ANNUAL REPORT 2023—24

Victorian Ambulance Cardiac Arrest Registry

Ambulance Victoria

Pictured left to right: Eden Bartlett, Belinda Delardes, Ashanti Dantanarayana, Brett Whibley, Kathryn Wilson, Candice Menezes, Ziad Nehme, Jenna Schwarz and Tara Ralph.

Absent: Kimberley Magain, Davina Vaughan and Imrana Hamdani.

WITH THANKS

We gratefully acknowledge the following people for their assistance in the collection of registry data and production of this report:

The VACAR and Research & Evaluation team: Kimberley Magain, Davina Vaughan, Imrana Hamdani, Alyce Drum, Candice Menezes, Kathryn Wilson, Belinda Delardes, Tara Ralph, Jenna Schwarz, Brett Whibley, Eden Bartlett, Devika Damodarasamy, Daniel Okyere, Emily Ockwell, Mikaela Drew, Olivia Latham, Erin Billinghurst, Emily Nehme, Ashanti Dantanarayana, Ziad Nehme.

Ambulance Victoria's Spatial Services team (Jason Muller), First Responder & Community Programs team (Dylan Hall), Community & Partner Engagement team (Joel Marley).

Victorian hospitals for provision of survival outcomes.

The Victorian Ambulance Cardiac Arrest Registry Annual Report 2023/24 is a publication produced by the Centre for Research and Evaluation, Ambulance Victoria.

If you would like to receive this publication in an accessible format, please contact the VACAR team at: **VACAR2@ambulance.vic.gov.au**

ACKNOWLEDGEMENT OF COUNTRY

Ambulance Victoria acknowledges the Traditional Owners of the lands in Victoria. We pay our respects to Aboriginal and Torres Strait Islander cultures and to Elders past and present and recognise Aboriginal self-determination is a human right.

At Ambulance Victoria, we recognise the diverse and unique cultures and histories of Aboriginal and Torres Strait Islander peoples and value the knowledge of countless generations of Custodians. We commit to working together to build a fair and just future. We will come together with Aboriginal and Torres Strait Islander communities to identify, understand, and develop opportunities to create and sustain a culturally aware organisation.

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A Message from the **Leadership Team**

Dr Ziad Nehme ASM

Director, Centre for Research & Evaluation
Chair, Victorian Ambulance Cardiac Arrest Registry

Dr Tegwyn McManamny

Executive Director, Quality and Clinical Innovation

Out-of-hospital cardiac arrest (OHCA) is a leading cause of death and a significant public health emergency in developed countries. Affecting more than 30,000 people every year in Australia, survival from OHCA remains low with one in ten patients surviving to hospital discharge. However, when Cardiopulmonary Resuscitation (CPR) and defibrillation are provided quickly, alongside an effective system-of-care, the likelihood of survival increases significantly – a sequence of actions known internationally as the **Chain of Survival**.

Since 1999, the Victorian Ambulance Cardiac Arrest Registry (VACAR) has been monitoring and improving the journey of OHCA patients across the links in the Chain of Survival.

Since that time, we have achieved substantial improvements in the care of OHCA patients, through innovations in resuscitation care, call-handling and dispatch, community engagement, and digital applications, including the launch of the smartphone CPR crowd-sourcing app, GoodSAM.

In addition, we have developed an internationally recognised capability for research and clinical trials at Ambulance Victoria which has helped inform the evidence-base in resuscitation.

Today, the VACAR is among the most comprehensive multi-source cardiac arrest registries in the world, routinely capturing 12-month quality-of-life outcomes in survivors and coronial and autopsy information from the National Coronial Information System in non-survivors.

Despite the significant challenges posed by the COVID-19 pandemic in recent years, Ambulance Victoria has recorded its highest ever internationally comparable (Utstein) survival rate in 2023/24.

A survival rate of 41% for bystander witnessed, initially shockable OHCA represents one of the highest survival rates in the world, and the single largest annual increase to survival over the past decade.

Today, the VACAR is among the most comprehensive multi-source cardiac arrest registries in the world.

These improvements in patient outcomes have not occurred by chance, but have been informed by the evidence-based insights and programs of our Cardiac Arrest Improvement Strategy 2023-2028.

The strategy was developed in response to the devastating impacts of the COVID-19 pandemic on OHCA outcomes in Victoria and underpins our commitment to enhancing the quality of care for OHCA patients.

Over the past 12 months, the strategy has informed the delivery of a number of novel initiatives at Ambulance Victoria. We launched an Australian-first initiative to notify paramedics in writing when patients they treated were discharged from hospital alive following an OHCA.

The initiative ensures that paramedics receive feedback about the outcomes of their patients and reinforces the importance of a quality feedback loop with clinicians.

In addition, we saw the delivery of end-of-life and termination of resuscitation education for paramedics and enhanced clinical practice guidelines that sought to roll-back changes made during the COVID-19 pandemic.

The impact of these changes has translated into some of the best resuscitation quality outcomes in our history.

In particular, the proportion of initially shockable OHCA patients receiving an adequate duration of resuscitation has almost doubled since targeted education was delivered to paramedics.

Furthermore, our Strategy and Engagement team have delivered a comprehensive program of community initiatives, launching 12 new HeartSafe communities, an expanded Kids Save Lives program, an upscaled Shocktober campaign and providing training to more than 18,000 Victorians in the Call, Push, Shock program.

Supported by competitive research funding we have also launched two new clinical trials with a focus on early defibrillation and post-resuscitation care.

The FIRST trial is a cluster randomised controlled trial that will examine the value of equipping smartphone-activated first responders (GoodSAM responders) with an ultraportable Automated External Defibrillator (AED), while the PANDA trial compares the use of adrenaline and noradrenaline in patients with cardiogenic shock.

These world-first clinical trials will enhance the evidence-base underpinning the chain of survival and provide new opportunities for improving patient outcomes.

To that end, we are pleased to present the findings of the 2023-24 VACAR Annual Report, showcasing the exceptional achievements of community, paramedics and clinicians, in the delivery of cardiac arrest care in Victoria.

Dr Ziad Nehme ASM

Director, Centre for Research & Evaluation

Chair, Victorian Ambulance Cardiac Arrest Registry

Dr Tegwyn McManamny

Executive Director, Quality and Clinical Innovation

Executive Summary:
2023/24 Key Highlights

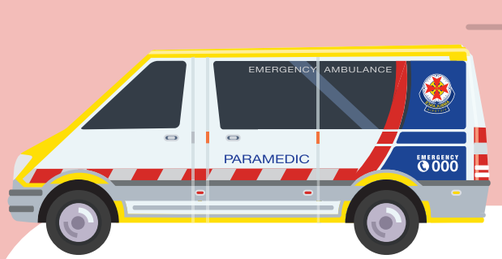
Ambulance Victoria are committed to the care of cardiac arrest patients

7,545
Out-of-hospital cardiac arrest patients across Victoria

3.7%
decrease from the previous year

67% were male

78%
of cardiac arrests occurred at home



93%
of calls were correctly directed by bystanders to Triple Zero Victoria (000) ambulance

87%
of cardiac arrests were identified in the Triple Zero Victoria (000) call

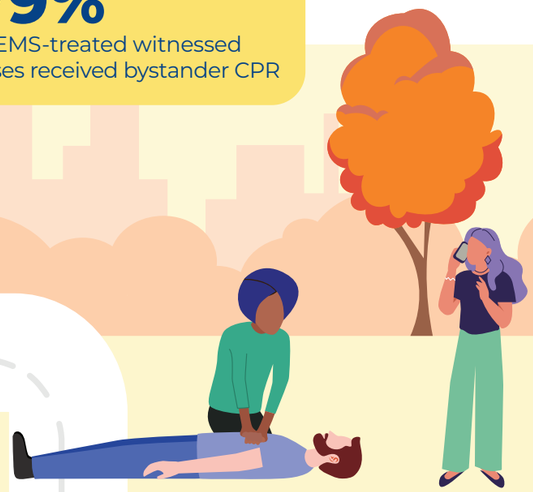
The majority of cardiac arrest patients were attended within 10 minutes

Median response time
8.0 minutes

Half of all patients were defibrillated within
9.9 minutes

More than ever before, the community are stepping in to help in cardiac arrest emergencies

79%
of EMS-treated witnessed cases received bystander CPR



141 cases
had a shock delivered from a public AED, the highest number on record

47%
survived when first shocked by public AED

32%
survived when first shocked by EMS

AED

14%
survived when they received bystander CPR

6% survived with no bystander CPR

Cardiac arrest patients are returning home to their families

84%
of survivors were discharged from hospital directly home to their families

422
patients were discharged alive

41%
of patients discharged alive (Utstein cohort)

88%
of patients who survived to 1 year report favourable neurological recovery

Victorian Ambulance
Cardiac Arrest Registry

The Victorian Ambulance Cardiac Arrest Registry (VACAR) was established in 1999 and incorporates prehospital clinical and operational data, communications centre dispatch records, and hospital follow-up data for all OHCA events in Victoria where Ambulance Victoria were in attendance. The data is collated in the registry based on the internationally recognised Utstein template and definitions (Grasner 2024).

