NSW Ambulance

Cardiac Arrest Registry

2019 REPORT

NSW GOVERNMENT Health
NSW Ambulance

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This report from the NSW Ambulance Cardiac Arrest Registry is a quality assurance activity designed to assist NSW Ambulance in improving clinical outcomes for an important group of acutely ill patients.

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Introduction

Adjunct Associate Professor Dominic Morgan ASM
Chief Executive, NSW Ambulance

Early recognition, early CPR and defibrillation and early advanced care are the key out-of-hospital links in the 'Chain of Survival', and highlight the importance of mobilising bystanders and other resources in the response to cardiac arrest

OUT-OF-HOSPITAL cardiac arrest (OHCA) remains a major global public health challenge. Survival rates following ambulance-attended OHCA remain low worldwide, although significant improvements in survival have been made over the past 40 years in developed country emergency medical services[1]. In Australia and New Zealand, in cases where resuscitation was attempted, reported survival rates to hospital averaged 28 per cent (range 21 per cent - 36 per cent) and survival to hospital discharge or 30 days at 12 per cent (range nine to 17 per cent)[2].

The Global Resuscitation Alliance outlined Ten Programs to improve community survival rates from OHCA[3]. Over the past few years, NSW Ambulance has taken steps to implement several of these steps. Telephone-CPR (Program Two) and Rapid Dispatch (Program Four) are already features of our Control Centre environment. In line with Program One, we established the NSW Ambulance Out-of-Hospital Cardiac Arrest Registry (OHCAR), which contains cases attended by NSW Ambulance clinicians since 1 January 2017. We are working towards accountability through annual reporting (Program Nine), with the 2019 report the third from the NSW Ambulance OHCAR. In addition to public reporting, the OHCAR has been used to provide data for a range of internal quality improvement and external research projects. In 2019, we developed High Performance CPR training (Program Three), and this is being rolled out as part of 2020-21 clinical training.

Early recognition, early CPR and defibrillation and early advanced care are the key out-of-hospital links in the 'Chain of Survival'[4], and highlight the importance of mobilising bystanders and other resources in the response to cardiac arrest. As we continue our progress against the Ten Programs, we look forward to reporting on initiatives relating to the recognition and delivery of bystander CPR and public access defibrillation in future reports.

Opposite page: FIGURE 1: Characteristics and outcomes of cardiac arrests, NSW 2019

Resuscitations and outcomes 2019

8,772
Cardiac arrest patients attended

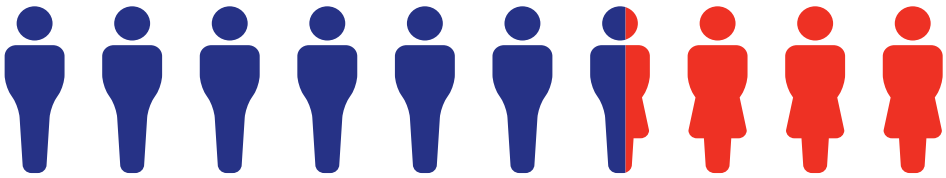
3,350
Resuscitations attempted*

27%
Survived to ED admission

12%
Survived to hospital discharge

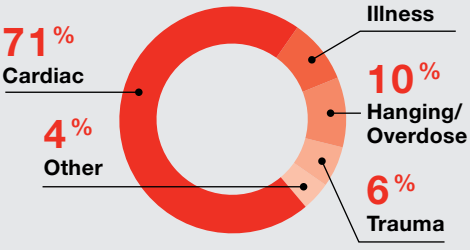
DEMOGRAPHICS

66%
MALE



34%
FEMALE

CAUSE



LOCATION

76%
Private residence

BYSTANDER CPR

63%
in bystander-witnessed arrests

UTSTEIN SUBGROUP

EMS-attempted resuscitation, bystander-witnessed arrest, shockable rhythm

16%
539 Resuscitations attempted

45%
242 Survived to ED

31%
Survived to hospital discharge

CPR = Cardiopulmonary resuscitation.

EMS = Emergency Medical Services including NSW Ambulance paramedics, doctors, community first responders and volunteer ambulance officers.

ROSC = Return of Spontaneous Circulation.

Survival rates are as a percentage of patients on whom resuscitation was attempted by NSW Ambulance.

The **Utstein subgroup** is a comparator group used to compare cardiac arrest survival rates internationally. This group represents the subgroup with the highest potential for successful resuscitation.

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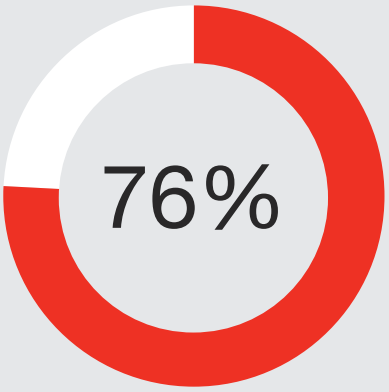
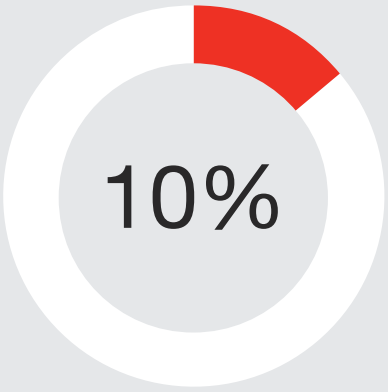
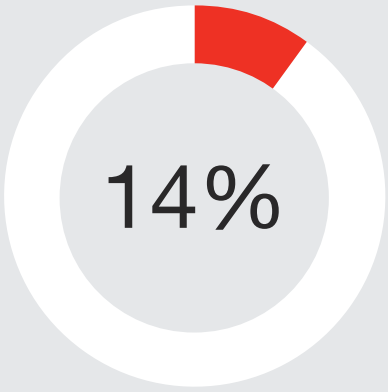
Executive Summary



Patients suffered a cardiac arrest in a private residence



Patients suffered a cardiac arrest in a nursing home or medical facility



Patients suffered a cardiac arrest in other locations (public places, schools and workplaces)

- This report presents an analysis of patients of all ages who suffered a documented OHCA in the period 1 January 2019 to 31 December 2019. In this period, NSW Ambulance clinicians attended 8,772 OHCAs and made a continued resuscitation attempt in 38% of cases (3,350 EMS-treated events). In a further 52 cases, the patient was revived by bystanders prior to EMS arrival
- The crude incidence of cardiac arrest in NSW was 108 per 100,000 population). The incidence of OHCA was lower in Greater Sydney (90 per 100,000 population) than in the rest of NSW (143 per 100,000 population)
- 98.4% of OHCAs involved adults (aged 16 or over). The demographic profile of OHCAs in 2019 was similar to previous years. Two-thirds of OHCA patients were male and the median age of adult cardiac arrests was 70 (males 67 years, females 74 years old)
- Where the cause of arrest is not attributed to a known precipitator, the aetiology is presumed to be cardiac. In 2019, 'cardiac' remains the most common OHCA cause in all age groups. Apart from cardiac causes, the precipitating factors varied by age group: in older adults - terminal illness; in younger adults - hanging, overdose and trauma; in children - sudden unexplained death in infancy (SUDI)
- 26% of EMS-treated adults and 8% of children presented in a shockable initial rhythm. The majority of children (71%) initially presented in asystole
- The median response time for EMS-treated events (excluding paramedic-witnessed OHCAs) was 8 minutes in Greater Sydney and the same in the Rest of NSW. Faster response times were associated with higher survival rates
- 76% of patients suffered a cardiac arrest in a private residence, 10% in a nursing home or medical facility and 14% in other locations (public places, schools and workplaces). Patients who arrested in a public place or medical facility were more likely to be witnessed, more likely to receive bystander CPR and more likely to survive (survival to Emergency Department (ED) was 32% following a public location OHCA compared with 25% in a private residence)
- Overall, 27% of OHCAs that received resuscitation by NSW Ambulance (EMS-treated OHCAs) survived to the ED and 12% to hospital discharge
- 25% of arrests were witnessed by bystanders, and in these arrests, bystanders performed CPR before EMS arrival 63% of the time
- In the Utstein patient subgroup in 2019, 45% of patients survived to ED and 31% to hospital discharge

Out-of-hospital cardiac arrest Emergency response

NSW is Australia's most populous state, with an estimated population at 30 June 2019 of 8.1 million people, 5.3 million of whom lived in the Greater Sydney area[5]. NSW Ambulance has over 250 ambulance response locations across the state, including superstations with paramedic response points in metropolitan Sydney, traditional ambulance stations throughout NSW, and Community First Responder (CFR) and Volunteer Ambulance Officer (VAO) locations in regional and rural NSW plus a number of helicopter and fixed-wing aircraft bases.

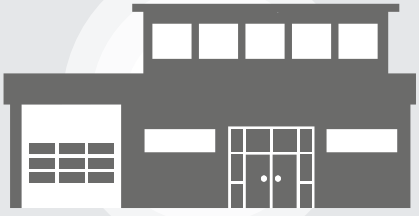
Calls to ambulance via Triple Zero (000), Australia's national emergency services telephone number, are triaged in NSW by NSW Ambulance call-takers using the Medical Priority Dispatch System (MPDS) ProQA software, the same software used in most other states and territories in Australia. The EMS chain of survival starts with call-takers, who can play a vital role in improving patient outcomes by recognising cardiac arrest and providing cardiopulmonary resuscitation (CPR) instructions to bystanders.

When NSW Ambulance paramedics arrive, they may be general paramedics or specialists. As a base qualification, paramedics have either a bachelor's degree in paramedicine from a recognised university or a Diploma of Paramedical Science gained through the vocational entry and training route. In cardiac arrest, all qualified paramedics can place supraglottic airways (i-gel), defibrillate, cannulate and give adrenaline. Specialist paramedics have higher skills that include endotracheal tube (ETT) placement and administration of anti-arrhythmic medications.

In rural and remote NSW, the initial emergency response may be by volunteers - CFRs or VAOs. The former are usually members of another agency, such as, the State Emergency Service (SES) or Rural Fire Service (RFS) with NSW Ambulance training, and the latter are accredited, trained and administered under the direct jurisdiction of NSW Ambulance. Volunteers can defibrillate and insert basic airways (nasopharyngeal and oropharyngeal airways).

Paramedics and volunteers are governed by NSW Ambulance protocols, which are consistent with the advice of the Australian Resuscitation Council (ARC)[6]. Once on scene, paramedics may decide not to continue or commence resuscitation if the patient is clearly deceased or has injuries incompatible with life, no CPR was performed for at least 20 minutes prior to paramedic arrival, or there is a treatment directive in place. If resuscitation is commenced and the patient remains in asystole or pulseless electrical activity (PEA) for over 20 minutes without return of spontaneous circulation (ROSC), paramedics may discontinue resuscitation.

8.1
MILLION PEOPLE IN NSW



MORE THAN
250
NSW AMBULANCE RESPONSE LOCATIONS

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NSW Ambulance Out-of-Hospital Cardiac Arrest Registry

THE NSW OHCAR includes all OHCA patients who were attended by NSW Ambulance road paramedics, aeromedical paramedics and doctors, CFRs and VAOs since 1 January 2017. Inclusion and exclusion criteria are detailed in **Table 1**.

TABLE 1: NSW Ambulance OHCAR inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Patients of all ages who suffer a documented OHCA	Brief episodes of pulselessness that do not receive CPR/ defibrillation by EMS
OHCA occurs in NSW (or neighbouring states) AND NSW Ambulance is the primary care-giver	Patients suffering an in-hospital cardiac arrest, where NSW Ambulance may attend, but is not the primary care-giver
Patient pulseless on arrival of EMS; OR becomes pulseless in the presence of EMS; OR has a pulse on EMS arrival, where a successful bystander defibrillation attempt was undertaken prior to EMS arrival	Patients with a pulse on EMS arrival, where a bystander suspected an OHCA but there was no defibrillation prior to EMS arrival, and no other evidence verifying the OHCA

The OHCAR was built using REDCap[7], a secure web application for building and managing online surveys and databases which was specifically created at Vanderbilt University to provide a data entry facility for research studies and operational activity. REDCap is used by other areas of NSW Health.

The OHCAR is hosted by the NSW Ambulance Research group within Clinical Systems, and managed by the Clinical Quality Registries Coordinator.

The OHCAR fields include Utstein variables plus additional variables relevant to NSW Ambulance. Utstein variables are a set of fields determined using an established consensus process, endorsed by the international resuscitation community, to facilitate consistency and comparability in resuscitation research[8].

The data collected from clinical and operational records describe the pre-hospital links in the chain of survival. Coders enter data in a sequence of forms in REDCap: patient details; case location; operational timings; clinical details (witnessed status, bystander CPR, initial rhythm, patient management); paramedic details (number and level); dispatch details (whether CPR instructions were provided); aeromedical involvement; and outcomes.

The process for recording cases in the OHCAR is to start with a monthly upload of electronic data to populate the database. The initial upload is then reviewed by coding staff to complete additional details of each OHCA, interpreting paramedic clinical records and ECG paperwork, seeking additional information, cleaning and re-classifying the data where necessary.

The identification of potential cases for inclusion in the OHCAR comes from linked NSW Ambulance data - Computer-Aided Dispatch (CAD) system data linked by incident number to electronic Patient Health Care Records (ePHCR) and electronic medical records (eMR). The ePHCR database contains paramedics' paper clinical records transcribed into an electronic database; eMR data comes directly from the paramedic electronic clinical records entered into the eMR system using devices in each ambulance. The inclusion criteria contain several dimensions, shown in **Table 2**.

Once the initial monthly upload to the OHCAR has occurred, the cases are reviewed to ensure they meet the OHCAR inclusion criteria. For cases deemed to be OHCAs, coders complete the OHCAR entry by viewing VisiNET and reading paramedic clinical records to capture information for fields that are not auto-populated from CAD/eMR/ePHCR. VisiNET is the recording system that interfaces with CAD and contains detailed information about the call, including caller statements and interactions with other emergency services agencies.

A sample of cases is re-abstracted by a second coder to ensure consistency and correctness. The level of agreement for key variables is monitored.

TABLE 2: OHCA electronic search criteria

Field	Treatment of data
Paramedic protocols	Search for relevant protocols including: C2 – Cardiac Arrest Decision Algorithm, C3 – Cardiac Arrest, A13 – Verification of Death, T20 – Traumatic Cardiac Arrest, OP4 - Newborn Resuscitation, OP5 – Confirmed Stillbirth, C16 - Return of Spontaneous Circulation, C17 – Torsades de Pointes
Patient management	Search for relevant management fields relating to Defibrillation , CPR, or Resuscitation Ceased
Initial rhythm	Search for Ventricular Fibrillation (Coarse or Fine), Asystole, Pulseless Electrical Activity
Observed Outcome	'Dead on Arrival', 'Died at Scene', 'Died en Route', 'ROSC at Hospital', 'Died in ED/ Hospital'
Assessment	'Cardiac Arrest', 'Deceased'
Other fields	'Witnessed Arrest' is not null 'Time 1st shock' is not null 'Total shocks' is not null and is not '0' 'Not transported reason' or 'Not treated reason'= 'Deceased on Examination'

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Reporting Approach

THIS report covers all out-of-hospital cardiac arrests attended by NSW Ambulance between 1 January and 31 December 2019. The analysis provides statistics relating to OHCA. Analyses in this report relate to different populations, depending on the statistics being presented. The most commonly used populations are:

- All OHCAs attended by NSW Ambulance (n = 8,772)
- All adult OHCAs (n = 8,636)
- All paediatric OHCAs (n = 136)
- All EMS-attempted resuscitations (n = 3,350)
- EMS-attempted resuscitations (excluding paramedic-witnessed OHCAs) (n = 2,816)
- Patients with ROSC prior to NSW Ambulance arrival (n=52)

Of the 8,772 OHCA records for 2019, the proportion of fields with missing data and how these were treated are shown in **Table 3**. There were fewer missing data fields in 2019 compared with previous years, with a notable improvement in the recording of witnessed status.

