



Out-of-Hospital Cardiac Arrest Report 2017



We continue to remember the profound contribution of the late Prof Ian Jacobs to the field of resuscitation science around the world.

Without Prof Jacobs' valuable contribution to out of hospital cardiac arrest research in Western Australia, this report would not be possible.

We stand on the shoulders of a giant.

Contents

List of Figures.....	2	Arrest locations	24
List of Tables.....	3	SJAWA response times.....	25
Abbreviations.....	4	Community response pre-ambulance arrival	29
Definitions	5	Outcomes	35
Survivor story.....	7	Scene outcome for OHCA in adults	35
Introduction	9	Adult outcomes from all cause cardiac arrest	36
Description of service	11	Adult outcomes according to presenting rhythm.....	36
Responding to a cardiac arrest.....	11	Utstein survival.....	38
About this report.....	12	Outcomes according to rurality	39
Description of registry.....	13	Functional outcomes in OHCA survivors	40
Definition of out-of-hospital cardiac arrest (OHCA)	13	Conclusion.....	43
Eligibility	13	Publications/research highlights	44
Data capture	14	Acknowledgements.....	45
Data quality	14		
Ethics approval	14		
Missing data.....	15		
Reference	15		
Incidence and demographics	17		
Incidence across rural and regional areas in Western Australia.....	19		
Precipitating events for adults.....	21		
Precipitating events for children	21		

List of Figures

- Figure 1:** Crude and age-standardised incidence rate of OHCA cases of all ages in WA in 2017
- Figure 2:** Trends in the crude and age-standardised rates of OHCA in Perth metropolitan area between 2007 and 2017
- Figure 3:** Crude incidence rates of OHCA cases of all ages by region in WA in 2017 (irrespective of whether resuscitation was commenced by SJAWA)
- Figure 4:** Crude incidence rates of OHCA cases of all ages by WA Health Region in 2017 (irrespective of whether resuscitation was commenced by SJAWA) (n=2505)
- Figure 4:** Causes of adult OHCA cases (age \geq 16)
- Figure 5:** Causes of paediatric OHCA cases (age $<$ 16) where resuscitation was commenced by SJAWA, in WA in 2017
- Figure 5.1:** The number of paediatric (age $<$ 16) OHCA cases due to hanging in WA from 1996 to 2017
- Figure 6:** Arrest locations of adult OHCA cases (age \geq 16) where resuscitation was commenced by SJAWA, in WA in 2017
- Figure 7:** Distribution of response time for OHCA cases of all ages where resuscitation was commenced by SJAWA, in the Perth metropolitan area in 2017
- Figure 8:** Distribution of response time of OHCA cases of all ages where resuscitation was commenced by SJAWA, in the rural areas of WA in 2017
- Figure 9:** Relationship between survival (to-hospital-discharge) and SJAWA response time (call answer to scene arrival), by witness status, for OHCA patients where resuscitation was commenced by SJAWA, excluding traumatic arrests and SJAWA-witnessed arrests
- Figure 10:** Survival outcomes after bystander CPR and resuscitation commenced by SJAWA in OHCA cases of all ages in WA in 2017 (Note: cases where SJAWA witnessed arrest were excluded (n=138))
- Figure 11:** Trends of bystander CPR rates by region among OHCA cases of all ages where resuscitation was commenced by SJAWA, in WA between 2015 and 2017

- Figure 12:** Trends of bystander CPR rates by region among OHCA cases of all ages where resuscitation was commenced by SJAWA, in WA between 2015 and 2017
- Figure 13:** Survival outcomes according to who shocked the patient first in OHCA cases of all ages (excluding SJAWA-witnessed cases) in WA in 2017
- Figure 14:** Survival outcomes according to who shocked the patient first in OHCA cases of all ages (excluding SJAWA-witnessed cases) in WA in 2017
- Figure 15:** Survival outcomes according to who shocked the patient first in OHCA cases of all ages (excluding SJAWA-witnessed cases) in WA in 2017
- Figure 16:** Trends in survival outcomes for all-cause OHCA in adults (age \geq 16) where resuscitation was commenced by SJAWA, in WA between 2015 and 2017
- Figure 17:** Survival outcomes of adult OHCA cases (age \geq 16) by initial arrest rhythm where resuscitation was commenced by SJAWA, in WA in 2017
- Figure 18:** Survival outcomes of OHCA cases of all ages in WA in 2017
- Figure 19:** Survival outcomes of adult OHCA cases (age \geq 16) by region where resuscitation was commenced by SJAWA, in WA in 2017
- Figure 20:** Frequency distribution of cerebral performance category (CPC) scores, pre-arrest versus post-arrest, among OHCA patients of all ages in metropolitan Perth who survived to hospital discharge (where resuscitation was performed by SJAWA or the patient was defibrillated by bystanders)

List of Tables

- Table 1:** SJAWA OHCA database inclusion criteria
- Table 2:** SJAWA OHCA database exclusion criteria
- Table 3:** Number and proportion of missing data for select SJAWA OHCA database variables in 2017 (n=2,505)
- Table 4:** Total number of OHCA cases of all ages in WA in 2017





Abbreviations

ALS	Advanced Life Support
AED	Automated External Defibrillator
AM	Area Manager
AO	Ambulance Officer
AUS-ROC	Australasian Resuscitation Outcomes Consortium
CAD	Computer Aided Dispatch
CFR	Community First Responder
CPR	Cardiopulmonary Resuscitation
CSP	Clinical Support Paramedic
DoH	Department of Health
ECG	Electrocardiogram
EMS	Emergency Medical Services
MMO	Manager Metropolitan Operations
MPDS	Medical Priority Dispatch System
OHCA	Out of Hospital Cardiac Arrest
PCR	Patient Care Record
PEA	Pulseless Electrical Activity
PRECRU	Pre-hospital, Resuscitation and Emergency Care Research Unit, Curtin University
ROSC	Return of Spontaneous Circulation
SJAWA	St John Ambulance Western Australia
SOC	State Operations Centre
SRU	Single Responder Unit
VACAR	Victorian Ambulance Cardiac Arrest Registry
VF	Ventricular Fibrillation
VT	Pulseless Ventricular Tachycardia
WA	Western Australia

Definitions

Adults

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

Ambulance officer

Crew member studying towards a degree in paramedicine

Asystole

Absence of any cardiac activity

Dead on arrival

Cases for which paramedics determine a patient to be deceased on arrival

Defibrillation

Providing an electrical shock to a patient in a shockable rhythm

Died at scene

Patients who receive an EMS attempted resuscitation but do not survive to transport

Emergency medical

SJAWA paramedics, Volunteer Ambulance Officers or first service responders, including community emergency response

EMS attempted resuscitation

Cases where either paramedics or first responders attempted to revive a patient in cardiac resuscitation arrest using CPR and/or defibrillation, irrespective of duration

EMS attended

Cardiac arrest events attended by paramedics regardless of whether treatment was provided

EMS response time

The time from 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

Metro

Denotes the Perth metropolitan area

Paediatrics

Patients aged less than 16 years

Paramedic

ALS Qualified Ambulance Officer

PCI-capable hospital

Denotes a hospital with access to 24/7 Percutaneous Coronary Intervention (PCI) capabilities

Presumed cardiac

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

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 (i.e. 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, by EMS, or a bystander with a public automated external 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 an attempt at resuscitation was made by EMS)

Volunteer Ambulance Officer

Unpaid Ambulance Officer providing emergency services to their community





Phil Mattaboni, Gary Mews, Gwynne Lennox and Rick Reid

You never know who might save your life

When the power is cut, the lights go out immediately. It is a similar situation when someone experiences a cardiac arrest. It is often triggered by an electrical malfunction of the heart, that causes the heart to stop beating.

A cardiac arrest requires immediate medical intervention by way of CPR and ideally defibrillation. Every minute the patient receives no assistance, the likelihood of survival diminishes greatly. This is why Rick Reid will be forever grateful to his workmates.

In November 2017 Rick was working at the WARP Traffic Management depot in Maddington when colleagues noticed him looking pale and unwell. He was seated upstairs on the mezzanine level so they went to move him but he collapsed on the way to the stairs.

The married father of four was unconscious and not breathing. Fortunately one of his colleagues was a volunteer ambulance officer and knew exactly what to do. CPR was commenced immediately and the ambulance was called. The call taker stayed on the line, encouraging them to continue chest compressions and mouth to mouth.

Paramedics arrived and took over CPR. Colleagues arranged for a forklift to get him and the paramedic to the ground floor. He was defibrillated three times before regaining a pulse. While being loaded into the ambulance Rick regained consciousness and was fully coherent.

Rick was rushed priority one to Fiona Stanley Hospital and taken straight to the catheterisation lab where he underwent heart surgery. Thanks to the quick response of his colleagues, Rick made a full recovery and is able to continue to enjoy family time with his 10 grandchildren.

SJAWA Area Manager Gary Mews, who was at the scene that day, said he was in no doubt that the reason Rick survived was due to the rapid response of his workmates.

“It just shows how critical it is to be able to perform effective CPR,” he said.





Tony Ahern / Paul Bailey / Judith Finn

Introduction from the CEO / Clinical Director / PRECRU Director

It is a great privilege to present the 2017 annual report into out of hospital cardiac arrest in Western Australia. Once again, we have been able to document progress in the field of cardiac arrest management and outcomes in our great state, through the collaboration of St John Ambulance and the Pre-Hospital, Resuscitation and Emergency Care Research Unit (PRECRU), based at Curtin University.

Sudden cardiac arrest remains a significant issue in our society, with five individuals per day being treated throughout Western Australia. Of those, just over two per week survive to hospital discharge. We are seeing increased deployment and use of community based automated external defibrillators; continued improvement in bystander CPR rates, most notably in country locations. Extensive efforts across all aspects of ambulance operations are being made so that our response to this vulnerable patient group is streamlined. St John Ambulance WA continues to promote community resilience through widespread provision of first aid training to school children and the general community, we facilitate the use of defibrillators through the St John Smartphone App and we continue to provide world class ambulance services.

We have built on the lessons learned at the Resuscitation Academy in Seattle in 2017 with participation in the CPR University course at the University of Arizona in Phoenix, USA. Once again the importance of doing the basics at an expert level has been demonstrated to us by world leaders in pre-hospital resuscitation. Several exciting developments in our management of OHCA patients have been deployed during 2018 and we look forward to updating the community on our progress next year, in the 2018 OHCA report. In the meantime, once again we pay our deep respect to the victims of OHCA that we were unable to save, along with their families. We continue with our resolve to improve OHCA outcomes in Western Australia.





Description of service

St John Ambulance Western Australia (SJAWA) provides emergency ambulance services to a vast geographic area – some 2.5 million square kilometres. We serve a population of approximately 2.6 million people.

Ambulance services are provided by approximately 800 paramedics and more than 5,000 volunteer ambulance officers, supported through an ongoing clinical education program.

Paramedics work in the Perth metropolitan area and larger regional locations, with dedicated and skilled volunteer ambulance officers and community paramedics providing care in rural and some regional locations. Care is provided to more than 300,000 patients per year in both ambulance and event health settings.

Our graduate paramedics complete a four year training program, including a tertiary degree with Curtin University (or other University), graduating with a bachelor's degree in paramedicine.

In Australia, emergency services are activated via the triple zero (000) call service. Ambulance calls in Western Australia are directed to the SJAWA State Operations Centre (SOC) where they are answered by specially trained call takers and prioritised according to the nature of the emergency – using a validated process called the Medical Priority Dispatch System (MPDS). There are two ambulance triple zero call centres in Western Australia – with the main facility at Belmont, near the Perth CBD, and a secondary centre at Wangara in Perth's northern suburbs. SJAWA receives approximately 850 calls per day for an emergency ambulance response.

In the Perth metropolitan area, the ambulance response to an out-of-hospital cardiac arrest includes two paramedic/ambulance crews and either an area manager or clinical support paramedic – that is to say a total of five paramedics respond. In larger regional areas, the response most commonly consists of two ambulances. In smaller rural locations, a cardiac arrest call-out will most commonly result in a single ambulance responding with a crew made up of two volunteer ambulance officers.

SJAWA Clinical Practice Guidelines of relevance to out-of-hospital cardiac arrest include those relating to basic life support, defibrillation, advanced life support (paramedics only), airway support and recognition of life extinct. The latter covers situations where resuscitation is clearly not appropriate.

SJAWA Clinical Practice Guidelines for cardiac arrest are based on the Australian Resuscitation Council (ARC) Guidelines resus.org.au/guidelines

All protocols are developed by SJAWA's Clinical Governance team and ratified by our Medical Policy Committee (MPC). The MPC consists of medical experts independent of SJAWA with expertise in diverse areas of medical practice including Emergency Medicine, General Practice, Anaesthesia, Trauma Surgery and Retrieval Medicine.

