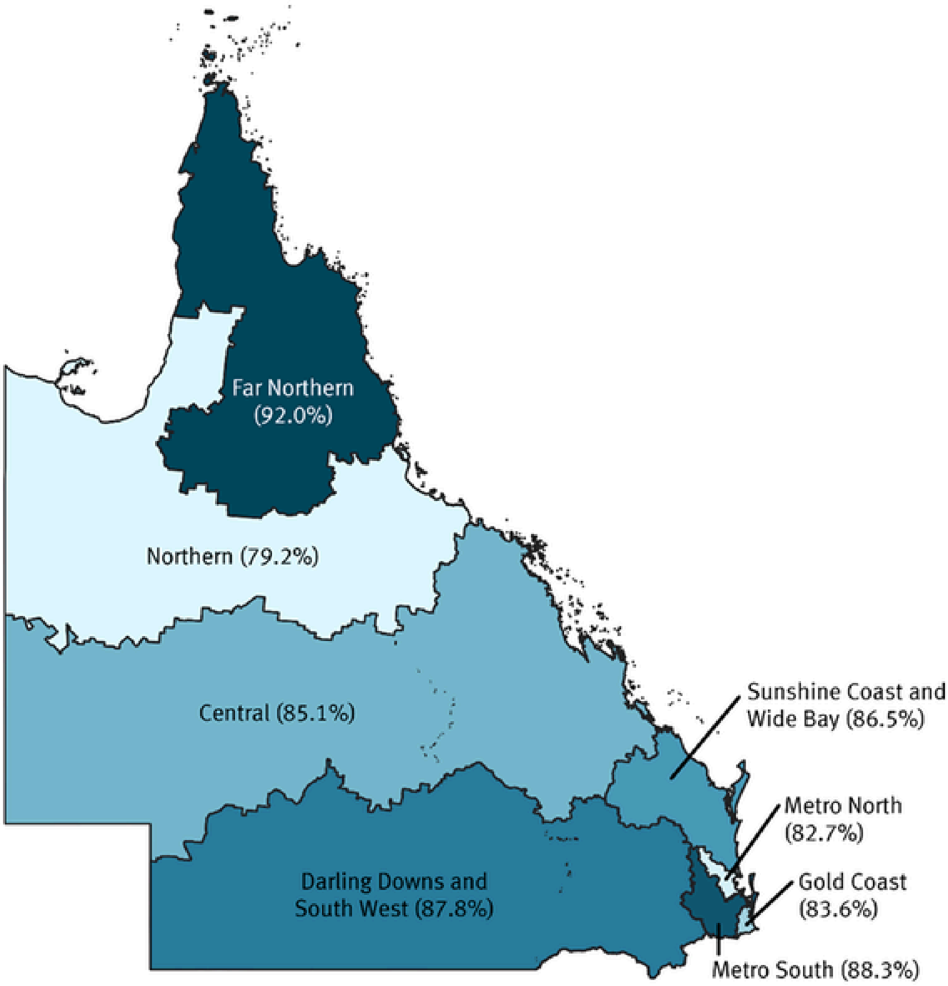
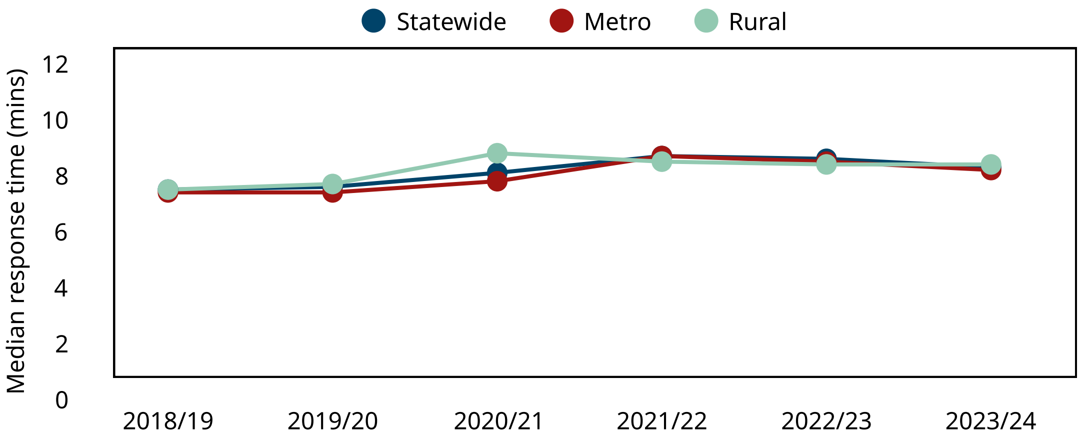


Figure 12. Rates of bystander interventions by QAS region, FY 2023/24.
Darker colours represent higher bystander CPR rates.

Response times

In FY 2023/24, statewide median response time was 8.3 minutes in attempted-resuscitation patients where the cardiac arrest was not witnessed by paramedics (Figure 13). Nearly two-thirds (63.5%) of patients were attended by paramedics within 10 minutes of the Triple Zero call. Response times were almost the same for both metropolitan and rural areas, and have shown a slight shortening trend for the most recent years (Figure 13).



Statewide*	7.5	7.6	8.1	8.7	8.6	8.3
Metropolitan*	7.4	7.4	7.8	8.7	8.5	8.2
Rural*	7.5	7.7	8.8	8.5	8.8	8.4

*Includes patients receiving a resuscitation attempt by paramedics, and excludes paramedic-witnessed arrests

Figure 13. Response times

Mechanical chest compression devices

Central to any resuscitative effort is the delivery of high-quality chest compressions with minimal interruptions. There are circumstances that present significant challenges to the delivery of high-quality manual chest compressions, such as during patient relocation or transport. Mechanical chest compression devices (MCCDs) can provide high-quality uninterrupted chest compressions in these situations. MCCDs are usually used by QAS paramedics on patients indicated for transport to hospital for extracorporeal CPR and/or primary percutaneous coronary intervention (PCI). MCCDs are distributed among strategic locations across the state.

From their introduction in July 2020 through to 30 June 2024 (cut-off of this report), MCCDs were used on a total of 1503 patients statewide, or on average 31 cases per month (Figure 14). Figure 15 shows the geographical location of those cases.

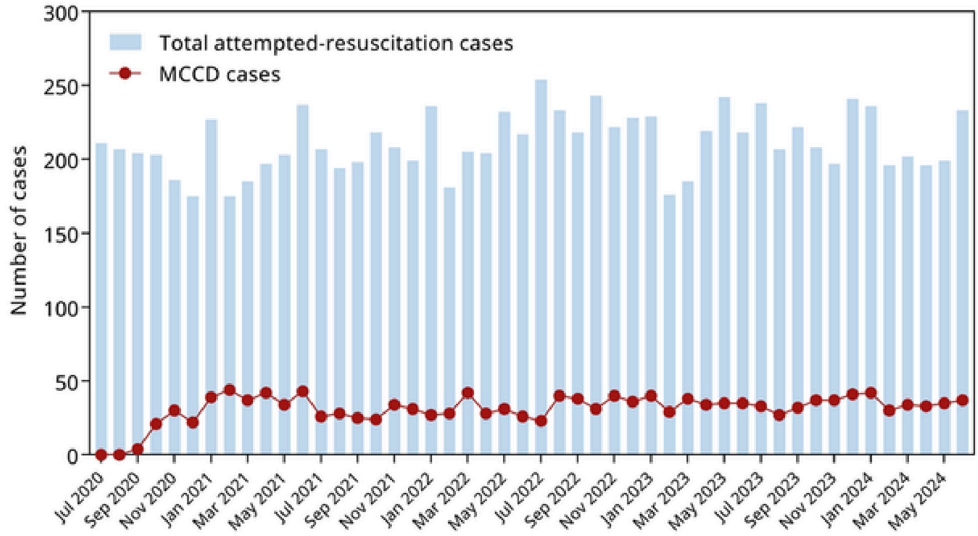


Figure 14. Monthly number of attempted-resuscitation cases receiving mechanical chest compressions.

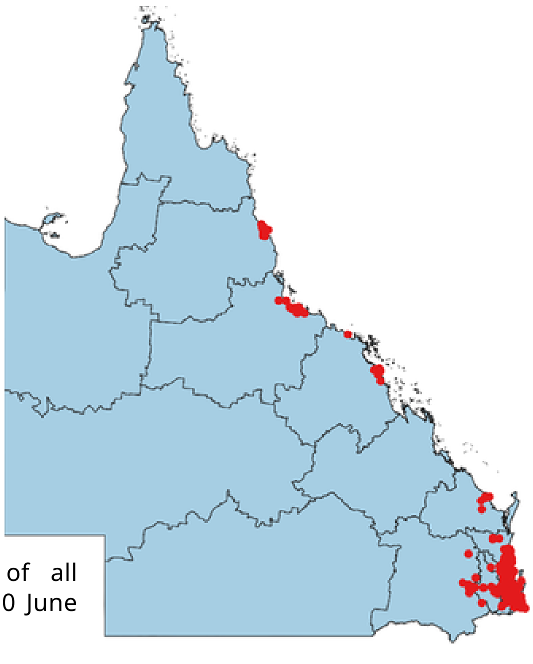


Figure 15. Geographical locations of all MCCD cases between July 2020 and 30 June 2024. Each dot represents a case.

Table 1 compares the characteristics of patients who received MCCD and those who did not. In accordance with the QAS eligibility criteria for MCCD, this analysis included only patients aged between 18 and 65 years of age, of medical aetiology, who received a resuscitation attempt by paramedics between July 2020 and June 2024. A notably higher percentage of MCCD patients were witnessed by bystanders, received bystander CPR, and were defibrillated and administered amiodarone by paramedics.

Table 1. Characteristics of patients who received MCCD and those who did not.

