



Victorian Ambulance Cardiac Arrest Registry

2018-2019 Annual Report



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The VACAR Annual Report 2018-2019 is a publication produced by the Centre for Research & Evaluation, Ambulance Victoria.

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This publication has been produced to provide Ambulance Victoria stakeholders with an overview of out-of-hospital cardiac arrest epidemiology and outcomes in the state of Victoria. The views contained in this document are not necessarily those of Ambulance Victoria, the State Government of Victoria or any Government departments.

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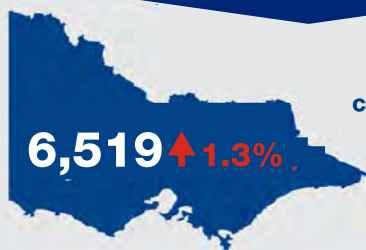
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DEMOGRAPHICS

THIS YEAR WE TREATED MORE
CARDIAC ARREST PATIENTS THAN
EVER BEFORE



We attended **6,519**
cardiac arrest patients
across Victoria—the
most cardiac arrest
cases ever

67%
MALE
65 years



33%
FEMALE
72 years

**75% of cases occurred
in private residences**

15% in a public place
8% in aged care facilities
1% in medical facilities

75%

RESPONSE

MORE CARDIAC ARREST PATIENTS
ARE RECEIVING THE CARE THEY
NEED, QUICKER



95% of bystanders correctly
directed their call for help to
Triple Zero (000) ambulance



84% OF CARDIAC
ARRESTS
were correctly identified
by ESTA Triple Zero
(000) call takers



7.5 minutes

We recorded our
FASTEST EVER
response time

Most patients were
defibrillated in
under 10 minutes
consistent with recent
years



BYSTANDER INVOLVEMENT

MORE OF THE COMMUNITY ARE
STEPPING IN TO HELP CARDIAC
ARREST EMERGENCIES



Bystander CPR has
increased in the
past decade from
48% to 62%



Patients who received
bystander CPR had a
higher survival rate
(14%) compared with those
with no bystander CPR (4%)



Public AED usage has tripled
in the past decade

97 patients were defibrillated by a
publically accessible defibrillator
- compared to 82 last year



POST CARDIAC ARREST OUTCOMES

CARDIAC ARREST PATIENTS
ARE RETURNING HOME TO THEIR
FAMILIES

365

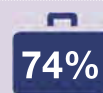
patients were discharged
alive from hospital



WE RECORDED OUR
HIGHEST EVER
UTSTEIN SURVIVAL RATE



89% of survivors
were able to return
home to
their families



74%
of patients were
able to return to
work (if working
prior)



Survivors were
recorded to be as
happy as the average
Australian population
(age matched)

VACAR data has been used to inform a
large research program to improve patient
care, including 30 new research papers





Survivor thanks saviours

As Rodney Smith arrived at work at a fuel depot just as he always did, he knew that something wasn't right.

Rodney Smith knew something wasn't right when he arrived at work at a fuel depot in Wodonga in January 2019.

He wasn't feeling well that morning and his wife suggested he take the day off.

Despite her advice, Rodney went to work – a decision that saved his life.

Not long after arriving, Rodney decided he wasn't well enough to stay and called his wife to collect him.

His manager Drew May was considering taking him to the doctor.

Without warning, Rodney collapsed on the floor as he went into cardiac arrest.

Drew started Cardiopulmonary Resuscitation (CPR), assisted by colleague Kevin Hansel.

As the Emergency Services Telecommunications Authority (ESTA) Triple Zero (000) call-taker gave instructions, Drew's first-aid training kicked in.

He continued CPR until Country Fire Authority (CFA) firefighters arrived. They'd responded as part of the CFA's Emergency Medical Response (EMR) program, which sees some brigades respond to life-threatening medical emergencies at the same time as paramedics.

Wodonga paramedics were quickly on scene to provide advanced care to Rodney.

He was able to be revived and was flown by air ambulance helicopter to Melbourne for further treatment.

Senior paramedic team manager Peter Greenall said Rodney's survival highlights the importance of CPR and someone calling Triple Zero (000).

"In a cardiac arrest, seconds count," Mr Greenall said.

"We want people to know to do three things – Call. Push. Shock. Call Triple Zero (000). Push hard and fast on the chest. Shock using an Automated External Defibrillator (AED)."

Rodney is now back at work, thanks to the combined efforts of bystanders, the Triple Zero (000) call-taker, firefighters and paramedics.

He's encouraging everyone to consider some sort of first-aid training.

"It could save someone's life," Rodney said.

Rodney's cardiac arrest has prompted the fuel depot to install an AED at the site. They've also purchased AEDs for a number of other depots in the region.

GoodSAM responder helps save tourist's life

A Swiss tourist visiting Melbourne has thanked paramedics and bystanders for helping save his life after he suffered a cardiac arrest in the gym of a Melbourne CBD apartment building.

Dr Christopher Portier, 62, of Switzerland, suddenly lost consciousness and collapsed while exercising in January 2019.

Fortunately an off-duty paramedic, Quinch Wong, who is a registered GoodSAM responder, was in the same building when the call to Triple Zero (000) triggered an alert to his smartphone, indicating the case nearby.

He went to the gym to assist two bystanders who had started CPR. Moments later, an AED was collected from the building's swimming pool area.

"We delivered the first shock to the patient with the AED about the same time as the first paramedics arrived," Quinch said.

As paramedics continued with CPR and defibrillation on Dr Portier, a MICA paramedic arrived on the scene, along with Metropolitan Fire Brigade (MFB) members, as part of the EMR collaborative program.

Using his first-hand knowledge of the building layout, Quinch helped crews move Dr Portier to the

ambulance so he could be taken to The Alfred Hospital.

Dr Portier is adamant that the early CPR he received at the scene from GoodSAM responder Quinch and the bystanders contributed to his recovery.

"I was on the elliptical trainer working out as I do every morning. The next thing I knew I was in the hospital," Dr Portier said.

"They saved my life. There is no hesitation about that.

"Without their CPR, I would likely have had a brain injury.

"I am extremely lucky these people were present and knew what to do."

Quinch noted that prompt recognition, calling Triple Zero (000) and early CPR are crucial steps during a cardiac arrest.

"With this case, everything just happened in the right way," he said.





Introduction

Out-of-hospital cardiac arrest (OHCA) remains a significant public health issue in Victoria. Across the nation every year, as many as 30,000 OHCA occur. Typically, less than 10% of arrest patients survive. However, when cardiopulmonary resuscitation (CPR) and defibrillation are provided quickly, alongside an effective system of care, the chance of an arrest patient being resuscitated and having a good neurological recovery greatly increases.

In order to improve systems of care and patient outcomes, it is essential to monitor performance, identify problems and successes and track progress. This can be achieved through a registry where all patients are enrolled to create a complete patient population. A registry can drive a quality agenda. It also fosters a culture of excellence in performance. A review commissioned by the Australian Commission on Safety and Quality in Health Care (ACSQHC) has also demonstrated the economic value of clinical quality registries to the health system (ACSQHC, 2016). In addition, the 'Strengthening Safety Statistics' report released by the Grattan Institute in 2017, emphasised the importance of health services having usable and useful safety data to drive improvements in patient safety (Duckett 2017). The Victorian Ambulance Cardiac Arrest Registry (VACAR) was one of the few clinical quality registries in the report to receive the highest possible score across all four domains used by the report to assess the robustness of clinical quality registries in Australia.


Ambulance paramedics and first responders, often with bystanders, comprise the front line in resuscitation following an OHCA event. As such, measuring the response, treatment and outcomes of OHCA patients is an essential component of an ambulance quality of care agenda. Ambulance Victoria uses VACAR data extensively to assess the quality of care of OHCA patients, identify areas for improvement and provide information and education to clinicians to drive change. The registry is also used to inform operational planning with respect to allocation and location of resources (eg prioritisation of the location of Public Access Defibrillation sites, fire first responder branches and areas to target for bystander awareness and training initiatives).

We are using our knowledge to develop a Cardiac Arrest Improvement Plan aligned with the Global Resuscitation Alliance's '10 Steps to Improve Cardiac Arrest Outcomes'. Key initiatives that we rolled out in 2018-2019 include the introduction of a 'high performance' CPR training package to all paramedics, which focuses on a pit crew approach to resuscitation and emphasises the importance of minimal

interruptions to chest compressions. To facilitate this and to support active review of resuscitation cases, we also introduced special defibrillation pads, which collect vital data on the quality of chest compressions performed by paramedics.

In cardiac arrest the heart completely stops pumping blood and seconds count. Thus, the biggest opportunity for improving outcomes is within the first few minutes of care. In recognition of this, many services are focusing on strengthening the bystander and community response to cardiac arrest. At Ambulance Victoria we are also strengthening the community response. We have rolled out the GoodSAM app this year, which alerts trusted responders to potential cardiac arrests in their vicinity allowing them to respond and start life-saving CPR. The app also alerts of a nearby available defibrillator if one exists. Defibrillation by the public produces the best patient outcomes and this year was no different with an astounding 56% of patients defibrillated by the public leaving hospital alive. We also saw our biggest number of patients defibrillated by the public (16% of all shockable arrests) including three paediatric patients. We strongly encourage all CPR trained personnel to download the app and become a first responder for their community! In addition we are working with the Emergency Services Telecommunication Authority (ESTA) to look at innovative ways to improve the detection of cardiac arrest in the Triple Zero (000) call and to ensure call-takers provide essential CPR instructions to bystanders. At the other end of the spectrum with the increase in survival rates we have become more aware of the need for evidence-based rehabilitation pathways for survivors and support for them and their families. To this end we are creating Sudden Cardiac Arrest Australia, a not-for-profit cardiac arrest survivor support group, to provide a platform for patient engagement, research and information. We have established a presence via social media channels and hope to launch the website in 2020.

The VACAR has been collecting data on cardiac arrest patients attended by ambulance in Victoria since 1999 and is one of the most comprehensive OHCA registries in the world. This year saw our highest number of cardiac arrests attended by paramedics and the most number of survivors per million population ever. On behalf of Ambulance Victoria, we are very pleased to present the 2018-2019 VACAR Annual Report.



Professor Karen Smith



Professor Stephen Bernard



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The Emergency Medical Service

The state of Victoria, Australia has an estimated population of 6.4 million spread over almost 227,500km², with over 4.9 million people living in the state's capital city of Melbourne. Almost fifteen per cent of the population are aged 65 years and over. The emergency medical service (EMS) comprises ambulance paramedics who have advanced life support skills (e.g. laryngeal mask airway, intravenous epinephrine) and MICA paramedics who are authorised to perform endotracheal intubation, rapid sequence induction, Pneumocath® insertion and administer a wider range of medications.

Paramedics in Victoria have a base qualification of a three year bachelor degree in emergency health sciences or Paramedicine. MICA paramedics are experienced paramedics who undergo a university-level post graduate diploma in Intensive Care Paramedic Practice. Since December 2018, all paramedics are required to be registered with the Paramedicine Board of Australia via the Australian Health Practitioner Regulation Agency (AHPRA) in order to practice.

Australia operates a single national telephone number for community access to emergency services (i.e. '000'). Telephone triage of emergency calls in Victoria is performed using the Medical Priority Dispatch System (MPDS). Unless circumstances suggest ventilations first (e.g. drowning), suspected cardiac arrest events identified in-call receive further call-taker instruction (telephone CPR) recommending 600 chest compressions, before two mouth-to-mouth breaths, and a subsequent ratio of 100 compressions to two breaths until professional help can take over.

Advanced Life Support and MICA paramedics are dispatched concurrently to suspected cardiac arrest events in the community. A first responder program for early defibrillation by fire-fighters operates for cardiac arrest patients in greater

Melbourne and a number of large regional towns. In addition, AV co-responds with 101 volunteer community teams in smaller, predominately rural communities across the state.

The AV cardiac arrest protocols follow the recommendations of the Australian Resuscitation Council (ARC). AV paramedics are not obliged to commence resuscitation when the clinical presentation is inconsistent with life. Paramedics may discontinue resuscitation if advanced life support has been performed for 30-45 minutes without return of spontaneous circulation (ROSC), the rhythm is not Ventricular Fibrillation (VF) or pulseless Ventricular Tachycardia (VT), there are no signs of life, no gasps or evidence of pupillary reaction and no evidence of hypothermia or drug overdose.

AV also maintains a registry of public automated external defibrillators (AEDs) throughout Victoria (<http://registermyaed.ambulance.vic.gov.au>). As at March 2019, there were nearly 5,200 AEDs in the AV AED Registry. During a Triple Zero (000) call, the emergency call taker may identify an AED close to the event which is available for use.

The public are encouraged to contact the registry and ascertain if their AED, or one that they become aware of, is registered with up to date information.



Victorian Ambulance Cardiac Arrest Registry

The Victorian Ambulance Cardiac Arrest Registry (VACAR) was established in 1999 and represents an internationally recognised standard of OHCA monitoring and reporting. The VACAR is managed by AV, the sole EMS provider in Victoria, Australia and is overseen by a multidisciplinary Steering Committee, chaired by Professor Karen Smith (Director, Centre for Research and Evaluation, Ambulance Victoria).

The VACAR is a clinical quality registry (CQR), incorporating both prehospital clinical and operational data and hospital follow-up data from all OHCA events in Victoria where AV are in attendance. The VACAR collects data from Communication Centre dispatch records, EMS patient care records, hospital medical records and from a telephone interview of adult survivors 12 months post-cardiac arrest (commenced January 2010). Hospital outcome data is supplemented by death records from the Victorian Registry of Births, Deaths and Marriages.

Data for all cardiac arrest patients attended by AV since October 1999 has been successfully captured for over 100,000 patients. The data is collated in the registry based on an internationally agreed template. The integrity and reputation of the registry relies on complete and accurate data collection, including hospital discharge data.

The VACAR provides essential information for the assessment of EMS performance in relation to the treatment and outcomes of OHCA patients. In particular, a number of key clinical indicators have been implemented, which are designed to measure the quality of care and allow for the benchmarking of EMS performance. These clinical indicators include ambulance response times, event survival and survival to hospital discharge.

The VACAR is also used to measure the impact of ambulance programs such as the fire-fighter Emergency Medical Response Program, 'Call, Push, Shock' community CPR education program, Heart Safe Community (in partnership with Heart Foundation Victoria) and Public Access Defibrillation (for more information, see www.ambulance.vic.gov.au). In addition, the VACAR has successfully established an internationally recognised research program, with the publication of scientific literature in key medical journals (see **2018-2019 Peer-reviewed Publications**, page 57). The results of the research program are used to provide an evidence base for AV treatment of cardiac arrest patients.

In 2010, VACAR expanded its methodology to become one of few registries globally that routinely captures the quality-of-life of adult survivors of OHCA. A structured telephone interview with adults 12 months following the event is conducted using previously validated quality-of-life assessment tools. This initiative ensures that the VACAR provides a robust framework for the measurement of immediate, early and long term quality clinical outcomes following OHCA in Victoria.

The VACAR contributes to the Australian Resuscitation Outcomes Consortium (Aus-ROC) Epistry, which is an OHCA epidemiologic registry (Beck 2016). The Aus-ROC Epistry was established with the aim of understanding regional, ambulance service and treatment factors associated with improved OHCA survival and outcomes in Australia and New Zealand. The VACAR contributes the highest number of cases to the Epistry. The Epistry will enable benchmarking across providers and identification of system-wide strategies associated with survival for OHCA patients in Australia and New Zealand.



How does VACAR operate?

Eligibility

The VACAR captures data on all OHCA patients where EMS are in attendance. For the purposes of this report, EMS is defined as AV and participating first responder organisations (see **Table 1**). The VACAR defines the state of cardiac arrest as the cessation of cardiac mechanical activity as confirmed by absence of signs of circulation, including the absence of a detectable carotid pulse, unresponsiveness and apnoea or agonal breathing. Patients eligible for inclusion in or exclusion from the VACAR are described below (see **Tables 2 and 3**).

Data capture

The registry is based on the internationally recognised Utstein template and definitions (Perkins 2015). Ambulance Victoria's in-field recording of patient data is performed electronically using the Victorian Ambulance Clinical Information System (VACIS), an electronic data capture system. All electronic patient care records (PCRs) are synchronised daily with organisational databases, providing an effective medium of clinical and administrative data capture. To ensure the capture of all OHCA events attended by AV, a broad electronic search is conducted of clinical databases utilising specific search criteria. This search strategy is focused at identifying potential cardiac arrest cases, which may be eligible for review. Paper PCRs are used in cases where in-field electronic data capture is not possible. In these instances, paramedic team managers are required to forward all potential cardiac arrest cases to VACAR for review. A hand search of all paper PCRs forwarded to the AV Accounts department (from metro and rural areas) is performed periodically to ensure complete case capture.

Following review of potential cases, eligible cardiac arrest cases are entered into the VACAR database, with PCR data being supplemented by information from communication centre dispatch records. The VACAR participating hospitals (i.e. those for whom ethics approval has been obtained) are contacted for survival status and patient discharge direction. A cross-match of VACAR records with the Victorian Registry of Births, Deaths and Marriages is undertaken for verification of deaths. Structured telephone interviews are conducted 12 months post-cardiac arrest for adult patients identified as having survived to hospital discharge. The interview questionnaires used include: the Extended Glasgow Outcome Scale (GOS-E), 12-item Short Form (SF-12) health survey and EuroQol 5 Dimension (EQ-5D) validated questionnaires, in addition to general questions relating to residential status, work status and level of education.

Table 1: Participating first responders dispatched to cardiac arrest events in Victoria.

1. Metropolitan Fire Brigade
2. Country Fire Authority (selected areas)

Table 2: VACAR inclusion criteria (all of the following).