Responding to a cardiac arrest

When a call consistent with cardiac arrest comes in, the highest priority response is allocated, resulting in the dispatch of the closest ambulance resources, regardless of pre-existing tasking. During the call, questions are asked regarding the availability of a defibrillator locally and any bystanders/family are instructed to commence CPR while an ambulance is enroute to their location.





About this report

Out-of-hospital cardiac arrest (OHCA) (sometimes referred to as ‘sudden cardiac death’) is a leading cause of death in Western Australia. Benchmarking of performance measures associated with OHCA is a recognised way of comparing the performance of ambulance services worldwide, although concerns are often raised with regards to the accuracy of data (and the standardisation of definitions).

In fact, the American Heart Association states that the management of OHCA by EMS agencies is the sentinel measure of the quality of EMS care.

The cases and data in this OHCA annual report, represent cases identified through the SJAWA OHCA registry covering the time period from 1 January to 31 December 2017 and represent all OHCA cases attended by SJAWA in that time period. Further information on this process is available in the description of registry.

Analysis in this report refers to two broad patient groups, the first being OHCA attended (all patients); the second being resuscitation attempted (a subset of the first group where SJAWA have commenced resuscitation). Major endpoints include ‘survived event’ which is defined as the presence of a pulse (otherwise referred to as a ‘return of spontaneous circulation’ or ROSC) at Emergency Department (ED) arrival and ‘survival to hospital discharge’ which is self-explanatory.

An interesting subgroup of OHCA patients are emerging, who have indeed suffered an OHCA – but have been successfully resuscitated in the community via the use of a community based automatic external defibrillator (AED), and are first encountered by our ambulance service post return of spontaneous circulation (ROSC).

These patients are in some instances fully conscious on first contact with SJAWA. They represent a classification conundrum for our OHCA database as they were not actually in cardiac arrest at the point of their first encounter with our service.

Although these patients are included in this report, they are excluded from the many tables and figures that relate specifically to patients where resuscitation was commenced by SJAWA.

In 2017, there were 11 OHCA survivors that were successfully defibrillated in the community, and did not require any further resuscitation attempt by SJAWA.

Description of registry

The SJAWA out-of-hospital cardiac arrest database (SJAWA OHCA database), established in January 1996 by the late Professor Ian Jacobs, was the first OHCA Registry in Australia/New Zealand. The SJAWA OHCA database is located within the Pre-hospital, Resuscitation and Emergency Care Research Unit (PRECRU) at Curtin University.

Since 1996, this database has primarily included:

1. **computer-aided dispatch data,**
2. **pre-hospital clinical management data from patient care records (electronic records available from mid-2011) and,**
3. **hospital outcome data from hospital medical records, for OHCA cases of all ages occurring in Perth where SJAWA paramedics attended.**

Comprehensive capture of rural WA data commenced in 2014.

Patient survival outcomes (e.g. 30-day and 12-month survival) are ascertained by checking against death records from the WA State Registry of Births, Deaths and Marriages.

Survival to hospital discharge and neurological outcomes (Cerebral Performance Category and Overall Performance Category)⁽¹⁾ are ascertained for patients admitted to a hospital in Perth through manual review of hospital medical records by a research nurse. These neurological outcomes cannot currently be determined for rural WA patients who are not transferred to a Perth hospital.

Over the last 21 years, data for OHCA cases (children and adults) has been captured for more than 32,500 patients in WA. The SJAWA OHCA database contributes data to the Australian Resuscitation Outcomes Consortium (Aus-ROC) Australian and New Zealand OHCA Epistry (epidemiologic registry); enabling better understanding of OHCA management and outcomes across Aus/NZ regions.⁽²⁾

Specifically these are when there is an absence of a detectable carotid pulse, unconsciousness/unresponsiveness, and agonal/absent breathing; with the event occurring outside of hospital.

Eligibility

The case inclusion and exclusion criteria for the SJAWA OHCA database are described in Tables 1 and 2.

Table 1:	SJAWA 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 was attended by SJAWA.
3	<p>a. All patients who are unconscious and pulseless with either agonal or no breathing on arrival of SJAWA</p> <p>OR</p> <p>b. All patients who become unconscious and pulseless with either agonal or no breathing in the presence of SJAWA (so called EMS-witnessed / paramedic-witnessed arrests)</p> <p>OR</p> <p>c. Patients who have a pulse on arrival of SJAWA following successful defibrillation provided by a bystander prior to arrival of SJAWA.</p>

Definition of out-of-hospital cardiac arrest (OHCA)

The SJAWA OHCA database defines an OHCA case as a patient with no signs of circulation.



Table 2:	SJAWA OHCA database exclusion criteria (any of the following).
1	Any patient who suffers a cardiac arrest in a hospital facility where SJAWA 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 SJAWA may be providing transport but are not the primary care providers.
3	Bystander/lay person suspected a cardiac arrest where the patient is not in cardiac arrest on arrival of SJAWA, and no defibrillation has occurred.

Data capture

The data fields in the SJAWA OHCA database are based on the internationally agreed definitions that are outlined in the Utstein template from the International Liaison Committee on Resuscitation (ILCOR)⁽³⁾.

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

1. Computer aided dispatch (CAD) system database

The CAD system database is an organisational database with comprehensive geographical and operational information collected by the SJAWA State Operations Centre. Specifically, the database includes date, incidence location, and timestamps of key steps in the call-taking process, i.e. time an emergency call received, ambulance response time, first ambulance dispatched time, and first ambulance arrival at scene.

2. Electronic patient care record (e-PCR)

SJAWA complete an electronic patient care record for all patients attended. The e-PCR includes data on patient demographics, clinical assessment and management, such as identification of cardiac arrest rhythms, defibrillation (including bystander use of automated external defibrillator: AED), and administration of cardiac arrest drugs. The e-PCR was introduced in 2011. Prior to this, patient care records were paper-based.

In order to ensure the capture of all OHCA cases in WA attended by SJAWA, a sensitive but not specific electronic search strategy is conducted to identify potential OHCA cases from the CAD database for review. After manual scrutiny of individual

cases by the database manager, only those cases meeting the criteria for cardiac arrest (Tables 1 and 2) are included in the SJAWA OHCA database. The initial arrest rhythm and causes of OHCA are also determined by manual review of the SJAWA e-PCR. Survival outcomes of return of spontaneous circulation (ROSC) and ROSC on arrival at hospital (i.e. patient survived event) are obtained from the e-PCR. Survival to hospital discharge and longer-term survival are determined by manual review of hospital records (Perth-only) and/or WA State Death Registry – as described above.

Data quality

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

In 2017, two variables were recoded, namely 'resuscitation attempted by SJAWA' and 'bystander-witnessed arrest', to more closely align with the Utstein definitions.⁽³⁾ 'Resus attempt' now only includes cases where SJAWA performed CPR and/or defibrillation. Bystander witnessed now includes OHCA cases that were 'seen or heard'.

Therefore, numbers reported in this report for 2016 may differ slightly from the 2016 SJAWA OHCA annual report.

Ethics approval

SJAWA has given approval for the SJAWA 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 SJAWA OHCA database to be used for specific research purposes. Ethics approval to access hospital medical records to determine OHCA patient outcomes has been granted by the individual hospital HRECs. The WA Registrar of Births, Deaths and Marriages has approved access to the WA Death Registry by PRECRU researchers for HREC-approved studies. All paper and electronic data relating to the SJAWA 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 SJAWA OHCA database relies on completeness of data capture. Missing data is relatively rare for all core variables (see Table 3 below).

Table 3:
Number and proportion of missing data for select SJAWA OHCA database variables in 2017 (n=2,505)

Variables	n	%
Patient age	16	0.6%
Patient sex	4	0.2%
Arrest location	Nil	0.0%
Witnessed status	5	0.2%
Bystander CPR	3	0.1%
Initial arrest rhythm	1	0.0%
SJAWA response time	4	0.2%
Outcome at scene	1	0.0%
Patient survived event (ROSC on arrival at hospital)	Nil	0.0%
Hospital discharge status*	2	0.1%

* Data still pending on survival to hospital discharge for two cases; however these cases were confirmed to have survived 30 days after the arrest.

Reference

1. Brain Resuscitation Clinical Trial I Study Group. A randomised clinical study of cardiopulmonary-cerebral resuscitation: design, methods, and patient characteristics. *Am J Emerg Med.* 1986;4²:72-86.
2. Beck B, Bray J, Cameron P, Smith K, Walker T, Grantham H, Hein C, Thorrowgood M, Smith A, Inoue M, Smith T, Dicker B, Swain A, Bosley E, Pemberton K, McKay M, Johnston-Leek M, Perkins GD, Nichol G, Finn J. Regional variation in the characteristics, incidence and outcomes of out-of-hospital cardiac arrest in Australia and New Zealand: Results from the Aus-ROC Epistry. *Resuscitation.* 2018;126:49-57.
3. Perkins GD, Jacobs IG, Nadkarni VM, Berg RA, Bhanji F, Biarent D, Bossaert LL, Brett SJ, Chamberlain D, de Caen AR, Deakin CD, Finn JC, Grasner JT, Hazinski MF, Iwami T, Koster RW, Lim SH, Ma MH, McNally BF, Morley PT, Morrison LJ, Monsieurs KG, Montgomery W, Nichol G, Okada K, Ong ME, Travers AH, Nolan JP, Utstein C. Cardiac Arrest and Cardiopulmonary Resuscitation Outcome Reports: Update of the Utstein Resuscitation Registry Templates for Out-of-Hospital Cardiac Arrest: A Statement for Healthcare Professionals From a Task Force of the International Liaison Committee on Resuscitation (American Heart Association, European Resuscitation Council, Australian and New Zealand Council on Resuscitation, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa, Resuscitation Council of Asia); and the American Heart Association Emergency Cardiovascular Care Committee and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation. *Resuscitation.* 2015;96:328-40.



Incidence and demographics

SJAWA provides emergency ambulance services in Western Australia covering a land mass of approximately 2.5 million square kilometres and a population of approximately 2.6 million people, of whom 21 per cent are children aged 15 or younger. Just over 2 million people live in the Perth metropolitan region with approximately 540,000 people living in regional Western Australia.

For the purposes of this report, the Perth metropolitan area is the Greater Capital City Statistical Area (GCCSA) as defined by the Australian Bureau of Statistics in 2017.

In the period 1 January to 31 December 2017 SJAWA attended 2,505 OHCA cases, of which 2,455 (98 per cent) were adults and 50 (two per cent) were children.

Table 5: Total number of OHCA cases of all ages in WA in 2017

Total	2,505
Children (<16)	50 (2%)
Adult (≥16)	2,455 (98%)
Note: Although data on exact age was missing for 16 cases, text descriptions in patient care records indicated that these patients were all adults.	