Statistics are presented as frequencies and proportions for categorical data. Unless otherwise stated, all statistical comparisons are unadjusted (crude) rates.

Rates are reported for NSW overall, unless otherwise specified. Analyses by geographical region are based on Australian Bureau of Statistics (ABS) structures (Statistical Area Level 4 (SA4) and Greater Capital City Statistical Area (GCCSA)). The latitude and longitude of the each cardiac arrest scene has been used to locate each OHCA within an ABS structure. When reporting on OHCA rates by region of NSW, the 9 cases that occurred outside NSW were excluded. However, these cases were included in all other analyses.

Population data at 30 June by age and by region was sourced from the ABS publications on Australian Demographic Statistics (Cat 3101.0) and Population by Age and Sex for Regions of Australia (Cat 3235.0)[5, 9]. The reference population for age-adjusted calcualtions is the Australian population as at 30 June 2001[10].

TABLE 3: Treatment of missing data, NSW OHCAR 2019

Field	Treatment of data	Number	Proportion
Patient sex missing	Treated as unknown sex, included in outcome measures	45	0.5%
Patient age not estimated / DOB missing	Treat as adult, excluded from age group reporting	311	3.5%
Witnessed status unknown	Treated as unwitnessed	550	6.3%
Bystander CPR unknown	Treated as no bystander CPR	298	3.4%
Aetiology unknown	Treated as 'Presumed cardiac'	-	-
Response time missing	Not included in response time calculations	-	-
Initial rhythm not documented (% resuscitations)	Initial rhythm 'Not documented' for purposes of calculating survival rates by rhythm	37	1.1% of resuscitations
"Non-shockable" initial rhythm, no further information (% resuscitations)	Initial rhythm 'Not documented' for purposes of calculating survival rates by rhythm	272	8.1% of resuscitations

In OHCAs with an ambulance outcome of 'CPR ongoing on handover', the patient outcome (death or survival) is either unknown to paramedics or has not been recorded in the paramedic clinical record. We have excluded these cases in the numbers of survivors to the Emergency Department (ED), consistent with the approach taken in other states. This means there is a small number of patients recorded as not surviving to ED, but who may survive to hospital discharge. In 2019, 21 of the 406 patients recorded as 'CPR ongoing on handover' survived to hospital discharge.

The presumed cause of each OHCA is based on information in the paramedic clinical record. Where the paramedic has not documented the cause directly, the coder may use other information in the clinical record to infer the cause of the OHCA. In the absence of information to attribute the OHCA to a particular cause (such as trauma, drowning, overdose, hanging, respiratory, terminal illness) the aetiology is assumed to be cardiac. This is consistent with the Utstein guidelines[8].

For the purposes of determining defibrillator use in public locations, 'public locations' are taken to be all locations excluding private residences, medical facilities and nursing homes.

The Centre for Health Record Linkage (CHeReL) carried out linkage of the OHCAR to the NSW Health Emergency Department Data Collection (EDDC), Admitted Patient Data Collection (APDC) and NSW Registry of Births, Deaths and Marriages (RBDM) death registration records to determine survival to hospital discharge. The linked data is stored in a secure analytics platform (SAPHaRI) in de-identified form. This de-identified linked dataset was created under the Public Health and Disease Registers provisions of the NSW Public Health Act 2010.

Not all patient records could be linked by the CHeReL. This means the denominator used to calculate survival rates to ED admission differs from that used for survival rates to hospital discharge. The denominator for survival to hospital discharge excludes OHCA where NSW Ambulance record indicated the patient was transported but no corresponding linked EDDC or APDC record could be found (n=213 patients). In other words:

- Survival to ED admission is based on the NSW Ambulance patient dataset (n=3,350 resuscitations)
- Survival to hospital discharge is based on the NSW Ambulance patient dataset excluding the patients that could not be linked to the EDDC or APDC (n=3,137 records)

NSW Ambulance

Incidence, demographics and causes of OHCA

FIGURE 2: OHCAs and resuscitation attempts, NSW, 2019

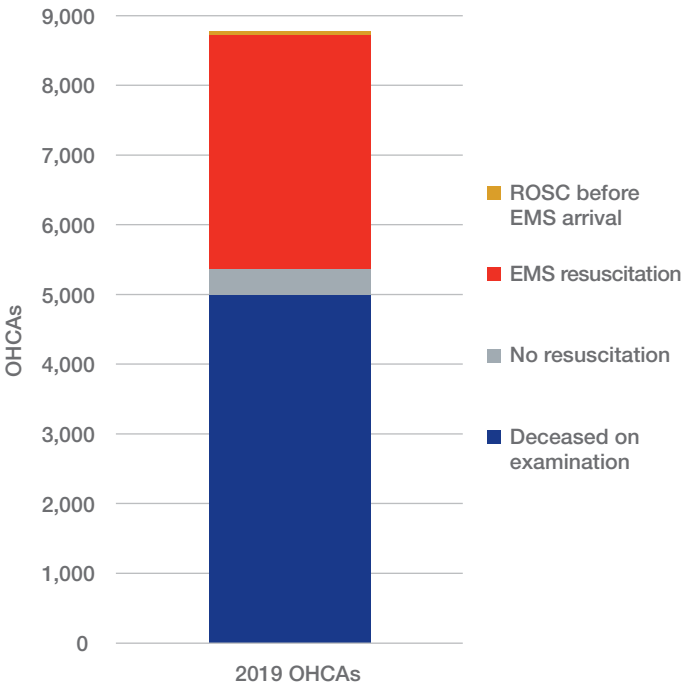
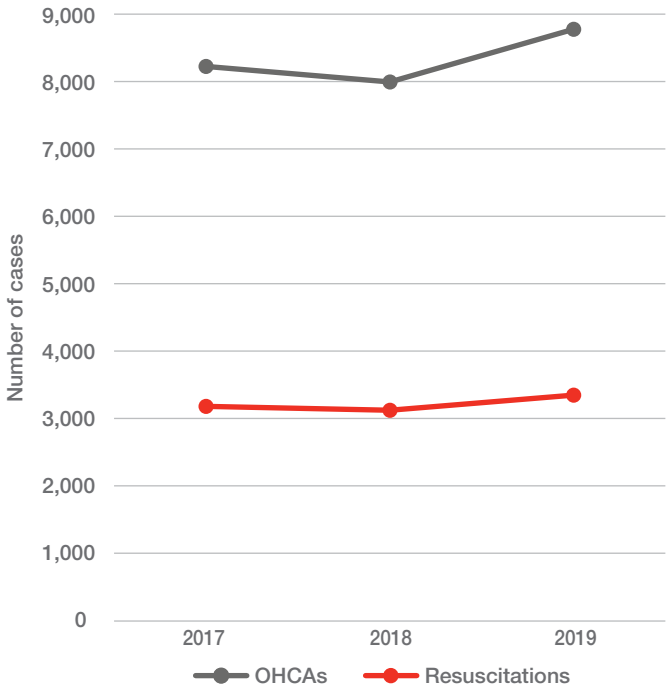


FIGURE 3: OHCAs and resuscitations, NSW, 2017 - 2019



Number of out-of-hospital cardiac arrests and resuscitations

In 2019, NSW Ambulance attended 8,772 OHCAs (including patients where no resuscitation attempt was made). Of these, 8,636 cases (98.4%) were adults (patients aged 16 and over, or age unknown) and 136 cases (1.6%) were children.

Of the 8,772 OHCAs attended, 5,001 (57%) were determined by paramedics to be deceased on examination. Resuscitation was withheld in a further 369 cases (4%), primarily because of written directives or family instructions. 52 cases (1%) were successfully resuscitated by bystanders before NSW Ambulance clinicians arrived. NSW Ambulance clinicians made 3,350 resuscitation attempts, representing 38% of all 2018 OHCAR cases (2018: 39%) (**Figure 2**).

The number of OHCAs in 2019 was 10% higher than 2018, and the number of resuscitations was 7% higher. The number of OHCAs and EMS-resuscitation attempts since 2017 is shown in **Figure 3**.

TABLE 4: Crude incidence of EMS-attended OHCA by age group and gender, NSW 2019

	Incidence per 100,000 population		
Age	**Female**	**Male**	**Persons**
Children (aged under 16)	7	10	9
Adults (aged 16 and over, or age unknown)	90	177	133
All ages	**74**	**143**	**108**

Incidence of out-of-hospital cardiac arrest

The incidence of OHCA per 100,000 population is shown in **Table 4**.

The number of OHCAs and the incidence per 100,000 population was higher than in 2017 and 2018 on both a crude and age-standardised basis (**Figure 4**). The age-standardised figures take age-specific rates in each year and apply them to a standard reference population, which is currently the Australian population at June 2001.

Geographic incidence of out-of-hospital cardiac arrest

This analysis is based on the ABS structures of Greater Capital City Statistical Area (GCCSA) and Statistical Area Level 4 (SA4). The numerator is the count of OHCAs in each region (based on scene location) and the denominator is the resident population.

There were 4,781 OHCAs in Greater Sydney (55% of the total) and 3,982 in the Rest of NSW (with the remaining 9 out of state). The crude incidence of OHCAs per 100,000 population was much lower in metropolitan Sydney than in regional and rural areas. In Greater Sydney in 2019, the crude incidence (unadjusted for differences in age and gender) was 90 per 100,000 compared with 143 per 100,000 in the Rest of NSW. The crude incidence of OHCA in Greater Sydney and the Rest of NSW since 2017 is shown in **Figure 5**. Patients in Greater Sydney were more likely to have a resuscitation attempt made than in the Rest of NSW (42% vs 34% respectively).

At the SA4 level, there was variation within each GCCSA. In Greater Sydney, the crude incidence of OHCAs varied between 65 and 156 per 100,000 population (North Sydney and Hornsby had the lowest incidence, Central Coast the highest). Age-standardisation reduces the variation in incidence between areas. For example, Central Coast's relatively old population and City and Inner South's relatively young population mean that the crude incidence of OHCA per 100,000 population is 156 and 93, respectively. On an age-standardised basis, the incidence is 113 and 109 per 100,000 (**Figure 6**).

Regionally, the incidence varied between 110 and 178 OHCAs per 100,000 population (Illawarra had the lowest incidence, Far West and Orana the highest as in 2018). All regions in the Rest of NSW have an older-than-average population so age-standardisation has less of an impact than in Greater Sydney in reducing the apparent inequalities in the incidence of cardiac arrest between regional SA4s (**Figure 7**).

FIGURE 4: Crude and age-standardised incidence of EMS-attended OHCA in NSW by age group, 2017 – 2019

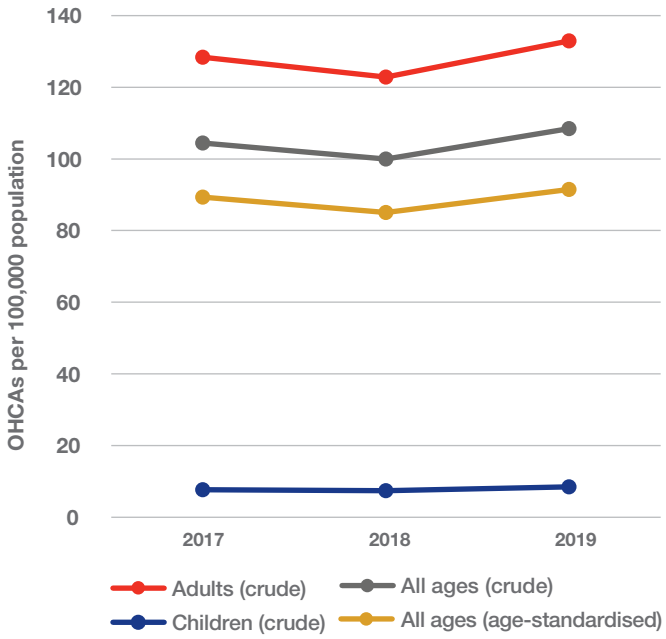


FIGURE 5: Crude incidence of EMS-attended OHCA in NSW by GCCSA, 2017 -2019

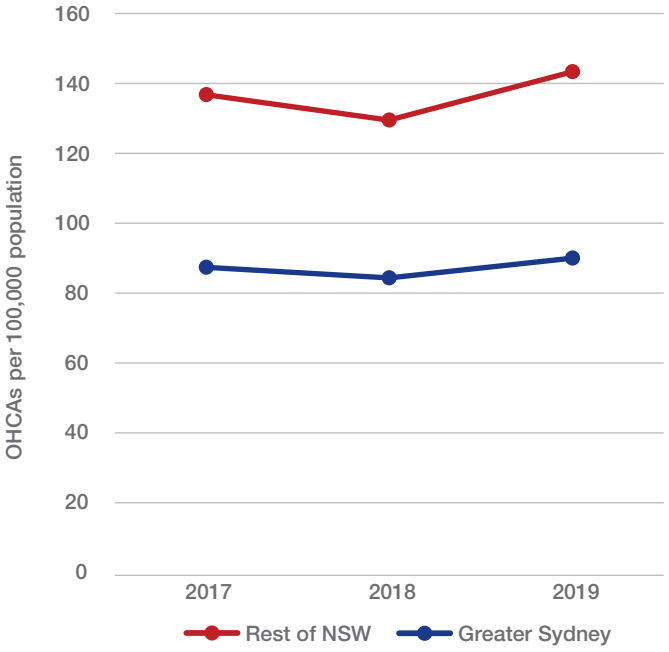


FIGURE 6: Crude and age-standardised incidence of EMS-attended OHCA in NSW by SA4, Greater Sydney, 2019

