



Out-of-Hospital Cardiac Arrest Registry

2020 REPORT



NSW Ambulance





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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Characteristics and outcomes for 2020

DEMOGRAPHICS

9,013

Cardiac arrest patients attended across NSW (highest number of all Australian States and Territories)

3,308

Resuscitations attempted

↑ 2.7%

More cardiac arrests (compared to 2019) and the highest number ever attended



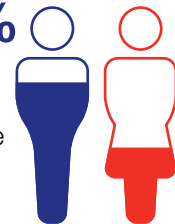
79%

Private residence
13% in a public place
7% in aged care facilities
1% other locations



65%

Male
average age
67 years



35%

Female
average age
74 years

RESPONSE

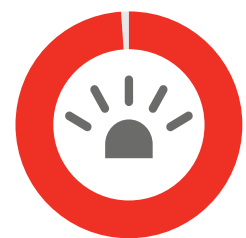


was our median response time



85%

of attended OHCA correctly received the highest response category (1A)



99%

received a lights and sirens response

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.

BYSTANDER INVOLVEMENT



60%

of bystander witnessed cardiac arrests received **bystander CPR**

78%

of EMS treated arrests received **bystander CPR** (excl. paramedic witnessed)



74

cardiac arrest patients were **successfully resuscitated by bystanders** prior to paramedic arrival



Patients who received **bystander CPR** had a **higher survival rate** (12%) compared to those with no bystander CPR (5%)

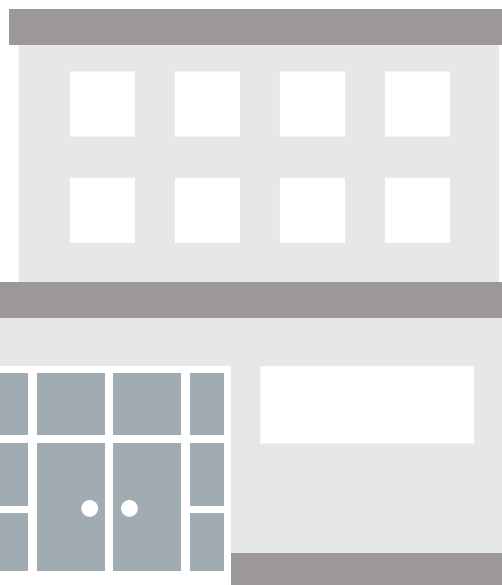


127 patients were **defibrillated by a bystander using an AED**. Survival was significantly higher when shocked first with a public AED prior to paramedic arrival (30% vs 9%)

CARDIAC ARREST SURVIVAL OUTCOMES

353

patients were discharged alive from hospital (11% of total resuscitation attempts)



25%

Survived to hospital discharge in the *Utstein patient subgroup

*Utstein subgroup EMS-attempted resuscitation, bystander-witnessed arrest, shockable rhythm.



Introduction

**Adjunct Professor
Dominic Morgan ASM**
Chief Executive, NSW Ambulance



OUT-OF-HOSPITAL cardiac arrest (OHCA) is a global public health challenge¹. Across Australia and New Zealand there are over 30,000 OHCA annually. OHCA across Australia and NZ has varied incidence, characteristics and survival. Understanding the variation in survival and modifiable predictors is key to informing strategies to improve outcomes². Overall, survival from OHCA across Australia and New Zealand is low with only 1 in every 8 persons surviving (13%).

Outcomes from OHCA can be improved with an earnest and sustained focus on strengthening the four most critical elements of the chain of survival, namely early access, early cardiopulmonary resuscitation (CPR), early defibrillation and early advanced care³. NSW Ambulance, like other peer

ambulance jurisdictions, is committed to implementing the Ten Programs described by the Global Resuscitation Alliance to continue to improve cardiac arrest survival in NSW communities⁴. During this reporting period NSW Ambulance continued to strengthen Program 2 (telephone-CPR) and Program 4 (rapid dispatch).

In 2020 NSW Ambulance commenced two important initiatives to address Program 3 (high performance CPR) and Program 6 (AED program for first responders). Our high performance CPR training commenced in early 2020 but unfortunately was impeded by the impacts of COVID-19. In November 2020 we launched the NSW Ambulance Emergency Service Organisation Public Access Defibrillation (PAD) Program with the NSW

2020

timeline

JANUARY

Commencement of 2020-2021 mandatory clinical training cycle including 1-day of high performance CPR training

JANUARY

First cases of COVID-19 in NSW

FEBRUARY

Publication of high performance CPR resources to support program 3

MARCH

Clinical safety notice to all staff introducing high performance CPR

Volunteer Rescue Association (VRA) and NSW State Emergency Service (SES).

We look forward to making further progress in these essential programs throughout the 2021 reporting period.

I am proud that we continue to be accountable to the NSW community by publishing our 4th annual cardiac arrest registry report made possible through the establishment of our Cardiac Arrest Registry which has collected OHCA data since 1 January 2017. The NSW Ambulance Cardiac Arrest Registry identifies opportunities for NSW Ambulance to improve, drive change and review our cardiac arrest strategy.

We have made some important changes to the look and feel of our 2020 report to further increase the impact and usefulness of this report. NSW Ambulance continues to work towards a culture of excellence in our approach to improving outcomes of OHCA. NSW Ambulance remains a collaborative organisation contributing data to the Australasian Resuscitation Outcomes Consortium Epistry to increase outcome oriented OHCA research⁵.

As we continue to work towards a culture of excellence against the Ten Programs, we look forward to reporting on initiatives relating to OHCA, and the measurable contributions that NSW Ambulance is making in the global effort to improve OHCA survival rates.

On behalf of NSW Ambulance, I am very pleased to present the Out-of-Hospital Cardiac Arrest in NSW 2020 Annual Report.

10 steps to improve Cardiac Arrest Survival

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

MARCH

Mandatory clinical training cancelled in response to COVID-19

MARCH

Review of all resuscitation practices in response to COVID-19

APRIL

NSW Ambulance Cardiac Arrest Registry 2018 Report published

MAY

Public Access Defibrillation (PAD) program announced

NOVEMBER

Launch of the NSW Ambulance ESO PAD Program with the NSW Volunteer Rescue Association (VRA) and NSW State Emergency Service (SES)



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Cardiac arrest in the community



Photo credit: Jonathan Ng,
The Saturday Telegraph

(L to R) Kevin McSweeney, Rugby League legend Garry Jack and friend of 20 years Simon Farnsworth

Saving a league legend

Minutes into a training session at his Brazilian Jiu-Jitsu gym, Garry was found motionless on the mat.

His heart stopped, he was clinically dead.

Long-time mate and training instructor Simon Farnsworth ran over to Garry after he heard a sickening moan. Simon made the crucial decision to start CPR after telling someone to call Triple Zero (000). Inspector Kevin McSweeney and the paramedics were on the way. "Simon performing CPR was basically keeping Garry's brain alive," Inspector McSweeney said.

"Good quality CPR certainly reduces the potential for brain damage."

Garry still doesn't remember what happened that day as he reflected with his heroes at his home.

"I know those first few minutes are critical. I can't thank Simon, Kevin and the paramedics enough - they saved my life," Garry said.

"Everyone played their part in helping us get to Garry, including the quality CPR from Simon," Inspector McSweeney said.

The actions of calling Triple Zero (000), starting CPR and waving down the ambulance, gave Garry a fighting chance of survival.

'Thank you for saving my life'

When Rhys White's mum kissed her son goodbye before jetting off for a short trip to Queensland, she asked him to take it easy and hold back on doing anything too physical while his parents were out of town.

He was a healthy 20 year old living with a heart condition.

So Rhys decided to 'take it easy' by playing some basketball with his mates – a decision that may have actually saved his life.

While shooting hoops just next to Sydney's idyllic Balmoral Beach, Rhys suffered a cardiac arrest, collapsing to the ground.

Thankfully the boys all knew how to administer CPR and there was an AED close by.

Rhys clearly had luck on his side that day as at the same time, a doctor and nurse happened to be walking past and assisted the boys until paramedics arrived to take over.

Quick thinking and actions taken by his friends, the assistance provided by the off-duty doctor and nurse, together with the brilliant work of NSW Ambulance paramedics who treated Rhys and rushed him to hospital, led to the best possible patient outcome.

Rhys is an out of hospital cardiac arrest survivor.



