



St John 

Out-of-Hospital Cardiac Arrest Report 2019

Introduction

We are proud to present our 2019 out-of-hospital cardiac arrest (OHCA) report for Western Australia (WA) in partnership with our colleagues at the Pre-Hospital, Resuscitation and Emergency Care Research Unit (PRECRU) based at Curtin University.

The PRECRU team work tirelessly to evaluate and compile the data submitted in this report and we continue to acknowledge their valuable collaborative support.

The Global Resuscitation Alliance (GRA) and Resuscitation Academy (RA) offer 10 'Steps', or 'Programs' to cardiac arrest improvement. They are principles we subscribe to and as such, this year's report is themed around the concept of 'It Takes a System to Save a Life' to update the community on the inputs we are making into various areas that is shaping our journey to influence outcomes.

In 2018, we reported a record number of OHCA survivors - 172. Calendar year 2019 was our second best year on record, with 136 survivors. There are victims of OHCA who unfortunately did not survive, and we take a moment to pay our deepest respects to them, their families and communities. Our commitment to persist with our efforts remains steadfast.

Finally, system improvement is diverse and there are a great many people behind the scenes playing key roles in helping us achieve our goals. They work in a variety of capacities and many volunteer their time. They co-ordinate first responders and community AED placements. They deliver first aid training or provide education our clinicians. They answer 000 calls and dispatch ambulances. They maintain our fleet and communications networks. They provide data analysis, administrative, operational and governance support. They are all the fabric of St. John and we applaud them for everything they do for the communities of WA.

Acknowledgements

A/Prof Paul Bailey
(Medical Director)

Prof Judith Finn
(Director PRECRU)

Dr Stephen Ball
(Dep. Director PRECRU)

Dan Rose (Clinical Services)

Michelle Fyfe APM
(C.E.O. St John WA)

Rudi Brits (Clinical Services)

Prof Ian Jacobs (late)

The PRECRU team

The Clinical Services team

The State Operations team

All our valuable volunteers
and career staff alike



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Cardiac Arrest Registry

The late Professor Ian Jacobs had extraordinary vision and foresight when in 1996 he established the first OHCA registry in the Australia/New Zealand region.

The registry compiles cardiac arrest data associated with the dispatch system, ambulance care records and patient care journeys through the hospital systems. In 2019, some 23 years on, we are fortunate to be able to benchmark our performance and outcomes against ourselves to evaluate how well, or indeed poorly, various changes in the system or hands-on care has had.

Under the skilful stewardship of Professor Judith Finn and managed by Dr Stephen Ball, the registry (located within the Pre-hospital, Resuscitation and Emergency Care Research Unit (PRECRU) at Curtin University, Perth) continues to collate outcome data and contribute to the wider knowledge base via publication of related peer-reviewed academic research.

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Telephone CPR with ongoing Training/QI

SJWA has been instructing 000 callers to perform CPR for many years. In 2010 we transitioned our system to ProQA/MPDS that provided our communications officers with a standardised, internationally-established protocol.

In partnership with our PRECRU colleagues, we have participated in research, including linguistics on how our communications officers might be better equipped to recognise a likely cardiac arrest early.

Each year, communications officers undertake a continued education program over several days that always includes cardiac arrest and CPR instruction. In recent years, we have invested

into the quality of this instruction by using video footage. De-identified, low definition vision is overlaid with the 000 call and gives some context on how callers react and behave during these vital minutes. Awareness around agonal activity is also reinforced with the use of publically available resources that demonstrate agonal breathing, in order to understand how a caller might describe the events and presentation.

Abbreviations

AED	Automated External Defibrillator	ILCOR	International Liaison Committee on Resuscitation
AM	Area Manager	IMPACT	Improved Performance And CPR Team Resuscitation
ARC	Australian Resuscitation Council	MPDS	Medical Priority Dispatch System
ALS	Advanced Life Support	OHCA	Out of Hospital Cardiac Arrest
BLS	Basic Life Support	PEA	Pulseless Electrical Activity
CAA	Council of Ambulance Authorities (Australia and New Zealand)	PCI	Percutaneous Coronary Intervention
CAD	Computer Aided Dispatch	PRECRU	Pre-hospital, Resuscitation and Emergency Care Research Unit (Curtin Uni)
CFR	Community First Responder	ProQA	Priority Dispatch Software
CPC	Cerebral Performance Category	ROSC	Return of Spontaneous Circulation
CPR	Cardio-Pulmonary Resuscitation	SIDS	Sudden Infant Death Syndrome
CSP	Clinical Support Paramedic	SJWA	St. John Western Australia
ED	Emergency Department	SJNZ	St. John New Zealand
EMS	Emergency Medical Services	VACAR	Victorian Ambulance Cardiac Arrest Registry
EMT	Emergency Medical Technician	VF	Ventricular Fibrillation (shockable rhythm)
ePCR	Electronic Patient Care Record	VT	Ventricular Tachycardia (shockable rhythm when pulseless)
GRA	Global Resuscitation Alliance	WA	Western Australia
HPCPR	High Performance CPR		
HREC	Human Research Ethics Committee		



Global Resuscitation Alliance

Definitions

Adults

Patients aged 16 years or greater, or where the age is missing/unknown.

Agonal

Agonal breathing or agonal gasps are the last reflexes of the dying brain.

Asystole

Absence of any cardiac activity.

Defibrillation

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

EMS attempted resuscitation

Cases where paramedics or volunteer EMTs attempted to revive a patient in cardiac arrest using CPR and/or defibrillation, as well as any patients who received an AED shock by bystanders.

EMS attended

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

EMS response time

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

EMS treated

Cases involving an EMS attempted resuscitation.

Event survival

Patients that have a palpable pulse on arrival at hospital as documented on the PCR.

Metropolitan/Metro

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

Out of Hospital Cardiac Arrest

Where the patient has no signs of circulation. Specifically these are 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

Patients aged less than 16 years.

Paramedic

ALS Qualified Ambulance Officer.

Presumed cardiac

Cases where the cause of arrest is not due to a known precipitator (eg. trauma, overdose/poisoning, etc), as acquired from the ePCR.

Regional/Rural WA

Denotes areas outside the Perth metropolitan area.

Return of Spontaneous Circulation

Cases in which the resuscitation attempt results in a return of spontaneous circulation (ie. detectable pulse) at any time.

State Operations Centre

Triple Zero (000) and non-urgent call centre.

Survival to hospital discharge

Patients who are discharged from hospital alive.

Shockable Rhythm

Rhythms which are appropriate to receive defibrillation, including ventricular fibrillation and pulseless ventricular tachycardia as determined by EMS, or by a bystander with a public defibrillator.

Transport Officer

Basic life support transport officers.

Utstein comparator patient group

Patients who are witnessed to arrest by a bystander, present in a shockable rhythm, and EMS attempted resuscitation.

Volunteer EMT

Unpaid Emergency Medical Technician (formerly referred to as a Volunteer Ambulance Officer), providing emergency services to their community.