1. Patients of all ages who suffer a documented cardiac arrest.
2. Occurs in the state of Victoria where Ambulance Victoria is the primary care giver. Cardiac arrests occurring in the neighbouring states of New South Wales and South Australia are considered for inclusion where Ambulance Victoria is clearly documented as the primary care giver.
3. Patients who are pulseless on arrival of EMS; OR
Patients who become pulseless in the presence of EMS (EMS witnessed arrests); OR
Patients who have a pulse on arrival of EMS, where a successful attempt at defibrillation was undertaken by a bystander prior to arrival of EMS.

Table 3: VACAR exclusion criteria (any of the following).

1. Patients who suffer a cardiac arrest in a hospital facility, where Ambulance Victoria may be in attendance but are not the primary care giver.
2. Brief episodes of pulselessness which do not receive cardiopulmonary resuscitation or defibrillation by EMS.
3. Bystander suspected cardiac arrest, where the patient is not in cardiac arrest on arrival of EMS, or no defibrillation prior to arrival, or no other evidence verifying a cardiac arrest state is present.

Data quality

The VACAR undergoes rigorous data quality control to ensure the accuracy of data collected. During data entry, automated validation rules and error messages are embedded into the VACAR database to capture erroneous values or sequences. Quality control audits are conducted monthly on a random sample of 10% of cases to validate the accuracy of data coding by the VACAR data entry team. Verification of data entry undergoes routine audit to identify inconsistencies with data coding. Trend analysis is performed on a quarterly basis to ensure consistency of case numbers, patient outcomes and response times. VACAR has undergone two independent external audits over the last decade, including an audit by the Victorian Auditor-General's Office. Cardiac arrest cases also undergo clinical auditing by senior paramedics. All cases where a patient requires defibrillation or where a death occurs in AV care undergo audit.

The data in the registry is subject to ongoing audit and quality control, with any necessary changes being incorporated back into the registry as needed. Quality assurance measures are conducted routinely, leading to improvements in the integrity of the data with time. As such, data presented in this report may differ slightly from previously published data. Previous years' data is subject to updates and is most current within this report. Data on survival to hospital discharge is also being continually updated and hence should be treated and interpreted with caution.

Ethical review

The registry maintains ethical review as a quality assurance initiative from the Human Research Ethics Committee of the Victorian Department of Health and Human Services. The VACAR is supported by more than 100 ethics approvals from Victorian hospitals for the access to medical records. This successful program has resulted in the capture of almost 99% of all out-of-hospital cardiac arrests transported to a Victorian emergency department.

In accordance with the National Health and Medical Research Council's National Statement on Ethical Conduct in Human Research, all paper and electronic data are securely stored at Ambulance Victoria, with access restricted to authorised VACAR staff.

Missing data

The value of VACAR relies on completeness of data capture. Missing data remains relatively low for all variables (see Table 4). Periodic quality control checks and data verification activities ensure the long-term validity of registry data.

Table 4: Number and proportion of missing data for select registry variables, 2018-2019 (n=6,519).

| | |
|------------------------------|---------|
| Patient age | 67 (1%) |
| Patient sex | 19 (0%) |
| Arrest location | 0 (0%) |
| Witnessed status | 75 (1%) |
| Bystander CPR | 0 (0%) |
| Rhythm on arrival | 18 (0%) |
| EMS response time | 0 (0%) |
| Defibrillation time | 17 (0%) |
| Outcome at scene | 19 (0%) |
| Event survival | 2 (0%) |
| Hospital discharge status | 17 (0%) |
| Hospital discharge direction | 2 (0%) |





About this Report

The American Heart Association states that monitoring the treatment of out-of-hospital cardiac arrest by EMS agencies should be the sentinel measure of the quality of EMS care in our communities.

Despite recent advances in resuscitation and post-arrest treatment strategies for OHCA patients, survival to hospital discharge rates remain low (approximately 10%) (Berdowski 2010). OHCA is a significant cause of disability and death in Australia, with a reported incidence of an average of 100 events per 100,000 peoples (Beck 2017). Much of the burden associated with OHCA, sometimes referred to as sudden cardiac death, occurs before a patient reaches hospital, therefore EMS has a crucial role in reducing the burden of illness in our communities. The American Heart Association states that monitoring treatment of OHCA by EMS agencies should be a sentinel measure of the quality of EMS care in our communities (Nichol 2008).

This report describes data from the VACAR for all OHCA events attended by AV. The main focus of this report is to summarise data pertaining to adult and paediatric OHCA in Victoria within the most recent fiscal year, 1 July 2018 to 30 June 2019. Final data for this report was extracted on 15 November 2019, with pending hospital follow-up remaining in a small proportion of events.

Analyses in this report are described across two predominant populations. The 'EMS attended' population is used for all cardiac arrest patients where AV is in attendance, regardless of whether emergency treatment is provided. The 'EMS treated' population specifically refers to patients who receive an attempted resuscitation by EMS, including eligible first responders. Our outcomes are defined by two major endpoints 'event survival' and 'survival to discharge'. These endpoints define patients with sustained return of spontaneous circulation on arrival at hospital and those discharged alive from hospital, respectively. All definitions used in this report have been described in detail on page 62.

Descriptive statistics in this report are presented as frequencies and proportions for categorical data and median and interquartile ranges for continuous variables. Comparisons of proportions were undertaken using the chi-square test. A logistic regression analysis was used to describe the risk-adjusted odds of survival to hospital discharge across years for different patient subgroups. These models were adjusted for known predictors of survival and are described in more detail in the report. Unless otherwise

stated, all other statistical comparisons were unadjusted.

Analyses in this report contain Metropolitan and Rural comparisons. Geospatial mapping has been used to define regional boundaries according to the Victorian Government Department of Health and Human Services regions (according to the following website <https://www2.health.vic.gov.au/about/publications/formsandtemplates/Department-of-Health-regional-boundaries-and-local-government-areas-map>). The Melbourne metropolitan region is comprised of three geographical regions: North and West, Eastern and Southern regions. The rural region comprises five geographical regions: Barwon South Western, Grampians, Loddon Mallee, Hume and Gippsland. The major rural urban centre of Geelong falls within the Barwon South Western region. Ballarat and Bendigo, two other rural urban centres, fall within the Grampians and Loddon Mallee regions, respectively. AV may be dispatched to a small number of OHCA events in New South Wales and South Australia which occur close to the Victorian border; these cases are included in VACAR if AV is the primary care giver. Any cases which occur off the coastline of Victoria are attributed to the nearest Victorian Department of Health and Human Services region.

Regional data for this report was sourced from the Regional Population Growth report (published 27 March 2019, Australian Bureau of Statistics (ABS)). The Victorian population up to the end of June 2018 was 6,459,786 persons (excluding unincorporated areas). Annual Victorian data by age was sourced from the Australian Demographic Statistics report (published 19 September 2019, ABS). This report also specifies the 2001 Australian Standard Population for use in age-standardisation.

Patients who suffer a cardiac arrest in the presence of paramedics represent a unique sub-group of patients. These patients differ considerably in survival factors (eg. time to defibrillation, presenting rhythm etc.). This may skew analyses. As such, data relating to paramedic or EMS witnessed OHCA have been analysed and depicted separately to those which are unwitnessed by paramedics in this report. Unless specifically stated, all analyses should be assumed to exclude EMS witnessed events.



Executive Summary

Over the last decade, rates of bystander CPR in the community have steadily risen and the odds of an out-of-hospital cardiac arrest patient surviving to hospital discharge has more than doubled.

1. Ambulance Victoria attended 6,519 OHCA events in the period between 1 July 2018 and 30 June 2019, with 99% involving adults. The proportion of all adult OHCA patients receiving emergency treatment by EMS was 46%; when excluding EMS witnessed arrests, 43% of adult EMS attended arrests received attempted resuscitation by EMS. The crude incidence of OHCA was higher in the rural region than in the metropolitan region: 139 versus 88 events per 100,000 population. The Loddon Mallee region recorded the highest crude incidence rate of OHCA. The age adjusted state-wide incidence of OHCA in 2018-2019 was 91 events per 100,000 population; age-adjusted OHCA incidence in males was 118 events per 100,000 and in females was 68 events per 100,000 (see **Incidence & Demographics**, pages 23-29).

2. The demographic profile of patients in 2018-2019 was similar to those observed over the last decade. OHCA due to a presumed cardiac cause accounted for 73% of adult EMS attended patients. Thirty percent of paediatric arrests were due to a presumed cardiac cause. Sudden infant death syndrome (SIDS) remained a leading cause of OHCA in paediatrics (27%). Patients who arrested in a public location had significantly better survival outcomes than those who arrested in the home or in an aged care facility (see **Incidence & Demographics**, pages 23-29).

3. Most bystander calls for help following OHCA were appropriately directed to Triple Zero (000) (95%). Emergency call-takers were effective at identifying cardiac arrest events during the emergency call; 84% of all EMS attended arrests were correctly identified (see **Chain of Survival**, pages 30-41).

4. The median state-wide response time to EMS treated events in 2018-2019 was 7.5 minutes (90th percentile time 16.4 minutes), which is faster than the previous year. The median EMS response time to EMS treated patients in the metropolitan region (median 7.1 minutes, 90th percentile 12.0 minutes) was faster than the previous year. The median EMS response time to EMS treated patients in the rural regions (median 9.3 minutes; 90th percentile time 24.6 minutes) was, again, faster than the previous year (see **Chain of Survival**, pages 30-41).

5. The rate of bystander CPR for bystander witnessed OHCA events in 2018-2019 remained high (62%), compared to 48% in 2009-2010. Also, the rate of bystander CPR amongst bystander witnessed OHCA patients receiving EMS attempted resuscitation in 2018-2019 remained high (76%). Use of public automated external defibrillators increased three-fold over the last decade for patients presenting in a shockable rhythm (see **Chain of Survival**, pages 30-41).

6. In 2018-2019, when an arrest was witnessed by a bystander, the proportion of patients who survived the event was higher than that observed for all OHCA events combined (39% vs 29%, respectively). Similarly, when an arrest was witnessed by a bystander, the proportion of patients who were discharged alive from hospital was higher than for all OHCA events combined (18% vs 11%, respectively) (see **Chain of Survival**, pages 30-41).

7. The state-wide rate of ROSC in adult EMS treated patients during 2018-2019 was 38%. The rate of event survival for all-cause adult OHCA in the EMS treated population during this period was 29%. Meanwhile, the rate of survival to hospital discharge was 12% and remained within recent observations (see **Survival Outcomes**, pages 42-49).

8. The rate of event survival for adult EMS treated patients presenting in a shockable rhythm was 54%, with 34% surviving to hospital discharge. This is consistent with recent observations. For adult EMS treated patients presenting in a shockable rhythm and witnessed to arrest by EMS, event survival and survival to hospital discharge were 79% and 66%, respectively. Adults presenting in asystole or pulseless electrical activity experienced the poorest survival outcomes, with 0.3% and 9% surviving to hospital discharge, respectively (see **Survival Outcomes**, pages 42-49).

9. The highest ever Victorian Utstein patient subgroup survival of 39% was recorded in 2018-2019. Victorian patients have comparable discharged alive rates to a number of international agencies (see **Survival Outcomes**, pages 42-49). Survival for Inner Melbourne was 56% which equals the survival demonstrated by the world leaders in cardiac arrest survival, Seattle/King County.

10. The risk-adjusted odds of survival to hospital discharge have improved significantly over time. The odds of survival to hospital discharge for OHCA patients in 2018-2019 was over 2.5 times higher than for OHCA patients in 2003-2004 (adjusted odds ratio 2.6, 95% CI 2.0-3.3, $p < 0.001$). A significant improvement was also observed for patients who presented in a shockable rhythm over the same period (adjusted odds ratio 2.8, 95% CI 2.1-3.7, $p < 0.001$) (see **Survival Outcomes**, pages 42-49).

11. Most OHCA patients with known survival to hospital discharge were discharged home (89% in 2018-2019). Phone interviews with adult survivors showed that most survivors maintained their independence and had a good quality of life 12 months after their arrest. Of those who had worked before their arrest, 74% had returned to work 12 months after their arrest (see **Long-term Functional Outcomes**, pages 52-55).





Incidence & Demographics

Incidence of all adult & paediatric events†

In 2018-2019, Ambulance Victoria attended 6,519 OHCA events, of which 6,433 (99%) were defined as adults aged greater than 15 years. This number of adult cases represents the highest number of annual events recorded in Victoria. The number of paediatric events attended by paramedics was slightly higher than the previous year (86 cases in 2018-2019 vs 82 cases in 2017-2018), and is within normal yearly fluctuations.

Of all adult OHCA events attended in 2018-2019, 46% received an emergency resuscitation attempt by paramedics and/or first-responders (includes EMS witnessed events; in the previous year, this was 46%). The rate of EMS attempted resuscitation for adult attended OHCA has risen over the last 10

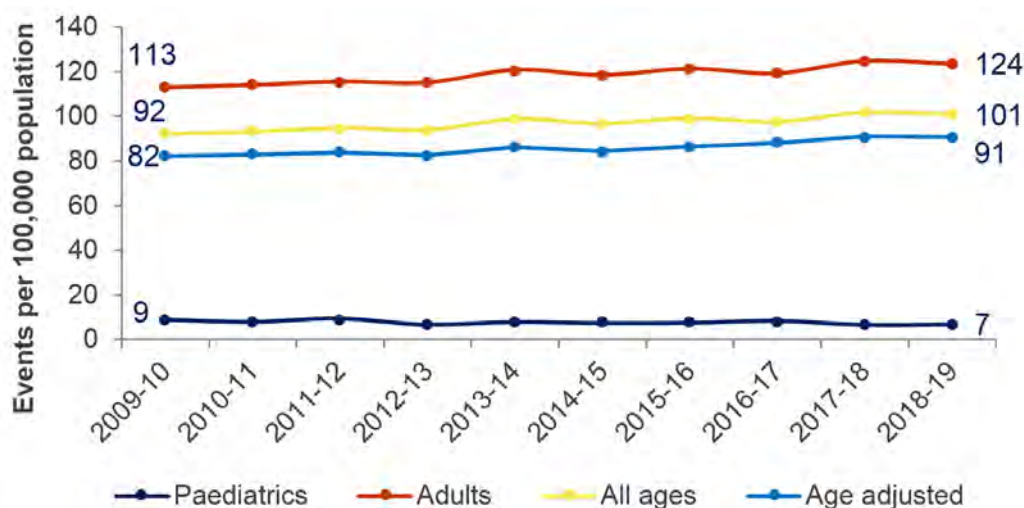


Figure 1: Crude incidence of all ages, adult and paediatric EMS attended OHCA in Victoria and age-adjusted incidence rate of EMS attended events (includes EMS witnessed events).

The crude incidence of OHCA has slowly increased over the last decade. In 2018-2019, the unadjusted incidence of all OHCA in Victoria was 101 events per 100,000 population, higher than the rate of 92 events per 100,000 population observed in 2009-2010 (see Figure 1). However, age standardisation gives rise to an adjusted OHCA incidence rate of 91 events per 100,000 population during 2018-2019. Age standardisation is a technique for comparing populations where the age profiles are different. Age-adjusted rates are rates that would exist if the population in a given year had the same age distribution as the standard population. In this case we have used the age profile of the 2001 Australian population as our standard population.

Age-adjusted incidence rates over the last 10 years have also been slowly increasing. The age-adjusted OHCA incidence rates for males and females during 2018-2019 was 118 events and 68 events per 100,000 population, respectively.

The incidence of adult events has slowly been increasing over time and paediatric events remained within recent observations. The numbers for 2018-2019 were 124 and 7 events per 100,000 population for adults and paediatrics, respectively. While variation in OHCA incidence across continents and regions are well established, these figures are within previously reported incidence rates.

year period (43% in 2009-2010; 43% vs 46%, $p=0.412$).

Lack of bystander witnesses and prolonged downtime are the major reasons for EMS withholding resuscitation efforts in adult patients. The crude incidence of adult EMS treated events was 57 events per 100,000 population.

In paediatric patients, the proportion of EMS treated events is higher than in adults. The majority of paediatric patients (81%) received an attempted resuscitation by EMS during 2018-2019 (includes EMS witnessed events; in the previous year, this was 78%). The rate of EMS attempted resuscitation for paediatric events over the last 10 years has been quite variable; this rate was 72% in 2009-2010. The crude incidence of paediatric EMS treated events was six events per 100,000 population.

† All results in this section include EMS witnessed events.

In 2018-2019, Ambulance Victoria attended 6,519 OHCA events, the highest number of events recorded. The rate of attempted resuscitation by EMS for all arrests was 47%.



Incidence across regions of Victoria†

In 2018-2019, the second highest number of OHCA events in the last 10 years was observed for the metropolitan regions of Victoria: Eastern Metropolitan, North and Western Metropolitan and Southern Metropolitan (4,322 cases, representing 66% of the total number of cardiac arrest events attended by AV). The highest number of events for the last decade were observed in rural Victoria in 2018-2019 (2,188 events, a 40% increase since 2009-2010).

Despite more arrests occurring in the metropolitan region, the crude incidence of OHCA is significantly higher in the rural regions (139 vs. 88 events per 100,000 population, $p < 0.001$) (see Figure 2).