Cardiac arrest survivor Rhys White (centre) with (L to R) Inspector Carolyn Parish, Paramedic James Laver, Intensive Care Paramedic Jordan Phillips, and his parents and friends



Executive summary

- Throughout 2020 the COVID-19 pandemic had a significant impact on the OHCA system of care in NSW. The pandemic interrupted the implementation of our high performance CPR training to our workforce and saw major changes to our resuscitation practices in order to keep clinicians safe. Additional PPE requirements resulted in unavoidable delays to access patients even when response times were maintained.
- NSW Ambulance attended 9,013 OHCA events in the period between 1 January 2020 and 31 December 2020 with 99% involving adults. Our mobile health service commenced treatment in 37% of patients (or 34% when excluding paramedic witnessed OHCA.) The crude incidence of OHCA was lower in “Greater Sydney and Central Coast” region when compared to the rest of NSW. (145 vs 92 per 100,000 population). The age-adjusted state-wide incidence of OHCA was 91 events per 100,000 population.
- The demographics in 2020 were similar to previous years with males accounting for 65% of OHCA cases, male patients were younger than female patients (67 vs 74). The majority of OHCA was at home (79%). OHCA due to a presumed medical cause accounted for 85% of all adult EMS-attended patients. In paediatrics (< 16 years) OHCA was presumed from a medical cause in 68% of patients.
- Emergency call takers were effective at identifying cardiac arrest events during the emergency call with 82% of all EMS-attended arrests being correctly identified.
- The median state-wide response to EMS-treated events in 2020 was 9 minutes, 90th percentile 17 minutes. The median EMS response time to EMS-treated patients in Greater Sydney & Central Coast was 8 minutes, 90th percentile 13 minutes. For the rest of NSW the median response time was 8 minutes, 90th percentile 20 minutes.
- The rate of bystander CPR for bystander witnessed OHCA events in 2020 was 60%. The rate of bystander CPR for bystander witnessed OHCA patients receiving EMS-attempted resuscitation was 80%. A public automated external defibrillator (AED) was used in 13% of patients presenting in a shockable rhythm.
- When an arrest was witnessed by a bystander, the proportion of patients who survived the event was higher than that observed for all OHCA combined (20% vs 10%).
- The state-wide return of spontaneous circulation (ROSC) in adult EMS-treated patients during 2020 was 33%. The event rate of survival for all-cause adult OHCA in the EMS-treated population was 24%, while 11% survived to hospital discharge.
- The event rate of survival for adult-EMS-treated patients presenting in a shockable rhythm was 43% with 29% surviving to hospital discharge. For adult EMS-treated patients presenting in a shockable rhythm and witnessed to arrest by EMS, event survival was 68% and survival to hospital discharge was 59%. Adults presenting in asystole or pulseless electrical activity experienced the poorest survival outcomes with 3% and 7% surviving to hospital discharge respectively.
- In 2020 a survival to hospital discharge rate of 25% was recorded for the Utstein patient subgroup – this survival rate has decreased by 6% from 2019. We attribute this reduction in survival to the impact of the COVID-19 pandemic.

Out-of-hospital cardiac arrest emergency response

Nearly a third of all Australians live in New South Wales (NSW), with most living in the state capital of Sydney. NSW has the highest population of any state in Australia, with 8,172,500 residents as of 31 December 2020. Roughly 64.5% of the state's population live in Greater Sydney. NSW has the fastest growing population in Australia growing by roughly 106,100 people annually. More than 16% of the NSW population are 65 years or older, 18.5% are aged 14 and under, 25% of people live in regional or remote areas and 2.9% identify as Aboriginal or Torres Strait Islander.

In 2019-2020 NSW Ambulance received 1,084,454 Triple Zero (000) calls which resulted in over 1.2 million ambulance responses. NSW Ambulance has over 4800 paramedics working across 221 operational ambulance stations and 17 paramedic response points. NSW Ambulance also operates several clinical volunteer responder models across metropolitan, regional and remote NSW across approximately 60 locations. These programs are an important part of building the resilience of small communities and minimising the time between calling for help, and receiving initial care from clinically skilled responders, until paramedics arrive.

Australia operates a primary national emergency number (Triple Zero) for community access to emergency service organisations which send Police, Fire and/or Ambulance to emergencies. Triple Zero (000) calls to NSW Ambulance are answered by an Emergency Medical Dispatcher (EMD) at one of five Control Centres. Emergency Medical Dispatchers perform telephone triage using Medical Priority Dispatch System (MPDS) software. When an out-of-hospital cardiac arrest is recognised (or suspected) EMDs provide telephone CPR advice commencing with 600 chest compressions then two

mouth-to-mouth breaths unless there is information to suggest that mouth-to-mouth breaths should be performed prior to chest compressions (e.g. drowning). A subsequent ratio of 100 compressions to two breaths is advised until help arrives.

In Australia, since December 2018, all paramedics are registered with the Paramedicine Board of Australia. In NSW, paramedics have either completed a vocational diploma / advanced diploma or an undergraduate paramedicine degree. All NSW Ambulance paramedics are trained in basic and advanced life support (ALS) techniques including manual defibrillation, airway adjuncts, supraglottic airway device, oxygen administration and intravenous adrenaline administration (in adults). Specialist intensive care paramedics are also credentialed in intubation, intra-osseous access and to administer additional ALS medications (e.g. amiodarone). NSW Ambulance cardiac arrest management is consistent with Australian New Zealand Committee on Resuscitation (ANZCOR) guidelines and the recommendations of the Australian Resuscitation Council.

During this reporting period NSW Ambulance deployed a small number of mechanical CPR devices. The closest ambulance resource is assigned to all OHCA with a minimum of three (usually 4) paramedics. If closer, clinical volunteers are responded who are trained in basic life support including semi-automatic defibrillation. 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
238
NSW AMBULANCE
RESPONSE LOCATIONS**



Out-of-Hospital Cardiac Arrest Registry

Clinical quality registries provide a powerful tool with which to understand variation in treatments and outcomes, identify prognostic factors, examine standard of care patterns, evaluate effectiveness, monitor safety, and influence clinician behaviour through feedback. Clinical research has consistently demonstrated that instituting clinical quality registries improves outcomes and reduces health care costs.

In 2017 the NSW Ambulance Out-of-Hospital Cardiac Arrest (OHCA) clinical quality registry (the registry) was created that includes all patients who experience a cardiac arrest outside of a hospital setting and who are attended by NSW Ambulance.

The registry adheres to the widely accepted Utstein dataset and definitions, with inclusion of minor additions to accommodate local conditions. The registry includes information on the arrest event, prehospital treatment and prehospital outcome. Longer term survival outcomes are obtained via data linkage, conducted by the Centre for Health Record Linkage (CHeReL), and overseen by the NSW Ministry of Health.

The registry is housed in the REDCap (Research Electronic Data Capture) platform, a secure, Health Records and Information Privacy Act (HRIPA) compliant, web-based, data collection application. Advantages to REDCap include secure multi-site access from anywhere with an internet connection, inbuilt data quality control tools, and multiple safeguards that protect health information and preserve privacy.

Case ascertainment and missing data

Maintaining a consistent approach to case identification in OHCA is of central importance when comparing survival between ambulance services and contributing data to resuscitation trials. The case ascertainment process used by NSW Ambulance has been informed by the processes used by the more established Queensland and Victorian OHCA registries and begins with the identification of cases from electronic and paper-based patient health care records.

Since 2010, the details of patient encounters at NSW Ambulance have been electronically recorded using mobile computer tablets

synchronised daily to a clinical data warehouse. A highly sensitive search algorithm is applied to these warehoused data to identify potential cardiac arrest cases. Registry data fields are initially populated through extraction of standardised data, eliminating the need for intermediary case report forms and minimising transcription errors and the level of missing data. The dataset is then completed through the abstraction of data of prognostic importance, by specifically trained data coders.

Quality control is facilitated by data range and validity checks using embedded electronic algorithms. Incomplete or erroneous data fields, for example, negative time intervals, are remedied manually using information from patient health care records or computer aided dispatch data. Where patient identifiers are sufficient and death has occurred, linkage of the registry to the NSW Register of Births Deaths and Marriages (RBDM) is used to obtain the date of death.

Out of hospital cardiac arrest as a reportable condition in NSW

The NSW Public Health Act 2010 allows for the Minister for Health to establish public health or disease registers to follow up the care and treatment of patients. The Centre for Epidemiology and Evidence establishes and manages a range of ad hoc and ongoing registers, based on linked administrative data. One such register is the Population Health and Risks Outcome Register (PHROR). NSW Ambulance is required to report all instances of OHCA, annually, to the PHROR. Survival to discharge and survival to 30 days outcomes for OHCA are then obtained through linkage of the PHROR to NSW Health Emergency Department Data Collection (EDDC) and the Admitted Patient Data Collection (APDC) to overcome RBDM linkage limitations due to missing patient identifiers.