The crude incidence of OHCA in WA for Adults was 119.9 per 100,000 population, which is similar to that reported by SJA New Zealand (121.7) (*SJA NZ OHCA Report 2017*) and Ambulance Victoria (118.6) (*VACAR 2016/17 Annual Report*)

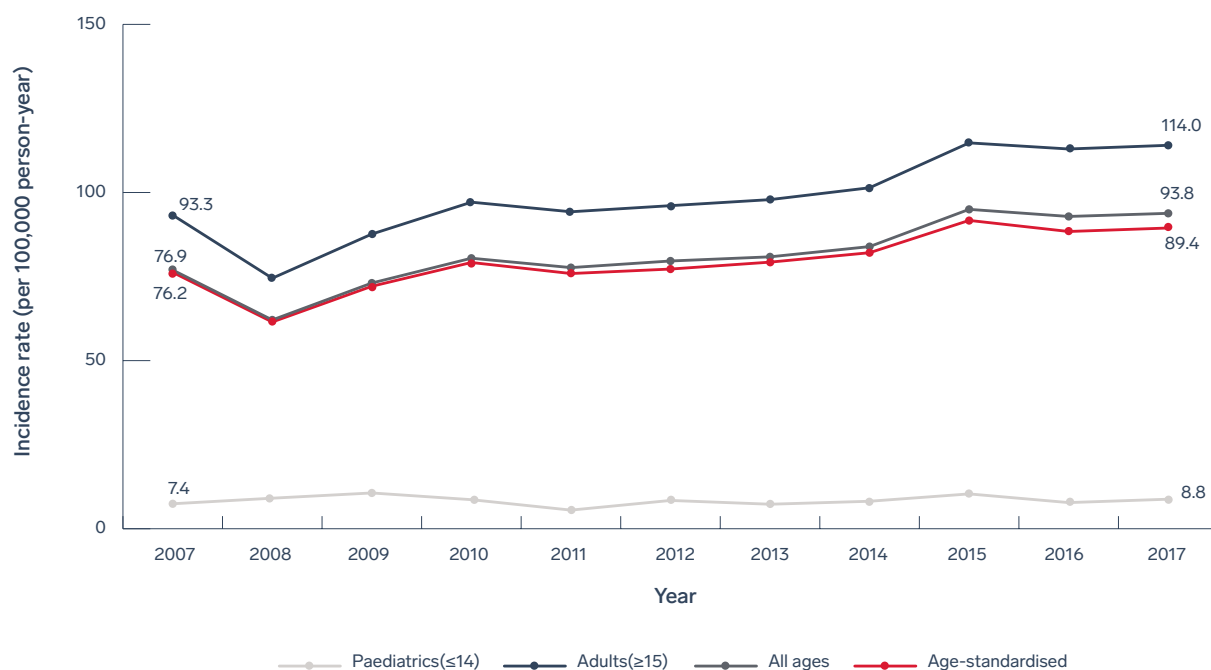
Rates in children at 9.4 cases per 100,000 population in WA were similar to those found elsewhere – SJA New Zealand reported 13.1 per 100,000 (*SJA NZ OHCA Report 2017, p14*) and Ambulance Victoria reported 9 per 100,000 (*2016-17 VACAR Report*)

Figure 1: Crude and age-standardised incidence rate of OHCA cases of all ages in WA in 2017

Adult (age ≥16):	119.9 per 100,000 person-years
Paediatrics (age ≤16):	9.4 per 100,000 person-years
All ages:	97.1 per 100,000 person-years
Age-standardised incidence rate (2011 census as standard):	99.3 per 100,000 person-years
Age-standardised incidence rate (2001 census as standard):	91.4 per 100,000 person-years
Note: Ten-year trend of age-standardised incidence rate in WA was not created because data capture for rural cases was incomplete before 2014.	



Figure 2: Trends in the crude and age-standardised rates of OHCA in Perth metropolitan area between 2007 and 2017



Notes:

1. Age standardisation was based on 5-year age bands e.g. (0 - 4 years).
2. Paediatrics were defined as patients younger than 15 years of age in this analysis because population of those aged 15 or younger was not available.
3. Populations of each age-band in the Perth metropolitan area in 2017 were estimated by linear extrapolation of 2015 and 2016 data.
4. Rural cases were not included because PCR/ePCR was incomplete before 2014.
5. Standard population based on the 2001 Australian national census population. Data source: 2001 ABS Census of Population and Housing: Basic Community Profile (Age by Sex).

Year	Paediatrics	Adult	All ages	Age-standardise incidence rate
2007	7.4	93.3	76.9	76.2
2008	9.1	74.5	62.1	61.5
2009	10.6	87.6	73.1	72.1
2010	8.6	97.1	80.5	79.2
2011	5.5	94.3	77.7	75.9
2012	8.4	96.1	79.6	77.2
2013	7.3	97.9	80.9	79.3
2014	8.2	101.4	83.9	82.1
2015	10.4	114.8	95.0	91.7
2016	7.8	112.9	92.9	88.4
2017	8.8	114.0	93.8	89.4

Of the 2,505 OHCA cases in WA in 2017, resuscitation was commenced by SJAWA crews in 1,167 cases (47 per cent), slightly lower than in 2016 - reflecting changes to our Recognition of Life Extinct (ROLE) guideline that addressed medically futile resuscitation attempts. In around half of all OHCA cases attended, the person had been 'deceased' for too long or was deemed to have injuries inconsistent with life, or had an 'advanced care directive' in place – and therefore SJAWA did not commence resuscitation.

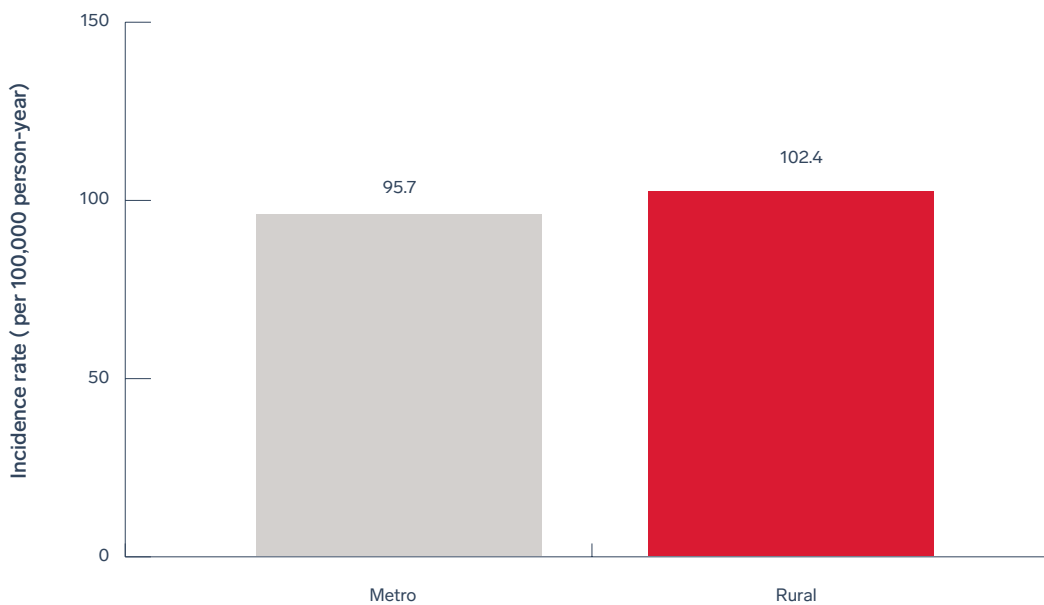
As is usually found in other OHCA reports, there was a predominance of males over females at 67 per cent male, 33 per cent female. Male victims of OHCA had a median age of 61 years compared to females at 69 years of age.

Incidence across rural and regional areas in Western Australia

Differences in OHCA incidence were identified between both metropolitan (95.7 cases per 100,000 person years) and rural/regional areas (102.4 cases per 100,000 person years).

There are also striking differences between WA Health Regions (Map under Figure 3.1) which are not easily explained. A heat map is shown representing population linked incidence rates across the state.

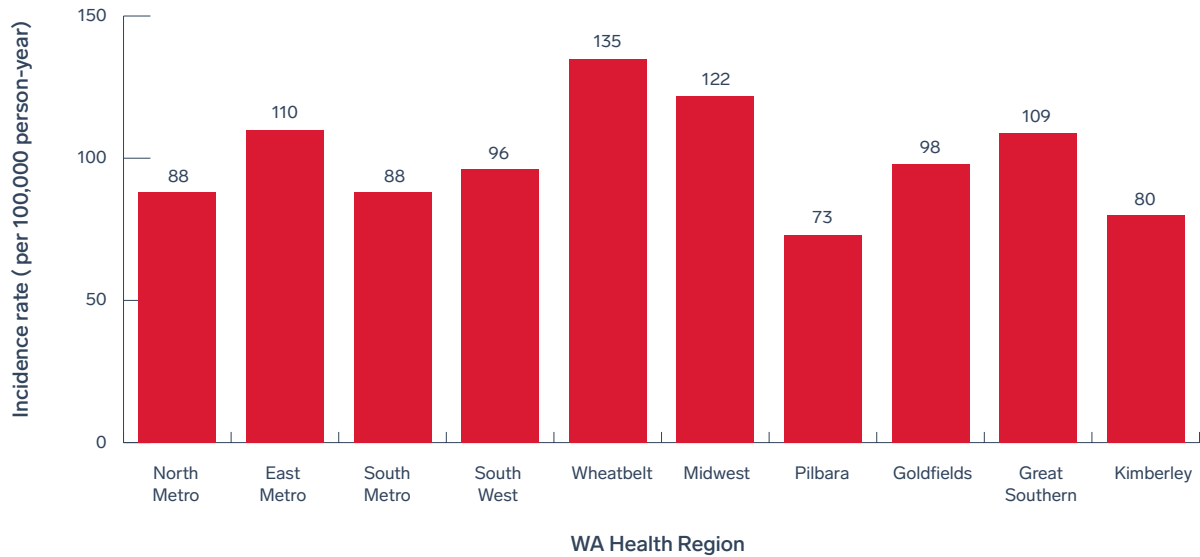
Figure 3: Crude incidence rates of OHCA cases of all ages by region in WA in 2017 (irrespective of whether resuscitation was commenced by SJAWA)



Location	Incidence	Population	Incidence rate*
Metro	1,955	2,043,138	95.7
Rural	550	537,216	102.4
Total	2,505	2,580,354	97.1

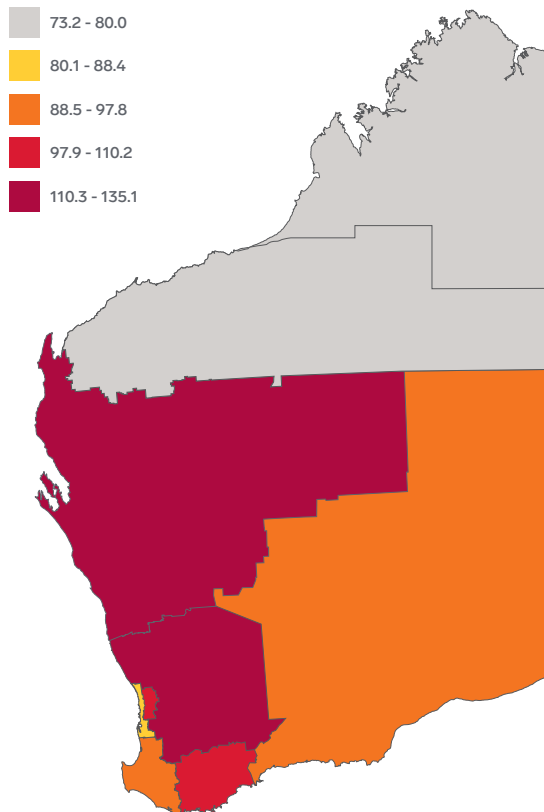
*per 100,000 person-year

Figure 3.1: Crude incidence rates of OHCA cases of all ages by WA Health Region in 2017 (irrespective of whether resuscitation was commenced by SJAWA) (n=2505)



*per 100,000 person-year (based on Estimated Residential Population as of 30 June 2017, ABS cat. no. 3218.0)

Incidence rate per 100,000 person-years



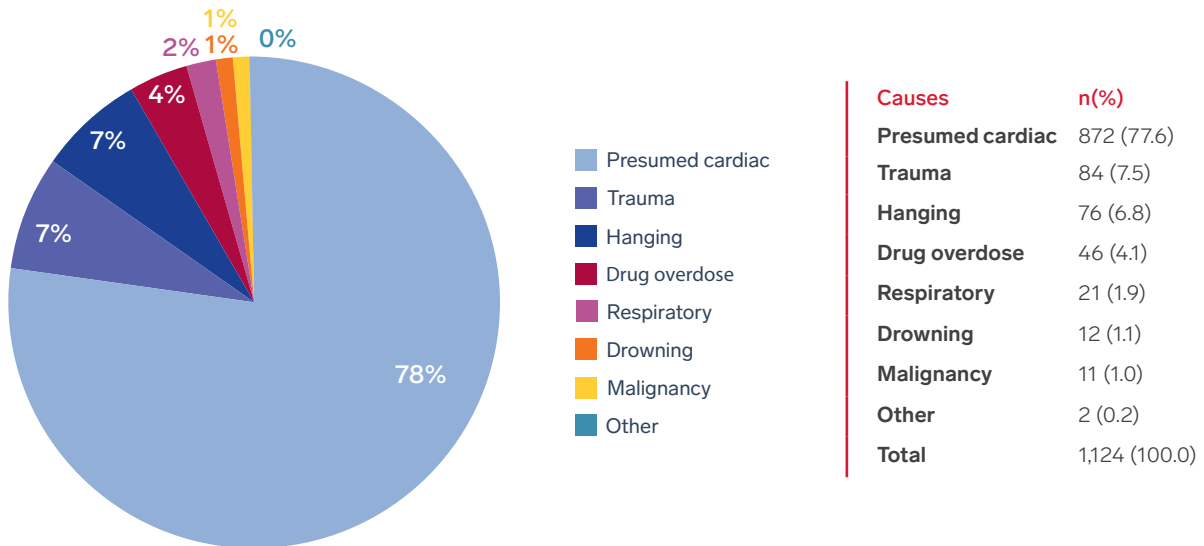
Health region	Incidence	Population	Incidence rate*
North Metro	631	717,763	88
East Metro	762	691,225	110
South Metro	564	638,370	88
South West	171	177,366	96
Wheatbelt	104	76,976	135
Midwest	78	64,049	122
Pilbara	45	61,467	73
Goldfields	55	56,244	98
Great Southern	66	60,664	109
Kimberley	29	36,230	80

*per 100,000 person-year (based on Estimated Residential Population as of 30 June 2017, ABS cat. no. 3218.0)

Precipitating events for adults

Events precipitating OHCA are recorded by SJAWA in the electronic patient care record (e-PCR). Unless a clear alternate cause is present, OHCA in adults is presumed to be cardiac in nature. As can be seen in Figure 4, the majority of OHCA occurring in adults in Western Australia are presumed to be of cardiac origin, with trauma, hanging and drug overdose making up the majority of the remainder causes.

