St John

Out-of-Hospital Cardiac Arrest Report

2022

Acknowledgement of country

St John WA acknowledges the First Nations people of the many Traditional lands and language groups across Western Australia, as the Traditional Custodians of the Country. We pay our respects to their Ancestors and Elders, past and present.

SJWA is committed to honouring the unique cultural and spiritual relationships to the land, sea and waterways and the rich continuing contribution Aboriginal and Torres Strait Islander peoples make to our society.

Introduction

St John WA presents its out-of-hospital cardiac arrest (OHCA) report for the calendar year 2022 that is made possible by the close collaboration and partnership with the researchers at Pre-hospital, Resuscitation and Emergency Care Research Unit (PRECRU) based at Curtin University, Perth. The Western Australia (WA) cardiac arrest database is managed and maintained at PRECRU and continues to inform and influence practice.

As with many healthcare systems, ambulance service delivery was heavily impacted by the high number of COVID-19-related cases due to WA borders being reopened in 2022. Unprecedented demand across the entire health system, coupled with staff shortages due to illness led to pressures impacting service delivery to all St John WA patients, including those in cardiac arrest.

As Western Australia's foremost ambulance service, we reflect on the challenges experienced in 2022 and thank staff and volunteers for their absolute dedication and perseverance in delivering the best possible care to patients and communities, while continuing to see positive outcomes in our out-of-hospital cardiac arrest (OHCA) patients.

In 2022, of the 1182 cases where resuscitation was attempted, 233 (19.7%) had spontaneous circulation on arrival at the emergency department. Ultimately 128 (10.8%) people survived to 30 days.

St John WA remains mindful of those who did not survive OHCA in WA and we pause to acknowledge and offer our respects to them, their families, and communities. We resolve to continue efforts to improve our systems and practice for the benefit of all.

Acknowledgements

A/Prof Paul Bailey **(Medical Director) (2022)**

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Dr Stephen Ball **(Dep. Director PRECRU)**

Dr David Reid **(Clinical Services) (2022)**

Jason Belcher **(Clinical Services)**

Rudi Brits **(Clinical Services)**

Michelle Fyfe APM **(CEO) (2022)**

Antony Smithson **(Acting CEO) (2022)**

Prof Ian Jacobs **(late)**

The PRECRU team

The Clinical Services team

The State Operations Centre team

Ambulance operational teams, spanning staff and volunteers

Community First Responder team, First Aid trainers and all other team members that contribute to strengthening the chain of survival

Learn more about our team at **news.stjohnwa.com.au** and follow the links.

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Abbreviations

AED	Automated External Defibrillator
ANZCOR	Australian and New Zealand Committee on Resuscitation
AusROC	Australasian Resuscitation Outcomes Consortium
CAD	Computer Aided Dispatch
CFR	Community First Responder
CP	Community Paramedic
CPR	Cardio-Pulmonary Resuscitation
CSP	Clinical Support Paramedic
ED	Emergency Department
EMD	Emergency Medical Dispatcher
EMS	Emergency Medical Service
ePCR	Electronic Patient Care Record
HREC	Human Research Ethics Committee
ILCOR	International Liaison Committee on Resuscitation
MPDS	Medical Priority Dispatch System
OHCA	Out of Hospital Cardiac Arrest
PEA	Pulseless Electrical Activity
PCI	Percutaneous Coronary Intervention
PRECRU	Pre-hospital, Resuscitation and Emergency Care Research Unit (Curtin University)
ROSC	Return of Spontaneous Circulation
SJWA	St John Western Australia
SOC	State Operations Centre
SUDI	Sudden Unexpected Death in Infancy
VF	Ventricular Fibrillation (shockable rhythm)
VT	Ventricular Tachycardia (shockable rhythm when pulseless)
WA	Western Australia

Definitions

30-day Survival
Where a patient is recorded as being alive 30 days after their out-of-hospital cardiac arrest.

Adults
Patients aged 16 years or greater, or where the age is missing/unknown (in the absence of the patient being described as a child).

Aetiology
The precipitating cause of a cardiac arrest (e.g., trauma, overdose/poisoning, asphyxia, presumed cardiac)

All-cause
Referring to OHCA cases of all aetiologies.

Asystole
Absence of any cardiac electrical activity.

Bystander witnessed
An out-of-hospital cardiac arrest that is witnessed by a bystander (seen or heard).

Community First Responder activation
An event where an AED registered on the Community First Responder network is applied to a patient prior to ambulance arrival.

Defibrillation
Providing an electrical shock to a patient in a shockable heart rhythm.

EMS attempted resuscitation
Cases where trained ambulance clinicians attempted to revive a patient in cardiac arrest using CPR and/or defibrillation, as well as any patients who received a defibrillator shock from bystanders.

EMS attended
Cardiac arrest events attended by trained ambulance personnel regardless of whether treatment was provided.

EMS response time
The time from the start of the emergency call to arrival of an ambulance crew on scene.

EMS witnessed
An out-of-hospital cardiac arrest that occurs in the presence of on-duty Emergency Medical Service personnel (paramedics and/or volunteer ambulance officers)

Event survival
Patients who have ROSC (a palpable pulse) on arrival at hospital as documented on the ePCR.

Metropolitan/Metro
Denotes the Perth metropolitan area (based on the Australian Bureau of Statistics classification for Greater Capital City Statistical Areas, 2016).

Non-shockable rhythm
Cardiac electrical rhythms which are not appropriate to receive a defibrillation shock. These rhythms include asystole and PEA.

Out of Hospital Cardiac Arrest
Where the patient has no signs of circulation. Specifically, when there is an absence of a detectable carotid pulse, the patient is unconscious/unresponsive, and has agonal/ absent breathing; with the event occurring outside of hospital.

Paediatrics/Children
Patients aged less than 16 years.

Paramedic
A healthcare professional registered with the Paramedicine Board of Australia as per the Health Practitioner National Law Act (WA) 2010. In the Western Australian ambulance service context, career ambulance crews consist of registered paramedics who provide cardiac arrest care consistent with the ANZCOR Advanced Life Support algorithm.

Presumed cardiac
Cases where the cause of arrest is not due to a known precipitator (e.g., trauma, overdose/poisoning, asphyxial), as determined from the ePCR.

Priority 1
High priority emergency ambulance response, with immediate vehicle dispatch responding with lights-and-sirens to the scene.

Pulseless Electrical Activity
The absence of a palpable pulse, with organised electrical activity on an electrocardiogram (other than ventricular tachycardia).

Regional/Rural WA
Denotes areas outside the Perth metropolitan area.

Resuscitation attempted
See EMS attempted resuscitation.

Return of Spontaneous Circulation (ROSC)
Return of circulation to the body with a detectable pulse.

State Operations Centre (SOC)
St John WA call centre for emergency ambulance Triple Zero (000) and non-urgent calls.

Shockable Rhythm
Cardiac electrical rhythms which are appropriate to receive defibrillation by St John WA ambulance clinicians, or from a bystander with a public AED. These rhythms include ventricular fibrillation and pulseless ventricular tachycardia.