This report comprises line level incidence, prognostic and treatment data from the NSW Ambulance Out-of-Hospital Cardiac Arrest Clinical Quality Registry and aggregated survival to discharge and 30 days data from the NSW Health PHROR.



Incidence and demographics

In 2020, NSW Ambulance clinicians attended 8,939 patients in cardiac arrest and 74 patients who had regained ROSC prior to NSW Ambulance arrival, a total of 9013 OHCA's (Table 1).

Most patients were male (64.9%). The median age was 70 (56-81) years. Female patients had a higher median age at arrest than males (74 versus 67 years). Case distribution by age and gender was similar to previous years (Figure 2). Adults (16 years or older) accounted for 98.6% of cases.

Arrests occurred most frequently in residential homes (78.6%), followed by public places (12.9%) and nursing homes (7.1%) (Figure 3).

NSW Ambulance clinicians attempted to resuscitate 3,308 (36.7%) patients. An initial shockable rhythm (ventricular fibrillation or ventricular tachycardia, VF/VT) was observed in 26.3% of these patients and bystander CPR was performed on 65.3%.



Table 1: Patient Characteristics

Variable	All OHCA attended	Resuscitation attempted	ROSC prior to arrival
Age (years)			
Median (Q1-Q3) [^]	70* (56-81)	66** (52-77)	62 (53-75)
Gender			
Female	3141 (34.8)	1033 (31.2)	13 (17.6)
Male	5819 (64.6)	2274 (68.7)	61 (82.4)
Not specified/unknown	53 (0.6)	1 (0.0)	0 (0.0)
Location of arrest			
Public place	1162 (12.9%)	619 (18.7%)	44 (59.5)
Residential home	7085 (78.6)	2439 (73.7)	12 (16.2)
Nursing home	640 (7.1)	159 (4.8)	2 (2.7)
Medical facility	126 (1.4%)	91 (2.8%)	16 (21.6)
Initial rhythm			
Shockable	934 (10.4)	871 (26.3)	45 (60.8)
Non-shockable	7924 (87.9)	2356 (76.7)	20 (27.0)
Unknown	155 (1.7)	81 (2.4)	9 (12.2)
Bystander CPR			
Yes	3211 (35.6)	2160 (65.3)	71 (95.9)
No	5619 (62.3)	1072 (32.4)	3 (4.1)
Unknown	183 (2.0%)	76 (2.3)	0 (0.0)
Bystander witnessed			
Bystander witnessed	2490 (27.6)	1536 (46.4)	65 (87.8)
Not witnessed	5443 (60.4)	1134 (34.3)	7 (9.5)
Paramedic witnessed	722 (8.0)	542 (16.4)	0 (0.0)
Unknown	358 (4.0)	96 (2.9)	2 (5.4)
Presumed aetiology			
Medical	7619 (84.5)	2840 (85.9)	65 (87.8)
Non-medical (incl trauma)	1394 (15.5)	468 (14.1)	9 (12.2)
Survival			
Survived event	884 (9.8)	807 (24.4)	74 (100.0)
Survived to discharge#	419 (4.7)	353 (11.0)	63 (85.1)
Survived 30 days#	419 (4.7)	354 (11.0)	62 (83.8)
Total	9013	3308	74

* Missing n=287 | ** Missing n=44 | [^] Q1 = quartile 1 (25th percentile); Q3 = quartile 3 (75th percentile) | # Missing n=90 | All denominators adjusted to account for missing data.



Figure 2: NSW Ambulance attended OHCA by age and gender

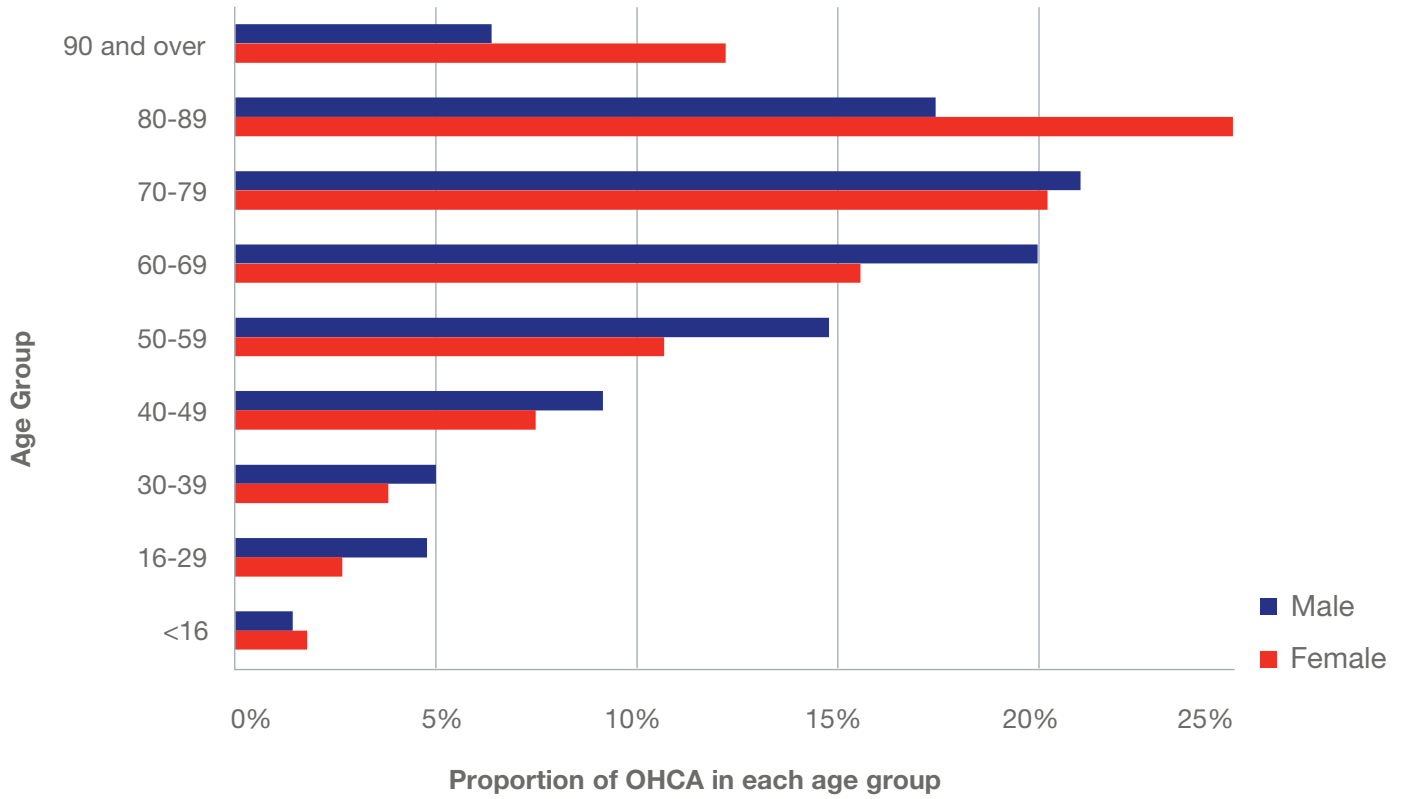


Figure 3: Location of NSW Ambulance attended OHCA

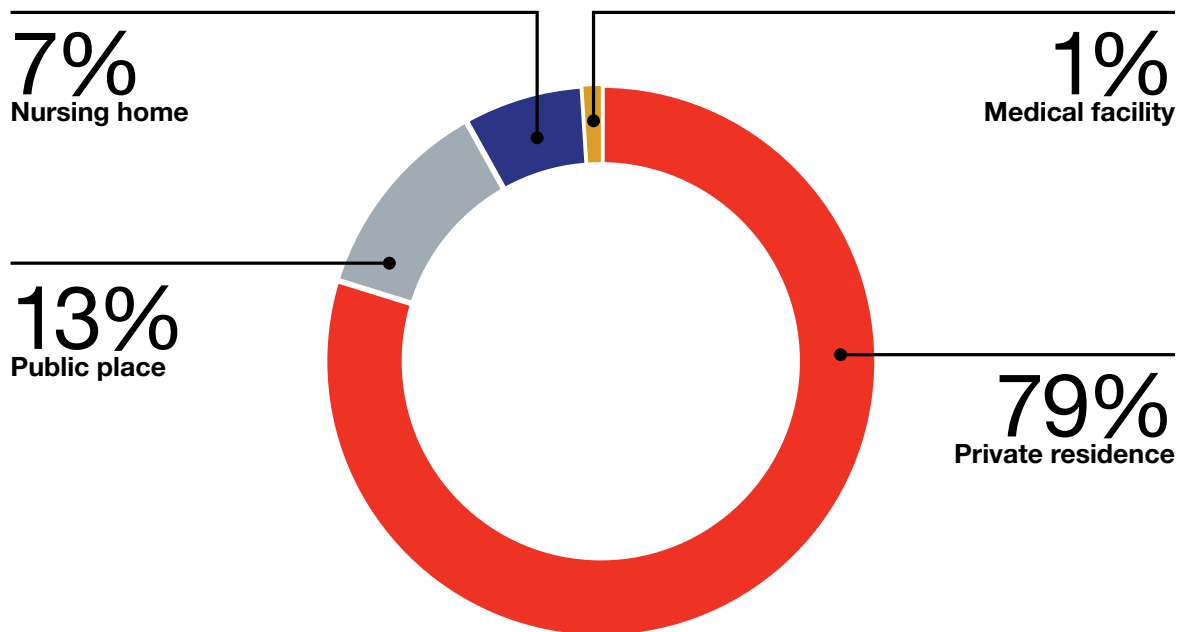


Figure 4a: OHCA incidence for non-metropolitan NSW (per 100,000 person-years)