About our service and response to cardiac arrest

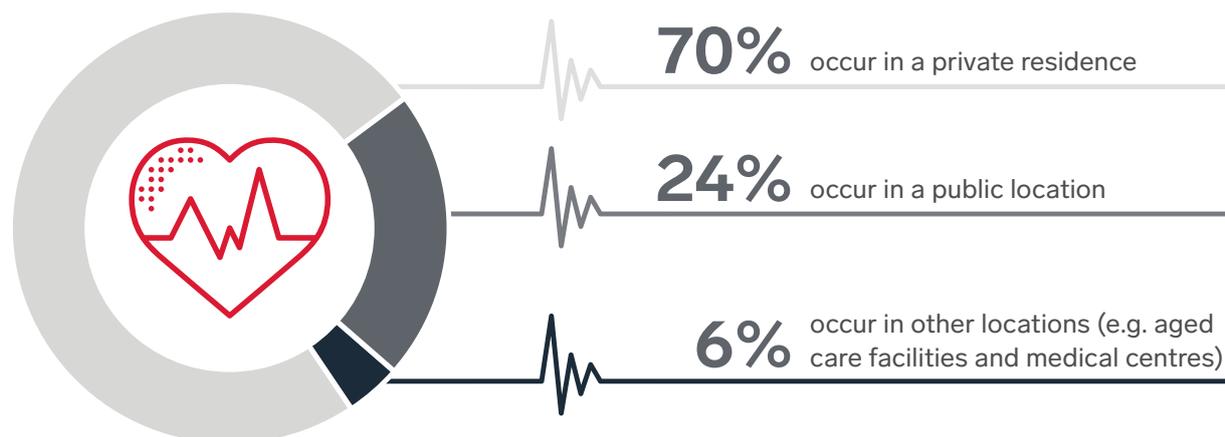
St. John WA (SJWA) serves a population of approximately 2.6 million across an area of 2.5 million km². This expansive geographical area presents us with some response challenges.

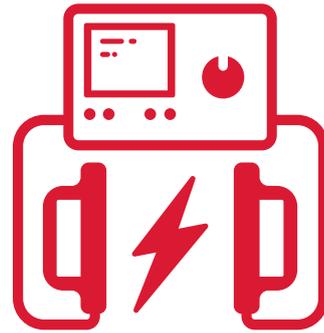
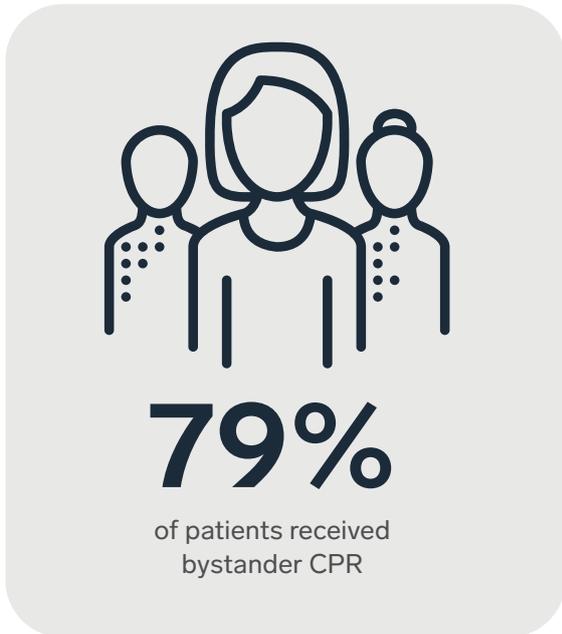
In our more remote locations with smaller populations, communities are faithfully served by a cohort of valuable volunteer EMTs supported by community paramedics. Larger regional centres have frontline care provided by a mixed model of volunteer EMTs and paramedics. Over 6000 volunteers step up for their communities to provide a range of administration support, event first aid cover and frontline emergency care across WA. Paramedics, often with a mix of ambulance officers (student paramedics) make up the exclusive crew dynamic in the greater metropolitan area of Perth, the state capital.

Approximately 1000 calls a day are made to SJWA. Emergency calls through the 000 system are triaged through Medical Priority Dispatch System (MPDS) and when cardiac arrest is identified, our dispatchers immediately task at least two 2-person ambulances. This is occasionally difficult in the remoter regions and wherever practicable, a community paramedic is dispatched in support. An additional clinical support paramedic (CSP) is allocated whenever possible in Perth. If CSPs are not immediately available, then an area manager (AM) is tasked. CSPs provide clinical leadership support and extended decision-making capabilities in support of their colleagues. Both CSPs and AMs carry a mechanical compression device to be used if required.

Bystander CPR is assertively and tactfully advocated by our communications officers for all patients who are recognised as being in cardiac arrest. Certain MPDS determinants (e.g. for chest pain) also alert communications officers to the locations and activation details of any nearby community automated external defibrillators (AEDs), in case the patient's condition develops into a cardiac arrest. When AEDs are activated for cardiac arrest, they are very often applied to the patient well before the arrival of ambulance as intended and subsequently have remarkable potential to effect favourable outcomes.

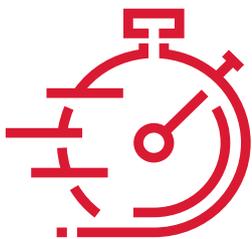
In 2018 SJWA began to introduce high performance CPR. By January 2019 most of our clinicians had received their training. With high performance CPR, a strong emphasis is made on excellent basic life support (BLS) quality, and minimally interrupted compressions that are accompanied by effective oxygenation and defibrillation opportunities. Administration of medications is encouraged as per the Australian Resuscitation Council (ARC) guidelines, but we advocate that this is not at the expense of excellent BLS, which is proven to be of more benefit to the patient.





5%

received defibrillation by a
community based defibrillator
prior to ambulance arrival



9.1
minutes

Median time in which a St John Ambulance
reached a patient in the Perth metropolitan area



13.3
minutes

Median time in which a St John Ambulance reached
a patient in rural and regional locations

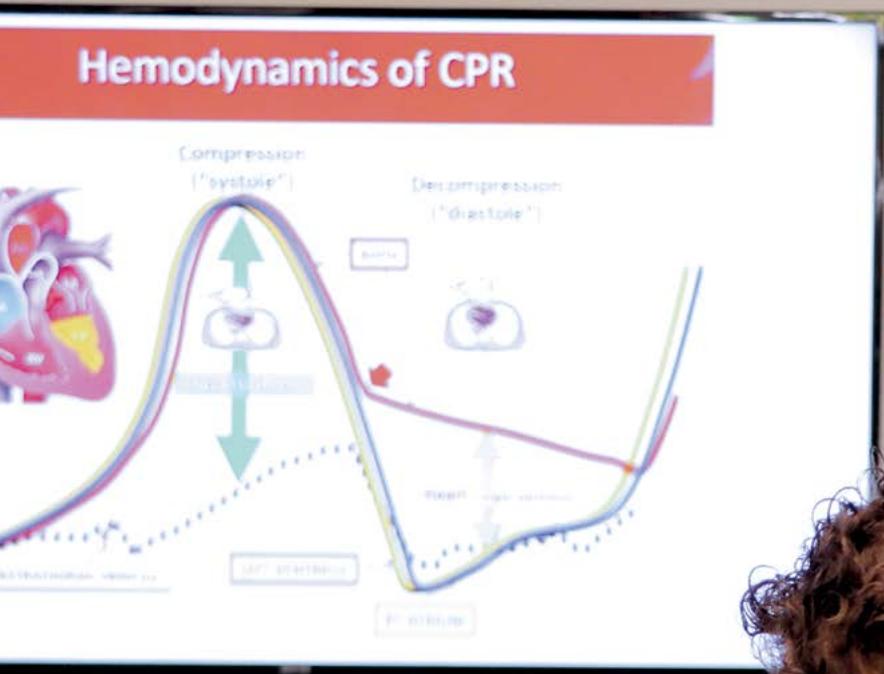


21% of patients survived the event
(had a pulse on arrival at hospital)

12% of patients survived to hospital
discharge

Utstein survival 35.1%*

*Refers to survival among OHCA patients who experienced a bystander-witnessed, shockable cardiac arrest.