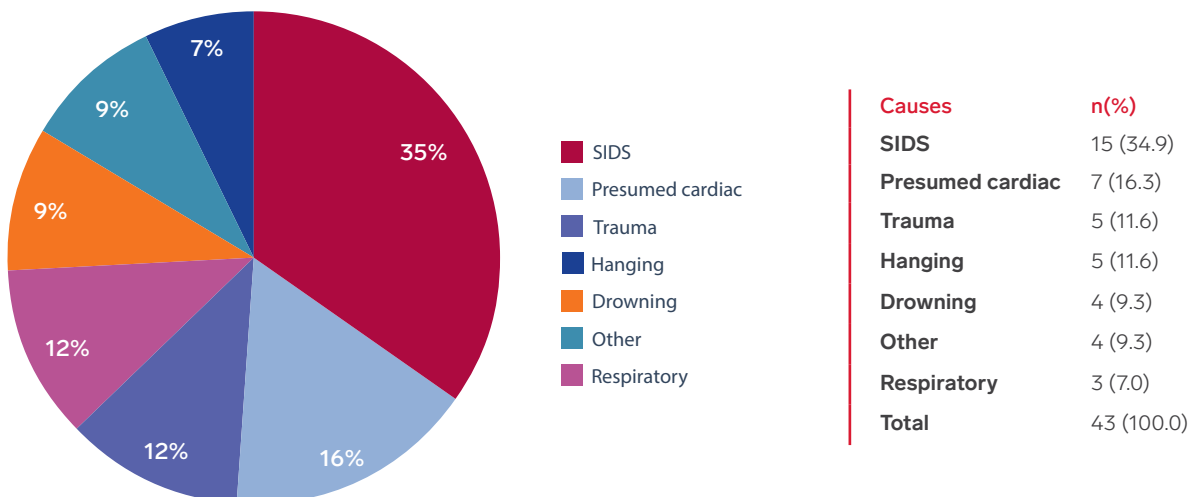
Figure 4: Causes of adult OHCA cases (age≥16) where resuscitation was commenced by SJAWA, in WA in 2017



Precipitating events for children

The aetiology of OHCA in children is very different to that of adults, with sudden infant death syndrome accounting for approximately one third of the cases and presumed cardiac causes, trauma, hanging, drowning and respiratory causes accounting for the remainder.

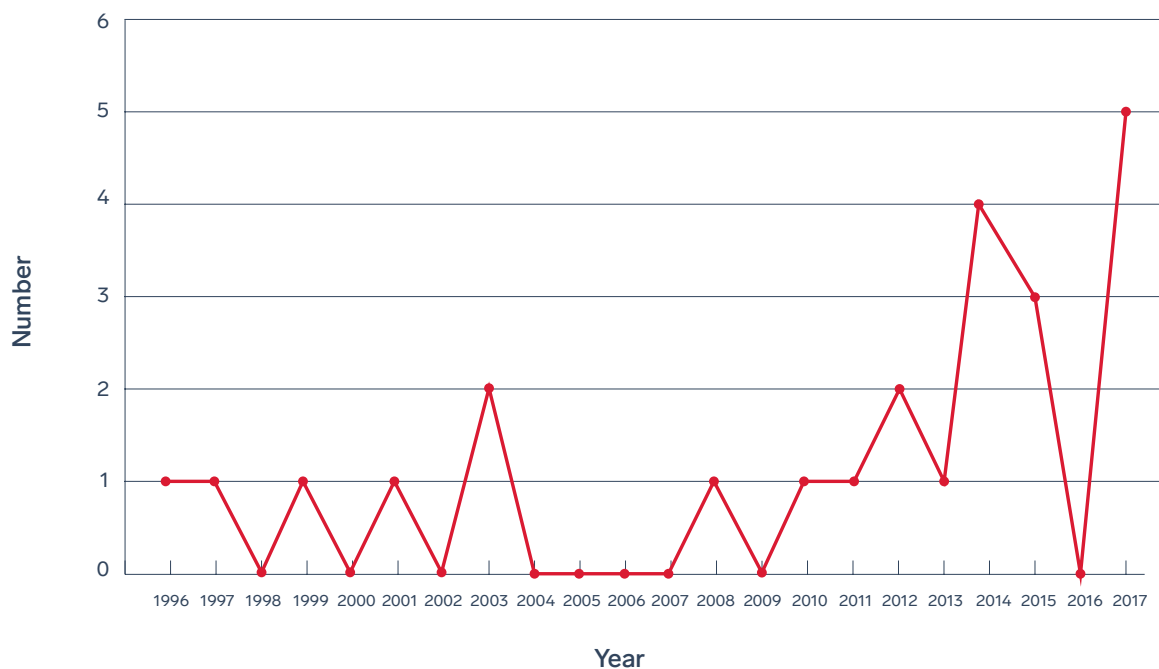
Figure 5: Causes of pediatric OHCA cases (age<16) where resuscitation was commenced by SJAWA, in WA in 2017





There has been a disturbing increase in the incidence of pediatric OHCA due to hanging in recent years. In the 14 years from 1996 through 2009 inclusive there were 7 pediatric OHCA cases due to hanging. In 2017 alone, there were 5 such cases.

Figure 5.1: The number of pediatric (age<16) OHCA cases due to hanging in WA from 1996 to 2017



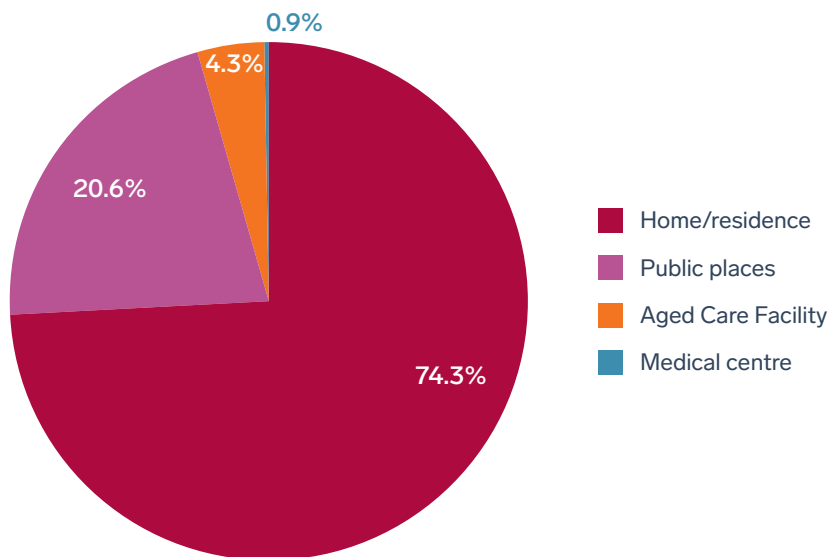
Years	(n)	Total
1996	1	14
1997	1	26
1998	0	20
1999	1	26
2000	0	22
2001	1	22
2002	0	15
2003	2	17
2004	0	22
2005	0	24
2006	0	14
2007	0	17
2008	1	22
2009	0	30
2010	1	18
2011	1	16
2012	2	28
2013	1	27
2014	4	36
2015	3	42
2016	0	33
2017	5	43
Total	24	534

Arrest locations

OHCA arrest location plays a critical role in the eventual outcome for the patient. On average, events occurring in public places such as the workplace, shops, and sporting/recreational facilities have a better outcome than those occurring in a residential setting.

This is because public OHCA events are more likely to be witnessed, more likely to have a prompt triple zero (000) call, more likely to have bystander CPR and more likely to have an AED deployed. However, the most common arrest location for adult OHCA is the family home.

Figure 6: Arrest locations of adult OHCA cases (age≥16) where resuscitation was commenced by SJAWA, in WA in 2017



Arrest location	n(%)
Home/residence	835 (74.3)
Public places	231 (21.4)
Aged Care Facility	48 (4.3)
Medical center	10 (0.1)
Total	1,124 (100)

SJAWA response times

For cases where resuscitation was commenced, the median response time from call pickup in SOC to arrival of the ambulance on scene was 9 minutes in the Perth metropolitan area and 13 minutes in rural and regional locations.

The median response times compared to SJAWA

New Zealand - 5 minutes urban and 8 minutes rural (SJA NZ OHCA Report 2017, p22);

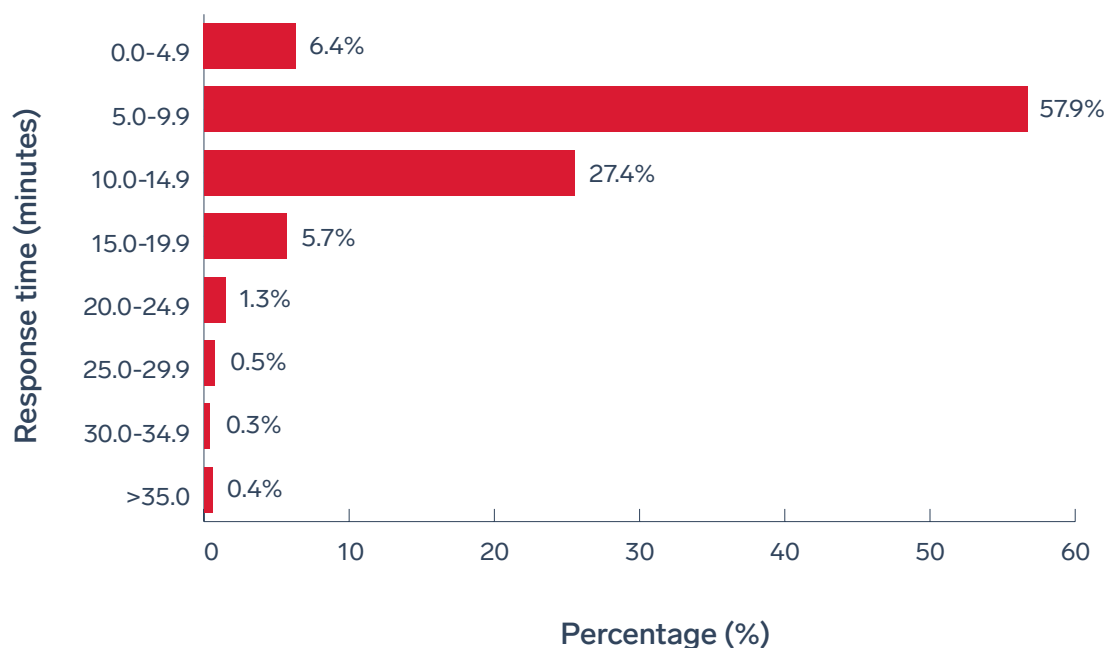
Wellington Free - 8 minutes urban and 13 minutes rural;

Ambulance Victoria - 7.3 minutes urban and 9.5 minutes rural (VACAR 2016/17 Annual Report, p29);

London Ambulance - 8 minutes and King County EMS – 6 minutes urban and 8 minutes rural.