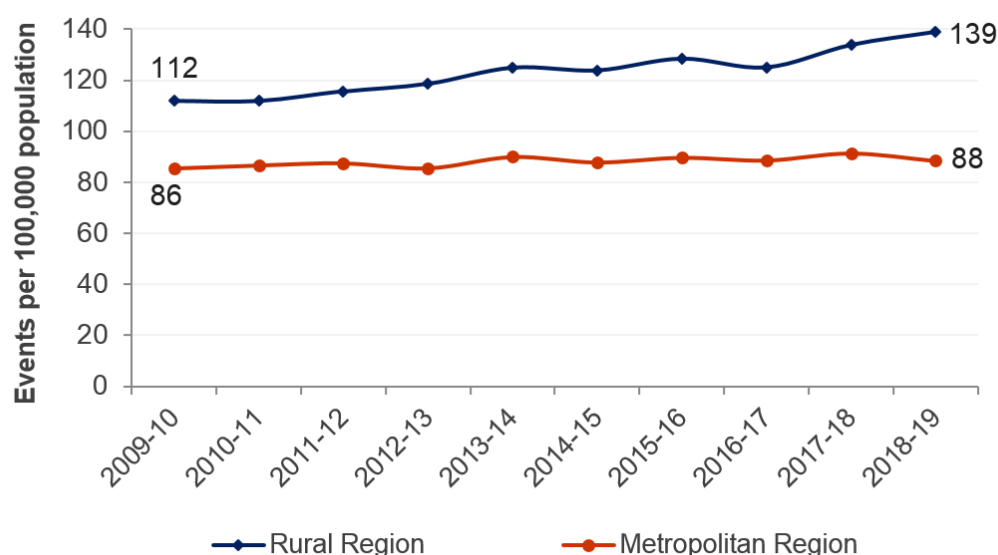


Figure 2: Yearly crude incidence of EMS attended events across metropolitan and rural regions of Victoria (includes EMS witnessed events).

The crude incidence of OHCA has increased over the last 10 years in rural Victoria, rising from 112 events in 2009-2010 to 139 events per 100,000 population in 2018-2019. As noted previously, this observation may reflect better case capture since the 2009-2010 period, which coincided with the completion of the roll-out of VACIS in the rural area. Unadjusted incidence in the metropolitan region has remained relatively unchanged during the same period. Figure 1 shows state-wide age-adjusted incidence of OHCA has remained stable.

There is regional variability in OHCA incidence across Department of Health and Human Services regions (see Figure 3). The lowest crude incidence during 2018-2019 was observed in the Eastern Metropolitan and North and West Metropolitan regions (85 events per 100,000 population, respectively) and the highest incidence was in the Loddon Mallee region (149 events per 100,000 population). The North and West Metropolitan region, which includes the Melbourne Business District, had a total of 1,863 OHCA.

The proportion of events receiving an attempted resuscitation by EMS varies considerably across regions. The highest proportion of EMS treated events during 2018-2019 occurred in the North and West Metropolitan region (52%) and the lowest in the Grampians region (39%).

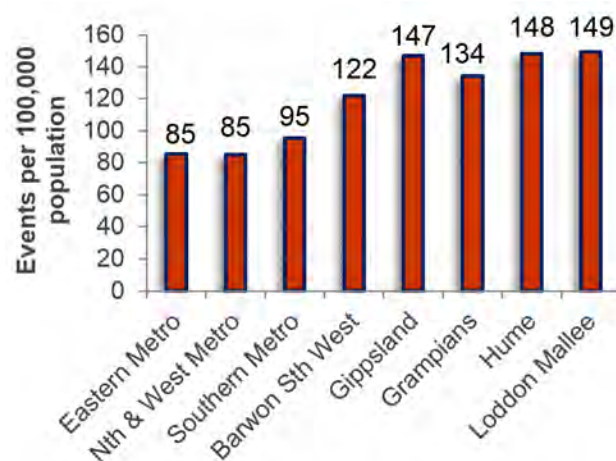


Figure 3: Crude incidence of EMS attended events across Department of Health and Human Services regions, 2018-2019.

† All results in this section include EMS witnessed events.

2017 Winter peak

OHCA usually follows a seasonal pattern with a higher incidence and lower survival rate during winter (Muller 2020). However, during the 2017-2018 first quarter (July to September), which is primarily during winter, there was an unprecedented number of OHCA in Victoria. Compared to 2016-2017 ($n=1,668$), there were 163 more OHCA during the first quarter of 2017-2018 ($n=1,831$), and the highest number ever reported for a quarter in VACAR. The survival rate in the 2017-2018 first quarter (10%) was also the lowest quarterly survival rate recorded in VACAR since 2007. These findings may have been influenced by Victoria's deadliest flu season which took place during this period. Nationally, the 2017 influenza season was the largest since the 2009 pandemic year and deaths due to laboratory confirmed influenza were higher than any previous year (National Influenza Surveillance Committee 2017). The VACAR team are currently undertaking a review of the winter peak seen in OHCA incidence to better understand the trends of recent years.

Demographics of adults

The demographic profile of adult OHCA events (excluding EMS witnessed arrests) has been consistent over the last decade. In 2018-2019, EMS-attended adult events were predominately male patients (67%). The median age of OHCA patients was 68 years. The age distribution varied significantly across the sexes (see **Figure 4**), with females having a higher median age of arrest (72 vs. 65 years, $p<0.001$). The proportion of cases witnessed to arrest by a bystander was 29% and the proportion occurring in a public location was 11%. Notably in 2018-2019, the proportion of adult patients receiving bystander CPR (39%), were almost a fifth higher than in 2009-2010 (28%) ($p=0.05$). In 2018-2019, 12% of adult OHCA patients presented in a shockable rhythm (VF or pulseless VT) to either EMS or a bystander who made use of an automated external defibrillator (AED).

Paramedics attempted resuscitation in 43% of all EMS attended adult OHCA events. The demographic profile of patients receiving EMS attempted resuscitation varied significantly from the overall population, with more male patients (69%), a lower median age (66 years), more events occurring in a public location (17%), more events witnessed by a bystander (50%) and a high rate of bystander CPR (72%).

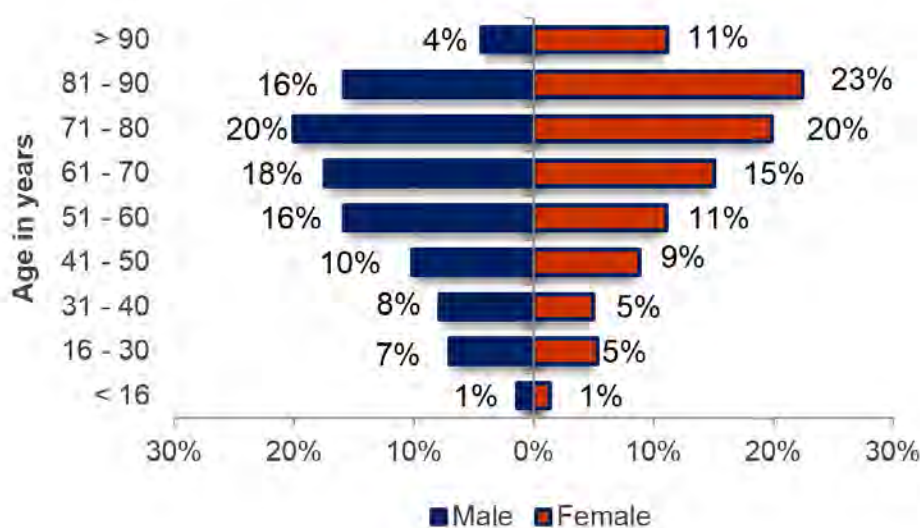


Figure 4: Age distribution of EMS attended OHCA events, 2018-2019.

Demographics of paediatrics

The frequency of EMS attended paediatric events (excluding EMS witnessed arrests) has remained relatively low over the last decade, with fewer than 100 events per year (81 in 2018-2019). The median age of arrest in 2018-2019 was two years, which is consistent with the past decade. The dominant precipitating factors in this population are described in a later section (see **Figure 7**, page 27).

The demographic profile of paediatric OHCA varies significantly across reporting years and is impacted by smaller samples sizes. In 2018-2019, EMS attended paediatric events were predominantly males (68%). Within the paediatric OHCA population, 14% of events during 2018-2019 occurred in a public location. Significantly more paediatric patients received bystander CPR than adult patients during 2018-2019 (68% vs. 39%, respectively; $p<0.001$).

The majority of paediatric patients during 2018-2019 presented to EMS in an asystolic rhythm (74%). In 2018-2019, three paediatric patients were defibrillated prior to the arrival of EMS with a public automated external defibrillator, compared to no patients in 2017-2018. All three of these patients survived their arrest and were able to be discharged home. This is the second highest number of paediatric patients during the last decade who received prior defibrillation; in 2016-2017, four patients received defibrillation prior to EMS arrival. The rate of EMS attempted resuscitation amongst paediatric patients during 2018-2019 remained high (80%). Significantly more paediatric cases received an attempted resuscitation by paramedics than adults during 2018-2019 (80% vs. 43%, respectively; $p<0.001$).

In 2018-2019, Ambulance Victoria attended 81 paediatric events. The median age was two years.



Precipitating events for adults

The precipitating causes of OHCA events are defined by paramedics and recorded directly from the patient care record. Unless the cause of arrest is clearly described (e.g. trauma, submersion, overdose/poisoning, hanging etc.), the aetiology of arrest is presumed to be of cardiac origin, as per Utstein definitions (Perkins 2015). In total, VACAR records 13 precipitating events for adults.

In 2018-2019, 73% of EMS attended adult OHCA were presumed to be of a cardiac cause. Other frequent causes of OHCA during 2018-2019 were: trauma (6%), terminal illness (6%), overdose/poisoning (5%), hanging (6%) and respiratory causes (3%), (see Figure 5).

For adult patients receiving an attempted resuscitation by EMS during 2018-2019, most cases were due to a presumed cardiac cause (76%).

The rate of EMS attempted resuscitation differed amongst patients according to the precipitating cause of the event. During 2018-2019, the rate of EMS attempted resuscitation for arrests due to presumed cardiac cases was 45%. Rates of EMS attempted resuscitation during 2018-2019 were lower for arrests due to trauma (30%), overdose/poisoning (39%), hanging (35%) and terminal illness (22%). In contrast, most OHCA events due to a respiratory cause received EMS attempted resuscitation (73%).

The precipitating event for arrests across age groups in the EMS attended adult population is presented in Figure 6. This graph highlights the relationship between arrest aetiology and patient age. A presumed cardiac cause was the predominant precipitating factor for most age groups: 36-50 years (56%), 51-75 years (80%) and >75 years of age (86%).

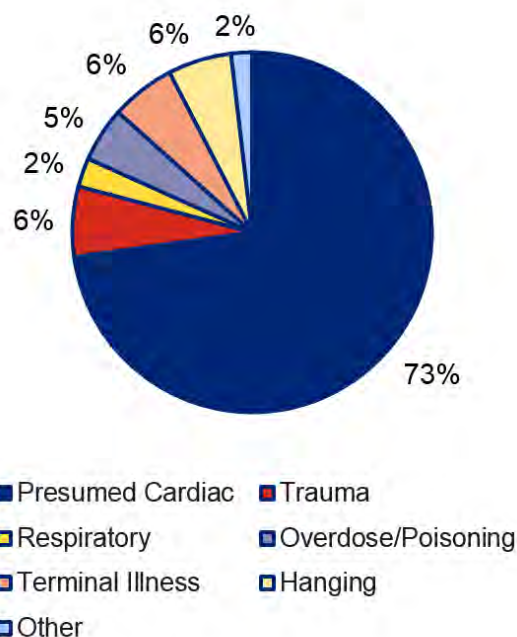


Figure 5: Adult precipitating events for EMS attended events, 2018-2019.

Meanwhile, in the 16-35 years age group during 2018-2019, the predominant precipitating factor was the combined causes of trauma and hanging (48%). In this young adult age group in 2018-2019, a presumed cardiac cause was the precipitating factor for 31% of OHCA events. There were few OHCA events due to trauma and hanging in the oldest age group of >75 years (2%) and no cases of overdose/poisoning in 2018-2019.

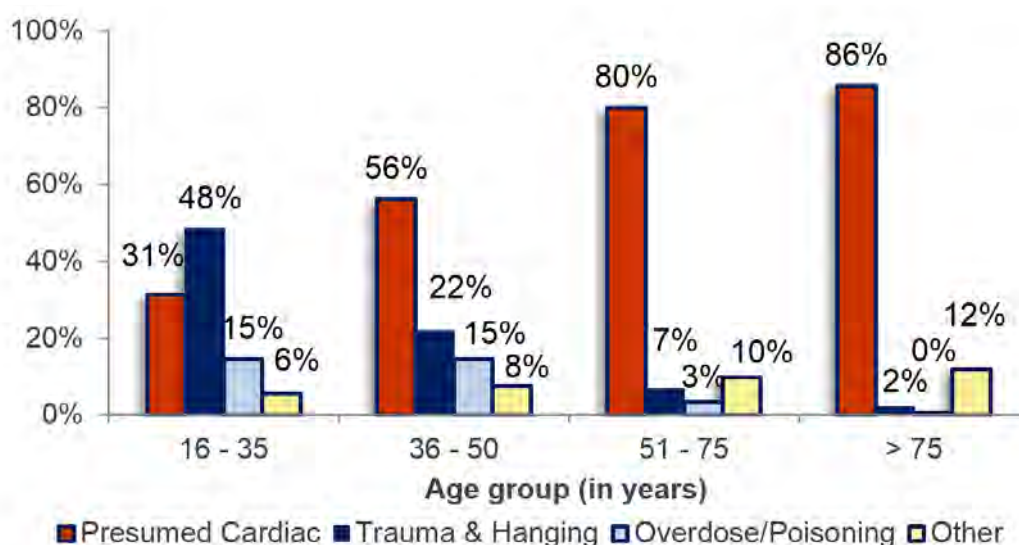


Figure 6: Adult precipitating events across age groups for EMS attended events, 2018-2019.

Presumed cardiac causes were the most common precipitating event for both adult and paediatric OHCA cases in 2018-2019.

Precipitating events for paediatrics

Precipitating events for paediatrics who suffer OHCA vary considerably in comparison to adults. In 2018-2019, 30% of EMS attended paediatric events were due to a presumed cardiac cause (see Figure 7). Sudden infant death syndrome (SIDS) is still a dominant cause of paediatric OHCA (27% in 2018-2019). During 2018-2019, less common causes of paediatric OHCA included trauma (16%), respiratory causes (6%), drowning (7%) and terminal illness (5%). Previous research conducted using VACAR data from paediatric OHCA events where trauma was the precipitating factor showed that resuscitation efforts were rarely effective and were associated with poor neurological outcome for the patient (Nehme 2018). The distribution of precipitating events in the EMS treated paediatric OHCA population mirrors the overall paediatric OHCA population data presented in Figure 7.

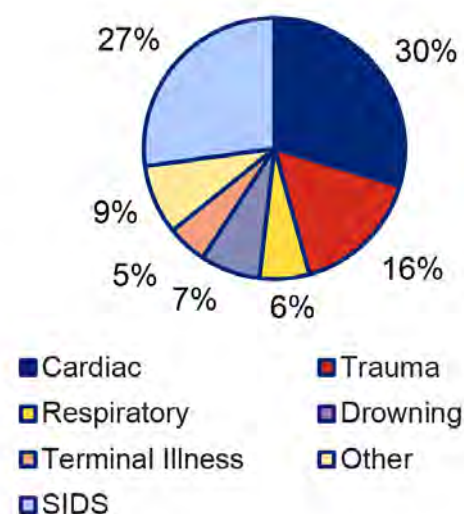


Figure 7: Paediatric precipitating events for EMS attended events, 2018-2019.

Mechanism of arrest in the traumatic sub-group*

Cardiac arrests secondary to major trauma are an important, potentially-preventable patient subgroup. During 2018-2019, arrests secondary to road trauma were responsible for 61% of events, while arrests following ballistic trauma and stabbings accounted for 14% and arrests following falls accounted for 9%, see Figure 8.

The following vehicles were the mode of transport associated with road trauma incidents during 2018-2019: a car or light vehicle (54%), train (17%), motorcycle (14%), truck (9%) and bicycle (3%). During 2018-2019, the role of the OHCA patient in these vehicles was as the vehicle driver (55%), pedestrian (32%) and passenger (12%).



Figure 8: Sources of trauma in EMS attended traumatic OHCA sub-group, 2018-2019.

* 'Other trauma' refers to any of the following: chemical exposure, environmental exposure, fire/smoke exposure, sting/bite/envenomation, animal related injury, electrical contact, sporting injury, assaults (excluding shooting/stabbing), crush injury or trauma due to an unknown reason. 'Other trauma' causes were responsible for 16% of trauma-related OHCA in 2018-2019.





Arrest location for adults and paediatrics

The location of the OHCA has important implications on OHCA outcome. The VACAR records over 20 cardiac arrest locations, the most common of which are presented in Figures 9 and 10. Public places include places of work, streets or roads, shops, vehicles and sporting/recreational facilities. In 2018-2019, most (75%) of EMS attended adult OHCA events occurred within a private residence. Other common arrest locations were a public place (15%) and aged care facility (8%) (see Figure 9).

Similar to EMS attended adult OHCA events, amongst adult patients who received an attempted resuscitation by EMS during 2018-2019, the most common site of an arrest was a private residence (70%), followed by arrests in a public place (17%) and aged care facility (7%). In comparison to arrests in the home, patients who arrested in public places were far more likely to be witnessed by a bystander and receive bystander CPR prior to EMS arrival (see Figure 10).

The presence of bystanders witnessing the arrest and/or providing CPR in public places has an important contribution to survival for adult events occurring in these locations (see Figure 10). In 2018-2019, the unadjusted rates of adult survival to hospital discharge were highest in public places (33%) and medical facilities (20%). Unadjusted adult survival to hospital discharge in a private residence (7%) and aged care facilities (2%) remained relatively low. Unadjusted adult survival to hospital discharge varied significantly between private residences and public places (7% vs. 33%, respectively; $p < 0.001$).