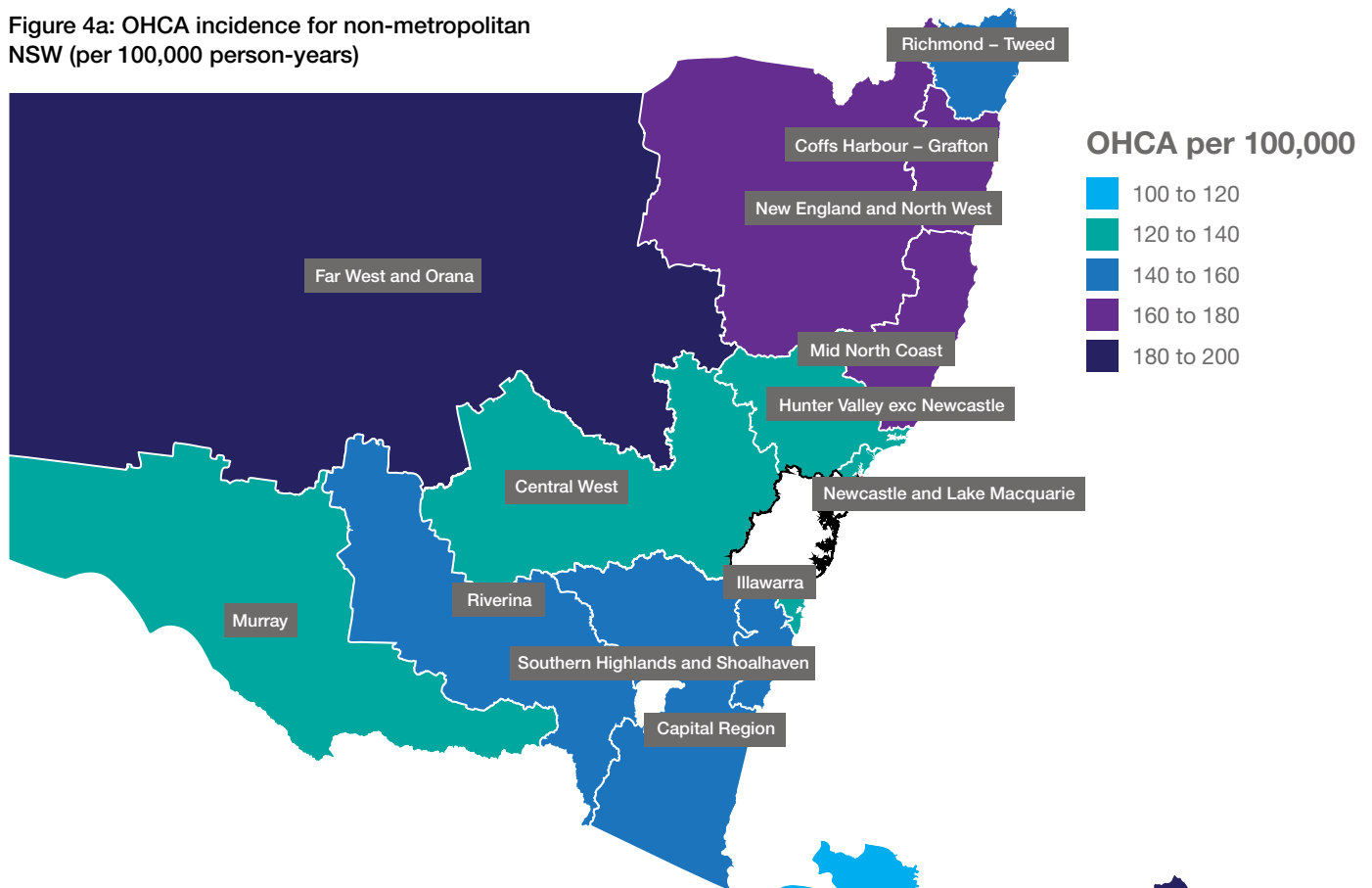


Figure 4b: OHCA incidence for Greater Sydney and the Central Coast (per 100,000 person-years)