	MCCD	No MCCD
Male	72.2%	67.5%
Median age	53 years	55 years
Presumed cardiac cause*	88.6%	85.0%
Bystander-witnessed	53.0%	43.4%
Bystander CPR	76.6%	67.8%
Defibrillated by paramedics	48.2%	40.8%
Amiodarone administered	28.3%	11.1%
Transported to hospital	44.4%	44.5%

*Unknown cause was allocated to presumed cardiac in accordance with the 2024 Utstein template.[2]

CPR-induced consciousness

During the period from FY 2018/19 to FY 2023/24, there were a combined total of 308 CPR-induced consciousness (CPRIC) cases, equating to an average of 51 cases per annum or 2.1% of attempted-resuscitation cases. The most common CPRIC sign was deliberate motor movements, reported in 56.8% of patients with CPRIC, followed by spontaneous breathing (30.5%), groaning (25.3%), and opening eyes (23.4%) (Figure 16).

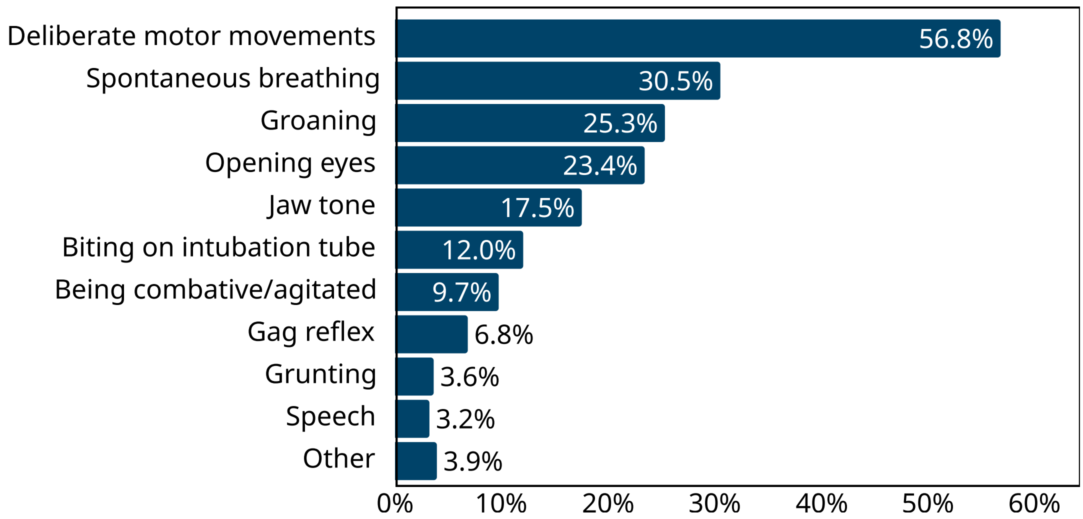


Figure 16. Signs of CPR-induced consciousness. A patient may exhibit more than more sign.

Of those with CPRIC, 24.7% (76/308) of patients received pharmacological interventions for CPRIC management. The most common pharmacological regimen was fentanyl in combination with midazolam, administered to approximately half (48.7%) of CPRIC patients receiving pharmacological interventions. This is followed by fentanyl alone (34.2%) and midazolam alone (14.5%). Fentanyl in combination with rocuronium and rocuronium alone each was used in one patient (Figure 17).

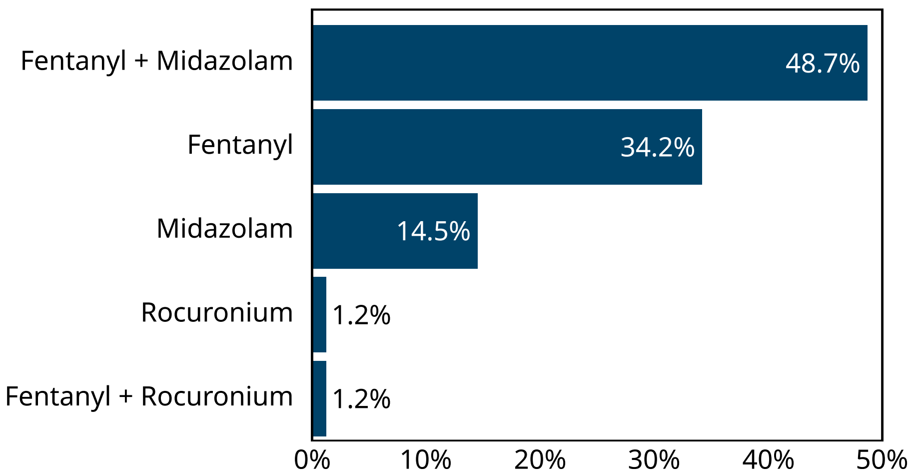


Figure 17. Pharmacological regimens administered to patients for CPRIC management

Survival outcomes

Survival outcomes of various patient groups are presented in Figure 18.

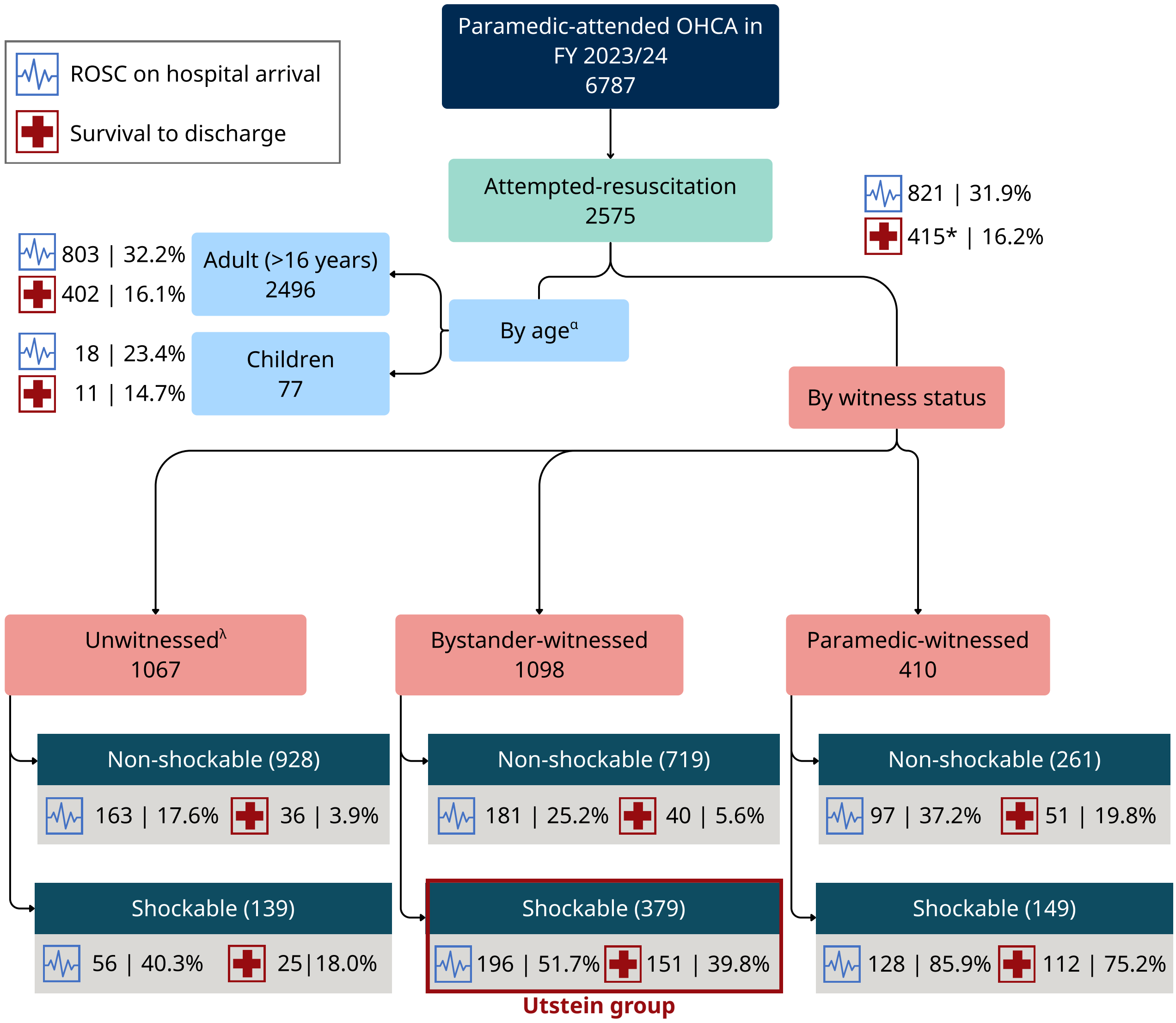


Figure 18. Survival outcomes of various patient groups, FY 2023/24.
*Unknown discharge survival status for seven attempted-resuscitation patients; those patients were excluded from the denominator in the calculation of discharge survival rates.
[α]Unknown age for two attempted-resuscitation patients.
[λ]Includes unknown witnessed status (47 attempted-resuscitation patients).

In FY 2023/24, 379 patients met the Utstein criteria (all-cause, attempted-resuscitation, initial shockable rhythm, bystander-witnessed). For this patient group, the rates of event survival (return of spontaneous circulation on hospital arrival), survival to discharge, and 30-day survival were 51.7%, 39.8%, and 39.8%, respectively. This represents a 12% relative increase in event survival and 24% relative increase in survival to discharge/30-day survival from previous FY (2022/23) (Figure 19).

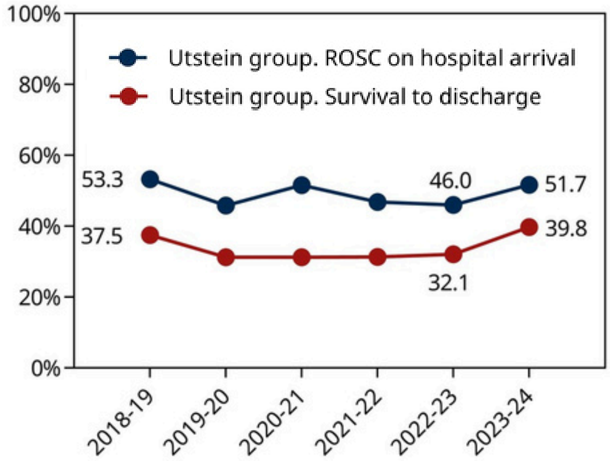


Figure 19. Trends of event survival and survival to discharge of the Utstein patient group.