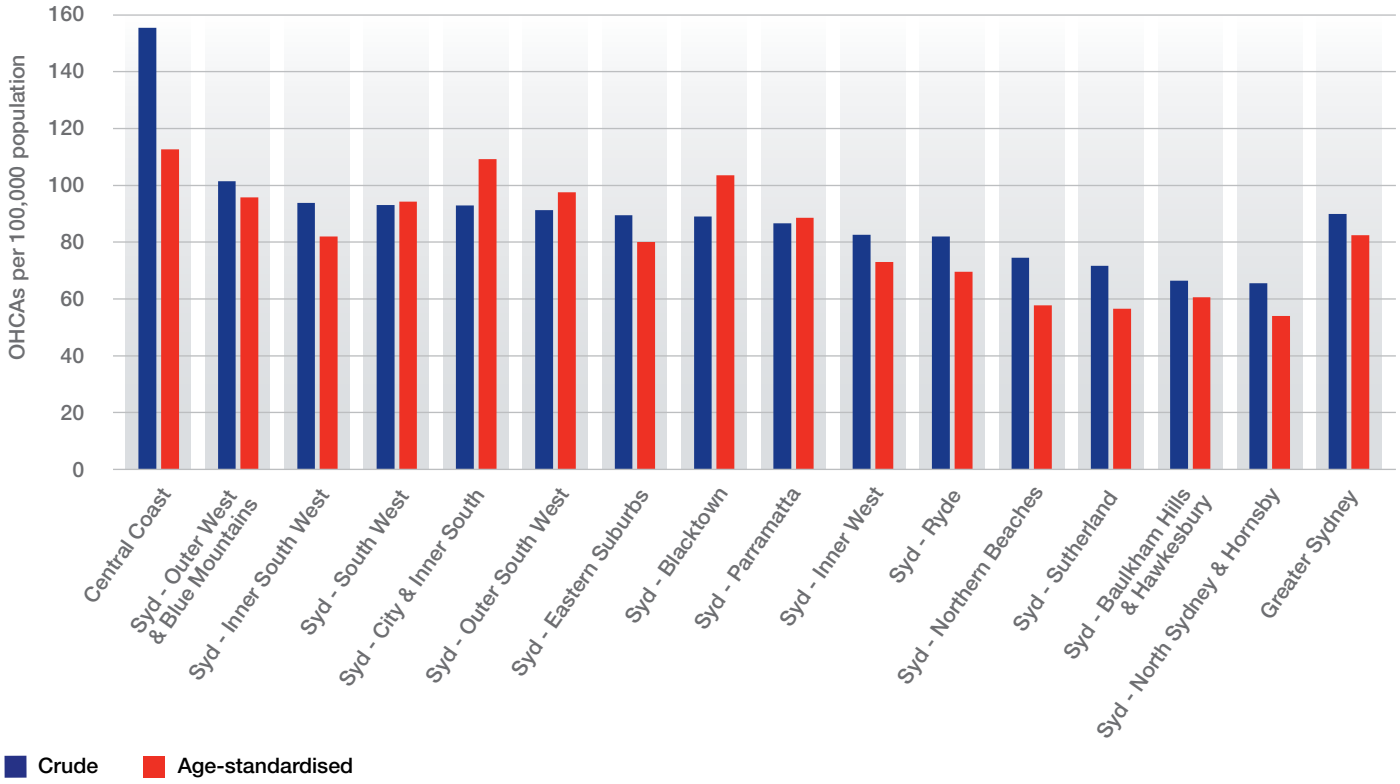
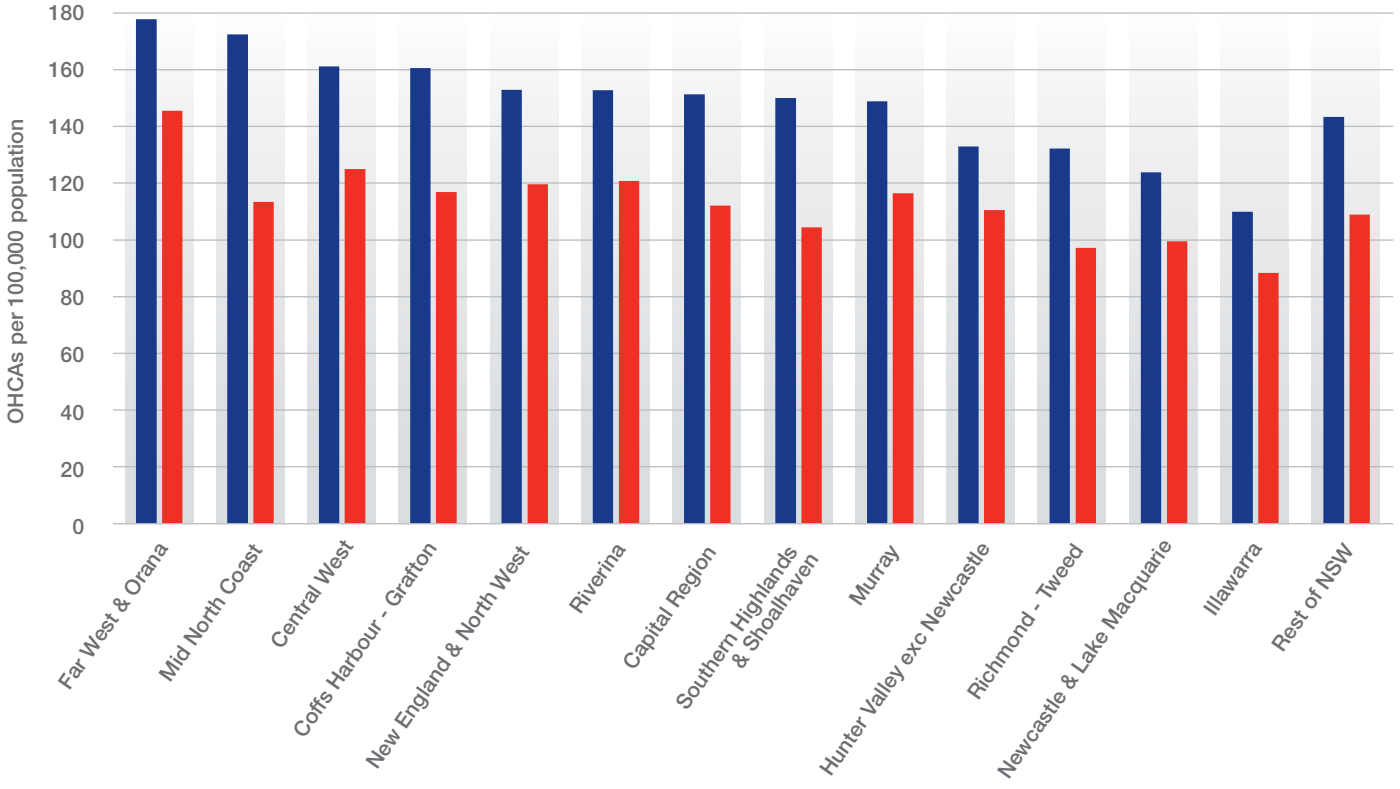


FIGURE 7: Crude and age-standardised incidence of EMS-attended OHCA in NSW by SA4, Rest of NSW, 2019



Cardiac arrests by age and gender

Cases in the OHCAR in 2019 had a very similar distribution to 2017 and 2018 (**Figure 8**). 66% of OHCAs were male and 34% female. The median age of adult OHCAs was 70 years, with females having a higher median age at cardiac arrest (female median 74 years vs male 67 years). The median age of paediatric OHCAs was 1.

Resuscitation was more likely to be attempted on males than females when NSW Ambulance resources arrived; a resuscitation attempt was made in 40% of male OHCAs and 36% of female OHCAs. Paediatric cases were much more likely to have a resuscitation attempt made than adult cardiac arrests (71% of paediatric OHCAs involved a resuscitation attempt vs 38% of adults).

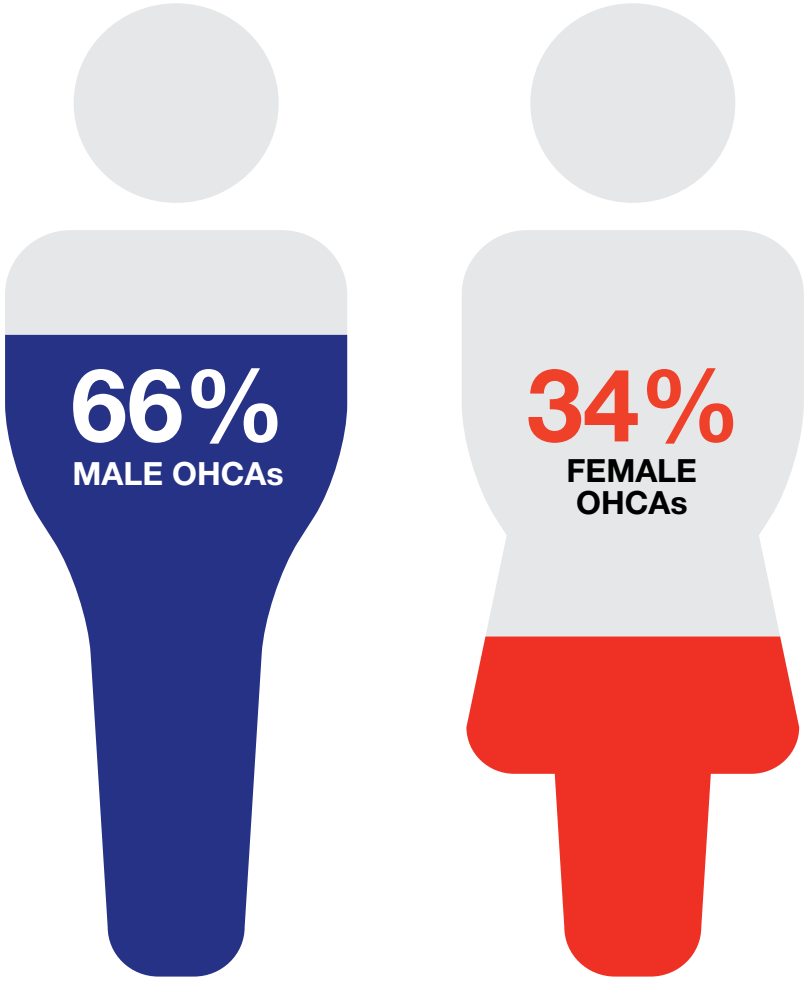
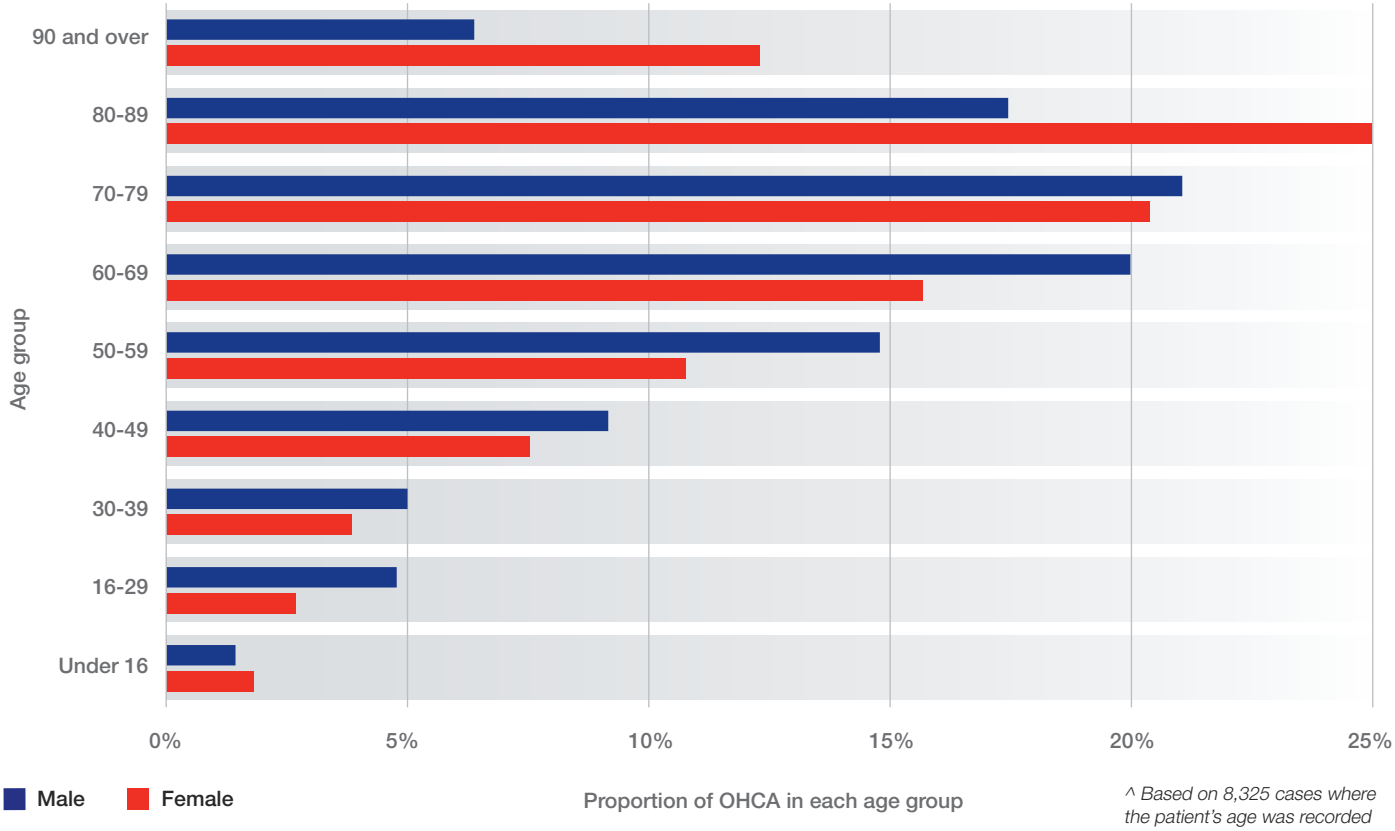


FIGURE 8: EMS-attended OHCAs by age and gender, NSW 2019^



^ Based on 8,325 cases where the patient's age was recorded

Cause of cardiac arrest in adults: OHCAs and resuscitations

The presumed cause of the OHCA is based on information in the paramedic clinical record, either indicated directly by paramedics or interpreted by coders. Unless there is a clear cause, the underlying precipitating factor is assumed to be cardiac. 6,173 (71%) of adult arrests attended by EMS were presumed to be of cardiac cause. Other common causes were terminal illness (746 cases, 9%), hanging/ strangulation or asphyxiation (578 cases, 7%), other trauma (excluding drowning, asphyxiation, hanging and overdose) (515 cases, 6%) and overdose/ poisoning (292 cases, 3%). **Figure 9** shows the presumed causes of all OHCAs (whether or not a resuscitation attempt was made) in adults.

By age group, traumatic deaths, overdoses and hangings were more likely to occur in younger adults (**Figure 10**). In the older age groups, cardiac and terminal illness were the most common causes.

Of the 3,305 adult patients where bystanders had already successfully resuscitated the patient prior to NSW Ambulance arrival, or where NSW Ambulance clinicians attempted resuscitation, 78% patients had an arrest of presumed cardiac cause, with the proportions of other causes reflecting the lower likelihood of resuscitation in cases of non-medical aetiology (32% of cases, compared with resuscitation attempted for 40% of cases with medical aetiology), and the particularly low likelihood of resuscitation of patients with terminal illness (11% of cases involved a resuscitation attempt) (**Figure 11**).