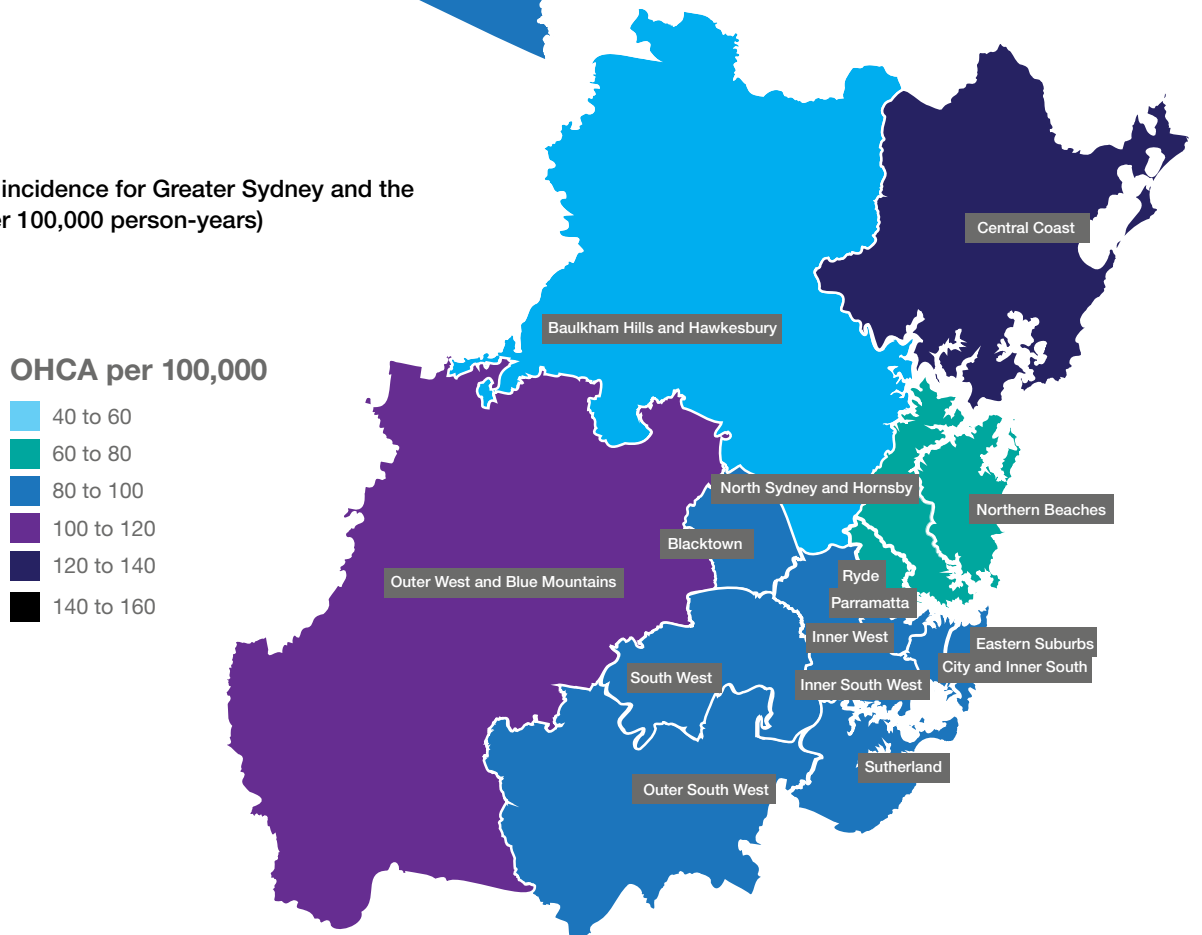




Figure 5a: OHCA events for non-metropolitan NSW

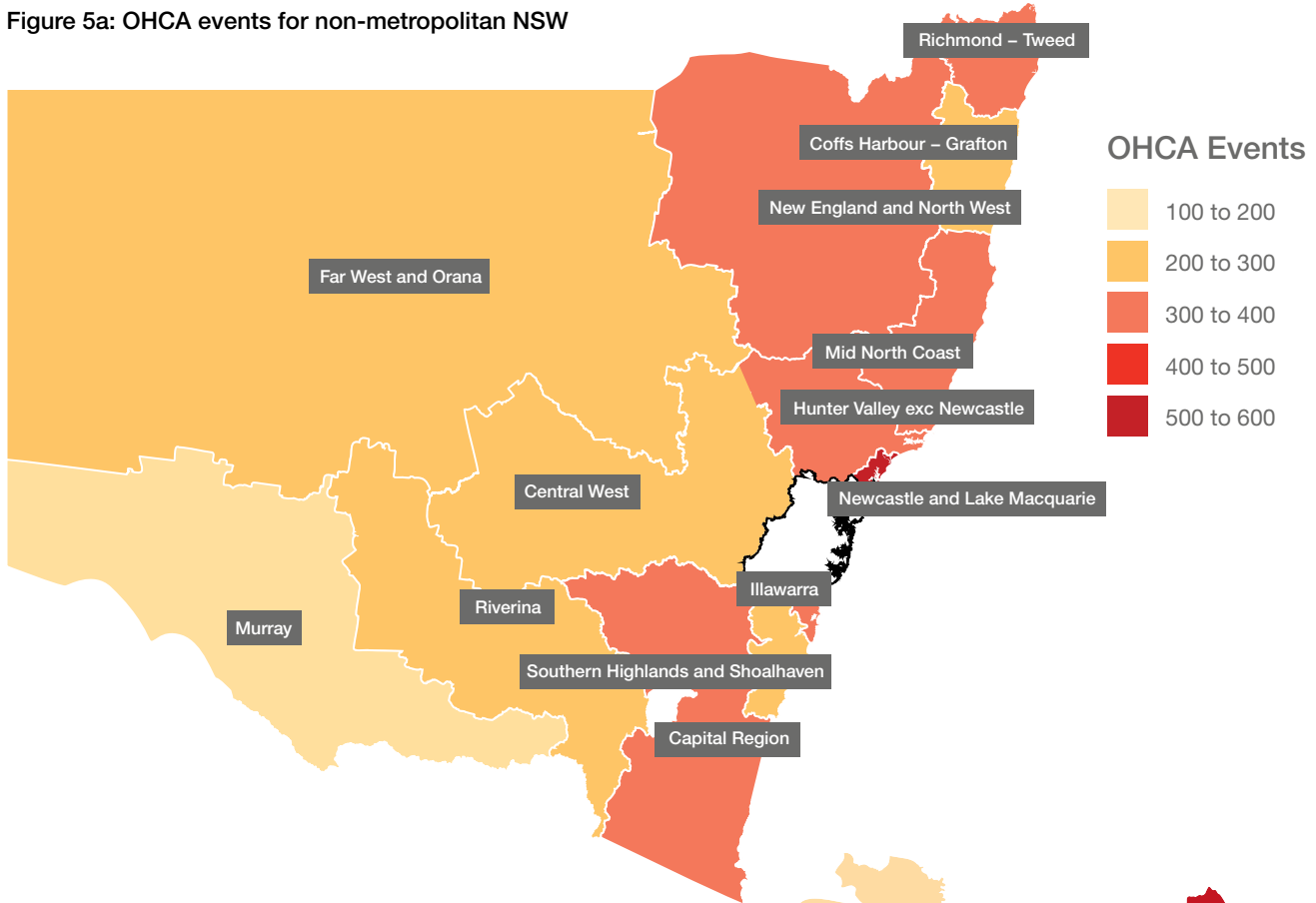


Figure 5b: OHCA events for Greater Sydney and the Central Coast

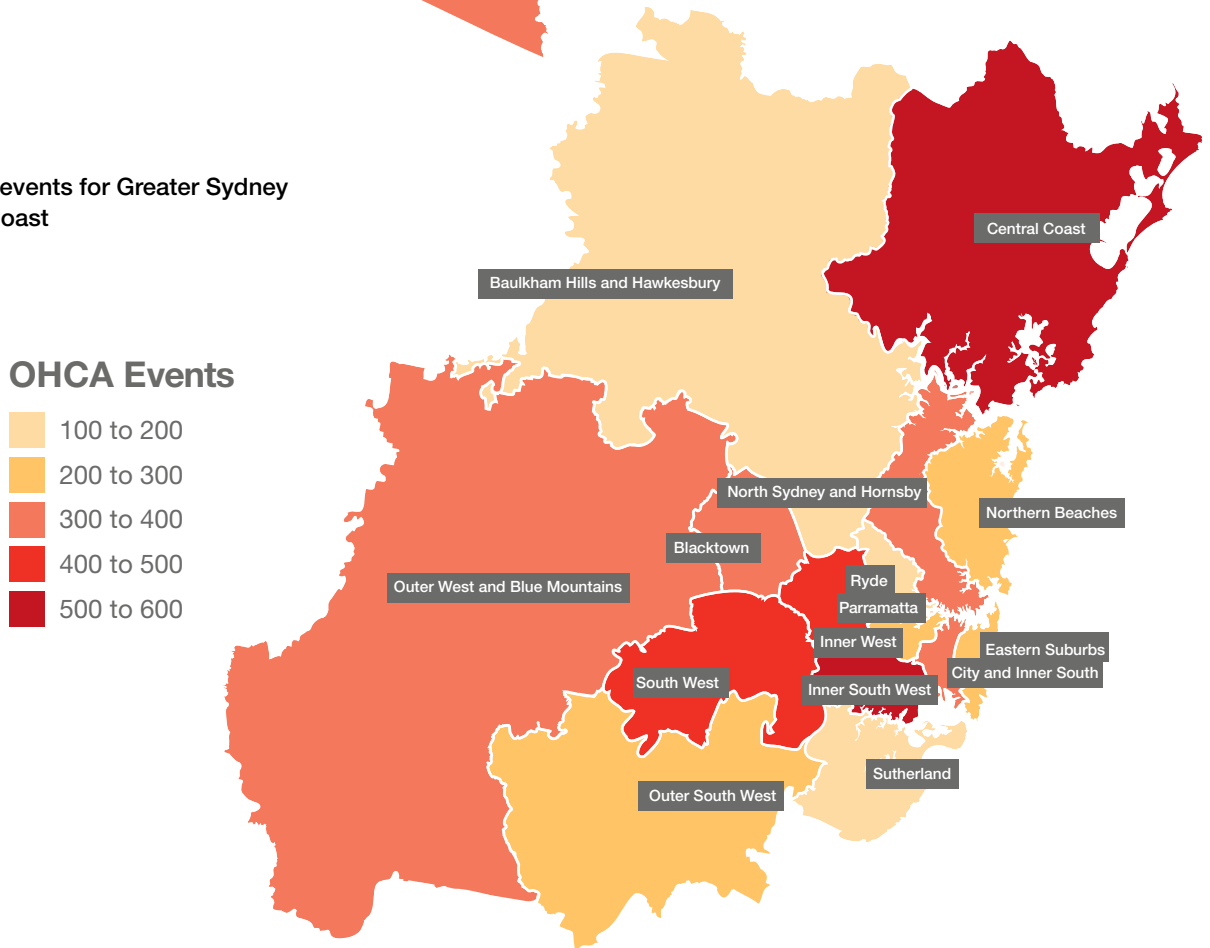


Table 2: Crude and age-standardised incidence of all NSW Ambulance attended OHCA by geographical area^{1,2}

Incidence of OHCA varied markedly across NSW. Both crude and age standardised rates were lowest in Baulkham Hills and Hawkesbury (56 and 50 per 100,000 person-years, respectively) and highest in Far West and Orana (192 and 152 per 100,000 person-years, respectively) (Table 2).