Figure 20 benchmarks QAS survival figures against those of other ambulance services in Australia, New Zealand, and internationally for the Utstein patient group. There are slight definitional differences across ambulance services in terms of Utstein patient group inclusion. Table 2 presents the Utstein inclusion criteria, survived event, survival to discharge and 30-day survival information by ambulance service for transparency of benchmarking. Our survival figures for the Utstein group compare favourably nationwide and internationally.

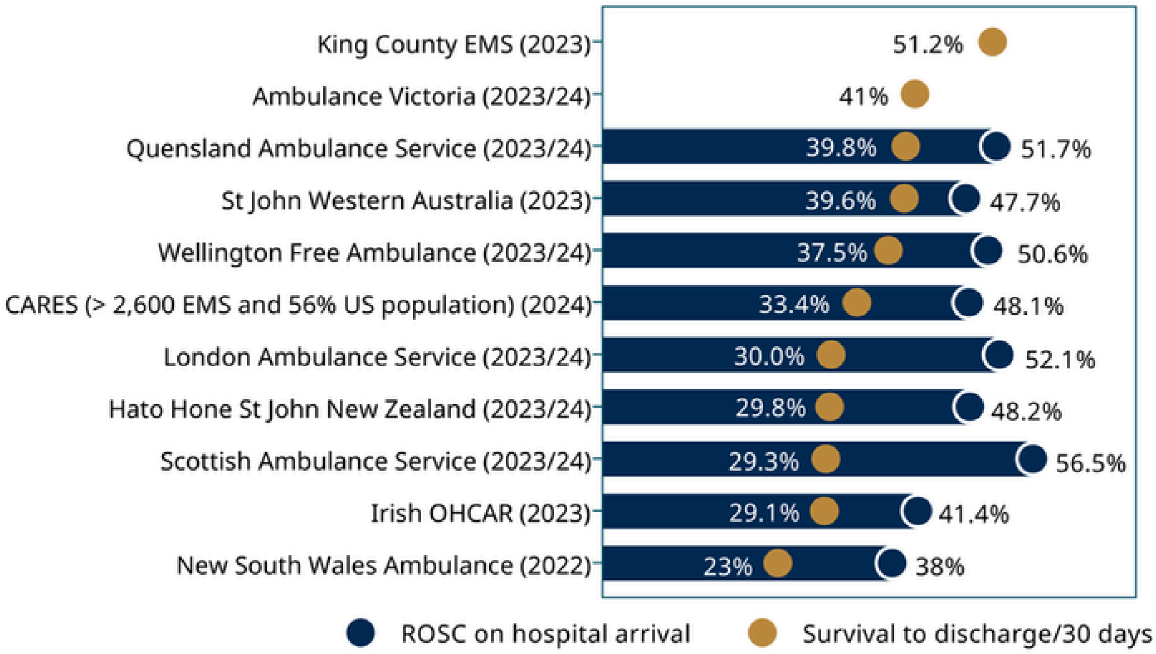


Figure 20. Survival figures of the Utstein patient group reported by national and international ambulance services. Latest reported figures are shown for each ambulance service.

Table 2. Definition, reporting period, and survival figures of the Utstein patient group reported by national and international ambulance services

Ambulance service	Reporting period	Definition of Utstein group	Survived event (%)	Discharged alive (%)	30-day survival (%)
Queensland Ambulance Service	1 July 2023 – 30 June 2024	All-age, All-cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	51.7	39.8	39.8
Hato Hone St John (New Zealand)[3]	1 July 2023 – 30 June 2024	⩾ 15 years old, All-cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	48.2	-	29.8
Wellington Free Ambulance (New Zealand)[3]	1 July 2023 – 30 June 2024	⩾ 15 years old, All-cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	50.6	-	37.5
Ambulance Victoria[4]	1 July 2023 – 30 June 2024	All-age, All-cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	-	41	-
St John Western Australia[5]	Calendar 2023	All-age, All-cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	47.7	-	39.6
Seattle & King County (USA)[6]	Calendar 2023	All-age, Non-traumatic, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	-	51.2	-
CARES (> 2,600 EMS and 56% US population)[7]	Calendar 2024	All-age, Non-traumatic, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	48.1	33.4	-
Irish OHCAR[8]	Calendar 2023	> 17 years old, Medical cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	41.4	29.1	-
Scottish Ambulance Service[9]	1 April 2023 – 31 March 2024	All-age, All-cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	56.5	-	29.3
London Ambulance Service[10]	1 April 2023 – 31 March 2024	All-age, Cardiac cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	52.1	-	30
New South Wales Ambulance[11]	Calendar 2022	All-age, Cardiac cause, Attempted-resuscitation, Bystander-witnessed, Initial shockable rhythm	38	-	23

Special topics

Intra-arrest vascular access by paramedics

The treatment of OHCA usually requires parenteral administration of resuscitation medications. Although resuscitation guidelines recommend either intravenous (IV) or intraosseous (IO) for vascular access during a cardiac arrest in adults, preference is given to IV, with IO being an alternative route when IV access is difficult to obtain.[12] Included in this analysis were adult OHCA patients of medical aetiology who received a resuscitation attempt by QAS paramedics between 1 July 2018 and 30 June 2024, and had IV or IO access attempted by paramedics during the arrest, regardless of the outcome of the first insertion attempt. A total of 8540 patients met the inclusion criteria. The overall initial attempt success rate of both access routes combined was 70.1%. The overall success rate within two and three attempts was 87.0% and 95.3%, respectively.

Figure 21 shows the insertion patterns. Of all patients who had vascular access attempted intra-arrest, first-line IV was attempted in 93.3% of patients and first-line IO 6.7%. The success rates of the initial attempt, within two attempts, and within three attempts among IV-first patients were 68.4%, 86.2% and 95.0%, respectively. The corresponding figures for IO-first patients were 94.0%, 98.2% and 99.1%, respectively.

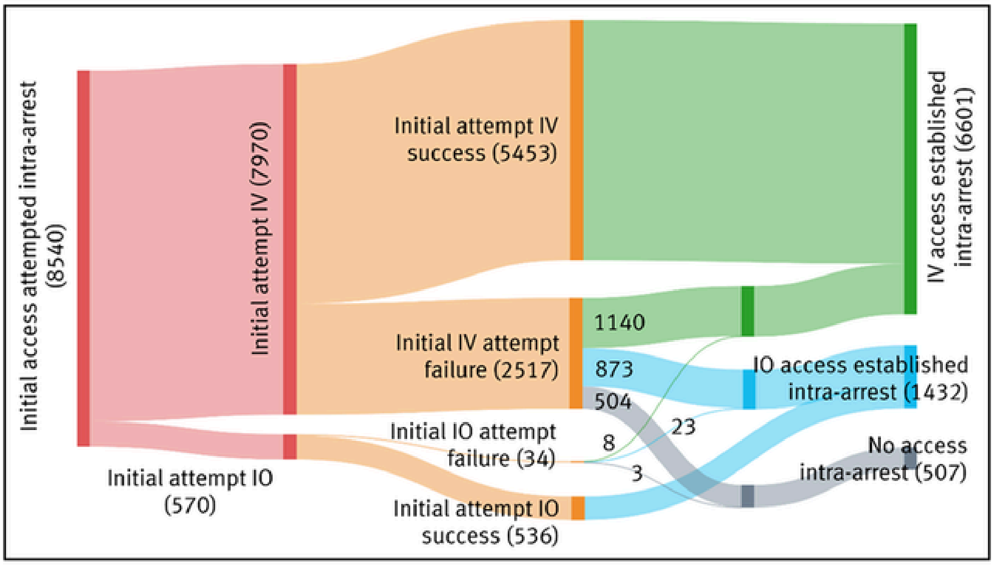


Figure 21. Flow diagram showing insertion patterns.

Our initial attempt success rate of 68.4% for IV access is markedly higher than that reported by Reades et al.[13] (49%) in a similar patient cohort in the United States. Our figure is also higher than the pooled estimate of 62.3% reported in a meta-analysis of randomised controlled trials in adult OHCA patients.[14] When successful IV access within two attempts is considered, our success rate of 86.2% is higher than that reported for adult medical OHCA in Denmark (80%) where OHCA are generally attended by a primary ambulance unit and a physician-manned unit.[15] Despite the unique challenges associated with IV insertion in OHCA, our initial attempt success rate is similar to that observed in the in-hospital setting. Carr et al.[16] reported the initial attempt success rate of IV to be 73% in the emergency department in Australia regardless of patient's presenting conditions. Our initial attempt success rate (94.0%) and success rate within two attempts (98.2%) for IO are higher than previous studies in similarly advanced emergency medical services which reported 92.3%[14] and 92%,[15] respectively.

The most common site of initial IV attempt was the antecubital fossa (79.8% of patients having IV access attempted), and the most common site of initial IO attempt was the proximal tibia (68.4% of patients having IO access attempted) (Figure 22). The most common cannula size for initial IV attempt was 18G (61% of patients having IV access attempted), and the most common needle size for initial IO attempt was 25 mm (55% of patients having IO access attempted) (Figure 23).