Survival
May refer to Event Survival (ROSC on arrival at hospital) or 30-day Survival.

Triple Zero (000)
The Australian emergency telephone number used by the public to activate EMS (or other emergency services). In Western Australia, Triple Zero (000) callers who request ambulance are connected to SJWA SOC.

Utstein comparator patient group
Patients who are witnessed to arrest by a bystander, present in a shockable rhythm, and receive EMS attempted resuscitation. This includes any patient who receives a bystander AED shock, as these patients are known to have a shockable initial rhythm.

Volunteer Ambulance Officer
Unpaid ambulance officer with relevant training and skill, volunteering ambulance services to their community. Volunteers provide cardiac arrest resuscitation consistent with the ANZCOR Basic Life Support standard.

About the organisation and its response to cardiac arrest

St John WA (SJWA) provides ambulance services across a vast land mass approximately 2.5 million km^2 in area. Western Australia (WA) has a population of approximately 2.79 million, the majority of whom reside within the Perth metropolitan and south-west areas of the state (1).

SJWA also provides first aid training and automated external defibrillator (AED) services to communities across the state, which supports ambulance in the event of sudden out-of-hospital cardiac arrest (OHCA). Research has shown that a patient's OHCA survivability decreases by about 10% with every minute that passes without lifesaving Cardio-Pulmonary Resuscitation (CPR) and delivery of an AED shock (2), making bystander assistance vital in those first critical minutes until ambulance arrives.

In 2022, Triple Zero (000) calls for cardiac arrest generate a multiple-asset response, typically comprising of two ambulances, each with two clinicians. Where possible a Clinical Support Paramedic (CSP) will be tasked in metropolitan areas to provide overview, leadership and additional decision-making authority. An operational manager may be deployed as an alternative. These responders also carry mechanical CPR devices to be used if transport to hospital is undertaken.

In larger regional centres where the organisation is funded to provide a career paramedic response, a multiple-asset response of two ambulances will routinely be dispatched to cases of cardiac arrest. In other rural areas, a Community Paramedic (CP) may be deployed where practical to provide paramedic support to volunteer Emergency Medical Technician (EMT) or Emergency Medical Assistant (EMA) crews, alternatively the response may be volunteer ambulance officers only.

SJWA, like other jurisdictional ambulance services, attempt to optimise the chain of survival to give OHCA patients the best possible chance of survival. The chain of survival requires early recognition of the cardiac arrest, activating a Triple Zero (000) response, initiating CPR and preferably early delivery of defibrillation from an AED before ambulance arrives. To strengthen WA's response to OHCA events, members of the community may also be alerted via SJWA's Community First Responder Network or First Responder App (3). The intent is for community responders to provide or assist with CPR and, where available, use a community AED while the ambulance response is enroute. See an explanation of these services on page 18-19.

Benchmarking Summary Report

Table 1: Key figures for all-cause events where EMS attempted resuscitation

Year	Total events	Bystander CPR%[1]	Bystander AED use % (pads applied)[1]	Median metro response time (mins)[1]	Median rural response time (mins)[1]	% ROSC at ED	% 30-day survival	Utstein % ROSC at ED[2]	Utstein % 30-day survival[2]
2018	1147	79.9	9.3	8.4	11.8	23.7	14.6	46.2	38.0
2019	1112	79.0	11.8	8.9	13.1	21.1	12.3	44.3	34.5
2020	1086	79.6	12.2	9.1	13.1	20.6	11.6	44.3	35.7
2021	1115	81.6	13.6	9.4	12.4	20.6	10.5	47.7	33.5
2022	1182	81.5	14.5	9.6	15.0	19.7	10.8	43.0	33.0

Table 2: Benchmarking survival outcomes for all-cause events, where EMS attempted resuscitation [3]

	Collection period	Total number of events	% ROSC at ED	% Survival[4]
St John WA	1 Jan to 31 Dec 2022	1182	19.7	10.8
Ambulance Victoria	1 Jan to 31 Dec 2022	3168	32.1	12.6
Hato Hone St John NZ	1 Jan to 31 Dec 2022	2776	26.3	13.8
QLD Ambulance Service[5]	1 Jan to 31 Dec 2021	2427	28.0	11.7

Table 3: Benchmarking survival outcomes – the Utstein comparator group[2]

	Collection period	Total number of events	% ROSC at ED	% Survival[4]
St John WA	1 Jan to 31 Dec 2022	200	43.0	33.0
Ambulance Victoria	1 Jan to 31 Dec 2022	528	58.5	36.1
Hato Hone St John NZ	1 Jan to 31 Dec 2022	583	45.1	29.3
QLD Ambulance Service[5]	1 Jan to 31 Dec 2021	338	49.1	28.1

[1] Excludes EMS-witnessed arrests.

[2] Refers to patients with EMS resuscitation attempt, who had a bystander-witnessed arrest, with an initial shockable rhythm.

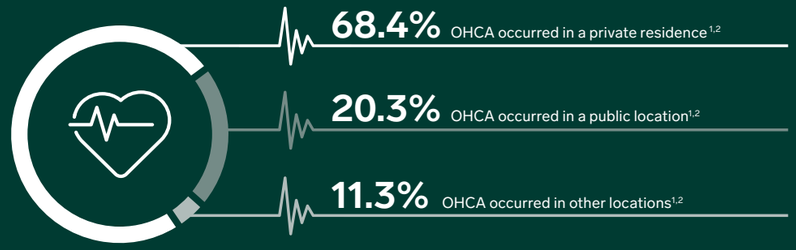
[3] EMS resuscitation attempt refers to patients with EMS CPR and/or EMS defibrillation and/or delivery of AED shock by bystanders; except for Queensland Ambulance Service, whose data here relates exclusively to cases with EMS CPR and/or EMS defibrillation.

[4] 30-day survival, except for Ambulance Victoria who report survival to hospital discharge.

[5] 2022 data not yet available at time of publication. Caution is advised when making comparisons across different time periods due to the effects of the COVID-19 pandemic at different times.