Hospital outcome data is supplemented by death records from the Victorian Registry of Births, Deaths and Marriages. Commencing January 2011, 12-month follow-up interviews have also been conducted with adult survivors. The VACAR maintains ethical approval from the Monash University Human Research Ethics Committee.

The VACAR is used to monitor key clinical indicators which measure the quality of ambulance care and allow for performance benchmarking. These clinical indicators include ambulance response times, event survival and survival to hospital discharge.

The registry 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 Communities (in partnership with Heart Foundation Victoria) and public AED use.

In addition, VACAR has successfully established an internationally recognised research program, with the publication of scientific literature in key medical journals (see Research, page 40). The results of the research program are used to provide an evidence base for Ambulance Victoria treatment of cardiac arrest patients.

The VACAR proudly contributes data to the Australian Resuscitation Outcomes Consortium (Aus-ROC) Epistry (**www.ausroc.org.au**), an epistry which was established with the aim of understanding regional, ambulance service and treatment factors associated with improved OHCA outcomes in Australia and New Zealand. In 2019, the VACAR also began contributing to the End Unexplained Cardiac Death (EndUCD) Registry which aims to collect data on all sudden cardiac arrests in patients aged 1–50 years.

Eligibility

The VACAR captures data on all OHCA patients where Emergency Medical Services (EMS) are in attendance. For the purposes of this report, EMS is defined as Ambulance Victoria and participating first responder organisations, including Fire Services Victoria (in selected areas).

The VACAR defines the state of cardiac arrest as the cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation, including the absence of a detectable carotid pulse, unresponsiveness and apnoea or agonal breathing. Patients eligible for inclusion in the VACAR are described at right.

VACAR inclusion and exclusion criteria

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.

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 CPR or defibrillation by EMS.
3. Bystander-suspected cardiac arrest where the patient is not in cardiac arrest on arrival of EMS, no defibrillation was provided prior to arrival, and no other evidence verifying a cardiac arrest state is present.

How we Respond to **Cardiac Arrest in Victoria**

The state of Victoria has an estimated population of 6.6 million spread over almost 227,000km^2. Over 5 million people live in the state's capital city of Melbourne. Ambulance Victoria is the state-wide EMS provider 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, needle thoracostomy and administer a wider range of medications.

Paramedics in Victoria have the base qualification of a three-year bachelor degree in 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 (Triple Zero Victoria '000'). Telephone triage is performed using the Medical Priority Dispatch System. Unless circumstances suggest ventilations (as is the case for patients under the age of 18 years old), suspected cardiac arrest events identified in-call receive telephone CPR, recommending chest compressions 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 firefighters operates for patients in greater Melbourne and a number of large regional towns. In addition, Ambulance Victoria co-responds with 101 volunteer community teams in smaller, predominately rural communities across the state.

Approved community volunteer responders, called GoodSAM responders, are also dispatched to suspected cardiac arrest events. GoodSAM (Smartphone Activated Medic) is a free global smartphone application that is used to facilitate a rapid response to cardiac arrests across the globe by connecting nearby persons to patients experiencing a cardiac arrest in those critical minutes before emergency services arrive. GoodSAM is activated at the same time as ambulance dispatch by Triple Zero Victoria (000) and alerts nearby registered users of the app of an event, as well as the location of the nearest AED.

Since the launch of the GoodSAM app on 28 January 2018, more than **17,327 volunteers have registered in the GoodSAM app**. More than 10,304 AEDs are currently active and registered to individuals and businesses in Ambulance Victoria's AED registry, more than 7,563 of which are public AEDs.

Since 2018

17,327

volunteers have registered to the **GoodSAM app**

Ambulance Victoria cardiac arrest protocols follow the recommendations of the Australian and New Zealand Committee on Resuscitation. Paramedics are not obliged to commence resuscitation when the clinical presentation is inconsistent with life. They may discontinue resuscitation if advanced life support has been performed for 45 minutes without sustained return of spontaneous circulation (ROSC), unless there are exceptional circumstances as described in clinical practice guidelines.

In 2019, a resuscitation quality improvement initiative was rolled out across the state, training all paramedics and first responders in high-performance CPR. The initiative was supported by team-based resuscitation training, real-time feedback on CPR performance, structured resuscitation choreography and scene leadership, and post-event debriefing.

Paramedics in Victoria are also required to complete an annual high-performance CPR competency test. Ongoing monitoring of resuscitation quality occurs after every resuscitation attempt and paramedics attending a resuscitation are provided with a data-driven post-resuscitation debriefing report. These debriefing reports, called Team Performance Reports, consist of 19 metrics which align with international treatment recommendations and key actions within the Chain of Survival.

AV's Key Initiatives to Improve Cardiac Arrest Outcomes

1999

Victorian Ambulance Cardiac Arrest Registry (VACAR) established

2000

Metropolitan Ambulance Service and rural Victoria start training paramedics in Advanced Life Support (ALS)

Firefighters in metropolitan Melbourne are trained as emergency medical responders (EMRs), being dispatched at the same time as paramedics to life-threatening emergencies

2003

CPR awareness program launched in Victoria by Metropolitan and Rural Ambulance Services

2007

Simplification of telephone-assisted CPR instructions to 400 compressions before mouth-to-mouth

x400 compressions

2008

Metropolitan Ambulance Service

Rural Ambulance Victoria

Alexandra District Ambulance Service

merge to form

Ambulance Victoria

Expansion of the firefighter EMR program to outer metropolitan and regional areas of Victoria

2009

Ambulance Victoria commences an AED Registry which records the locations of AEDs across Victoria

2011

VACAR starts collecting patient-reported quality of life (QOL) and functional recovery data

2012

Expansion of MICA single responder units in metropolitan Melbourne and rural Victoria

2016

Clinical practice guidelines for resuscitation updated

2017

240+ career firefighters across Victoria are trained through the EMR program

Commencement of the EXACT clinical trial (titration of oxygen after cardiac arrest)

2018

CPR awareness programs, including

Heart Safe Communities, train more than 1 million people since 2004

Pilot of real-time and post event feedback on CPR quality for paramedics

Launch of the GoodSAM first responder app to paramedics and members of partner organisations

2019

Expansion of the GoodSAM first responder app to members of the public

VACAR 20-year anniversary and milestone 100,000th OHCA case recorded

20 YEARS ANNIVERSARY

2020

Introduction of Team Performance Report for cardiac arrest debriefing

Roll out of High Performance CPR for paramedics

2022

Artificial Intelligence developed to improve the detection of cardiac arrest in Triple Zero Victoria (000) calls (the AIDE study)

2023

2023-2028 Cardiac Arrest Improvement Strategy released

Commencement of FIRST and AUGMENT-VA clinical trials in 2022

2024

Notification of Cardiac Arrest Survivors for Staff to receive feedback on their quality of care and outcomes

Commencement of PANDA trial

Cardiac Arrest **Improvement Strategy**

In 2018/19, Ambulance Victoria reported its highest ever survival rate from OHCA. This improvement was not due to luck, but rather, the implementation of a targeted and comprehensive resuscitation quality improvement bundle. However, the COVID-19 pandemic had a devastating impact on the OHCA system of care across Australia and internationally. OHCA survival remains lower now than it was prior to the pandemic.

To improve survival from OHCA, Ambulance Victoria developed a Cardiac Arrest Improvement Strategy 2023–2028. The strategy provides a focus for improving survival from OHCA between 2023 and 2028. Its ambitious goal is to improve survival to hospital discharge by 30% in bystander witnessed, initially shockable OHCA (the Utstein comparator group), or from 34% in 2021/22, to 44% in 2027/28.

See the Strategy here

Our Target

To improve survival to hospital discharge by

30%

in bystander witnessed initially shockable OHCA

Cardiac Arrest Improvement **Strategy Highlights**

Notifying paramedics when patients survive

In 2023/24, we launched a new initiative where VACAR are sending letters to Ambulance Victoria staff involved in the resuscitation of cardiac arrest patients when those patients have been discharged alive from hospital.

As one of the Cardiac Arrest Improvement Strategy (CAIS) recommendations, these letters play an integral part in the quality feedback loop and recognises the importance of providing paramedics with information about the health outcomes of their patients.

Thanks to the hard work of paramedics, **422 cardiac arrest patients were discharged alive in 2023/24** with the vast majority returning to their families, living healthy and independent lives.

From March 2024, over 1,200 survivor letters have been sent to Ambulance Victoria staff involved in the resuscitation of cardiac arrest patients.

Over 1,200 survivor letters have been sent to Ambulance Victoria Staff in 2023/24

Choosing the best treatment for cardiogenic shock

Cardiogenic shock is a common medical condition that is present after cardiac arrest. It happens when the body does not have enough oxygen to keep vital organs working properly and this can lead to death or prolong recovery after cardiac arrest. To treat cardiogenic shock, clinicians commonly use medications that constrict blood vessels or increase the heart's pumping function. However, there is limited information on which medication is safer and more effective.

PANDA trial is a world-first clinical trial that aims to compare noradrenaline and adrenaline, the two commonly used drugs for patients with shock in the pre-hospital setting. This world-first clinical trial will help improve future clinical decision-making for patients with shock and ultimately improve patient outcomes. As of June 2024, 31 patients have been enrolled with **75% of MICA paramedics completing the Education package**.