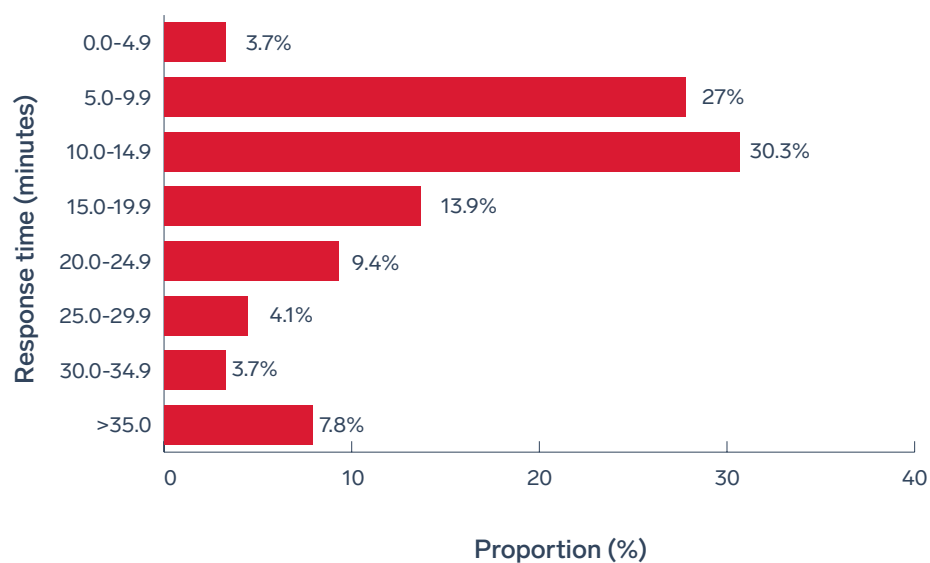
(Source – St John Ambulance New Zealand 2017 OHCA Annual Report)

Figure 7: Distribution of response time for OHCA cases of all ages where resuscitation was commenced by SJAWA, in the Perth metropolitan area in 2017



Response time	n(%)	Cumulative percentage(%)
0.0-4.9	59 (6.4)	6.4
5.0-9.9	533 (57.9)	64.2
10.0-14.9	253 (27.4)	91.7
15.0-19.9	53 (5.7)	97.4
20.0-24.9	12 (1.3)	98.7
25.0-29.9	5 (0.5)	99.2
30.0-34.9	3 (0.3)	99.6
≥35.0	4 (0.4)	100
Total	922	

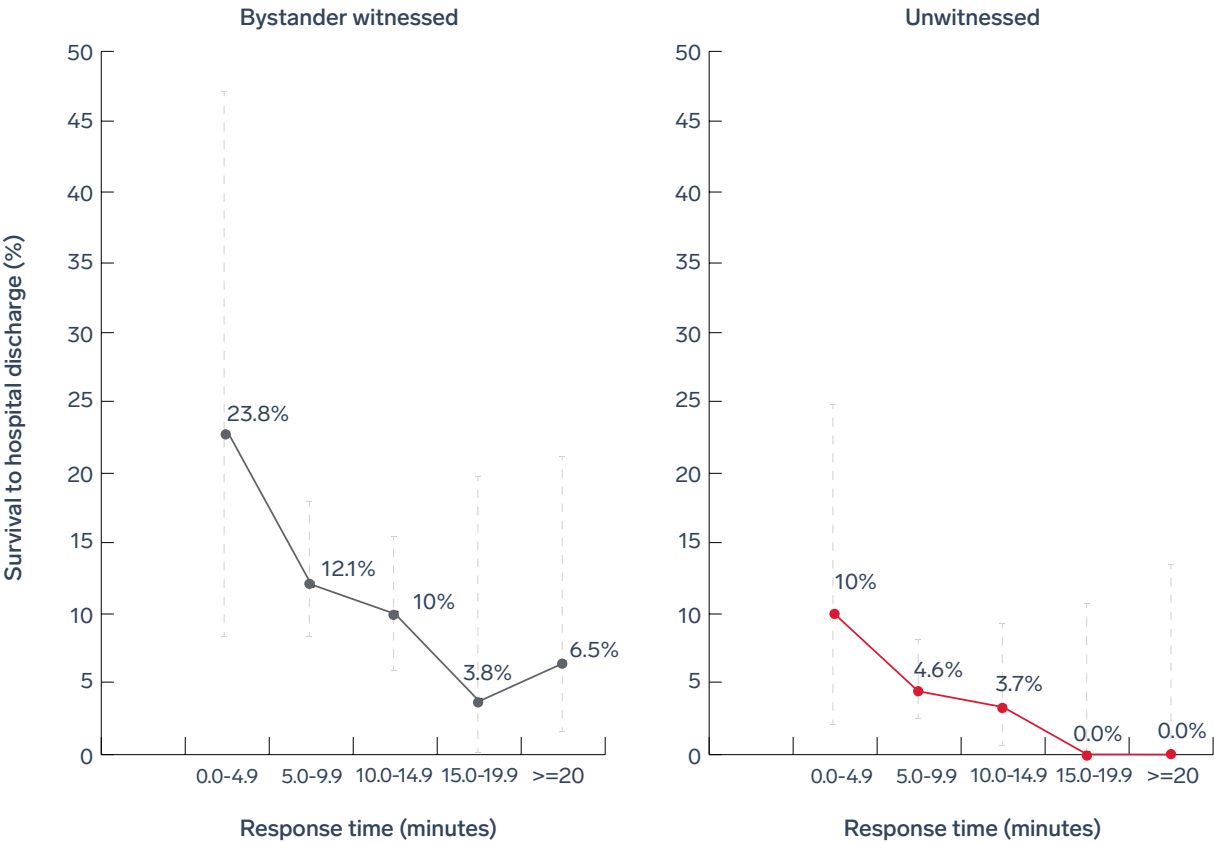
Figure 8: Distribution of response time of OHCA cases of all ages where resuscitation was commenced by SJAWA, in the rural areas of WA in 2017



Response time	n(%)	Cumulative percentage(%)
0.0-4.9	9 (3.7)	3.7
5.0-9.9	66 (27.0)	30.7
10.0-14.9	74 (30.3)	61.1
15.0-19.9	34 (13.9)	75.0
20.0-24.9	23 (9.4)	84.4
25.0-29.9	10 (4.1)	88.5
30.0-34.9	9 (3.7)	92.2
≥35.0	19 (7.8)	100.0
Total	244	



Figure 9: Relationship between survival (to-hospital-discharge) and SJAWA response time (call answer to scene arrival), by witness status, for OHCA patients where resuscitation was commenced by SJAWA, excluding traumatic arrests and SJAWA-witnessed arrests



Response time	Bystander witnessed Survivors	n	Unwitnessed Survivors	n
0.0-4.9	5 (23.8%)	21	3 (10.0%)	30
5.0-9.9	24 (12.1%)	198	12 (4.6%)	262
10.0-14.9	14 (10.0%)	140	4 (3.7%)	109
15.0-19.9	1 (3.8%)	26	0 (0.0%)	32
>=20 mins	2 (6.5%)	31	0 (0.0%)	29
Total	46 (11.1%)	416	19 (4.1%)	462

Although all of the confidence intervals overlap, there is a suggestion in our data of a relationship between response times and eventual patient survival that is in keeping with common sense and serves as a motivator to focus on this area in 2018 and beyond.



A woman in a white hoodie is performing CPR on a man lying on the ground. She is leaning over him, with her hands on his chest. In the background, two paramedics in green uniforms are standing, one holding a stretcher. The scene is outdoors with trees and a red diagonal graphic in the top left corner.

**Bystander CPR
plays such a vital
role in patient
outcomes**

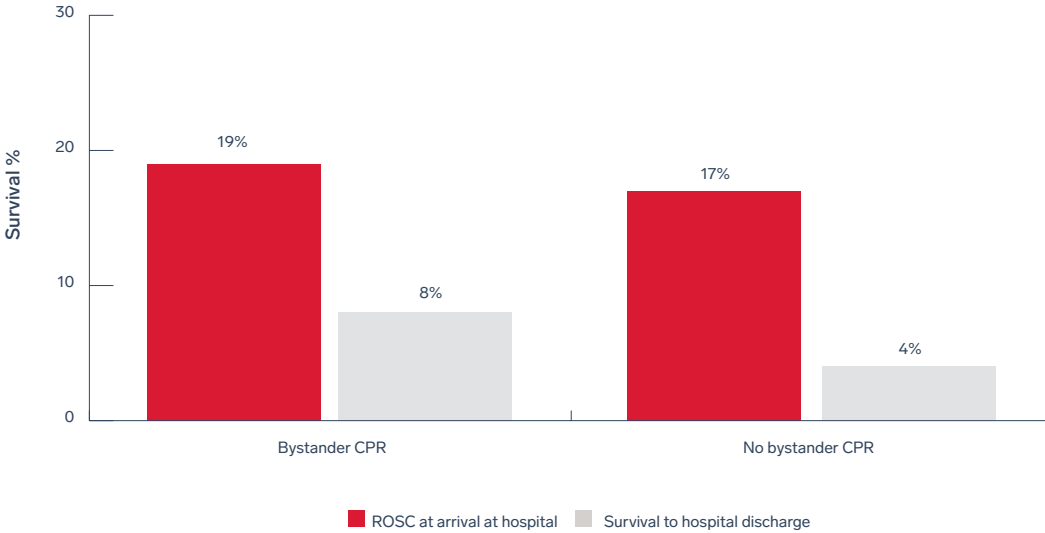
Community response pre-ambulance arrival

The slope of the patient survival curve post-arrest is steep. For every minute post-arrest without either CPR or defibrillation, survival falls 10 per cent. This carries the heavy implication that events preceding ambulance arrival are critical to the eventual patient outcome. Patients who receive early, high quality CPR and defibrillation with a locally available AED survive at approximately five times the rate of those who have neither.

SJAWA supports community and bystander CPR via our first aid training courses, the presence of AEDs in the community, our Community First Responder program and the SJAWA First Responder App. [Link to app and signup.](#)

Understanding that bystander CPR plays such a vital role in patient outcomes, SOC call takers are trained to provide instruction on the provision of chest compressions and defibrillation to OHCA bystanders.

Figure 10: Survival outcomes after bystander CPR and resuscitation commenced by SJAWA in OHCA cases of all ages in WA in 2017 (Note: cases where SJAWA witnessed arrest were excluded (n=138))



	Bystander CPR	No bystander CPR
ROSC achieved at ED arrival	141 (19%)	50 (17%)
Survival to hospital discharge*	56 (8%)*	11 (4%)
Total	738	291

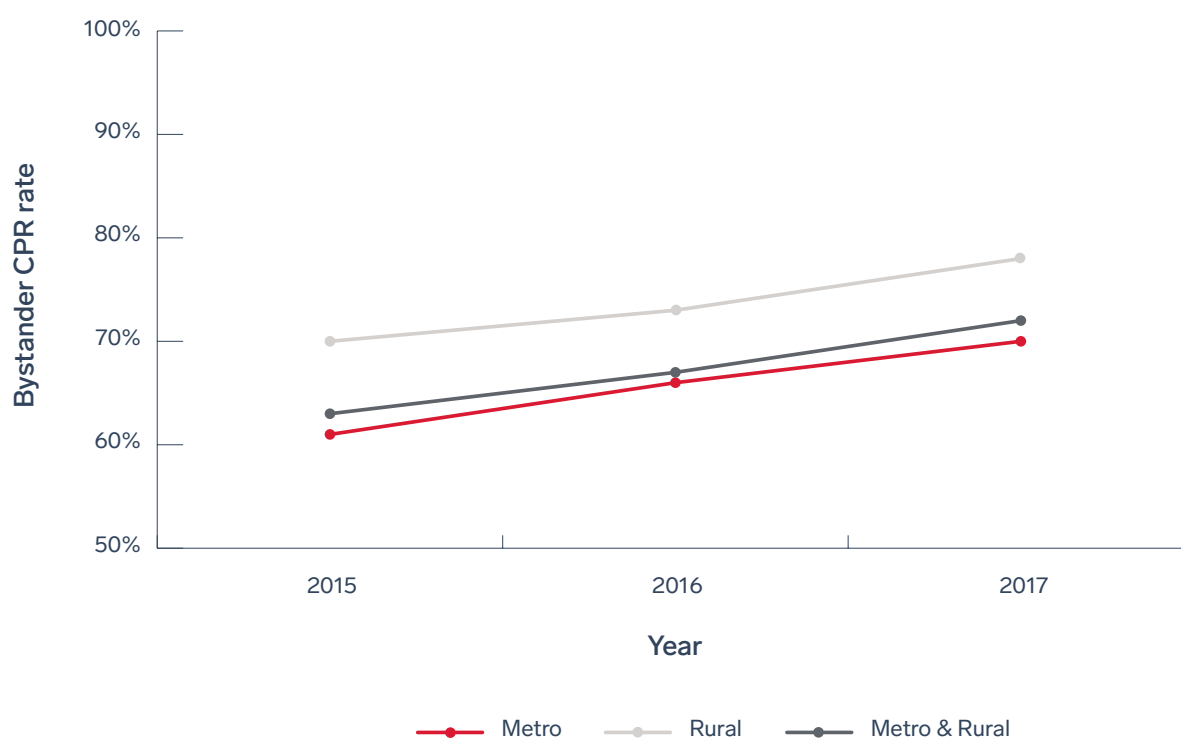
*Includes one case where survival status at hospital discharge is unknown, but the patient is known to have survived at least 30 days after the arrest.