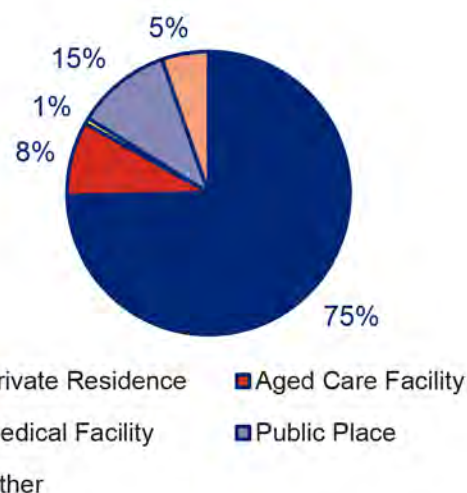


Figure 9: Location of arrest for EMS attended adult events, 2018-2019.

The locations of arrest for paediatric events were similar to those in adults. In 2018-2019, 71% of EMS attended paediatric events occurred in a private residence and 12% occurred in a public place.

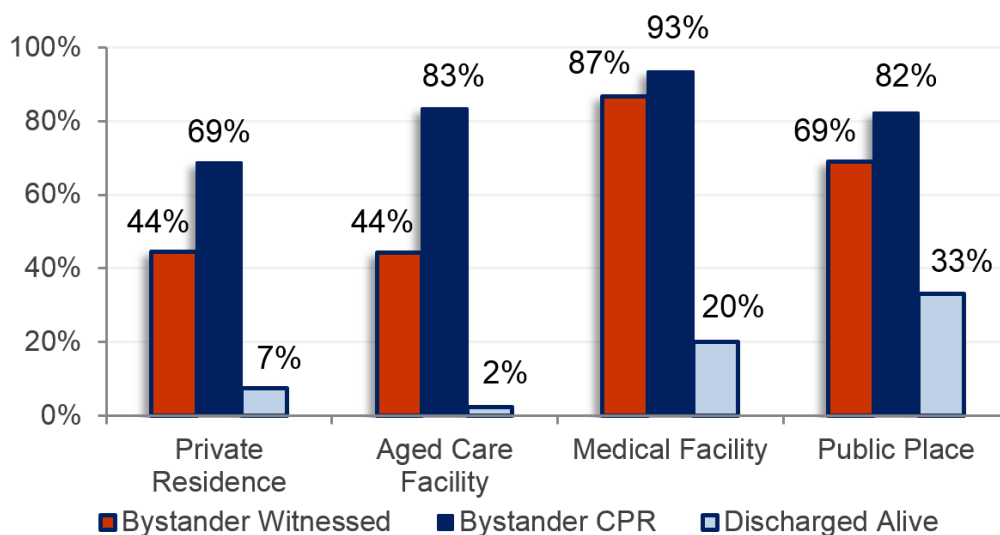


Figure 10: Proportion of EMS treated adult events that are bystander witnessed, receive bystander CPR and are discharged alive across arrest locations, 2018-2019.

Bystander action in public places, including performing cardiopulmonary resuscitation, has a significant influence on overall survival following OHCA.



Chain of Survival

The chain of survival is an internationally recognised initiative aimed at maximising survival following out-of-hospital cardiac arrest. The four key links in the chain involve correct identification and early access to help, early CPR, early defibrillation and early access to advanced cardiac life support.

Bystander call for help

In 2018-2019, the first bystander call for help was correctly directed to ambulance in the majority of cases (95%). However, emergency call delays continue to exist for a small subset of attended OHCA events, where the first call for help is directed to a relative/friend (2%), neighbour (1%), police (1%) or another person (<1%) rather than to emergency medical services. Previously published work by VACAR researchers has shown that bystanders inappropriately directing their first phone call to neighbours, relatives or others is associated with significantly poorer survival outcomes following OHCA (Nehme 2014). This is because misdirection of the call for help can significantly impact the timely delivery of CPR and defibrillation to the patient.

Emergency response to the incident

The distribution of response times for the EMS treated population across regions in 2018-2019 is presented in **Figure 11**. EMS response time, or the time from the beginning of the emergency call to the arrival of EMS at the scene, is an important measure of time to definitive resuscitation treatment by EMS. Some OHCA events may occur after the '000' call is made, such as those arrests which are witnessed by a paramedic. These cases may not be dispatched as a high priority as the initial event was not a cardiac arrest; including these cases in OHCA response time analyses can give rise to misleading results. As such, EMS witnessed arrests are excluded from the following response time analyses.

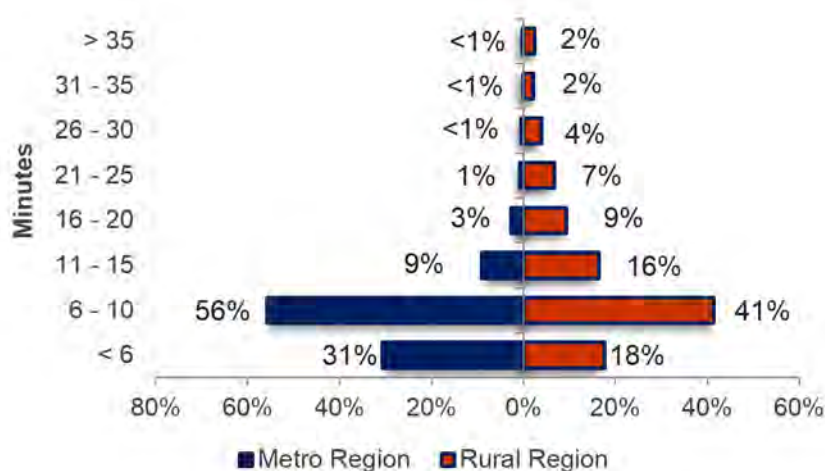


Figure 11: Distribution of time from call to arrival of EMS on scene in the EMS treated population, 2018-2019.

In 2018-2019, state-wide, median response time to EMS treated events was 7.5 minutes (90th percentile time 16.4 minutes). These were faster than the response times noted in the previous year (median time 7.6 minutes; 90th percentile time 15.1 minutes). In 2018-2019, median response time to EMS treated events in metropolitan regions was 7.1 minutes (90th percentile time 12.0 minutes) compared to 7.2 minutes (90th percentile time 11.8 minutes) in the previous year. Median response time in rural areas in 2018-2019 was 9.3 minutes (90th percentile time 24.6 minutes), faster than in the previous year (median time 9.4 minutes; 90th percentile time 23.3 minutes). Improvements in response times were observed in the face of increased demand on AV.

Bystander cardiopulmonary resuscitation

Over the last decade in Victoria, there have been substantial increases in rates of bystander CPR (see Figure 12). Of all OHCA events in 2018-2019, 39% of patients received CPR performed by bystanders, compared to 28% of patients receiving bystander CPR 10 years ago ($p=0.06$). Of OHCA events witnessed to collapse by bystanders in 2018-2019, 62% of patients received bystander CPR, in comparison to 48% of patients in 2009-2010 ($p=0.002$). Of bystander witnessed OHCA events receiving an attempted resuscitation by EMS, 76% received bystander CPR in 2018-2019, compared to 59% in 2009-2010 ($p=0.003$). The rate of bystander CPR amongst bystander witnessed OHCA cases which received EMS attempted resuscitation has been over 70% for the past seven years.

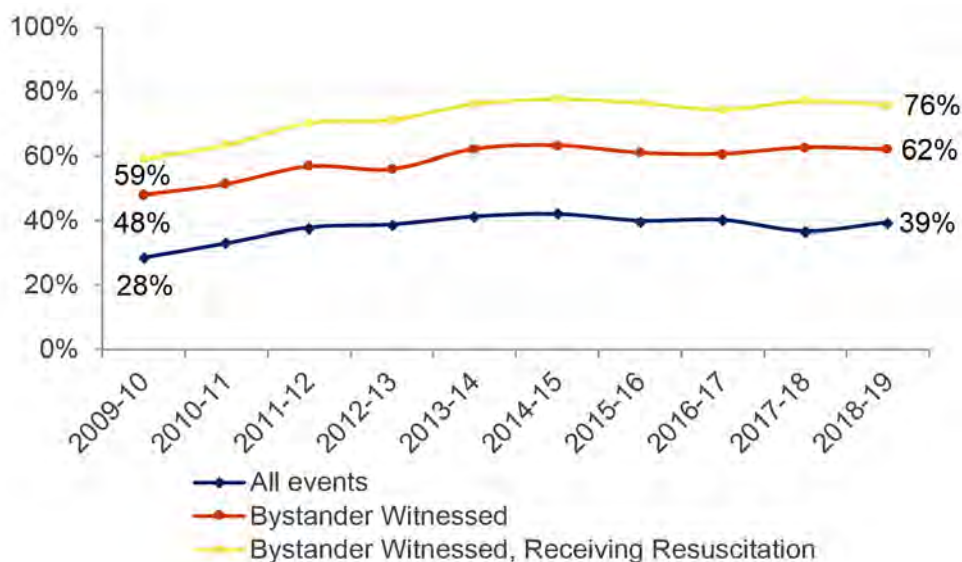


Figure 12: Bystander CPR rates.

These improvements can be partly attributed to more accurate identification of OHCA during the emergency call and delivery of dispatcher-assisted CPR instructions (Bray 2011).

Previous VACAR research shows early, effective bystander CPR increases the likelihood of an initial shockable rhythm and improves the chances of survival following OHCA (Fridman 2007).

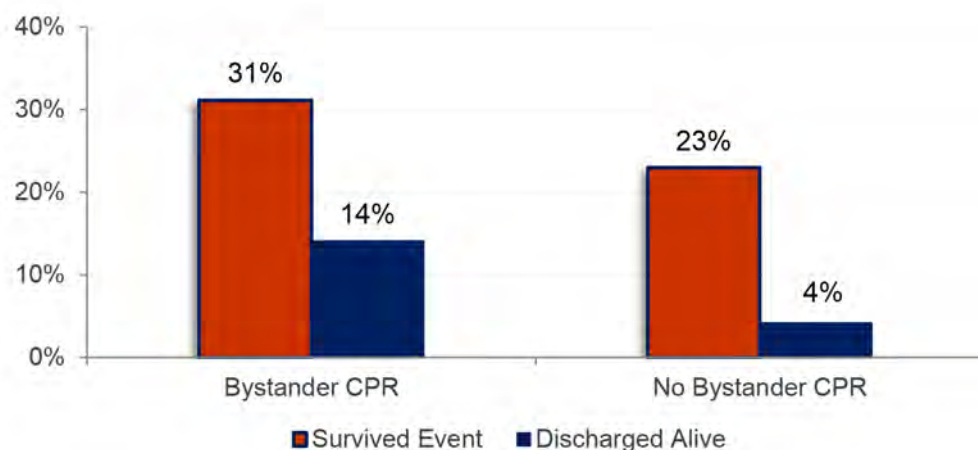


Figure 13: Unadjusted survival outcomes after bystander CPR in the EMS treated population, 2018-2019.

Unadjusted survival was strongly associated with the presence of bystander CPR (see Figure 13). In 2018-2019, for EMS treated OHCA events, the rate of event survival for patients receiving bystander CPR (31%) was significantly higher than for patients not receiving bystander CPR (23%), $p<0.001$.

In 2018-2019, survival to hospital discharge was significantly higher for patients receiving bystander CPR (14%) versus no bystander CPR (4%), $p<0.001$. Compared to rates in 2017-2018, those who received bystander CPR were more likely to be discharged alive (12% in 2017-2018 vs 14% in 2018-2019) but survival for those who received no bystander CPR remained the same (4%).

When you call Triple Zero (000), the call-taker can help you do CPR even if you have never done it before. Any CPR is better than no CPR.



Alert and dispatch of community responders via the GoodSAM app

Cardiac arrest is often unexpected and for every minute a patient doesn't get CPR/defibrillation, their chances of survival fall by 10%. This is why AV introduced the GoodSAM (Smartphone Activated Medic) app on 28th January 2018. GoodSAM is a free global smartphone app that connects responders to patient in those first critical minutes of cardiac arrest while paramedics are on the way. GoodSAM is linked to the Triple Zero (000) communications centre, so as soon as an ambulance is dispatched, a GoodSAM alert will be sent in parallel.

Key media coverage saw an increase in the number of individuals and businesses that registered their AED via the GoodSAM app, meaning more community members have access to an AED when needed. Through the implementation of GoodSAM, the AED registry grew and there are now over 1,000 Victorian AED's registered with GoodSAM.

GoodSAM eligible cases are based on dispatch events identified as the most commonly occurring OHCA events that included

suspected OHCAs, apnoeic seizures and drownings. GoodSAM notifications, sent via an alert message to a person's smartphone, highlight the sophistication of this advanced emergency alerting technology. VACAR will be pivotal in monitoring the impact of GoodSAM in Victoria on OHCA patient survival.

Establishing successful partnerships with five key community responder agencies led to an initial pool of trained responders in the Victorian community. The program was expanded to the general public on 4th July 2019 to include those holding first aid/CPR certification. Partner organisations include: St John Ambulance, Surf Life Saving Victoria, Country Fire Authority, Chevrah Hatzolah, Australian Volunteer Coast Guard and the Australian Health Practitioner Regulation Agency (AHPRA).

We are now calling on all members of the Victorian community to join up to GoodSAM and save lives. As of November 2019, there are almost 10,000 registered GoodSAM responders.

How does GoodSAM work?

1. A Triple Zero (000) call triggers an alert to be sent to a GoodSAM Responder.
2. The responder is told the location of the patient and the nearest available defibrillator (AED).
3. At the same time, the closest available ambulance is simultaneously sent to the patient, and in some parts of Victoria, the fire brigade is also dispatched.
4. Meanwhile, the GoodSAM Responder can provide CPR and, if possible, make use of the nearest available defibrillator.

Anyone who wants to save lives can now register with GoodSAM

Become a GoodSAM Responder by registering at ambulance.vic.gov.au/goodsam/ today.

Our aim is to have one registered GoodSAM responder for every 250 Victorian residents by mid-2020.



High-performance cardiopulmonary resuscitation (HP CPR)

The quality of CPR is significantly associated with OHCA survival. High-performance CPR (HP CPR) uses targeted metrics that are known to increase survival. The main components of high-performance CPR are quality external chest compressions (ECC): high chest compression fraction, targeted chest compression rate and depth, allowing full chest recoil, and avoidance of over-ventilation. HP CPR ties together quality ECC with a well-practised choreography (the “pit-crew” approach) aimed to minimise interruptions to resuscitation. In February 2019, AV transitioned to an HP CPR model with training provided to all First Responders, ALS and MICA paramedics. State-wide, EMR partners were also trained in an integration model of HP CPR.

Recommendations for optimal chest compressions include a target depth of ≥ 5 cm for adults and a rate of 100-120 compressions per minute. To maximise perfusion, guidelines

for CPR and ECC recommend minimising pauses in chest compressions. Lower chest compression fraction (CCF; i.e. longer pauses and lower proportion of time with CPR being performed) during resuscitation is associated with decreased likelihood of ROSC and survival. Interruptions in ECC result in a fall in coronary perfusion pressure, and an associated decrease in the likelihood of successful defibrillation. It has been previously demonstrated that the odds of survival to hospital discharge decline by 7%-18% for every consistent five-second increase in pre-shock CPR interruptions.

Since the introduction of HP CPR into AV clinical practice in February 2019, a significant increase in all metrics optimising chest compression rate, depth and CCF, has been demonstrated in Victoria. In addition, significant changes in pre and post-shock pauses have been demonstrated.



Time to first defibrillation

The time from emergency call to first defibrillation for patients presenting in a shockable rhythm is a key measure for EMS. Timely response by first responder teams and early intervention by bystanders remains a key factor driving favourable outcomes for patients with a shockable rhythm in Victoria (Lijovic 2014).

The proportion of cases where AV performed the first defibrillation has reduced significantly between 2009-2010 and 2018-2019, from 87% to 74% ($p<0.001$). This decline has been driven by an over three-fold increase in the use of public automated external defibrillators (AED) by bystanders over the same period (5% to 16%, $p<0.001$) and the expansion of EMR over the decade. This year, we have seen the highest ever proportion of arrests defibrillated by public AEDs (16%) prior to EMS arrival. The proportion of cases first defibrillated by first responders during 2018-2019 was 10% (the same as in 2017-2018).

The time to first defibrillation by EMS is recorded for EMS treated patients whose rhythm is shockable on EMS arrival. In 2018-2019, the state-wide time to defibrillation of 9.8 minutes (90th percentile time 16.4 minutes) was the same as for the previous year (median time 9.8 minutes; 90th percentile time 16.1 minutes; $p=0.77$). The median time to defibrillation in the metropolitan region in 2018-2019 was 9.3 minutes (90th percentile time 14.6 minutes), slightly faster than for the previous year (median time 9.5 minutes; 90th percentile time 14.5 minutes; $p=0.83$). In the rural region in 2018-2019, median time to defibrillation was 10.5 minutes (90th percentile time 19.4 minutes), again slightly faster than for the previous year (median time 10.9 minutes; 90th percentile time 21.0 minutes; $p=0.60$).

Time to defibrillation for patients in a shockable rhythm correlates closely with EMS response time as well as the availability of public defibrillators (see [Emergency response to the incident](#), page 30).