12 new **Heart Safe Communities** were established in 2023/24.

A trial of ultraportable AEDs

We launched the First Responder Shock Trial (FIRST) in collaboration with Hato Hone St John New Zealand. The FIRST trial is an evolutionary clinical trial that aims to examine whether equipping GoodSAM responders with a personal, single use, ultraportable AED can help reduce the time to first defibrillation and increase survival from OHCA.

The trial is the first of its kind internationally and helps to address the social and geographical barriers that exist in the current placement of AEDs in the community. As of June 2024, **646 patients have been enrolled in the FIRST trial** and it is expected to complete recruitment early in 2025.

Expansion of the Heart Safe communities program

Heart Safe Communities is a public health initiative aimed at improving survival from cardiac arrest by empowering bystanders to step in and have a go at CPR and using an AED.

Heart Safe communities is a joint initiative between AV and the National Heart Foundation of Australia. In 2023/24, **12 new Heart Safe Communities were established** reaching 3,116 Victorians with 62 new 24/7 public AEDs registered and 46 new active GoodSAM responders added.

As part of Ambulance Victoria's Cardiac Arrest Improvement Strategy, Ambulance Victoria will establish 40 new Heart Safe Communities in high-risk regions across Victoria.

Spreading the message: Call Push Shock

Call Push Shock is a community awareness program which aims to raise awareness of the actions required to save a life and address major barriers behind why bystanders fear taking action during cardiac arrest. The program highlights the desired actions to save a life – Call Triple Zero, Push on the patient's chest hard and fast and Shock the heart using an AED.

In 2023/24, 700 Call Push Shock sessions were delivered to over 18,000 individuals. As part of Ambulance Victoria's Cardiac Arrest Improvement Strategy, Ambulance Victoria aims to train more than 100,000 Victorians in the Call Push Shock Program by 2028.

A Story of **Survival**

Austin Blight, 17, said there was no warning before he collapsed on 15 July 2024.

“The last thing I remember was texting my mates’ group chat, then I woke in the cardiac unit a few days later,” he said.

When Austin fell unconscious, gym staff immediately rushed to his aid and quickly realised he didn’t have a pulse.

They called Triple Zero Victoria (000), began cardiopulmonary resuscitation (CPR) and applied the gym’s automated external defibrillator (AED), delivering one shock while paramedics were on their way.

Ambulance Victoria (AV) Mobile Intensive Care Ambulance (MICA) paramedic Michelle Winterton said these steps – **Call (Triple Zero Victoria 000), Push (perform CPR by pushing hard and fast on the middle of the chest), Shock (use an AED)** – were crucial in giving Austin the best chance of survival.

“Minutes matter in cardiac arrests and when a patient receives CPR and a shock from an AED before paramedics arrive, their chance of survival more than doubles,” Michelle said.

Austin was rushed to hospital and, just a few days later, was in the cardiac unit recovering.

Austin’s mum Alicia said the incident was any parent’s worst nightmare and she was thankful to everyone who helped save her son.

“It was terrifying and by far the worst experience of my life,” she said.

“It just didn’t make sense – he was healthy and there had been no indication anything was wrong.

“Thank you is inadequate for what everyone did for him.

“Our family would never have been the same without him, so they saved us too.”

Austin was able to return to school to finish Year 12 and was back drumming and working out in the gym.

He said the only thing that was still taking a toll was his fatigue.

“Other than that, I recovered very well.”

“I’m grateful I’m still here and can do whatever I want to do. I can’t really say anything else other than that I’m very thankful for what everyone did to keep me alive.”

Some of the paramedics who cared for Austin were able to reunite with him, his family and the gym staff as part of Shocktober, a month-long cardiac arrest awareness campaign encouraging all Victorians to learn Call, Push, Shock.

Michelle said all Victorians should feel confident to use an AED, regardless of whether they’ve had training.

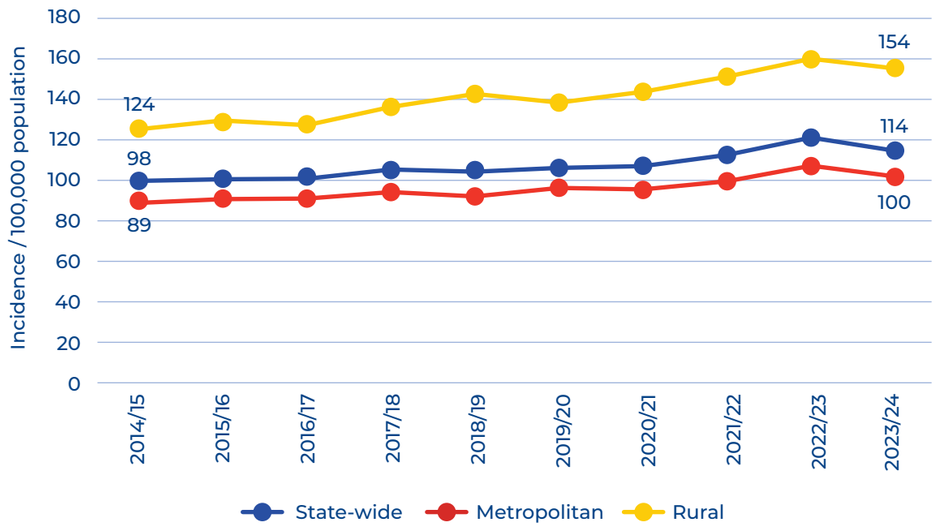
“Anyone can use a defibrillator by simply opening it and following the instructions,” she said.

“They are automated devices that are safe to use – they will not deliver a shock unless it is necessary.”

“Call, Push and Shock were crucial in giving Austin the best chance of survival.”

Incidence

Out-of-hospital cardiac arrest incidence per 100,000 population



In 2023/24, Ambulance Victoria attended **7,545 OHCA events**, a 3.7% decrease on 2022/23.

The state-wide incidence of OHCA was **114 per 100,000 population**, which is a small decrease from 120 per 100,000 population in 2022/23 and similar to the result reported in 2021/22 (111 per 100,000 population).

OHCA incidence in metropolitan and rural areas also decreased in 2023/24.

The age-adjusted incidence was 99 OHCA per 100,000 population for 2023/24, similar to what was reported in 2022/23.

Ambulance Victoria attended

7,545

OHCA events

3.7% decrease

114 per

100,000 population

Demographics

	Adult (≥ 16 years) population demographics^	**Paediatric** (< 16 years) population demographics^
	6,835 OHCAs	**74** OHCAs
	67% **were male** and the median age was 70 years	**50%** **were male** and the median age was 3 years
	29% were witnessed by a bystander	**35%** were witnessed by a bystander
	38% received a resuscitation attempt by EMS	**81%** received a resuscitation attempt by EMS

^Excludes EMS witnessed events.

Precipitating **Events**

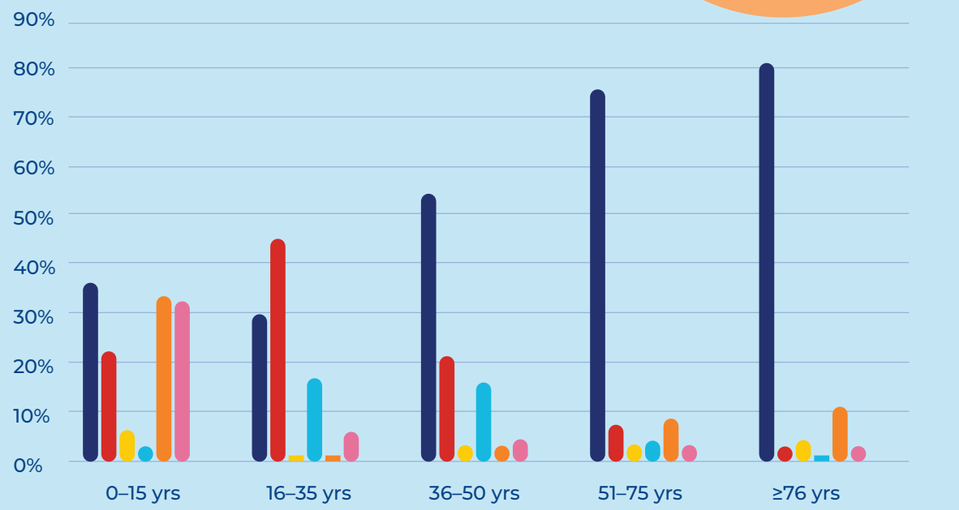
In 2023/24, 70% of OHCAs were due to a presumed cardiac aetiology. In accordance with the Utstein recommendations (Grasner 2024), OHCAs are presumed to be of cardiac origin unless a clear precipitator is specified on the patient care record.

In adult patients, the proportion of presumed cardiac events increased with increasing age. Among patients aged between 16 and 35 years, the most common cause of OHCA was trauma / hanging (46%).

In paediatric patients, most events were of presumed cardiac origin (36%). This was followed by Terminal Illness (33%) and 'Other' causes which include cases of sudden unexpected death in infancy (32%).