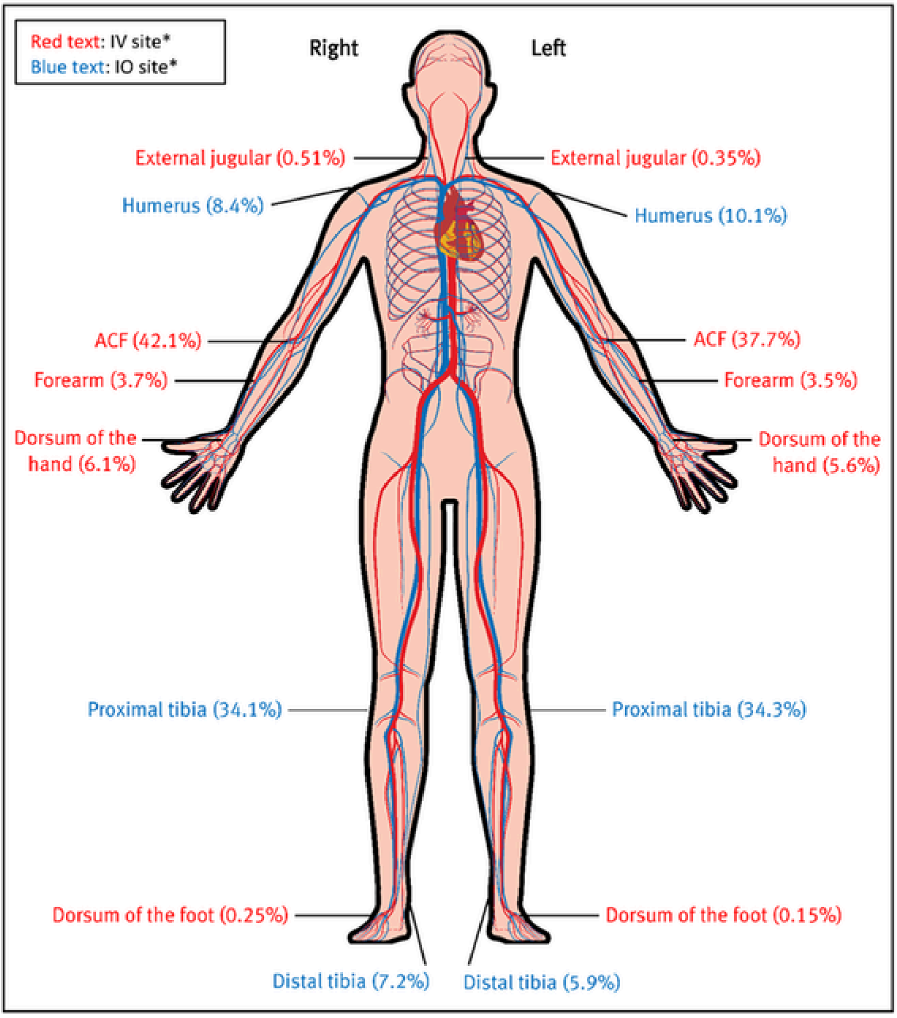


Figure 22. Sites of initial vascular access attempt.
*Unknown IV sites (6.4% of all IV cases) and unknown IO sites (4.4% of all IO cases) are not shown

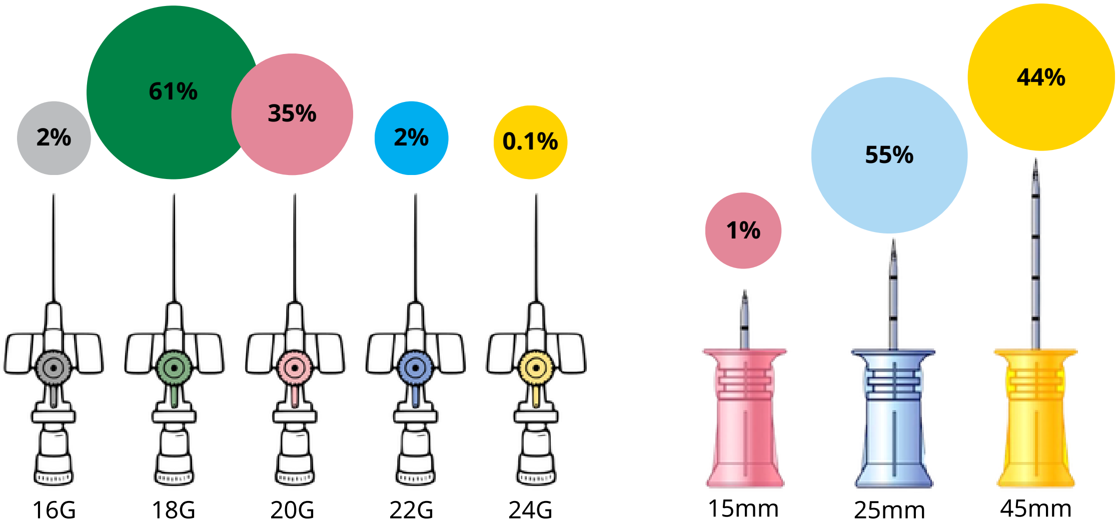


Figure 23. Initial attempt needle size.
Left panel IV, right panel IO. Needle size is unknown for 5.6% of IV patients and 8.1% of IO patients.

Special topics

Intra-arrest fibrinolysis

Between 1 April 2013 (first recorded intra-arrest fibrinolysis case) to 30 June 2024 (cutoff of this report), a total of 101 OHCA patients were administered intra-arrest fibrinolysis with tenecteplase. This was administered in the setting of paramedic-identified STEMI on 12-lead electrocardiogram (ECG) (70/101) or suspected pulmonary embolism (PE) as a presumed cause of the cardiac arrest (31/101).

Table 3 shows patient's characteristics. The median age for the entire study sample was 55 years, with STEMI patients being on average 8 years older than suspected PE patients. Compared to suspected PE patients, STEMI patients had a higher percentage of male (80.0% versus 41.9%), initial shockable rhythm (65.7% versus 9.7%), paramedic defibrillation (71.4% versus 12.9%), and amiodarone administration (44.3% versus 9.7%). Time from cardiac arrest to fibrinolysis was shorter in STEMI patients than suspected PE patients (median 23 minutes versus 31 minutes), while total resuscitation time was similar between the two groups. Suspected PE patients had higher survival rates than STEMI patients (25.8% versus 18.6% for both discharge survival and 30-day survival). For comparison, discharge survival rates for attempted-resuscitation OHCA adult patients of suspected PE and presumed cardiac aetiology for the same period were 17.2% and 17.8%, respectively.

Table 3. Characteristics of OHCA patients receiving intra-arrest fibrinolysis

Variable	All patients (STEMI + PE) n = 101	STEMI n = 70	PE n = 31
Median age	55 years	56 years	48 years
Male	68.3%	80.0%	41.9%
Arrest occurs in private residence	80.2%	81.4%	77.4%
Witnessed arrest (by bystanders or paramedics)	98.0%	98.5%	96.8%
Bystander CPR*	81.6%	81.5%	81.8%
Initial rhythm shockable	48.5%	65.7%	9.7%
Paramedic defibrillation	53.5%	71.4%	12.9%
Number of shocks‡ (median)	8	7	11
Median time from cardiac arrest to resuscitation	0 min	0 min	0 min
Median time from cardiac arrest to tenecteplase	25 mins	23 mins	31 mins
Median duration of resuscitation	52 mins	52 mins	54 mins
Adrenaline administration	95.0%	92.9%	100%
Amiodarone administration	33.7%	44.3%	9.7%
Intra-arrest fibrinolysis regimen			
Tenecteplase only	26.7%	24.3%	32.3%
Tenecteplase + heparin	64.4%	64.3%	64.5%
Tenecteplase + enoxaparin	8.9%	11.4%	3.2%
Tenecteplase dose (mean, SD)	43.5 (8) mg	43 (8) mg	44 (7) mg
ROSC on hospital arrival	38.6%	40.0%	35.5%
Discharged alive	20.8%	18.6%	25.8%
30-day survival	20.8%	18.6%	25.8%

*In patients who were not witnessed by paramedics.
‡Among those defibrillated by QAS paramedics only.

ST-ELEVATION MYOCARDIAL INFARCTION

Key Statistics 2023/24

7 min

median time from paramedic arrival to first 12-lead ECG

80%

of patients had first 12-lead ECG within 10 min of paramedic arrival

72%

prehospital reperfusion treatment rate

31 min

median time from STEMI identification to tenecteplase

19 min

median time from STEMI identification to PCI referral call

54%

of patients had PCI referral call within 20 min of STEMI identification

86 min

median time from STEMI identification to reperfusion*

57%

of direct PCI referral patients achieved reperfusion within 90 min of STEMI identification

97%

30-day survival rate in direct PCI referral patients

93%

30-day survival rate in prehospital fibrinolysis patients

* direct PCI referral patients

Number of cases, incidence rate & **Demographics**

In FY 2023/24, QAS paramedics attended and treated 1290 STEMI patients. This equates to a crude incidence rate of 31 cases per 100,000 adult population (Figure 24). Males accounted for 72% of paramedic-identified STEMI cases, and on average were seven years younger than females (Figure 25).

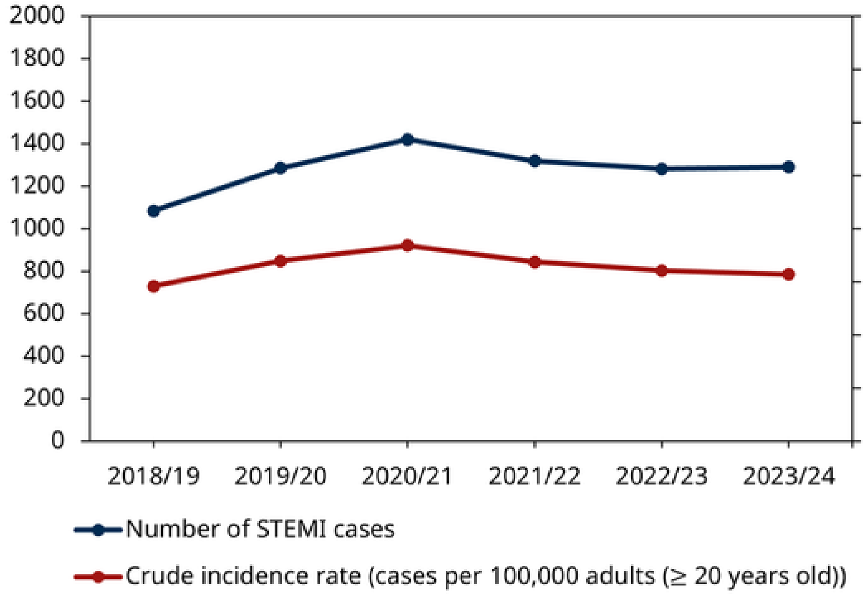


Figure 24. Number and incidence rate of paramedic-identified STEMI.

