Ambulance Victoria

Victorian Ambulance Cardiac Arrest Registry

2020-2021 Annual Report

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The VACAR Annual Report 2020-2021 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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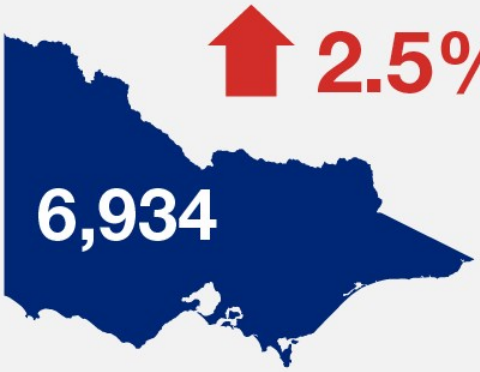
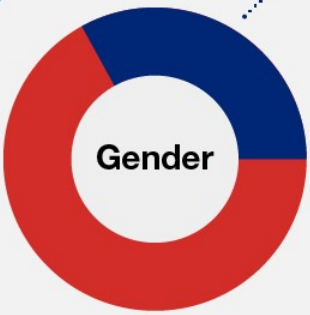
Contents

Demographics

This year we treated more cardiac arrest patients than ever before



We attended 6,934 cardiac arrest patients across Victoria - the most cardiac arrest cases ever



34% Female
73 years

66% Male
66 years

79% of cases occured in private residences

8% in a public place
7% in aged care facilities

Response

Most cardiac arrest patients were attended within 10 minutes

91%

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

We recorded a Fast response time

87%

of cardiac arrests were correctly identified by ESTA Triple Zero (000) call-takers

Half of all patients were defibrillated within **10.5 minutes**

Consistent with recent years

Bystander Involvement

Despite COVID-19, the community stepped in to help in cardiac arrest emergencies

77%

of bystander-witnessed, EMS-treated arrests received **bystander CPR**

Patients who received **bystander CPR** had a **higher survival rate** (11%) compared with those with no bystander CPR (5%)

82 patients were defibrillated by a public AED

Survival was significantly higher when shocked first by public AED compared to paramedics (50% versus 27%)

Public AED usage has close to doubled in the past decade

Post Cardiac Arrest Outcomes

Cardiac arrest patients are returning home to their families

396

396 patients were discharged alive from hospital

35%

of patients in the Utstein patient subgroup were discharged alive from hospital

85%

of survivors were able to be discharged from hospital **directly home to their families**

72%

of 12-month survivors were able to **return to work** (if working prior)

VACAR data has been used to inform a large research program to improve patient care, including **14 new research papers**

Horsham workers save colleague's life

When it comes to work colleagues, Horsham's Jon Symes knows he has some of the best. The 74-year-old was at work last October when he suddenly collapsed at his desk.

Thankfully, his colleague Amanda heard Jon slump and suspected a cardiac arrest.

"I immediately called for medical help and for someone to get the AED," Amanda said.

"I removed Jon's shirt and put the defib on and at that point it told us to shock him, which we did, and then it analysed him again and told us to do CPR."

Amanda and another co-worker kept Jon's heart beating until paramedics arrived. Horsham paramedic Matt Perry said it was unlikely Jon would have survived without the actions of his workmates.

"By the time we got there, Jon had been revived and was starting to wake up," Matt said.

"He is very lucky. To have had a cardiac arrest near an AED, and that his colleagues knew to do CPR and use it, is why Jon is alive today."

Only 1 in 10 people will survive a cardiac arrest.

When bystanders act to call Triple Zero (000), begin CPR and shock using an AED, the chances of survival more than double.

After six months recovery, Jon is back at work and enjoying life to the fullest.

"What they did was marvellous," Jon said.

"All these people did their bit and I'm very grateful."


EMERGENCY
AMBULANCE
KEEP
LEFT


360
ZOLL
STEP Safe Working Load = 150 kg

Introduction

Out-of-hospital cardiac arrest (OHCA) is one of the leading causes of death worldwide and a significant public health issue in Australia. Every year, as many as six million OHCAs occur around the globe with 30,000 of these occurring in Australia. Although survival rates from OHCA are reported to be low across developed countries (as low as 5%), many emergency medical services (EMS) have reported a doubling or tripling of survival rates following improvements to systems-of-care for OHCA patients.

Survival from OHCA is determined by the provision of quality and timely pre-hospital interventions, known as the 'Chain of Survival'. Early access and recognition, quality cardiopulmonary resuscitation (CPR), timely defibrillation and early advanced care are the four hallmark components of the Chain of Survival which are monitored by EMS globally. More recently, a fifth link 'Survivorship' has been added to the Chain of Survival, highlighting the need for increased investment in initiatives which aim to improve the long-term outcomes and quality-of-life of OHCA survivors.

From roadside to recovery, the Victorian Ambulance Cardiac Arrest Registry (VACAR) has been monitoring and improving the journey of OHCA patients for over two decades. In that time we have achieved substantial improvements in the care of OHCA patients, through developments in pre-hospital care, better call-handling and dispatch, telecommunicator CPR, community engagement in CPR programs, the launch of the smartphone CPR crowdsourcing app, GoodSAM®, and an enormous investment in resuscitation research. In 2010, we also become one of the first registries in the world to routinely measure the quality-of-life of adult OHCA survivors, highlighting our vision to monitor and improve the outcomes that are most important to our patients.

Every year we strive to build on these investments. In 2020-2021, we published the results of our high-performance CPR training programme which was implemented in 2019 and consisted of team-based paramedic training, real-time feedback on CPR performance, structured resuscitation choreography and scene leadership, and post-event debriefing. The results of the programme revealed significant improvements in survival for OHCA patients treated with high -performance CPR, equivalent to 46 additional survivors from OHCA every year in Victoria. A key initiative in this programme was the implementation of post-resuscitation debriefing reports, which provide paramedics with objective feedback relating to their resuscitation performance. The reports consist of 19 metrics which align with international treatment recommendations. Over 700 paramedics are now receiving post-resuscitation debriefing reports every month, highlighting the value of VACAR in helping to create a 'measure and improve' culture at Ambulance Victoria. The findings of these reports are now also embedded into regular reporting, meaning that senior leaders at Ambulance Victoria are now able to monitor variation in resuscitation performance across the state.

Unfortunately, the impact of the COVID-19 pandemic continues to be felt across a number of urgent health conditions. For OHCA systems-of-care, there have been a number of direct impacts. Paramedic and first-responder donning of personal protective equipment has led to delays in the commencement of resuscitation and key interventions, such as CPR and defibrillation. Critical changes to clinical practice guidelines aiming to minimise the aerosol risk associated with OHCA interventions has also impacted the quality of resuscitation provided. In addition, social restrictions have led to fewer people experiencing an OHCA in public, which reduces the utility of public access defibrillators to improve survival outcomes. Furthermore, due to the potential risk of infection to bystanders, we also made the difficult decision to limit the dispatch of GoodSAM® first responders to only paramedics with an adequate supply of personal protective equipment.

Our ongoing commitment is to find new ways to strengthen the Chain of Survival as we approach a 'COVID-19 normal' environment. This includes the safe but reduced use of personal protective equipment to improve the early commencement of resuscitation attempts, and the re-launching of the GoodSAM® app to crowdsource bystanders and public access defibrillators to OHCA events. It also requires us, more than ever, to increase the monitoring activities of the VACAR, to better understand the barriers to providing optimal care and find novel opportunities to increase the provision of early bystander actions which are so critical for survival.

To that end, it is a pleasure to present to you the findings of the 2020-2021 VACAR Annual Report.

Professor Karen Smith
Director, Centre for Research and Evaluation
Ambulance Victoria

List of Tables

List of Figures


AMBULANCE

The Emergency Medical Service

The state of Victoria, Australia has an estimated population of 6.6 million spread over almost 227,500km^2, with over 5.0 million people living in the state's capital city of Melbourne. Almost fifteen per cent of the population are aged 65 years and over. Ambulance Victoria (AV) is the state-wide provider of emergency medical services (EMS) and comprises ambulance paramedics who have advanced life support skills (e.g. laryngeal mask airway, intravenous epinephrine) and Mobile Intensive Care Ambulance (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 in order to practice.

Australia operates a single national telephone number for community access to emergency services (i.e. Triple Zero '000'). Telephone triage of emergency calls in Victoria is performed using the Medical Priority Dispatch System. 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. Approved community first responders, called GoodSAM® responders, may also be dispatched to suspected cardiac arrest events.

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 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 October 2021, there were over 8,000 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 VACAR was established in 1999 and represents an internationally recognised standard of OHCA monitoring and reporting. The VACAR is managed by AV 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 , 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 have been successfully captured for over 118,000 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 2020-2021 Peer-reviewed Publications, page 59). 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 and functional recovery 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 July 2020, we added additional instruments to the follow-up interviews which assess the impact of fatigue, anxiety and depression on OHCA survivors.

The VACAR contributes to the Australian Resuscitation Outcomes Consortium (Aus-ROC) Epistry, which is an OHCA epidemiologic registry (https://www.ausroc.org.au/). 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.

In 2019, VACAR also began contributing to the End Unexplained Cardiac Death (EndUCD) Registry which was established in 2018 by A/Prof Andre La Gerche from Baker Heart and Diabetes Institute. The Registry aims to collect data on all sudden cardiac arrests in patients aged 1-50 years, including pre-hospital, hospital, coronial, genotype and phenotype data. The program has also established new multi-disciplinary post-discharge clinics for cardiac arrest survivors and families. The EndUCD Registry will provide insight into the causes of sudden cardiac arrest in younger individuals based on clinical, demographic, and genetic analyses.


PARAMEDIC

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 VACIS, an electronic data capture system. All electronic patient care records (PCRs) are synchronised daily with organisational databases. To ensure the capture of all OHCA events attended by AV, a broad electronic search is conducted utilising specific criteria. This search strategy is focused at identifying potential cardiac arrest cases. Paper PCRs are used in cases where in-field electronic data capture is not possible. In these instances, paramedic team managers 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 12 months.

Table 1: Participating first responders dispatched to cardiac arrest events in Victoria
1. Metropolitan Fire Brigade
2. Country Fire Authority (selected areas)
3. GoodSAM

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 was provided 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 data accuracy. 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 one independent external audit over the last decade. Cardiac arrest cases also undergo clinical auditing by team managers.

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 data integrity 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 has ethics approval as a Clinical Quality Registry from Monash University Human Research Ethics Committee (project number: 21046). 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 outcomes for almost 99% of OHCAs 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 AV, 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: Missing data for select registry variables, 2020-2021 (n=6,934)

Patient age	50 (1%)
Patient sex	14 (0%)
Arrest location	0 (0%)
Witnessed status	58 (1%)
Bystander CPR	0 (0%)
Rhythm on arrival	12 (0%)
EMS response time	3 (0%)
Defibrillation time	29 (0%)
Outcome at scene	1 (0%)
Event survival	1 (0%)
Hospital discharge status	24 (1%)
Hospital discharge direction	15 (0%)

About this Report

“A cardiac arrest registry is the essence of measurement”.

The Global Resuscitation Alliance

Despite recent advances in resuscitation and post-arrest treatment strategies for OHCA patients, survival to hospital discharge rates remain low (approximately 10%) (Dyson 2019). 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 2016). 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 2020 to 30 June 2021. Final data for this report was extracted on 28 September 2021, 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 64.

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 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 Services region.

Regional data for this report was sourced from the Regional Population Growth report (published 30 March 2021, Australian Bureau of Statistics (ABS)). The estimated Victorian population as at 30 June 2020 was 6,696,630 persons. Annual Victorian data by age was sourced from the National, State and Territory Population report (December 2020, 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

1. This year, the COVID-19 pandemic had a significant impact on the OHCA system of care in Victoria. Arrests occurring in public locations were less common, as were patients presenting in a shockable arrest rhythm. Survival outcomes have also declined (see **Impact of the COVID-19 pandemic**, pages 20-21).

2. AV attended 6,934 OHCA events in the period between 1 July 2020 and 30 June 2021, with 99% involving adults. The proportion of all adult OHCA patients receiving emergency treatment by EMS was 43%, or 39% when excluding EMS-witnessed arrests. The crude incidence of OHCA was higher in the rural region than in the metropolitan region: 141 versus 92 events per 100,000 population. The age-adjusted state-wide incidence of OHCA was 90 events per 100,000 population (see **Incidence & Demographics**, pages 23-29).

3. The demographic profile of patients in 2020-2021 was similar to that observed over the last decade. OHCA due to a presumed cardiac cause accounted for 69% of adult EMS -attended patients. Fourteen percent of paediatric arrests were due to a presumed cardiac cause. Sudden infant death syndrome (SIDS) remained a leading cause of OHCA in paediatrics (29%) (see **Incidence & Demographics**, pages 23-29).

4. Most bystander calls for help following OHCA were appropriately directed to Triple Zero (000) (91%). Emergency call-takers were effective at identifying cardiac arrest events during the emergency call, with 87% of all EMS-attended arrests being correctly identified (see **Chain of Survival**, pages 30-41).

5. The median state-wide response time to EMS-treated events in 2020-2021 was 8.2 minutes (90th percentile 17.2 minutes), which was slightly longer than the previous year. The median EMS response time to EMS-treated patients in the metropolitan and rural regions was also slightly longer than the previous year (Metro: median 7.9 minutes, 90th percentile 13.5 minutes; Rural: median 9.5 minutes, 90th percentile 26.5 minutes) (see **Chain of Survival**, pages 30-41).

6. The rate of bystander CPR for bystander-witnessed OHCA events in 2020-2021 remained high (61%), compared to 57% 10 years ago. Also, the rate of bystander CPR amongst bystander-witnessed OHCA patients receiving EMS-attempted resuscitation was 77%, consistent with previous years. Use of public automated external defibrillators has increased over the last decade for patients presenting in a shockable rhythm (13% vs 7%) (see **Chain of Survival**, pages 30-41).

7. 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 26%) (see **Chain of Survival**, pages 30-41).

8. The state-wide rate of return of spontaneous circulation (ROSC) in adult EMS-treated patients during 2020-2021 was 39%. The rate of event survival for all-cause adult OHCA in the EMS-treated population was 27%, while 9% survived to hospital discharge (see **Survival Outcomes**, pages 42-49).

9. The rate of event survival for adult EMS-treated patients presenting in a shockable rhythm was 52%, with 30% surviving to hospital discharge. For adult EMS-treated patients presenting in a shockable rhythm and witnessed to arrest by EMS, event survival was 84% and survival to hospital discharge was 76%. Adults presenting in asystole or pulseless electrical activity experienced the poorest survival outcomes, with 0.3% and 8% surviving to hospital discharge, respectively (see **Survival Outcomes**, pages 42-49).

10. Despite the significant impact of the COVID-19 pandemic, a survival to hospital discharge rate of 35% was recorded for the Utstein patient subgroup in 2020-2021. This rate is comparable to a number of international agencies. Utstein survival in Inner Melbourne was 41% (see **Survival Outcomes**, pages 42-49).

11. The risk-adjusted odds of survival to hospital discharge for OHCA patients in 2020-2021 was 1.5-times higher than for OHCA patients in 2005-2006 (adjusted odds ratio 1.5, 95% CI 1.1-1.9, p=0.003). For patients who presented in a shockable rhythm, the risk-adjusted odds of survival to hospital discharge was 1.7-times that of patients who arrested in 2005-2006 (adjusted odds ratio 1.7, 95% CI 1.3-2.3, p<0.001) (see **Survival Outcomes**, pages 42-49).

12. Most OHCA patients known to have survived to hospital discharge were discharged home (85% in 2020-2021). Phone interviews with adult survivors revealed 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, 72% had returned to work 12 months after their arrest (see **Long-term Outcomes**, pages 52-57).

Impact of the COVID -19 pandemic

Analysis of health service data is essential to understand the impact of a pandemic on processes, patient care and outcomes. Findings can inform policies, procedures and clinical practice guidelines leading to pandemic preparedness. The COVID-19 pandemic has introduced unprecedented challenges and implications for healthcare services worldwide, including EMS. Figure 1 displays the dramatic impact that the pandemic has had on Triple Zero (000) demand in Victoria. Increased demand can be seen during non-lockdown periods. Such unprecedented demand patterns make planning and forecasting difficult.

For the pre-hospital response to OHCA, highly co-ordinated systems of care that optimise survival and functional outcomes are paramount. Any disruption to the system of care has potential to influence patient outcomes. In 2020, the VACAR team investigated the early impact of the COVID-19 pandemic on OHCA incidence, management and outcomes in Victoria (Ball et al, 2020). Comparing the period of March to May 2020 with historical data, the study reported that initiation of resuscitation by paramedics decreased during the pandemic period. Additionally, arrests occurring in public locations decreased, as did the proportion of patients receiving defibrillation from a public access defibrillator. Delays were observed in the commencement of key time-sensitive interventions, and overall survival to hospital discharge decreased by 50%.

This year, we have continued to monitor the impact of the COVID-19 pandemic on the OHCA system of care. Table 5 presents the characteristics and outcomes of patients who arrested during a lockdown versus non-lockdown period in Victoria in 2020-2021. We observed similar results to last year's study, with fewer patients arresting in public locations, fewer initially shockable patients receiving defibrillation by a public access defibrillator, and poorer survival outcomes. After adjustment for arrest characteristics, the risk-adjusted odds of survival to hospital discharge for patients presenting in a shockable rhythm reduced by 40% (OR 0.60 95% CI 0.39-0.92, p= 0.019) during lockdown periods.

It is likely that paramedic and first-responder donning of personal protective equipment has led to delays in the commencement of resuscitation and key interventions, such as CPR and defibrillation. Social restrictions are likely to have led to fewer people experiencing an OHCA in public, in turn reducing the utility of public access defibrillators to improve survival outcomes. The GoodSAM responder program (see page 36) was also paused during the height of the COVID-19 outbreak. Critical changes to clinical practice guidelines aiming to minimise the aerosol risk associated with OHCA interventions may have also impacted the quality of resuscitation provided.