FIGURE 9: Cause of adult OHCA, all cases, NSW 2019

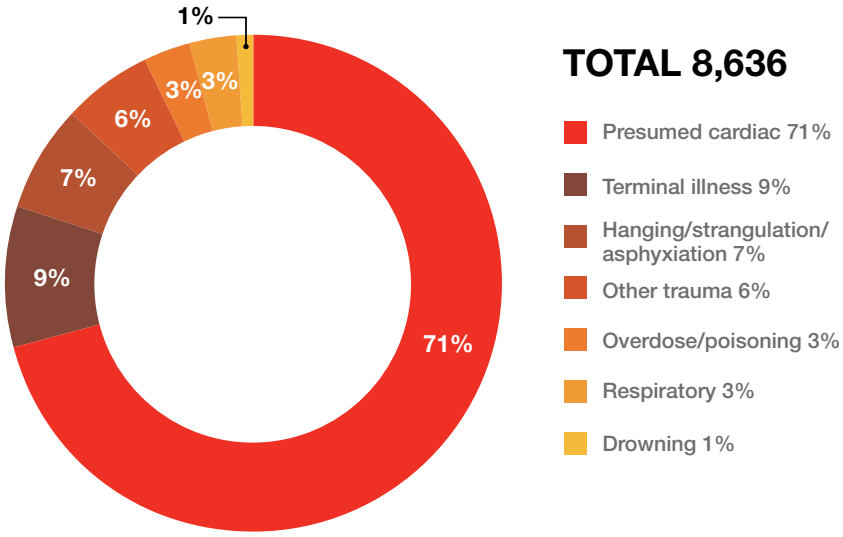


FIGURE 10: Cause of adult OHCA by age group, NSW 2019^

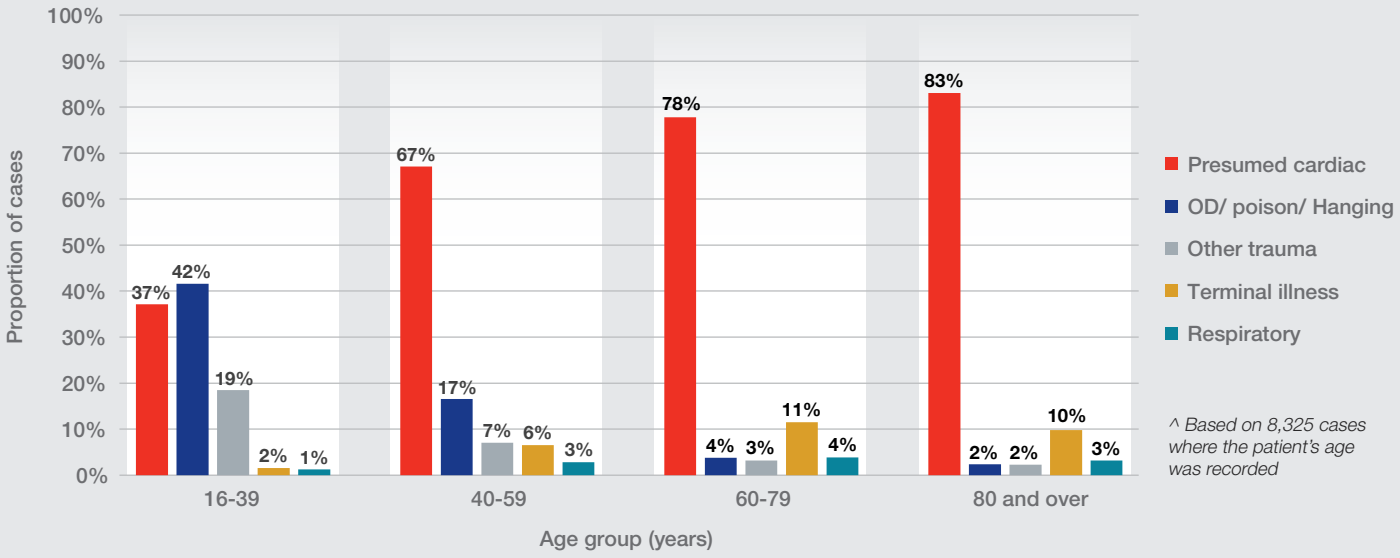
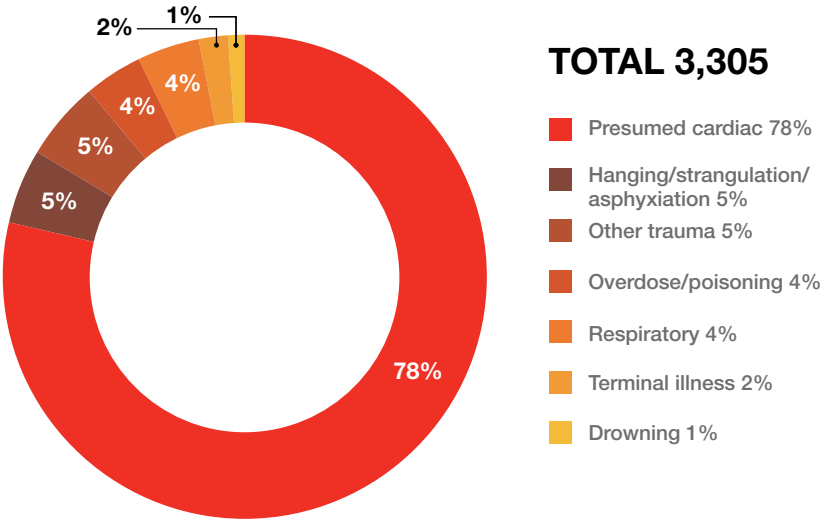


FIGURE 11: Cause of adult OHCA, resuscitation attempts or ROSC before NSW Ambulance arrival, NSW 2019



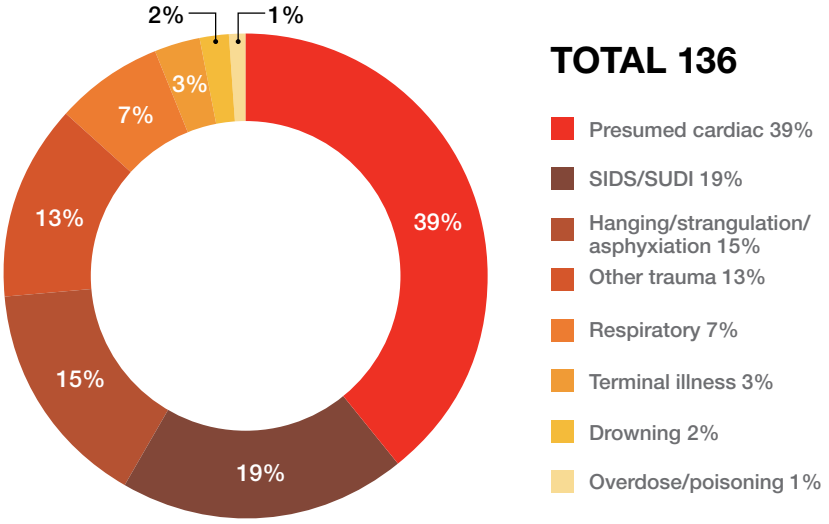
Cause of cardiac arrest in children

As shown in **Figure 12**, cardiac was also the most common presumed cause (39%) of paediatric arrests. 19% of OHCAs were attributed to Sudden Unexpected Death in Infancy (SUDI) (of which Sudden Infant Death Syndrome (SIDS) is the unexplained subset). Hanging/strangling or asphyxiation was another common cause (15% of OHCAs). The number of paediatric arrests is very small (136 in total or 1.6% of all cases in the OHCAR), and small changes in cause from year to year can affect the proportions attributed to each cause.

39%

PAEDIATRIC ARRESTS WERE PRESUMED CARDIAC

FIGURE 12: Cause of paediatric OHCA, all cases, NSW 2019



Bystanders successfully resuscitated the patient prior to NSW Ambulance arrival, or NSW Ambulance clinicians attempted resuscitation in 97 children (71% of paediatric arrests). The proportion of paediatric resuscitations by cause was similar to the proportion of paediatric OHCAs by cause, with the exception of terminal illness (no attempted resuscitations) (**Figure 13**).

FIGURE 13: Cause of paediatric OHCA, resuscitation attempts or ROSC before NSW Ambulance arrival, NSW 2019

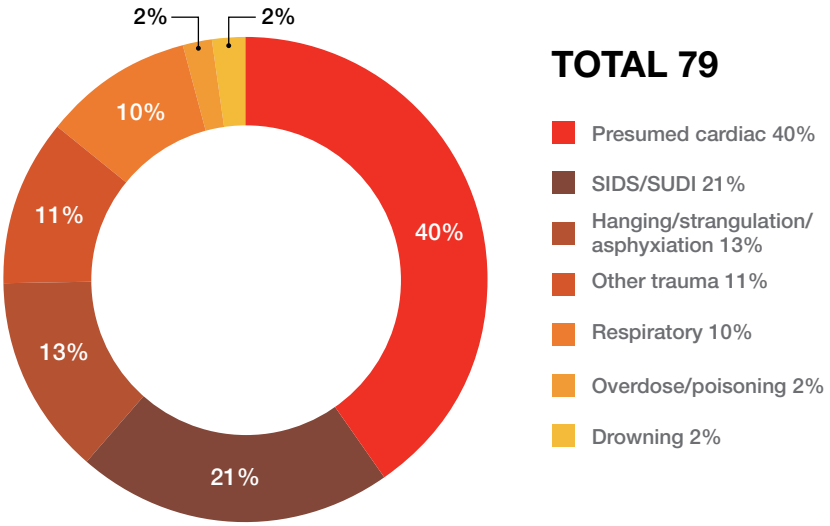
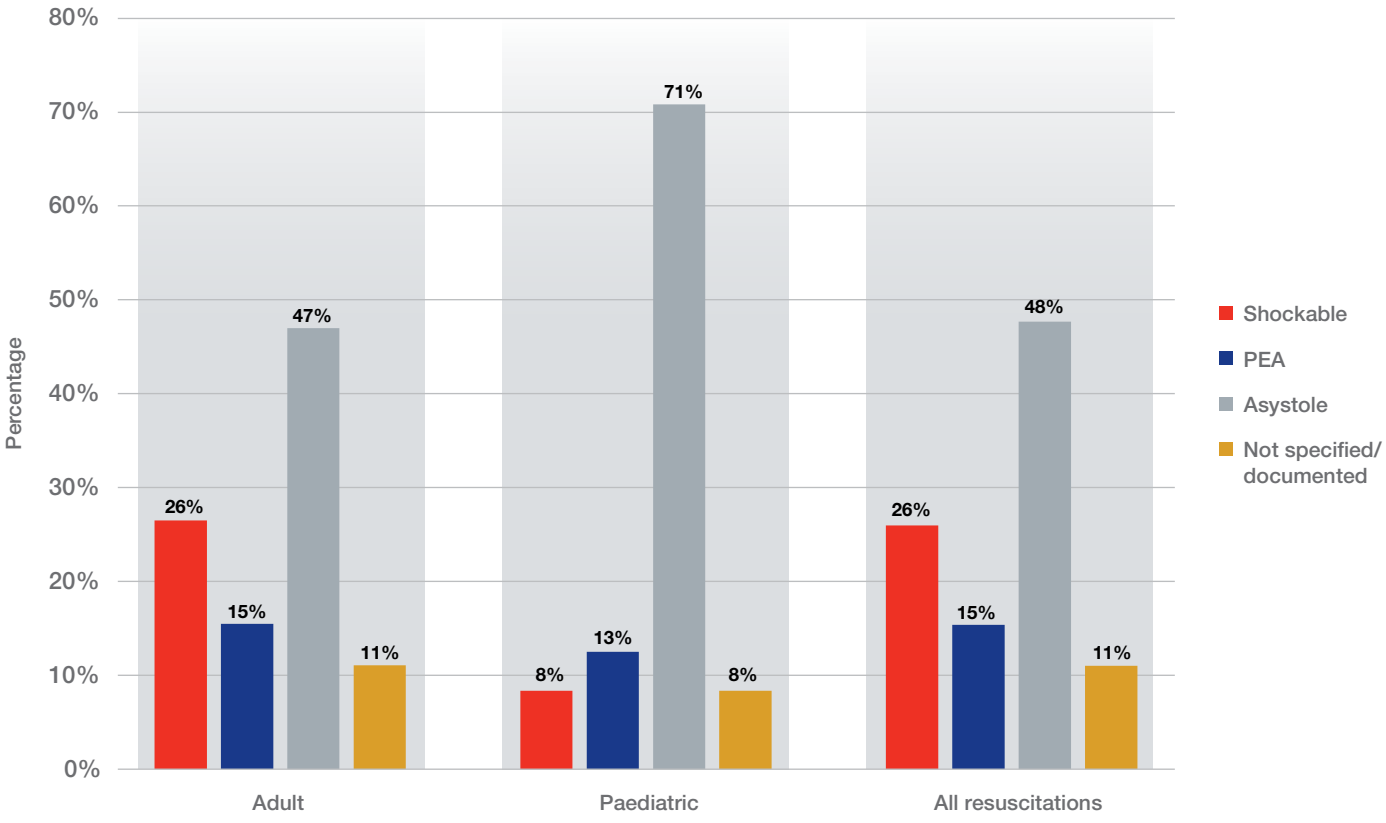


FIGURE 14: Distribution of Initial presenting rhythm following OHCA, by age group, NSW 2019



Initial rhythm

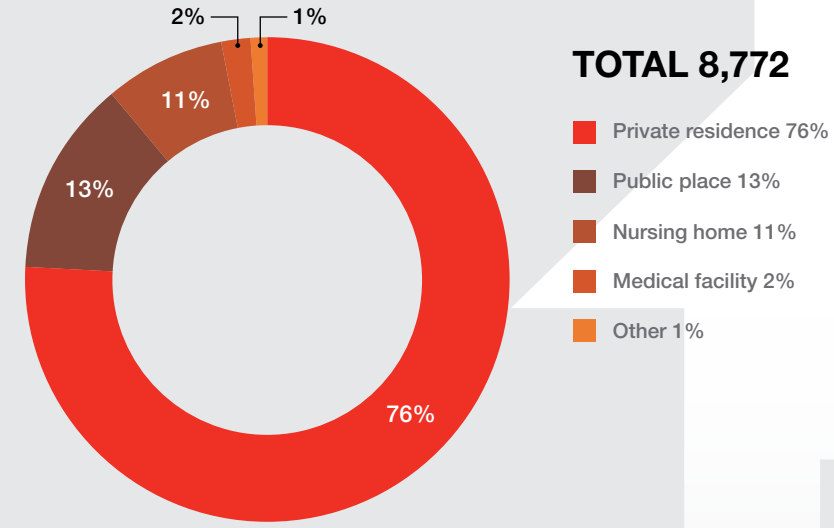
Of the 3,350 patients on which an EMS resuscitation attempt was undertaken, 870 (26%) initially presented in a shockable rhythm, 515 (15%) were in a non-shockable Pulseless Electrical Activity (PEA) and 1,597 (48%) were in a non-shockable asystole. For the remaining 368 (11%), the initial rhythm was not fully documented (including unspecified 'non-shockable' rhythms). Adult patients were more likely to be in a shockable rhythm than children (26% vs 8%). The majority of paediatric patients (71%) were in asystole. **Figure 14** indicates the distribution of initial rhythms for adult and paediatric patients.

Location of arrest

Where an OHCA happened is an important factor in whether it is likely to be witnessed, and whether CPR and defibrillation are likely to be performed prior to EMS arrival. Most OHCAs (6,689 cases, 76%) occurred in a private residence. 13% of OHCAs occurred in a public location (**Figure 15**). Women were more likely to arrest in a private residence or nursing home than men (91% of female vs 81% of male OHCAs) whereas men were more likely to arrest in a public location (17% of male vs 8% of female OHCAs).

In 2019, 25% of all cardiac arrests in the OHCAR were witnessed by a bystander and 8% by a paramedic, similar to previous years. Arrests in a public place or medical facility were more likely to be witnessed than those that occurred in a nursing home or private residence (**Figure 16**).