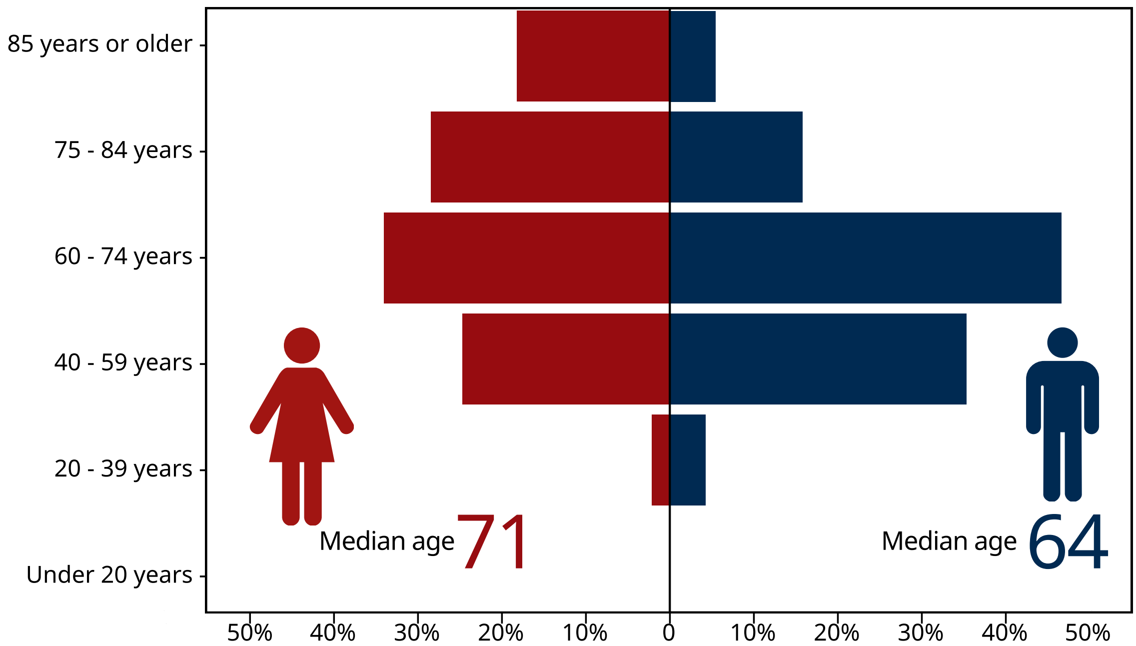


Figure 25. Age distribution of paramedic-identified STEMI patients in FY 2023/24, by sex.

Prehospital reperfusion pathway

Over the years, there has been a significant improvement in the proportion of STEMI patients who received prehospital reperfusion treatment by paramedics, being either direct referral to a hospital for primary PCI (direct PCI referral) or prehospital fibrinolysis. The overall proportion of patients who received any form of prehospital reperfusion therapy increased from 65.3% in FY 2018/19 to 71.8% in FY 2023/24, a 10% relative increase (Figure 26).

The observed trend of increasing proportion of patients who received any form of prehospital reperfusion therapy was mainly attributable to the increase in direct PCI referral over time. Across the state, direct PCI referral has steadily increased over the years and remained the primary prehospital reperfusion pathway. This increase was more notable in rural areas than in metropolitan areas. In particular, the proportion of patients receiving direct PCI referral in rural increases increased 33% during this period (from 25.8% to 34.4%); whereas it was a 7% relative increase for metropolitan areas (from 66.0% to 70.7%) (Figure 26).

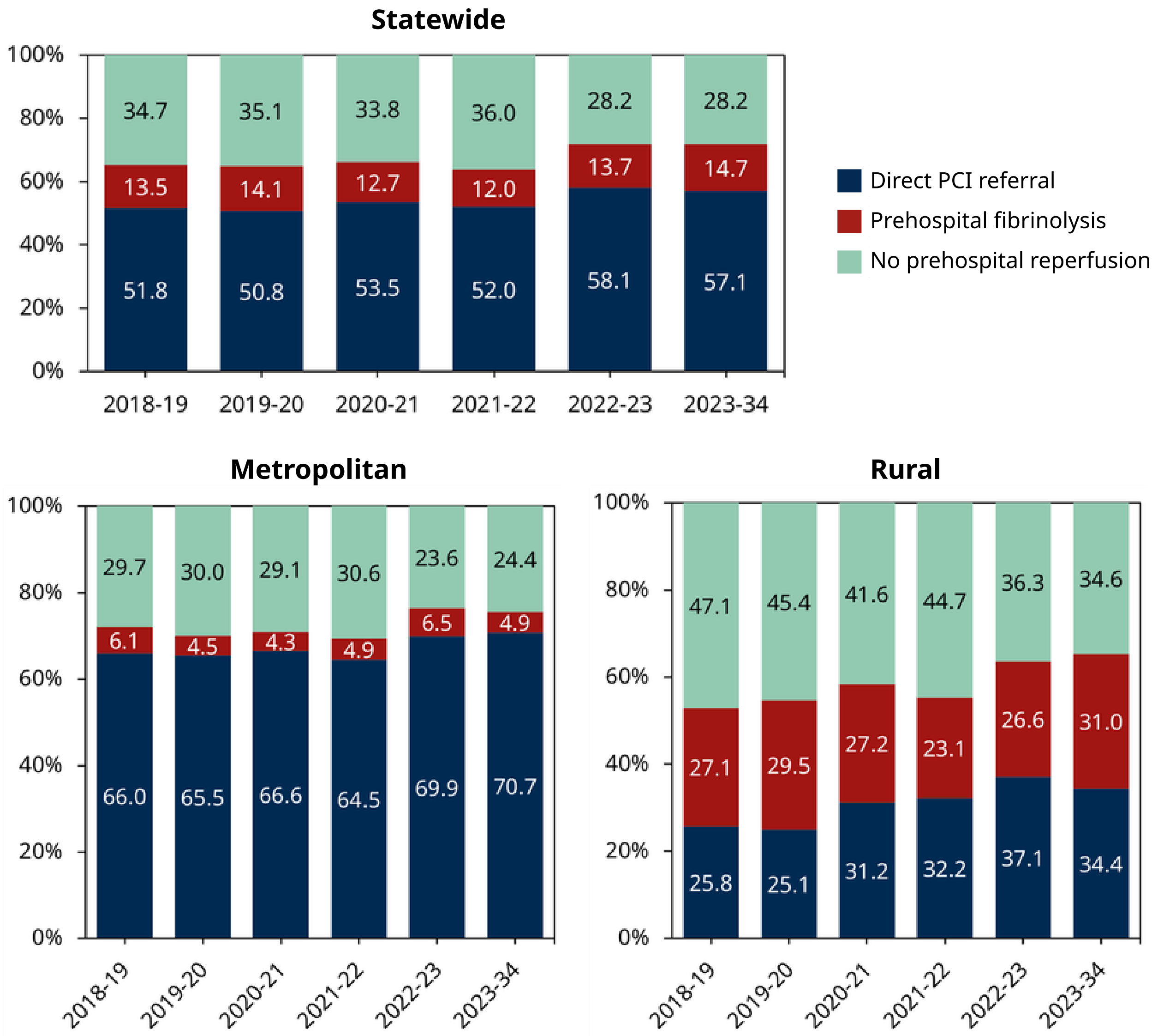


Figure 26. Prehospital reperfusion pathways.

Time from paramedic arrival at scene to first 12-lead ECG

In FY 2023/24, the median time from paramedic arrival at scene to first 12-lead ECG was 7.0 minutes for both metropolitan and rural areas, and 80% of patients had first 12-lead ECG performed within 10 minutes of paramedic arrival (Figure 27).

7 minutes

median time from paramedic arrival to first 12-lead ECG

80%

of patients had first 12-lead ECG within 10 min of paramedic arrival

Figure 27. Median time from paramedic arrival at scene to first 12-lead ECG and percentage of patients having this time interval within 10 minutes, FY 2023/24.

Time from STEMI identification to tenecteplase

Across the state, the median time from STEMI identification to prehospital tenecteplase administration was 31 minutes for FY 2023/24 (Figure 28). Almost half (47.5%) of prehospital fibrinolysis patients were transported directly to a PCI-capable facility, with the Princess Alexandra Hospital the most common destination (Figure 29).

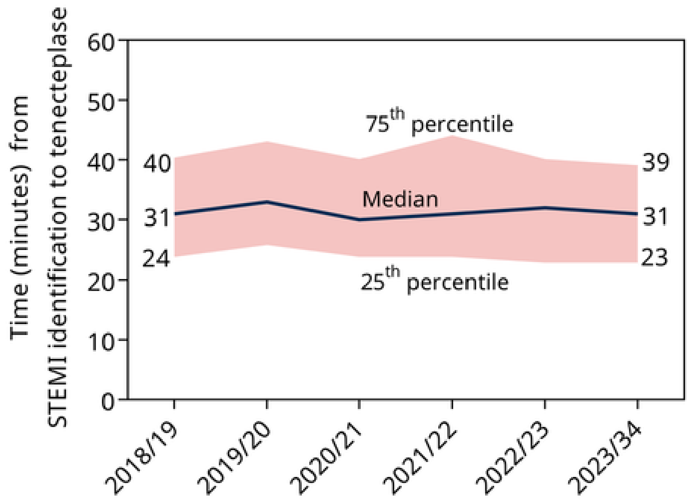


Figure 28. Time from STEMI identification to prehospital tenecteplase administration.