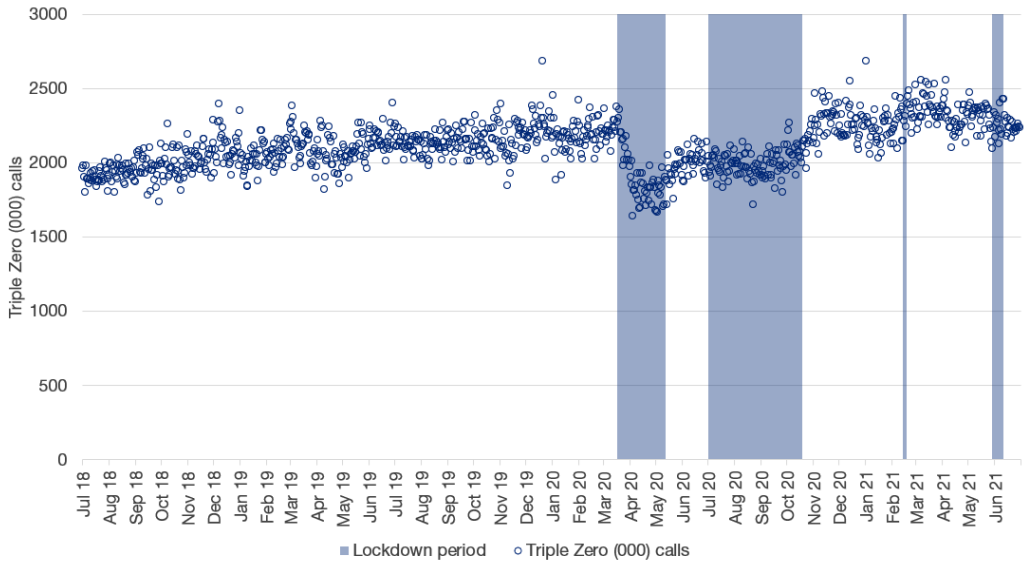


Figure 1: Daily Triple Zero (000) calls for an emergency ambulance, 2018 to June 2021.

Table 5: Characteristics and survival outcomes according to COVID-19 lockdown period in 2020-2021

	Lockdown period	Non-lockdown period
Total events^	2,126	4,045
Baseline characteristics		
- Age (years), mean (SD)	66.4 (19.3)	65.6 (18.8)
- Male gender, n (%)	1,414 (66.6)	2,681 (66.4)
- EMS response time (minutes), median (90th percentile)	8.5 (19.4)	8.8 (24.2)
- Public location, n (%)	110 (5.2)	391 (9.7)†
- Presumed cardiac aetiology, n (%)	1,487 (69.9)	2,845 (70.3)
- Metropolitan region, n (%)	1,468 (69.1)	2,693 (66.6)
- Bystander-witnessed, n (%)	572 (26.9)	1,165 (28.8)
- EMS attempted resuscitation, n (%)	824 (38.8)	1,615 (39.9)
- Initial shockable rhythm, n (%)	215 (10.1)	432 (10.7)
- Initial defibrillation by public AED*, n (%)	13 (6.3)	65 (15.2)†
Survival outcomes*		
- Event survival, n (%)	88 (44.4)	231 (56.3)†
- Discharged alive, n (%)	45 (22.8)	138 (34.2)†

^Includes adult patients, excluding EMS-witnessed events. *For patients presenting in a shockable rhythm.
†$p<0.05$ for comparison between lockdown and non-lockdown period.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Incidence & Demographics

Incidence of all adult & paediatric events†

In 2020-2021, AV attended 6,934 OHCA events, of which 6,836 (99%) were defined as adults aged greater than 15 years. This number of adult cases represents the highest number of annual events ever recorded in Victoria. The number of paediatric events attended by paramedics was slightly higher than the previous year (98 cases in 2020-2021 vs 88 cases in 2019-2020), and is within normal yearly fluctuations.

The crude incidence of OHCA has slowly increased over the last decade. In 2020-2021, the unadjusted incidence of all OHCA in Victoria was 104 events per 100,000 population which is higher than the rate of 95 events per 100,000 population observed in 2011-2012 (see **Figure 2**). However, the age-adjusted OHCA incidence rate was 90 events per 100,000 population during 2020-2021.

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 slowly increased. The age-adjusted OHCA incidence rates for males and females during 2020-2021 was 117 events and 69 events per 100,000 population, respectively.

The incidence of adult events has slowly increased over time, while paediatric events remained within recent observations. The numbers for 2020-2021 were 126 and 8 events per 100,000 population for adults and paediatrics, respectively.

Of all adult OHCA events attended in 2020-2021, 43% received an emergency resuscitation attempt by paramedics and/or first-responders (includes EMS-witnessed events; in the previous year, this was 44%). The rate of EMS-attempted resuscitation for adult OHCA has remained steady over the last 10 years (45% in 2011-2012; 45% vs 43%, p=0.085).

Lack of bystander witnesses and prolonged downtime are major contributors to EMS withholding resuscitation efforts in adult patients. The crude incidence of adult EMS-treated events was 54 events per 100,000 population.

In paediatric patients, the proportion of EMS-treated events was higher than in adults. The majority of paediatric patients (81%) received an attempted resuscitation by EMS during 2020-2021 (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.

† All results in this section include EMS witnessed events.

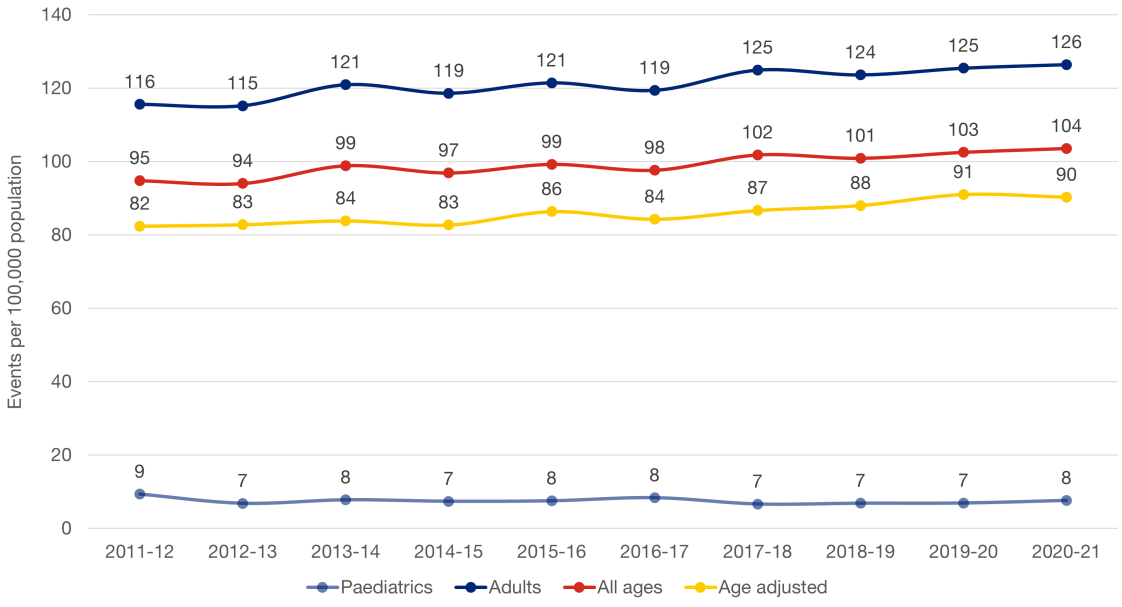

Figure 2: Crude incidence of all ages, adult and paediatric EMS-attended OHCA in Victoria and age-adjusted incidence rate of EMS-attended events (includes EMS-witnessed events).

Incidence across regions of Victoria

In 2020-2021 in the metropolitan region, there were 4,659 cases, representing 67% of the state-wide total, while 2,275 events were recorded in the rural region. Despite more arrests occurring in the metropolitan region, the crude incidence of OHCA was significantly higher in the rural regions (141 vs. 92 events per 100,000 population, p<0.001, see Figure 3). Unadjusted incidence in the metropolitan region has remained relatively unchanged over the last 10 years, however rural incidence rates are increasing.

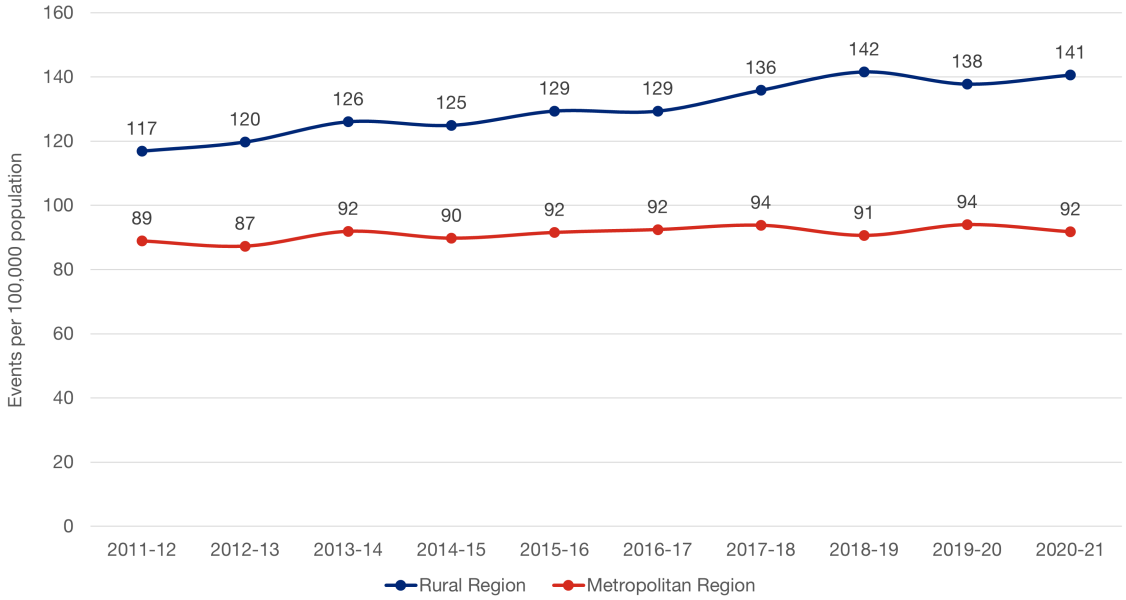

Figure 3: Yearly crude incidence of EMS-attended events across metropolitan and rural regions of Victoria (includes EMS witnessed events).

There was regional variability in OHCA incidence across Department of Health regions (see Figure 4). The lowest crude incidence during 2020-2021 was observed in the North and West Metropolitan region (85 events per 100,000 population) and the highest incidence was in the Gippsland region (164 events per 100,000 population).

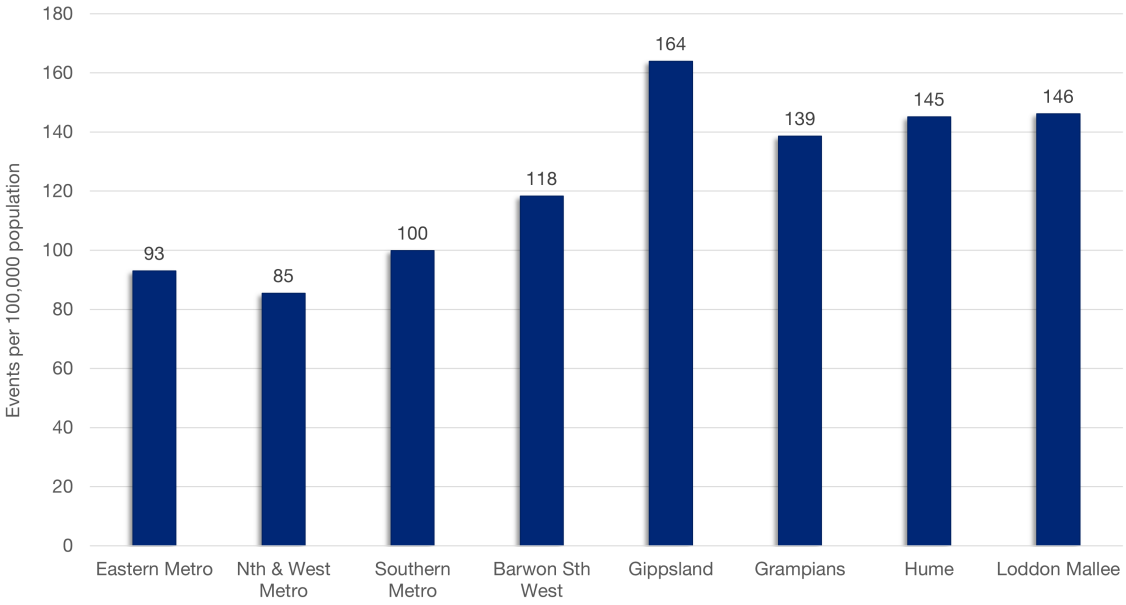

Figure 4: Regional crude incidence of EMS-attended events

Demographics of adults

The demographic profile of adult OHCA events (excluding EMS-witnessed arrests) has been consistent over the last decade. In 2020-2021, EMS-attended adult events involved predominately male patients (66%). The median age of OHCA patients was 69 years. The age distribution varied significantly across the sexes (see **Figure 5**), with females having a higher median age of arrest (73 vs. 66 years, p<0.001).

Paramedics attempted resuscitation in 39% of all EMS-attended adult OHCA events. The demographic profile of patients receiving resuscitation varied significantly from the overall population, with more male patients (69%), a lower median age (65 years), more events occurring in a public location (14%), more events witnessed by a bystander (48%) and a high rate of bystander CPR (71%).

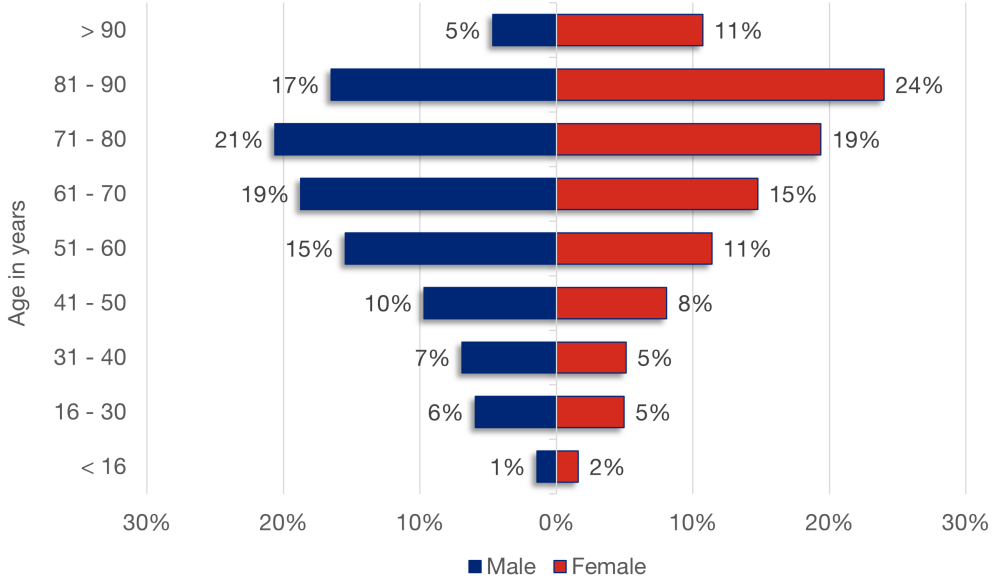

Figure 5: Age distribution of EMS-attended OHCA events.

Demographics of paediatrics

EMS attendance to paediatric OHCA (excluding EMS-witnessed arrests) has remained relatively infrequent over the last decade, with fewer than 100 events per year (93 in 2020-2021). The median age of arrest in 2020-2021 was two years, which is consistent with the past decade.

The demographic profile of paediatric OHCA varies significantly across reporting years and is impacted by smaller samples sizes. In 2020-2021, EMS-attended paediatric events were predominantly males (63%). Within the paediatric OHCA population, 15% of events during 2020-2021 occurred in a public location. More paediatric patients received bystander CPR than adult patients during 2020-2021 (67% vs. 37%, respectively; p=0.92).

The majority of paediatric patients during 2020-2021 presented to EMS in an asystolic rhythm (83%). One paediatric patient was defibrillated prior to the arrival of EMS with a public AED. This patient survived their arrest and was discharged home.

The rate of EMS-attempted resuscitation amongst paediatric patients during 2020-2021 remained high (80%, excludes EMS-witnessed events). Significantly more paediatric patients received an attempted resuscitation by paramedics than adult patients (80% vs. 39%, respectively; p<0.001).

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 16 precipitating events for adults.

In 2020-2021, 69% of EMS-attended adult OHCA were presumed to be of a cardiac cause. Following this, terminal illness (8%) and traumatic arrests (6%) were most common (see **Figure 6**). For adult patients receiving an attempted resuscitation by EMS during 2020-2021, most cases were due to a presumed cardiac cause (73%).

The rate of EMS-attempted resuscitation differed according to the precipitating cause of the event. During 2020-2021, the rate of EMS-attempted resuscitation for arrests due to overdose/poisoning was 41%. Rates of EMS resuscitation were lower for arrests occurring due to presumed cardiac causes (42%), trauma (37%), hanging (33%) and terminal illness (16%). In contrast, most OHCA events due to a respiratory cause received EMS-attempted resuscitation (60%).