3 people

Per day treated for OHCA in Western Australia



68.4% OHCA occurred in a private residence[1,2]

20.3% OHCA occurred in a public location[1,2]

11.3% OHCA occurred in other locations[1,2]

92.2%

OHCA patients had cardiac arrest recognised on Triple Zero (000) call[1,2]

9.6 minutes

Median time it took SJWA to reach a patient in the metropolitan area[1,2]

81.4%

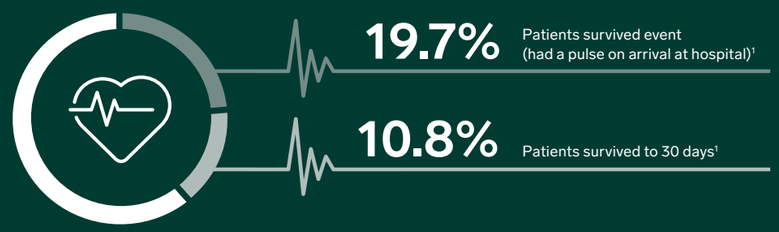
Patients received bystander CPR[3]

9.4%

Patients had defibrillation shock delivered by a community-based AED[3]

15.0 minutes

Median time it took SJWA in regional and remote locations[1,2]



19.7% Patients survived event (had a pulse on arrival at hospital)[1]

10.8% Patients survived to 30 days[1]

128

Patients survived out-of-hospital cardiac arrest (to 30 days) in WA in 2022

Utstein survival 33.0%[4]

1 Cases where EMS attempted resuscitation.
2 Excludes EMS-witnessed arrests.
3 Bystander-witnessed arrests where SJWA provides ongoing resuscitation.
4 Refers to survival among patients who experience OHCA witnessed by a bystander, present in a shockable rhythm, and receive EMS attempted resuscitation.

The Registry

In 1996, the SJWA out-of-hospital cardiac arrest database was established. It is maintained by the team at PRECRU, at Curtin University in Perth, WA, and includes all ambulance-attended OHCA cases in Western Australia. The data is compiled from:

1. Computer aided dispatch data;
2. Pre-hospital clinical care and management data through ambulance patient records (electronic records became available from around mid-2011); and
3. Date of death, as well as hospital outcome data.

In 2014, a more comprehensive ability to capture state-wide data commenced, with research nurses manually reviewing hospital medical records to determine survival to hospital discharge. In addition, survival to 30 days is confirmed by checking the WA State Registry of Births, Deaths and Marriages (4).

The database contains more than 46,000 OHCA records (as of 31 December 2022). De-identified data is shared with the Australasian Resuscitation Outcomes Consortium (AusROC) OHCA Epistry (Epidemiological Registry), which enables unique insights to be gained regarding OHCA patients across Australia and New Zealand.

All data is subject to ongoing quality improvement; with changes being incorporated and updated, including historical data, as needed.

Definition of OHCA

The database defines an OHCA patient as someone with no signs of circulation — specifically the absence of a carotid pulse, in combination with unconsciousness, and agonal or absent breathing; with the event occurring outside of hospital.

Eligibility

Table 4: SJWA OHCA database inclusion criteria

	SJWA OHCA database inclusion criteria (all of the following):
1	All patients, of any age who suffer a cardiac arrest in an out-of-hospital setting. This includes residential aged care facilities.
2	Occurred in the state of Western Australia and were attended by SJWA.
3	**a.** All unconscious patients who are pulseless and not breathing (or have "agonal", gasping breaths) on arrival of SJWA; OR **b.** All patients who become unconscious, pulseless and stop breathing (or have initial "agonal", gasping breaths) in the presence of SJWA (i.e., EMS-witnessed arrests); OR **c.** Patients who have a pulse on arrival of SJWA having been successfully defibrillated by a bystander prior to the arrival of SJWA.

Table 5: SJWA OHCA database exclusion criteria

	SJWA OHCA database exclusion criteria (any of the following):
1	Any patient who suffers a cardiac arrest in a hospital facility where SJWA may be in attendance but are not the primary care providers.
2	Any patient who suffers a cardiac arrest during an inter-hospital transfer where SJWA may be providing transport but are not the primary care providers.
3	Any patient where the bystander or lay person suspected a cardiac arrest, but the patient is not in cardiac arrest on arrival of SJWA, and no defibrillation has occurred.
4	Patients with brief episodes of pulselessness who DO NOT receive CPR or defibrillation from SJWA.

Data capture

The data fields in the SJWA OHCA database are based on the internationally agreed definitions that are outlined in the Utstein template from the International Liaison Committee on Resuscitation (ILCOR) (5).

Several data sources are used to capture OHCA cases in WA:

1. Computer aided dispatch (CAD) system database

CAD is an organisational database with comprehensive geographical and operational information collected by the SJWA State Operations Centre. Specifically, the database includes date and incident location. The system timestamps key points such as the receipt time of the Triple Zero (000) emergency call, the dispatch time of the first ambulance, as well as the time of arrival at scene of the first ambulance. This data enables response time data to be accurately calculated.

2. Electronic patient care record (ePCR)

The ePCR records multiple data fields, including patient demographics, clinical assessment and management. Importantly, this includes identification of the cardiac arrest heart rhythms, defibrillation delivery (including bystander use of AED), as well as the administration of any cardiac arrest medicines. The ePCR was introduced in SJWA in 2011, with paper-based records used previously.

A sensitive but not specific electronic search strategy is conducted to identify potential cases from the CAD database to ensure the capture of all OHCA cases in WA attended by SJWA. A research nurse carefully scrutinises the results manually, and only those cases meeting the criteria for OHCA (Tables 4 and 5) are included in the SJWA OHCA database.

Presenting arrest rhythms and probable causes of OHCA are determined by manual review of the ePCR records.

Survival outcomes of 'return of spontaneous circulation' (ROSC) and 'ROSC on arrival at hospital' (i.e. event survival) are also obtained from the ePCR records.

3. Survival follow up

The 2020 OHCA report onwards reports the 30-day survival as the primary survival outcome, whereas previous reports outlined survival to hospital discharge. These two measures are almost 100 per cent equivalent in WA, with less than one in every 200 cases being discordant between the two measures among initial survivors to hospital.

Ethics approval

SJWA has given approval for the SJWA OHCA database to be managed at PRECRU (Curtin University) – under strict data access and security protocols. The Human Research Ethics Committee (HREC) at Curtin University has given approval for the SJWA OHCA database to be used for specific research purposes.

PRECRU has standing ethics approval, granted by individual hospital HRECs, to access relevant hospital medical records for the purposes of determining OHCA patient outcomes. The Registrar of Births, Deaths and Marriages in WA has approved PRECRU researchers to access the WA Death Registry for HREC-approved studies.

All data relating to the SJWA OHCA database is securely stored by PRECRU at Curtin University as per the PRECRU Data Access and Security Policy.

Missing data

The utility of the SJWA OHCA database relies on completeness of data capture. Missing data are relatively rare for all core variables (see Table 6).

Table 6: Missing data

Variable	Number of cases
Sex	0
Age	0
Aetiology	0
Witness Status	0
Location Type	0
Response Time	0
Initial Arrest Rhythm	17
Bystander CPR	0
Bystander shock given	0
30-day survival	0

Number of records with missing data for select SJWA OHCA database variables in 2022 (from total of n=3115 cases)

Incidence and *demographics*

SJWA attended 3115 OHCA cases in the calendar year 2022 (1 January – 31 December), an 8% increase on 2021 (n=2873). The majority of cases (n=3062) were classified as adults (16 years and above) compared to those aged under 16 years of age (n=53).

Of all OHCA cases, 68.0% were recorded as male and 32.0% as female by SJWA clinicians.

The crude incidence of OHCA increased from 2021 to 2022. In 2022 for adults, crude incidence was 137.2 per 100,000 population, compared to children at 9.5 per 100,000. By comparison, in 2021 OHCA incidence for adults was 129.6/100,000, and for children was 7.1/100,000.