Begin EMS HPCPR with ongoing Training/QI

In 2018 our version of high performance CPR was rolled out – we call it IMPACT.

Our 2018 OHCA report was heavily themed around this. All our clinicians, both career and volunteer, have received training that advocates for the foundation of all non-traumatic resuscitation to be well established on a platform of excellent focused compressions, oxygenation and timely defibrillation. The model is framed not only around the metric skills, but also around principles of great leadership, functional

language and calm communication. Ongoing training occurs at least annually and as often as can be accommodated by our resuscitation improvement coordinator and education teams around the State. Additionally, aligned to Step 5, teams who attend cardiac arrest cases are encouraged to contextually debrief performance and are increasingly provided with developmental feedback data after the event.

Benchmarking Summary Report

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

Year	Total events	Bystander CPR %	% AED use (pads applied)	Metro response times (mins)	Rural response times (mins)	% ROSC at ED	% survival
2015	1265	63.7	2.4	8.9	13.5	21.4	10.1
2016	1207	67.4	3.7	9.1	12.4	18.9	9.4
2017	1181	71.8	7.2	8.8	13.3	21.4	9.6
2018	1147	79.9	9.3	8.6	12.1	23.7	15.0
2019	1096	79.1	11.9	9.1	13.3	21.4	12.4

Percentages for bystander CPR and AED use were calculated specifically for non-EMS witnessed arrests

Table 2: Benchmarking survival outcome for all-cause events, where EMS attempted resuscitation

	Collection period	Total number events	% ROSC at ED	% Survival
St John WA	1 Jan 2019 to 31 Dec 2019	1096	21.4	12.4
St John NZ	1 Jul 2018 to 30 Jun 2019	2233	29.4	15.2
Qld Ambulance Service	1 Jan 2018 to 31 Dec 2018	2214	31.6	15.3

Criteria: Excludes cases where resus was not attempted

Survival measured as survival to hospital discharge for SJWA and QAS; survival measured as 30-day survival for SJNZ

Table 3: Benchmarking survival outcome - the Utstein Comparator group

	Collection period	Total number events	% ROSC at ED	% Survival
St John WA	1 Jan 2019 to 31 Dec 2019	194	44.3	35.1
St John NZ	1 Jul 2018 to 30 Jun 2019	535	51.4	33.8
Qld Ambulance Service	1 Jan 2018 to 31 Dec 2018	347	51.6	37.1

Criteria: Excludes cases where resus was not attempted

Survival measured as survival to hospital discharge for SJWA and QAS; survival measured as 30-day survival for SJNZ



Rapid Dispatch

In our system, the dispatch team receive notification when the MPDS determinants for cardiac arrest have been selected.

If the caller does not provide information that aligns with our obvious death protocols, then 2 ambulances and an additional solo responder (CSP or AM) are immediately deployed. Our aim is to have nearest available resources allocated within 20 seconds. Quite often, when a communications officer is receiving a call that presents challenges such as exact location

verification, colleagues provide assistance and the dispatch team have some advance notice to plan which resources will be allocated once the chief complaint is selected. In 2020, background work is being undertaken to review these and other processes and explore refinements that influence response to these cases.

The Registry

Maintained by PRECRU at Curtin University, the SJWA cardiac arrest database, established in 1996 has included;

1. Computer aided dispatch data,
2. Pre-hospital clinical care and management data through ambulance patient records (electronic records became available from mid-2011) and,
3. Hospital outcome data, from hospital medical records, for OHCA cases of all ages occurring in Perth where SJWA paramedics attended.

Comprehensive state wide data capture commenced in 2014. Patient survival outcomes are ascertained by checking against death records from the WA State Registry of Births, Deaths and Marriages. Survival to hospital discharge and neurological outcomes are determined via manual review of hospital medical records by a research nurse. The database now contains over 37,500 OHCA cases (as of 31 December, 2019). We share this data to the Australian Resuscitation Outcomes Consortium (Aus-ROC) Australian and New Zealand OHCA Epistry, which enables unique insights to be gained regarding these patients across Australia and New Zealand, including regional comparisons.

Definition of OHCA

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

Eligibility

The case inclusion and exclusion criteria for the SJWA OHCA database is described in the Tables below;

Table 4	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 (including residential care facilities).
2	Occurred in the State of Western Australia and were attended by SJWA.
3	<p>a. All unconscious patients who are also pulseless with either agonal or no breathing on arrival of SJWA</p> <p>OR</p> <p>b. All patients who become unconscious and pulseless with either agonal or no breathing in the presence of SJWA (so called EMS witnessed/paramedic-witnessed arrests)</p> <p>OR</p> <p>c. Patients who have a pulse on arrival of SJWA following successful defibrillation provided by a bystander prior to arrival of SJWA.</p>

Table 5	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 bystander/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).

Two 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. It also timestamps key points such as time of emergency call received, first ambulance dispatch time, and arrival at scene of first ambulance. This enables response time data to be accurately calculated.

2. Electronic patient care record (e-PCR)

The e-PCR records data on patient demographics, clinical assessment and management. This includes identification of cardiac arrest rhythms, defibrillation (including bystander use of automated external defibrillator- AED), and administration of cardiac arrest medicines. The e-PCR was introduced in 2011. Paper-based records were previously used.

In order to ensure the capture of all OHCA cases in WA that are attended by SJWA, a sensitive but not specific electronic search strategy is conducted to identify potential cases from the CAD database. Clinical research staff carefully scrutinise the results manually, and only those cases meeting the criteria for OHCA (Tables 1 and 2) are included in the SJWA OHCA database.

Initial arrest rhythms and likely causes of OHCA are also determined by manual review of the e-PCR records.

Survival outcomes of return of spontaneous circulation (ROSC) and ROSC on arrival at hospital (ie. patient survived event) are also obtained from the e-PCR records. Survival to hospital discharge (STHD), and longer term survival, are determined by manual review of hospital records and/or WA State Death Registry.

Data quality

Data in the SJWA OHCA database are subject to ongoing quality improvement, with changes being incorporated and back-dated in the database as needed.