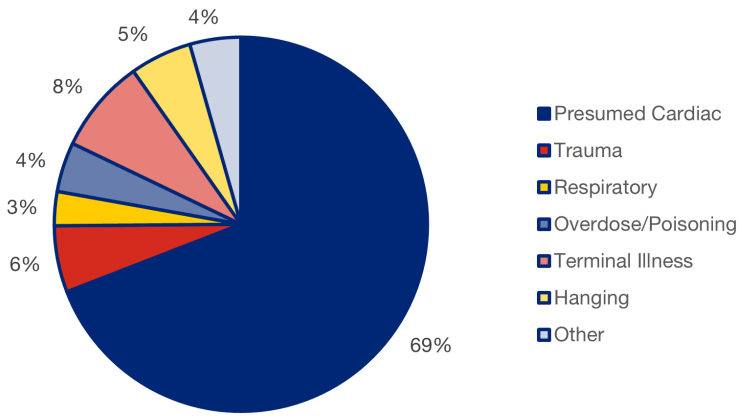

Figure 6: Adult precipitating events for EMS-attended events.

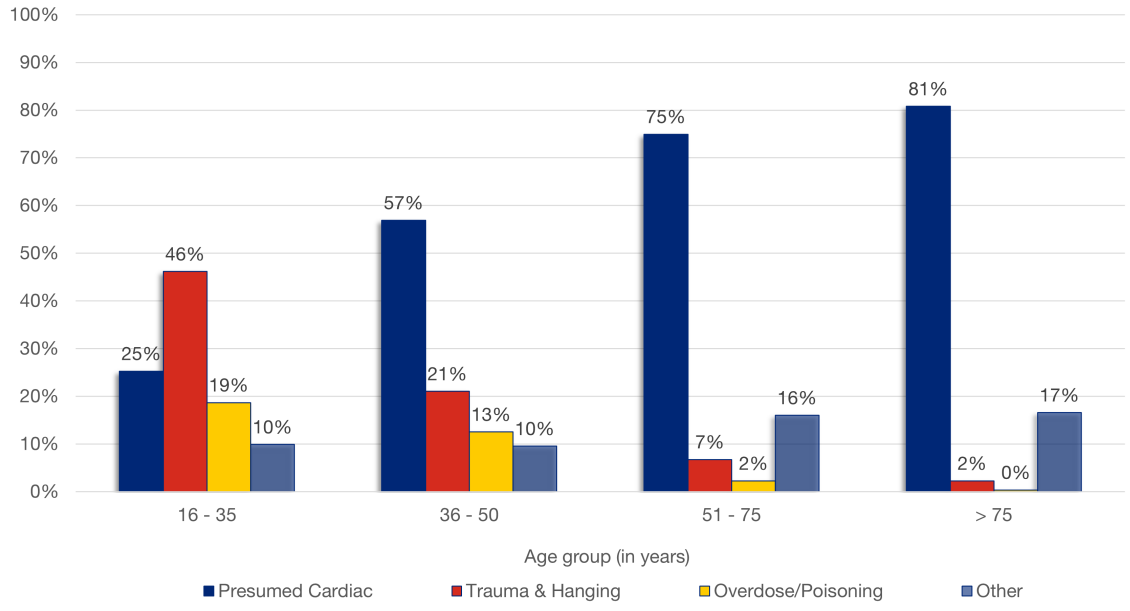

Figure 7: Adult precipitating events across age groups for EMS-attended events.

The precipitating event for arrests according to age groups in the EMS-attended adult population is presented in **Figure 7**. A presumed cardiac cause was the predominant precipitating factor for most age groups: 36-50 years (57%), 51-75 years (75%) and >75 years of age (81%). However, in the 16-35 years age group, the predominant precipitating factor was the combined causes of trauma and hanging (46%). 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 2020-2021 (0%).

Precipitating events for paediatrics

Precipitating events for paediatrics who suffer OHCA vary to considerably to adults. In 2020-2021, 14% of EMS-attended paediatric events occurred due to a presumed cardiac cause (see Figure 8). Sudden infant death syndrome (SIDS) remained a dominant cause of paediatric OHCA (29% in 2020-2021). Other common causes of paediatric OHCA included trauma (16%) and drowning (19%).

The distribution of precipitating events in the EMS-treated paediatric OHCA population mirrors the overall paediatric OHCA population data presented in Figure 8.

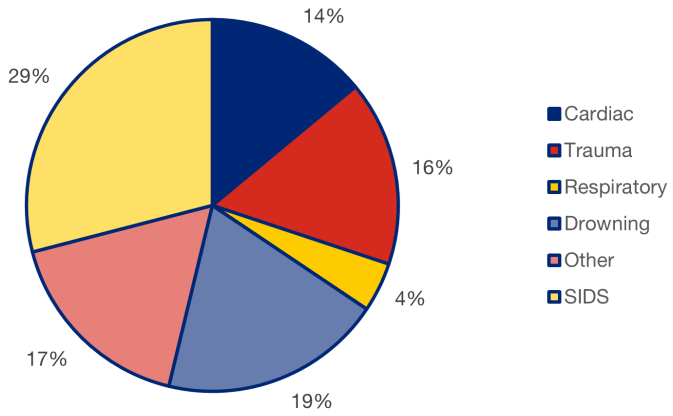

Figure 8: Paediatric precipitating events for EMS-attended events.

Mechanism of arrest in the traumatic sub-group

Cardiac arrests secondary to major trauma are an important, potentially-preventable patient subgroup. During 2020-2021, arrests secondary to road trauma were responsible for 52% of traumatic events, while arrests following falls accounted for 15%. Ballistic trauma and stabbings accounted for 13%, see Figure 9.

The vehicles associated with road trauma incidents in 2020-2021 were: a car or light vehicle (56%), train (16%), motorcycle (18%), truck (4%) and bicycle (6%). The role of the OHCA patient in these vehicles was the vehicle driver (68%), pedestrian (26%) and passenger (6%).

*'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 20% of trauma-related OHCA in 2020-2021.

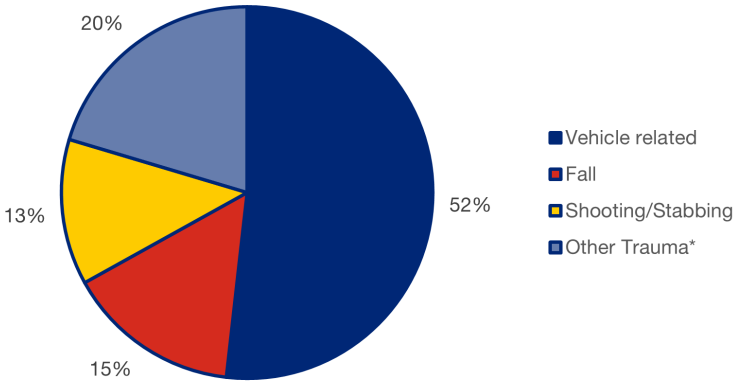

Figure 9: Sources of trauma in EMS-attended traumatic OHCA sub-group.

Arrest location for adults and paediatrics

The location and witness status of the OHCA have important implications on outcome. The VACAR records over 20 cardiac arrest locations, the most common of which are presented in **Figures 10 and 11**. Public places include places of work, streets or roads, shops, vehicles and sporting/recreational facilities.

In 2020-2021, most (79%) EMS-attended adult OHCA events occurred within a private residence. Other common arrest locations were a public place (8%) and aged care facility (7%) (see **Figure 10**).

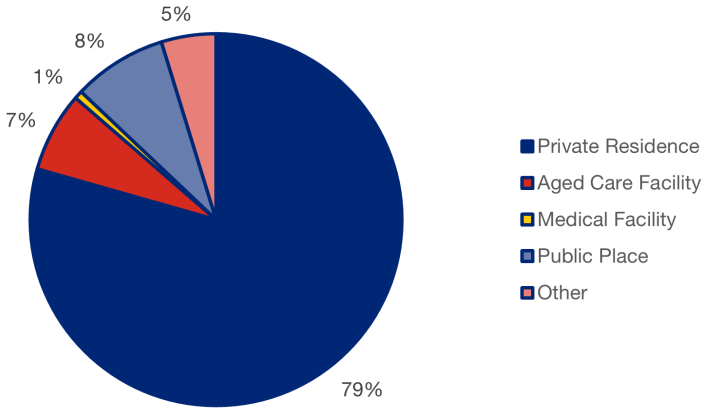

Figure 10: Location of arrest for EMS-attended adult events.

Among adult patients who received an attempted resuscitation, 73% of arrests occurred in a private residence. This was followed by public places (14%) and aged care facilities (5%).

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 11**). In 2020-2021, the unadjusted rates of adult survival to hospital discharge were highest in public places (22%) and medical facilities (16%). Unadjusted adult survival to hospital discharge in a private residence (7%) and aged care facilities (1%) remained relatively low.

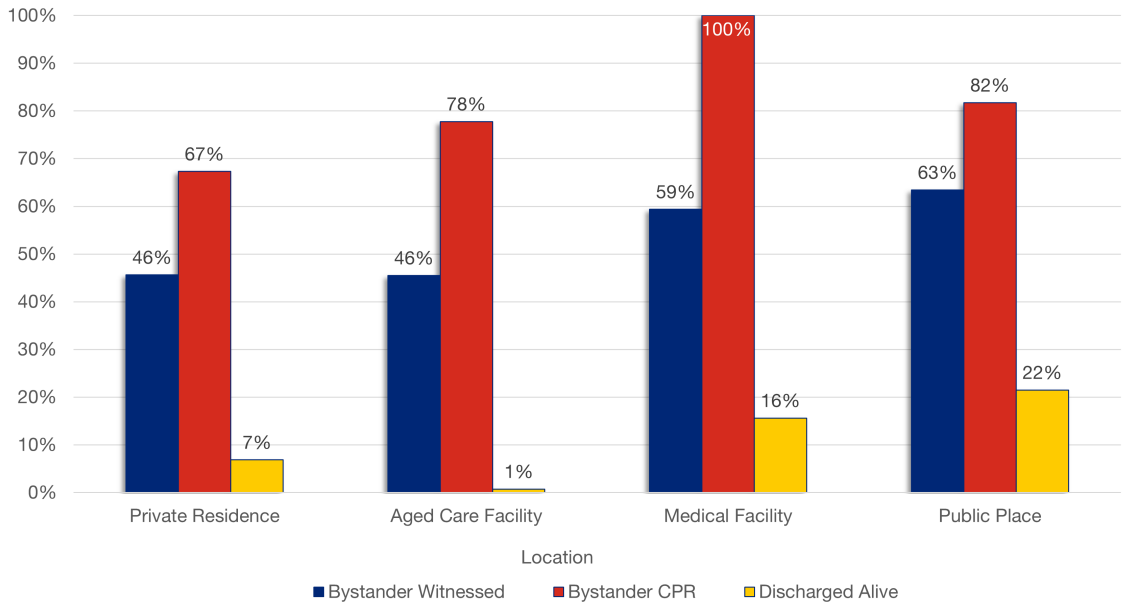

Figure 11: Proportion of EMS-treated adult events that were bystander witnessed, received bystander CPR and were discharged alive across arrest locations, 2020-2021.

The location of arrest for paediatric events was similar to that of adults. In 2020-2021, 82% of EMS-attended paediatric events occurred in a private residence and 16% occurred in a public place.


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Chain of Survival

The chain of survival is an internationally recognised initiative aimed at maximising survival following out-of-hospital cardiac arrest.

Survival from OHCA is determined by the provision of quality and timely pre-hospital interventions, known as the 'Chain of Survival'. Early recognition and activation of EMS, quality cardiopulmonary resuscitation (CPR), timely defibrillation, early advanced life support, and advanced post-arrest care are the hallmark components of the Chain of Survival. More recently, 'Survivorship' has been added to the Chain of Survival, highlighting the need for increased investment in initiatives which aim to improve the long-term outcomes and quality-of-life of OHCA survivors.

Early recognition and activation of emergency medical services

Immediate, high-quality CPR

Rapid defibrillation

Basic and advanced life support

Advanced post-arrest care

Healing and survivorship

Early recognition and activation of EMS

Bystander call for help

In 2020-2021, the first bystander call for help was correctly directed to ambulance in the majority of cases (91%). 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 (3%), neighbour (1%), police (3%) or another person (1%) rather than to EMS. 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.

Further, emergency call-takers were effective at identifying cardiac arrest events during the emergency call, with 87% of all EMS-attended arrests being correctly identified.

Emergency response to the incident

The distribution of response times for the EMS-treated population across regions in 2020-2021 is presented in **Figure 12**. EMS response time, or the time from the emergency call-taker answering the 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 Triple Zero (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.

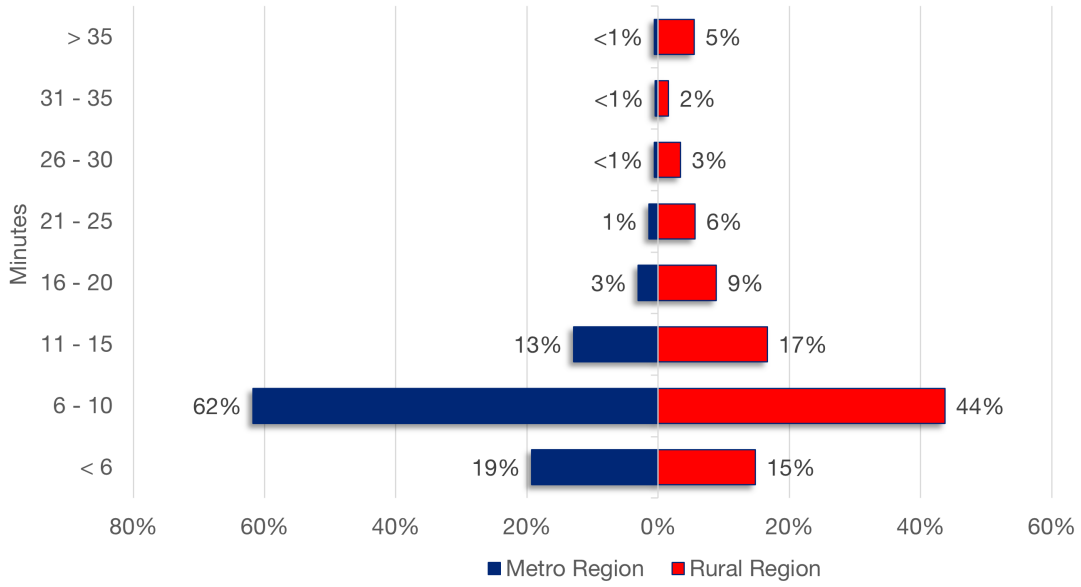


Figure 12: Distribution of time from call to arrival of EMS on scene in the EMS-treated population.

In 2020-2021, the state-wide median response time to EMS-treated events was 8.2 minutes (90th percentile 17.2 minutes). This was slightly longer than the response time noted in the previous year (median time 7.7 minutes; 90th percentile 15.2 minutes). Overall, 74% of OHCA patients were attended within 10 minutes of their call being answered. In 2020-2021, the median response time to EMS-treated events in metropolitan regions was 7.9 minutes (90th percentile 13.5 minutes), compared to 7.3 minutes (90th percentile 11.8 minutes) in the previous year. The median response time in rural areas in 2020-2021 was 9.5 minutes (90th percentile 26.5 minutes), compared to 9.3 minutes (90th percentile 23.1 minutes) in the previous year.

Immediate CPR

Bystander cardiopulmonary resuscitation

Over the last decade in Victoria, there have been substantial increases in rates of bystander CPR (see **Figure 13**). Of OHCA patients witnessed to collapse by bystanders in 2020-2021, 61% of patients received bystander CPR, in comparison to 57% in 2011-2012 (p=0.04). Of bystander-witnessed OHCA events receiving an attempted resuscitation by EMS, 77% received bystander CPR in 2020-2021, compared to 70% in 2011-2012 (p=0.01). 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). Importantly, the rates of bystander CPR observed this year are slightly lower than the previous year, and this is likely to be associated with the COVID-19 pandemic as more arrests occurred in the home and were not witnessed by a bystander.

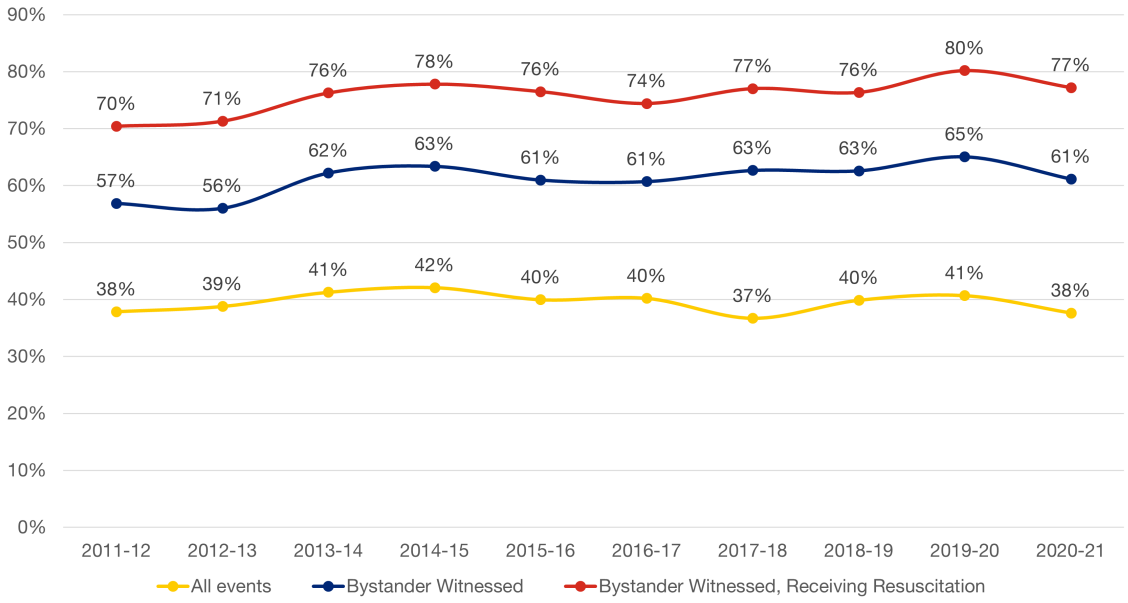


Figure 13: Bystander CPR rates.