CPR rates amongst OHCA cases where resuscitation was commenced by SJAWA average 72 per cent, with a gap between metropolitan (70 per cent) and regional communities (78 per cent) that is unexplained. Trends in these figures over the last few years are presented in figure 9 and figure 24.

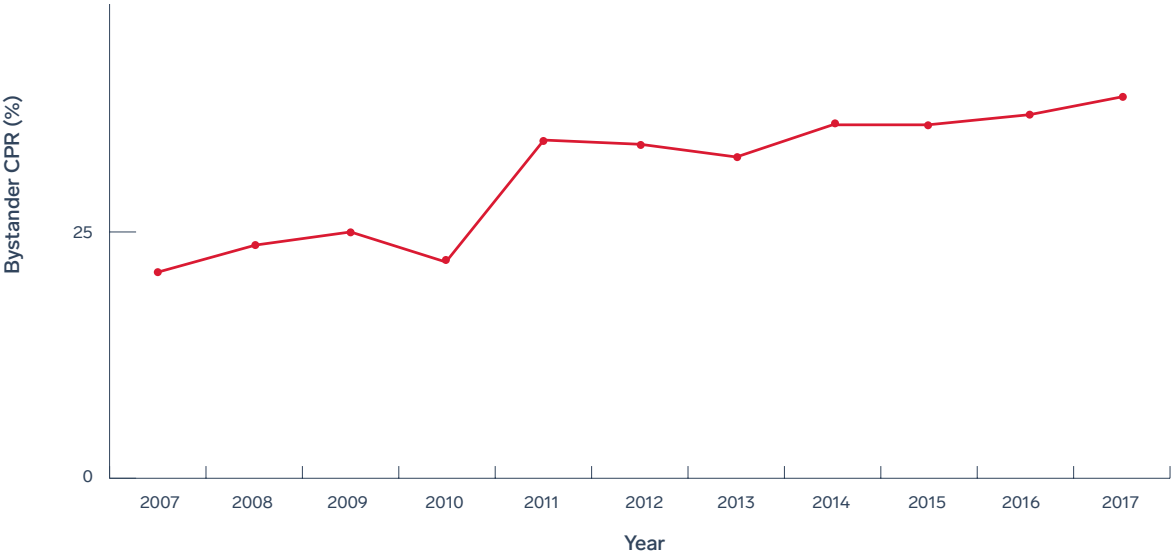
Figure 11: Trends of bystander CPR rates by region among OHCA cases of all ages where resuscitation was commenced by SJAWA, in WA between 2015 and 2017

(Note: Patients whose arrest was witnessed by SJAWA were excluded from this analysis (n=138 in 2015 and 2017, n=147 in 2016))



Location		2015	2016	2017	Total
Metro	Total	906	829	813	2,548
	Bystander CPR	556	547	570	1,673
	Rate	61%	66%	70%	66%
Rural	Total	214	216	216	646
	Bystander CPR	150	158	168	476
	Rate	70%	73%	78%	74%
Metro & Rural	Total	1,120	1,045	1,029	3,194
	Bystander CPR	706	705	738	2,149
	Rate	63%	67%	72%	67%

Figure 12: Bystander CPR rate of OHCA cases of all ages (excluding SJAWA witnessed cases) in the Perth metropolitan area between 2007 and 2017

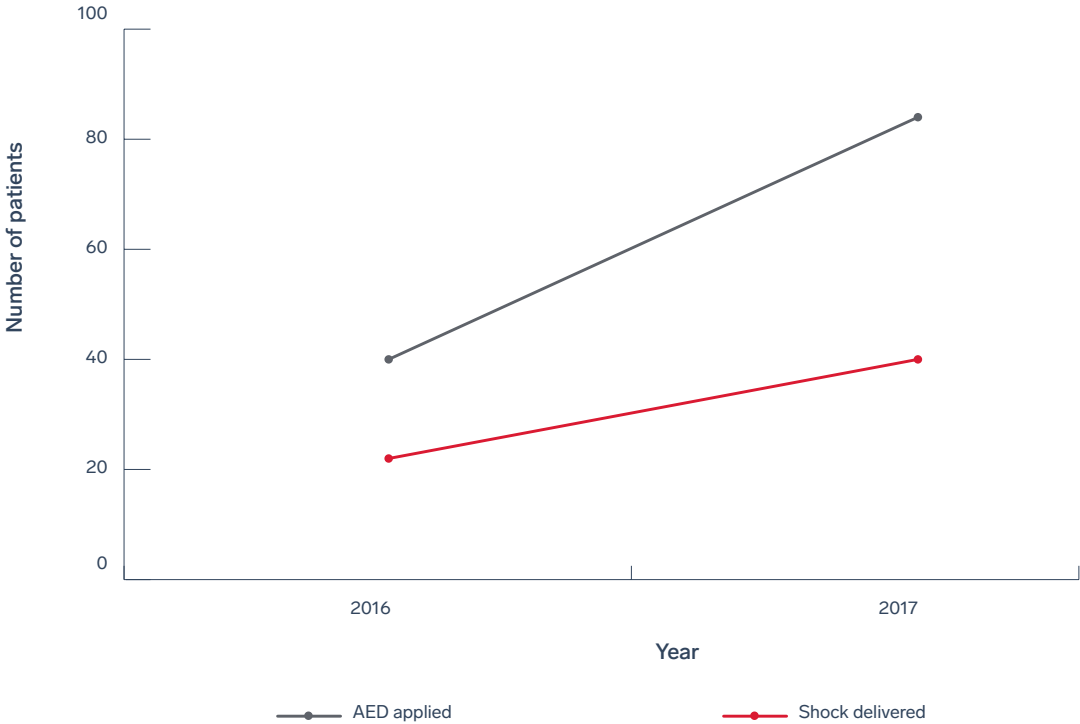


All Events	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Bystander CPR	246 (20%)	233 (24%)	300 (25%)	307 (22%)	455 (34%)	486 (33%)	507 (33%)	575 (36%)	655 (36%)	648 (37%)	700 (38%)	5,112 (32%)
Total	1,209	985	1,210	1,373	1,328	1,453	1,532	1,619	1,823	1,754	1,822	16,108

Note: Includes cases regardless of whether resuscitation was commenced by SJAWA

Time to defibrillation also plays a pivotal part in ensuring good patient outcomes. SOC call takers provide instructions on AED use when present. A steep increase in AED use is noted in 2017 compared to 2016.

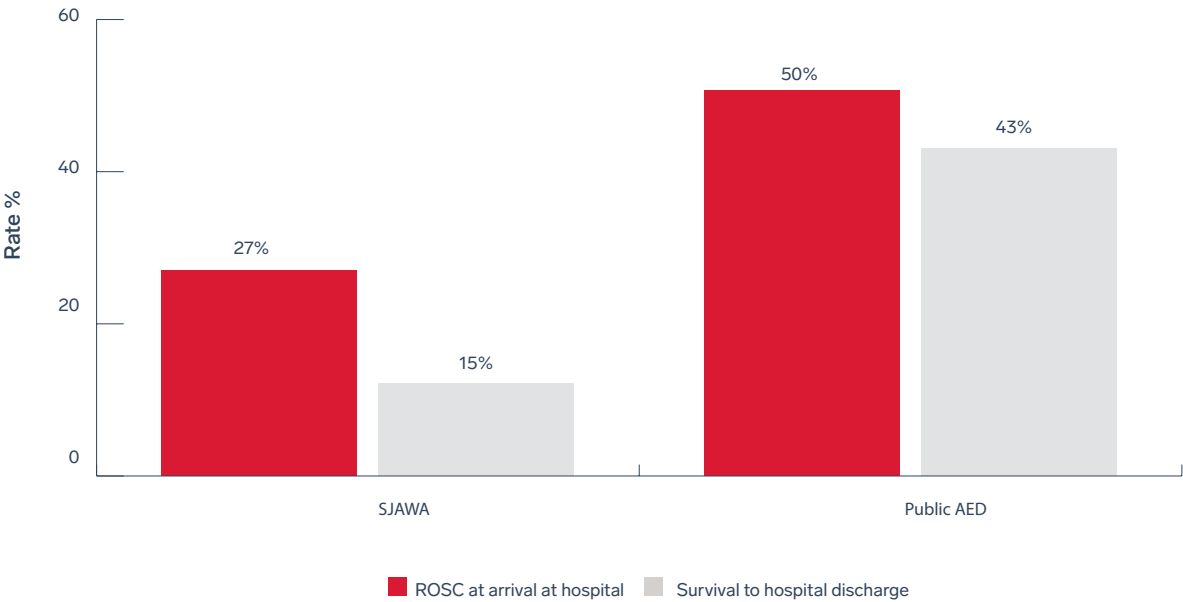
Figure 13: Numbers of patients where an AED was applied and a shock was delivered by bystanders, among all OHCA in WA between 2016 and 2017



As has been demonstrated elsewhere, early defibrillation via an AED increases survival to hospital discharge to approximately 43 per cent in comparison to 15 per cent if an AED is not available prior to the ambulance's arrival.



Figure 14: Survival outcomes according to who shocked the patient first in OHCA cases of all ages (excluding SJAWA-witnessed cases) in WA in 2017



	SJAWA	Public AED
ROSC at arrival at hospital	80 (27%)	20 (50%)
Survival to hospital discharge	46 (15%)*	17 (43%)
Total	300	40

*Includes 1 case where survival status at hospital discharge is unknown, but the patient is known to have survived at least 30 days after the arrest.

Esperance residents Heather and Kevin James have been thanked by St John Ambulance WA for their generosity after they donated a defibrillator to Lucky Bay.

They said they decided to make the donation in January 2018 after a visit to the remote location, approximately 60 kilometres southeast of Esperance.

Heather's friend is a St John Ambulance first aid trainer and she told her that they were very excited because there were more than 50 defibrillators being distributed in town.

“We went out to Lucky Bay in October last year and knew there wasn’t one there so we talked to someone at St John Ambulance and they got the ball rolling,” said Heather.





Outcomes

Scene outcome for OHCA in adults

ROSC at ED arrival is often referred to as the key measure of success of an OHCA resuscitation. While rates vary, over a 10 year period there has been a doubling in the rates of ROSC, and a four-fold increase in the absolute numbers of patients being transported with ROSC. This is due to a large increase in the number of resuscitations attempted over this period of time.

It is common practice around the world to continue resuscitation at the scene of an OHCA until either ROSC is achieved or resuscitation termination criteria are met. In many instances this is because CPR in the back of a moving vehicle is considered to be problematic.

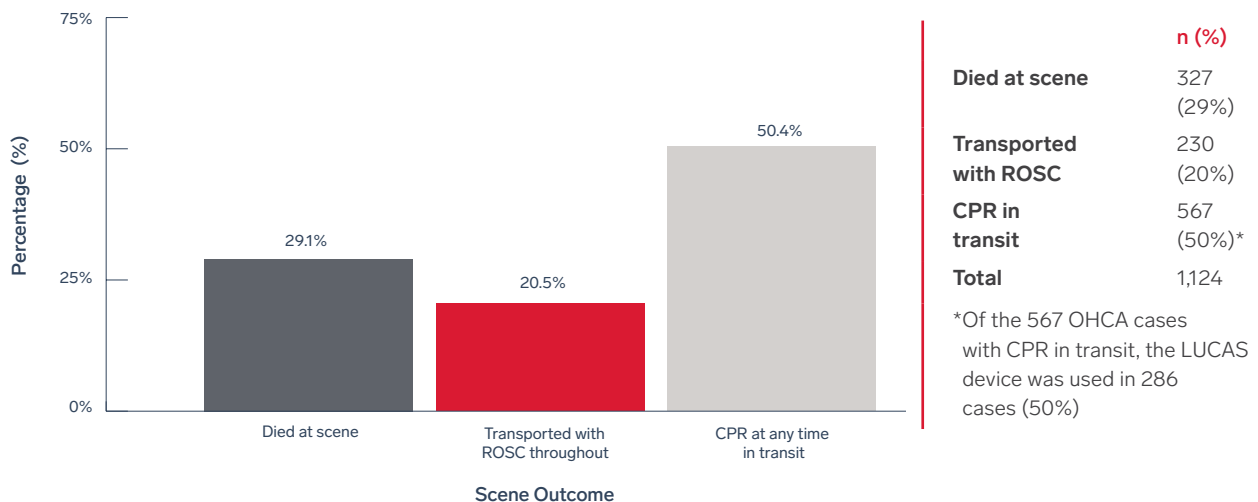
SJAWA has taken a different approach to many other services around the world in regards to the transport of patients with CPR in progress, many of whom have the LUCAS device in situ, providing mechanical CPR. There is a small but significant number of patients who are transported with CPR in progress who survive to hospital discharge. In 2017, that number was 8.