Area	Incidence per 100,000 person-years			
	Crude	Adjusted	Lower 95% CI	Upper 95% CI
Capital Region	146	104	93	117
Central West	141	107	95	121
Coffs Harbour – Grafton	174	120	104	139
Far West and Orana	192	152	132	175
Hunter Valley exc Newcastle	133	110	99	122
Illawarra	116	93	83	103
Mid North Coast	170	106	94	119
Murray	136	107	90	126
New England and North West	165	126	112	142
Newcastle and Lake Macquarie	136	107	97	117
Richmond – Tweed	142	105	93	118
Riverina	141	117	101	134
Southern Highlands and Shoalhaven	146	99	85	114
Central Coast	161	114	104	125
Baulkham Hills and Hawkesbury	56	50	42	59
Blacktown	91	101	91	112
City and Inner South	97	107	96	120
Eastern Suburbs	86	75	66	85
Inner South West	95	79	73	86
Inner West	88	76	68	86
North Sydney and Hornsby	72	56	50	63
Northern Beaches	73	57	49	66
Outer South West	94	98	87	111
Outer West and Blue Mountains	107	99	89	111
Parramatta	92	92	84	101
Ryde	78	63	53	74
South West	91	90	82	100
Sutherland	83	67	57	77
Greater Sydney and Central Coast	92	83	80	85
Non-metropolitan NSW (Rest of NSW)	145	108	105	112
All NSW	110	91	90	93

¹ Geographical area was statistical area level 4 (SA4) as defined by Australian Bureau of Statistics (ABS).

² SA4 Area was unknown for 17 cases.



Witnessed status and bystander interventions

Of the 3,308 arrests where resuscitation was attempted, 1536 (46.4%) arrests were witnessed by bystanders, and 542 (16.4%) were witnessed by paramedics. (Table 1) Compared to unwitnessed arrests, paramedic and

bystander-witnessed arrests occurred less often in residential homes, more often had an initially shockable rhythm, and more often received bystander CPR (only applicable to bystander-witnessed arrest) (Table 3).

Table 3: Patient characteristics and witnessed status (n=3308)

Characteristic	n	Paramedic witnessed		Bystander witnessed*		Not witnessed		Unknown (n=96)	
Age (years)									
Median (Q1-Q3)		70	(59-80)	67	(54-77)	62	(46-75)	-	-
Gender									
Female	1033	181	(17.5%)	449	(43.5%)	374	(36.2%)	29	(2.8%)
Male	2274	361	(15.9%)	1086	(47.8%)	760	(33.4%)	67	(2.9%)
Location of arrest									
Public place	619	73	(11.8%)	353	(57.0%)	176	(28.4%)	17	(2.7%)
Residential home	2439	377	(15.5%)	1085	(44.5%)	905	(37.1%)	72	(19.1%)
Nursing home	159	35	(22.0%)	74	(46.5%)	44	(27.7%)	6	(3.8%)
Medical facility	91	57	(62.6%)	24	(26.4%)	9	(9.9%)	1	(1.1%)
Initial rhythm									
Shockable	871	152	(17.5%)	522	(59.9%)	175	(20.1%)	22	(2.5%)
Non-shockable	2356	359	(15.2%)	981	(41.6%)	946	(40.2%)	70	(3.0%)
Unknown	81	31	(38.3%)	33	(40.7%)	13	(16.0%)	4	(4.9%)
Bystander CPR									
Yes (n=2160)		-	-	1225	(56.7%)	850	(39.4%)	68	(3.1%)
No (n=1072)		-	-	282	(26.3%)	250	(23.3%)	20	(1.9%)
Unknown (n=76)		-	-	29	(38.2%)	34	(44.7%)	8	(10.5%)

*Witnessed status was unknown for 96 cases; Gender was unknown for 1 case.



“ Survival was highest in patients found in a shockable rhythm or where their arrest was witnessed by a paramedic ”

LIFEPAK



Survival and factors associated with survival

Of the 3,308 arrests where a NSW Ambulance clinician attempted resuscitation, event survival and 30-day survival were 24.4% and 11.0%, respectively (Table 1). There was no real difference in survival at any time between males and females, or across the

broad categories of presumed medical and non-medical aetiologies (Table 4). Survival was highest where patients presented for resuscitation in a shockable rhythm or where their arrest had been witnessed, particularly by a paramedic.

Table 4: Survival by patient characteristics

Characteristic	Survived Event (n=3308)		Survived to discharge* (n=3218)		Survived 30 days* (n=3218)	
Age^ (years)	62	(49-76)	62	(49-72)	62	(49-72)
Gender						
Female	276	(26.7)	103	(10.1)	103	(10.1)
Male	531	(23.4)	250	(11.4)	251	(11.4)
Location of arrest						
Public place	175	(28.3)	91	(16.0)	91	(16.0)
Residential home	572	(23.5)	233	(9.7)	234	(9.7)
Nursing home	27	(17.0)	7	(4.4)	7	(4.4)
Medical facility	33	(36.3)	22	(25.0)	22	(25.0)
Initial rhythm						
Shockable	372	(42.7)	242	(29.1)	240	(28.9)
Non-shockable	435	(18.5)	87	(3.8)	90	(3.9)
Witnessed status						
Bystander witnessed	428	(27.9)	168	(11.3)	169	(11.3)
Not witnessed	182	(14.6)	47	(4.2)	47	(4.2)
Paramedic witnessed	197	(36.3)	132	(25.1)	132	(25.1)
Aetiology						
Medical	685	(23.8)	309	(11.1)	310	(11.2)
Non-medical (incl trauma)	122	(25.6)	44	(10.0)	44	(10.0)
Response time^ (min)	8		9		9	

*Survival to discharge or 30 days was unknown for 90 cases where ambulance records indicated the patient was transported but there was no corresponding linked EDDC or APDC record, all denominators were adjusted accordingly.

^Median (25th-75th percentile). Gender was unknown for 1 case; Age was unknown for 44 cases; Bystander CPR was unknown for 73 cases; Witnessed status was unknown for 94 cases.

Survival was greatest when both features were present (67.8% survived the event; 58.9% survived 30 days). Conversely, survival was poorest where patients presented in a non-

shockable rhythm or where their arrest had not been witnessed, and was minimal when both were present (12.0% survived the event; 2.3% survived 30 days) (Table 5).

Table 5: Survival by witnessed status and initial rhythm, EMS-treated OHCAs^

Indicator	Witnessed status	Initial rhythm	Number	Denominator	%
Survived event	Paramedic-witnessed	Shockable	103	152	67.8
		Not shockable/ not documented	91	390	23.3
		Total - all rhythms	194	542	35.8
	Bystander-witnessed	Shockable	208	522	39.8
		Not shockable/ not documented	214	1,014	21.1
		Total - all rhythms	422	1,536	27.5
	Not witnessed / Unknown	Shockable	57	197	28.9
		Not shockable/ not documented	124	1,033	12.0
		Total - all rhythms	181	1,230	14.7
	All witnessed statuses	Shockable	368	871	42.3
		Not shockable/ not documented	429	2,437	17.6
		Total - all rhythms	797	3,308	24.1
Survived 30 days^	Paramedic-witnessed	Shockable	86	146	58.9
		Not shockable/not documented	46	379	12.1
		Total - all rhythms	132	525	25.1
	Bystander-witnessed	Shockable	124	496	25.0
		Not shockable/not documented	45	993	4.5
		Total - all rhythms	169	1,489	11.3
	Not witnessed / Unknown	Shockable	30	189	15.9
		Not shockable/not documented	23	1,015	2.3
		Total - all rhythms	53	1,204	4.4
	All witnessed statuses	Shockable	240	831	28.9
		Not shockable/not documented	114	2,387	4.9
		Total - all rhythms	354	3,218	11.0