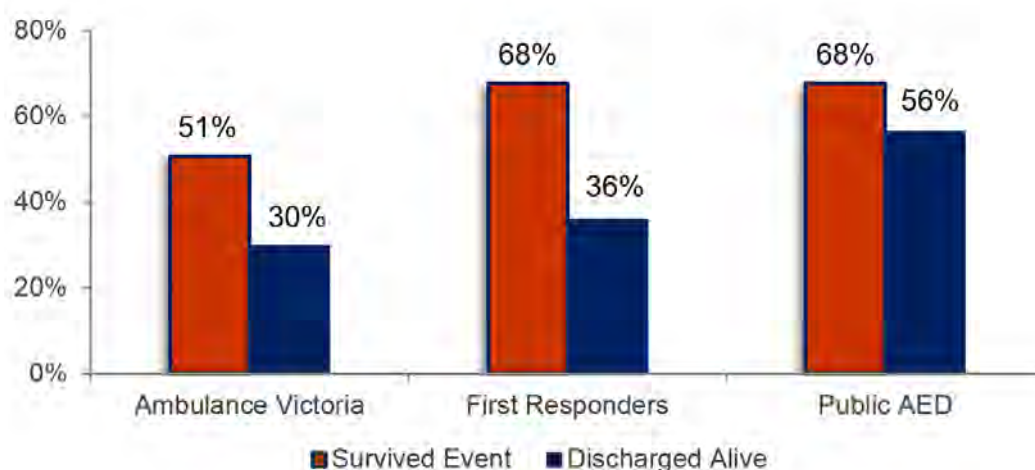


Figure 14: Unadjusted survival outcome according to who shocked first in the EMS treated population with a shockable rhythm on or before EMS arrival, 2018-2019.

It is widely accepted that reducing delays to defibrillation leads to better outcomes for patients in a shockable rhythm. Unadjusted survival outcomes for patients presenting in a shockable rhythm on or before EMS arrival vary according to who performed the first defibrillation (see [Figure 14](#)). It should be noted that some fluctuations in survival proportions may be observed over time due to small samples sizes.

The proportion of OHCA patients surviving the event when first defibrillated with a public AED was 68%, compared with 68% of patients first shocked by first responders and 51% of patients first shocked by paramedics. The 2018-2019 event survival rates were significantly higher if a public AED was used compared to when patients were shocked first by paramedics ($p<0.001$).

Survival to hospital discharge in 2018-2019 was significantly different according to who provided the first defibrillation. The proportion of patients surviving to hospital discharge when first defibrillated with a public AED was 56%, compared with 36% of patients first shocked by first responders and 30% of patients first shocked by paramedics. The 2018-2019 survival to hospital discharge rates were significantly higher if a public AED was used compared with patients shocked by paramedics ($p<0.001$). The small sample size of these groups can result in yearly fluctuations in the survival rate.

A discharged alive rate of 56% for OHCA patients defibrillated with a public AED during 2018-2019 illustrates how early intervention, especially the application of an AED for OHCA patients in a shockable rhythm, has an obvious and positive impact on survival outcomes.





early access



early cpr



early defibrillation



early advanced care

Impact of bystanders on OHCA

Bystanders play an important role in improving OHCA survival. Three of the four steps of the OHCA chain of survival can be carried out by bystanders. Typically, bystanders are the first on scene and make the emergency call (early access). With the help of the call-taker, or if skilled through prior CPR training, bystanders can start CPR prior to the arrival of EMS. If an AED is located near the location of the arrest, bystanders have the opportunity to provide vital defibrillation prior to the arrival of EMS. OHCA events witnessed to occur by a bystander have more positive survival outcomes.

Table 5: Number and proportion of patients receiving bystander CPR or defibrillation and unadjusted survival, for all and bystander witnessed events, 2018-2019.

| | All OHCA | Bystander witnessed |
|---------------------------|--------------------|---------------------|
| Total events | 6,519 [^] | 1,690 |
| - Bystander CPR | 2,332 (36%) | 1,049 (62%) |
| - Bystander AED use | 108 (2%) | 97 (6%) |
| - Shockable rhythm | 693 (11%) | 520 (31%) |
| EMS treated events | 2,545 | 1,249 |
| - Survived event | 733 (29%) | 492 (39%) |
| - Discharged alive | 286 (11%) | 230 (18%) |

[^]Total OHCA events includes EMS witnessed events; all other data in the table exclude EMS witnessed events.

Table 5 provides an overview of the impact of bystanders during 2018-2019. Bystander CPR rates were higher amongst OHCA patients witnessed to arrest by a bystander, compared with all OHCA patients (62% vs. 36%, respectively).

In addition, unadjusted likelihood of an OHCA patient presenting in a shockable rhythm in 2018-2019 was eleven times higher for patients receiving bystander CPR than those not receiving bystander CPR (excluding EMS witnessed events).

The proportion of patients presenting in a shockable rhythm was higher amongst those who were witnessed to arrest by a bystander as compared to all OHCA patients combined (31% vs 11%, respectively). When an arrest was witnessed by a bystander, the proportion of patients who survived the event was higher than for all OHCA patients combined (39% vs. 29%, respectively). Similarly, when an arrest was witnessed by a bystander, the proportion of patients who were discharged alive was higher than for all OHCA events combined (18% vs. 11%, respectively).



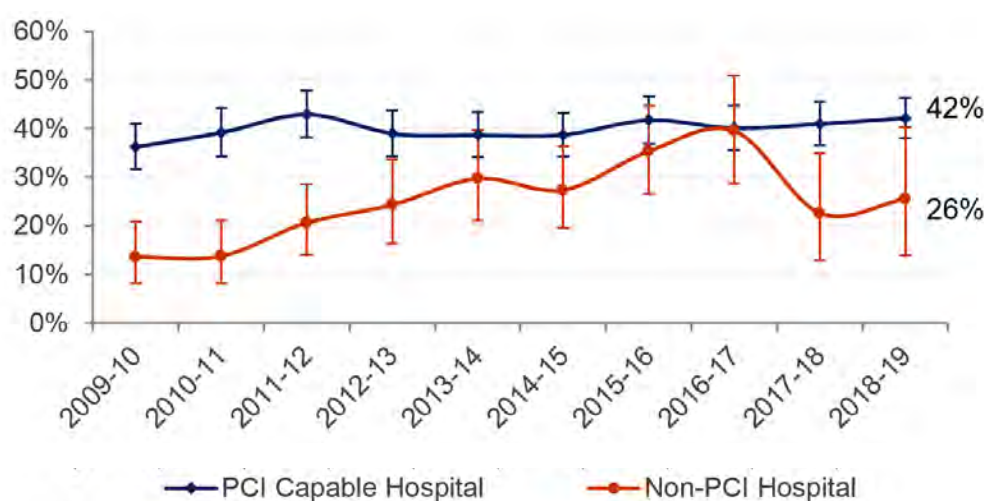
Transport to a cardiac centre

Previous VACAR research demonstrates that transport of OHCA patients to a percutaneous coronary intervention (PCI)-capable hospital is associated with improved survival to hospital discharge (Stub 2011).

State-wide during 2018-2019, 92% of EMS treated arrests due to a presumed cardiac cause were transported to a PCI-capable hospital. Within the metropolitan region during 2018-2019, 97% of arrests due to a presumed cardiac cause were transported to a PCI-capable hospital. This is the equal highest rate (with the 2017-2018 year) of transportation to PCI-hospital in the last 10 years.

Within the rural region during 2018-2019, 77% of arrests due to a presumed cardiac cause were transported to a PCI-capable hospital. This represents the highest rate of transportation to PCI-capable hospitals in the rural region in the last 10 years (77% vs 30% in 2009-2010). Rates of transportation to PCI-capable hospitals in rural regions vary due to the location of arrest. Patients are predominantly transported to University Hospital Geelong and Ballarat Hospital, two PCI-capable hospitals.

In 2018-2019, 42% of OHCA patients transported to PCI-capable hospitals survived to hospital discharge (unadjusted survival, see Figure 15). Of OHCA patients transported to hospitals without PCI capability during 2018-2019, 26% were discharged alive. This is a slight improvement compared to the previous year (23%) and a significant improvement compared to 10 years ago (14%). It is likely that hospital-based factors contribute to the variation in outcomes observed across hospitals, including optimal post-arrest treatment strategies.



‡ Data in the graph refers to Victorian hospitals with a current process to receive AV emergency patients via a pre-notification system, have full-time PCI-interventional capabilities and was the first hospital that the OHCA patient was transported to. Error bars show the 95% confidence interval around the proportion.

Figure 15: Unadjusted survival to hospital discharge for adult presumed cardiac EMS treated events according to transport to a PCI-capable hospital.



Survival Outcomes

Scene outcomes in adults

Successful attempts at resuscitation following OHCA are often evaluated by the attainment of return of spontaneous circulation (ROSC) in the field and transportation of patients to hospital.

During 2018-2019, the achievement of ROSC was highest amongst adult OHCA patients who arrested in the presence of EMS (56%). Bystander witnessed arrests attained higher rates of ROSC than unwitnessed arrests in 2018-2019 (47% vs. 22%, respectively).

Across the entire state in 2018-2019, ROSC was achieved in 38% of all adult EMS treated events (includes EMS witnessed arrests); slightly higher than the previous year (37% in 2017-2018). During 2018-2019, ROSC was achieved in 39% of OHCA events in the metropolitan region (higher than the previous year of 38%) and 37% of OHCA events in the rural region (in the previous year, this was 34%); includes EMS witnessed arrests. There was no significant difference in ROSC outcomes observed in the metropolitan region compared to the rural region (39% vs. 37%, $p=0.207$).

Over time, there has been an increase in the proportion of OHCA events where resuscitation efforts were ceased at scene, accompanied by a reduction in transportation with ongoing resuscitation efforts (see **Figure 16**). In 2018-2019, the proportion of adult EMS treated events which were transported from the scene with ROSC was 29%; higher than in previous years. Efforts were ceased at scene for 69% of adult EMS treated events and the rate of transportation with CPR was low (2%).

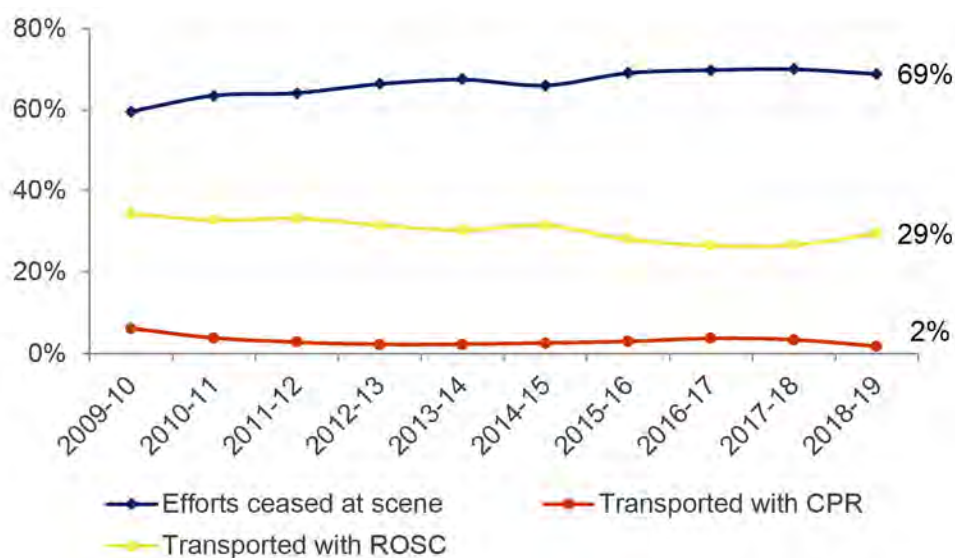


Figure 16: Scene outcomes for adult EMS treated events.

Previous VACAR research has shown that the majority of OHCA patients with an initial shockable rhythm who do not achieve sustained ROSC in the field are declared deceased rather than being transported to hospital (Stub 2014). There are several reasons for the low rate of transport with ongoing CPR. Firstly, the transportation of a patient with ongoing CPR is potentially hazardous to the EMS crews. Secondly, if advanced life support measures have been provided by paramedics at the scene for >30 minutes and the patient remains in a non-shockable rhythm, there are typically no additional treatment options at hospital. However, Ambulance Victoria are planning on trialling innovative treatments for these patients to increase the treatment options for patients in a shockable rhythm who don't respond to paramedic treatment in the field.

Adult survival from all-cause cardiac arrest

Unadjusted adult survival from all-cause OHCA has remained steady over the past 10 years. In 2018-2019, the rate of event survival for adult EMS treated events was 29% and discharged alive rate was 12% (see Figure 17). The rate of event survival has declined slightly since 2009-2010, however survival to hospital discharge was consistent with recent observations.

In the metropolitan region during 2018-2019, event survival was 29% and discharged alive rate was 12%. In the rural region during 2018-2019, event survival was 28% and discharged alive rate was 11%.

In 2018-2019, 27% of the overall adult EMS treated patient population presented to EMS or bystanders in a shockable rhythm. The proportion of adults presenting in a shockable rhythm has decreased slowly over the last 10 years (32% in 2009-2010; 32% vs. 27%, $p=0.001$; see Figure 18). Despite this, the rate of patients surviving to hospital discharge has not significantly decreased over the past decade (11% in 2009-2010 vs. 12% in 2018-2019, $p=0.703$) (see Figure 17).

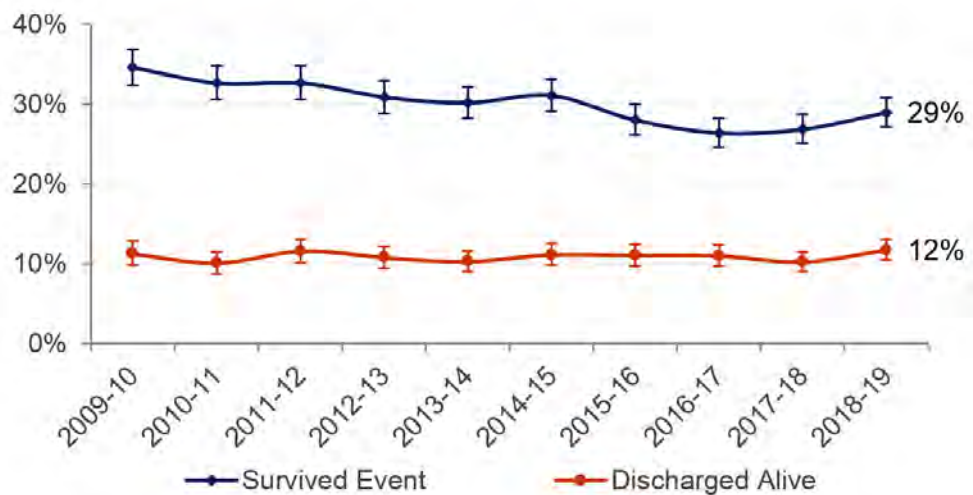


Figure 17: Unadjusted survival outcomes for all-cause adult EMS treated events.

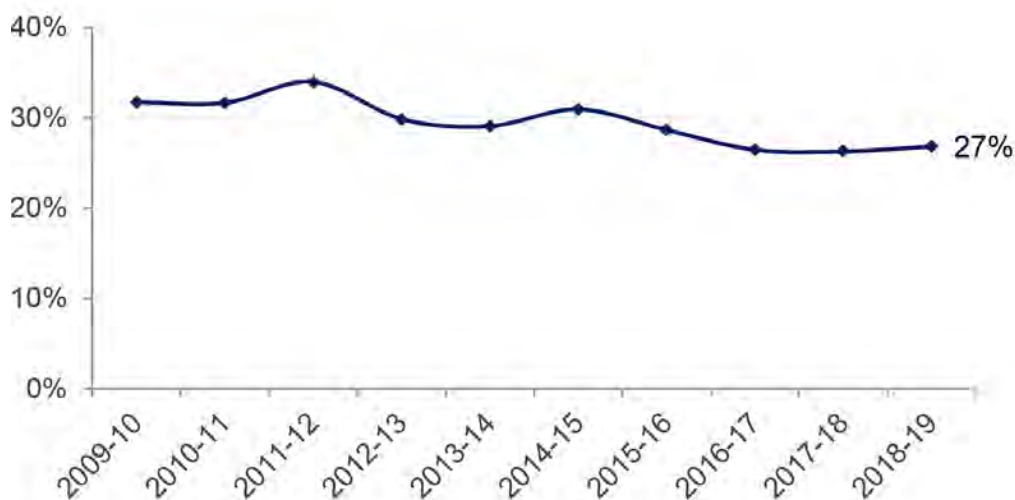


Figure 18: Proportion of adult EMS treated events presenting in a shockable rhythm on arrival.



Adult and all-ages survival from shockable rhythms

Survival outcomes for patients presenting to EMS or bystanders in a shockable rhythm are consistently better than patients presenting in pulseless electrical activity (PEA) or asystole. A shockable rhythm is a strong predictor of OHCA survival (Fridman 2007).

For patients of all ages found in a shockable rhythm during 2018-2019, the rate of event survival was 54% (in 2017-2018, this was 53%) and the discharged alive rate was 34% (see Figure 19).

In comparison to adult patients presenting in a shockable rhythm during 2018-2019, 9% of adult patients who presented in PEA were discharged alive (in the previous year, this was 7%). Few adults presenting in asystole (0.3%) were discharged alive (in the previous year, this was 0.2%).

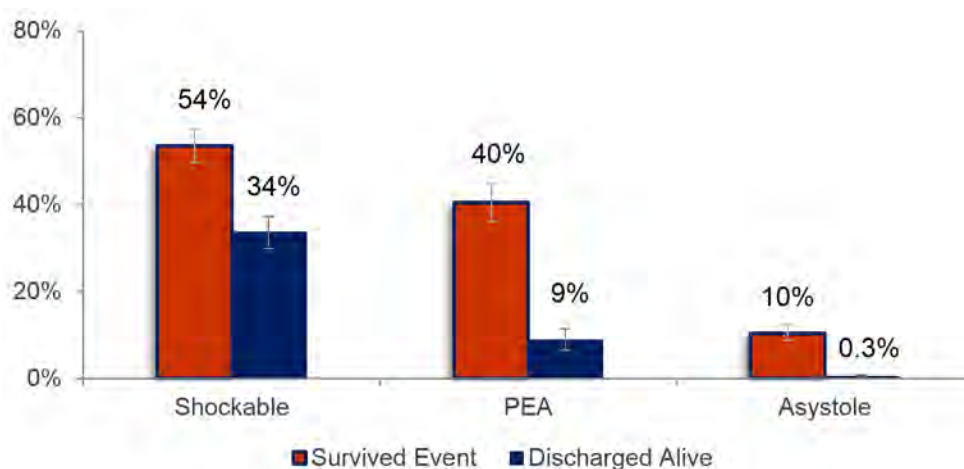


Figure 19: Unadjusted survival outcomes for adult EMS treated events according to presenting rhythm on arrival, 2018-2019.