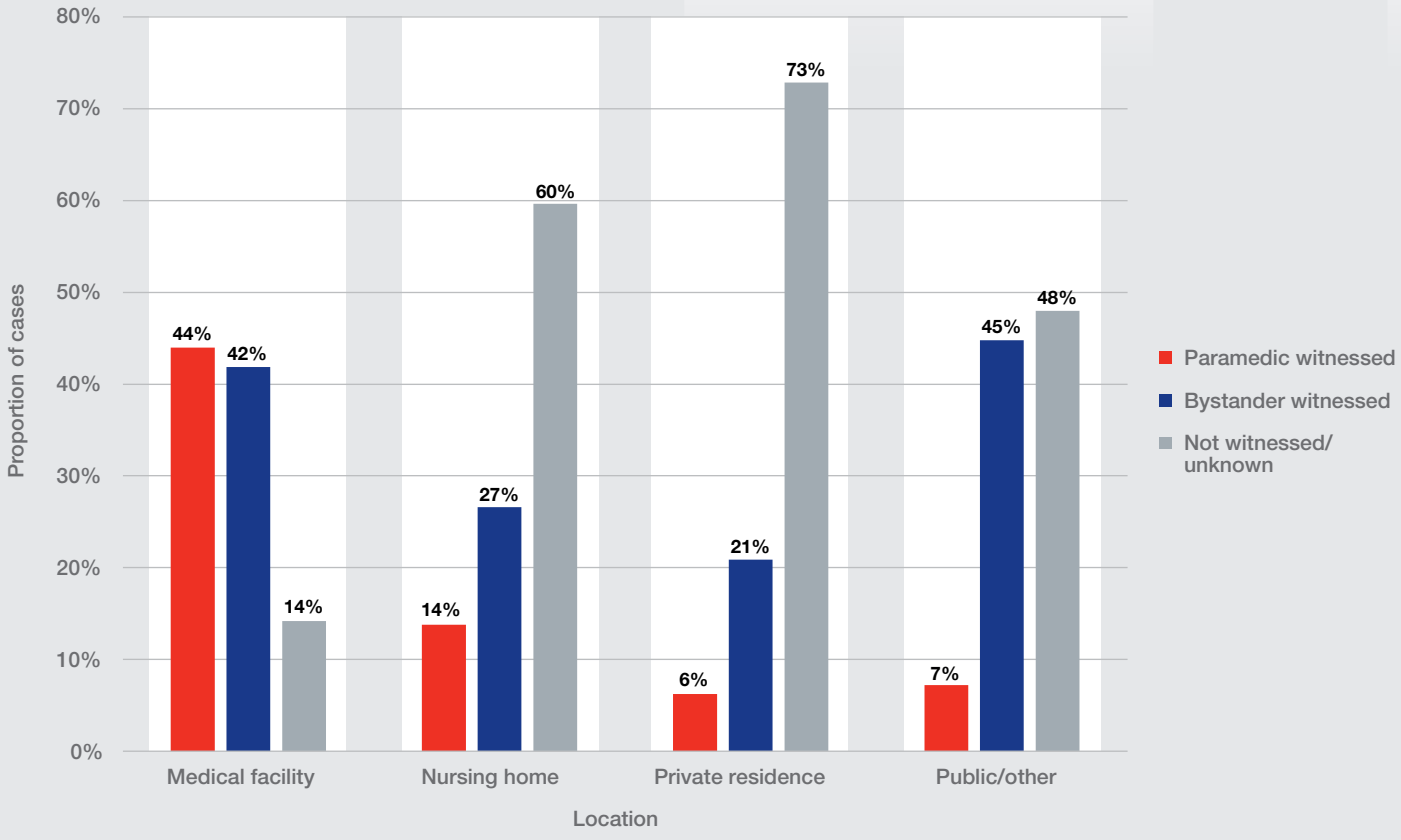
FIGURE 15: Location of OHCA, NSW 2019



76%

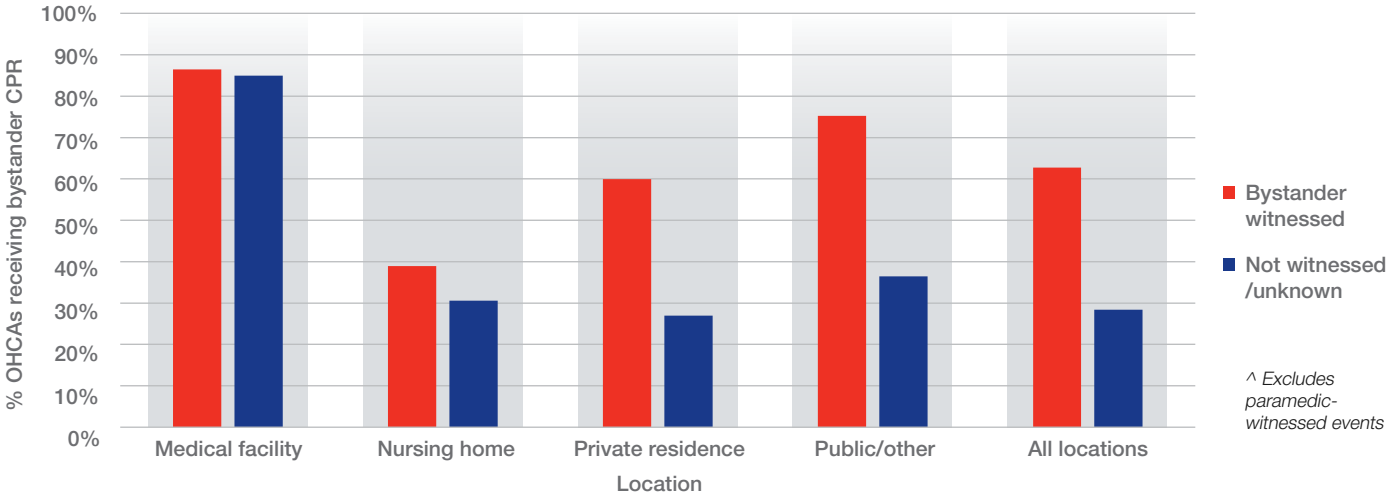
OF OHCAS OCCURRED IN A PRIVATE RESIDENCE

FIGURE 16: Witnessed status of OHCA by location, all OHCAs, NSW 2019



Chain of Survival

FIGURE 17: Likelihood of bystander CPR by location and witnessed status, OHCAs (excl paramedic-witnessed), NSW 2019^



THE links in the chain of survival are: identification of cardiac arrest and activation of emergency response; immediate high-quality CPR; rapid defibrillation; advanced resuscitation; post-arrest care and recovery[4]. This sequence aims to increase the chances of survival following cardiac arrest.

Identification of cardiac arrest

There are no data on how quickly callers identified cardiac arrests and called Triple Zero (000), or whether they called ambulance first as opposed to another emergency service. The assessment of whether the call-taker identified cardiac arrest during the call was based on comments in VisiNET or on the paramedic clinical record. On this basis, it appears that call-takers identified the call as a cardiac arrest in 88% of OHCAs (excluding those witnessed by paramedics).

Bystander CPR

When considering the 8,108 EMS-attended OHCAs that did not occur in the presence of a paramedic, 2,200 (27%) were witnessed by a bystander and 5,908 (71%) were unwitnessed or the witnessed status not recorded. Overall, in EMS-attended OHCAs (excluding paramedic-witnessed), bystanders performed CPR 38% of the time. Bystanders were more likely to perform CPR in cases where the arrest was witnessed. Across all locations, there was a 63% chance of bystanders performing CPR where the arrest was witnessed and a 28% likelihood of bystander CPR where the arrest was unwitnessed. In 2019, as in previous years, the proportion of OHCAs witnessed by a bystander and receiving bystander CPR was highest in medical facilities and public locations (**Figure 17**).

FIGURE 18: Likelihood of shockable rhythm by witnessed status and bystander CPR, OHCAs (excl paramedic-witnessed), NSW 2019^

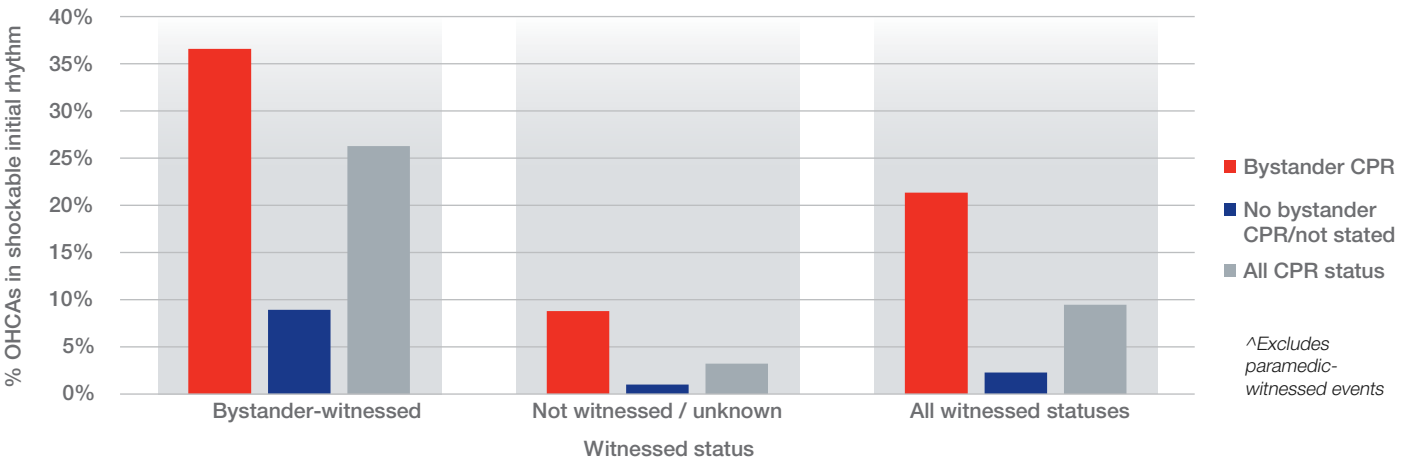


TABLE 5: AED use in OHCAs by witnessed status, NSW 2019^

	Bystander witnessed	Not witnessed/ unknown	Total (excl paramedic-witnessed events)
	Number or %		
OHCAs in which an AED was used	181	84	265
Number of OHCAs with bystander CPR	1,381	1,676	3,057
Total number of OHCAs	2,200	5,908	8,108
Proportion of bystander CPR cases where an AED was used	13.1%	5.0%	8.7%
Proportion of all OHCAs where AED used	8.2%	1.4%	3.3%

^ Excludes paramedic-witnessed events

Where bystanders performed CPR, the patient was more likely to be in a shockable rhythm on EMS-arrival (**Figure 18**). This is because either NSW Ambulance arrived sooner after the arrest occurred due to it being witnessed, or bystander CPR made a positive difference to the rhythm, or both.

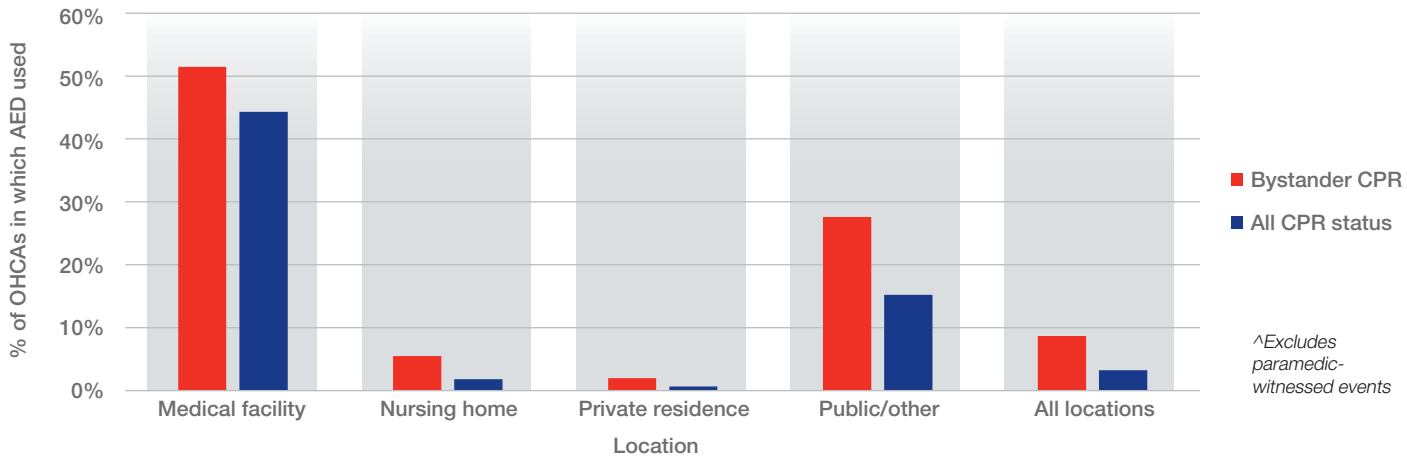
Defibrillator use prior to NSW Ambulance arrival

In 2019, Automated External Defibrillators (AEDs) were used prior to NSW Ambulance arrival in 265 cases (3% of all EMS-attended OHCAs (excluding paramedic-witnessed). AEDs were more likely to be use in OHCAs that were witnessed by bystanders (8% of bystander-witnessed OHCAs vs 1% of unwitnessed OHCAs). AEDs were only used in cases where bystanders attempted CPR, where they were used in 9% of cases (13% of bystander-witnessed OHCAs with bystander CPR and 5% of unwitnessed OHCAs with bystander CPR) (**Table 5**).

An AED was used in 38 of the 52 cases (73%) in which ROSC was achieved prior to paramedic arrival, and in 193 of the 2,816 cases (7%) where resuscitation was subsequently continued by paramedics. In 34 cases where a defibrillator was used, paramedics discontinued resuscitation on arrival.

Most OHCAs occurred in private residences, where an AED was unlikely to be accessible. An AED was used in 43 cases (<1% of OHCAs) that occurred in a private residence. AED use was common in medical facilities (used in 44% of OHCAs) and uncommon in nursing homes (2% of OHCAs). In public locations (all locations except private residences, nursing homes or medical facilities), AEDs were used by bystanders on 176 patients out of 1,156 OHCAs (15% of all public-location OHCAs and 27% where bystanders attempted CPR) (**Figure 19**).

FIGURE 19: AED use in OHCAs by location, NSW 2019^



Emergency response

Priority 1A is the highest priority a call can be given. Priority 1A calls receive a lights and siren response with multiple resources assigned to the incident. Of the 2,816 arrests (excluding paramedic-witnessed arrests) in which EMS-resuscitation was attempted, 2,345 (83%) had a 1A response priority. A further 433 (15%) were 1B or 1C responses (also lights and siren). Overall, 99% of cases where a resuscitation attempt was made by paramedics (excluding paramedic-witnessed arrests) received a lights and siren response.

Paramedic-witnessed arrests are excluded from the above analysis because the OHCA did not occur until after the paramedics arrived on scene, so these cases would not necessarily be assigned a priority 1A at the time of the call. However, the vast majority of paramedic-witnessed cardiac arrests received a lights and siren response (91% of cases).

In cases where the caller stated that the patient was already deceased, and where NSW Ambulance attended but no resuscitation attempt was made, a lower priority was assigned to the call (2 Immediate, no lights or siren).

The median response time to OHCAs where a resuscitation attempt was made (excluding paramedic-witnessed arrests) was 8 minutes in Greater Sydney, and the same in the Rest of NSW. **Figure 20** illustrates the distribution of response times in Sydney and the rest of NSW.