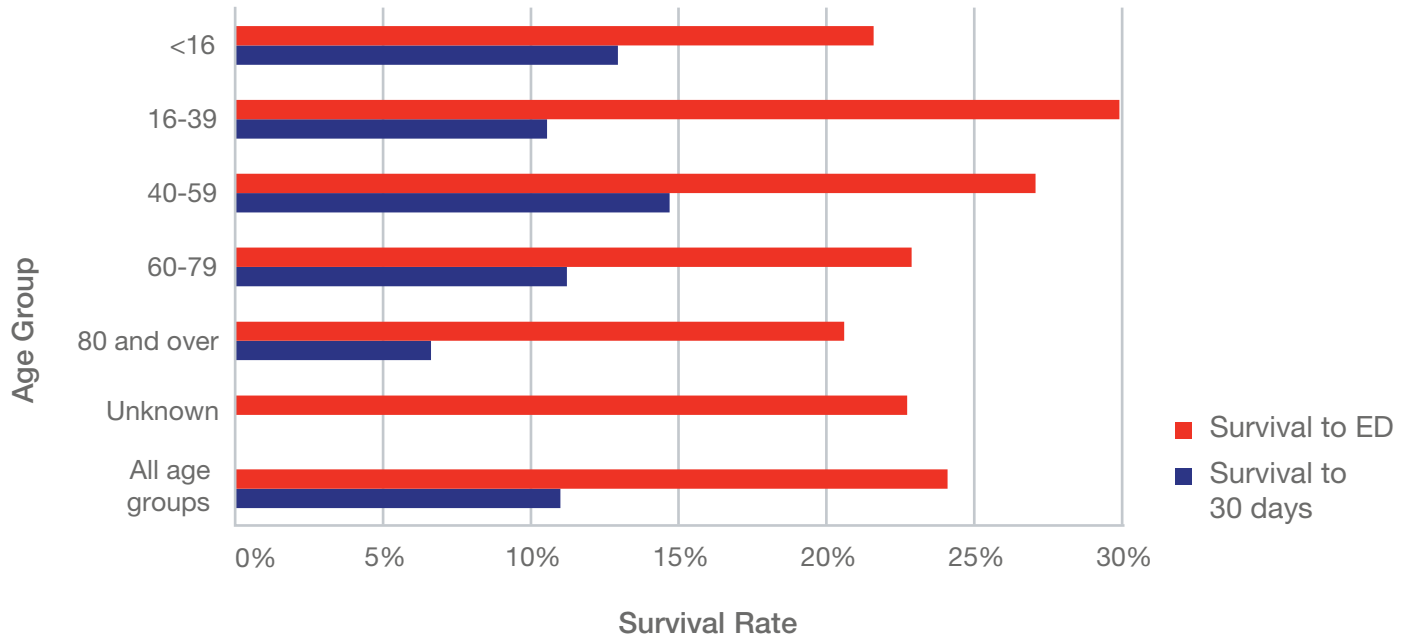
^Survived 30 days was unknown for 90 cases.



The highest survival rates were observed in the 16-39 year age group (30% survived event) and in the 40-59 year age group (15% survived 30

days). The lowest survival rates were observed in the 80 and over age group (21% survived event; 7% survived 30 days) (Figure 6).

Figure 6: Survival by age group, EMS-treated OHCA



Survival rates by bystander CPR and witnessed status

Early interventions initiated by bystanders during the first moments after the patient collapses in OHCA are critical for survival. In 2020, of all non-paramedic witnessed OHCA where the patient subsequently received resuscitation by paramedics, 65.3% had received bystander CPR. The survival benefit of bystander CPR was more substantial in the subset of patients whose arrest was witnessed by a bystander and had an initial shockable rhythm on EMS arrival (Table 5).

More than half (52.0%) of these patients survived the event when they received bystander CPR, compared to 41.2% without bystander CPR. Survival to discharge (36.8% versus 26.5%), and 30-day survival (36.8%

versus 26.5%) was also higher for patients receiving bystander CPR.

Across all witnessed statuses, the survival rate was highest for patients who received bystander CPR (25% survived event; 12% survived 30 days), compared to patients who did not receive bystander CPR (19% survived event; 5% survived 30 days). The survived event rate and hospital discharge was highest for patients who had a bystander witnessed OHCA and received bystander CPR (32% and 16% respectively) (Table 6). In assessing the impact of bystander CPR, patients with ROSC prior to NSW Ambulance arrival have been included and paramedic-witnessed OHCA have been excluded.

Table 6: Survival outcomes by witnessed status and bystander CPR, EMS-treated or ROSC prior to EMS arrival OHCA, all ages, in NSW for 2020[^]

Indicator	Witnessed status	Bystander CPR	Number	Denominator	%
Survived event	Bystander-witnessed	Bystander CPR	407	1,287	31.6
		No/ unknown bystander CPR	80	314	25.5
		Total – all CPR	487	1,601	30.4
	Not witnessed / Unknown	Bystander CPR	153	927	16.5
		No/ unknown bystander CPR	37	312	11.9
		Total – all CPR	190	1,239	15.3
	All witnessed statuses (excl para-witness)	Bystander CPR	560	2,214	25.3
		No/ unknown bystander CPR	117	626	18.7
		Total – all CPR	677	2,840	23.8
Survived 30 days [^]	Bystander-witnessed	Bystander CPR	201	1,242	16.2
		No/ unknown bystander CPR	25	309	8.1
		Total – all CPR	226	1,551	14.6
	Not witnessed / Unknown	Bystander CPR	50	904	5.5
		No/ unknown bystander CPR	8	306	2.6
		Total – all CPR	58	1,210	4.8
	All witnessed statuses (excl para-witness)	Bystander CPR	251	2,146	11.7
		No/ unknown bystander CPR	33	615	5.4
		Total – all CPR	284	2,761	10.3

[^]Excludes OHCA where ambulance records indicated the patient was transported but no corresponding linked EDDC or APDC record.



Survival rates by AED use and witnessed status

Bystander defibrillation, when the patient is in VF/VT, is another bystander intervention that has proven survival benefit. In 2020, an AED was applied by a bystander to 258 patients in cardiac arrest, with 127 of these patients receiving a shock prior to paramedic arrival.

Across all witnessed statuses, the survival rate was highest for patients on whom an AED was used (45% survived event; 30% survived 30 days), compared to patients who

did not have an AED used (22% survived event; 9% survived 30 days). The event survival rate and 30 day survival rate was highest for patients who had a bystander witnessed OHCA and had an AED used (54% and 37% respectively) (Table 7).

In assessing the impact of AED use, patients with ROSC prior to NSW Ambulance arrival have been included and paramedic-witnessed OHCA's have been excluded.

Table 7: Survival outcomes by witnessed status and AED use, EMS-treated or ROSC prior to EMS arrival OHCA, all ages

Indicator	Witnessed status	Bystander CPR	Number	Denominator	%
Survived event	Bystander-witnessed	AED used	86	159	54.1
		AED not used	401	1,442	27.8
		Total – all AED use	487	1,601	30.4
	Not witnessed / Unknown	AED used	14	63	22.2
		AED not used	176	1,176	15.0
		Total – all AED use	190	1,239	15.3
	All witnessed statuses (excl para-witness)	AED used	100	222	45.0
		AED not used	577	2,618	22.0
		Total – all AED use	677	2,840	23.8
Survived 30 days [^]	Bystander-witnessed	AED used	55	149	36.9
		AED not used	171	1,402	12.2
		Total – all AED use	226	1,551	14.6
	Not witnessed / Unknown	AED used	8	59	13.6
		AED not used	50	1,151	4.3
		Total – all AED use	58	1,210	4.8
	All witnessed statuses (excl para-witness)	AED used	63	208	30.3
		AED not used	221	2,553	8.7
		Total – all AED use	284	2,761	10.3

[^]Excludes OHCA where ambulance records indicated the patient was transported with no corresponding linked EDDC or APDC record.

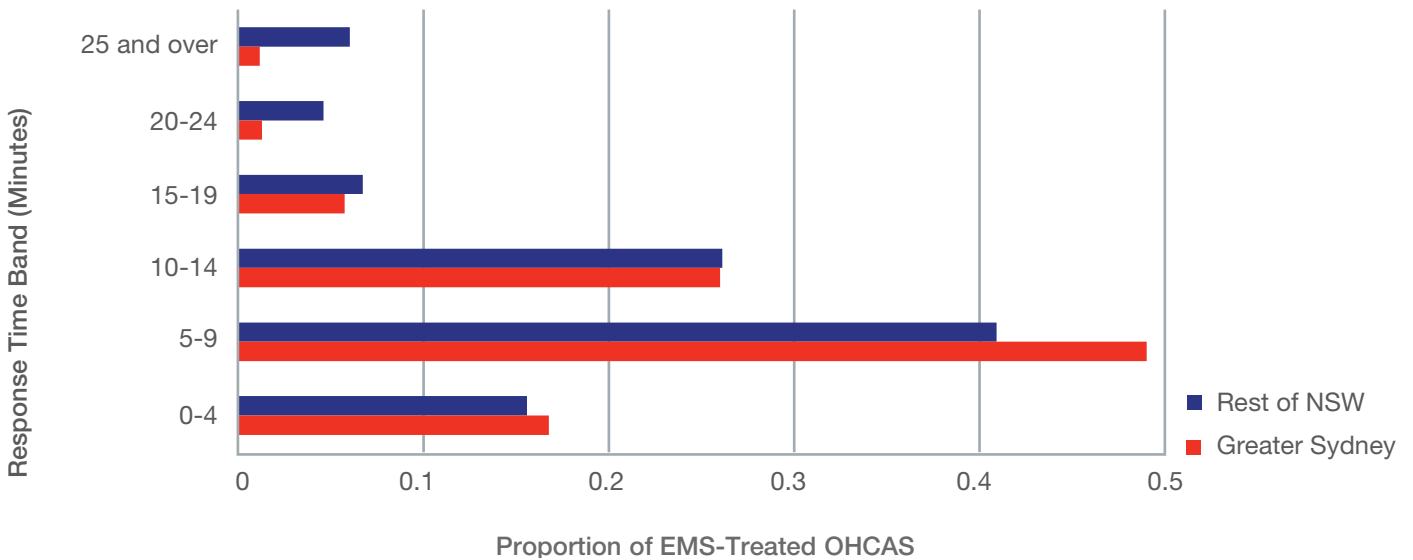
Ambulance response times

Ambulance response time, defined as the period of time that elapses between receipt of the Triple Zero (000) call and the arrival of EMS at the scene, is a key prognostic factor for OHCA.