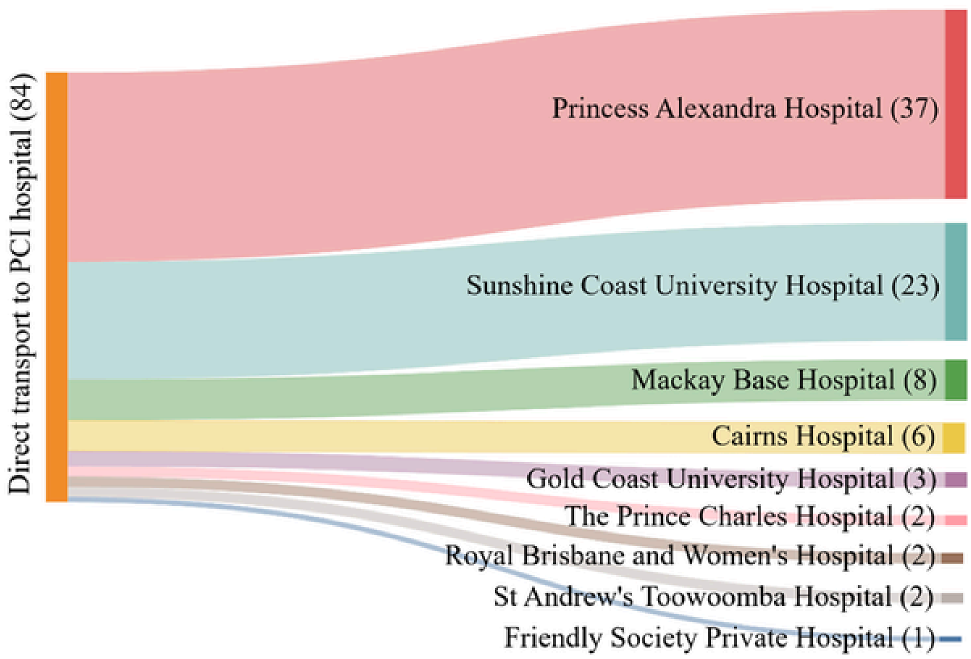


Figure 29. Hospital destinations of prehospital fibrinolysis patients who were transported directly to a PCI-capable hospital, FY 2023/24.

Prehospital fibrinolysis patients with direct transport to a PCI-capable hospital arrived at the facility on average 45 minutes after pre-hospital tenecteplase administration (Figure 30). For those who were initially transported to a non-PCI hospital, with subsequent transfer to a PCI-capable hospital, the median time from prehospital tenecteplase administration to arrival at the PCI-capable facility was five hours and 24 minutes (Figure 30). The most common PCI-capable hospital for inter-hospital transfer patients was the Prince Charles Hospital (Figure 31).

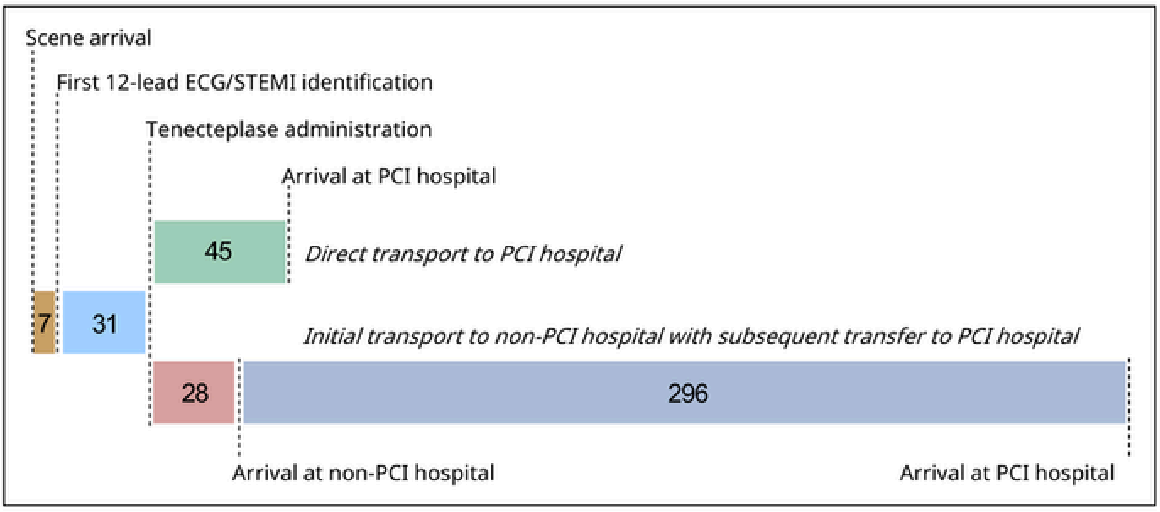
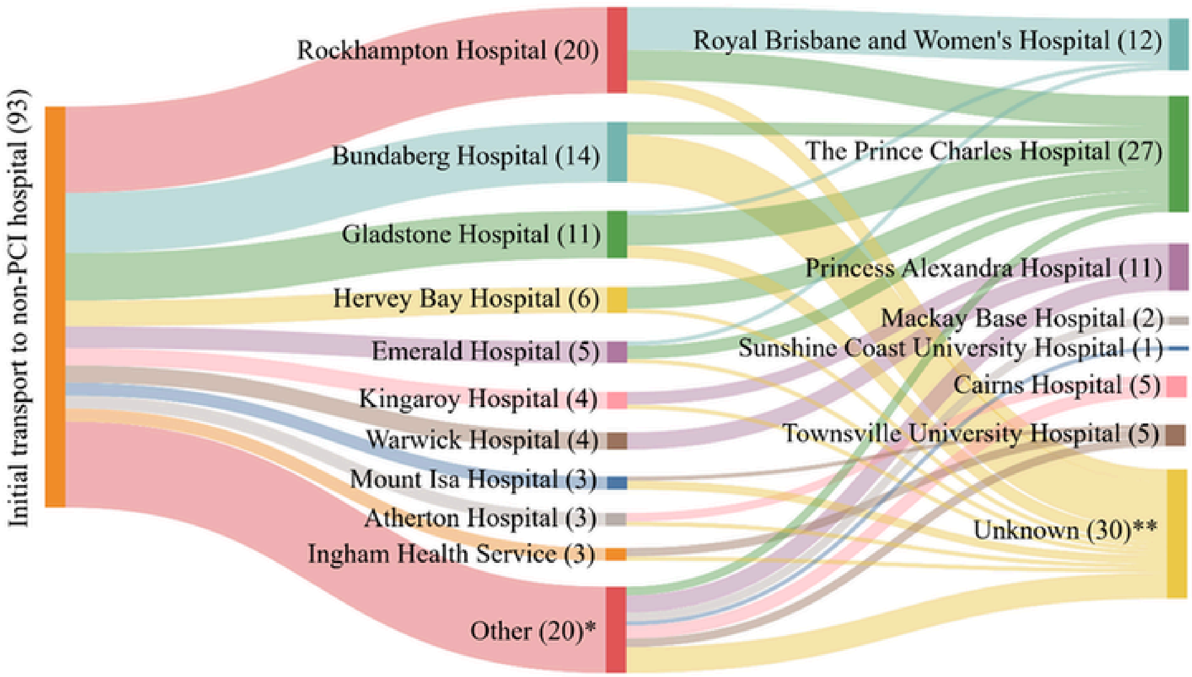


Figure 30. Time components (minutes) from scene arrival to arrival at PCI-capable hospital in prehospital fibrinolysis patients, FY 2023/24.



*Sixteen different hospitals with each receiving one or two patients.
**Lack of data to enable determination of whether inter-facility transfer occurred, and if so, to which tertiary receiving facility.

Figure 31. Hospital destinations of prehospital fibrinolysis patients who were initially transported to a non-PCI hospital, FY 2023/24.

Time from STEMI identification to PCI referral phone call

For direct PCI referral, prehospital notification of the cardiac catheterisation laboratory (CCL) by paramedics following prehospital STEMI identification, timely response of the primary PCI team upon receiving the prehospital notification, and timely admission to the CCL are integral parts of the treatment cascade for prehospital STEMI (Figure 32). Minimising delays in each of those components helps reduce reperfusion delays. There has been global recognition of the importance of prehospital notification in ensuring timely activation of the CCL and consequently reducing reperfusion delays. Quantifying delays in prehospital notification is part of the QAS system performance evaluation, with efforts targeting reductions in those delays.

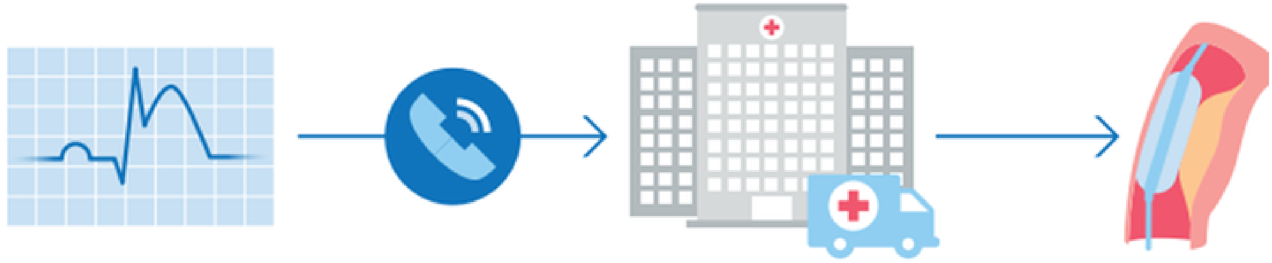


Figure 32. QAS direct PCI referral pathway.

In FY 2023/24, the median time from STEMI identification to initiation of the PCI referral phone call was 19 minutes. Statewide, 54% of patients had a PCI referral phone call initiated within 20 minutes of STEMI identification (Figure 33).

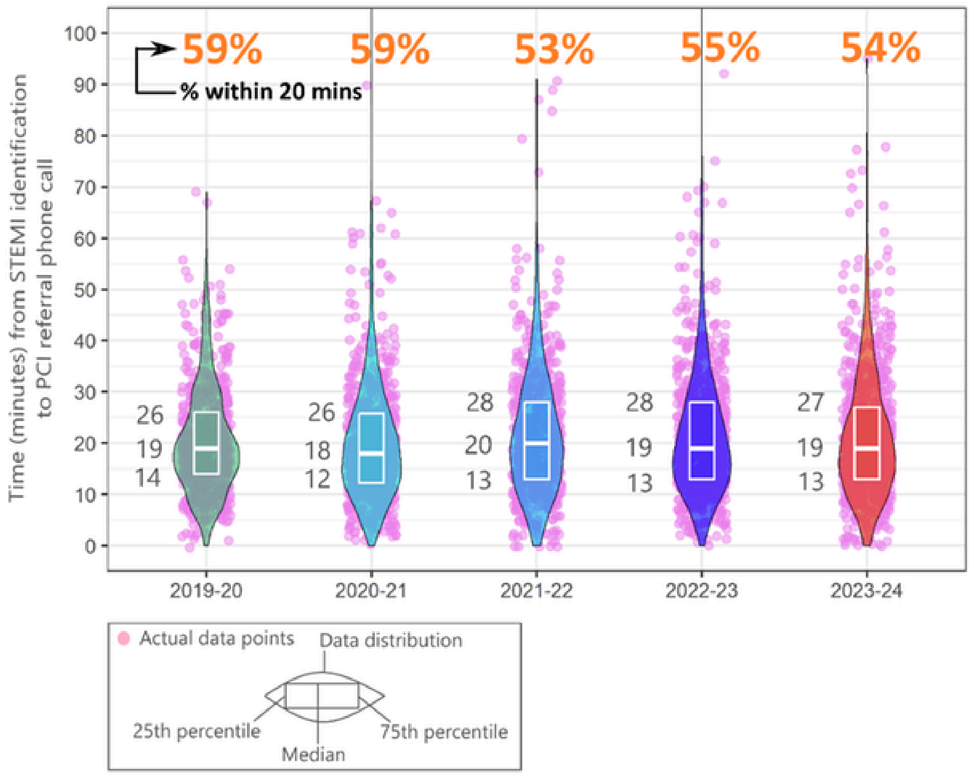


Figure 33. Time from prehospital STEMI identification to PCI referral phone call. Time of PCI referral phone call was not available before 2019.