Two variables were re-coded in 2017. These were 'resuscitation attempted by SJWA' and 'bystander-witnessed arrest', to better align with the Utstein definitions.

As with the 2018 cardiac arrest report, 'resuscitation attempt' is defined as any EMS resuscitation attempt (CPR and/or defibrillation shock delivered) OR a bystander AED shock delivered. This is consistent with the SJNZ OHCA annual reporting.

In the 2017 SJWA annual report, the resuscitation attempt variable was defined as being restricted to cases with an EMS resuscitation attempt (CPR and/or defibrillation shock delivered). That is to say this EXCLUDED cases where there was a bystander AED shock delivered (but no EMS resuscitation attempt).

In the 2016 SJWA annual report, the resuscitation attempt variable was defined as being restricted to EMS resuscitation attempt (CPR and/or defibrillation) OR any other EMS interventions (e.g. drugs, airway assistance). This EXCLUDED cases where there was a bystander AED shock delivered (but no EMS resuscitation attempt).

In this report, data are produced for each of the years 2015 to 2019, using the same "2018/2019" version of resuscitation attempt (i.e. EMS resuscitation attempt (CPR and/or defibrillation) OR bystander AED shock delivered).

Thus, the numbers in this report for 2016 and 2017 will differ to the numbers in corresponding annual reports, due to this change in definition.

In addition, there are also some minor changes to data in previous years due to reviews of coding. As part of these reviews, several cases in previous years have been now excluded from the database, on the basis of being short runs of pulselessness that self-resolved without any resuscitation attempt. This is consistent with the VACAR exclusion criteria.

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

All paper and electronic data relating to the SJWA OHCA database are 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 is relatively rare for all core variables (see Table 6 below).

Table 6: Number and proportion of missing data for select SJWA OHCA database variables in 2019 (n=2722)

Missing data	Number of cases
Sex	0
Age	0
Aetiology	0
Witness status	1
Location type	2
Response time	5
Initial Arrest Rhythm	16
Bystander CPR	1
Bystander shock given	0
Survived to hospital arrival	1
Survived to hospital discharge	0





Measure professional resuscitation performance with defibrillation recording

We have always been committed to trying to obtain CPR performance data, and there were some challenges to obtaining that data prior to 2019/2020.

Over the last year or so, we have been transitioning to the Corpuls3 monitor and the use of CPR measuring devices is now observed in the vast majority of cases. This provides us with a great level of metric performance data. Additionally, the device is configured to begin audio recording when resuscitation begins.

The ability to align metric performance and the non-technical, communication aspects allows somewhat of a 3D perception of the case to be formed. These data are collated, summarised and provided back to teams, who feedback that they find it of immense value to their development.

Incidence and demographics

The total number of OHCA cases has slowly trended upward in WA since 2015. A total of 2722 cases were attended by SJWA in the period 01 January – 31 December 2019. There were 41 cases classified as children (<16 yrs) and 2681 classified as adults (16 yrs and above).

The crude incidence for adults was 128.9 per 100,000, which is slightly increased over that reported in 2018 (123.6/100,000). The population of WA at the mid-point of 2019 consisted of approximately 2.08 million adults, and 543,000 under-16's. For children in 2019 this was 7.6 per 100,000 which is a somewhat concerning increase from 2018 (6.5/100,000).

Males comprised 68.3% of all OHCA cases, and females comprised 31.7%.

The median male age was 62 years compared to 68 years of age in females

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

	No. Cases	% of all cases	% resus attempted	Incidence rate	Gender
Adults	2681	98.5	40.2% (n=1095)	128.9	Male 68.3% Female 31.7%
Children	41	1.5%		7.6	
Total	2722	100		--	

Location of Cardiac Arrest

Excluding those who suffer a cardiac arrest when they are already in the care of SJWA ambulance officers, the majority of patients (70%) arrested at a residential address. This is largely unchanged from our previous reports and is similarly observed in other systems.

Just under a quarter of OHCA patients occurred in a public area, which increases the likelihood of being 'seen or heard' to collapse and the chain of survival commencing expeditiously.

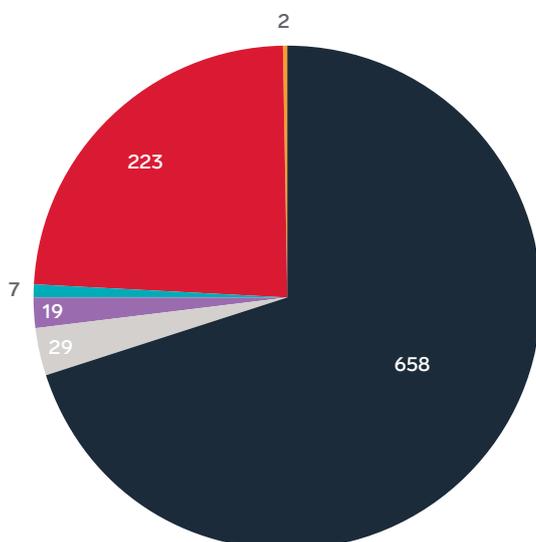


Figure 1: Location of Arrest

- 658 occurred in a private residence
- 29 occurred in an aged care facility
- 19 occurred in accommodation - other
- 7 occurred in a medical centre
- 223 occurred in public
- 2 occurred in an unknown location

Total: 938

Criteria: excludes EMS-witnessed arrests and cases where resuscitation was not attempted. "Accommodation - other" includes hotels, backpacker hostels and caravan parks.