70%
of OHCAs were due to a presumed cardiac aetiology

Precipitating events by age group^



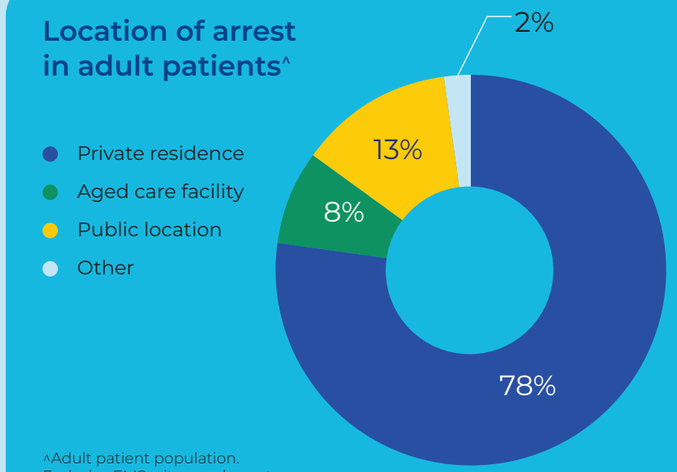
^Excludes EMS witnessed events.

Location **of Arrest**

In 2023/24, 78% of OHCAs occurred in the home, while 13% occurred in a public location.

Among patients who received a resuscitation attempt by EMS, 70% of OHCAs occurred in the home and 22% occurred in a public location.

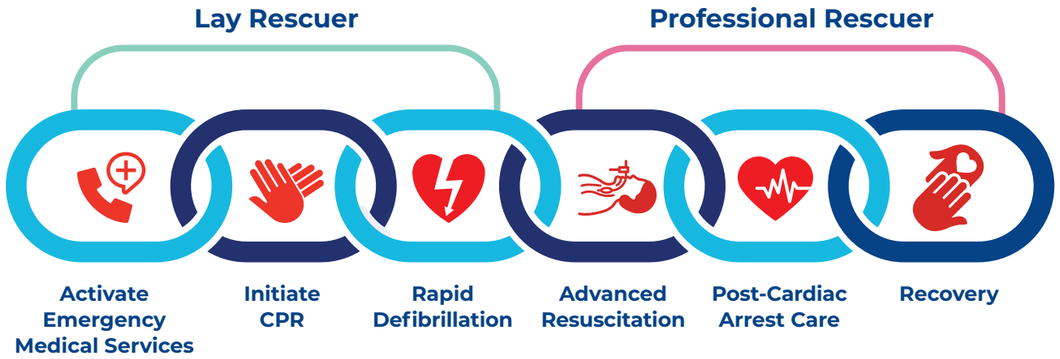
Location of arrest in adult patients^



^Adult patient population.
Excludes EMS witnessed events.

The **Chain of Survival**

The chain of survival is an internationally recognised series of steps that bystanders and EMS can take in order to maximise survival from OHCA.



The first three links, which can be administered by bystanders, have been associated with the largest gains in survival (Marijon et al, 2023).

Interventions which aim to maximise bystander participation in resuscitation have the greatest impact on OHCA survival rates.

Link 1:
Activate EMS

After collapse from OHCA, an early call for help is arguably the most important action taken by bystanders.

Early activation of EMS through Triple Zero Victoria (000) results in a whole of system response, including the dispatch of paramedics and professional and volunteer first responders, and the provision of life-saving CPR and AED instruction by Triple Zero Victoria (000) call-takers. EMS response time, or the time between the Triple Zero Victoria (000) call and the arrival of EMS at scene, is a international measure of quality for OHCA Care.

In 2023/24, 93% of calls were initially directed by bystanders to Triple Zero Victoria (000) ambulance and 87% of OHCAs were correctly identified by Triple Zero Victoria (000) call-takers. The median EMS response time was 8.0 mins in 2023/24, a decrease from 8.3 mins reported in 2022/23.

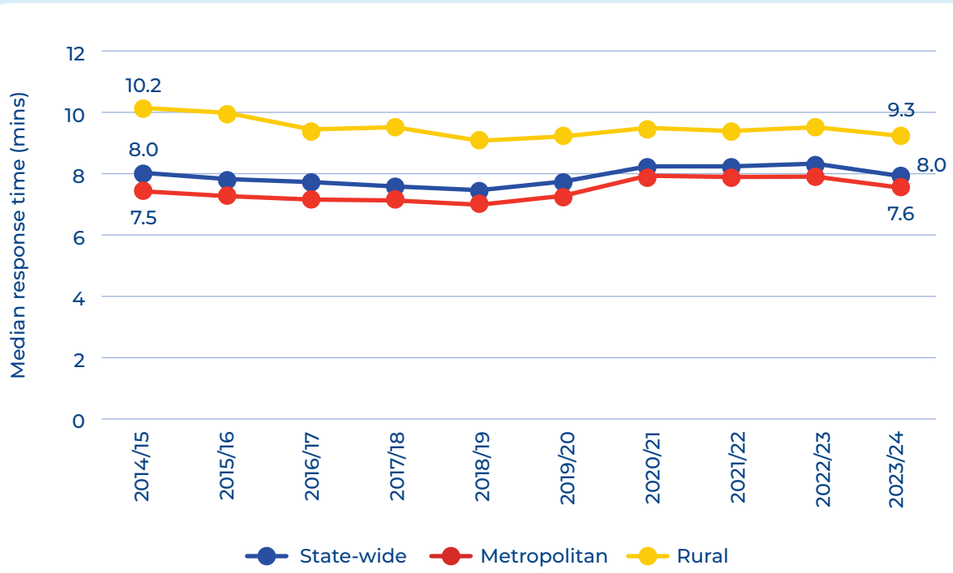
93% of calls were initially directed to Triple Zero Victoria (000) ambulance*

87% of OHCAs were identified during the Triple Zero Victoria (000) call*

8.0 mins the median EMS response time^

64% were attended by EMS within 10 minutes^

EMS response times over the past 10 years^



*Excludes EMS witnessed events.
^Includes patients receiving a resuscitation attempt by EMS. Excludes EMS witnessed events.

Link 2:
Initiate CPR

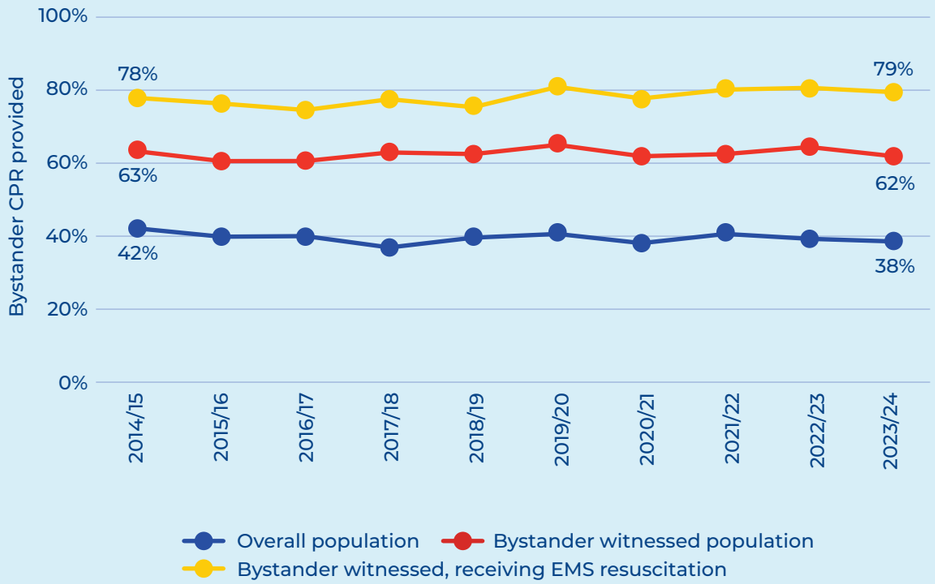
In 2023/24, 79% of bystander witnessed OHCA patients who received a resuscitation attempt by EMS were administered bystander CPR. A slight decrease from 80% in 2022/23.

Over the last decade, the rate of bystander CPR administration has plateaued. The implementation of the GoodSAM responder application in 2018 was associated with an increase in bystander resuscitation.

The Ambulance Victoria 2023–2028 Cardiac Arrest Improvement Strategy aims to improve community-based participation in CPR and public access defibrillation by investing in community education programs (including education in schools) and Heart Safe Communities, as well as encouraging the use of digital media applications, such as GoodSAM, to enhance the community response to OHCA.