Figure 34 shows the time interval from prehospital STEMI identification to PCI referral phone call for each PCI-capable hospital that has an approved direct PCI referral pathway with the QAS. Given the fact that the sample size is reduced when broken down into individual hospitals, data of five years (FY 2019/20 to FY 2023/24) were combined in this figure for statistical stability. Note that time of PCI referral phone call was not available before 2019. Direct PCI referral patients transported to Greenslopes Private Hospital had the longest time from STEMI identification to direct PCI referral phone call (median 23 minutes); whereas Townsville University Hospital the shortest (16 minutes).

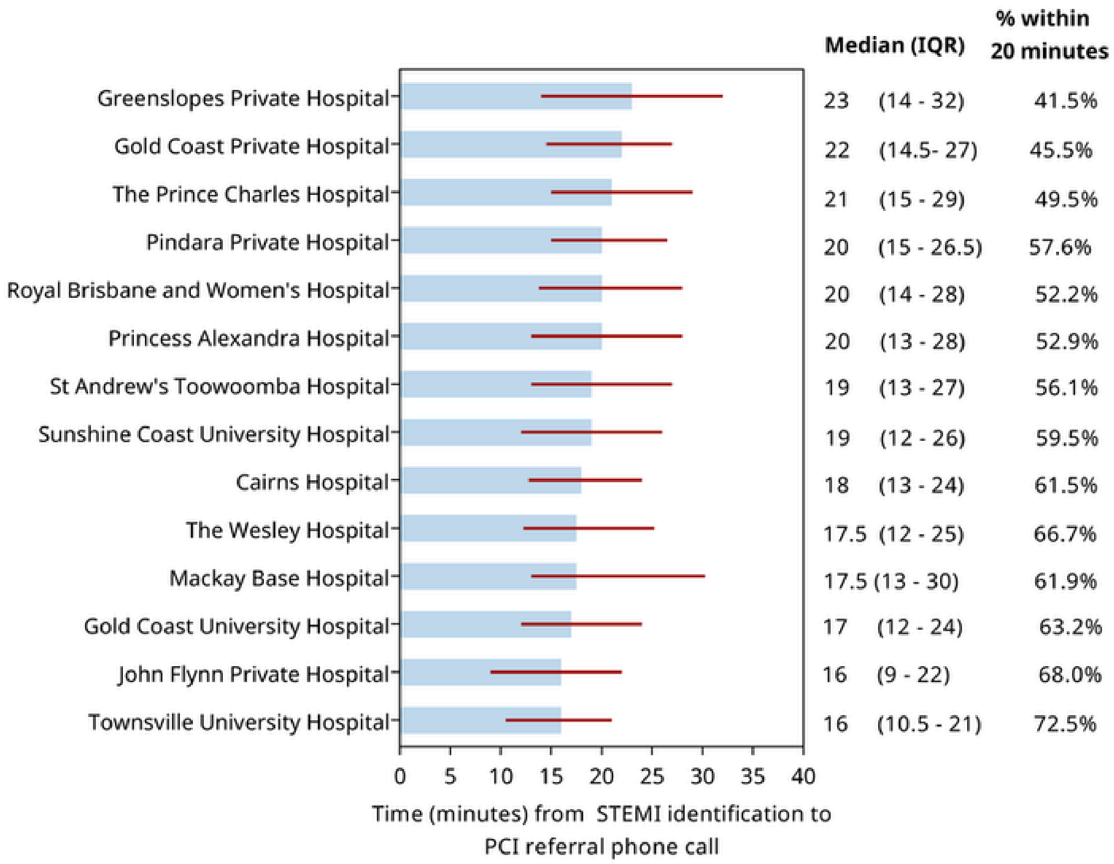


Figure 34. Time from prehospital STEMI identification to PCI referral phone call, and percentage of patients having this time interval within 20 minutes, for each individual PCI-capable hospital.

Time from STEMI identification to reperfusion in direct PCI referral patients

Reperfusion time for direct PCI referral patients was defined as time of TIMI-3 flow, where available. Where this timestamp was not available, the time of first device deployment was used as a surrogate for reperfusion time. Across the years from FY 2019/20 to 2023/24, all hospitals' combined median time from STEMI identification to reperfusion was 86 minutes, with median times for individual hospitals ranging from 73 minutes (Cairns Hospital) to 96.5 minutes (Mackay Base Hospital) (Figure 35). Statewide, 57.4% of direct PCI referral patients achieved time from STEMI identification to reperfusion within 90 minutes. Additional refinements to the STEMI program are required to further optimise referral pathways to maximise patients receiving early reperfusion. Strategies to reduce delays to reperfusion include early and appropriate notification of CCL by paramedics, timely response of the on-call PCI team upon receiving the prehospital notification of arriving cases from paramedics, and timely admission to the CCL when clinically appropriate.

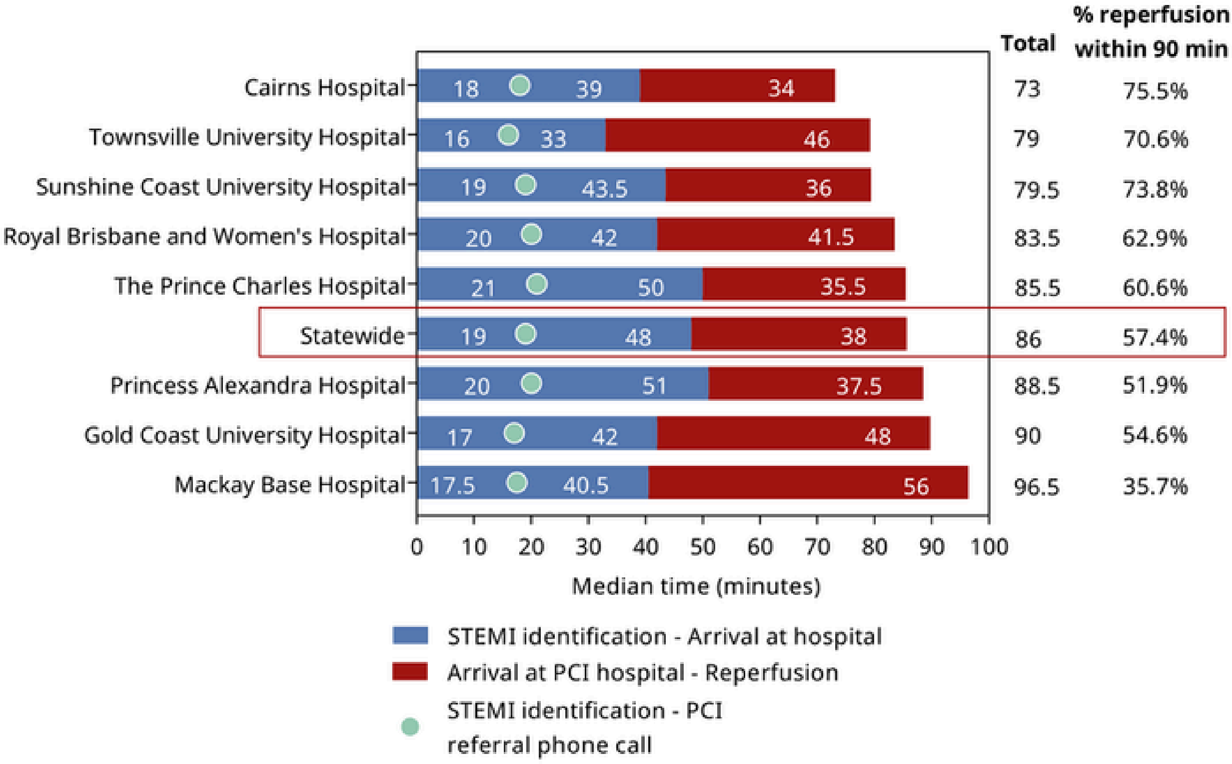


Figure 35. Time from prehospital STEMI identification to reperfusion in direct PCI referral patients, by hospital.

Survival outcomes

Mortality in paramedic-identified STEMI patients remains low, with 30-day all-cause mortality rates of 3.0% in direct PCI referral patients and 6.8% in prehospital fibrinolysis patients for FY 2023/24 (Figure 36). Our data do not allow reporting of outcomes other than mortality, and in turn do not consider clinical sequalae such as heart failure and unplanned cardiac readmissions. It would be expected that earlier treatment of STEMI patients would lower this complication burden. This is an important subject of future research.

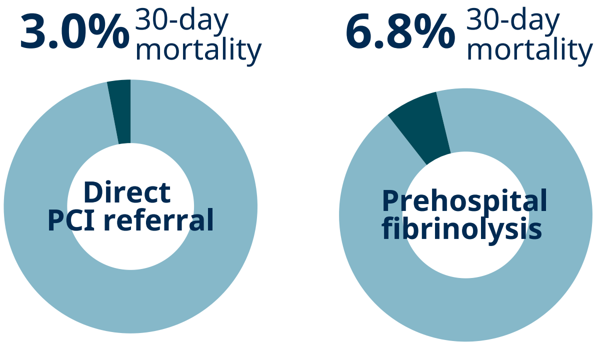


Figure 36. 30-day all-cause mortality rates

Cardiac data dashboards

Understanding data is essential to making informed data-driven decisions. However, the amount and complexity of data in its original form can be overwhelming for users. Data dashboards visually represent key information using visualisations (such as charts, graphs, maps), thus providing a way to make complex data easier to understand. Visual representation of information in a dashboard enables monitoring of progress, and identification of patterns, trends and anomalies at a quick glance.