83%

ARRESTS HAD A 1A RESPONSE PRIORITY

FIGURE 20: Distribution of response times, EMS-treated OHCA (excluding paramedic witnessed), by region, NSW 2019

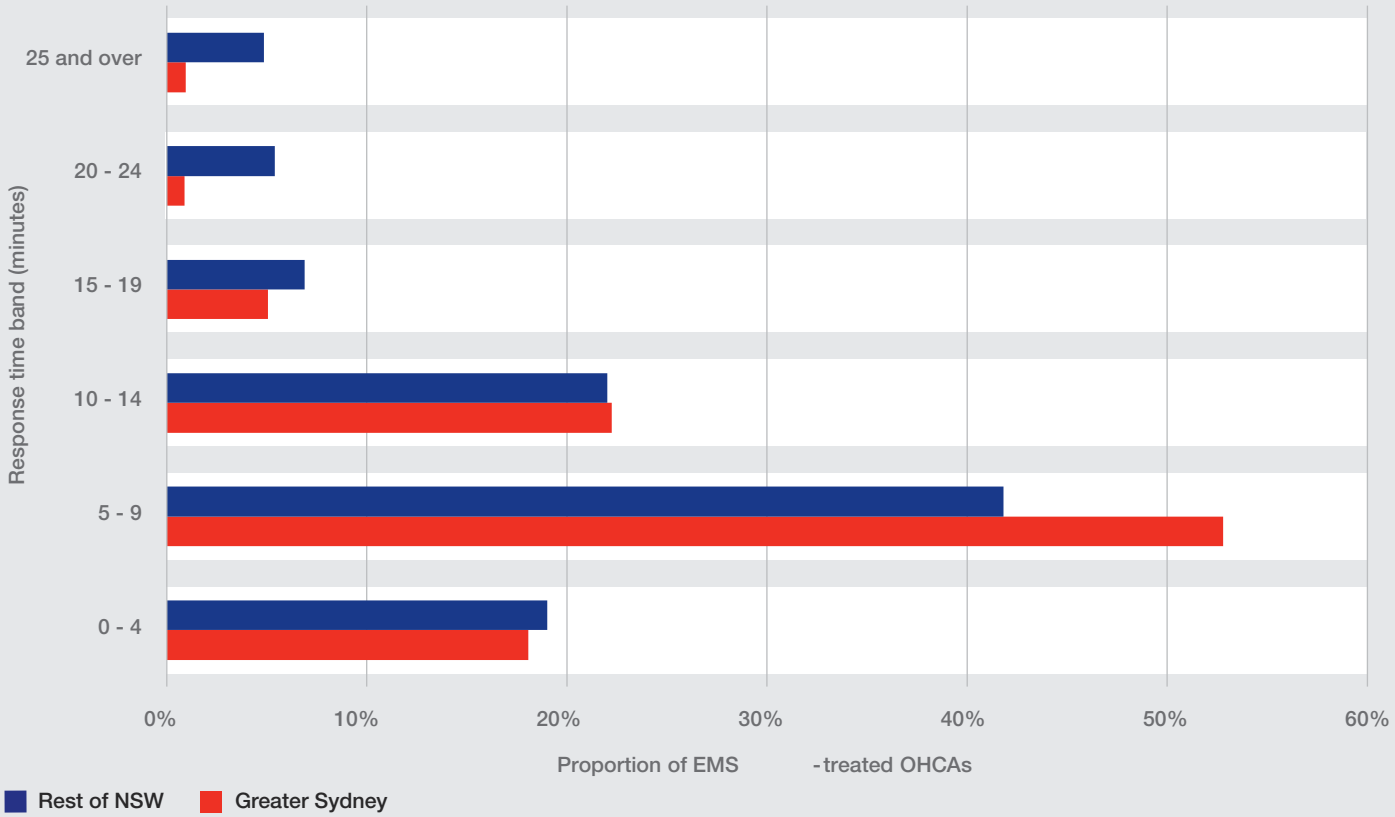


TABLE 6: Likelihood of resuscitation by witnessed status and bystander CPR, EMS-attended OHCA, NSW 2019^

Witnessed status	Bystander CPR	Resuscitations	Denominator	% resuscitated
Paramedic-witnessed	Total - all CPR	**534**	**664**	**80%**
Bystander-witnessed	Bystander CPR	1,154	1,337	86%
	No/ unknown bystander CPR	328	817	40%
	Total - all CPR	**1,482**	**2,154**	**69%**
Not witnessed / Unknown	Bystander CPR	945	1,670	57%
	No/ unknown bystander CPR	389	4,232	9%
	Total - all CPR	**1,334**	**5,902**	**23%**
All witnessed status	**Total - all CPR**	**3,350**	**8,720**	**38%**

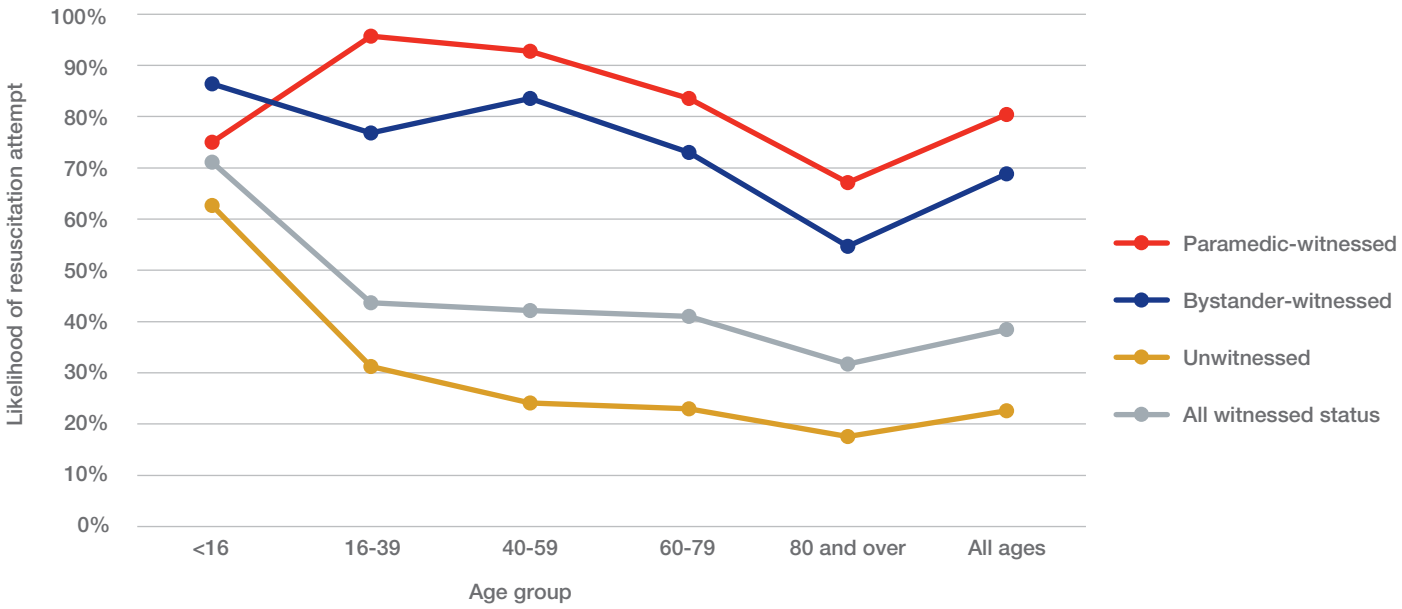
^Excluding cases where ROSC was achieved before NSW Ambulance arrival

Likelihood of resuscitation by NSW Ambulance

When NSW Ambulance clinicians arrived on scene, the likelihood that a resuscitation attempt was made differed based on a number of factors, including whether the OHCA was witnessed and whether bystander CPR was performed prior to NSW Ambulance arrival. **Table 6** shows the likelihood that NSW Ambulance clinicians made a resuscitation attempt on arrival. Cases that were bystander witnessed and/ or where bystanders were performing CPR were more likely to be resuscitated. OHCAs where the patient achieved ROSC prior to NSW Ambulance arrival are excluded from the denominator because there is no initial decision to resuscitate in cases where ROSC has already been achieved.

The patient's age was also a factor in whether a resuscitation attempt was likely to be made on paramedic arrival. The relative likelihood of resuscitation attempt, by witnessed status and age group is shown in **Figure 21**.

FIGURE 21: Likelihood of resuscitation attempt, by witnessed status and age, NSW 2019



NSW Ambulance

Cardiac Arrest Outcomes

ROSC before NSW Ambulance arrival

Of the 52 cases where ROSC was achieved prior to NSW Ambulance arrival 51 (98%) survived to ED admission, and one was pronounced dead in ED.

NSW Ambulance resuscitation outcomes

ROSC at any time

Return of spontaneous circulation (ROSC) is the measure of whether a resuscitation attempt has been successful. Some patients achieve and maintain ROSC, while others only have a brief and unsustained period of ROSC. In OHCAs where NSW Ambulance clinicians made a resuscitation attempt, 35% of patients (1,175 out of 3,350) achieved ROSC at some point.

Scene outcomes

When NSW Ambulance clinicians make a resuscitation attempt, if ROSC is not achieved within 20 minutes and the patient is not in a shockable rhythm at that time, a decision may be made to cease resuscitation efforts on scene. The alternative scene outcomes are that the patient will be transported, having already attained ROSC, or with CPR in progress. In 2019, 50% of patients had resuscitation efforts ceased on scene, 23% were transported with CPR and 27% were transported with ROSC.

Ambulance outcomes are recorded as: deceased on examination; died at scene; died en route; CPR continuing on handover; or survived to ED admission. In the 'CPR continuing…' group, the paramedic clinical record described CPR en route to hospital but did not indicate whether the patient had ROSC on arrival at hospital. **Table 7** indicates scene outcomes against ambulance outcomes for patients where a resuscitation attempt was made. The vast majority of patients transported with ROSC survived to ED (99%), while very few (2%) of the patients transported with CPR did. Transporting patients with CPR presents challenges as it is difficult to maintain effective manual CPR in the back of a moving vehicle, and is potentially hazardous to clinicians. The low rates of survival to ED within the 'transported with CPR' group underscores the difficulty of maintaining effective CPR in transit.

FIGURE 22: Ambulance outcome, EMS-treated OHCA, by witnessed status, NSW 2019

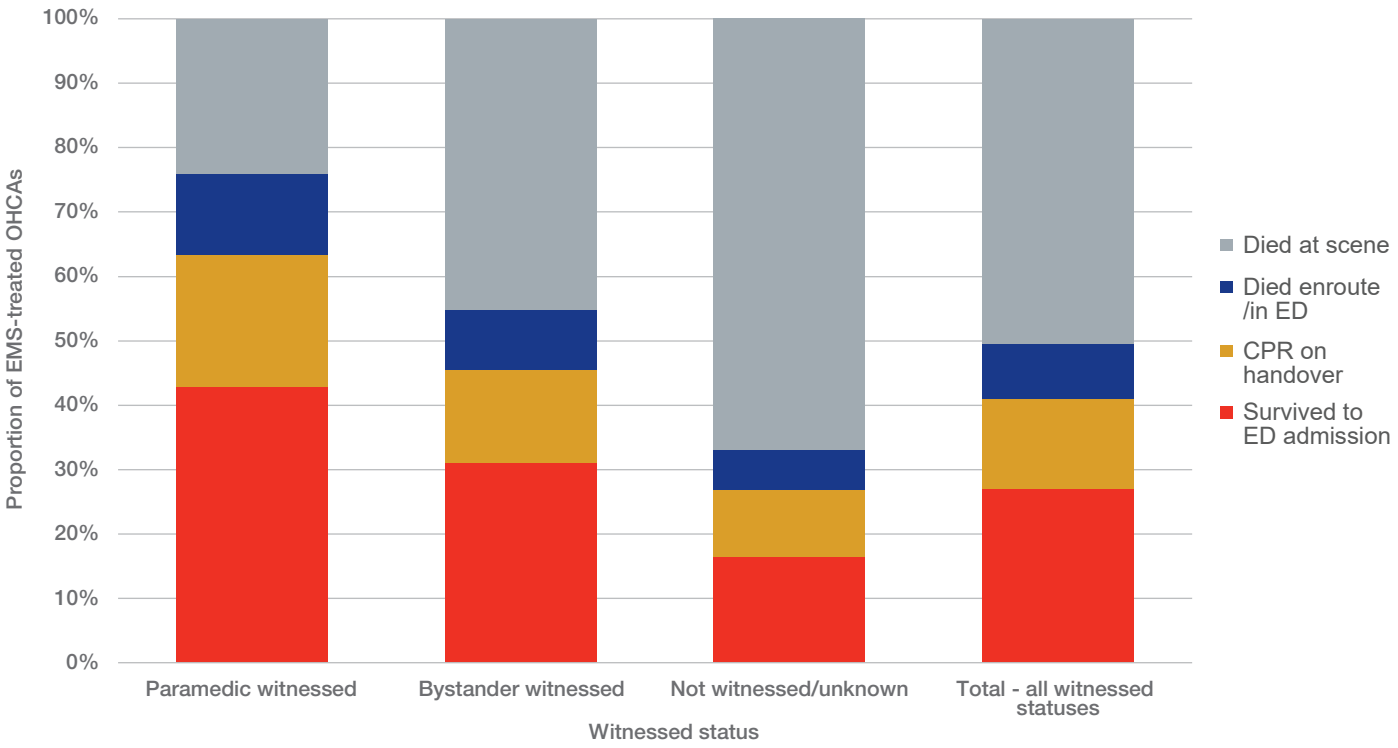


TABLE 7: Ambulance outcomes and scene outcomes, EMS-treated OHCA, NSW 2019

	Scene outcome			
Ambulance outcome	**Resuscitation ceased on scene**	**Transported with CPR**	**Transported with ROSC**	**Total - all scene outcomes**
Died at scene	1,690	-	-	1,690
Died en route/in ED	-	278	10	288
CPR ongoing on handover	-	464	1	465
Survived to ED	-	12	895	907
Total - all ambulance outcomes	**1,690**	**754**	**906**	**3,350**

TABLE 8: Survival by witnessed status, EMS-treated OHCA, NSW 2019

Indicator	Witnessed Status	Number	Denominator	%
Survived to ED	Paramedic-witnessed	229	534	42.9
	Bystander-witnessed	460	1,482	31.0
	Not witnessed/Unknown	218	1,334	16.3
	Total - all witnessed statuses	**907**	**3,350**	**27.1**
Survived to hospital discharge^	Paramedic-witnessed	140	495	28.3
	Bystander-witnessed	191	1,368	14.0
	Not witnessed/Unknown	40	1,274	3.1
	Total - all witnessed statuses	**371**	**3,137**	**11.8**

^Excludes OHCA where ambulance records indicated the patient was transported with no corresponding linked Emergency Department or Admitted Patient Record

Survival rates by witnessed status

Figure 22 relates to the 3,350 EMS-attempted resuscitation patients (that is, resuscitation attempts by NSW Ambulance clinicians and excluding patients with ROSC who were successfully resuscitated by bystanders prior to EMS arrival). As expected, it shows that patients who have a paramedic-witnessed OHCA and where advanced life support can be provided immediately are more likely to survive to ED admission compared with bystander-witnessed or not witnessed/ unknown cardiac arrests.

The overall survival rate to ED across all patients was 27% (907 of 3,350 EMS-attempted resuscitations). The survival rate to ED was highest for paramedic-witnessed OHCAs at 43% (229 out of 534 patients), followed by bystander-witnessed OHCAs (31%, 460 of 1,482 patients) and then unwitnessed OHCAs (16%, 218 of 1,334 patients).