In July 2019, revised clinical practice guidelines were introduced at SJWA, expanding on situations where in-field resuscitation attempts could be withheld or ceased. In 2022, SJWA attempted resuscitation on 37.9% (n=1182) of OHCA patients.

Table 7: Overview of OHCA cases attended by St John WA

	No of Cases	% of all cases	Incidence Rate*	No. of resuscitation attempted	% resuscitation attempted
Adult	3062	98.3	137.2	1147	37.5%
Children	53	1.7	9.5	35	66.0 %
TOTAL	3115	100%	111.7	1182	37.9%

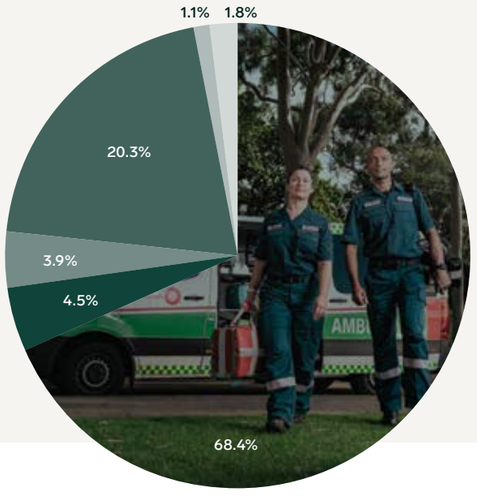
*per 100,000 population

Location of Arrest

Similar to previous years, the majority of patients (68.4%) suffered a cardiac arrest at a private residential address, which is similarly observed in other systems. If the cardiac arrest occurs in a public place, the likelihood of being 'seen or heard' to collapse is greater and is associated with improved outcomes as the chain of survival is activated sooner. In 2022, 20% of patients suffered a cardiac arrest in a public place compared to 22% in 2021.

These figures exclude cases where the cardiac arrest occurred whilst the patient was already in the care of SJWA ambulance personnel (i.e. EMS-witnessed arrests).

Figure 1: Location of arrest



Criteria: Excludes EMS-witnessed arrests, and cases where resuscitation not attempted.

Precipitating causes – adults (16+ yrs)

Of adult OHCA cases in 2022 where SJWA attempted resuscitation, 78.3% had a presumed cardiac cause (n=898), with the next most common causes being trauma (6.8%, n=78), hanging (4.9%, n=56), drug overdose (4.6%, n=53), respiratory pathology (3.0%, n=34) and drowning (1.4%, n=16).

Table 8: Aetiology – adults

	2018	2019	2020	2021	2022	TOTAL
Presumed cardiac	890	822	811	851	898	4272
Respiratory	29	33	23	19	34	138
Drowning	8	16	21	17	16	78
Trauma	57	75	67	73	78	350
Hanging	67	69	68	74	56	334
Drug overdose	50	52	58	43	53	256
Electrocution	-	2	2	2	1	7
Malignancy/Palliative	15	10	9	10	11	55
TOTAL	1116	1079	1059	1089	1147	5490

Criteria: Excludes cases where resuscitation was not attempted.

Precipitating causes – children (<16 yrs)

Among the 35 paediatric OHCA cases where SJWA attempted resuscitation in 2022, a presumed cardiac aetiology was recorded in 8 cases, with other causes including trauma (n=4), hanging (n=4) and SUDI (n=11).

Table 9: Aetiology – children

	2018	2019	2020	2021	2022	TOTAL
Presumed cardiac	8	10	10	10	8	46
Respiratory	4	2	3	--	2	11
Drowning	6	2	3	1	5	17
Trauma	3	6	5	6	4	24
Drug overdose	--	--	--	1	--	1
Hanging	2	4	1	5	4	16
SUDI*	7	9	6	4	11	37
Electrocution	1	--	--	--	--	1
Malignancy/Palliative	--	--	1	--	1	2
TOTAL	31	33	29	27	35	155

Criteria: Excludes cases where resuscitation was not attempted.

*In previous reports, this has been reported as SIDS (Sudden Infant Death Syndrome), from 2022 onwards this is more correctly reported as SUDI (Sudden Unexpected Death in Infancy). The definition remains unchanged from previous years – that is, death of an infant under 1 year of age where there is no obvious cause reported at the time of assessment by the responding ambulance crew.

Presenting rhythms

Of the 1147 adult OHCA cases receiving a resuscitation attempt, 285 (24.8%) presented in a shockable rhythm (VF or VT).

A total of 855 cases presented in non-shockable rhythms, the most common was asystole, which recorded 632 cases (55.1%). Pulseless electrical activity (PEA) featured in 173 cases (15.1%). Of note, 50 cases (4.4%) had an unspecified non-shockable rhythm, associated with some volunteer non-metro locations that use screenless automated AEDs and no shock was advised. Data on presenting rhythm was missing for seven cases.

Figure 2: Frequency of adult initial arrest rhythms 2022

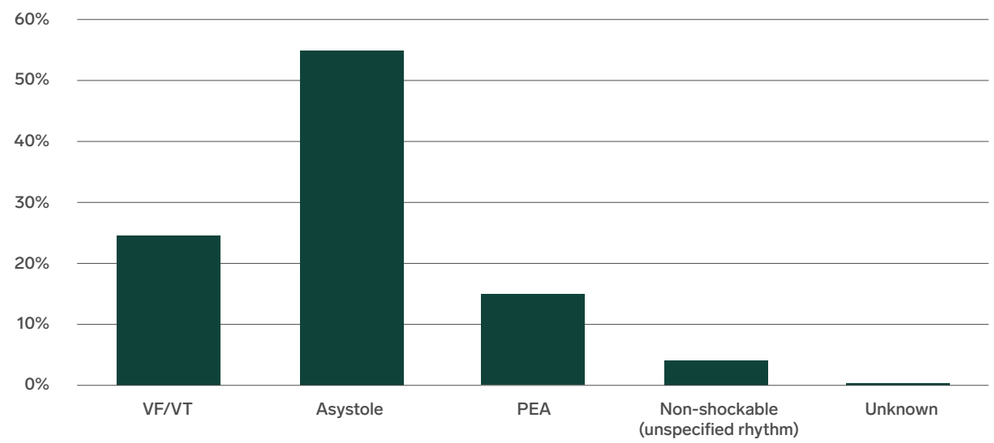


Table 10: Initial arrest rhythm for adults 2018-2022

Rhythm	2018	2019	2020	2021	2022
Shockable	328	282	282	258	285
Non-shockable	753	788	760	818	855
Unknown	35	9	17	12	7
Bradycardia	--	--	--	1	--
TOTAL	1116	1079	1059	1089	1147

Recognition of OHCA during Triple Zero (000) call

All incoming Triple Zero (000) emergency calls to SJWA are handled and triaged through the Medical Priority Dispatch System (MPDS) by specialist Emergency Medical Dispatchers (EMDs). More than 1100 calls for assistance are received by the State Operations Centre (SOC) per day.