The QAS OHCA dashboard and STEMI dashboard, built in Microsoft Power BI, are visual interfaces of the QAS OHCA and STEMI data collections. The dashboards were developed through consultation with users and stakeholders within the organisation to support their needs and requirements. The dashboards provide insights into the community response, ambulance response, prehospital care, conveyance and outcomes of OHCA and prehospital STEMI patients in Queensland. They allow users to interact with and explore data held in the OHCA and STEMI data collections in a visual and user-friendly way. Users can filter on variables of interest such as demographics, geography, time periods, patient groups, and much more. The dashboards host an interactive map of Queensland with geolocations of incidents. The dashboards enable data-driven conversations about the functioning of a region, current system performance, opportunities for improvement, and future service planning. Features to ensure security and data safety, such as secure user credentialing and server hosting, underpin the dashboards. Key attributes of the dashboards are shown in Figure 37. Sample screenshots of the OHCA and STEMI dashboards are shown in Figures 38 and 39, respectively.

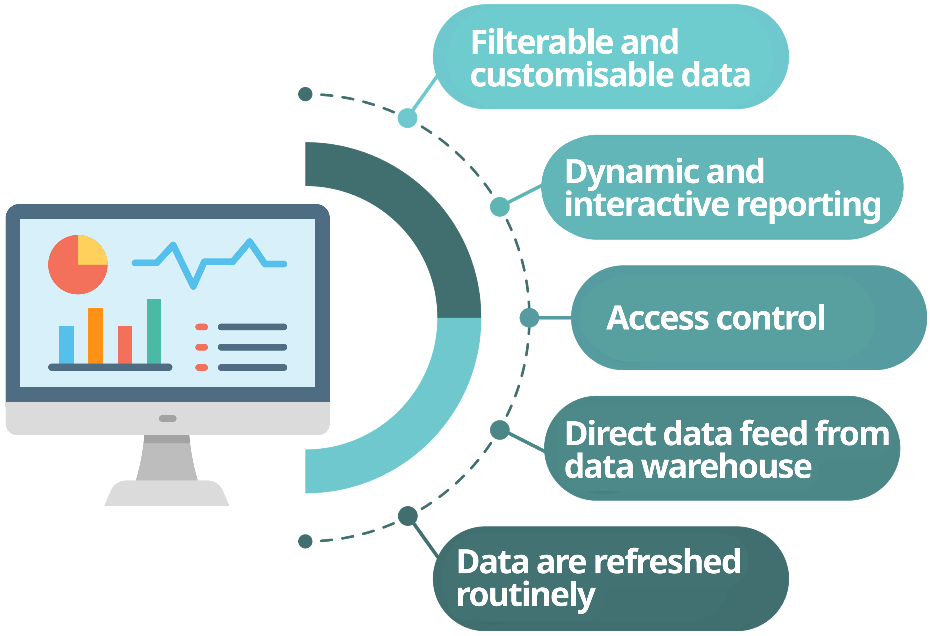


Figure 37. Key attributes of the QAS OHCA and STEMI dashboards.

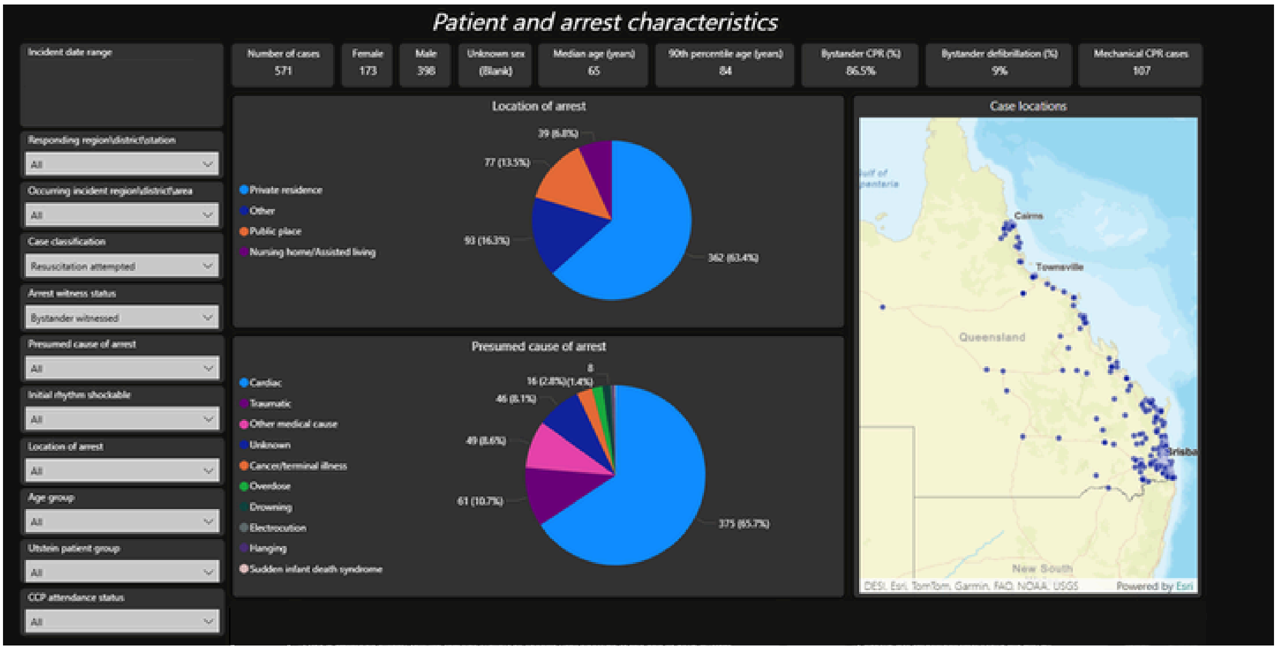


Figure 38. Screenshot of the QAS OHCA dashboard.

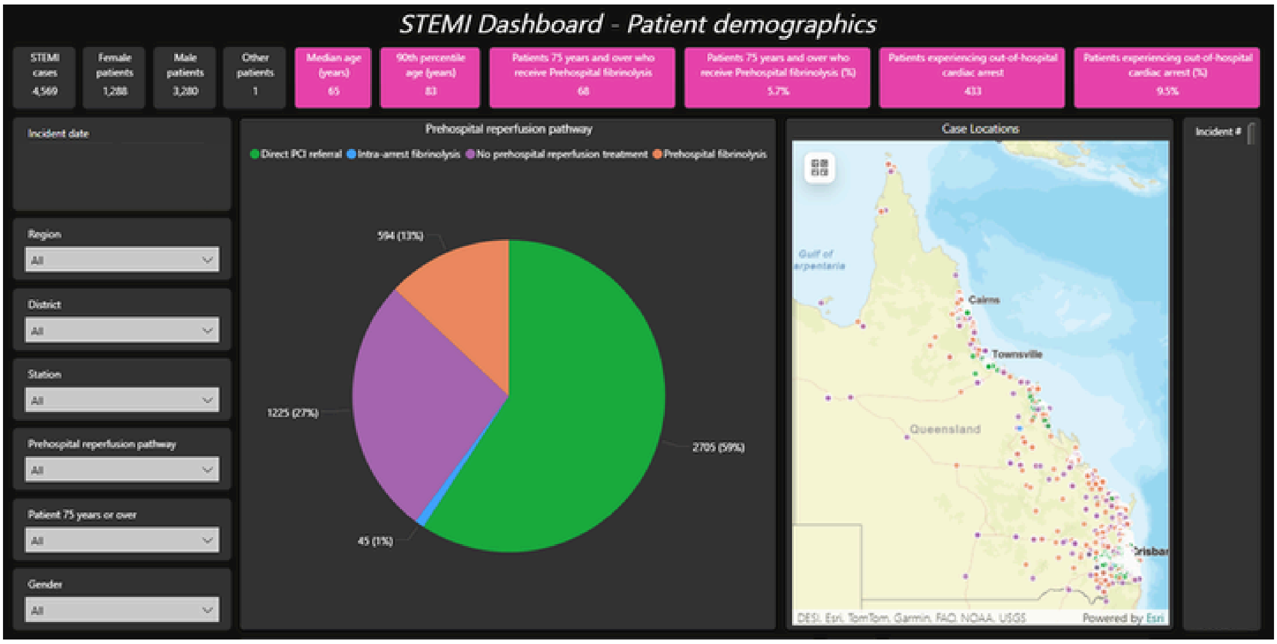


Figure 39. Screenshot of the QAS STEMI dashboard.

Conclusions

The QAS continues to deliver outstanding prehospital care to OHCA and STEMI patients across Queensland. Our OHCA survival rates increased from last FY and continue to compare very favourably with other high-performing ambulance services in Australia and internationally. Community response to OHCA in Queensland has improved over the years, evident by the increasing bystander CPR rates and AED use.

QAS ambulance clinicians demonstrate competence in vascular access during an arrest with high initial attempt success rate. The QAS continues to embrace digital technology with the development of the OHCA and STEMI dashboards, enhancing data accessibility, performance monitoring and decision-making.

Contributions

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Ms Louise Sims	Queensland Ambulance Service
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List of figures and tables

Abbreviations

ACF	Antecubital fossa
CCL	Cardiac catheterisation laboratory
CPR	Cardiopulmonary resuscitation
CPRIC	Cardiopulmonary resuscitation induced consciousness
ECG	Electrocardiogram
FY	Financial year
IV	Intravenous
IO	Intraosseous
MCCD	Mechanical chest compression device
OHCA	Out-of-hospital cardiac arrest
PCI	Percutaneous coronary intervention
PE	Pulmonary embolism
QAS	Queensland Ambulance Service
ROSC	Return of spontaneous circulation
SD	Standard deviation
STEMI	ST-segment elevation myocardial infarction

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