Unadjusted survival was strongly associated with the presence of bystander CPR (see **Figure 14**). In 2020 -2021, for EMS-treated OHCA events, event survival for patients receiving bystander CPR (30%) was significantly higher than for patients not receiving bystander CPR (19%, p<0.001). In addition, survival to hospital discharge was significantly higher for patients receiving bystander CPR (11%) versus no bystander CPR (5%, p<0.001).

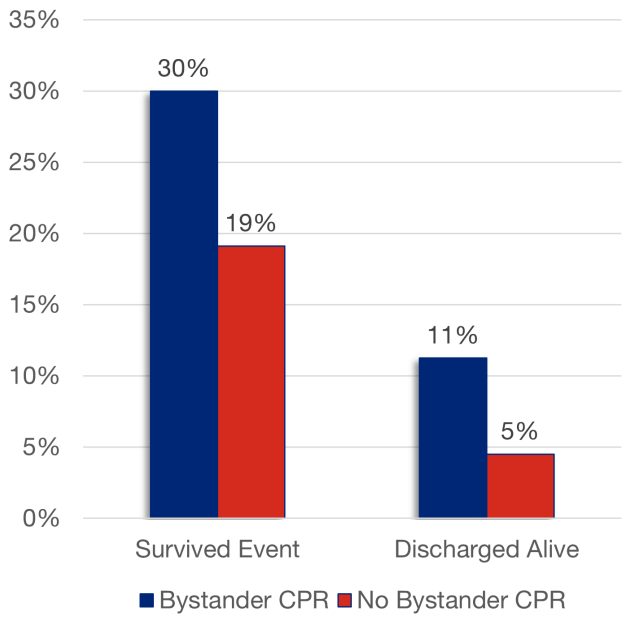


Figure 14: Unadjusted survival outcomes after bystander CPR in the EMS-treated population.

Bystander CPR improves survival and maintains shockable rhythms for longer

When bystanders perform CPR, the likelihood of survival is significantly increased. **Figure 15** shows that, this year, when OHCA patients received bystander CPR prior to EMS arrival, survival to hospital discharge more than doubled when the EMS response time was <6 minutes and more than tripled when response time was between 6 and 10 minutes. When it took between 11 and 15 minutes for EMS to arrive, bystander CPR still contributed to a four-fold increase in survival. With no bystander CPR, patient survival significantly decreases as response time increases.

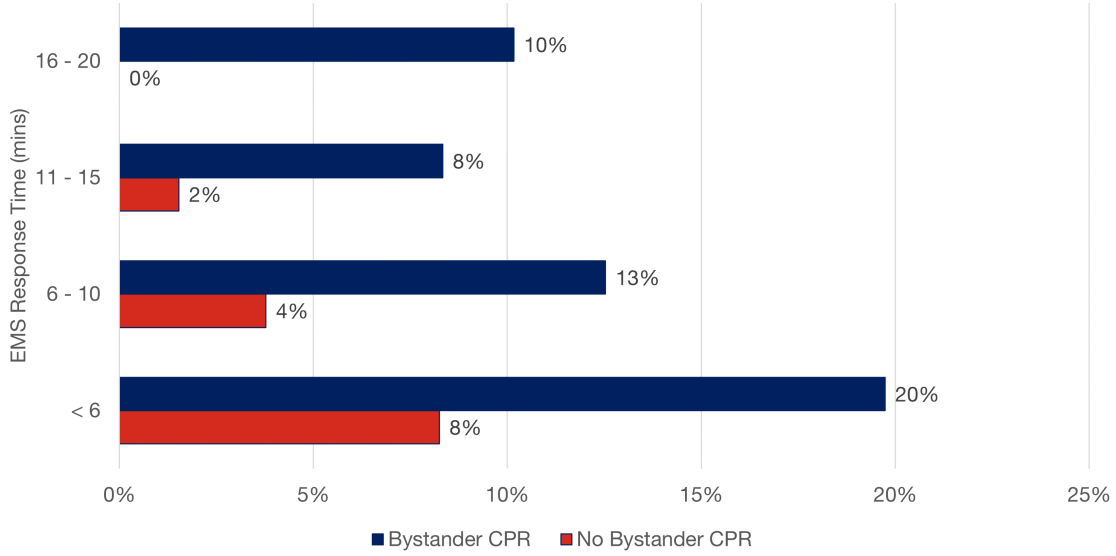


Figure 15: Survival to hospital discharge by EMS response time and bystander CPR status.
Includes adult patients with cardiac arrest due to a presumed cardiac cause where EMS attempted resuscitation (excludes EMS-witnessed events)

Not only does bystander CPR improve survival to hospital discharge, but it helps OHCA patients remain in a shockable (i.e. treatable) rhythm for longer. Therefore, upon their arrival, EMS intervention and treatment is more likely to be effective. **Figure 16** shows that, this year, for EMS response times between 0-15 minutes, close to 40% of patients presented in a shockable rhythm when bystander CPR was performed.

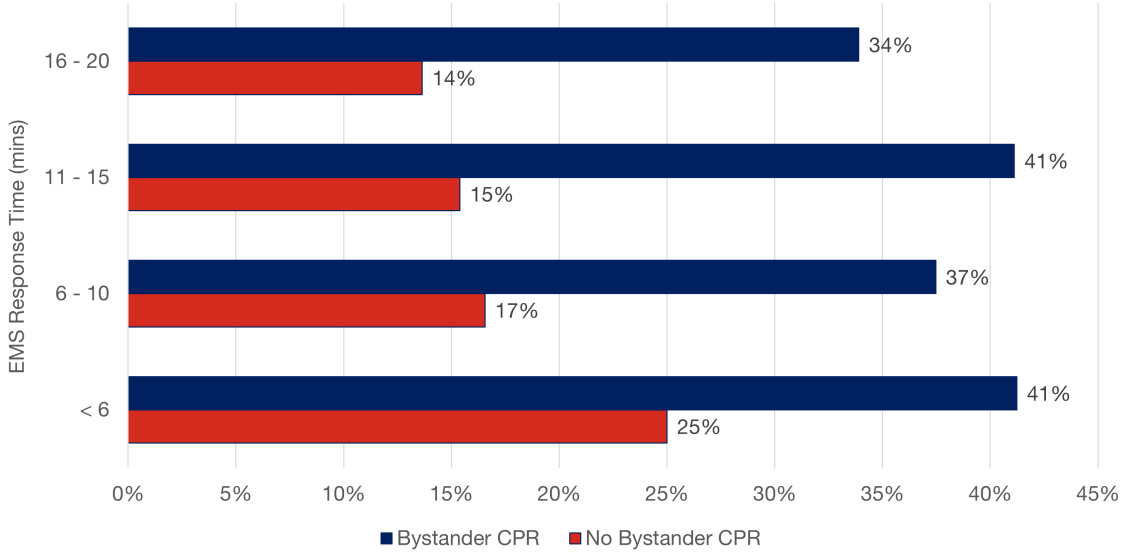


Figure 16: Proportion of adult patients presenting in a shockable rhythm by EMS response time and bystander CPR status.
Includes cardiac arrest due to a presumed cardiac cause where EMS attempted resuscitation (excluding EMS-witnessed events).

Rapid defibrillation

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 significant 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 from 81% in 2011-2012 to 77% in 2020-2021 ($p<0.001$). This decline has been driven by close to a two-fold increase in the use of AEDs by bystanders over the same period (7% to 13%, $p=0.002$) and the expansion of first responder programs over the decade. This year, we saw the third highest ever proportion of arrests defibrillated by public AEDs (13%) prior to EMS arrival. The proportion of cases initially defibrillated by first responders during 2020-2021 was 10% (the same as in 2019-2020).

The time to first defibrillation by EMS is recorded for EMS-treated patients whose rhythm is shockable on EMS arrival. In 2020-2021, the median state-wide time to defibrillation of 10.5 minutes (90th percentile 16.2 minutes) was consistent with the previous year (median time 10.0 minutes; 90th percentile 16.4 minutes; $p=0.02$). The median time to defibrillation in the metropolitan region in 2020-2021 was 10.4 minutes (90th percentile 15.1 minutes), while in the rural region, the median time was 10.8 minutes (90th percentile 20.8 minutes).

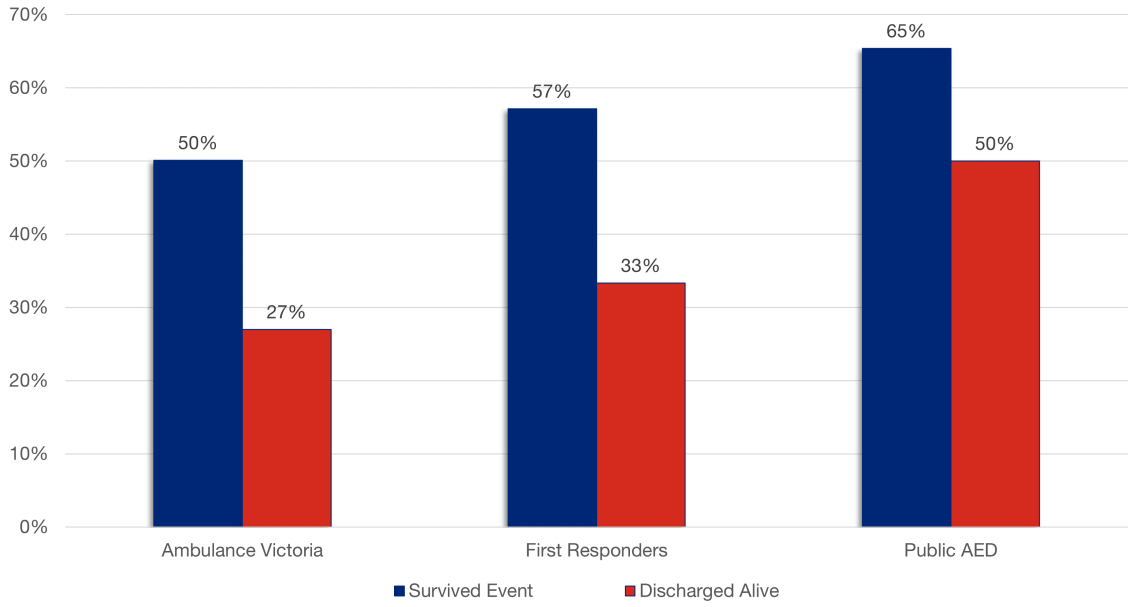


Figure 17: Unadjusted survival outcome according to who shocked first in the EMS-treated population with a shockable rhythm on or before EMS arrival.

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 17**).

The proportion of OHCA patients surviving the event when first defibrillated with a public AED was 65%, compared with 57% of patients first shocked by first responders and 50% of patients first shocked by paramedics ($p<0.001$). Survival to hospital discharge was also significantly higher when a public AED was used compared to when patients were shocked by paramedics (50% vs. 27%, $p<0.001$). The small sample size of these groups should be taken into consideration as this can result in yearly fluctuations in survival rates.

The survival rate (50%) for patients defibrillated with a public AED during 2020-2021 illustrates how early intervention, especially the application of an AED for patients in a shockable rhythm, has an obvious and positive impact on survival outcomes.

Impact of bystanders on OHCA

OHCA events witnessed to occur by a bystander have more positive survival outcomes. **Table 6** provides an overview of the impact of bystanders during 2020-2021. Bystander CPR rates were higher amongst OHCA patients witnessed to arrest by a bystander, compared with all OHCA patients (61% vs. 34%, respectively). In addition, the unadjusted likelihood of an OHCA patient presenting in a shockable rhythm in 2020-2021 was eleven times higher for patients receiving bystander CPR than those not receiving bystander CPR (excluding EMS witnessed events).

Table 6: The impact of bystanders in 2020-2021

	All OHCA	Bystander witnessed
Total events	6,934^	1,755
- Bystander CPR	2,377 (34%)	1,073 (61%)
- Bystander AED use	80 (1%)	60 (3%)
- Shockable rhythm	652 (9%)	480 (27%)
EMS treated events	2,532	1,206
- Survived event	663 (26%)	472 (39%)
- Discharged alive	226 (9%)	177 (15%)

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

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 chance of survival falls by 10%. This highlights the importance of early bystander intervention and the significant role that crowdsourcing mobile device applications may have in facilitating bystander involvement in resuscitation efforts. The benefits of using crowdsourcing technologies in the emergency response to OHCA are becoming clearer and may soon demonstrate significant impact on patient outcomes (Valeriano et al, 2021; Blewer et al, 2020). The use of crowdsourcing apps is recommended in treatment guidelines for OHCA (Semeraro et al, 2020; Rumsfeld et al, 2016).

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 patients 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 8,000 Victorian AED's registered with GoodSAM.

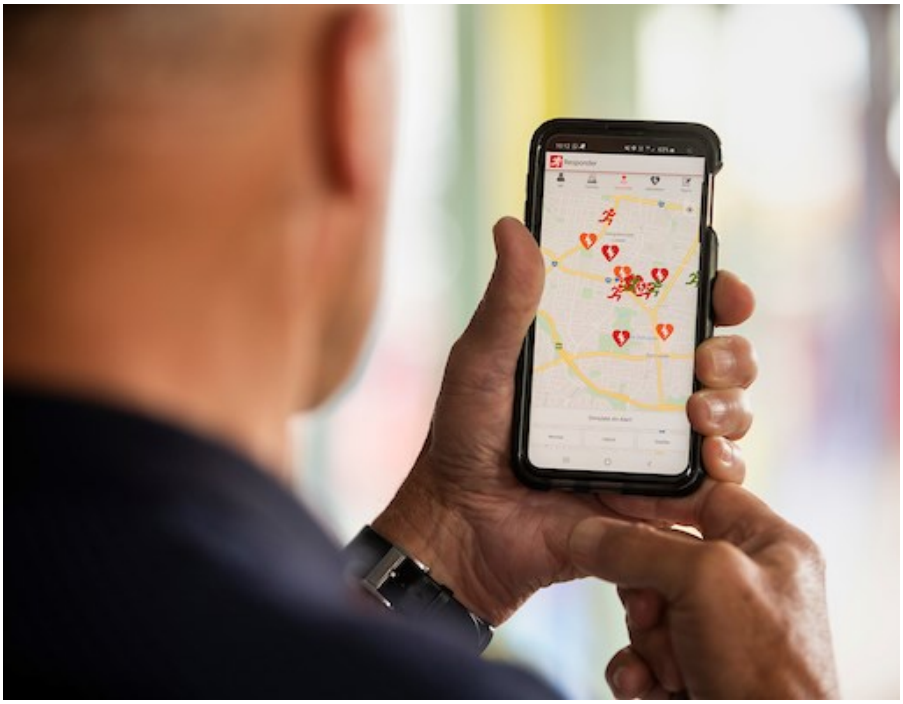
GoodSAM-eligible cases are based on dispatch events identified as the most commonly occurring OHCA events. These include suspected OHCAs, apnoeic seizures and drownings. GoodSAM notifications, sent via an alert message to a person's smartphone, highlight the sophistication of this advanced emergency alerting technology. VACAR is pivotal in monitoring the impact of GoodSAM in Victoria on OHCA patient survival. As of 22nd November 2021, there were over 29,728 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.



When a GoodSAM responder becomes a lifesaver

When Beth Laister's husband Paul suffered a cardiac arrest in April, she never expected a stranger would be the first to respond. Chloe Wirth, an occupational therapist and GoodSAM Responder had just sat down to eat lunch when she got an alert on her phone.

"I could see the case was only a few streets away and I knew I had to go," Chloe said.

"When I arrived, I walked straight through the front door and I could see Beth doing CPR on Paul. I was able to take over and give her a break." Chloe continued CPR until paramedics arrived.

After spending three weeks in ICU, 67-year-old Paul was able to return home and has since made a full recovery. The grandfather of two said it's difficult to describe his gratitude to Chloe, the paramedics and doctors who saved his life.

"Thank you many, many times over just doesn't seem to be adequate," Paul said.

"The very fact someone was here with CPR skills, a very caring person who was able to relieve some of the panic Beth and Liam were experiencing, I'm just so grateful."

Ambulance Victoria CEO Professor Tony Walker said anyone can make a life-changing difference like Chloe.

"Our message is simple – you don't need to be a paramedic to be a life saver, you just have to be over 18 and willing to give hands-only CPR," he said.

"Become a GoodSAM Responder and help us help more Victorians survive cardiac arrest."

Basic and advanced life support

High-performance cardiopulmonary resuscitation (HP-CPR)

The quality of CPR is significantly associated with OHCA survival (Soreide et al, 2013; Hopkins et al, 2016; Pearson et al, 2016; Bobrow et al, 2013). High-performance CPR (HP-CPR) uses targeted metrics that are known to increase survival (Eisenberg et al, 2018). The main components of HP-CPR are high chest compression fraction, targeted chest compression rate and depth, allowing full chest recoil, and avoidance of over-ventilation. HP-CPR involves the delivery of high-quality CPR which meets international standards and a well-practiced choreography (the "pit-crew" approach) aimed at minimising interruptions to resuscitation. In February 2019, AV transitioned to a HP-CPR model with training provided to all First Responders, ALS and MICA paramedics.

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 external cardiac compressions recommend minimising pauses in chest compressions. Lower chest compression fraction (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 chest compressions 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 chest compression fraction, has been demonstrated in Victoria. In addition, significant improvements in pre- and post-shock pauses have been demonstrated.

In a recent VACAR research publication, AV's resuscitation quality improvement program, which consisted of HP-CPR, was associated with a 33% increase in the risk-adjusted odds of survival over the first 12 months of the program (Nehme 2021).