Resuscitation Attempted

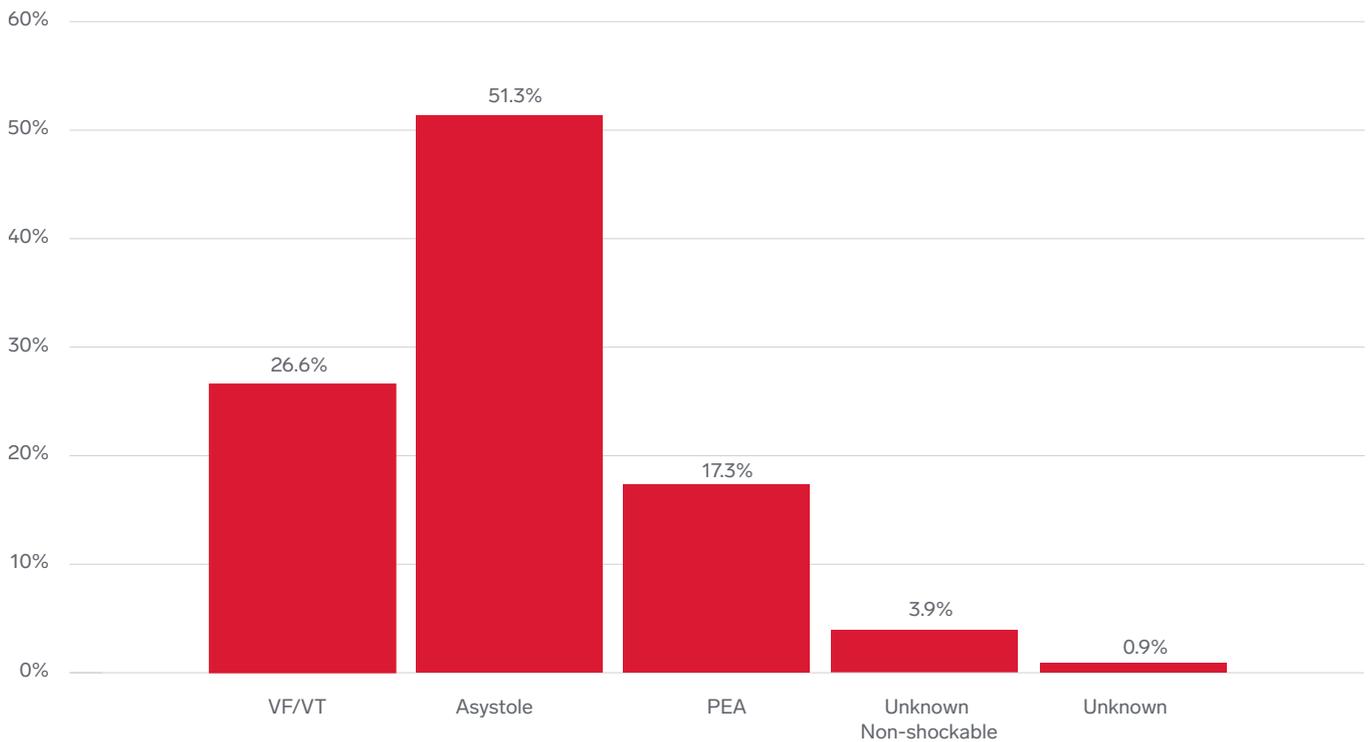
The total number of OHCA cases in 2019 increased by 143 over 2018 (n=2722 v 2579). However, the proportion of cases where resuscitation was attempted was lower at 40.3% compared to 44.5% in 2018.

During 2019, revised clinical practice guidelines (CPG's) were introduced that highlighted instances where a strict combination of less favourable prognostic criteria could be taken into account in determining whether a resuscitation attempt was appropriate.

Presenting Rhythms

Among adult OHCA patients who received a resuscitation attempt (n=1064), just over one quarter (27%) had a shockable initial arrest rhythm (VF/VT). 72% had a non-shockable rhythm (51% asystole, 17% PEA, and 4% unknown non-shockable). The initial rhythm was not recorded for 1% of cases. The 'unknown/non-shockable' cohort relates to non-metro locations where an automated AED is utilised by volunteer EMTs and there is no means for a rhythm to be observed and interpreted for the record.

Figure 2: Incidence of adult presenting rhythms 2019



■ Incidence of adult presenting rhythms 2019

**excludes cases <16 years of age*

Precipitating Causes – Adults (16 + yrs)

Ambulance officers record the most likely precipitating cause in the ePCR when it appears obvious (e.g. trauma, hanging, drug overdose). In non-specific circumstances, there is a presumption of cardiac aetiology. Cases relating to trauma, electrocution and particularly drowning increased during 2019. As is observed across many other systems, those of a presumed cardiac aetiology account for the majority of OHCA attended by SJWA.

Table 9: Aetiology - Adults

Cause of arrest	2015	2016	2017	2018	2019	TOTAL
Presumed cardiac	992	912	884	889	810	4487
Respiratory	14	21	21	30	33	119
Malignancy	17	14	11	15	10	67
Trauma	69	98	87	57	73	384
Hanging	80	72	74	67	68	361
Drowning	8	11	12	8	16	55
Drug overdose	39	45	46	50	52	232
Electrocution	3				2	5
Other	1	1	2			4
TOTAL	1223	1174	1137	1116	1064	5714
Criteria: Excludes cases where resus was not attempted						

Precipitating Causes – Children (<16 yrs)

The number of paediatric OHCA cases (<16 years) in 2019 was 32, slightly lower than the average of 37.5 over the previous four years. In 2019, the number of paediatric OHCA cases of traumatic cause (n=6) was the lowest since 2015. Conversely, in 2019, the number of paediatric OHCA cases related to drowning (n=2) was the lowest it has been in the last five years.

Table 8: Aetiology - Children

Cause of arrest	2015	2016	2017	2018	2019	TOTAL
Presumed cardiac	16	8	9	8	9	50
Respiratory	2	2	3	4	2	13
Malignancy						
Trauma	6	4	5	3	6	24
Hanging	3		5	2	3	13
Drowning	7	3	4	6	2	22
Drug overdose						
Electrocution	1			1		2
SIDS	7	16	12	7	9	51
Other			6		1	7
TOTAL	42	33	44	31	32	182
Criteria: Excludes cases where resus was not attempted						



AED Program and Community First Responder (CFR)

During 2019, our First Responder and Fundraising teams did some amazing work to increase the prevalence of publically available AEDs.

All of these locations are painstakingly geo-mapped, so that when the 000 call taker locates a cardiac arrest, or other selected determinants, the location will be immediately visible. The number of CFR locations rose by 1589 over the 2019 calendar year, a fantastic achievement. When a CFR-registered AED is applied to a patient, St. John replaces the pads on a complimentary basis to ensure that it is serviceable as soon as possible. Rhythm data

from AEDs is retrieved and sent to hospital wherever possible after use in cardiac arrest. We aim to this within 24 hours, but quite often this is done within 12 hours. Our 2018 report presented a small feature on this.

Wider projects to support the increase in community available AEDS on a 24/7 basis continues to yield positive results with this year on year increase in registered units.

Pre-ambulance community response (bystander and AED activity)

Approximately 79% of non-EMS witnessed cases received bystander CPR in 2019, consistent with 2018, both of which are a steady improvement on previous years. A total of 131 (14%) cases had AEDs applied, 45% of whom had a shock delivered (n=59). This is more applications than the previous year although the number of shockable cases remained similar. A total of 30 OHCA patients who received an AED shock survived to hospital discharge (51%).

Table 10: Bystander CPR (all of WA)

	2015	2016	2017	2018	2019	Grand Total
CPR provided	706	718	748	800	742	3714
No evidence of bystander CPR	403	347	294	201	196	1441
Grand Total	1109	1065	1042	1001	938	5155
% where CPR provided	63.7	67.4	71.8	79.9	79.1	
Criteria: Excludes EMS-witnessed arrests, and cases where resus was not attempted						

Table 11: Bystander use of AED and number of survivors - all of WA

Values	2015	2016	2017	2018	2019	Grand Total
AED pads applied by bystander	Unknown	40	86	111	131	395
AED shock delivered by bystander	26	25	41	60	59	211
ROSC at ED after bystander AED shock	17	14	20	46	35	132
STHD after bystander AED shock	13	14	17	40	30	114



Smart Technologies to notify communities and improve bystander CPR and AED use

In 2017 we designed and launched our own app that provides multiple functions.

Primarily it alerts registered users within a 500m radius of a cardiac arrest in a public place. That provides increased potential for bystander CPR and AED use in the critical minutes before ambulance arrival. Having our in-house app affords us flexibility and the ability to redesign, update and shape content seamlessly. The app shows the locations of all CFR registered AED locations. It also allows

any app user to upload the location of any AED they see, which is then verified by SJWA through consultation with the owner. As of Sept 2020, there have been over 250,000 downloads of the app since launch, with 21,000 alerts generated for a variety of incidents.