This is reflected in scene outcomes for all cases of OHCA in adults where resuscitation was attempted.

Of the 1124 OHCA in adults where resuscitation was commenced by SJAWA, 71% (767/1124) were transported to hospital, with 21% (230/1124) being in ROSC throughout (from scene departure to arrival at ED), and 50% (567/1124) requiring CPR during the journey to hospital (including patients who had ROSC on departure but re-arrested, as well as patients transported from the scene without ROSC). In comparison, St John New Zealand and Ambulance Victoria both transport a total of 30% of those patients who had an EMS resuscitation attempt (St John NZ OHCA Report 2017; VACAR 2016/2017 Annual Report), with patients only rarely transported when CPR is in progress at the scene (2% of patients, and 4% of patients, respectively).

Figure 15: Scene outcomes of all causes OHCA cases in adults (age ≥ 16) where resuscitation was commenced by SJAWA, in WA in 2017

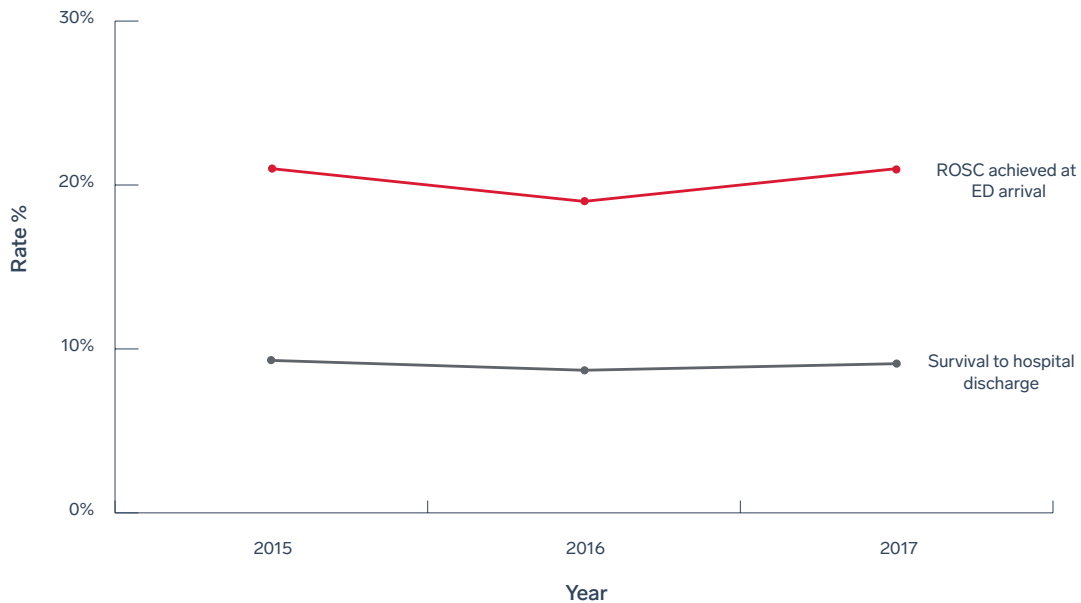
Note: 'Transported with ROSC' is defined as those OHCA patients who achieved ROSC at the scene and sustained ROSC until arrival at ED without receiving CPR during transportation. CPR in transit refers to cases where CPR occurred at any time en route to hospital, with or without ROSC being achieved.



Adult outcomes from all cause cardiac arrests

Survival from OHCA is regarded as an international benchmark of ambulance service effectiveness. Our 2017 cardiac arrest survival rate of 21 per cent (ROSC sustained to ED arrival) was comparable with recent years. The rate of survival to hospital discharge has remained steady at 9.1 per cent.

Figure 16: Trends in survival outcomes for all-cause OHCA in adults (age≥16) where resuscitation was commenced by SJAWA, in WA between 2015 and 2017



	2015	2016	2017	Total
ROSC achieved at ED arrival	261 (21%)	216 (19%)	236 (21%)	713 (20%)
Survival to hospital discharge	113 (9.3%)*	101 (8.7%)	102 (9.1%)**	314 (9.0%)
Total	1,216	1,159	1,124	3,499

* 2015 data excludes 2 cases where survival status at hospital discharge (and 30 day survival) is unknown.

** 2017 data includes 2 cases where survival status at hospital discharge is unknown, but the patients are known to have survived at least 30 days after the arrest.

Adult outcomes according to presenting rhythm

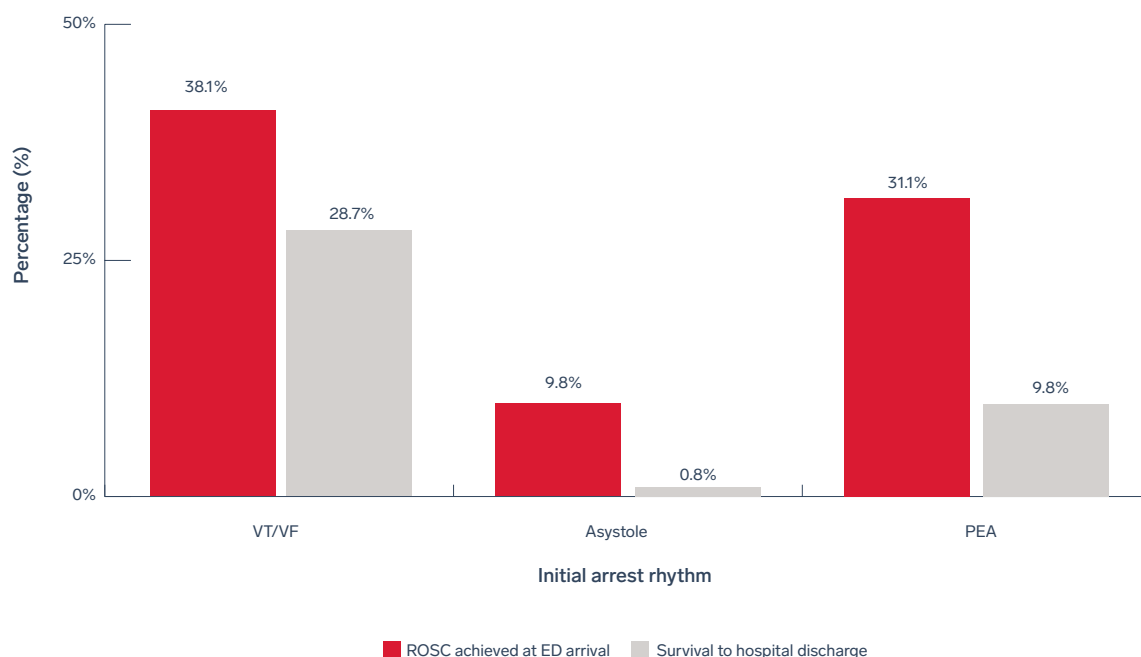
OHCA cases presenting in either ventricular fibrillation (VF) or ventricular tachycardia (VT) have the greatest potential for survival when compared to patients with a non-shockable rhythm such as pulseless electrical activity (PEA) or asystole.

This is because VF/VT can be treated with a defibrillator; whereas treatment for non-shockable rhythms requires complex treatments not commonly available in the pre-hospital environment.

Adult patients presenting with a shockable rhythm had an event survival rate of 38 per cent, compared to 10 per cent for asystole and 31 per cent for PEA. Survival to hospital discharge tells a different story, with the majority of patients in shockable rhythm who have ROSC at ED arrival surviving to hospital discharge. Survival to hospital discharge is less common in PEA and unusual in asystole.

Western Australia has an unexplained and unusually low percentage of patients presenting in a shockable rhythm (despite comparable ambulance response times), and this percentage is decreasing over time while absolute numbers of patients encountered in shockable rhythms has increased.

Figure 17: Survival outcomes of adult OHCA cases (age≥16) by initial arrest rhythm where resuscitation was commenced by SJAWA, in WA in 2017 (See data for 2015 and 2016 in the table below)



	VT/VF	Asystole	PEA
2015			
ROSC achieved at ED arrival	107 (43%)	75 (11%)	80 (30%)
Survival to hospital discharge*	79 (32%)	5 (1%)	30 (11%)
Total	249	705	263
*Excludes 3 cases where survival status at hospital discharge is unknown (1 case for each of VT/VF, Asystole and PEA). Numbers may differ to those reported in the 2016 SJAWA Cardiac Arrest Report due to changing to the ILCOR definition of 'resuscitation commenced'.			
2016			
ROSC achieved at ED arrival	100 (42%)	55 (8%)	62 (24%)
Survival to hospital discharge*	82 (35%)	0 (0.0%)	20 (8%)
Total	237	662	260
*Excludes 1 case where survival status at hospital discharge is unknown (1 case of PEA). Numbers may differ to those reported in the 2016 SJAWA Cardiac Arrest Report due to changing to the ILCOR definition of 'resuscitation commenced'.			
2017			
ROSC achieved at ED arrival	94 (38%)	60 (10%)	82 (31%)
Survival to hospital discharge*	71 (29%)	5 (1%)	26 (10%)
Total	247	613	264
* Includes 2 cases where survival status at hospital discharge is unknown, but the patients are known to have survived at least 30 days after the arrest (1 case of VT/VF, and 1 case of PEA).			
Total (2015-2017)			
ROSC achieved at ED arrival	300 (41%)	190 (10%)	223 (28%)
Survival to hospital discharge*	231 (31.6%)	10 (0.5%)	75 (9.6%)
Total	732	1980	786
* Excludes 3 cases in 2015 and 1 case in 2016 where survival status at hospital discharge is unknown and includes 2 cases in 2017 where survival status at hospital discharge is unknown, but the patients are known to have survived at least 30 days after the arrest.			

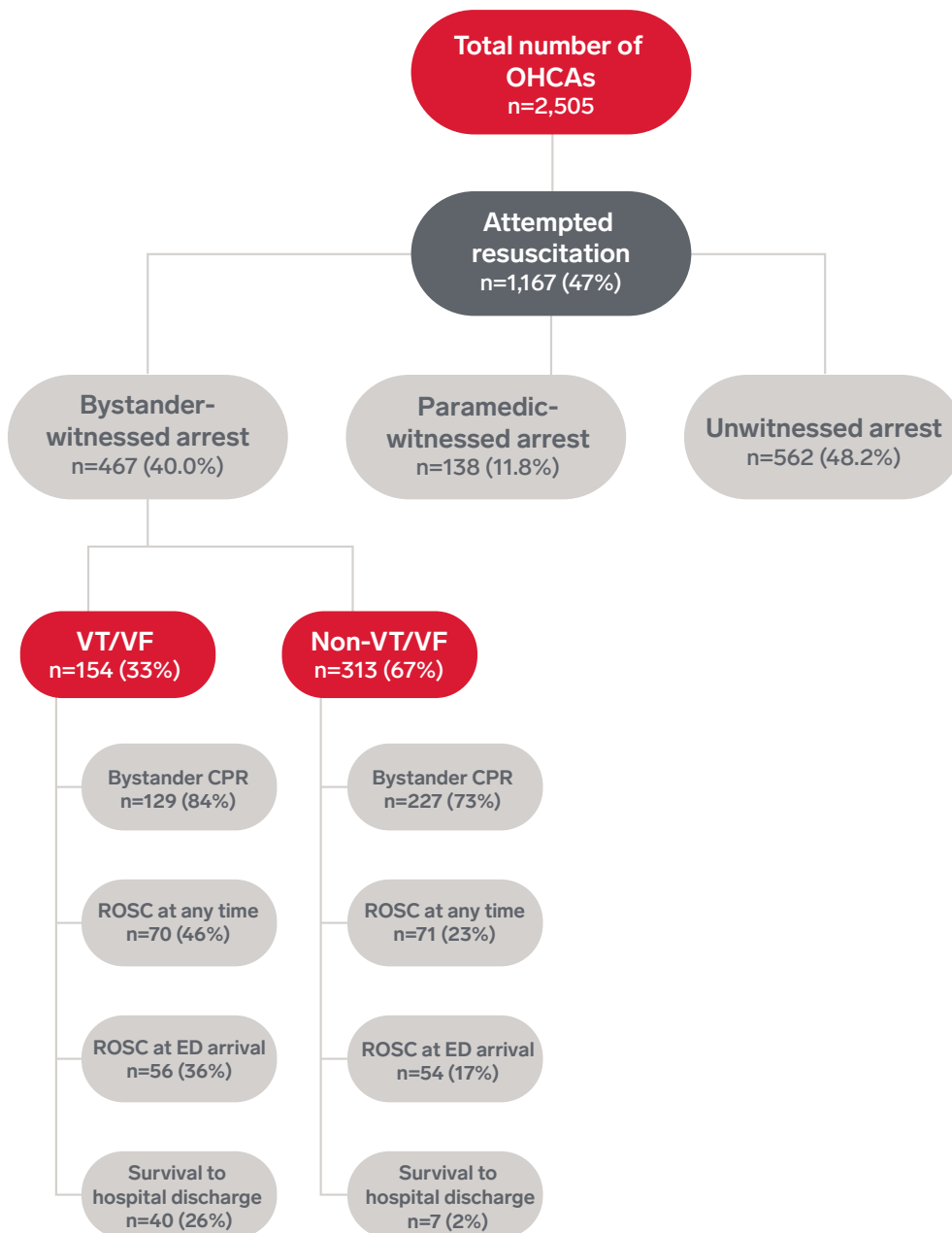


Utstein survival

There is a group of patients whose OHCA is considered the most likely to survive. This group includes those who have an OHCA which is bystander witnessed, and have an initial shockable rhythm. Survival outcomes for this sub-group of OHCA patients (referred to as the 'Utstein comparator group') are often compared internationally. The calculation of patient survival for all-cause bystander-witnessed arrests with a shockable rhythm (where resuscitation was commenced by SJAWA) is demonstrated in the figure below. The number of patients meeting this criteria in Western Australia in 2017 was 154, with 56 (36 per cent) achieving ROSC at ED arrival and 40 (26 per cent) surviving to hospital discharge.