Team performance reports (TPR)

One of our ongoing quality improvement initiatives this year was the introduction of the Team Performance Report (TPR) in August 2020. The TPR contains timely, objective clinical feedback on paramedic performance for every adult medical cardiac arrest attended. A report is sent to all paramedics present at a cardiac arrest case and their associated Team Managers. The reports provide an opportunity to recognise and celebrate good performance, identify areas for improvement and facilitate discussion between paramedics, their manager, and clinical leaders. An example TPR is provided overleaf.

The TPRs use the technology of the chest compression sensor and collate it with other routinely collected data into a standardised report. The TPR includes 19 key performance metrics which are both measurable and evidence based. The metrics target each of the links in the 'Chain of Survival' which are strongly associated with patient outcomes following OHCA and have been tailored specifically for paramedics, such that they represent real-life interventions that can be improved with training.

The metrics are summarised by five key components; 1) early recognition (including the timing and placement of defibrillation pads and commencement of CPR); 2) quality CPR (including compression depth, rate, recoil and chest compression fraction); 3) timely defibrillation (including 'pre-shock' and 'post-shock' pauses); 4) advanced interventions (including early placement of a laryngeal mask airway, administration of adrenaline and amiodarone) and 5) post resuscitation care (including 12 lead ECG acquisition, blood pressure targets and transport to an appropriate hospital for definitive care).

As cardiac arrest cases are both challenging and infrequent, the feedback provided within the TPR capitalises on every cardiac arrest attended, encouraging self-reflection, as well as identifying learning opportunities and guiding skills-based training as required. Furthermore, recognising and celebrating good performance may help foster a positive workplace culture, promoting discussion and improvement. This year, we published a research letter detailing a novel post-cardiac arrest debrief report to inform other EMS agencies of the approach used by AV (Villani 2021).

Example Team Performance Report

Your team performance rating

Case date	13/04/2021	Case number	12345	CSP ID	20001
Initial arrest rhythm	Ventricular Fibrillation				
Paramedics on scene	John, Fiona, Matthew, Jane				

Component	Performance metric	Target performance	Actual performance
Early recognition	Arrival at patient to placement of defibrillation pads	<1 minute	0 minutes
	Compressions underway during pad placement	Yes	Yes
	Correct identification of arrest rhythm on paramedic arrival	Yes	Yes
Quality cardiopulmonary resuscitation	Compressions at target depth	≥ 96%	98%
	Compressions at target rate	≥ 88%	83%
	Total compressions in target	≥ 80%	83%
	Compression fraction	≥ 93%	86%
	Average recoil velocity	≥ 448 mm/sec	477 mm/sec
Defibrillation	Arrival at patient to first defibrillation or disarm	≤ 1 minute	1 minutes
	Average length of pause before a defibrillation	≤ 4.0 seconds	5.6 seconds
	Average length of pause after a defibrillation	≤ 2.7 seconds	4.5 seconds
Advanced interventions	Arrival at patient to insertion of iGel	≤ 2 minutes	2 minutes
	Arrival of sufficient crews to first bolus adrenaline	≤ 3 minutes	10 minutes
	Arrival of sufficient crews to first bolus amiodarone	≤ 1 minutes	2 minutes
Post-resuscitation care	Adequate duration of resuscitation before termination	Yes	NA
	Intubation with first-pass success	Yes	Yes
	Time between sustained ROSC and 12 lead ECG	≤ 4 minutes	11 minutes
	Blood pressure ≥100mmHg on hospital arrival	Yes	Yes
	Transport to 24-hour PCI facility if applicable	Yes	Yes

Advanced post-arrest care

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 2020-2021, 94% of EMS-treated arrests due to a presumed cardiac cause were transported to a PCI-capable hospital. Within the metropolitan region during 2020-2021, 99% of patients were transported to a PCI-capable hospital. In rural regions, this figure was 79%. This represents the second highest rate of transportation to PCI-capable hospitals in the rural region in the last 10 years (79% vs 37% in 2011-2012). Rates of transportation to PCI-capable hospitals in rural regions vary due to the location of arrests.

This year, 37% of OHCA patients who were transported to PCI-capable hospitals survived to hospital discharge (unadjusted survival, see **Figure 18**). Of the OHCA patients transported to hospitals without PCI capability during 2020-2021, 28% were discharged alive. This is a significant improvement compared to 10 years ago (20%). It is likely that hospital-based factors contribute to the variation in outcomes observed across hospitals, including optimal post-arrest treatment strategies.

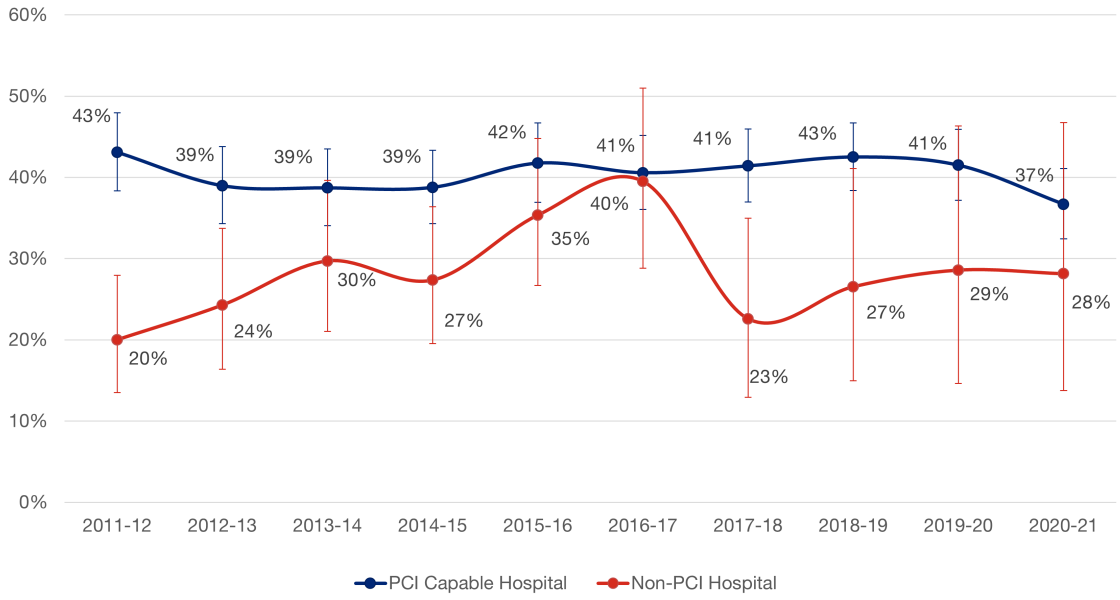


Figure 18: Unadjusted survival to hospital discharge for adult presumed cardiac EMS-treated events according to transport to a PCI-capable hospital.

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


TEAM MANAGER
M.I.C.A.
PARA
AMBULANCE VICTORIA
M.I.C.A.
PARAMEDIC
CANNON PLUG
LSU OUTLET

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 2020-2021, ROSC was most commonly achieved amongst adult OHCA patients who arrested in the presence of EMS (77%). Bystander-witnessed arrests attained higher rates of ROSC than unwitnessed arrests (47% vs. 18%, respectively).

Across the entire state in 2020-2021, ROSC was achieved in 39% of all adult EMS-treated events (includes EMS-witnessed arrests) which is higher than the previous year (36% in 2019-2020). In the metropolitan region, ROSC was achieved in 39% of OHCA events (in the previous year, this was 37%) while in the rural region, this figure was 40% (in the previous year, this was 33%).

Over time, there has been an increase in the proportion of OHCA events where resuscitation efforts were ceased at scene (see Figure 19). In 2020-2021, the proportion of adult EMS-treated events which were transported from the scene with ROSC was 26%. Efforts were ceased at scene for 72% of adult EMS-treated events and the rate of transportation with CPR was low (2%).

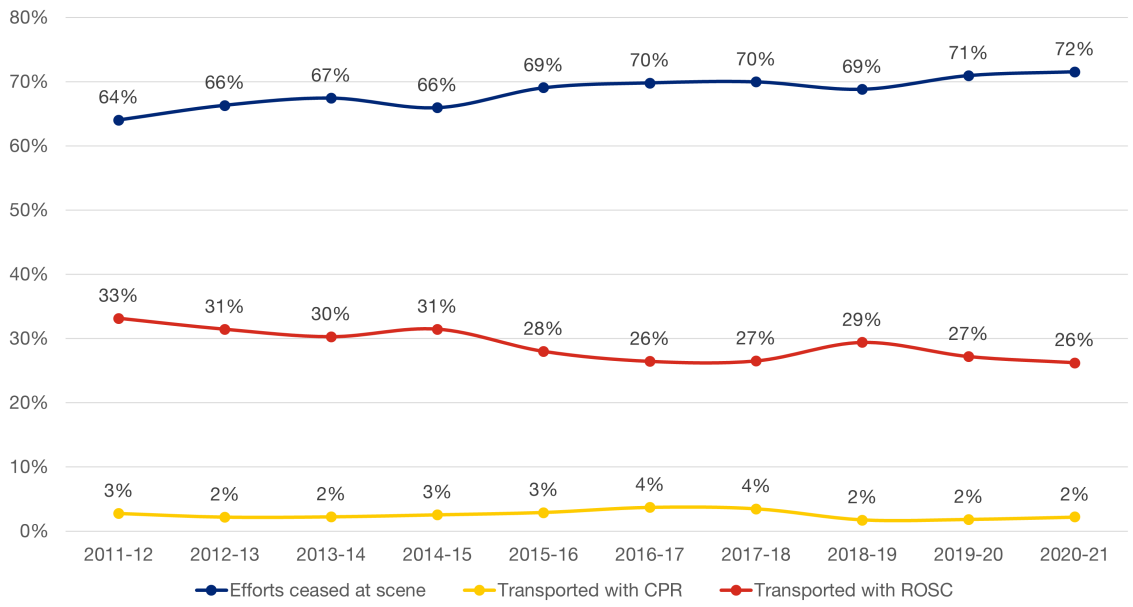


Figure 19: Scene outcomes for adult EMS treated events.

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 very limited additional treatment options at hospital.

Adult survival from all-cause cardiac arrest

In 2020-2021, the rate of event survival for adult EMS-treated events was 27% and 9% were discharged alive (see **Figure 20**). The rate of event survival has declined slightly since 2011-2012, however survival to hospital discharge is relatively consistent with recent observations. In the metropolitan region during 2020-2021, event survival was 28% and 9% were discharged alive. In the rural region, event survival was 25% and 9% were discharged alive.

The reduced survival rates observed in 2019-2020 and 2020-2021 are likely to be influenced by the COVID-19 pandemic, as previously discussed (see page 20).

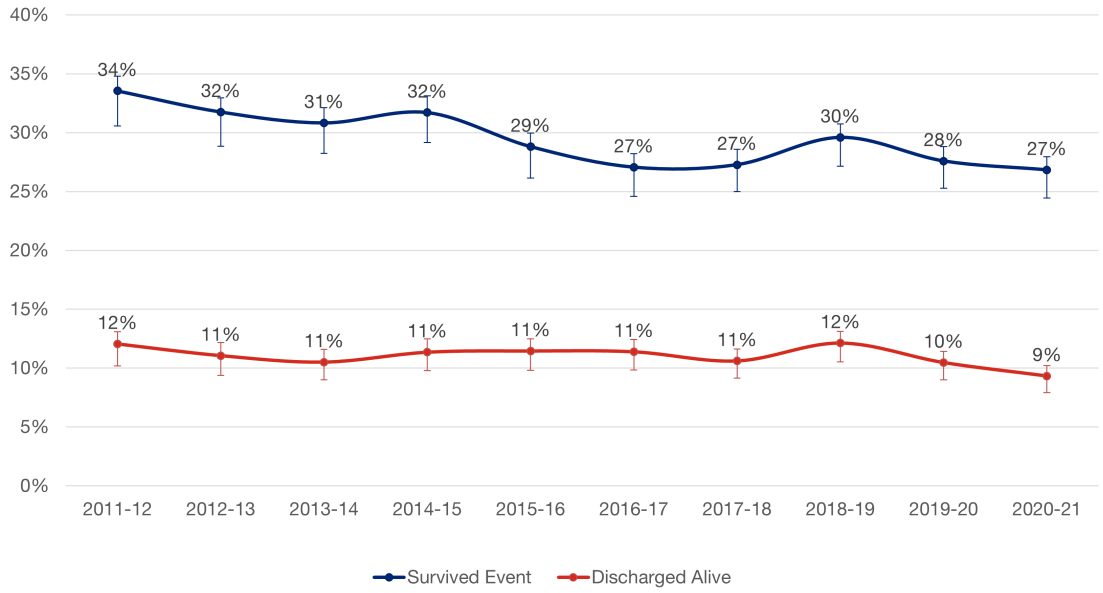


Figure 20: Unadjusted survival outcomes for all-cause adult EMS-treated events.

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 2020-2021, 1% of EMS-treated paediatric cases presented in a shockable rhythm (6% in the previous year). Asystole was the most common presenting rhythm (78%).

In 2020-2021, 27% of paediatric EMS-treated patients survived the event (22% in the previous year), and there were six paediatric patients (8%) who were discharged alive (6% in the previous year). There were five EMS-witnessed paediatric events in 2020-2021. Three patients survived the event and one patient was discharged alive from hospital.

Adult patients presenting in a shockable rhythm

In 2020-2021, 26% 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 (34% in 2011 -2012; 34% vs. 26%, p<0.001; see **Figure 21**), consistent with international trends. As the number of arrests presenting in a shockable rhythm decreases, overall survival is subsequently impacted.

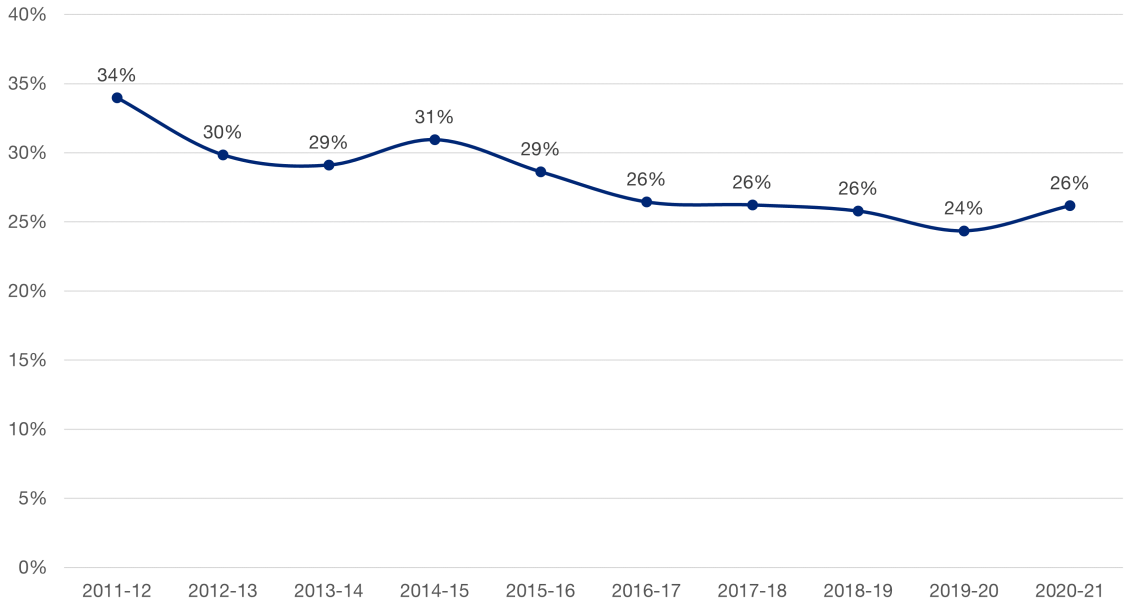


Figure 21: Proportion of adult EMS-treated events presenting in a shockable rhythm on arrival.

Adult 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 adult patients found in a shockable rhythm during 2020-2021, 52% survived the event and 30% were discharged alive (see **Figure 22**). In comparison, 8% of adult patients who presented in PEA were discharged alive (in the previous year, this was 9%). Few adults presenting in asystole (0.3%) were discharged alive (in 2019-2020, this was 1%).

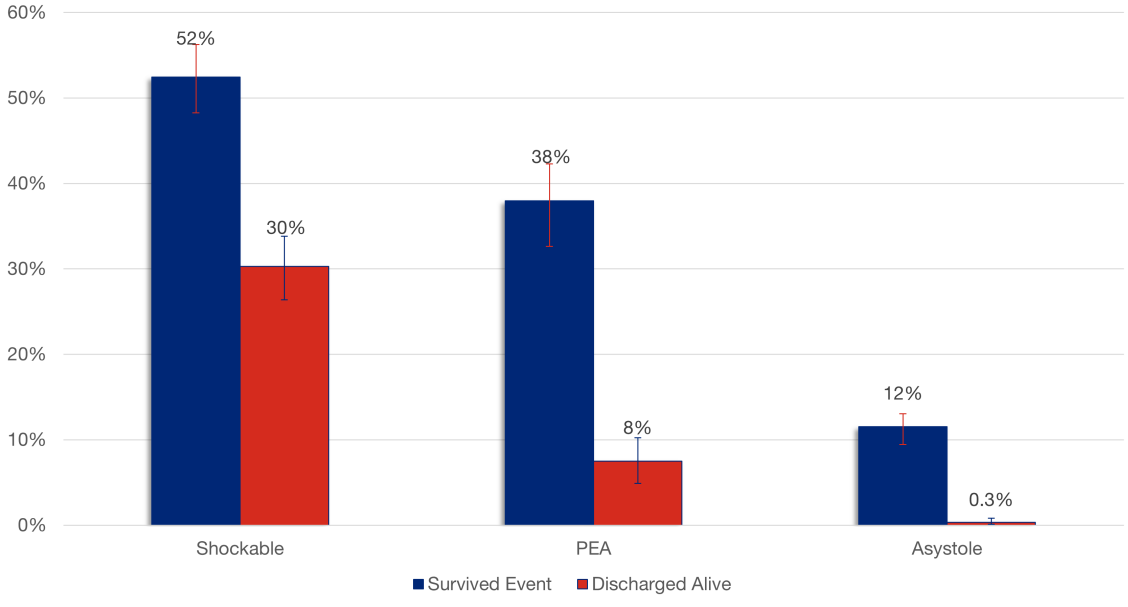


Figure 22: Unadjusted survival outcomes for adult EMS-treated events, according to presenting rhythm.