Within the app are great first aid infographics for a variety of situations, including adult and child CPR instructions, and a convenient metronome within the 'toolbox'.

SJWA Response times

In comparison to last year, our response times were slightly extended. Median times in our remote and rural locations increased by just over a minute, whereas in the metropolitan area this increase was approximately 30 seconds.

Table 12: Metro response times (in minutes)

Metro response times (in minutes)	2015	2016	2017	2018	2019
Median	8.9	9.1	8.8	8.6	9.1
10th centile	5.3	5.3	5.6	5.1	5.5
25th centile	6.8	7.1	7.0	6.4	6.9
75th centile	11.2	11.7	11.3	10.9	11.8
90th centile	14.1	15.1	14.4	14.4	14.6
Criteria: Excludes cases where resuscitation was not attempted					

Table 13: Rural/Regional response times (in minutes)

Rural/Regional response times (in minutes)	2015	2016	2017	2018	2019
Median	13.5	12.4	13.3	12.1	13.3
10th centile	6.9	6.4	6.5	6.8	5.8
25th centile	9.0	9.0	9.0	8.9	9.1
75th centile	19.6	19.8	20.2	18.8	21.9
90th centile	32.0	33.0	32.3	29.0	32.3
Criteria: Excludes cases where resus was not attempted					

Outcomes

We are pleased to report that in 2019, a total of 136 people survived to hospital discharge following OHCA in WA (133 adult ; 3 children). It is the second most successful year to date and although it is not as close to 2018 as we had hoped, it nonetheless suggests that the overall improvement program that we have committed to is effective, which is good for our communities.

A key predictor of survival is whether the patient arrived at ED with a pulse. In 2019, 235 of the 1096 patients where resuscitation was attempted arrived at the ED with a pulse (21.4%), equal to the rate in 2015 and 2017. However, unlike those two years, STHD was noticeably higher at 12.4%

Table 14: % Survival (of resus.- attempted cases)

% Survival	2015	2016	2017	2018	2019
%ROSC at ED	21.4	18.9	21.4	23.7	21.4
%STHD	10.1	9.4	9.6	15.0	12.4



CPR Training and AED awareness in schools and the community

SJWA is the dominant provider of first aid courses in WA, all of which include CPR and AED awareness as standard.

Furthermore, all participants are familiarised with, and asked to download our responder app. Thousands of people pass through our facilities, with over 100,000 members of the community in 2019. SJWA has a strong relationship with the community, especially our youth population. As part of our commitment to make first aid a part of everyone's life, we also provided 321,000 youths with first aid training at no cost.

Our fantastic first aid trainers are pivotal in helping us on our resuscitation improvement program. Some of the principles of HPCPR that apply to professionals are translatable to the community within our ARC standards, such a promoting minimally interrupted, good quality compressions (including full release) and regularly swapping compressors wherever possible.

Adult outcomes according to initial presenting rhythm

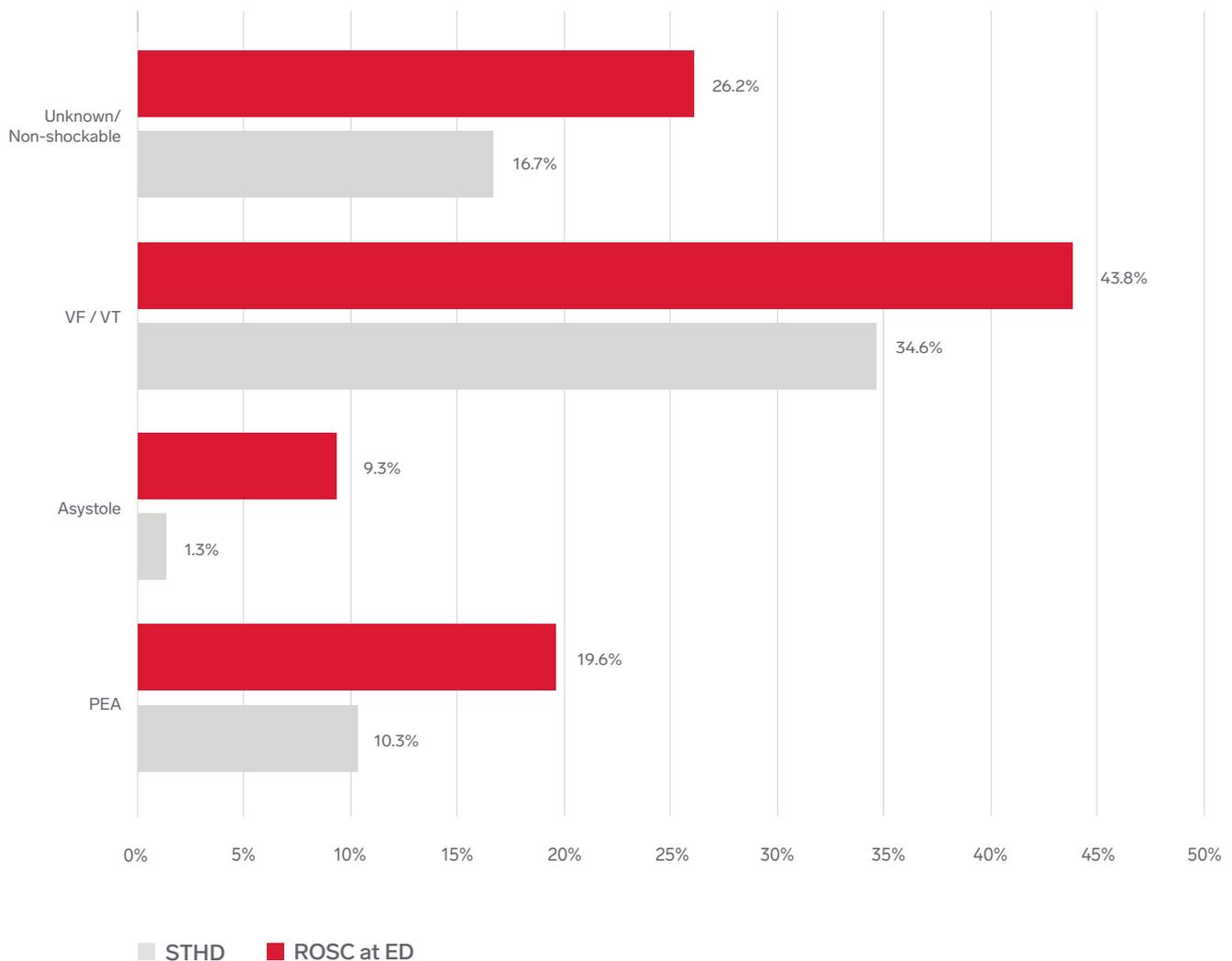
Shockable rhythms (VF/VT) were predictably the most common presentation (73.7%) in adult patients who survived to hospital discharge. Conversely, patients with a non-shockable rhythm comprised nearly one quarter (24.8%) of all survivors, with 1.5% of survivors having an unknown initial rhythm. This highlights that approximately 3 out of 4 survivors, not an insignificant number, are a large proportion of survivors even though they were non-shockable at initial presentation.