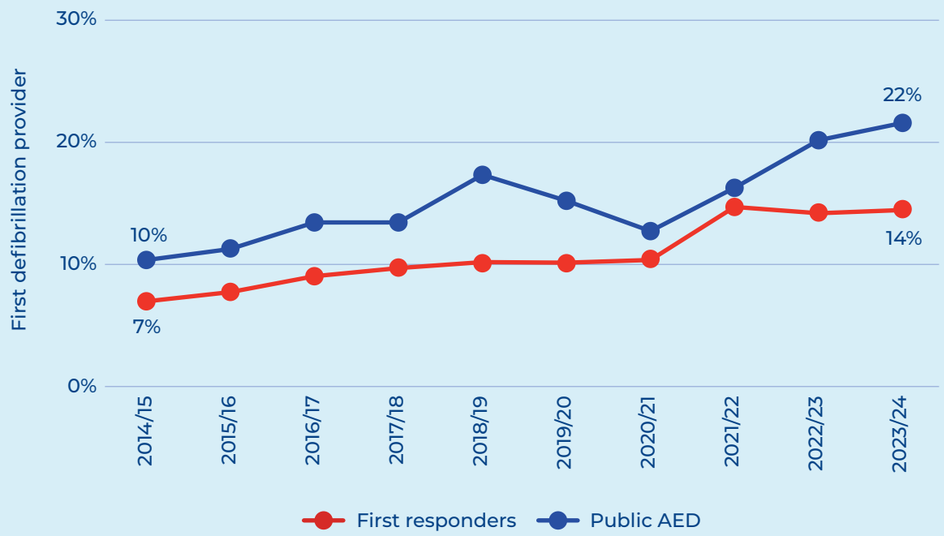
79% of EMS-treated bystander witnessed OHCA

Bystander CPR rates over the past 10 years



Link 3:
Rapid Defibrillation

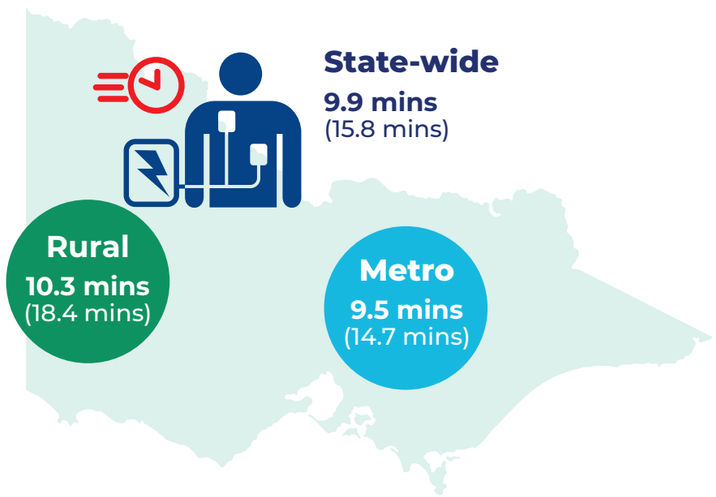
Initial defibrillation provider over the past 10 years^



Although reduced rates of bystander defibrillation were observed during the COVID-19 pandemic, this year we saw the highest rate of bystander defibrillation on record.

In 2023/24, **22% of patients who presented in a shockable rhythm** received their initial defibrillation from a bystander with a public AED.

Median (90th percentile) time to first defibrillation in 2023/24^



^Includes initially shockable patients who received a resuscitation attempt from EMS. Excludes EMS witnessed events.

Link 4:
Advanced Resuscitation

Advanced resuscitation refers to the phase of OHCA management when paramedics step in and provide additional life-saving measures.

This includes the provision of high-quality CPR and defibrillation, amongst other clinical interventions designed to achieve ROSC.

CPR is of high quality if it meets internationally-defined standards and follows a well-practiced choreography (the 'pit-crew' approach) aimed at minimising interruptions to resuscitation.

Recommendations for optimal chest compressions include a target depth of **≥5cm** for adults and a rate of **100–120 compressions per minute**.

The main components of high-performance CPR (HP-CPR) are:

- high chest compression fraction
- targeted chest compression rate and depth
- allowing full chest recoil
- avoidance of over-ventilation

Recommendations for optimal chest compressions include a target depth of ≥5cm 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.

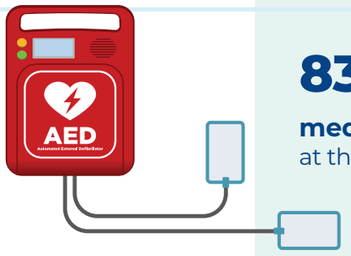
Lower chest compression fraction (i.e. lower proportion of time with CPR being performed) during resuscitation is associated with a decreased likelihood of ROSC and survival.

Resuscitation Quality Snapshot 2023/24

Early recognition

92%
of cases had placement of pads
within **2 minutes** of EMS arrival

96%
of cases had compressions underway
on pad placement



93%
of cases had the initial rhythm
correctly identified

High quality CPR

92%
median chest compression fraction

83%
median compressions
at the target depth

72%
median compressions
at the target rate

Early defibrillation

68%
of cases had the first defibrillation
within **2 minutes** of EMS arrival at patient

5.2 sec
median pre-shock pause

3.6 sec
median post-shock pause

Advanced care

86%
first pass intubation success

89%
of transported cases had a systolic blood pressure > 100mmHg on hospital arrival

72%
of VF/VT patients
who died on scene had an adequate duration **(45 minutes)** of resuscitation

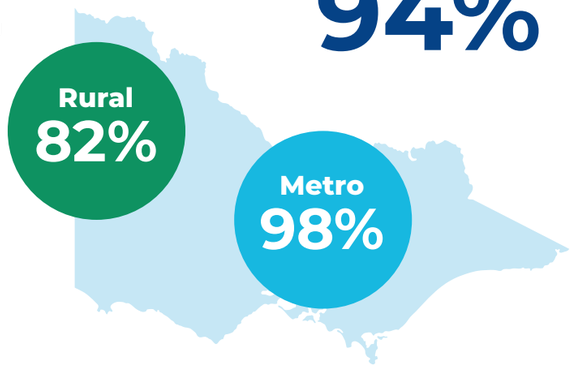
45 min

Note: Includes all EMS attempted resuscitations for 2023/24. Excludes patients aged <12 years and traumatic cardiac arrests.

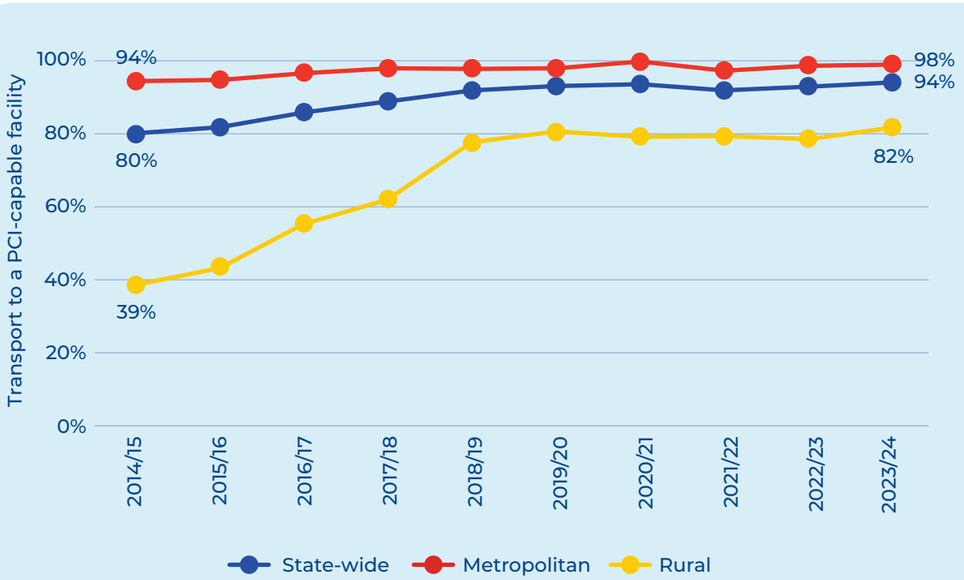
Link 5:
Post-Cardiac Arrest Care

In 2023/24, **94% of presumed cardiac aetiology OHCA patients were transported to a percutaneous coronary intervention (PCI)-capable facility**, in line with recent years.

PCI-capable hospitals have a process for receiving emergency patients via a pre-notification system and have full-time PCI capabilities.



Transport to a PCI-capable facility in 2023/24^



^Includes adult patients with a presumed cardiac aetiology who received a resuscitation attempt by EMS and transport to hospital. Excludes EMS witnessed events.

Link 6:
Recovery

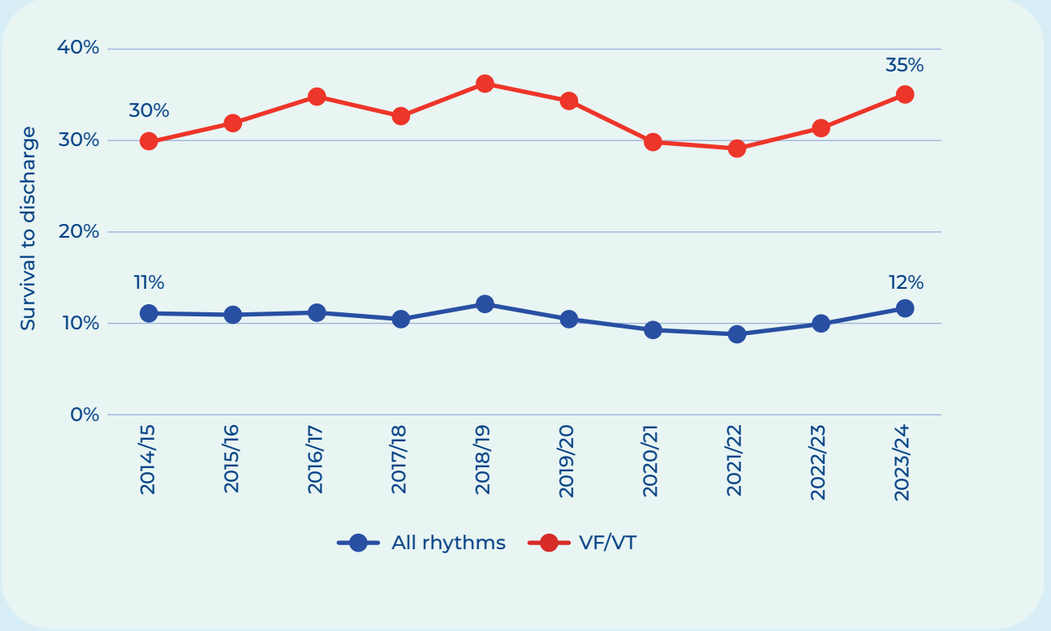
In 2023/24, **12% of all patients who received a resuscitation attempt by EMS survived to hospital discharge**, an increase from 10% in 2022/23.