While both event survival and survival to hospital discharge for adults in shockable rhythms were lower than the previous year (55% and 34%, respectively), survival rates for adult patients presenting in a shockable rhythm have remained relatively consistent over the last decade (see **Figure 23**). The reduced survival rates observed this year are again likely to be influenced by the COVID-19 pandemic, as fewer patients arrested in public places, were witnessed to arrest by a bystander, and delays to time-critical EMS interventions were observed.

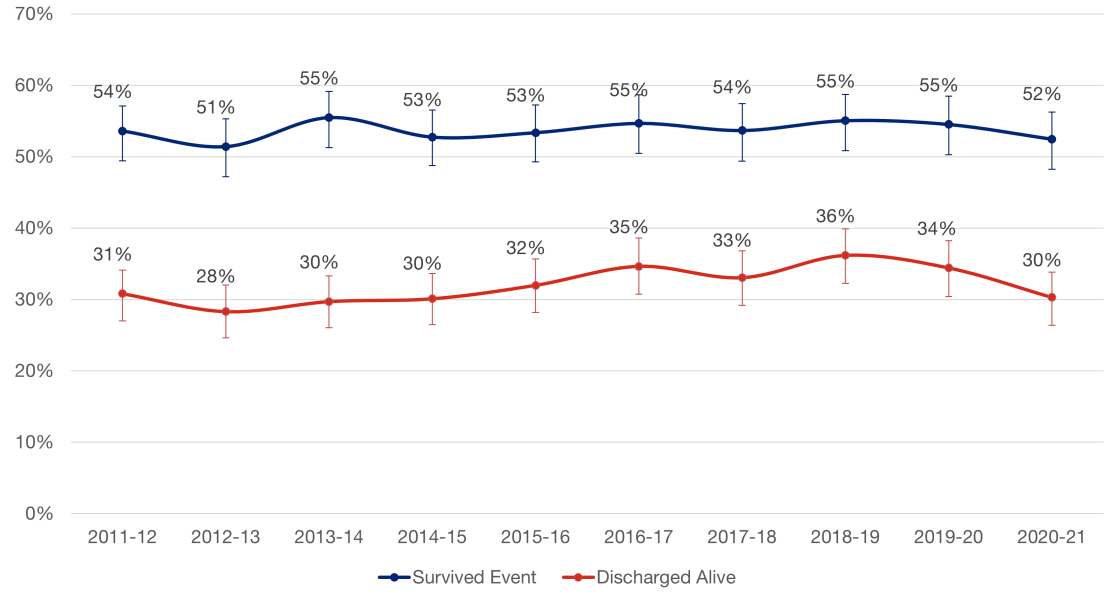


Figure 23: Unadjusted survival outcomes for adult EMS-treated patients presenting in a shockable rhythm.

Adult survival from EMS-witnessed arrests

In 2020-2021, for adult EMS-witnessed events arresting into a shockable rhythm, the rate of event survival was 84% and the rate of survival to hospital discharge was 76% (see **Figure 24**). When considering all adult EMS-witnessed events during 2020-2021, the rate of event survival was 52% (in the previous year, this was 47%) and 30% were discharged alive.

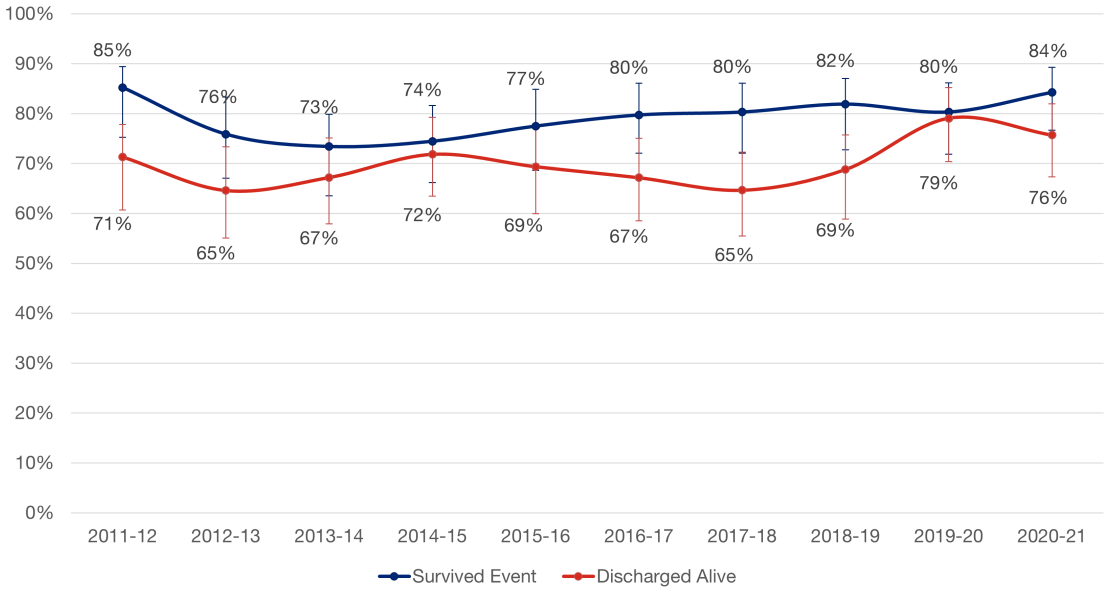


Figure 24: Unadjusted survival outcomes for adult EMS-witnessed, EMS-treated events with a shockable arrest rhythm.

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.

The Utstein template focuses on survival within the following patient subgroup: OHCA events where EMS attempted resuscitation, the arrest was witnessed by a bystander and the presenting cardiac rhythm was shockable (VF or VT).

Figure 25 shows state-wide survival to hospital discharge for the Utstein patient subgroup for the last decade. In 2020-2021, the state-wide rate of survival to hospital discharge for was 35%, which is lower than the 38% observed in 2019-2020. The Utstein patient subgroup is another subgroup of patients in which this year's reduced survival rate is likely to be influenced by the COVID-19 pandemic.

Within the metropolitan and rural regions, the rates of being discharged alive within the Utstein patient subgroup were 34% and 36%, respectively.

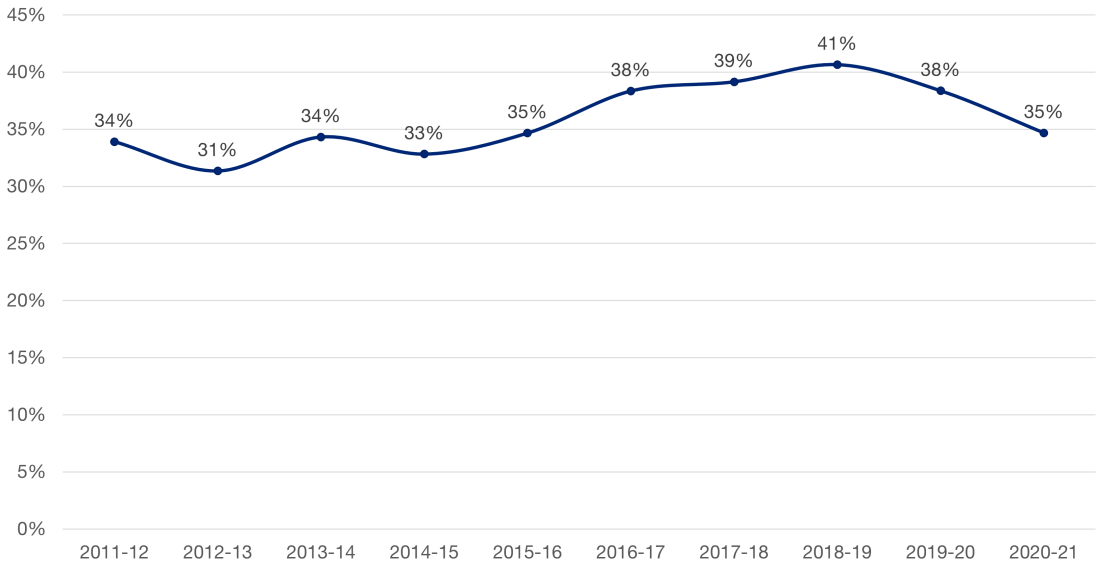


Figure 25: Survival outcomes for the Utstein patient group over the last decade.

Survival per million population

Figure 26 presents the rate of survival per million population. In 2020-2021, there were 55 all-cause OHCA survivors per million population. Understanding the number of survivors per million population allows for international comparison, and controls for variations within populations that influence absolute case numbers. In 2020-2021, the survivors per million population within the Utstein group (23 survivors per million) was lower than recent observations. Survival per million population for patients with an initial rhythm of VF/VT was 44 survivors per million, and patients that were witnessed by EMS was 21 survivors per million.

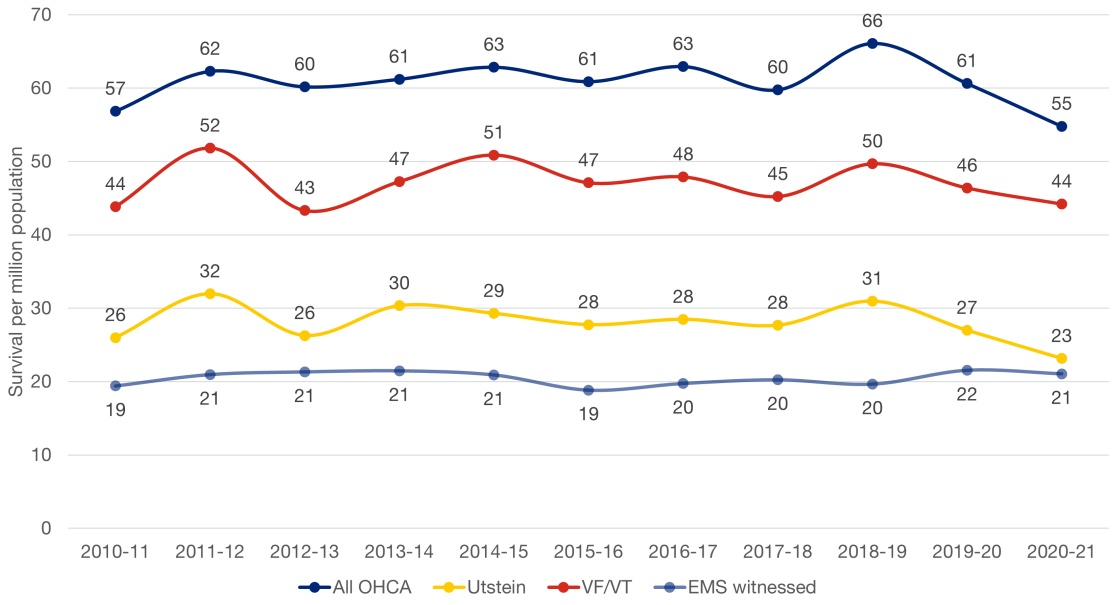


Figure 26: Survival per million population for all OHCA, the Utstein patient group, patients presenting in VF/VT, and EMS-witnessed arrests.

Benchmarking Utstein survival

Table 7 compares survival to hospital discharge in Victoria for the Utstein patient group, a useful benchmarking patient subgroup, to international data.

It should be noted that there are discrepancies in the definition of the Utstein patient subgroup by international ambulance services, making comparison of survival rates difficult. The Utstein patient subgroup definition used by AV no longer specifically selects patients where the arrest was due to a presumed cardiac cause. Instead, we include arrests due to any causes, as per the most recent recommendations for reporting of the Utstein comparator group (Perkins 2015). As evident in Table 7, some groups still focus on the presumed cardiac patient subgroup and some exclude patients arresting due to a traumatic cause. Some groups also only include adult patients.

Other factors to consider in interpreting this data and drawing comparisons include: some ambulance services follow different guidelines for when to start and/or stop resuscitation; it is possible that some organisations omit short, yet futile resuscitation attempts from their analyses of patient outcome data; ambulance agencies service markedly different land areas and population sizes; some of the survival data presented in Table 7 are from the pre-COVID-19 pandemic period, and results should therefore be interpreted with caution given the impact COVID-19 has had on OHCA survival in Victoria.

The survival to hospital discharge rate in the Utstein patient subgroup in Victoria was 35% in 2020-21, which is comparable to a number of other ambulance services or other large collaborative studies/registries around the world. Survival for metropolitan Melbourne was 34% in 2020-2021. 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 41%.

Table 7: Published Victorian and international OHCA survival to hospital discharge data for the Utstein patient group.

Organisation	Time period	% survival
Ambulance Victoria - Metropolitan Melbourne - Inner Melbourne*	2020-2021	35% 34% 41%
Seattle & King County EMS 2021 Annual Report)^^	2020	39%
London Ambulance Service Cardiac Arrest Annual Report 2018-2019^	2018-2019	37%
St John Western Australia Out-of-Hospital Cardiac Arrest Report 2019	2019	35%
Queensland Ambulance Service Out-of-Hospital Cardiac Arrest 2019 Annual Report	2019	35%
St John New Zealand Out-of-Hospital Cardiac Arrest Registry Summary Report 2019-2020^^^	2019-2020	31%
CARES (Cardiac Arrest Registry to Enhance Survival) 2020 Annual Report^^	2020	29%
South Australian Ambulance Service Cardiac Arrest Registry Summary Report 2016-2017	2016-2017	33%
Out-of-Hospital Cardiac Arrest Register (OHCAR) Ireland Annual Report 2019^^	2019	28%
NSW Ambulance Cardiac Arrest Registry Report 2019	2019	31%
British Columbia Emergency Health Services Cardiac Arrest Annual Report 2019/2020	2019-2020	30%
EuReCa TWO (28 European country OHCA registries, Grasner 2020)	2017	28%
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.
^^^Adult (≥15 years) survival to 30 days.

Yearly risk-adjusted odds of adult survival

Assessing the risk-adjusted odds of survival provides a balanced method of measuring yearly trends in resuscitation performance and outcome. We evaluated the odds of survival to hospital discharge for the adult EMS-treated population across years using a multivariable model adjusted for known predictors of survival. These predictors included: age, sex, public location, initial shockable rhythm^, bystander-witnessed status and bystander CPR. The 2005-2006 year was used as the reference category. Some of these initiatives outlined in **Table 10** are likely to have driven improvements in patient outcomes outlined in this report.

Figure 27 demonstrates strong growth in the survival to hospital discharge outcomes from 2005-2006 to 2018-2019. However, the relative odds of survival decreased in 2019-2020 and 2020-2021. Such findings are likely to be associated with the COVID-19 pandemic. Despite this in 2020-2021, the relative odds of survival to hospital discharge for adult EMS-treated patients were 1.5-times that of 2005-2006 (adjusted odds ratio 1.5, 95% CI 1.1-1.9, p=0.003).

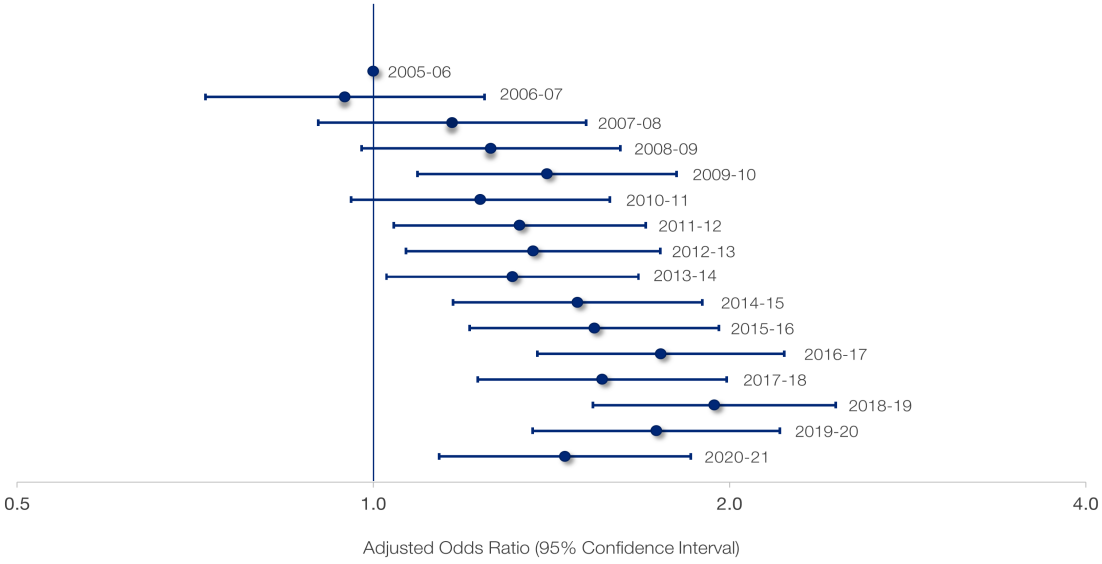


Figure 27: Risk-adjusted odds of adult survival to hospital discharge by year in the overall EMS-treated population.

Similarly, over time there have been improvements in the odds of survival to hospital discharge for patients presenting in a shockable rhythm (see **Figure 28**), although the impact of the COVID-19 pandemic can again be seen. In 2020-2021, the relative odds of being discharged alive had increased by 70% compared to 2005-2006 (adjusted odds ratio 1.7, 95% CI 1.3-2.3, p<0.001).