Calls for suspected cardiac arrest are treated as the highest priority response above other Priority 1 cases. These cases generate a multiple asset response. Other community response may also be activated to cardiac arrest cases if available.

Recognition of cardiac arrest during the Triple Zero (000) call is vitally important to ensure that an appropriate ambulance dispatch is allocated to maximise a fast response. Early recognition of OHCA during the emergency call also allows the EMD to activate an early community response, provide CPR instructions to the caller, and give directions to the nearest publicly accessible defibrillator if another bystander can retrieve it.

In 2022, 92.2% of cardiac arrest cases (excluding EMS-witnessed arrests) were recognised as such by the end of the Triple Zero (000) call and dispatched accordingly.

Table 11: Recognition of OHCA on a Triple Zero (000) call

	2022
OHCA recognised on emergency call	956
OHCA not recognised	81
% recognised	92.2%

Criteria: Excludes EMS-witnessed arrests, cases where resuscitation was not attempted, and five cases where the ambulance crew was flagged down prior to the Triple Zero (000) call.

Pre-ambulance community response (Bystander CPR and AED activity)

The percentage of OHCA patients receiving bystander CPR prior to the arrival of SJWA was 71.0% among bystander-witnessed arrests, and 29.5% among unwitnessed arrests.

Table 12: Bystander CPR witnessed/unwitnessed

% bystander CPR	2018	2019	2020	2021	2022
Among bystander-witnessed arrests	71.1	69.0	66.8	69.8	71.0
Among unwitnessed arrests	31.2	30.0	31.4	27.4	29.5

The percentage of OHCA patients receiving bystander CPR prior to the arrival of SJWA was 81.4% for all cases where resuscitation attempts were made.

Table 13: Bystander CPR among cases with an EMS resuscitation attempt

	2018	2019	2020	2021	2022
CPR provided	801	754	747	785	850
No evidence of bystander CPR	202	200	191	177	193
TOTAL	1003	954	938	962	1043
% where CPR provided	79.9%	79.0%	79.6%	81.6%	81.5%

Criteria: Excludes EMS-witnessed arrests, and cases where resuscitation was not attempted.

Community AEDs are unequivocally associated with improved chances of survival (5). AEDs were used by bystanders (i.e. AED pads applied) on 180 OHCA patients in 2022, with a defibrillation shock being delivered in 75 cases. Of those 75 patients, 34 (45.3%) had a pulse on arrival at ED and 29 survived to 30 days (38.7%).

Table 14: Bystander use of AED and number of survivors (all of WA)

	2018	2019	2020	2021	2022
AED pads applied by bystander	111	131	134	157	180
AED shock delivered by bystander	60	59	55	56	75
ROSC at ED after bystander AED shock	46	35	25	30	34
30-day survivors after bystander AED shock	40	30	22	26	29
% ROSC at ED after bystander AED shock	76.7%	59.3%	45.5%	53.6%	45.3%
% 30-day survival after bystander AED shock	66.7%	50.8%	40.0%	46.4%	38.7%

Criteria: Excludes EMS-witnessed arrests.

For patients in an initial shockable rhythm, when the first defibrillation shock gets delivered by a community AED as compared to an EMS (ambulance) response, the patient is 2.9 times more likely to be a 30-day survivor (5 year moving average).

Table 15: Survival statistics based on who delivered first defibrillation shock

	2018	2019	2020	2021	2022	TOTAL
% ROSC at ED						
Community AED	76.7%	59.3%	45.5%	53.6%	45.3%	**55.7%**
EMS	26.5%	25.9%	26.5%	27.7%	27.7%	**26.8%**
% 30-day survival						
Community AED	66.7%	50.8%	40.0%	46.4%	38.7%	**48.2%**
EMS	16.4%	15.3%	18.5%	15.1%	17.2%	**16.5%**

Criteria: Excludes EMS-witnessed arrests and cases where resuscitation was not attempted.

Community First *Responders*

St John WA supports parallel programs which enable members of the community to be spontaneous first responders to moments of crisis.

- **The Community First Responder (CFR) Network:** This includes 7063 locations across WA where a total of 8458 AEDs are registered with the SOC as being available to deploy either by the person who registered it, or a member of the public, in event of an OHCA, including those available 24/7.
- **The First Responder App:** This connects first aid qualified responders to incidents including OHCA which occur in a public place within 500m of their location, providing vital early intervention to emergencies.

Community First Responder Network

During 2022, the network of locations in Western Australia registered with at least one AED which can be deployed by the SJWA SOC grew 11.4% to a total of 7063, making it one of the biggest networks per capita of registered AEDs with an ambulance service in the country.

The Community First Responder (CFR) program invites members of the community who own an AED to register it with the SOC. That person is considered by St John WA to be a "spontaneous volunteer", meaning they can be called upon in the event an OHCA is nearby to render assistance.

Additionally, AEDs mounted on external secure cabinets with a lockbox which can be accessed with a code provided by the SOC can be used by any bystander who calls Triple Zero (000), increasing the likelihood of defibrillation being applied in the crucial first few minutes following OHCA. The number of publicly available AEDs increased 6.8% in the year to 2512.

St John WA advocates for widespread installation and ownership of AEDs to improve likelihood of survival following OHCA and has invested in the program for more than a decade.

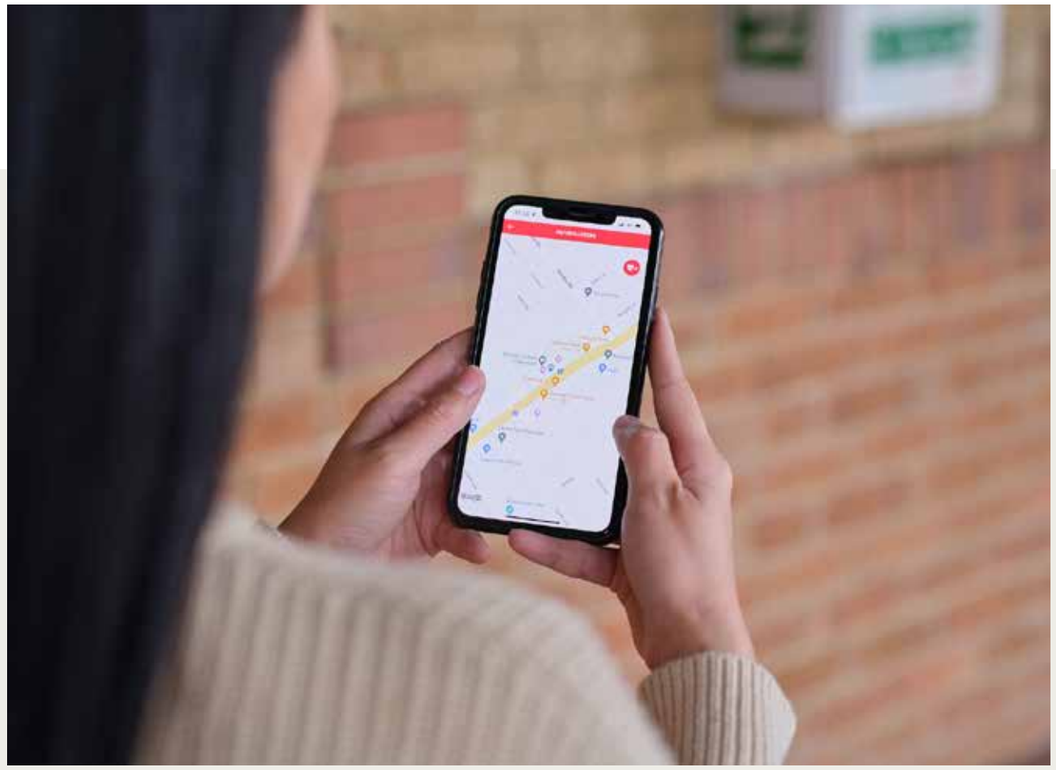
During 2022, there were 79 CFR activations from a registered AED out of 180 bystander responses where defibrillation pads were applied to a patient in cardiac arrest. Of those 79 CFR activations, a shock was delivered by the AED in 39 cases. When compared to a total 75 OHCA cases to receive a community AED shock, more than half came from a CFR activation.