Outcomes for patients with shockable rhythms have improved slightly over time (see Figure 20). In 2018-2019, adult event survival for patients presenting in a shockable rhythm was 54%. The rate of adult survival to hospital discharge was 34%. This is slightly higher than the adult survival to hospital discharge in shockable patients in 2017-2018 (34% vs. 32%, respectively).

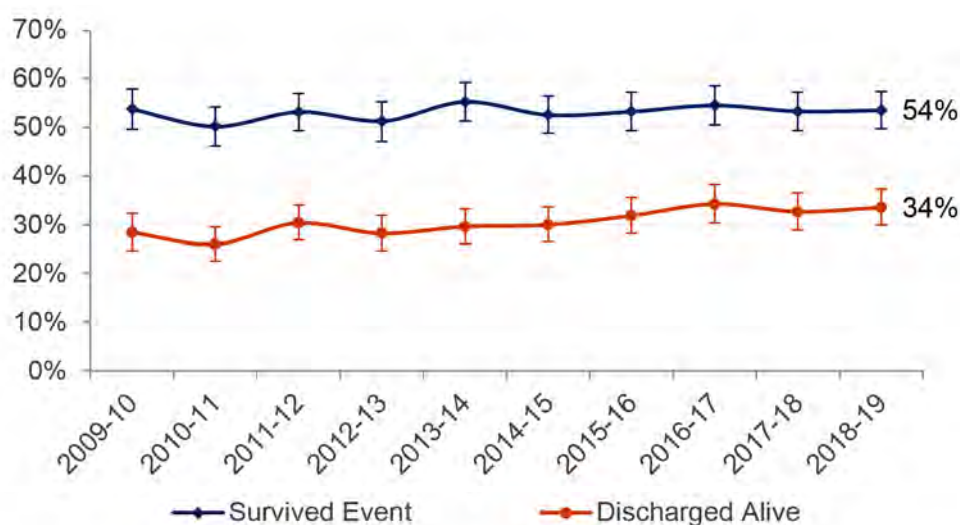


Figure 20: Unadjusted survival outcomes for adult EMS treated events with a shockable rhythm on arrival.

Adult survival from EMS witnessed arrests

In 2018-2019, for adult EMS witnessed events presenting in a shockable rhythm, the rate of event survival was 79% and the rate of survival to hospital discharge was 66% (see Figure 21). These findings are consistent with recent observations. When considering all adult EMS witnessed events during 2018-2019, the rate of event survival was 48% (in the previous year, this was 46%) and the discharged alive rate was 26%, equal to the discharged alive rate for 2017-2018.

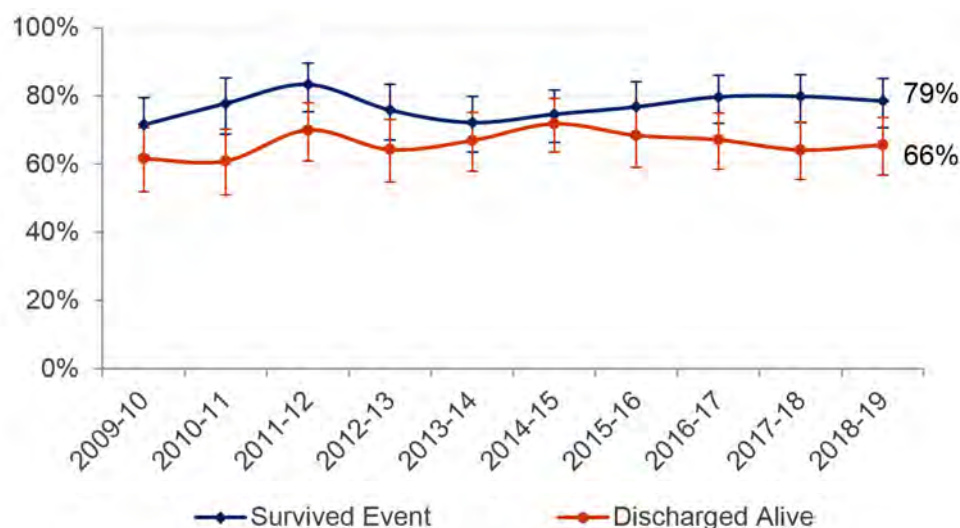


Figure 21: Unadjusted survival outcomes for adult EMS witnessed, EMS treated events with a shockable arrest rhythm.

Paediatric survival from all-cause cardiac arrest

Annual incidence of paediatric OHCA is low, with survival factors and outcomes differing from adults. Notably, paediatric cases rarely present in a shockable rhythm. In 2018-2019, 9% of EMS treated paediatric cases presented in a shockable rhythm (5% in the previous year). Asystole was the most common presenting rhythm (68%).

In 2018-2019, 25% of paediatric EMS treated patients survived the event (24% in the previous year). During 2018-2019, there were seven paediatric patients (11%) who were discharged alive (7% in the previous year), relatively consistent over the last 10 years.

There were five EMS witnessed paediatric events in 2018-2019. Two patients (40%) survived the event and one (20%) was discharged alive.



Survival per million population

As shown in Figure 22, in 2018-2019, there were 65 OHCA survivors per million population. This is the highest number of survivors per million population ever recorded. In 2018-2019, the survivors per million population for the Utstein group (30 survivors per million), cases with an initial rhythm of VF/VT (49 survivors per million), and OHCA that were witnessed by EMS (20 survivors per million) were consistent with recent observations.

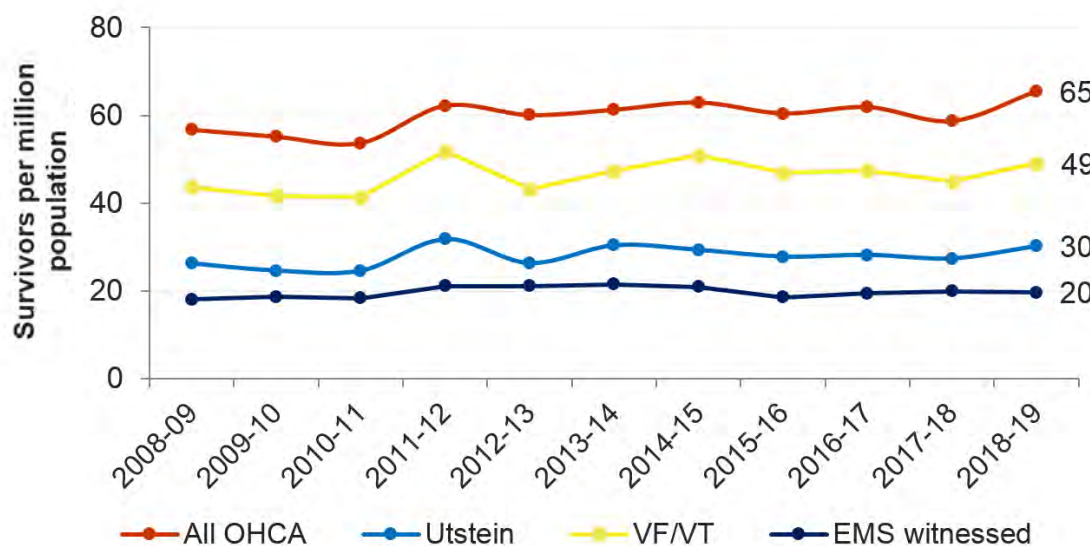


Figure 22: Survival per million population for all OHCA (red), the Utstein patient group (light blue), patients initially in VF/VT (yellow) and EMS witnessed arrests (navy blue).

Utstein patient group survival

The Utstein template is part of a set of guidelines which was developed to promote uniform presentation of OHCA survival data across different regions of the world (Perkins 2015). These guidelines define key data fields to ensure consistency in terminology and makes recommendations as to core and supplementary data to be recorded for each OHCA event.

OHCA patients who are witnessed to arrest and present in a shockable rhythm are the most likely subgroup to survive an arrest. Data presented using the Utstein template focuses on survival within the following patient subgroup: OHCA events where EMS attempted resuscitation, where the arrest was witnessed by a bystander and the presenting cardiac rhythm was shockable (VF or VT).

Figure 23 shows the total number of OHCA events in 2018-2019 and progressively shows the breakdown of events according to EMS attempted resuscitation, precipitating event, witnessed status and presenting rhythm.

In 2018-2019, the state-wide rate of survival to hospital discharge for the Utstein patient subgroup presenting in a shockable rhythm was 39%, the highest survival ever recorded. In the previous year, the state-wide rate of being discharged alive within the Utstein patient subgroup was 38%.

Within the metropolitan and rural regions, the rates of being discharged alive within the Utstein patient subgroup was 42% and 32%, respectively. In the previous year, these rates in the metropolitan and rural regions were 42% and 27%, respectively.

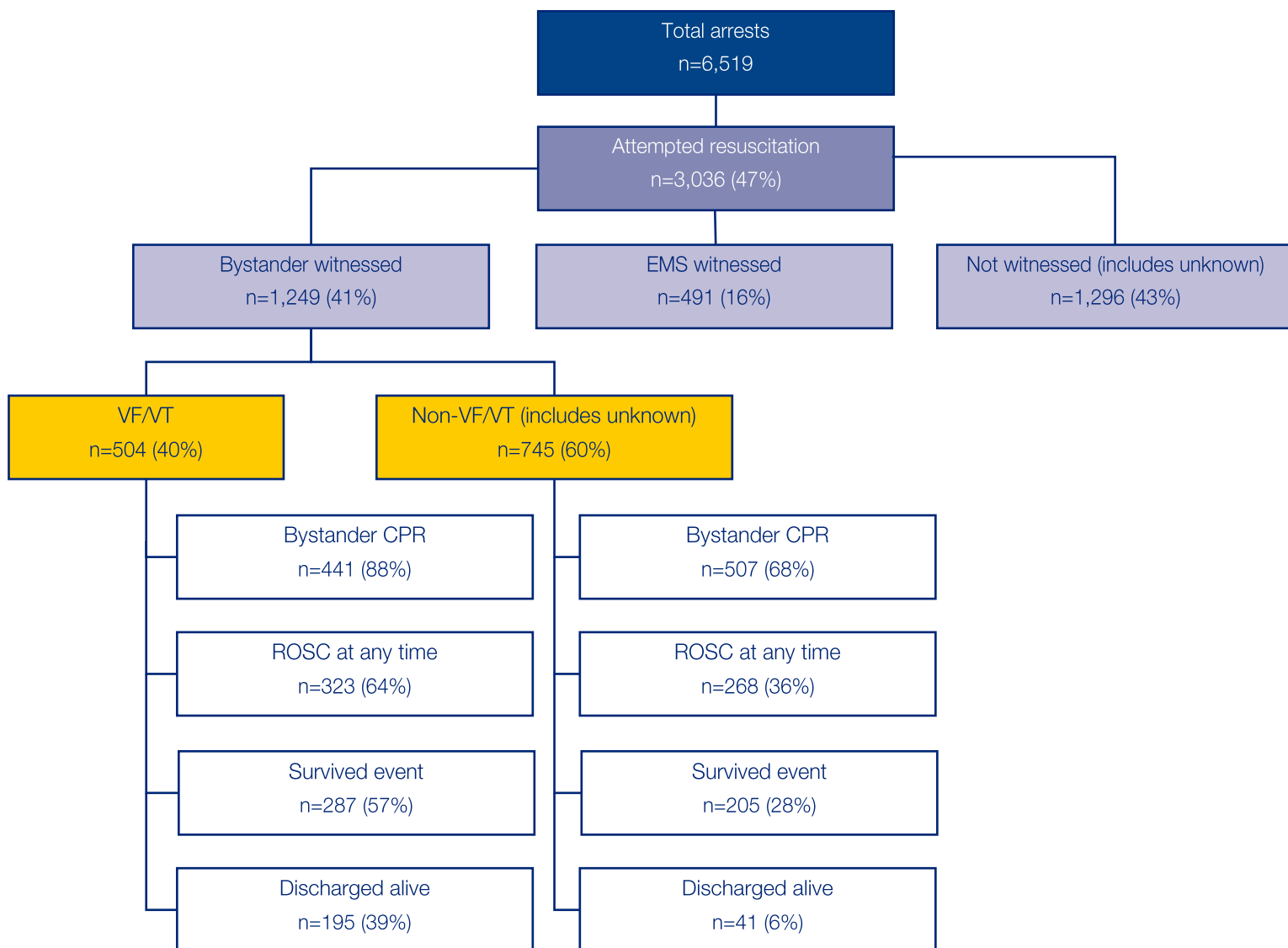


Figure 23: Survival outcomes for the Utstein patient group, 2018-2019 (comparing shockable rhythm (VF/VT) on arrival of EMS/bystanders to non-shockable (non-VF/VT) rhythm on arrival).



Utstein patient group survival in Victoria compared to international data

Table 6 compares survival to hospital discharge for the Utstein patient group in Victoria to other international data for this patient subgroup, a useful benchmarking patient group.

It should be noted that there are discrepancies in the definition of the Utstein patient subgroup by different international ambulance services, making comparison of survival rates difficult. In addition, different ambulance services follow different guidelines for when to start and/or stop resuscitation, which further complicates comparison of resuscitation outcomes data. It is also not possible to accurately know the extent to which some international organisations omit cases from their analyses of patient outcome data (eg. omitting cases with short, yet futile resuscitation attempts), as suggested by anecdotal evidence.

The Utstein patient subgroup definition used by AV no longer specifically selects patients where the arrest was due to a presumed cardiac cause. Instead, the AV Utstein patient group definition includes arrests due to any causes, as per the most recent recommendations for reporting of the Utstein comparator group (Perkins 2015). As evident in Table 6, some groups still focus on the presumed cardiac patient subgroup and some exclude patients arresting due to a traumatic cause.

Victorian OHCA patients experience a discharged alive rate for the Utstein patient subgroup (39%) which is comparable to a number of other ambulance services or other large collaborative studies/registries around the world. Some caveats should be noted, however, when comparing the Victorian Utstein group survival to other ambulance agencies, including markedly different service areas and population statistics.

Survival for metropolitan Melbourne was 42% in 2018-2019, an increase on the previous year. For the Australian Bureau of Statistics (ABS) Statistical Area Level 4 Inner Melbourne (comprising Melbourne—Inner, Melbourne—Inner East and Melbourne—Inner South and a population of over 1.5 million in total), Utstein survival was 56%. This Utstein survival rate matches that of Seattle/King County (population 2.2 million). Given these survival statistics, Victoria is one of the safest places in the world to have a cardiac arrest.

Table 6: Published Victorian and international OHCA survival to hospital discharge data for the Utstein patient group.

| Organisation | Time period | % survival |
|---|-------------|------------|
| Ambulance Victoria | | 39% |
| - Metropolitan Melbourne | 2018-2019 | 42% |
| - Inner Melbourne* | | 56% |
| CARES (Cardiac Arrest Registry to Enhance Survival) 2018 Annual Report^^ | 2018 | 33% |
| Seattle/King County EMS (Seattle & King County EMS 2019 Annual Report)^ | 2018 | 56% |
| St John Western Australia (St John Ambulance WA, 2019) | 2018 | 38% |
| Out-of-Hospital Cardiac Arrest Register (OHCAR) Ireland^^ | 2018 | 30% |
| London Ambulance Service (London Ambulance Service 2018)^ | 2017-2018 | 32% |
| St John New Zealand (Dicker, Oliver and Tunnage, 2018)^^^ | 2017-2018 | 32% |
| NSW Ambulance Cardiac Arrest Registry | 2017 | 30% |
| EuReCa ONE (27 European country OHCA registries, Grasner 2016) | 2014 | 30% |
| Pan Asian Resuscitation Outcomes Study, PAROS (7 Asian EMS services; Ong 2015)^ | 2009-2012 | 28% |

*ABS Statistical Area 4 (SA4 which is made up of regions with populations in the range 100,000—500,000) Inner Melbourne which includes Melbourne—Inner, Melbourne—Inner East and Melbourne Inner South.

^Only includes patients arresting due to a presumed cardiac cause.

^^ Excludes patients arresting due to a traumatic cause.

^^^Survival to 30 days.

Yearly risk-adjusted odds of adult survival

The risk-adjusted odds of survival outcome provide a balanced method of measuring yearly trends in resuscitation performance and outcome. In the analyses presented in **Figures 24 and 25**, the odds of survival to hospital discharge for the adult EMS treated population is evaluated across years using a multivariate model adjusted for known predictors of survival. These predictors include: age, sex, public location, presenting in shockable rhythm[^], bystander witnessed status and bystander CPR.

The 2003-2004 year is used as the reference category. **Table 7** outlines the start dates of a number of important AV programs and initiatives since the initiation of the VACAR, in 1999, up to the current fiscal year. Some of these initiatives are likely to have driven improvements in patient outcomes outlined in this report.

The analysis represented in **Figure 24** demonstrates strong growth in the survival to hospital discharge outcomes over recent years. In 2018-2019, the relative odds of survival to hospital discharge for adult EMS treated patients had increased 2.5-fold compared to patient outcomes in 2003-2004 (adjusted odds ratio 2.6, 95% CI 2.0-3.3, $p < 0.001$).