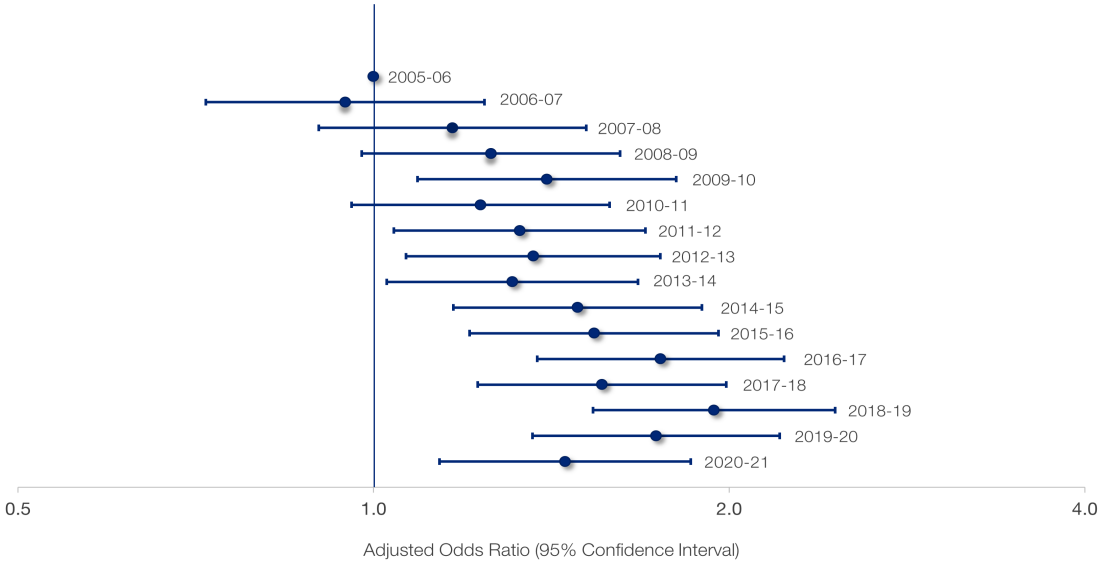


Figure 28: Risk-adjusted odds of survival to hospital discharge for adults presenting in a shockable rhythm by year in the EMS-treated population.
^The shockable rhythm factor was not included in this regression model.

Improving survival from out-of-hospital cardiac arrest

AV 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 themes 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.

Despite the challenges of the last year, AV has continued 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 Quality Improvement
3. Begin high-performance EMS CPR with ongoing training and Quality Improvement
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

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

AV was the first Australian ambulance service to establish a state-wide 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. VACAR now collects extensive data from Triple Zero (000) calls of cardiac arrest events, including time of arrest recognition and time of telephone CPR instructions. AV is also developing an artificial intelligence framework to assist call-takers in recognising the potential for the patient to be in cardiac arrest at the earliest point in the call.

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 ROSC, surviving to hospital and surviving to hospital discharge with good neurological outcomes. As previously explained, implementing HP-CPR has been associated with a 33% improvement in the risk-adjusted odds of survival to hospital discharge.

Program 5: Measure resuscitation efforts

Data from feedback pads used during the resuscitation, combined with call-taking and dispatch data, patient care record 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 organisational performance.

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 Fire Rescue Victoria (FRV) and the Country Fire Authority (CFA) through the Emergency Medical Response (EMR) program. FRV and participating CFA crews are co-dispatched 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 close to 40 volunteer and integrated CFA stations across Victoria.

Program 7: Use technology to improve community response

AV has introduced the GoodSAM program to alert community responders to cases of cardiac arrest. 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.

Program 10: Work towards a culture of excellence

AV's introduction of post-arrest debrief reports for paramedics is a key step towards building a culture of excellence in OHCA management. The reports provide an opportunity to recognise and celebrate good performance, identify areas for improvement and facilitate discussion between paramedics, their manager, and clinical leaders. AV is also an international leader in conducting clinical trials which aim to expand the scientific evidence-base underpinning pre-hospital care. AV paramedics are actively involved in these clinical trials by randomising, enrolling and treating eligible patients. These trials inspire clinicians and build a culture of excellence.

Long-term outcomes

Discharge direction for all survivors

When considering all adult OHCA survivors to hospital discharge, 85% were discharged home (including EMS-witnessed events and excluding unknown discharge status; see **Figure 29**). The rate of discharge to the home for adult survivors has remained consistent over the last decade. In 2020-2021, remaining adult survivors were discharged to rehabilitation (13%) and nursing homes (2%). 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, 88% were discharged home.

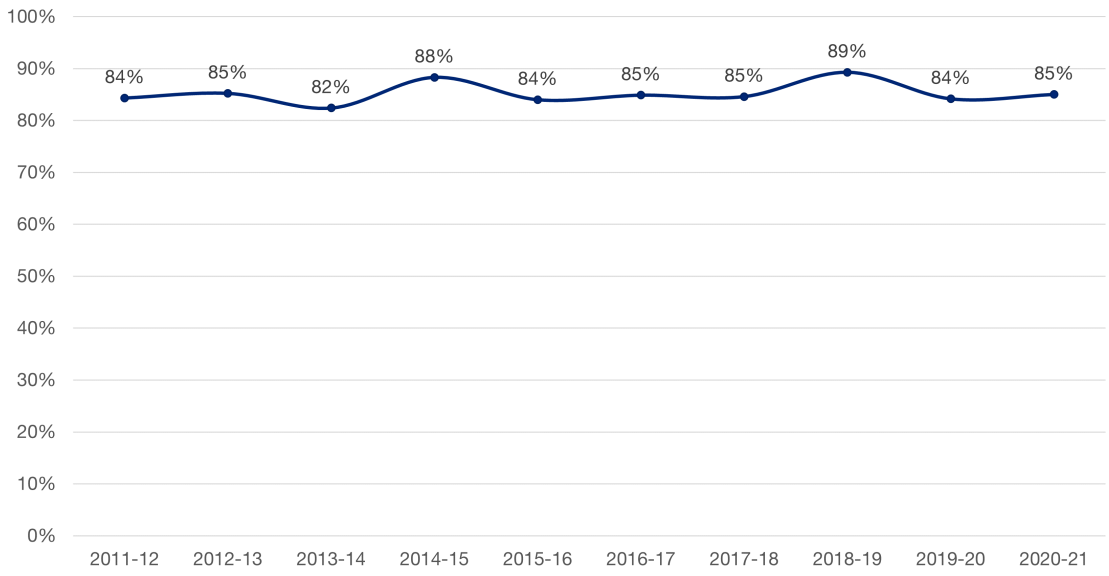


Figure 29: Proportion of adult survivors to discharge who were discharged to private residence (includes EMS-witnessed events).

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 three attempts are made to contact patients at different time points, including after hours. Interviews are performed from a central location.

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

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) population norms; scores range from -0.594 (worse than death) to 1 (full health) (Szende 2007). In 2020/21, we transitioned from using the 3-Level version of the EQ-5D to the 5-Level version. It is hoped that the 5-Level version will increase discrimination among patient responses.

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 responders by complete this questionnaire. SF-12 scores consist of the Physical Health Component Summary (PCS) and Mental Health Component Summary (MCS), each of which range from 0-100 (full health). A standardised mean difference (SMD) can be calculated to demonstrate 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.

Modified Fatigue Impact Scale (MFIS) (Schiehser 2015). The MFIS is a multidimensional scale that consists of 21 questions, each ranging from 0 (Never) to 4 (Always). The scale reports on three subscales of fatigue: physical fatigue, with scores ranging from 0 to 36; cognitive fatigue, with scores ranging from 0 to 40; and, psychosocial fatigue, with scores ranging from 0 to 8. The scores of each subscale can be totalled to achieve an overall fatigue score, ranging from 0 to 84. High scores indicates higher levels of fatigue. An overall MFIS score of 38 or above has been reported to be indicative of fatigue in populations of patients with Multiple Sclerosis (Learmonth et al. 2013).

Hospital Anxiety and Depression Scale (HADS) (Zigmond 1983). The HADS is a reliable instrument consisting of 14 questions, 7 of which are used to detect states of anxiety and 7 which are used to detect states of depression. Each individual question is scored a value of between 0 and 3, and relevant questions are totalled to obtained a final score for each of anxiety and depression. Total anxiety/depression scores of between 0 and 7 are considered normal, while scores between 8 and 10 indicate borderline abnormality, and scores between 11 and 21 indicate an abnormal state.

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.

Response rates and returning to work

Of 396 individuals who arrested between 1 July 2019 and 30 June 2020 and were discharged alive from hospital, 378 (95%) were alive 12 months post-arrest and were eligible for contact in 2020-2021. Interviews were conducted with 230 patients and 31 proxies (n=261), producing a response rate of 72% (response rate excludes patients who were inappropriate to contact). This is the lowest response rate that we have observed in the last decade, and may be influenced by COVID-19 lockdowns.

There were 159 individuals who had worked prior to their arrest. Of these, 72% (114 of 159) returned to work after their arrest. Of those returning to work, 93% (106 of 114) returned to work in the same role. VACAR have previously conducted more detailed research regarding drivers of returning to work for OHCA survivors (Kearney 2020). Factors which were positively associated with returning to work included 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).

SF-12 Health Survey

SF-12 survey data for OHCA patients who arrested during 2019-2020 and were followed up 12 months later were expressed as SMD scores (outlined on page 53). SF-12 data was available for n=225 patients.

For the first time, we observed reduced physical and mental component outcomes relative to Australian population norms in 2020-2021. The PCS SMD was -0.262 (95% CI -0.408 to -0.116). Similarly, the SMD for the MCS was -0.249 (95% CI –0.401 to -0.096, see **Figure 30**).

Given that the population norms were derived in 2003, it is possible that our findings are related to the COVID-19 pandemic. Existing evidence suggests that the life satisfaction and mental health of Victorians worsened during periods of COVID-19 lockdown. COVID-19 has also generally been associated with high rates of anxiety, depression, and psychological distress.

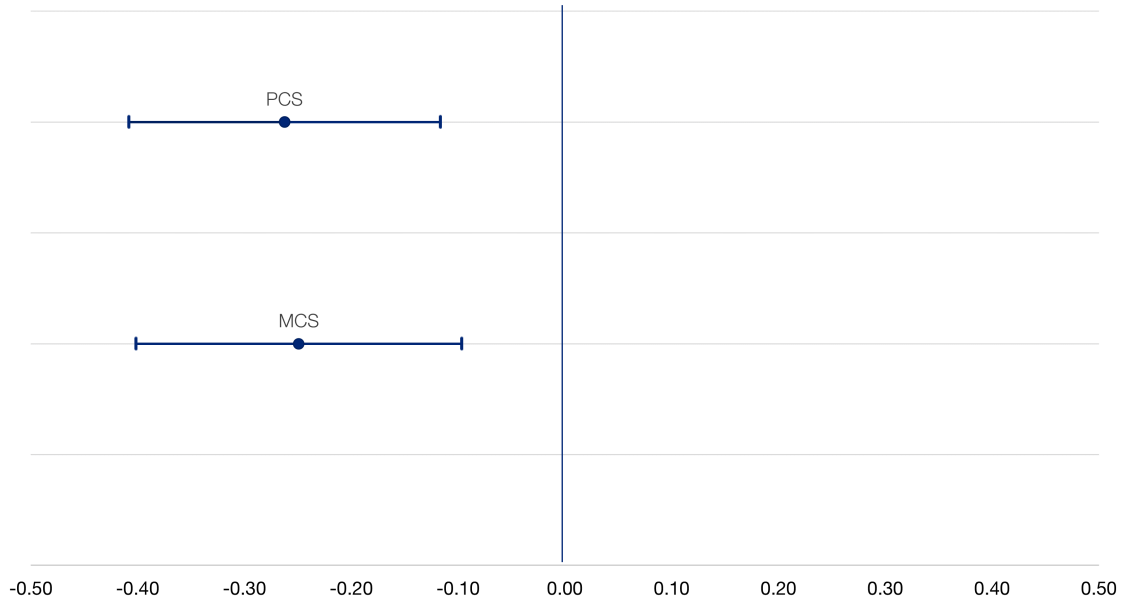


Figure 30: Standardised mean differences for SF-12 scores of OHCA survivors 12 months post-arrest versus the Australian population (patients who arrested in 2019-2020).

GOS-E

According to the GOS-E, 82% of survivors who arrested during 2019-2020 (214 of 260) reported having lower or upper good functional recovery 12 months after their arrest (see **Figure 31**). An additional 8% reported recovery with only moderate disability.

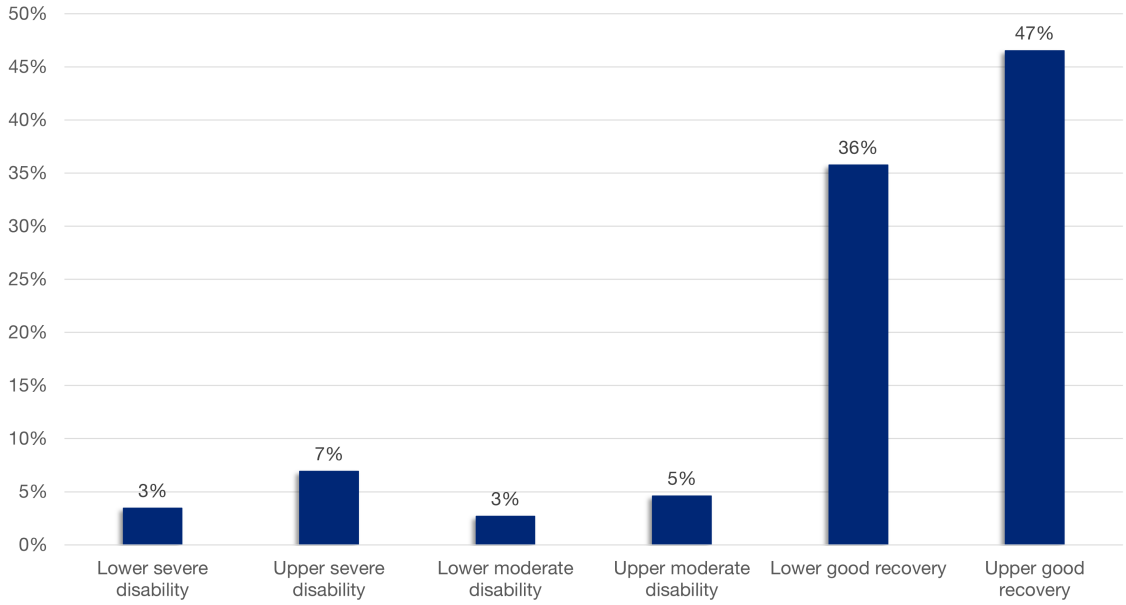


Figure 31: Disability or recovery status according to the GOS-E for OHCA survivors at 12 months post arrest (patients who arrested in 2019-2020).

According to GOS-E scores recorded over the last decade, the majority of OHCA survivors have experienced good post-arrest recovery (indicated by a GOS-E score ≥7). After a decline in 2015 of survivors reporting good functional recovery, a steady increase has been seen since 2016. In 2019-2020, we recorded 82% of 12-month survivors to have a good functional recovery (**Figure 32**).

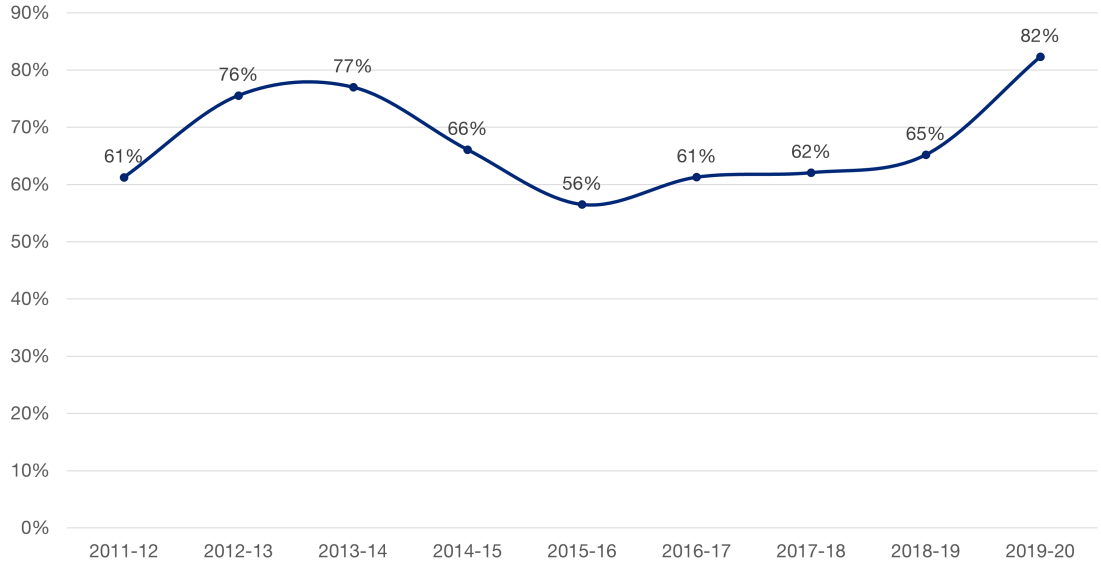


Figure 32: Proportion of survivors with a GOSE-E Score ≥7 (good recovery) over time (2011-2012 to 2019-2020)

EQ-5D

The proportion of responders who reported 'No Problems' in each of the five EQ-5D domains in 2020-2021 are presented in Table 8 below. Respondents were most likely to report 'No Problems' in the domain of self-care, followed by daily activities and mobility.