And out of 1043 non-EMS witnessed OHCA cases that had a resuscitation attempt, 22.8% of patients survived to 30 days where there was a CFR activation, compared to 7.9% of patients where there was no CFR activation.

Table 16: Community First Responder activations

	2022
Total CFR activations	79
(% of all OHCA)	7.6%
CFR activations where AED shock delivered	39
Outcomes associated with CFR activation	
% 30-day survival where CFR activated	22.8%
% 30-day survival where CFR was not activated	7.9%

Criteria: Includes cases where resuscitation was attempted; Excludes EMS-witnessed arrests.



First Responder App

Responders registered on the SJWA First Responder App (3) as being available to respond to Triple Zero (000) emergencies in a public place within 500 metres of their location grew 12.6% in 2022 to 43,065, up from 38,236 the previous year.

The First Responder App invites members of the public, and SJWA team members, with a current recognised First Aid certification to make themselves available to be notified if a Triple Zero (000) call in a public place within 500m of their location is identified.

This means bystanders may be available to respond in the critical minutes while an ambulance is enroute to the scene, and can provide important information to the SOC about the scene which can assist ambulance crews to understand a situation and render assistance efficiently.

The St John First Responder App is an invaluable tool in an emergency. It pinpoints a user's exact location when dialling Triple Zero (000) for an ambulance and sends GPS coordinates to the SOC operator, speeding up the time it takes to confirm location and the dispatch of an ambulance when every second counts.

It also offers users access to vital information, such as defibrillator locations, first aid instruction guides, location of the nearest medical centre and emergency department, as well as real time updates on emergency department waiting times and more.

More than 500,000 Western Australians have downloaded the app, to find out more visit: **https://stjohnwa.com.au/online-resources/st-john-first-responder-app**

Survivor Stories

Ben Aldred

Rising cricket star Ben Aldred was a fit and healthy 18-year-old who survived cardiac arrest in extremely rare circumstances, with the chances of an athlete experiencing a cardiac arrest being two in 100,000.

He managed to beat all odds due to his uncle's CPR efforts guided by St John WA SOC Emergency Medical Dispatcher Jess Simpson over the phone, until SJWA crews arrived five minutes later.

Ben had fallen down unconscious while walking on a Perth beach in October 2022, and began developing cyanosis – turning blue – from lack of oxygen.

Paramedic Kat Sobczyk, together with Ambulance Officers David Hyatt and Callum Lloyd-Watters and Clinical Support Paramedic Ben Robinson kept the teenager alive until they got to Joondalup Health Campus, but none were optimistic about Ben's chances of survival.

Yet they were reunited a month later, with Kat saying the odds of Ben recovering well were "incredibly rare".

"I've been in the job nearly 14 years and I've actually never witnessed this before," she said.

Ben told media that he was incredibly grateful and wanted people to understand the importance of learning CPR.

"I wouldn't be here if it wasn't for these people, which is incredible every time I say it," he said.

Mark Donovan

Mark Donovan also defied the odds and survived his near-death experience thanks to life-saving CPR and the deployment of a defibrillator.

A family picnic along the Swan River in January 2022 took a turn for the worse when Mark suffered a sudden cardiac arrest.

Mark's family and first aid-trained bystanders performed CPR until nearby Water Police were signalled for help and administered an AED.

One shock was all it took, with paramedics Andrew Lake and Mark Hill escorting a conscious Mark to hospital.

Paramedic Mark Hill said good quality CPR and the portable AED made all the difference.

"If it wasn't for both the CPR being applied almost immediately and then the defibrillator, they said I would not have been alive," Mark Donovan said.

Without intervention, the damage caused by cardiac arrest after 10 minutes is almost always irreversible, with only 1 in 10 people surviving an out-of-hospital cardiac arrest.

But Mark lived to tell his tale.

Neil O'Brien

Having a cardiac arrest was far from the mind of freshly retired Neil O'Brien, 55, as he and his wife kicked off their trip of a lifetime around Australia.

But three days into his camping trip at Coronation Beach, about half an hour north of Geraldton, Neil felt dizzy and collapsed in front of his wife Maria in their caravan.

Maria called for help and, thanks to a nearby AED and a fellow camper who knew first aid, saved her husband's life.

Neil was revived after being shocked four times before ambulance crews arrived.

Neil shared his story with 9 News on Restart a Heart Day, October 16, to raise awareness of the importance of people learning first aid.

He encouraged anyone whose skills were not up to date to sign up to learn CPR and how to use a defibrillator – both of which saved his life.

SJWA *response times*

In cases where resuscitation was attempted, median response times in 2022 in metropolitan Perth was 9.6 minutes, compared to 9.4 minutes in 2021. In regional and remote WA, median response time in 2022 was 15.0 minutes, compared to 12.4 minutes in 2021.

Table 17: Metropolitan response times (in minutes)

	2018	2019	2020	2021	2022
Median	8.4	8.9	9.1	9.4	9.6
10th centile	5.0	5.4	5.3	5.6	5.6
25th centile	6.3	6.8	6.9	7.2	7.4
75th centile	10.6	11.6	11.4	12.2	12.4
90th centile	13.7	14.2	14.3	16.0	16.7
Number of cases	738	727	699	698	795

Criteria: Excludes EMS-witnessed arrests and cases where resuscitation was not attempted.

Table 18: Regional and remote response times (in minutes)

	2018	2019	2020	2021	2022
Median	11.8	13.1	13.1	12.4	15.0
10th centile	6.6	5.7	6.3	6.3	6.8
25th centile	8.7	9.1	7.8	8.2	9.3
75th centile	18.5	21.7	19.0	18.1	23.2
90th centile	29.0	31.8	27.8	29.2	33.2
Number of cases	263	224	239	264	248

Criteria: Excludes EMS-witnessed arrests and cases where resuscitation was not attempted.