In patients who presented with a shockable cardiac rhythm including ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT), **35% of patients survived to hospital discharge**, an increase on the 31% observed in 2022/23.

Survival to hospital (event survival) in these patients was 57% in 2023/24, an increase from 56% in 2022/23.

In the population of patients who were witnessed to arrest by EMS and arrested into VF/VT, 66% survived to hospital discharge, a decrease from 72% in 2022/23.

Survival to hospital discharge over the past 10 years^



^Includes adult patients receiving a resuscitation attempt by EMS. Excludes EMS witnessed events.

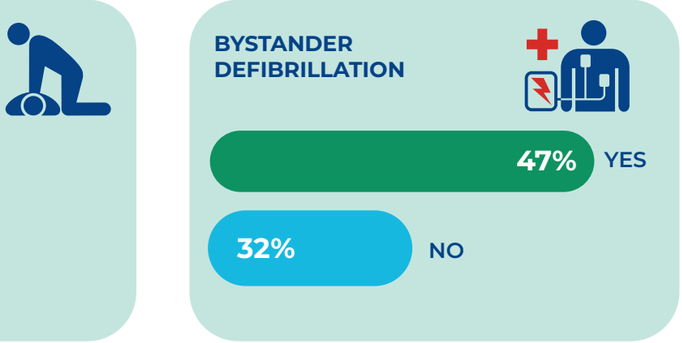
The importance of bystanders

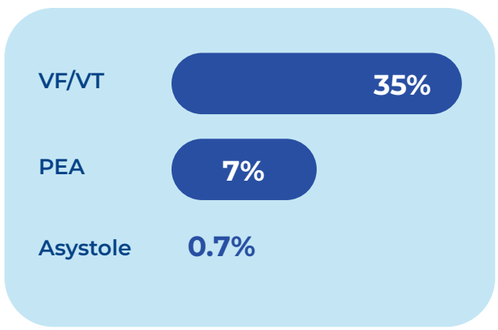
In 2023/24, **14% of patients who received bystander CPR survived to hospital discharge**, compared with 6% of patients who did not receive bystander CPR.

Further, **47% of the patients who received bystander defibrillation survived to hospital discharge**, compared with 32% of patients who did not receive bystander defibrillation.

Patients who receive bystander CPR are also more likely to present to EMS in a shockable cardiac rhythm, and therefore have the greatest chance of survival.

These figures reiterate the importance of bystander interventions.





The chance of survival is highest when the initial cardiac rhythm is shockable.

Figures include adult patients who received a resuscitation attempt by EMS. Excludes EMS witnessed events.

Patient outcomes

In 2023/24, **84% of adult patients who were discharged** from hospital alive were discharged back to their home or usual place of residence.

For patients arresting in 2022/23, **356 patients were alive 12 months after their arrest**. Among these patients, 271 responded to 12-month follow-up interviews this year.

At 12 months, **82% of responders were living at home without additional care**. In addition, 88% reported a good functional recovery according to the Glasgow Outcome Scale-Extended, a widely used global measure of functional outcome.

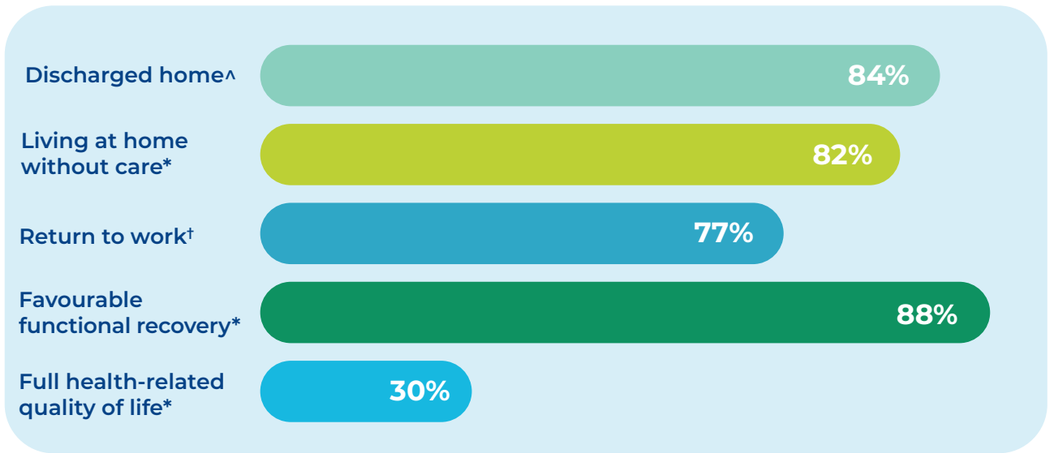
In total, 30% of patients reported full health-related quality of life (score = 1) at 12 months according to the ED-5D-5L. Among patients who were working prior to their arrest, 77% had returned to work.

84%

of adult patients

who were discharged from hospital alive were discharged back to their home.

Patient recovery



^Presented as a proportion of all survivors to hospital discharge in 2023/24

*Presented as a proportion of 271 patients whose OHCA occurred in 2022/23 and responded to 12-month follow-up..

†Presented as a proportion of 161 patients whose OHCA occurred in 2022/23, responded to 12-month follow-up and were working prior to arrest.

Survival
Benchmarking

Utstein comparator group benchmarking

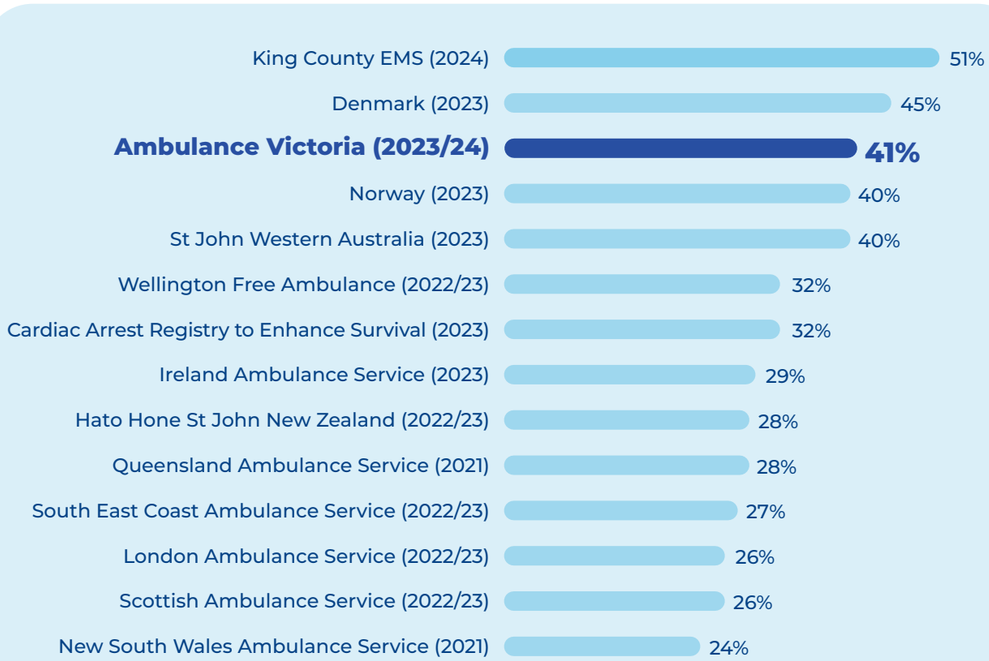
The Utstein template is a set of guidelines developed to promote uniform international reporting of OHCA data (Grasner 2024). The Utstein comparator group focusses on reporting survival within the cohort of patients who have a bystander witnessed OHCA, present in an initial shockable cardiac rhythm (VF/VT), and receive a resuscitation attempt by EMS.

The figure below displays survival rates reported nationally and internationally for the Utstein comparator group.

In 2023/24, **41% of patients within the Utstein comparator group in Victoria survived to hospital discharge**. This is our highest ever Utstein survival rate and is slightly higher than the result achieved in 2018/19, prior to the COVID-19 pandemic.