The overall survival rate to hospital discharge across all patients was 12% (371 of 3,137 EMS-attempted resuscitations where records could be matched to EDDC or APDC). The survival rate to hospital discharge was highest for paramedic-witnessed OHCAs at 28% (140 of 495 patients), followed by bystander-witnessed OHCAs (14%, 191 of 1,368 patients) then unwitnessed OHCAs (3%, 40 of 1,274 patients). These results were similar to 2018 (**Table 8**).

Survival rates by bystander CPR and witnessed status

In assessing the impact of bystander CPR, we have included patients with ROSC prior to EMS arrival. Compared with Table 8, Table 9 includes the patients that achieved ROSC prior to NSW Ambulance arrival and excludes the paramedic-witnessed arrests. Over all witnessed statuses, patients who received bystander CPR had a higher chance of survival to ED (27% vs 22%) than patients who did not, and a higher chance of survival to hospital discharge (12% vs 6%). The effect was more pronounced in cardiac arrests that were witnessed. In bystander-witnessed, EMS-treated or OHCAs with ROSC prior to EMS arrival, bystander CPR was associated with a higher crude survival rate to ED admission (35% with bystander CPR vs 25% without bystander CPR) and hospital discharge (19% with bystander CPR vs 8% without, **Table 9**). This analysis underlines the time-critical nature of cardiac arrest and the importance of early bystander CPR.

TABLE 9: Survival outcomes by witnessed and bystander CPR, EMS-treated or ROSC prior to EMS arrival OHCA, all ages, NSW 2019

Indicator	Witnessed status	Bystander CPR	Number	Denominator	%
Survived to ED	Bystander-witnessed	Bystander CPR	423	1,198	35.3
		No/ unknown bystander CPR	82	330	24.8
		Total - all CPR	**505**	**1,528**	**33.0**
	Not witnessed / Unknown	Bystander CPR	150	951	15.8
		No/ unknown bystander CPR	74	389	19.0
		Total - all CPR	**224**	**1,340**	**16.7**
	All witnessed statuses (excl para-witnessed)	Bystander CPR	573	2,149	26.7
		No/ unknown bystander CPR	156	719	21.7
		Total - all CPR	**729**	**2,868**	**25.4**
Survived to hospital discharge^	Bystander-witnessed	Bystander CPR	205	1,108	18.5
		No/ unknown bystander CPR	25	304	8.2
		Total - all CPR	**230**	**1,412**	**16.3**
	Not witnessed / Unknown	Bystander CPR	31	900	3.4
		No/ unknown bystander CPR	13	379	3.4
		Total - all CPR	**44**	**1,279**	**3.4**
	All witnessed statuses (excl para-witnessed)	Bystander CPR	236	2,008	11.8
		No/ unknown bystander CPR	38	683	5.6
		Total - all CPR	**274**	**2,691**	**10.2**

^Excludes OHCA where ambulance records indicated the patient was transported but no corresponding linked Emergency Department or Admitted Patient Record

TABLE 10: Survival outcomes by witnessed and AED use, EMS-treated or ROSC prior to EMS arrival OHCA, all ages, NSW 2019

Indicator	Witnessed status	AED use	Number	Denominator	%
Survived to ED	Bystander-witnessed	AED used	86	166	51.8
		AED not used	419	1,362	30.8
		Total - all AED use	**505**	**1,528**	**33.0**
	Not witnessed / Unknown	AED used	8	65	12.3
		AED not used	216	1,275	16.9
		Total - all AED use	**224**	**1,340**	**16.7**
	All witnessed statuses (excl para-witnessed)	AED used	94	231	40.7
		AED not used	635	2,637	24.1
		Total - all AED use	**729**	**2,868**	**25.4**
Survived to hospital discharge^	Bystander-witnessed	AED used	60	148	40.5
		AED not used	170	1,264	13.4
		Total - all AED use	**230**	**1,412**	**16.3**
	Not witnessed / Unknown	AED used	5	58	8.6
		AED not used	39	1,221	3.2
		Total - all AED use	**44**	**1,279**	**3.4**
	All witnessed statuses (excl para-witnessed)	AED used	65	206	31.6
		AED not used	209	2,485	8.4
		Total - all AED use	**274**	**2,691**	**10.2**

^Excludes OHCA where ambulance records indicated the patient was transported but no corresponding linked Emergency Department or Admitted Patient Record

Survival rates by AED use and witnessed status

In assessing the impact of AED use, we have included patients with ROSC prior to EMS arrival and excluded paramedic-witnessed arrests. Over all witnessed statuses, patients on whom an AED was used had a higher chance of survival to ED than patients who did not (41% vs 24%), and a higher chance of survival to hospital discharge (32% vs 9%). The effect was more pronounced in cardiac arrests that were witnessed. In bystander-witnessed, EMS-treated or OHCAs with ROSC prior to EMS arrival, AED use was associated with a higher crude survival rate to ED admission (52% with AED use vs 31% without) and hospital discharge (41% with AED use vs 13% without) (**Table 10**).

Survival rates by initial rhythm

Physiologically, survival from cardiac arrest is more likely if the patient is in a shockable rhythm. Over all attempted resuscitations, 27% of patients survived to ED and 12% to hospital discharge), For patients in a shockable initial rhythm, the survival rate to ED was 46% and to hospital discharge was 33%, compared with 13% survival to ED and 2% to discharge for patients in asystole on initial presentation (**Figure 23** and **Table 11**).

Survival by initial rhythm and witnessed status

Combining witnessed status and initial rhythm, survival rates to ED and hospital discharge are shown in **Table 12**. The group with the highest survival were patients whose cardiac arrest was witnessed by a paramedic and who initially presented in a shockable rhythm (71% to ED, 63% to hospital discharge). Unwitnessed cardiac arrests in a non-shockable rhythm had the poorest chance of survival (15% to ED, 2% to hospital discharge).

FIGURE 23: Survival by initial rhythm (all ages), EMS-treated OHCA, NSW 2019

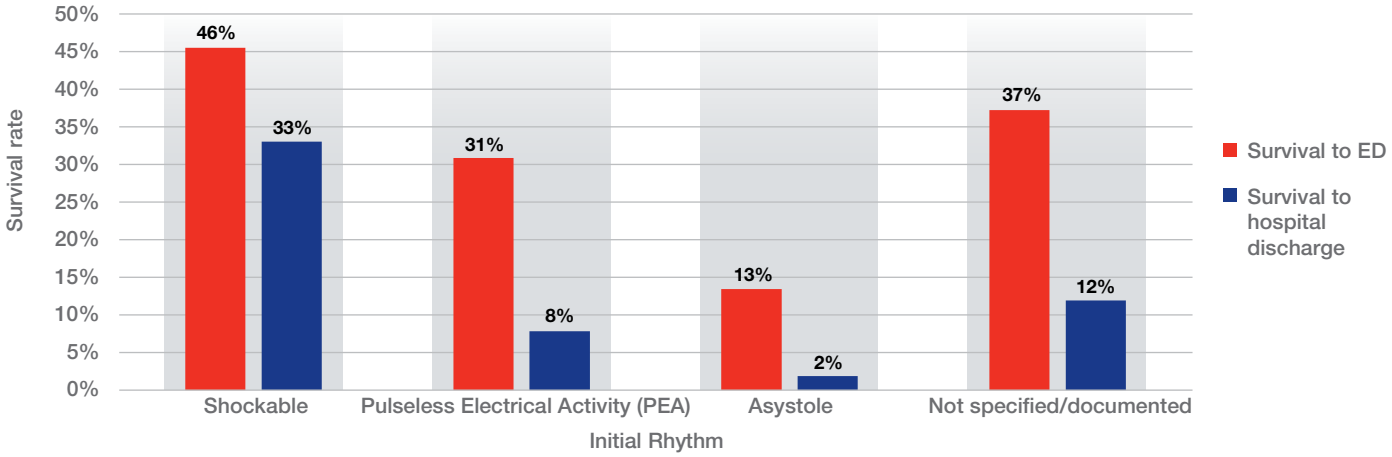


TABLE 11: Survival outcomes by initial rhythm, EMS-treated OHCA, NSW 2019

Indicator	Witnessed Status	Number	Denominator	%
Survived to ED	Shockable rhythm	396	870	45.5
	Pulseless Electrical Activity (PEA)	159	515	30.9
	Asystole	215	1,597	13.5
	Not documented	137	368	37.2
	Total – all rhythms	**907**	**3,350**	**27.1**
Survived to hospital discharge^	Shockable rhythm	265	802	33.0
	Pulseless Electrical Activity (PEA)	37	471	7.9
	Asystole	29	1,529	1.9
	Not documented	40	335	11.9
	Total – all rhythms	**371**	**3,137**	**11.8**

^Excludes OHCA where ambulance records indicated the patient was transported with no corresponding linked Emergency Department or Admitted Patient Record

TABLE 12: Survival by witnessed status and initial rhythm, EMS-treated OHCAs, NSW 2019

Indicator	Witnessed status	Initial rhythm	Number	Denominator	%
Survived to ED	Paramedic-witnessed	Shockable	106	149	71.1
		Not shockable/ not documented	123	385	31.9
		Total - all rhythms	**229**	**534**	**42.9**
	Bystander-witnessed	Shockable	242	539	44.9
		Not shockable/ not documented	218	943	23.1
		Total - all rhythms	**460**	**1,482**	**31.0**
	Not witnessed / unknown	Shockable	48	182	26.4
		Not shockable/ not documented	170	1,152	14.8
		Total - all rhythms	**218**	**1,334**	**16.3**
	All witnessed statuses	Shockable	396	870	45.5
		Not shockable/ not documented	511	2,480	20.6
		Total - all rhythms	**907**	**3,350**	**27.1**
Survived to hospital discharge^	Paramedic-witnessed	Shockable	89	141	63.1
		Not shockable/ not documented	51	354	14.4
		Total - all rhythms	**140**	**495**	**28.3**
	Bystander-witnessed	Shockable	155	497	31.2
		Not shockable/ not documented	36	871	4.1
		Total - all rhythms	**191**	**1,368**	**14.0**
	Not witnessed / unknown	Shockable	21	164	12.8
		Not shockable/ not documented	19	1,110	1.7
		Total - all rhythms	**40**	**1,274**	**3.1**
	All witnessed statuses	Shockable	265	802	33.0
		Not shockable/ not documented	106	2,335	4.5
		Total - all rhythms	**371**	**3,137**	**11.8**

^Excludes OHCA where ambulance records indicated the patient was transported with no corresponding linked Emergency Department or Admitted Patient Record

Survival by age group and initial rhythm

Adults make up 98.4% of the EMS-attended OHCAs (8,636 out of 8,772) and 97% of the EMS resuscitation attempts (3,254 out of 3,350). Survival rates by age band for children and adults are shown in **Figure 24**.

Adults are more likely to present in a shockable rhythm than children (26% of adults vs 8% of children) and this is a factor in the higher adult OHCA survival rates compared with paediatric arrests (survival to ED 27% of adults compared with 19% of children; survival to hospital discharge 12% of adults, 10% of children (**Table 13**).

Survival rates by cause

Survival rates to ED were higher for cardiac arrests of medical cause than non-medical causes. 27% of all–ages medical OHCAs survived to ED (774 patients out of 2,873 resuscitations) compared with 25% of non-medical OHCAs (133 out of 523 resuscitations). Survival to hospital discharge was also higher for medical OHCAs: 13% of medical OHCAs compared with 6% of non-medical OHCAs (**Table 14**).

Survival rates by response time

For the 2,816 non-paramedic witnessed, EMS-treated arrests, faster response times were associated with higher survival rates to ED admission and hospital discharge (**Figure 25**).

TABLE 13: Survival outcomes by age group and initial rhythm, EMS-treated OHCA, NSW 2019

Indicator	Age	Initial rhythm	Number	Denominator	%
Survived to ED	Child	Shockable	6	8	75.0
		Not shockable/ not documented	12	88	13.6
		Total - all rhythms	**18**	**96**	**18.8**
	Adult	Shockable	390	862	45.2
		Not shockable/ not documented	499	2,392	20.9
		Total - all rhythms	**889**	**3,254**	**27.3**
	All Ages	Shockable	396	870	45.5
		Not shockable/ not documented	511	2,480	20.6
		Total - all rhythms	**907**	**3,350**	**27.1**
Survived to Discharge^	Child	Shockable	3	8	37.5
		Not shockable/ not documented	5	75	6.7
		Total - all rhythms	**8**	**83**	**9.6**
	Adult	Shockable	262	794	33.0
		Not shockable/ not documented	101	2,260	4.5
		Total - all rhythms	**363**	**3,054**	**11.9**
	All Ages	Shockable	265	802	33.0
		Not shockable/ not documented	106	2,335	4.5
		Total - all rhythms	**371**	**3,137**	**11.8**

^Excludes OHCA where ambulance records indicated the patient was transported with no corresponding linked Emergency Department or Admitted Patient Record