Figure 18: Survival outcomes of OHCA cases of all ages in WA in 2017

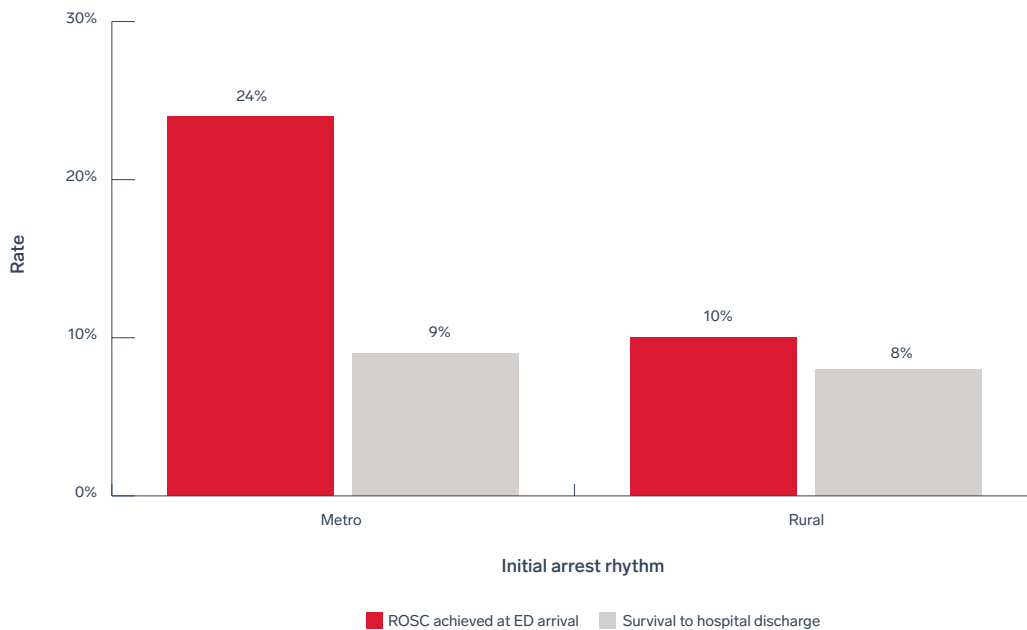
*Includes 1 case where survival status at hospital discharge is unknown, but the patient is known to have survived at least 30 days after the arrest.



Outcomes according to rurality

Given the population distribution of Western Australia, where the majority of the population (79 per cent in 2017) live in the Perth metropolitan area, comparatively few cardiac arrests occur in regional areas. A comparison of rural and metropolitan outcomes are demonstrated in Figure 14. While response times are generally longer in rural and regional locations, rates of bystander CPR are higher in rural areas and there are comparatively more AEDs available. ROSC is less common in rural and regional locations (24% metro, 10% rural); but survival to hospital discharge is far closer (9% metro, 8% rural).

Figure 19: Survival outcomes of adult OHCA cases (age≥16) by region where resuscitation was commenced by SJAWA, in WA in 2017



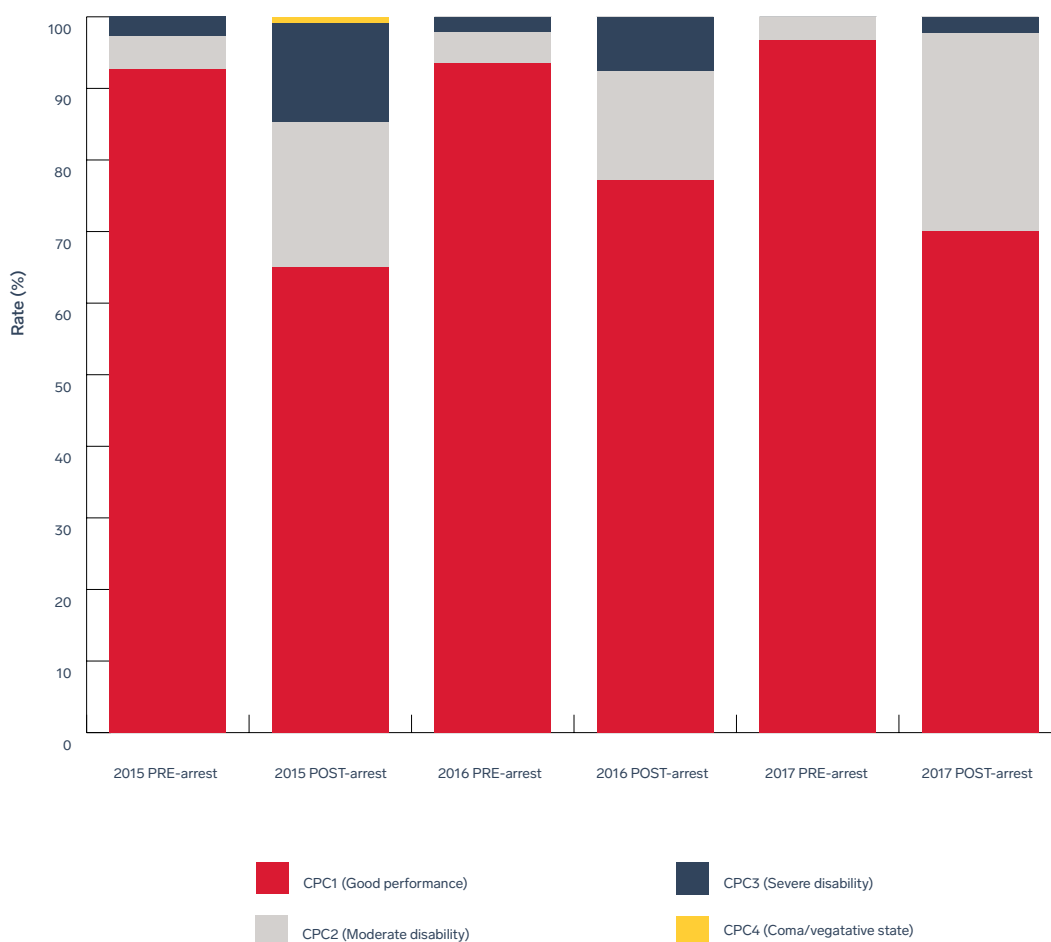
	ROSC achieved at ED arrival	Survival to hospital discharge*	Total
Metro	213 (24%)	83 (9%)	889
Rural	23 (10%)	19 (8%)	235
Total	236 (21%)	102 (9%)	1,124

*Includes 2 cases where survival status at hospital discharge is unknown, but the patients are known to have survived at least 30 days after the arrest.

Functional outcomes in OHCA survivors

An important consideration in OHCA outcomes is that of functional capacity in survivors. All OHCA patients in the Perth metropolitan area who survive to hospital discharge have a cerebral performance category score determined from medical record review – using a scale of 1-5 which ranges from little to no detectable impairment (CPC1) to brain death (CPC5). Figure 40 demonstrates the CPC outcomes of OHCA survivors in Perth in the period 2015 – 2017. Functional outcomes for OHCA survivors are generally very good, and there were no survivors with brain death.

Figure 20: Frequency distribution of cerebral performance category (CPC) scores, pre-arrest versus post-arrest, among OHCA patients of all ages in metropolitan Perth who survived to hospital discharge (where resuscitation was performed by SJAWA or the patient was defibrillated by bystanders)



	CPC1	CPC2	CPC3	CPC4	Total
2015 PRE-arrest	101 (92.7%)	5 (4.6%)	3 (2.8%)	0 (0.0%)	109 (100%)
2015 POST-arrest	71 (65.1%)	22 (20.2%)	15 (13.8%)	1 (0.9%)	109 (100%)
2016 PRE-arrest	86 (93.5%)	4 (4.3%)	2 (2.2%)	0 (0.0%)	92 (100%)
2016 POST-arrest	71 (77.2%)	14 (15.2%)	7 (7.6%)	0 (0.0%)	92 (100%)
2017 PRE-arrest	87 (96.7%)	3 (3.3%)	0 (0.0%)	0 (0.0%)	90 (100%)
2017 POST-arrest	63 (70.0%)	25 (27.8%)	2 (2.2%)	0 (0.0%)	90 (100%)

NB: 4 cases in 2015 and 4 cases in 2017 had CPC data missing (these records are excluded)





**Making first aid
a part of
everyone's life**

Conclusion

The data presented in this report demonstrates that the response to OHCA in Western Australia provided by SJAWA is of a high standard. The process of generating this report and reviewing our data formally has provided significant insight into the performance of our service, how we compare with others and the road ahead – where we might best focus on implementing change.

It however, affirms our view that we provide the people of Western Australia with a first class ambulance service and that making first aid a part of everyone's life has a positive impact on the community.

Work in 2018 has focused so far on the State Operations Centre, improving the timeliness of response at the point of dispatch and the initiation of bystander CPR by the SOC call taker – a process referred to as telephone CPR or TCPR. We have also appointed a dedicated Resuscitation Improvement Officer who will assist in this process.

Furthermore, exciting work is occurring in the area of community response to OHCA and the targeted distribution of public AEDs across Western Australia.

We are certainly pleased with our performance and the way it compares with others nationally and internationally, not withstanding there is still work to be done to be on an even pegging with world's best practice.

We look forward to discussing our progress in the 2018 annual report.



Publications/research highlights

SJAWA is committed to promoting and participating in resuscitation research. The SJAWA OHCA database (dating back to 1996) enables important observational studies to be undertaken, in order to provide a better understanding of the factors associated with survival outcomes after OHCA (see the publications list below).

In addition, together with a number of other Ambulance services in Australia and New Zealand, SJAWA contributes data to the Australian Resuscitation Outcomes Consortium (Aus-ROC: www.ausroc.org.au Australia and New Zealand out-of-hospital cardiac arrest (OHCA) epistry.⁽¹⁾ The first publication arising from the Aus-ROC (2015) data has highlighted some variation in outcomes in OHCA across Australia and New Zealand.⁽²⁾ The challenge now is to disentangle true differences in outcomes from those due to differences in coding and/or case mix.

Over the last few years, PRECRU and SJAWA have conducted an innovative program of research into the linguistic analysis of '000' emergency calls relating to OHCA, which was funded by a NHMRC Partnership project. This has led to some

fascinating insights into the association between what is said and how it is said and rapid recognition of OHCA by the call-taker;⁽³⁾ which is important for the initiation of instructions for bystander CPR and priority one ambulance response.

All research studies undertaken by SJAWA are required to comply with the National Health and Medical Research Council – National Statement on Ethical Conduct in Human Research (2007) and have ethics approval from either a Western Australian university or Western Australian hospital (and in some cases both) Human Research Ethics Committee. In addition, all studies are reviewed, approved and monitored by the SJAWA Research Advisory Group - weblink. <http://healthsciences.curtin.edu.au/health-sciences-research/research-centres-and-institutes/precru/our-research/ethics/>

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