Note: From 2022 onwards, response times reported exclude EMS-witnessed arrests. This brings our reporting into alignment with other services we benchmark against and is a more accurate measure of response times to patients in cardiac arrest during the emergency response. The exclusion of EMS-witnessed arrests from historical trend data in this report means there are slight variations from reports published in previous years.

Outcomes

The total number of patients who survived their OHCA at 30 days in 2022 was 128 (126 adults and 2 children). This represents 10.8% of the 1182 OHCA patients who had resuscitation attempted. Arriving at ED with a pulse (ROSC at ED) is a prognostically favourable indicator and arguably a barometer of prehospital performance. As highlighted in Table 19, of the 1182 resuscitation attempted cases, 233 patients had ROSC at ED (19.7%).

Excluding EMS-witnessed cases, survival among resuscitation-attempted cases in 2022 was 17.9% for ROSC at ED, and 9.0% for 30-day survival.

Table 19: Percentage survival (of resuscitation attempted cases)

	2018	2019	2020	2021	2022
% ROSC at ED	23.7	21.1	20.8	20.6	19.7
% 30 Day Survival	14.6	12.3	11.6	10.5	10.8

Adult outcomes according to initial presenting rhythm

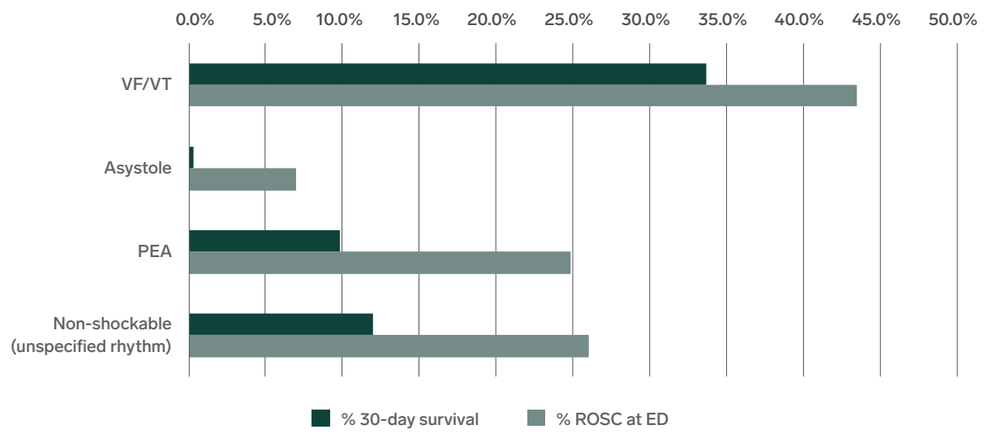
Those OHCA patients who presented in shockable rhythms were most likely to have a favourable outcome and comprised the majority of cases with ROSC at ED recorded in 2022. Of the adult patients who survived to 30-days, 76.2% were initially in VF/VT (n=96).

Asystole as a presenting rhythm is associated with poorer outcomes. A total of 44 patients in this cohort were recorded as ROSC at ED, with two survivors to 30 days. Other non-shockable rhythms had higher 30-day survival than asystole, however much lower than survival for shockable (VF/VT) patients. See Table 20 and Figure 3.

Table 20: Number of survivors by initial arrest rhythm, for adults

	ROSC at ED	30-day survivors	TOTAL
VF/VT	124	96	285
Asystole	44	2	632
PEA	43	17	173
Non-shockable (unspecified rhythm)	13	6	50
Unknown	4	5	7
TOTAL	228	126	1147

Figure 3: Survival by initial arrest rhythm for adults



Utstein comparator group

The Utstein comparator group is defined as all-cause cardiac arrest in the community where the patient is witnessed to collapse by bystanders, presents with an initial shockable rhythm, and receives an EMS resuscitation attempt. It reflects a cohort who are regarded as most likely to have prognostically favourable survival outcomes. Importantly, the Utstein comparator group, in having a defined set of patient characteristics, facilitates more meaningful benchmarking against other systems.

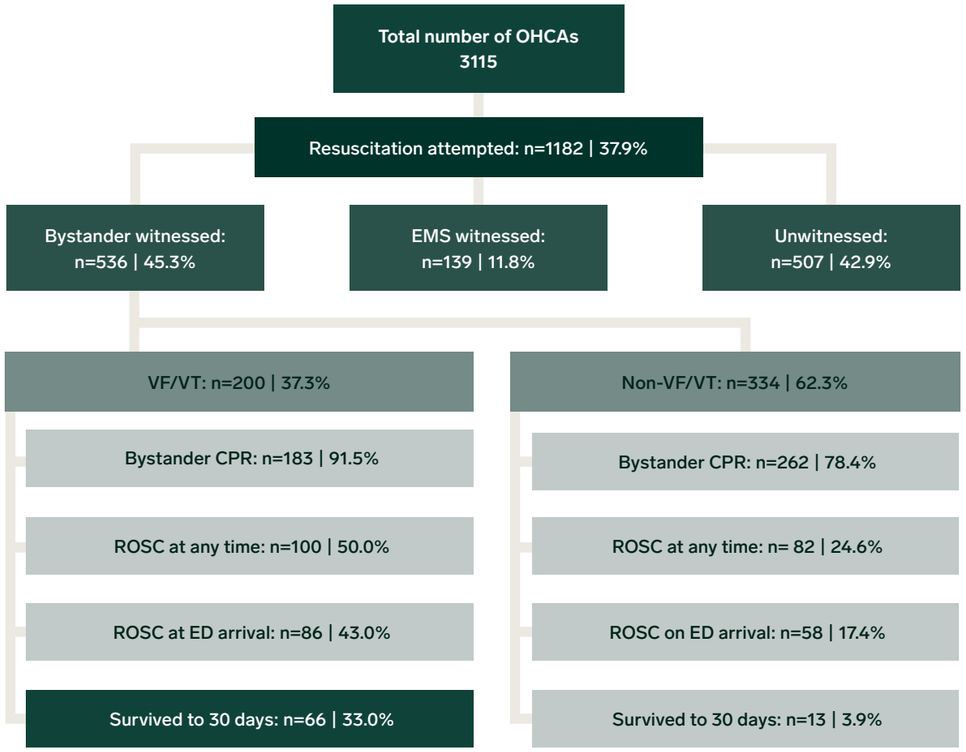
Table 21: Utstein survival by year

	2018	2019	2020	2021	2022
Utstein survival %	38.0	34.5	35.7	33.5	33.0

Resuscitation was commenced in 1182 patients, 536 (45.3%) of whom were witnessed (or heard) to collapse by a bystander. A shockable rhythm (VF/VT) was recorded in 200 (37.3%) of those cases. A large proportion of those cases received bystander CPR (91.5%). As shown in Figure 4, of the 200 patients in VF/VT, 66 (33.0%) were recorded as ROSC at ED and 66 survived to 30 days (33.0%).