FIGURE 24: Survival by age group, EMS-treated OHCA, NSW 2019

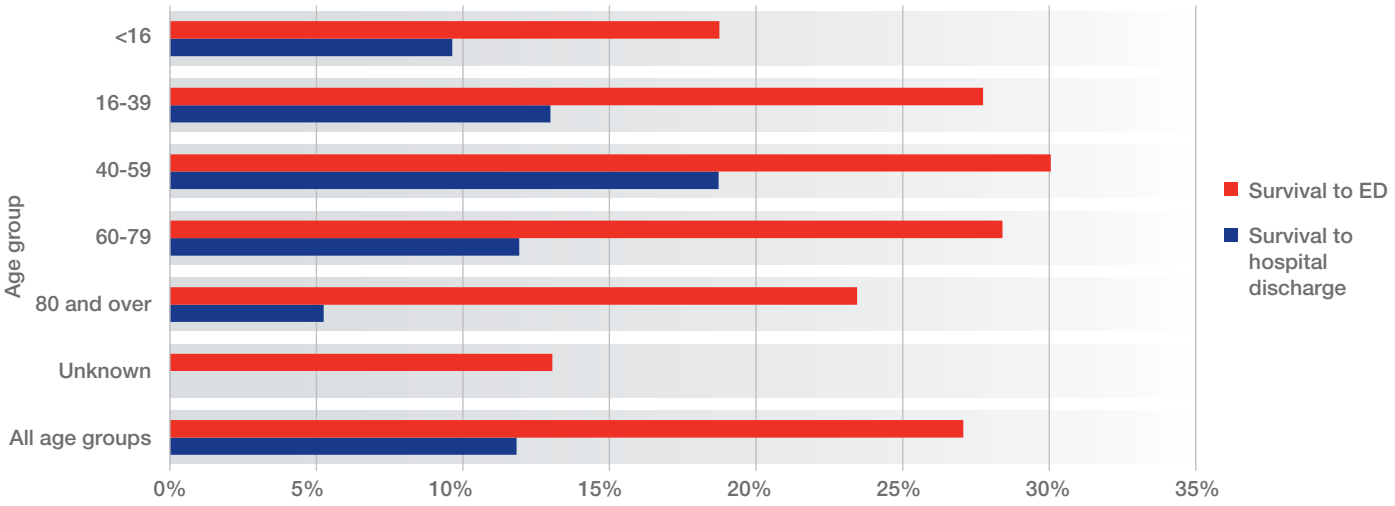
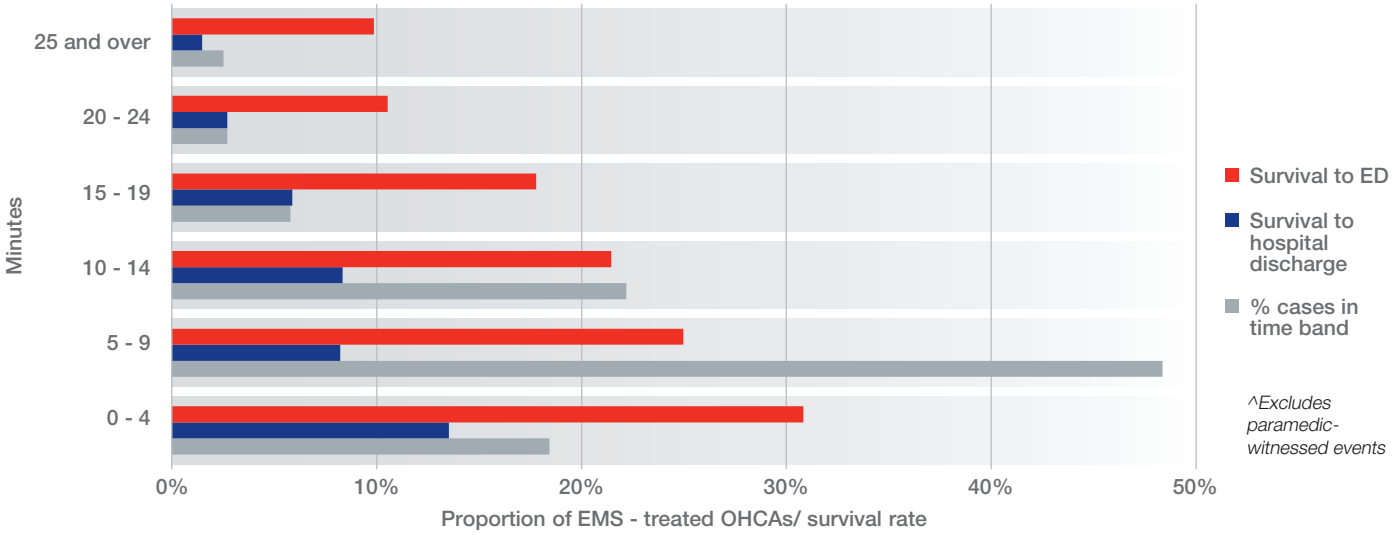


TABLE 14: Survival outcomes by aetiology, EMS-treated OHCA, NSW 2019

Aetiology	Indicator	Number	Denominator	%
Survived to ED	Medical ^^	774	2,827	27.4
	Non-medical	133	523	25.4
	Total - all causes	**907**	**3,350**	**27.1**
Survived to hospital discharge^	Medical ^^	344	2,675	12.9
	Non-medical	27	462	5.8
	Total - All Causes	**371**	**3,137**	**11.8**

^Excludes OHCA where ambulance records indicated the patient was transported with no corresponding linked Emergency Department or Admitted Patient Record
^^Includes missing aetiology

FIGURE 25: Distribution of response times and survival rates, EMS-treated OHCA, NSW 2019^



Survival rates by location

Patients who arrested in a medical facility had the highest chance of survival (48% survival to ED and 35% to hospital discharge, followed by cardiac arrests in public locations (31% survival to ED, 20% to hospital discharge) and cardiac arrests in private residences (26% survival to ED, 9% to hospital diacharge). Patients who experienced a cardiac arrest in a nursing home had the lowest chance of survival (18% to ED and 5% to hospital discharge). The relative survival rates reflect differences in the likelihood that the arrest was witnessed, that a bystander performed CPR and that an AED was available, as well as differences in patient age and other factors) (**Figure 26**).

Utstein patient group survival

The Utstein guidelines include selection criteria for cardiac arrests to allow consistent comparison of key measures between ambulance services. The Utstein patient subgroup is:

- Arrest witnessed by a bystander (not paramedic-witnessed) and
- EMS-attempted resuscitation and
- Initial rhythm shockable

There were 539 (16%) of 3,350 resuscitations attempted that met these criteria. **Figure 27** indicates measures for the Utstein patient subgroup.

FIGURE 26: Survival rates by location, EMS-treated OHCA, NSW 2019

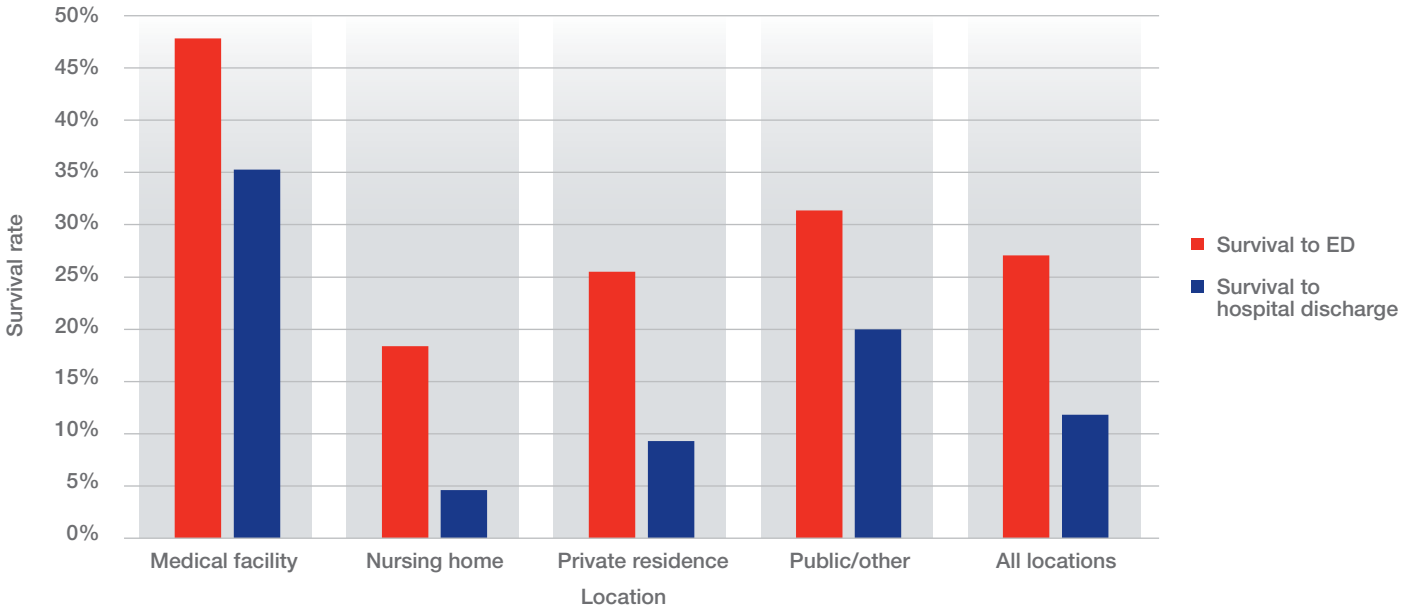
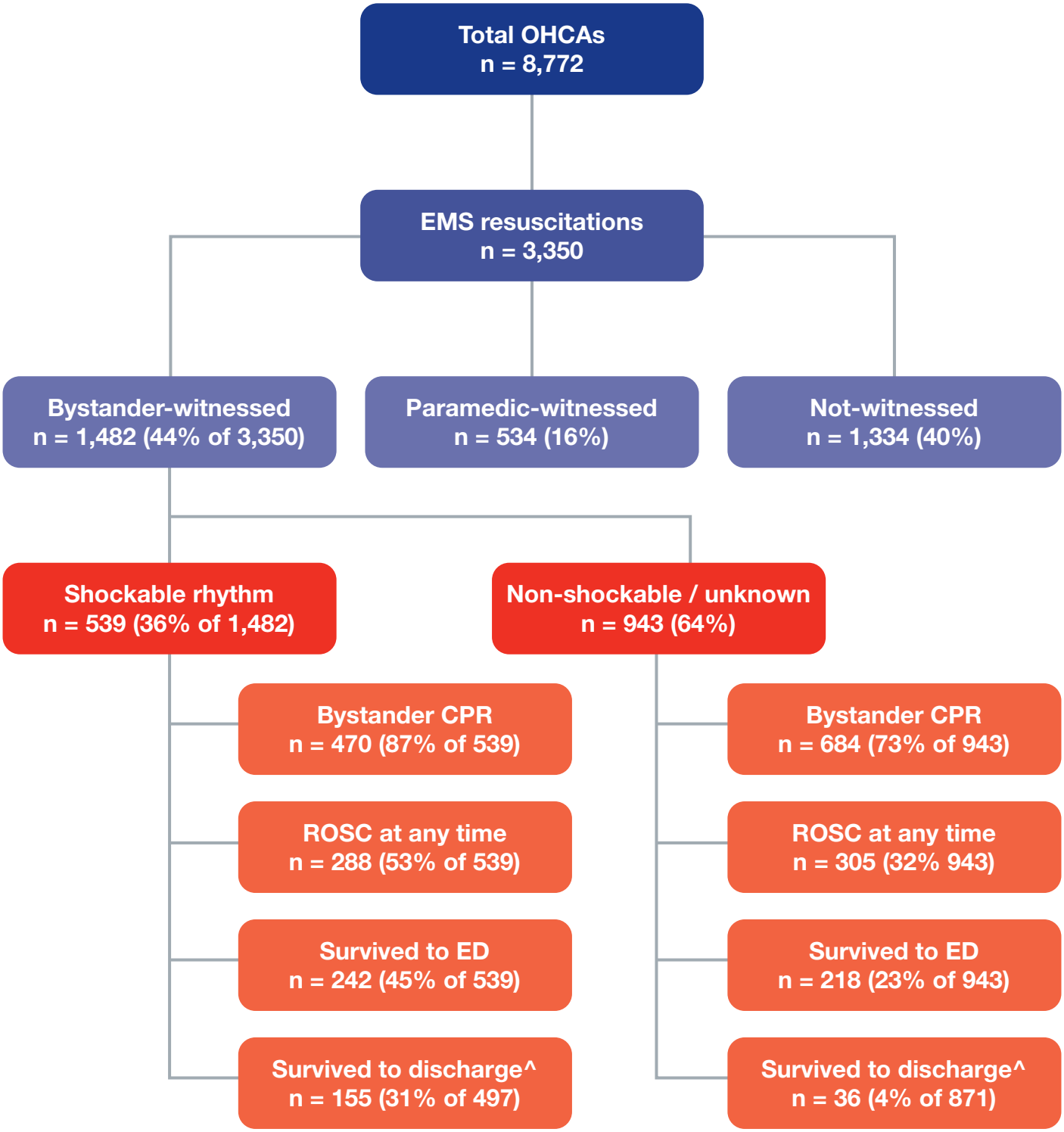


FIGURE 27: Utstein patient subgroup measures, NSW 2019



^Excludes OHCA where ambulance records indicated the patient was transported with no corresponding linked Emergency Department or Admitted Patient Record

Comparison with other jurisdictions

The ability to compare performance across jurisdictions depends on consistency of presentation and definitions. The presentation of results for different patient sub-groups (age group, aetiology, initial rhythm, witnessed status) and differences in definitions (for example, what counts as a resuscitation attempt) hampers easy comparison. The Utstein measure is intended to allow comparison of survival rates for the same patient subgroup (bystander-witnessed EMS resuscitations with an initial shockable rhythm) but even with this measure, inconsistent definitions of resuscitation, and variations in jurisdictional population size and density make like-for-like comparisons inexact. **Table 15** shows the latest available figures from a number of ambulance services on survival rates to ED and hospital discharge for the Utstein subgroup.

TABLE 15: Benchmark OHCA survival rates across jurisdictions, Utstein subgroup

Organisation	Time Period	% survival rate to ED by patient group	% survival to hospital discharge or 30 days
NSW Ambulance	1 Jan 19 – 31 Dec 19	45%	31%
Ambulance Victoria[11]	1 Jul 19 – 30 Jun 20	-	37%
Queensland Ambulance Service[12]	1 Jan 19 – 31 Dec 19	51%	35%
South Australia Ambulance Service[13]	1 Jul 16 – 30 Jun 17	55%	33%
St John Ambulance WA[14]	1 Jan 19 – 31 Dec 19	44%	35%
New Zealand (St John Ambulance NZ and Wellington Free Ambulance)[15]	1 Jul 18 – 30 Jun 19	52%	35%
London Ambulance Service[16]	1 Apr 18 – 31 Mar 19	63%	37%
King County EMS[17]	1 Jan 18 – 31 Dec 18	-	56%

Definitions used in this report

Term	Description
Adults	Persons aged 16 or over at date of cardiac arrest, or where age is missing or unknown.
Automated External Defibrillator (AED)	A portable electronic device that automatically diagnoses the life-threatening cardiac arrhythmias of ventricular fibrillation and pulseless ventricular tachycardia. The AED can treat these arrhythmias through defibrillation (the application of electricity which stops the arrhythmia, allowing the heart to re-establish an effective rhythm). AEDs provide simple audio and visual commands allowing them to be used by bystanders without medical training.
CPR ongoing at handover	Patients who are administered ongoing CPR during transport and on handover at ED. Final patient outcome may be unknown to paramedics.
Deceased on arrival	Incidents at which paramedics determine the patient to be deceased on arrival and no resuscitation attempt is undertaken.
Do Not Resuscitate (DNR) order	Documentation expressing the patient's wishes not to be resuscitated in the event of a cardiac arrest.
Electronic Medical Record (eMR)	Paramedic clinical record captured electronically using the GETAC rugged notebook computer.
Emergency Medical Services (EMS)	NSW Ambulance paramedics, doctors, Community First Responders (CFRs) or Volunteer Ambulance Officers (VAOs).
EMS response time	Time from call in queue to first vehicle arrived on scene.
EMS-attended	Cardiac arrest events attended by EMS, regardless of whether treatment was provided.
EMS-treated/ EMS-attempted resuscitation	Cases where either paramedics, CFRs or VAOs attempt to revive a patient in cardiac arrest using compressions and/or defibrillation. This excludes cases where compressions were performed only briefly during an information-gathering phase and ceased as a result of information provided, such as a DNR instruction.
Event survival / survival to ED admission	Patients with a return of spontaneous circulation (ROSC) on arrival at the hospital emergency department (ED).
Paediatric	Children aged under 16 at date of cardiac arrest.
Patient Health Care Record (PHCR)	Paramedic clinical record documented on paper (and subsequently entered into the electronic PHCR (ePHCR) database).
Presumed cardiac aetiology	Cases where the cause of arrest is not due to a known precipitator (such as trauma, hanging or terminal illness) as documented on the eMR or PHCR.
Return of spontaneous circulation (ROSC)	Cases in which the resuscitation attempt results in a return of spontaneous circulation (measured by a detectable pulse) at any time.
Shockable Rhythm	Rhythms which are appropriate to receive defibrillation, including ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT), by EMS or a bystander with a public automated external defibrillator.
Survival to hospital discharge	Patients who are discharged from hospital alive following cardiac arrest.
Utstein patient group	An international comparator group representing the patients most likely to be successfully resuscitated. It contains patients who are witnessed to arrest by a bystander, present in a shockable rhythm and where an attempt at resuscitation was made by EMS.


Nicole

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