Table 8: Proportion of responders reporting 'No Problems' across EQ-5D Domains

	n=261
Anxiety	52.5%
Pain	62.8%
Activities	65.1%
Self-care	80.5%
Mobility	64.6%

The median EQ-5D index score for responders who were interviewed in 2020-2021 was 0.86 (Interquartile range 0.66 to 1.0). Most responders (54%) had an EQ-5D index score ≥0.81, approaching full health. Since 2010/2011, OHCA survivors have consistently reported a high level of health as indicated by median EQ-5D index scores of ≥0.81 which is approaching full health (Figure 33). These high EQ-5D index scores are similar to age-and sex-adjusted population norms (Smith 2015). EQ-5D index scores were available for 260 of 261 responders.

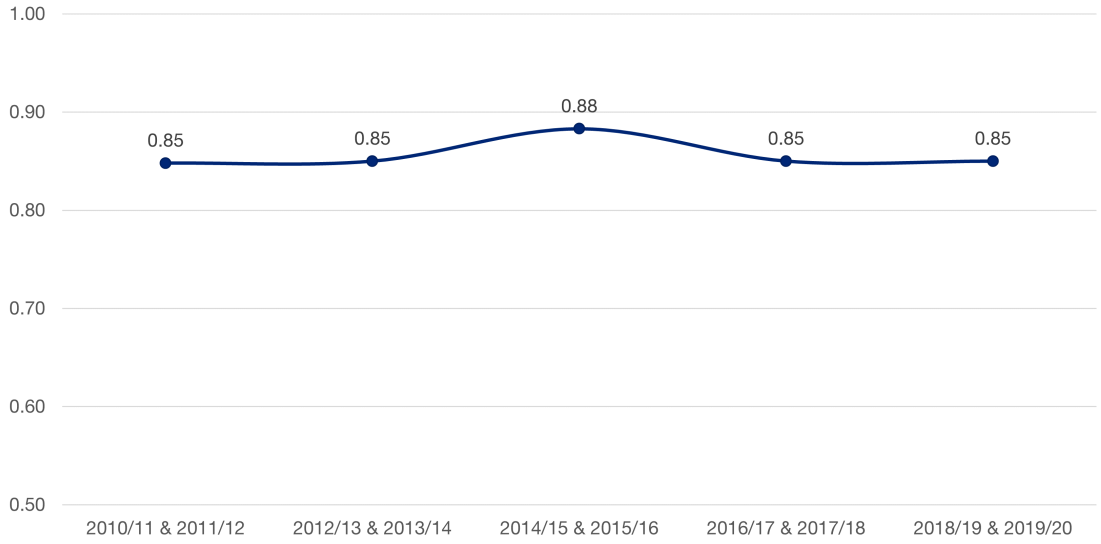


Figure 33: Median EQ-5D Index Score of 12-month OHCA survivors over time (2011-2020)

MFIS

In 2020-2021, we added the MFIS to our 12-month HRQoL interviews. This is therefore the first year in which we are able to report on the fatigue-related outcomes of OHCA survivors.

The results are presented in Table 9. Responses were available for 259 of the 261 responders. For the physical fatigue subscale, 24.7% of responders reported no issues in the previous four weeks, while 32.8% reported no issues in cognitive fatigue. Overall, 22.8% reported no issues with fatigue in the four weeks prior to their interview.

Table 9: Fatigue-related outcomes according to the MFIS

	n=259
Physical subscale (range 0-36)	
Median (90th percentile)	11 (28)
Proportion with no issues in past 4 weeks	24.7%
Cognitive subscale (range 0-40)	
Median (90th percentile)	4 (24)
Proportion with no issues in past 4 weeks	32.8%
Psychosocial subscale (range 0-8)	
Median (90th percentile)	0 (6)
Proportion with no issues in past 4 weeks	51.7%
Overall score (range 0-84)	
Median (90th percentile)	17 (57)
Proportion with no issues in past 4 weeks	22.8%

HADS

We also added the HADS scale to our12-month HRQoL interviews in 2020-2021. Responses were available for 258 patients. The vast majority of responders reported no problems with anxiety (74.4%) or depression (81.3%).

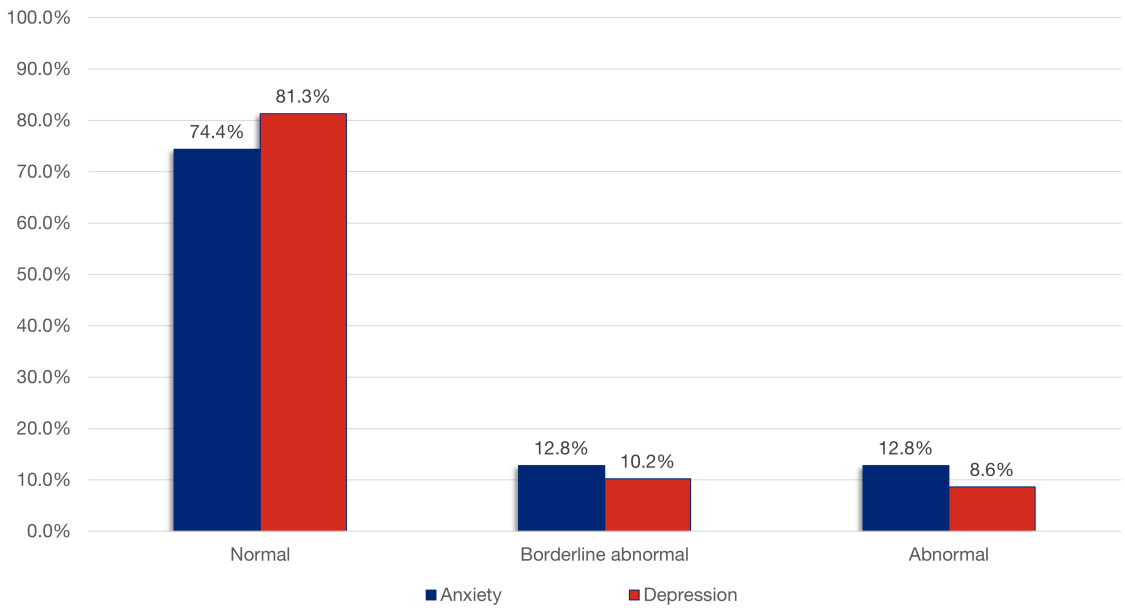


Figure 34: Anxiety and depression outcomes according to the HADS (patients who arrested in 2019-2020).

2020-2021 Research Highlights

"Supporting AV's response to the COVID-19 pandemic has been a high priority for the Research team this year. However, we have continued our extensive research program including our ongoing investigation into the evolving epidemiology of OHCA."

Professor Karen Smith, VACAR Principal Investigator and Chair.

Cardiac arrest in general practice clinics

The outcomes of OHCAs occurring in general practice clinics have not been well described. In this study published in the *Medical Journal of Australia*, Haskins et al. investigated the outcomes of patients who had a cardiac arrest in a general practice clinic. The authors reported that people arresting in general practices who were defibrillated by clinic staff with an AED prior to paramedic arrival were twice as likely to survive to hospital discharge as patients who were not defibrillated until after paramedic arrival. The study suggests that AEDs should be standard equipment in general practice clinics.

Haskins B, Nehme Z, Cameron PA, Smith K. Cardiac arrests in general practice clinics or witnessed by emergency medical services: a 20-year retrospective study. Medical Journal of Australia.2021;215:222-227.

Effect of a resuscitation quality improvement programme

Many ambulance services internationally are implementing programmes to improve the quality and performance of resuscitation. In this study published in *Resuscitation*, Nehme et al. explored the impact of the resuscitation quality improvement programme (consisting of 'HP-CPR') which was implemented in Victoria in February 2019. The authors reported the programme to be associated with a significant increase in survival to hospital discharge, survival to hospital arrival and ROSC. The findings indicate that successful implementation of quality improvement programmes can improve patient outcomes.

Nehme Z, Ball J, Stephenson M, Walker T, Stub D, Smith K. Effect of a resuscitation quality improvement programme on outcomes from out-of-hospital cardiac arrest. Resuscitation. 2021;162:236-44.

Post-resuscitation debrief reports

Post-resuscitation debriefing involves focussed discussion after a cardiac arrest event in which individual actions and team performance are reviewed. In this study published in *Resuscitation*, Villani et al. describe the post-resuscitation debriefing reports developed by AV. The reports are based on 19 key CPR performance metrics which align with international guidelines. The reports are supported by the collection of real-time CPR quality data during resuscitation. Between July and December 2020, over 980 reports were generated and provided to paramedics. The implementation of these reports is a novel example of how a routine feedback process may be embedded into a large state-wide ambulance service.

Villani M, Nehme Z, Burns S, Ball J, Smith K. Detailed post-resuscitation debrief reports: A novel example from a large EMS system. Resuscitation. 2021;162:70-2.

Daylight savings time transitions and out-of-hospital cardiac arrest

Few studies have evaluated the risk of cardiac arrest following daylight savings time transitions. In this world-first study published in *Resuscitation*, Hook et al. evaluated the risk of OHCA following the spring and autumn daylight saving transitions. The authors reported an increased risk of cardiac arrest on the day of the spring transition when sleep is lost, and a cumulative increased risk over the first two days following the transition. In comparison, there was no immediate effect of the autumn transition (when sleep is gained) on risk of cardiac arrest, however there was a 30% reduced in incidence of cardiac arrest up to 6 days after the transition. The study recommended that strategies to reduce the risk of cardiac arrest in vulnerable populations following the spring transition should be considered.

Hook J, Smith K, Andrew E, Ball J, Nehme Z. Daylight savings time transitions and risk of out-of-hospital cardiac arrest: An interrupted time series analysis. Resuscitation. 2021;168:84-90 .

2020-2021 Peer-reviewed Publications

2020-2021

Alqudah Z, Nehme Z, Williams B, Oteir A, Bernard S, Smith K. Impact of a trauma-focused resuscitation protocol on survival outcomes after traumatic out-of-hospital cardiac arrest: An interrupted time series analysis. Resuscitation. 2021;162:104-11 .

Alqudah Z, Nehme Z, Williams B, Oteir A, Smith K. Survival outcomes in emergency medical services witnessed traumatic out-of-hospital cardiac arrest after the introduction of a trauma -based resuscitation protocol. Resuscitation. 2021;168:65-74.

Case R, Stub D, Mazzagatti E, Pryor H, Mion M, Ball J, Cartledge S, Keeble TR, Bray JE, Smith K. The second year of a second chance: Long-term psychosocial outcomes of cardiac arrest survivors and their family. Resuscitation. 2021;167:274-281

Haskins B, Nehme Z, Ball J, Mahony E, Parker-Stebbing L, Cameron P, Bernard S, Smith K. Comparison of out-of-hospital cardiac arrests occurring in schools and other public locations: a 12-year retrospective study. Prehospital Emergency Care. 2021:1-14.

Haskins B, Nehme Z, Cameron PA, Smith K. Cardiac arrests in general practice clinics or witnessed by emergency medical services: a 20-year retrospective study. Medical Journal of Australia.2021;215:222-227.

Hook J, Smith K, Andrew E, Ball J, Nehme Z. Daylight savings time transitions and risk of out-of-hospital cardiac arrest: An interrupted time series analysis. Resuscitation. 2021;168:84-90

Kempster K, Howell S, Bernard S, Smith K, Cameron P, Finn J, Stub D, Morley P, Bray J. Out-of-hospital cardiac arrest outcomes in emergency departments. Resuscitation. 2021;166:21-30

Naccarella L, Saxton D, Lugg E, Marley J. It takes a community to save a life in cardiac arrest: Heart safe community pilots, Australia. Health Promotion Journal of Australia.2021 .

Nehme Z, Ball J, Stephenson M, Walker T, Stub D, Smith K. Effect of a resuscitation quality improvement programme on outcomes from out-of-hospital cardiac arrest. Resuscitation. 2021;162:236-44 .

Nehme Z, Burns S, Ball J, Bernard S, Smith K. The impact of ventricular fibrillation amplitude on successful cardioversion, resuscitation duration, and survival after out-of-hospital cardiac arrest. Crit Care Resusc. 2021;23(2):202-10.

Nehme Z, Smith K. It's time to talk about the 'prevention of resuscitation'. Resuscitation. 2021;163:191-2.

Paratz ED, Smith K, Ball J, van Heusden A, Zentner D, Parsons S, Morgan N, Thompson T, James P, Pflaumer A, Semsarian C, Stub D, Liew D, La Gerche A. The economic impact of sudden cardiac arrest. Resuscitation. 2021;163:49-56.

Villani M, Nehme Z, Burns S, Ball J, Smith K. Detailed post-resuscitation debrief reports: A novel example from a large EMS system. Resuscitation. 2021;162:70-2

Ambulance Victoria key initiatives over time

Table 10 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.

Table 10: 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	▶ Victorian Ambulance Cardiac Arrest Registry established ▶ Pilot of firefighters as first responders in central Melbourne
2000-01	▶ Metropolitan Ambulance Service and Rural Victoria start training paramedics in Advanced Life Support (ALS)
2001-02	▶ Roll out of fire-fighters as first-responders across metropolitan Melbourne ▶ Victorian State Government announces funding for a Public Access Defibrillation (PAD) program
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	▶ Completion of VACIS roll-out in ambulances servicing metropolitan regions of Victoria ▶ Australian Resuscitation Council (ARC) Guidelines update 2006
2006-07	▶ Simplification of telephone-assisted CPR instructions to 400 compressions before mouth-to-mouth
2007-08	▶ Pilot of volunteer fire-fighters as first-responders in peripheral Melbourne ▶ Pre-hospital therapeutic hypothermia for selected patients
2008-09	▶ Metropolitan Ambulance Service, Rural Ambulance Victoria and Alexandra District Ambulance Service merge to form Ambulance Victoria (AV) ▶ 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 ▶ Completion of VACIS roll-out in ambulances servicing rural regions of Victoria ▶ AV commences AED Registry which records the locations of AEDs across Victoria
2010-11	▶ 2011 ARC Guidelines update ▶ AV CPR awareness programs trains 800,000 people since 2004 ▶ Pilot of fire-fighter first-responders in peripheral Melbourne and one rural location
2011-12	▶ Victorian State Government announces funding for mobile intensive care (MICA) single responder units (SRUs) in rural areas ▶ Expansion of operating area for MICA Single Responder Units in metropolitan areas

Year	Table 10 (continued)
2014-15	▶ Update and simplification of the Utstein template for uniform collection and reporting of OHCA data ▶ AV Dispatch Grid review and implementation of revised grid ▶ Victorian Government commits to expanding fire fighter first responder program to all integrated (staffed by both full-time and volunteer fire-fighters) fire stations
2015-16	▶ 2016 ARC Guidelines update ▶ AV OHCA guidelines updated ▶ Upgrade of the AV AED Registry
2016-17	▶ More than 88,000 OHCA cases entered into VACAR ▶ AV CPR awareness programs trains more than 979,000 people since 2004
2017-18	▶ More than 95,000 OHCA cases entered in VACAR ▶ AV CPR awareness programs train more than 1 million people since 2004 ▶ Upgrade of the AV AED Registry and publicity campaign encouraging AED owners to register their devices ▶ Pilot of real-time and post event feedback on CPR quality for paramedics ▶ Roll out of the GoodSAM first responder app to paramedics and members of partner organisations
2018-19	▶ VACAR contains 20 years of Victorian OHCA data ▶ The 100,000th OHCA case entered into VACAR ▶ Roll out of High Performance CPR for EMS management of OHCA ▶ Expansion of the GoodSAM first responder app to appropriately first-aid trained members of the public ▶ Establishment of Sudden Cardiac Arrest Australia (SCAA) support group for cardiac arrest survivors
2019-20	▶ More than 110,000 cases entered into VACAR ▶ Introduction of Team Performance Report for cardiac arrest brief ▶ Impact of COVID-19 on OHCA outcomes monitored in real time; findings to reinforce maintaining the links in
2020-21	▶ Additional Quality of Life survey tools introduced to 12-month follow-up ▶ VACAR data capture expanded to include more data points related to High Performance CPR, 000 call-data

List of Abbreviations

ABS	Australian Bureau of Statistics
ACO	Ambulance Community Officer
ALS	Advanced Life Support
AED	Automated External Defibrillator
ARC	Australian Resuscitation Council
AV	Ambulance Victoria
CERT	Community Emergency Response Team
CFA	Country Fire Authority
CI	Confidence Interval
CPR	Cardiopulmonary Resuscitation
DH	Department of Health
ECG	Electrocardiogram
EMS	Emergency Medical Services
EQ-5D	EuroQoL 5 Dimension questionnaire
FRV	Fire Rescue Victoria
GOS-E	Glasgow Outcome Scale—Extended
HADS	Hospital Anxiety and Depression Scale
HP-CPR	High Performance CPR
HRQoL	Health-Related Quality Of Life
LGA	Local Government Area
MCS	Mental Component Summary of the SF-12
MFIS	Modified Fatigue Impact Scale
MICA	Mobile Intensive Care Ambulance
OHCA	Out-of-Hospital Cardiac Arrest
OR	Odds Ratio
PCR	Patient Care Record
PCI	Percutaneous Coronary Intervention
PCS	Physical Component Summary of the SF-12
PEA	Pulseless Electrical Activity
ROSC	Return of Spontaneous Circulation
SF-12	Twelve-item Short Form health survey
SD	Standard deviation
SIDS	Sudden Infant Death Syndrome
TPR	Team Performance Report
VACAR	Victorian Ambulance Cardiac Arrest Registry
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia

Definitions used in this Report

Adults	Patients aged greater than 15 years of age, or where the age is missing/unknown.
Died at scene	Patients who receive an EMS-attempted resuscitation but do not survive to transport.
Emergency Medical Services	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 the emergency call being answered by the call-taker 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	A 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 AED
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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