Similarly, over time there has been vast improvements in the odds of survival to hospital discharge for patients presenting in a shockable rhythm (see **Figure 25**). In 2018-2019, the relative odds of being discharged alive had increased almost three-fold for adult EMS treated patients presenting in a shockable rhythm compared to patient outcomes in 2003-2004 (adjusted odds ratio 2.8, 95% CI 2.1-3.7, $p < 0.001$).

Of note, there was a slight decline in the odds ratios for 2017/2018 relative to the previous year (2016/2017). This is not statistically significant and is predominantly due to the high mortality seen during winter 2017.

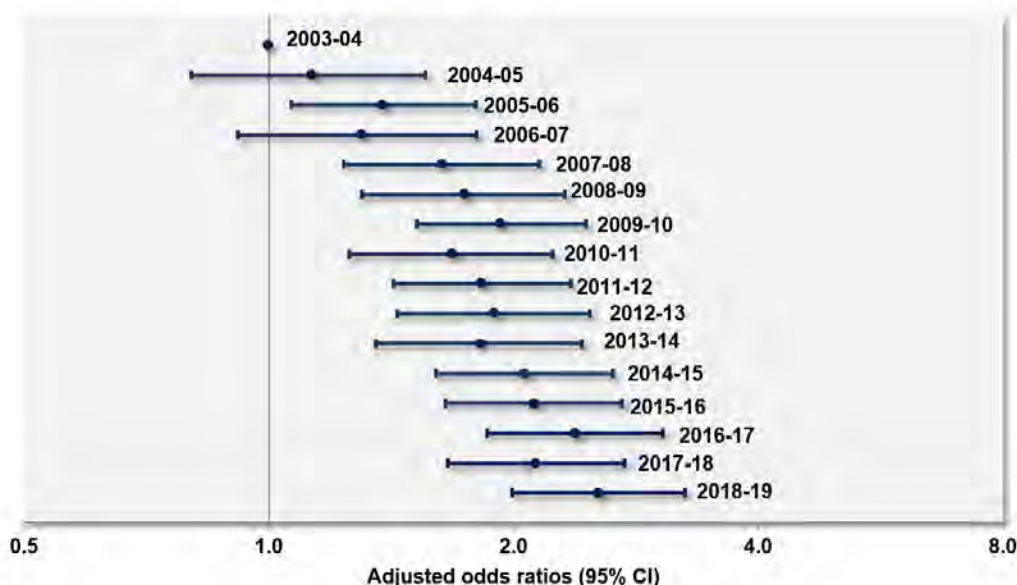


Figure 24: Risk-adjusted odds of adult survival to hospital discharge by year in the overall EMS treated population.

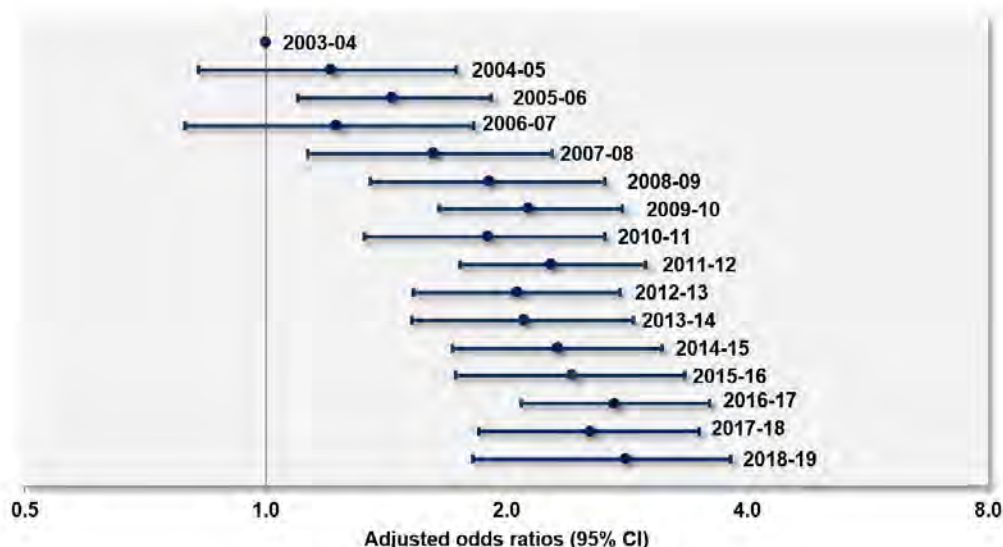


Figure 25: Risk-adjusted odds of survival to hospital discharge for adults presenting in a shockable rhythm by year in the overall EMS treated population. (For this analysis, only patients presenting in a shockable rhythm were included. As such, the “shockable rhythm” factor was removed from the regression model)



Improving survival from out-of-hospital cardiac arrest

Ambulance Victoria is part of the Global Resuscitation Alliance (GRA) which is an international collaboration aiming to increase OHCA survival rates by at least 50%. The GRA promotes ten programs based on recent evidence and best practice in OHCA management that are designed to provide the framework for EMS systems to improve OHCA survival in their community (Figure 26).

In the last year, AV has been working to implement programs or improve upon existing programs in an effort to increase cardiac arrest survival rates in Victoria.

Ten Steps to Improve Cardiac Arrest Survival

1. Establish a cardiac arrest registry
2. Begin telephone-CPR with ongoing training and QI
3. Begin high-performance EMS CPR with ongoing training and QI
4. Begin rapid dispatch
5. Measure professional resuscitation using the defibrillator recording (and voice if possible)
6. Begin an AED program for first responders, including police officers, guards, and other security personnel
7. Use smart technologies to extend CPR and public access defibrillation programs to notify volunteer bystanders who can respond to nearby arrest to provide early CPR and defibrillation
8. Make CPR and AED training mandatory in schools and the community
9. Work toward accountability—submit annual reports to the community
10. Work toward a culture of excellence

Figure 26: Global Resuscitation Alliance – 10 Programs to Improve Cardiac Arrest Survival .

Programs 1 & 9: Establish a Cardiac Arrest Registry and submit Annual Reports to the community

Ambulance Victoria was the first Australian service to establish a statewide Cardiac Arrest Registry. VACAR is also the only registry in Australia and New Zealand which collects quality of life data on survivors. In addition, VACAR was the first cardiac arrest registry in Australia and New Zealand to produce an Annual report that is publicly available to the community. We will continue to expand VACAR data collection and reporting to actively evaluate new initiatives as they are implemented.

Programs 2 & 4: Telephone CPR and rapid dispatch with ongoing quality improvement

AV and the Emergency Services Telephone Authority (ESTA) have been working closely to improve systems of care to decrease call-taker time to recognition of OHCA and increase the incidence of bystander CPR and AED use at the scene.

Program 3: High-Performance CPR with ongoing training and quality improvement

AV paramedics commenced high-performance CPR (HP-CPR) training in late 2018 and it became standard practice service-wide on 11 February 2019. HP CPR reduces periods of hands-off-chest time during the resuscitation attempt and affords the patient a greater chance of achieving a return of spontaneous circulation (ROSC), surviving to hospital and surviving to hospital discharge with good neurological outcomes.

Program 5: Measure resuscitation efforts

Data from feedback pads used during the resuscitation, combined with call-taking and dispatch data, VACIS data and hospital data enables AV to accurately measure CPR performance during resuscitation efforts. These data are used to guide feedback and debriefing for responders with the aim to improve individual, team and organisation performance at management of OHCA.

Program 6: AED programs for first responders

AV has a well-established AED program for first responders including Community Emergency Response Teams (CERTs), Ambulance Community Officers (ACOs) and Remote Area Nurses (RANs). AV also has a successful co-responder program with the Metropolitan Fire Brigade (MFB) and the Country Fire Authority (CFA) through the Emergency Medical Response (EMR) program. The MFB and participating CFA crews are co-responded to suspected cardiac arrests and commence life-saving CPR and rapid defibrillation prior to AV arrival. EMR crews then assist with continuing efforts at the resuscitation where required. The EMR program continues to expand to CFA stations and since it commenced in 2008, has now expanded to include 30 volunteer and integrated CFA stations across Victoria with plans for further rollout over the next 12 months.

Program 7: Use technology to improve community response

AV have introduced the GoodSAM program to alert suitably qualified responders to cases of cardiac arrest and there are now numerous cases of off-duty paramedics providing early CPR and defibrillation with positive patient outcomes. The GoodSAM app connects people in cardiac arrest with nearby trained and trusted responders in the critical minutes between a Triple Zero (000) call and emergency services arriving. GoodSAM commenced at AV in January 2018, and was launched publicly in May 2018. The partnership with GoodSAM has also aided AV in maintaining a registry of publicly accessible AEDs that bystanders can be directed to when responding to an OHCA.



Long-term Outcomes

Discharge direction for all survivors

When considering all adult OHCA survivors, 89% were discharged home (including EMS witnessed events and excluding unknown discharge status; see Figure 27). Discharge home for adult survivors has remained consistent over the last decade. In 2018-2019, remaining adult survivors were discharged to rehabilitation (10%) and nursing homes (1%). If a patient resided in a nursing home and was discharged to a nursing home, this was considered 'home'. For adult OHCA survivors who presented in a shockable rhythm, 92% were discharged home.

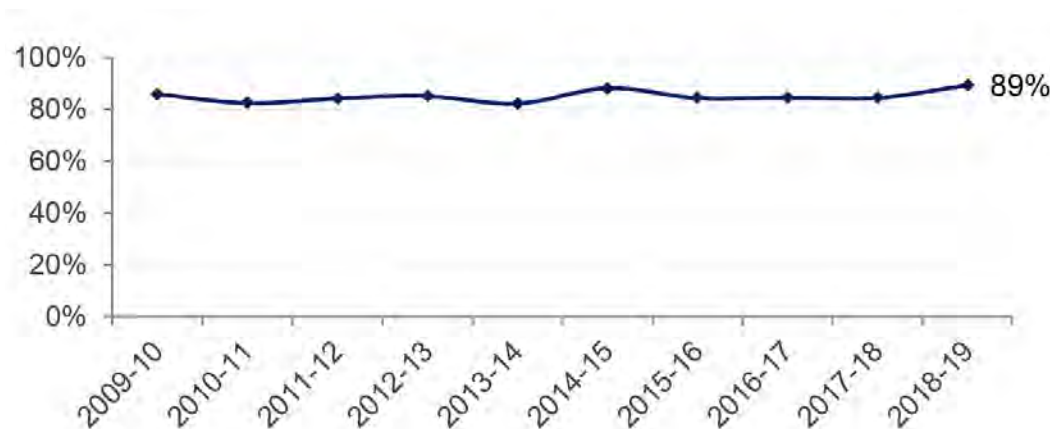


Figure 27: Proportion of adult discharged alive patients who are discharged to private residence (includes EMS witnessed events).

Supporting survivors with life post-arrest

With increasing survival from OHCA comes increasing numbers of survivors. With current models of post-arrest care typically ending when a patient is discharged from hospital following the event, there is a large unmet need for survivor support, particularly as survivors may be at higher risk of suffering from mental illness and cognitive impairment as a result of their arrest. AV has committed to addressing this “missing link” in the Chain of Survival by investigating feasible and effective methods of support.

In September 2019, “Sudden Cardiac Arrest Australia” (SCAA) was formed to provide peer support to OHCA survivors and their families. Professor Karen Smith was elected President of this Australian-first, not-for-profit group and co-ordinates the group’s activities alongside cardiac arrest survivor, Jeff Waters, and researchers from Monash University.

Social media channels (Facebook, Twitter) are used to communicate to survivors, initiate conversations, and provide connection of survivors and family members with each other. An open-facing Facebook page provides general information about cardiac arrest, while a closed group for survivors only provides a forum for discussion and facilitates the sharing of personal experiences and what life has been like since suffering a cardiac arrest. Twitter provides a platform for sharing of research findings and news items related to cardiac arrest. Improving awareness of OHCA within the community is also a key objective of SCAA.

A website is also being established which will contain a wealth of resources for survivors and their families in addition to family and friends of those who did not survive.



Assessing quality of life post arrest

Since January 2010, adult OHCA patients (aged ≥ 18 years) who were discharged alive have undergone health-related quality of life (HRQoL) interviews via telephone follow-up 12-months after their arrest. The Victorian Registry of Births, Deaths and Marriages is initially searched for death information. Patients identified as alive at 12-months are sent a letter indicating they will receive a telephone call regarding their health and requesting verification of current contact information. Patients are then contacted by a dedicated researcher experienced in undertaking these interviews. Where necessary, a proxy is interviewed in place of the patient (if appropriate for the tool being used). At least five attempts are made to contact patients at different time points, including after hours. Interviews are performed from a central location.

Interviews include the following measures:

The EuroQol 5 dimension (EQ-5D) questionnaire (Rabin 2001). The EQ-5D is validated to measure HRQoL. The tool assesses five domains: mobility, self-care, usual activities, pain/discomfort, anxiety/depression. EQ-5D health status can be converted to a single index score by weighting each of the dimensions against United Kingdom (UK) norms; scores range from -0.594 (worse than death) to 1 (full health) (Szende 2007).

Twelve-item short form (SF-12) health survey (Ware 1996). The SF-12 is a generic HRQoL instrument that measures physical and mental health status; only patients provide data. SF-12 scores consist of the Physical Health Component Summary (PCS) and Mental Health Component Summary (MCS). Standardised mean difference (SMD) was used to show the degree of deviation of a score from the population norm. SMD is calculated by subtracting the mean score of the corresponding Australian age and sex category from the OHCA respondent's score and dividing by the standard deviation of the appropriate age/sex category (McGough et al. 2009). The size of the SMD represents the magnitude of the difference between population groups, with values >0.8 considered large.

Glasgow Outcome Scale – Extended (GOS-E) (Wilson 1998). The GOS-E provides a global measure of function on an eight level scale from death (1) to upper good recovery (8). Scores ≥ 7 equate to good recovery.

Work related factors. Return to work is recorded, with additional questions regarding same employer and/or same role if the patient has returned to work.

Living status factors. Residential status of the patient at the time of interview is recorded. If the patient has returned home, they are asked about use of additional support services.

The VACAR is still one of only a few registries in the world that routinely collect health-related quality-of-life outcomes for cardiac arrest patients. VACAR contains one of the largest cohorts of OHCA quality-of-life outcomes.



Quality of life findings

Of 365 individuals who arrested between 1 July 2017 and 30 June 2018 and were discharged alive from hospital, 335 patients were alive 12-months post-arrest and were eligible for contact in 2018-2019. Interviews were conducted with 230 patients and 53 proxies (n=283), producing a response rate of 84%. There were 153 individuals who had worked prior to their arrest; 74% of individuals (113 of 153) returned to work after their arrest. Of those returning to work, 89% (101 of 113) returned to work in the same role. VACAR have recently conducted more detailed research regarding drivers of returning to work for OHCA survivors (Kearney 2019); male gender (OR 4.13; 95% CI 2.38-7.18), arrests witnessed by EMS (OR 2.72; 95% CI 1.50-9.25), discharge from hospital directly to home (OR 4.13; 95% CI 0.95-0.98) and favourable QoL (on EQ-5D) were positively associated with return to work.

SF-12 survey data for OHCA patients who arrested during 2017-2018 and were followed up 12 months later were expressed as SMD scores (outlined on page 53). The SMD ($\pm 95\%$ CI) for the PCS crossed zero meaning that the physical health of the OHCA patients was not significantly different than Australian population norms (SMD PCS 0.026, 95% CI -0.111 to 0.164). The SMD ($\pm 95\%$ CI) for the MCS was positive and did not cross zero meaning that the mental health of the OHCA patients was significantly better than Australian population norms (SMD MCS 0.142, 95% CI 0.012 to 0.273) (see Figure 28). SF-12 data was available for all but two patients (n=228).

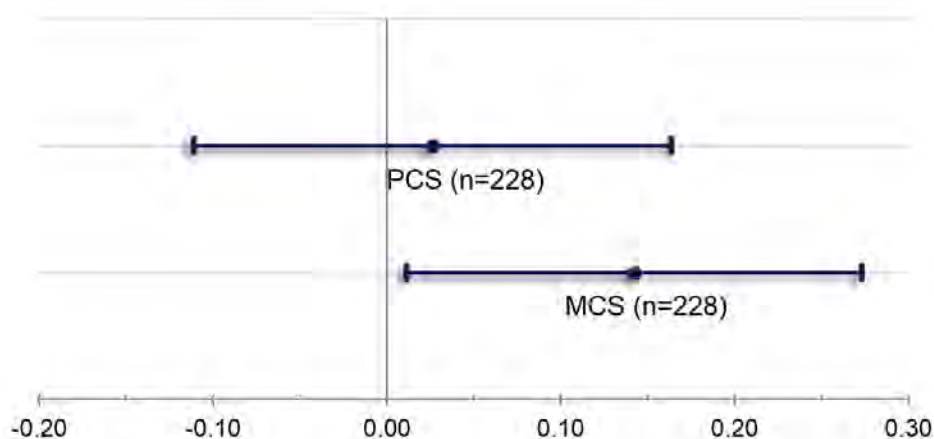


Figure 28: Standardised mean differences for SF-12 scores at 12 months post arrest for OHCA survivors versus the Australian population (patients who arrested between 2017-2018).