While the Utstein comparator group represented only 16.9% (200/1182) of patients with an EMS resuscitation attempt, they comprised 51.6% of all 30-day survivors (66/128).

Figure 4: Utstein criteria

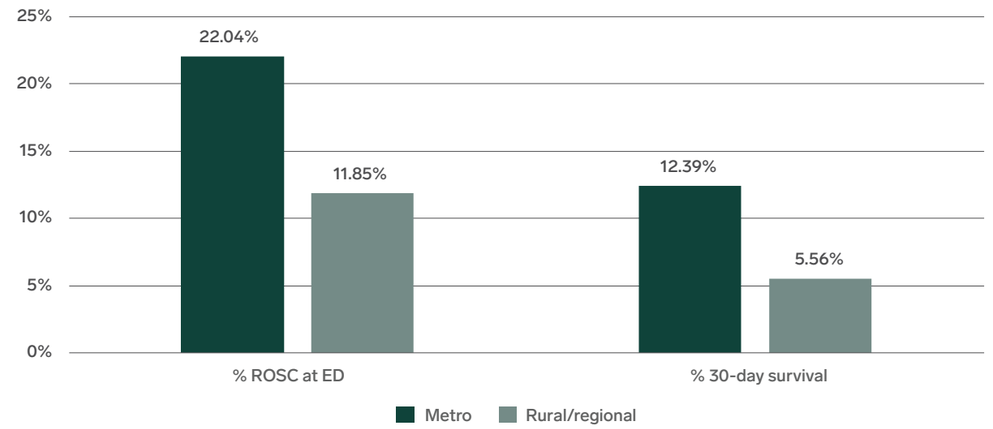


Data on initial arrest rhythm was missing for two bystander-witnessed cases.

Outcomes according to rurality

As of mid-2022, the Australian Bureau of Statistics recorded approximately 2.79 million people living in WA, with 79.8% (2.23 million) in metropolitan Perth, and approximately 563,000 in regional WA. The majority of OHCA cases with attempted resuscitation occur in metropolitan Perth (912/1182 = 77.2%).

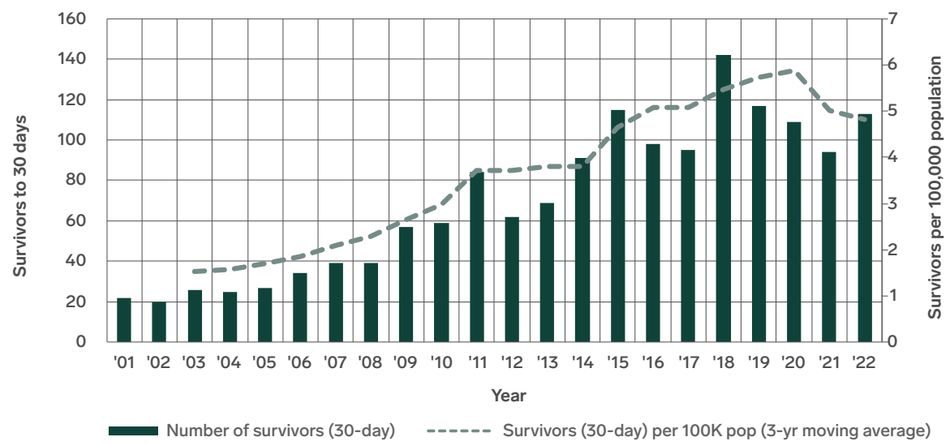
Figure 5: Comparative outcomes – metropolitan Perth vs regional Western Australia



Survival per 100,000 population

From 2020 to 2022 in the Perth metropolitan area, there was an average of 4.83 OHCA survivors (30-day survival) per 100,000 population per year. This metric of the number of survivors per 100,000 population provides a useful measure for comparison with other EMSs, due to its independence from any differences between EMSs (or over time) in the propensity for attempting versus withholding resuscitation.

Figure 6: Number of survivors, and Survival per 100K population (metro Perth)



Outcomes at scene

Table 22: Outcomes at scene

	Cases	%
Transported from scene with ROSC	261	22.1
Transported from scene without ROSC	269	22.8
Resuscitation efforts ceased at scene	652	55.2
TOTAL	1182	-

Criteria: Excludes cases where resuscitation was not attempted.

Among patients in 2022 with an EMS resuscitation attempt, 22.8% were transported from the scene without ROSC (i.e., CPR was in progress during transport), down from 40% in 2019. There are two factors that likely contributed to this change. Firstly, additional criteria for termination-of-resuscitation, introduced in July 2019 likely meant an increase in the number of patients declared deceased on scene, and corresponding decrease in the number being transported from the scene without ROSC. In addition, since the introduction of high-performance CPR in late 2018, SJWA has continually encouraged clinicians to pursue (among patients not meeting termination-of-resuscitation criteria) more prolonged resuscitation efforts on scene to maintain quality of care and increase the chances of earlier ROSC. As a result of these initiatives, we expect that some patients who would have previously been transported from the scene without ROSC are likely to achieve and be transported with ROSC, due to the sustained resuscitation efforts on scene.

Outcome by destination hospital

All of WA's large tertiary teaching hospitals are located in Perth. Given that a large proportion of OHCA cases have a presumed cardiac cause (see Tables 8 and 9), when patients are transported to a hospital that has an on-site 24-hour primary percutaneous coronary intervention (PCI) service, the odds of 30-day survival are much increased. In 2022, a total of 128 OHCA patients in Perth who had ROSC at the time of scene departure were transported directly to a PCI capable hospital, of which 58.6% survived to 30 days. This contrasts with 39.2% 30-day survival in the 51 OHCA patients in Perth who had ROSC at the time of scene departure and were transported to a non-PCI capable hospital.

Table 23: Percentage 30-day survival according to whether the patient had direct transport to a PCI hospital

	% of cases
% Survival if PCI	58.6
% Survival if not PCI	39.2

Criteria: Includes adult OHCA cases of presumed cardiac aetiology in metropolitan Perth, where EMS resuscitation was attempted, and the patient had ROSC at the time of being transported from the scene to hospital.

Conclusion

St John WA's Clinical Services team reflects on the challenges that 2022 brought to the community, health system and to frontline ambulance service delivery. Despite the challenges faced, associated increases in response times and a 6% year-on-year increase in the number of OHCA patients treated, the proportion of patients surviving to 30 days remained steady. We thank the community for their commitment in providing early response to cardiac arrest, with high rates of bystander CPR and growing rates of community defibrillator use. Early response is vital in the OHCA chain of survival and crucial to changing outcomes ahead of ambulance arrival.

We re-affirm our commitment to continual improvement in OHCA response in WA, across the chain of survival, and look forward to our efforts having a positive impact on OHCA survivability.

We celebrate the successes we have observed with each of the 128 patients who survived their out-of-hospital cardiac arrest, and the aspects of the system and care that contributed to this outcome.

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