Table 15: Number of survivors to hospital discharge by Initial Arrest Rhythm

Row Labels	2015	2016	2017	2018	2019	Grand Total
VF/VT	85	94	80	120	98	477
Asystole	6		5	13	7	31
PEA	29	19	25	21	19	113
Non-shockable (unspecified rhythm)					7	7
Unknown				13	2	15
Grand Total	120	113	110	167	133	643

Criteria: Restricted to adults (≥ 16 yrs); Excludes cases where resus was not attempted

Figure 3: Percentage survival by initial arrest rhythm





Accountability

This 2019 report is our 4th consecutive cardiac arrest report. These reports are all widely promoted, distributed and publically available.

2016 marked the first year of a dedicated annual undertaking to consistently report our data, that we hope not only informs the wider community of WA, but also serves as a reference point for our health partners, academic readership, ambulance services in other jurisdictions, and media outlets. Not only are all of our reports available on our

public internet site, we also actively promote its publication and content through our public relations and social media platforms. We are committed to drafting and designing our reports in as simple a manner as possible to ensure that the readership finds it easy to understand, with clear definitions in order to identify and scrutinise the data.

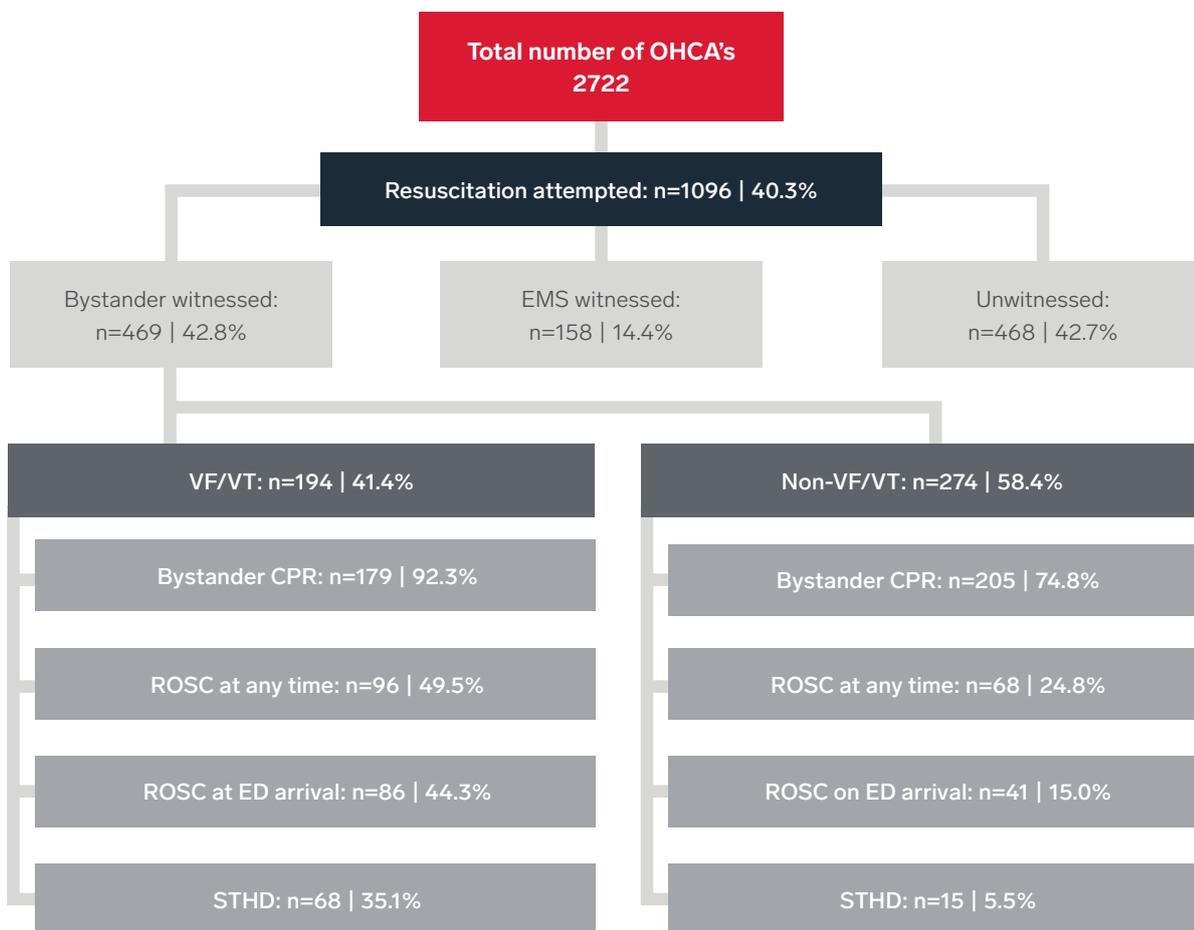
Utstein Comparator Group

Defined as all-cause cardiac arrest in the community where the patient is witnessed to collapse by bystanders and presents with a shockable rhythm, the Utstein comparator group reflects outcomes for a cohort who are recognised to be the most likely to have favourable outcomes. It also allows for less ambiguous benchmarking against other systems.

Of the 1096 OHCA patients in 2019 who had resuscitation attempted, 469 (42.8%) had been bystander-witnessed, and of those, 194 (41.4%) patients had a shockable initial rhythm. Among these 194 patients in the Utstein comparator group, 35.1% survived to hospital discharge.

Note that the Utstein comparator group comprised a small proportion (194/1096 = 17.7%) of all OHCA cases where resuscitation was attempted, but made up 50% (68/136) of all OHCA survivors in 2019.

Figure 4: Utstein criteria





Culture of excellence

We believe the culture of excellence extends right across our organisation from the executive to our administration, support staff and clinicians alike.

This organisational philosophy is evident in our approach to improving cardiac arrest outcomes. In order to be the best that we can, we have engaged and collaborated with other services across Australia and New Zealand through the Council of Ambulance Authorities (CAA) to discuss ideas and principles of excellence in OHCA care. We have sent delegates to the CPR University in Arizona to learn about the effects of hands-on skills, minimally interrupted resuscitation, general high performance CPR and leadership in OHCA care. Our friends at the Resuscitation Academy in Seattle, Washington