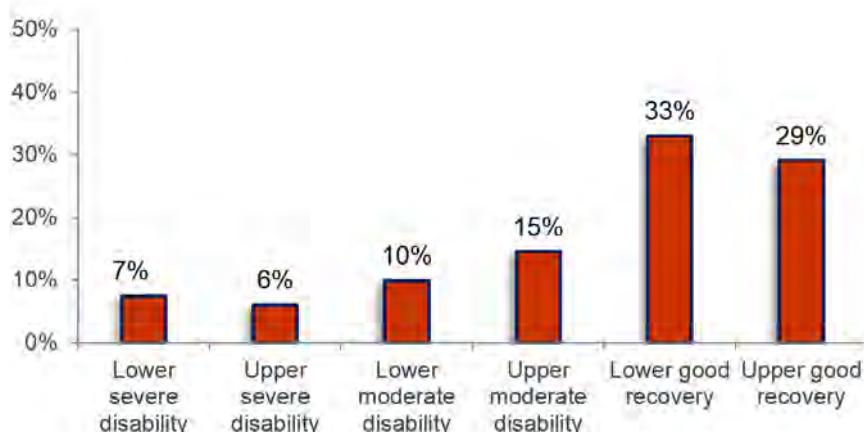


Figure 29: Disability or recovery status according to the GOS-E for OHCA survivors at 12 months post arrest (patients who arrested between 2017-2018).

The GOS-E measure indicated that 62% of survivors who arrested during 2017-2018 (175 of 282) were rated as having good functional recovery 12 months after their arrest (see Figure 29). An additional 25% reported recovery with only moderate disability.

Mean EQ-5D index score for responders followed up in 2018-2019 was 0.82 (95% CI 0.80 to 0.85); most (68%) had an EQ-5D index score ≥ 0.81 , approaching full health level. These high EQ-5D index scores are similar to age- and sex-adjusted population norms (Smith 2015). EQ-5D index scores were available for 274 of 283 responders.

Together, the SF-12, GOS-E and EQ-5D results indicate good HRQoL for survivors of arrests during 2018-2019 who responded.



2018-2019

Research Highlights

'We are continuing to investigate the impact of various interventions at different points in the chain of survival and to further delineate the evolving epidemiology of OHCA. This year, some research highlights have investigated exercise-related OHCA, trends in OHCA survival according to who shocked first, international variation in OHCA survival, and sex differences in QoL and functional outcome of OHCA survivors.' Prof Karen Smith, VACAR Principal Investigator and Chair.

Exercise-related OHCA

Characteristics and outcomes of exercise-related out-of-hospital cardiac arrest (OHCA) are not well described in Australia. Eastwood et al. conducted a retrospective observational study of non-exercise-related and exercise-related OHCA occurring in Victoria between 2008 and 2016 including 12-month quality of life data. Exercise-related OHCA occurred in younger individuals compared to non-exercise-related arrests. Exercise-related OHCA were more likely to survive to hospital discharge and survive to 12 months with good functional recovery. Exercise-related OHCA were associated with better short- and long-term prognoses compared to non-exercise-related OHCA. The underlying factors associated with this survival benefit warrant further investigation.

Eastwood D, Andrew E, Smith K, Nair R, Nehme Z, Bernard S, Dyson K. Exercise-related out-of-hospital cardiac arrest in Victoria, Australia. Resuscitation. 2019; 139: 57-64.

International variation in OHCA survival

Out-of-hospital cardiac arrest (OHCA) survival varies greatly between communities. The Utstein template was developed to improve comparability of OHCA outcome reports but has undergone limited empiric validation. Dyson et al. sought to assess how much variation in OHCA survival between emergency medical services (EMS) is explained by differences in the Utstein factors. Data from twelve registries were analysed. The Utstein factors explained 51% of the variation in survival to discharge among multiple large geographically separate EMS agencies. Therefore, quality improvement and public health efforts should continue to target modifiable Utstein factors to improve OHCA survival.

Dyson K, Brown SP, May S, Smith K, Koster RW, Beesems SG, Kuisma M, Salo A, Finn J, Sterz F, Nurnberger A, Morrison LJ, Olasveengen TM, Callaway CW, Shin SD, Grasner J-T, Daya M, Ma MH-M, Herlitz J, Stromsoe A, Aufderheide TP, Masterson S, Wang H, Christenson J, Stiell I, Vilke GM, Idris A, Nishiyama C, Iwami T, Nichol G. International variation in survival after out-of-hospital cardiac arrest: A validation study of the Utstein template. Resuscitation. 2019; 138: 168-181.

Sex differences in QoL and functional outcome of OHCA survivors

Although survival from out-of-hospital cardiac arrest (OHCA) is improving, little is known about the long-term outcome of survivors and if any impact of gender exists. In this study, Nehme et al. analysed quality-of-life (QoL) data collected at 12 months post-arrest. Unadjusted outcomes were consistently poorer for females compared to males. Fewer women reported good functional recovery and living at home without care. Following adjustment, female sex reduced the odds of good functional recovery, living at home without care, and good mental and physical QoL. Reasons why female survivors reported poorer functional recovery and QoL after OHCA requires further research.

Nehme Z, Andrew E, Bernard S, Smith K. Sex differences in the quality-of-life and functional outcome of cardiac arrest survivors. Resuscitation. 2019; 137: 21-28.

Trends in survival from OHCA according to who shocked first

Despite survival from out-of-hospital cardiac arrest (OHCA) improving, little is known about the long-term trends in survival for patients defibrillated by first responders and bystanders. Nehme et al. assessed trends in survival to hospital discharge according to whether patients were initially shocked by paramedics, first responders or bystanders. Patients initially shocked by first responders and bystanders were more likely to survive to hospital discharge than those initially shocked by paramedics. Year-on-year, the odds of survival increased for patients shocked by paramedics, first responders and bystanders by 8.1%, 6.1% and 11.8%, respectively. OHCA patients initially defibrillated by bystanders yielded the largest improvements in survival over time.

Nehme Z, Andrew E, Bernard S, Haskins B, Smith K. Trends in survival from out-of-hospital cardiac arrests defibrillated by paramedics, first responders and bystanders. Resuscitation. 2019; 143: 85-91.

2018-2019 Peer-reviewed Publications*

2019

Alqahtani S, Nehme Z, Williams B, Smith K. Emergency medical services and cardiac arrest from drug overdose: a protocol for a systematic review of incidence and survival outcomes. *JBI Database System Rev Implement Rep*. 2019;17(4):500-6.

Alqahtani S, Nehme Z, Williams B, Smith K. The incidence and outcomes of out-of-hospital cardiac arrest precipitated by drug overdose. A systematic review and meta-analysis. *Resuscitation*. 2019; 134: 10-18

Alqudah Z, Nehme Z, Williams B, Oteir A, Bernard S, Smith K. A descriptive analysis of the epidemiology and management of paediatric traumatic out-of-hospital cardiac arrest. *Resuscitation*. 2019;140:127-34.

Andrew E, Nehme Z, Cameron P, Smith K. Drivers of increasing emergency ambulance demand. *Prehosp Emerg Care*. 2019.

Beck B, Smith K, Mercier E, Bernard S, Jones C, Meadley B, Clair TS, Jennings PA, Nehme Z, Burke M, Bassed R, Fitzgerald M, Judson R, Teague W, Mitra B, Mathew J, Buck A, Varma D, Gabbe B, Bray J, McLellan S, Ford J, Siedenburg J, Cameron P. Potentially preventable trauma deaths: A retrospective review. *Injury*. 2019;50(5):1009-16.

Beck B, Smith K, Mercier E, Gabbe B, Bassed R, Mitra B, Teague W, Siedenburg J, McLellan S, Cameron P. Differences in the epidemiology of out-of-hospital and in-hospital trauma deaths. *PLoS ONE*. 2019;14(6):e0217158.

Bray JE, Smith K, Hein C, Finn J, Stephenson M, Cameron P, Stub D, Perkins GD, Grantham H, Bailey P, Brink D, Dodge N, Bernard S. The EXACT protocol: A multi-centre, single-blind, randomised, parallel-group, controlled trial to determine whether early oxygen titration improves survival to hospital discharge in adult OHCA patients. *Resuscitation*. 2019;139:208-13.

Dolorenzo A, Nehme Z, Yates J, Bernard S, Smith K. Double sequential external defibrillation for refractory ventricular fibrillation out-of-hospital cardiac arrest: A systematic review and meta-analysis. *Resuscitation*. 2019; 135: 124-129

Dyson K, Brown SP, May S, Smith K, Koster RW, Beesems SG, Kuisma M, Salo A, Finn J, Sterz F, Nürnberger A, Morrison LJ, Olasveengen TM, Callaway CW, Shin SD, Gräsner J-T, Daya M, Ma MH-M, Herlitz J, Strömsöe A, Aufderheide TP, Masterson S, Wang H, Christenson J, Stiell I, Vilke GM, Idris A, Nishiyama C, Iwami T, Nichol G. International variation in survival after out-of-hospital cardiac arrest: A validation study of the Utstein template. *Resuscitation*. 2019;138:168-81.

Eastwood D, Andrew E, Smith K, Nair R, Nehme Z, Bernard S, Dyson K. Exercise-related out-of-hospital cardiac arrest in Victoria, Australia. *Resuscitation*. 2019;139:57-64.

Epinephrine in Out-of-Hospital Cardiac Arrest. *N Engl J Med*. 2019;380(4):394-8.

Fouche PF, Smith K, Jennings PA, Boyle M, Bernard S. The association of paramedic rapid sequence intubation and survival in out-of-hospital stroke. *Emerg Med J*. 2019.

Fouche PF, Stein C, Jennings PA, Boyle M, Bernard S, Smith K. Review article: Emergency endotracheal intubation in non-traumatic brain pathologies: A systematic review and meta-analysis. *Emerg Med Australas*. 2019.

Lord B, Andrew E, Henderson A, Anderson DJ, Smith K, Bernard S. Palliative care in paramedic practice: A retrospective cohort study. *Palliat Med*. 2019;33(4):445-51.

Nehme Z, Andrew E, Bernard S, Smith K. Reply to: Poor prognosis of female out-of-hospital cardiac arrest survivors: A risk assessment. *Resuscitation*. 2019.



Nehme Z, Andrew E, Bernard S, Smith K. Reply to: Poor prognosis of female out-of-hospital cardiac arrest survivors: A risk assessment. *Resuscitation*. 2019.

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Baert V, Escutnaire J, Nehme Z, Mols P, Lagadec S, Vilhelm C, Jacob L, Wiel E, Adnet F, Hubert H, on behalf GRR. Development of an online, universal, Utstein registry-based, care practice report card to improve out-of-hospital resuscitation practices. *J Eval Clin Pract*. 2018;24(2):431-8.

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Delorenzo A, St Clair T, Andrew E, Bernard S, Smith K. Prehospital Rapid Sequence Intubation by Intensive Care Flight Paramedics. *Prehosp Emerg Care*. 2018;22(5):595-601.

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Glasheen J, Hooper J, Donohue A, Murray-Smith B, Finn E. Endotracheal Intubation for Traumatic Cardiac Arrest by an Australian Air Medical Service. *Air Med J*. 2018.

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List of Abbreviations

| | | | |
|--------------|---|---------------|--|
| ABS | Australian Bureau of Statistics | HP CPR | High-performance CPR |
| ACO | Ambulance Community Officer | HRQoL | Health-related quality of life |
| ALS | Advanced Life Support | LGA | Local Government Area |
| AED | Automated external defibrillator | MCS | Mental Component Summary of the SF-12 survey |
| AV | Ambulance Victoria | MFB | Metropolitan Fire Brigade |
| CCF | Chest Compression Fraction | MICA | Mobile Intensive Care Ambulance |
| CERT | Community Emergency Response Team | OHCA | Out-of-Hospital Cardiac Arrest |
| CFA | Country Fire Authority | OR | Odds Ratio |
| CI | Confidence Interval | PCR | Patient Care Record |
| CPR | Cardiopulmonary Resuscitation | PCS | Physical Component Summary of the SF-12 |
| CSO | Clinical support officer | PEA | Pulseless Electrical Activity |
| DHHS | Department of Health and Human Services | ROSC | Return of Spontaneous Circulation |
| ECC | External Chest Compressions | VACAR | Victorian Ambulance Cardiac Arrest Registry |
| ECG | Electrocardiogram | SF-12 | Twelve-item Short Form health survey |
| EMS | Emergency Medical Services | VF | Ventricular Fibrillation |
| EQ-5D | EuroQoL 5 Dimension questionnaire | VT | Ventricular Tachycardia |
| GOS-E | Extended Glasgow Outcome Scale | | |



Ambulance Victoria key initiatives over time

Table 7 outlines the start dates of a number of important AV programs and initiatives since the initiation of the VACAR, in 1999, up to the current fiscal year. Some of these initiatives are likely to have driven improvements in patient outcomes in this

Table 7: Key Ambulance Victoria and other national/international initiatives impacting cardiac arrest outcomes in Victoria, since the establishment of the VACAR.

| Year | AV and other national/international cardiac arrest initiatives |
|---------|--|
| 1999-00 | <p>Victorian Ambulance Cardiac Arrest Registry (VACAR) established</p> <p>Pilot of fire-fighters as first-responders in central Melbourne</p> |
| 2000-01 | Metropolitan Ambulance Service and Rural Ambulance Victoria start training paramedics in Advanced Life Support (ALS) |
| 2001-02 | <p>Roll out of fire-fighters as first-responders across metropolitan Melbourne</p> <p>Victorian State Government announces funding for a Public Access Defibrillation (PAD) program</p> |
| 2003-04 | CPR awareness program launched in Victoria by Metropolitan and Rural Ambulance Services |
| 2004-05 | Commencement of VACIS in-field electronic data capture system and linked clinical database in Metropolitan Ambulance Service |
| 2005-06 | <p>Completion of VACIS roll-out in ambulances servicing metropolitan regions of Victoria</p> <p>Australian Resuscitation Council (ARC) Guidelines update 2006</p> |
| 2006-07 | Simplification of telephone-assisted CPR instructions to 400 compressions before mouth-to-mouth |
| 2007-08 | <p>Pilot of volunteer fire-fighters as first-responders in peripheral Melbourne</p> <p>Pre-hospital therapeutic hypothermia for selected patients</p> |
| 2008-09 | <p>AV Dispatch Grid review/monitoring to increase accuracy of event prioritisation and Medical Priority Dispatch System coding, as well as increase appropriateness of dispatched care</p> <p>Completion of VACIS roll-out in ambulances servicing rural regions of Victoria</p> <p>Metropolitan Ambulance Service, Rural Ambulance Victoria and Alexandra District Ambulance Service merge to form Ambulance Victoria (AV)</p> <p>AV commences AED Registry which records the locations of AEDs across Victoria</p> |

| Year | AV and other national/international cardiac arrest initiatives |
|---------|---|
| 2010-11 | <p>2011 ARC Guidelines update</p> <p>AV CPR awareness programs trains 800,000 people since 2004</p> |
| 2011-12 | <p>Pilot of fire-fighter first-responders in peripheral Melbourne and one rural location</p> <p>Expansion of operating area for MICA Single Responder Units in metropolitan areas</p> <p>Victorian State Government announces funding for mobile intensive care (MICA) single responder units (SRUs) in rural areas</p> |
| 2013-14 | Electronic call taking algorithm implemented in rural areas |
| 2014-15 | <p>Update and simplification of the Utstein template for uniform collection and reporting of OHCA data</p> <p>AV Dispatch Grid review and implementation of revised grid</p> <p>Victorian Government commits to expanding fire-fighter first-responder program to all integrated (staffed by both fulltime and volunteer fire-fighters) fire stations</p> |
| 2015-16 | <p>2016 ARC Guidelines update</p> <p>AV OHCA guidelines updated</p> <p>Commenced rollout of fire-fighter first-responders at all integrated fire stations across Victoria</p> |
| 2017-18 | <p>More than 95,000 OHCA cases entered into VACAR</p> <p>AV CPR awareness programs trains more than 1 million people since 2004</p> <p>Upgrade of the AV AED Registry and publicity campaign encouraging AED owners to register their devices</p> <p>Pilot of real-time and post event feedback on CPR quality for paramedics</p> <p>Roll out of the GoodSAM first responder app to paramedics and members of partner organisations</p> |
| 2018-19 | <p>VACAR contains 20 years of Victorian OHCA data</p> <p>The 100,000th OHCA case entered into VACAR</p> <p>Roll out of High Performance CPR for EMS management of OHCA</p> <p>Expansion of the GoodSAM first responder app to appropriately first-aid trained members of the public</p> <p>Establishment of Sudden Cardiac Arrest Australia (SCAA) support group for cardiac arrest survivors</p> |



Definitions used in this Report

| | |
|--|--|
| Adults | Patients aged greater than 15 years of age, or where the age is missing/unknown. |
| Dead on arrival | Cases for which paramedics determine a patient to be deceased on arrival. |
| Died at scene | Patients who receive an EMS attempted resuscitation but do not survive to transport. |
| Emergency Medical Services (EMS) | Denotes Ambulance Victoria paramedics or first responders, including fire services, or community emergency response teams. |
| EMS attempted resuscitation | Cases where either paramedics or first responders attempted to revive a patient in cardiac arrest using CPR and/or defibrillation, irrespective of duration. |
| EMS attended | Cardiac arrest events attended by paramedics or first responders, regardless of whether treatment was provided. |
| EMS response time | The time from emergency call to arrival of the first 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. |
| Paediatrics | Patients aged less than 16 years. |
| PCI-capable hospital | Denotes a hospital with part-time or full-time Percutaneous Coronary Intervention (PCI) capabilities. |
| Presumed cardiac aetiology | Cases where the cause of arrest is not due to a known precipitator (e.g. trauma, overdose/poisoning etc.) as acquired from the PCR. |
| Return of Spontaneous Circulation (ROSC) | Return of spontaneous circulation (i.e. detectable pulse) at any time during the case. |
| Survival to hospital discharge (or discharged alive) | 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. |
| Transported with CPR | Patients who, at the time of scene departure, are administered ongoing CPR. |
| Transported with ROSC | Patients that, at the time of scene departure, have a ROSC (i.e. detectable pulse). |
| Utstein 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. |

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