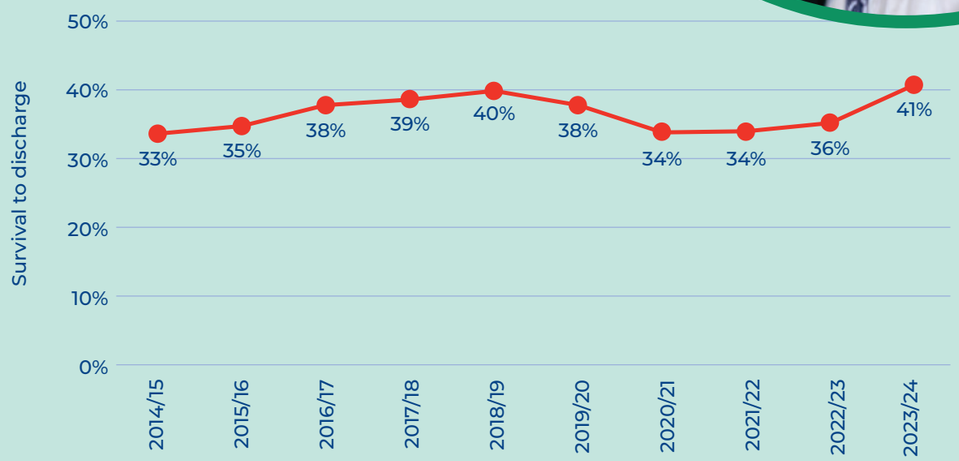
The result compares favourably to similar figures recently published by national and international ambulances services.

Utstein comparator group survival rates nationally and internationally

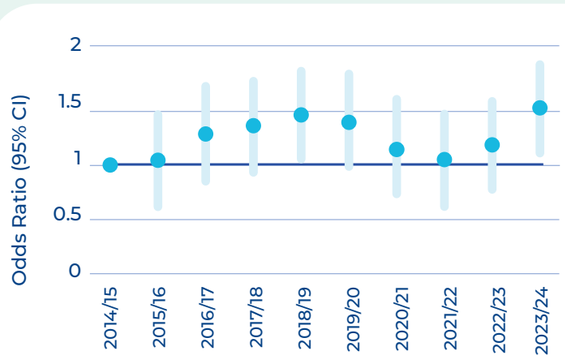


Note:
King County EMS and the Cardiac Arrest Registry to Enhance Survival report on non-traumatic OHCAs.
St John Western Australia, Queensland Ambulance Service, London Ambulance Service, Scottish Ambulance.
Service, Hato Hone St John New Zealand and Wellington Free Ambulance report 30-day survival.
Hato Hone St John and Wellington Free Ambulance report on adult patients (≥15 years) only.
National Ambulance Service Ireland report on adult patients (>17 years) only.
South East Coast Ambulance Service report 30-day survival.

Utstein comparator group survival over the past 10 years in Victoria



Risk adjusted odds of survival^



Risk adjusted odds of survival to discharge in the Utstein comparator group

The risk-adjusted odds of survival to hospital discharge in 2023/24 were 41% higher compared to 10 years ago. This is the first significant improvement in the yearly risk-adjusted odds of survival since the implementation of high-performance CPR in 2018/19.

^ Risk-adjusted model was adjusted for patient age, male gender, public location and year of arrest.

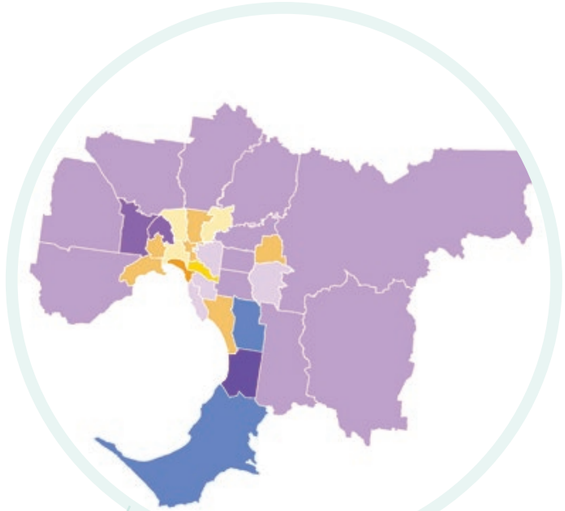
Priority **Locations**

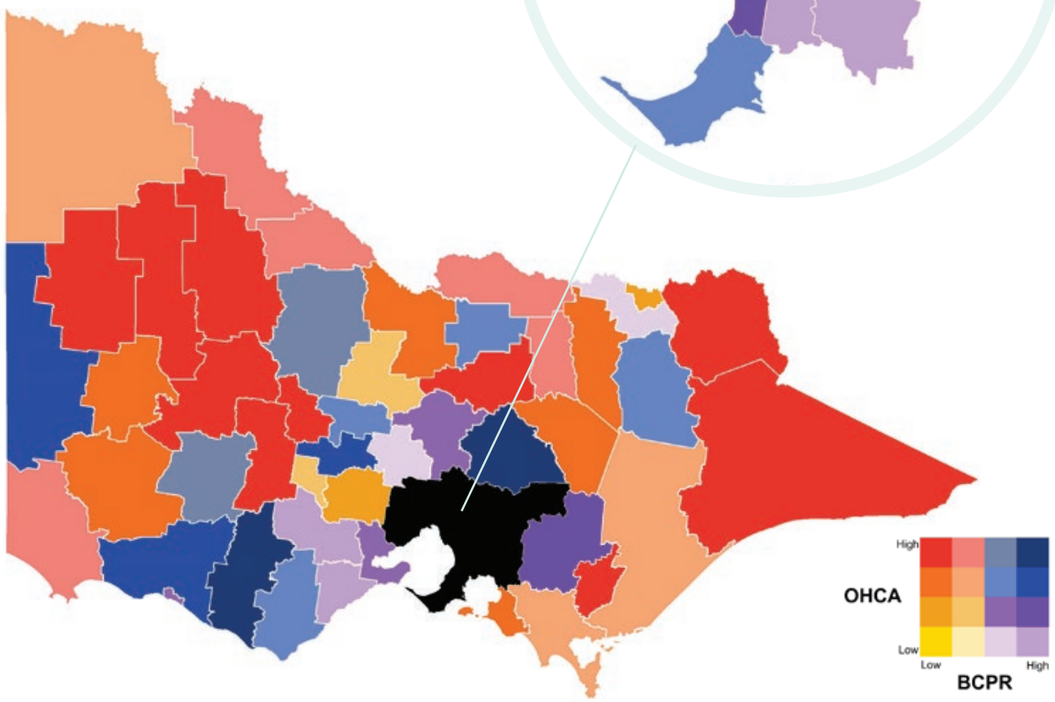
OHCA incidence relative to bystander CPR provision

The below map depicts the incidence of OHCA (per 100,000 population) within Local Government Areas of Victoria, relative to the proportion of patients who received bystander CPR within that Local Government Area. Red areas are those with high incidence of OHCA, but low rates of bystander CPR provision. These represent the highest priority areas for CPR education and awareness.

CPR priority locations:

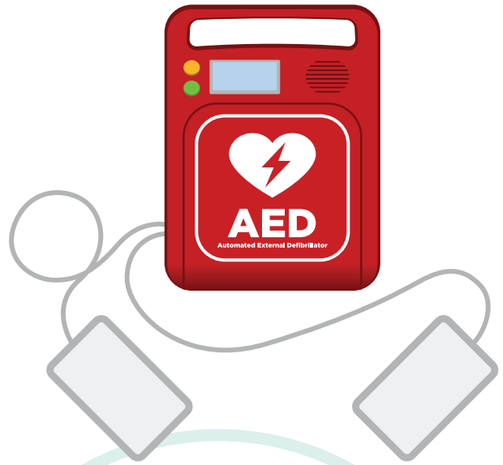
- Buloke
- Central Goldfields
- East Gippsland
- Hindmarch
- Latrobe
- Northern Grampians
- Pyrenees
- Strathbogie
- Towong
- Yarriambiack





OHCA incidence relative to public AED availability

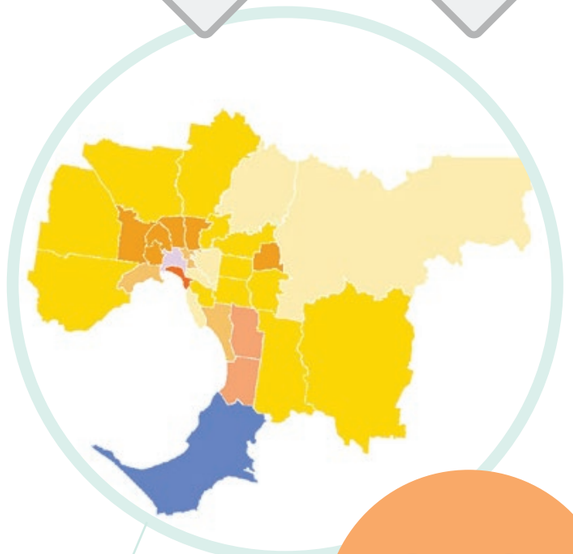
The below map depicts the incidence of OHCA (per 100,000 population) within Local Government Areas of Victoria, relative to the incidence of public AEDs (per 10,000 population) within that Local Government Area. Pink, dark orange and peach areas are those with high incidence of OHCA, but low incidence of public AEDs. These represent the highest priority areas in which public AED availability could be increased.