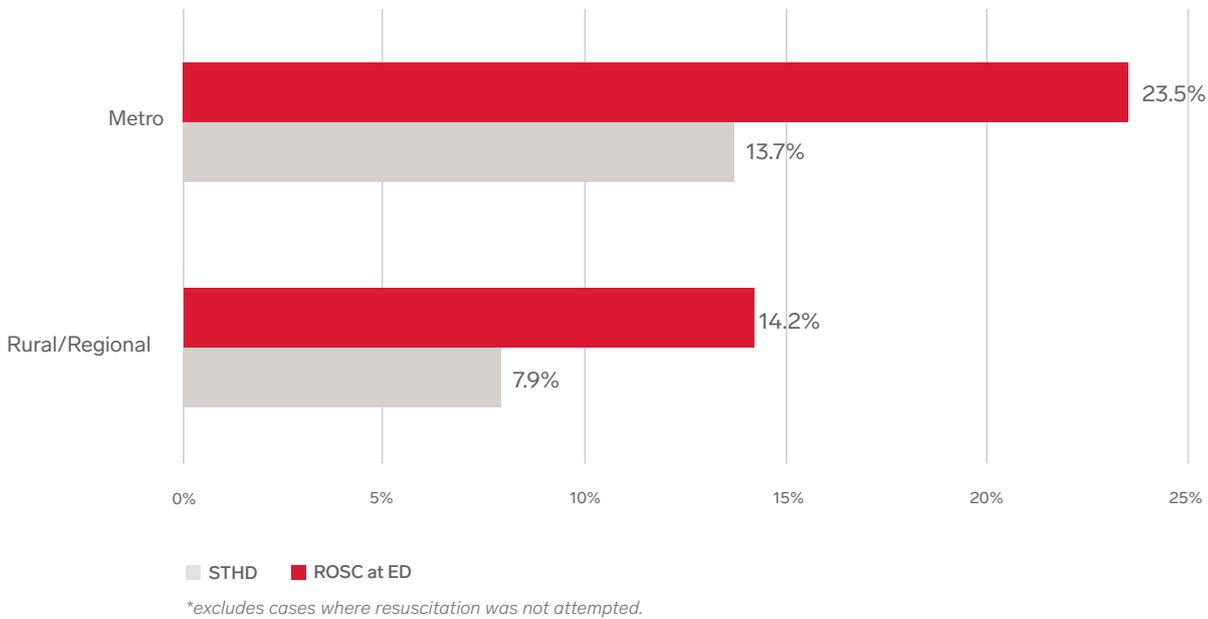
have welcomed many of us on several occasions where we have learned much about the influences of a strategic approach to system change that we have been able to bring back and empower our people with.

When we are engaged in training and education of our practitioners, we emphasise the importance of task focus, team cohesion, leadership, a 'pursuit of ROSC' mindset and that every compression counts as much as the one before. Performance feedback as addressed in Step 5 above aligns very closely with excellence.

Outcomes according to rurality

The vast majority (80%) of the West Australian community live in the metropolitan areas of Perth, the State capital, which is where the majority (76%) of OHCA cases occur, and where there is better access to tertiary healthcare services. Outcomes in the metropolitan areas subsequently continue to be more favourable.

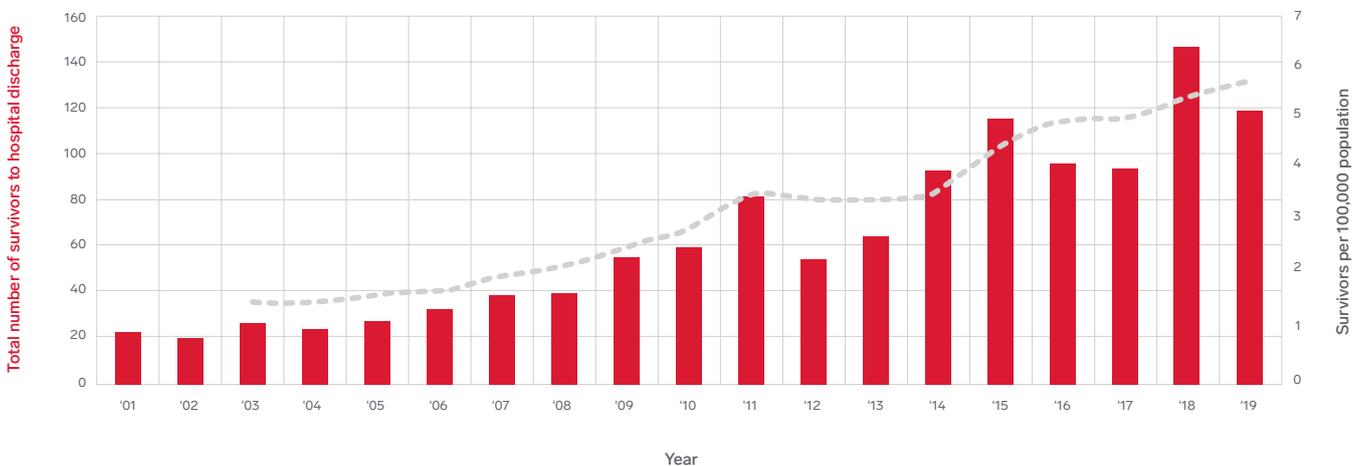
Figure 5: Comparative outcomes - Metro Perth vs Regional WA



Survival per 100,000 population

Calculated as a 3-year moving average, approximately 5.75 persons per 100,000 population in the metropolitan area survive to hospital discharge following OHCA in metropolitan Perth, where the majority of cases occur. It is a number that has trended upward over time, and one that we very much hope continues to do so.

Figure 6: Number of survivors, and survival per 100K Population (Metro Perth)



Outcomes at scene

Table 16: Outcomes at scene and those by destination hospital

Scene Outcomes	Cases	%
Transported from scene with ROSC	239	21.8%
Transported from scene without ROSC	438	40.0%
Resuscitation efforts ceased at scene	419	38.2%
TOTAL	1096	
Criteria: Excludes cases where resus was not attempted.		

In cases where efforts are attempted, 38% are not transported to hospital, 22% patients have ROSC at the time of being transported from the scene to hospital, and the remainder (40%) do not have ROSC at the time of being transported from the scene to hospital.

When OHCA patients in the metropolitan Perth achieve ROSC at the time of transport, we advocate that our paramedics proceed directly to a tertiary hospital wherever possible, especially those cases where there is a presumption of cardiac aetiology (primary cardiac arrest).

In WA, the large teaching, tertiary hospitals have on-site cardiac services with primary cardiac catheterisation facilities (PCI capable). These hospitals are all within the Perth metropolitan area. Larger regional centres may have some cardiac services. One regional centre is PCI-capable but is not a 24/7 service and has some admission criteria. As already reported, the vast majority of OHCA cases occur within the Perth area, and the table below demonstrates the outcome differences according to this capability for primary cardiac arrest patients.

Table 17: Percentage survival (STHD) according to whether the patient had direct transport to PCI hospital

	2019
%Survival PCI Hospital	64.8%
%Survival if not PCI Hospital	35.6%
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

Our commitment in improving OHCA outcomes continues to progress and show much promise. The hard work that many of our colleagues have invested in this pursuit has made a valuable contribution, if only in some small part to each of the 136 survivors of OHCA in 2019.

The research and data we continue to undertake and collate with our academic partners at PRECRU will continue to inform and help us understand where continued focus is required as we progress with our improvement program.

References

- (1) WA population
<https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3101.0Jun%202019?OpenDocument>
- (2) ARC Guidelines
<https://resus.org.au/guidelines/>
- (3) 10 steps Global Resuscitation Alliance
<https://www.globalresuscitationalliance.org/ten-programs/>





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