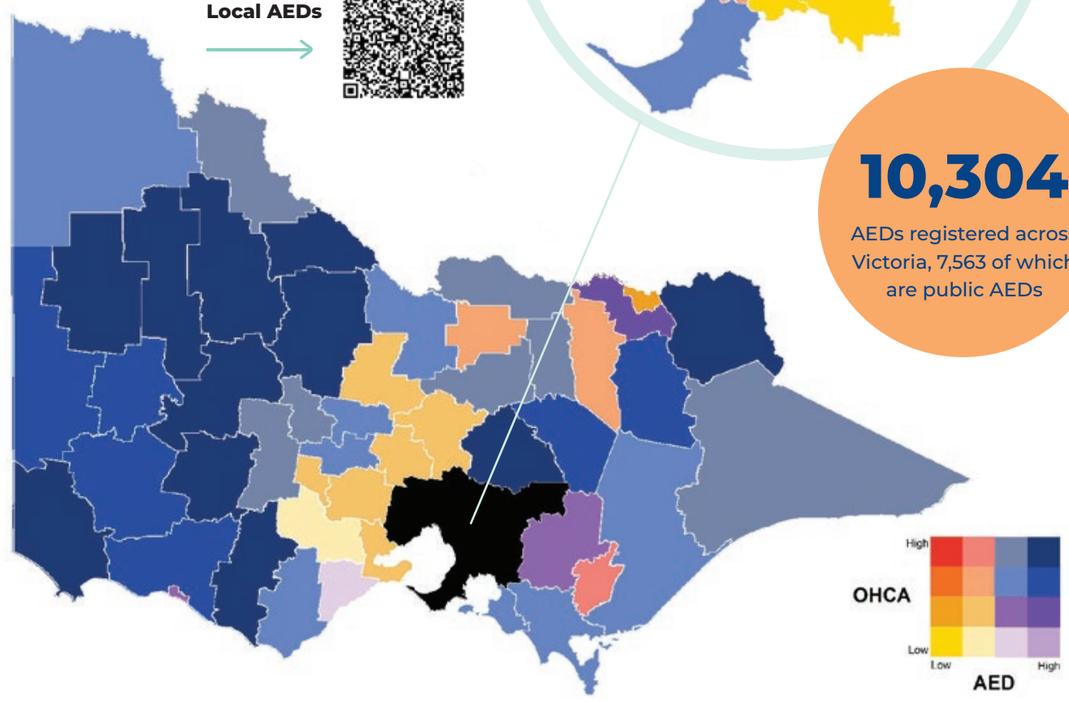


Public access defibrillation priority locations:

- Frankston
- Greater Dandenong
- Greater Shepparton
- Latrobe
- Wangaratta
- Port Phillip

Locate Local AEDs





10,304

AEDs registered across Victoria, 7,563 of which are public AEDs

OHCA incidence relative to GoodSAM responder incidence

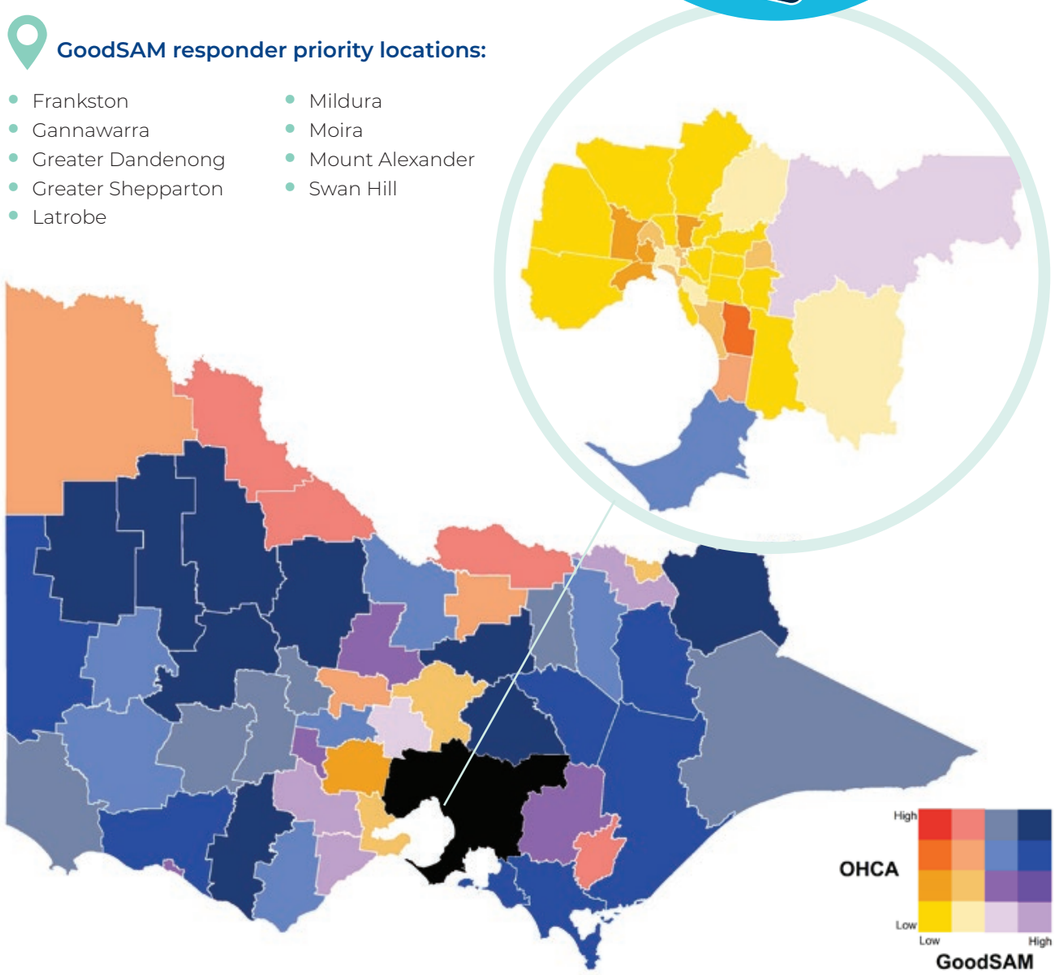
The below map depicts the incidence of OHCA (per 100,000 population) relative to the incidence of GoodSAM responders within Local Government Areas of Victoria. Pink, dark orange and peach coloured areas are those with high incidence of OHCA, but low incidence of GoodSAM responders. These represent the highest priority areas in which registered GoodSAM responders could be increased.

17,327

GoodSAM responders registered across Victoria

GoodSAM responder priority locations:

- Frankston
- Gannawarra
- Greater Dandenong
- Greater Shepparton
- Latrobe
- Mildura
- Moira
- Mount Alexander
- Swan Hill



Become a **GoodSAM Responder**

For every minute that a cardiac arrest patient goes without CPR and/or defibrillation, their likelihood of survival decreases by 10%. Early intervention by bystanders can improve a patient's chances of survival.

GoodSAM is a free global smartphone app that is used to facilitate bystander response to cardiac arrest. A Triple Zero Victoria (000) call for suspected cardiac arrest triggers an alert to be sent to a nearby user of the app. The GoodSAM responder is notified of the patient's location, and the location of the nearest AED registered in Ambulance Victoria's AED registry.

Registered GoodSAM responders

793

patients attended by a GoodSAM responder in 2023/24

481

patients administered CPR by a GoodSAM responder in 2023/24

Become a GoodSAM responder

Register your AED in the AED registry

2023/24
Research Publications

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3. Bloom JE, Wong N, Nehme E, Dawson LP, Ball J, Anderson D, Cox S, Chan W, Kaye DM, Nehme Z, Stub D. Association of socioeconomic status in the incidence, quality-of-care metrics, and outcomes for patients with cardiogenic shock in a pre-hospital setting. European Heart Journal – Quality of Care and Clinical Outcomes. 2024;10(1):89-98.
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11. Villani M, Nehme E, Cox S, Anderson D, Reinders N, Nehme Z. Outcomes of adult patients discharged at scene by emergency medical services. Emergency Medicine Journal. 2024:emermed-2023-213777.

Abbreviations

AED	Automated External Defibrillator
CPR	Cardiopulmonary Resuscitation
EMS	Emergency Medical Services
MICA	Mobile Intensive Care Ambulance
OHCA	Out-of-Hospital Cardiac Arrest
PCI	Percutaneous Coronary Intervention
ROSC	Return of Spontaneous Circulation
VACAR	Victorian Ambulance Cardiac Arrest Registry
VF/VT	Ventricular Fibrillation / Ventricular Tachycardia

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Cardiac Arrest Registry to Enhance Survival. CARES 2023 Annual Report.

Hato Hone St John. Out-of-Hospital Cardiac Arrest Registry Summary Report 2022/23.

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Queensland Ambulance Service. 2021 Annual Report Out of Hospital Cardiac Arrest & Prehospital ST-segment Elevation Myocardial Infarction.

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London Ambulance Service. Cardiac Arrest Annual Report April 2022 – March 2023

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