Numerous studies have shown that shorter response times are associated with higher probability of survival to 30 days or hospital discharge, and favourable neurological outcome.

In keeping with previous years, the median response time to OHCA where a resuscitation attempt was made (excluding paramedic-witnessed arrests) was 8 minutes in both metropolitan areas (Greater Sydney and the Central Coast) and Rest of NSW (Figure 7).

Figure 7: Distribution of response times, EMS treated OHCA (excluding paramedic witnessed), by region



Comparisons with other jurisdictions

The latest available figures from a number of ambulance services on survival rates for patients meeting Utstein criteria can be found in Table 8.

Table 8: Benchmark OHCA survival rates across jurisdictions, Utstein subgroup

Organisation	Time period	Survived event (%)	Survived to hospital discharge or 30 days (%)
NSW Ambulance	1 Jan 20 – 31 Dec 20	40	25
Ambulance Victoria ⁸	1 Jul 20 – 30 Jun 21	–	35
Queensland Ambulance Service ⁹	1 Jan 20 – 31 Dec 21	44	26
St John Ambulance WA ¹⁰	1 Jan 19 – 31 Dec 19	44	35
London Ambulance Service ¹¹	1 Apr 18 – 31 Mar 19	63	37
King County EMS ¹²	1 Jan 20 – 31 Dec 20	–	39
New Zealand (St John Ambulance NZ and Wellington Free Ambulance) ¹³	1 Jul 20 – 30 Jun 20	49	28



Survival outcomes for patients meeting Utstein criteria

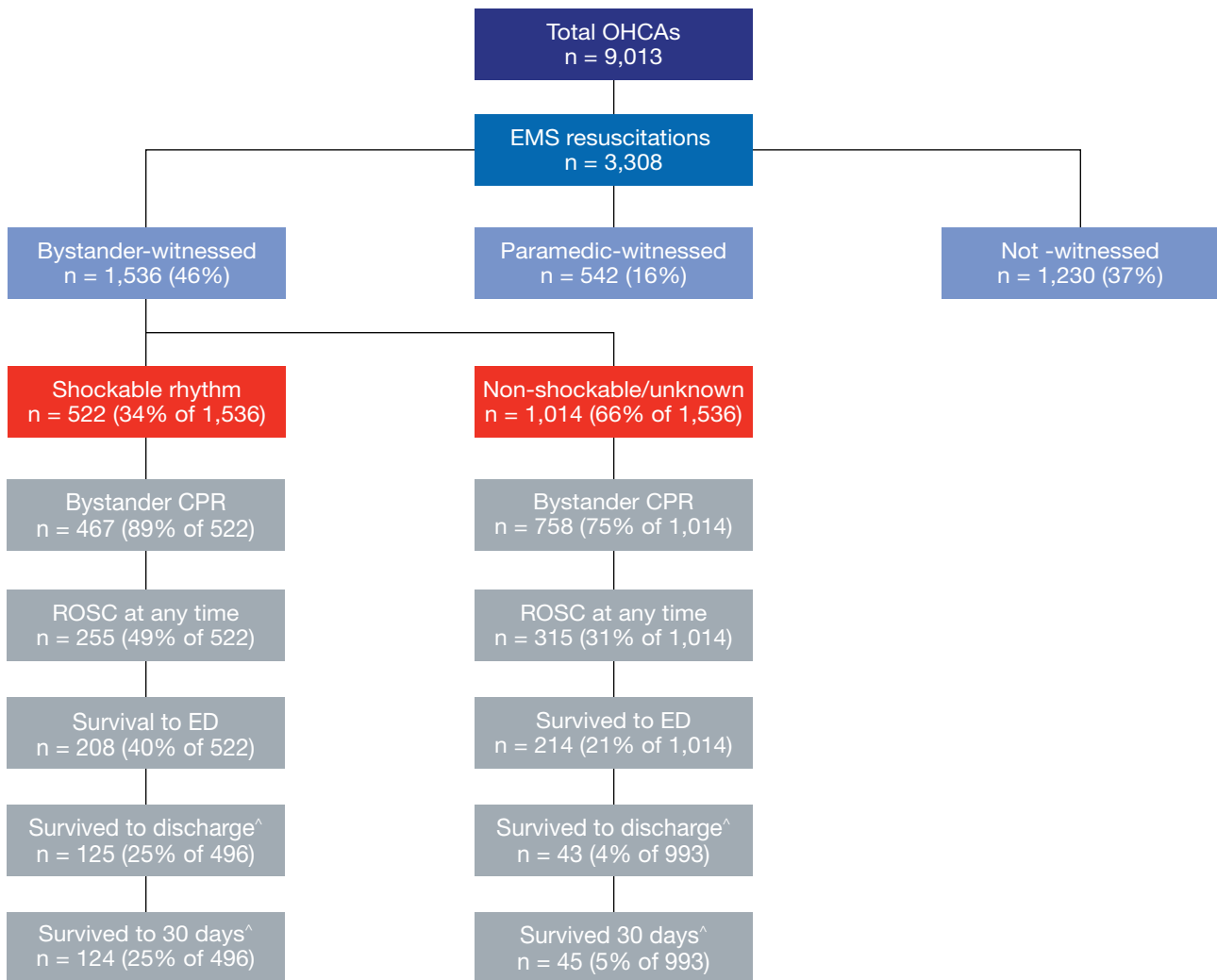
The ability to compare performance across jurisdictions depends on consistency of presentation and definitions. The Utstein measure is intended to allow comparison of survival rates for the same patient subgroup (bystander-witnessed EMS resuscitations with an initial shockable rhythm). However, even with this measure, inconsistent definitions of resuscitation, and variations in jurisdictional population size and density complicates like-for-like comparisons.

The Utstein patient subgroup is defined as:

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

There were 522 (16%) of 3,308 resuscitations attempted that met these criteria (Figure 8).

Figure 8: Utstein patient subgroup measures



[^]Excludes OHCA where ambulance records indicated the patient was transported with no corresponding linked EDDC or APDC record.





Appendix

Table A1: Age in 5 year groupings at time of arrest – Signs of Life prior to EMS arrival

Age Group (years)	All EMS attended OHCA	Signs of life (ROSC) prior to EMS arrival	Any ROSC	Survived event	Survival to Hospital discharge
0-4	75	1	1	1	1
5-9	12	1	1	1	1
10-14	27	0	0	0	0
15-19	84	0	0	0	0
20-24	149	2	2	2	1
25-29	147	1	1	1	0
30-34	181	0	0		
35-39	213	1	1	1	1
40-44	266	2	2	2	2
45-49	401	5	5	5	5
50-54	482	7	7	7	6
55-59	689	12	12	12	8
60-64	780	7	7	8	7
65-69	782	8	8	8	7
70-74	995	6	6	6	5
75-79	969	9	9	9	9
80-84	878	7	7	7	5
85+	1596	5	5	5	5
Unknown	287	0	0	0	0
Totals	9013	74	74	74	63[^] (85%)

[^] Survival to hospital discharge could not be confirmed for 6 patients.

Table A2: Resuscitation outcomes for OHCA where EMS-attempted resuscitation by age group

Age Group (years)	OHCA attended by EMS	Resuscitation attempted by EMS	Any ROSC	Survived event	Survival to Hospital discharge
0-4	75	55	11	9	6
5-9	12	10	4	4	3
10-14	27	17	5	4	2
15-19	84	41	18	12	6
20-24	149	65	26	18	4
25-29	147	55	21	17	7
30-34	181	73	25	22	8
35-39	213	103	40	32	7
40-44	266	122	31	26	15
45-49	401	169	69	57	33
50-54	482	215	77	64	31
55-59	689	292	93	69	35
60-64	780	319	112	79	36
65-69	782	326	107	73	49
70-74	995	363	124	87	37
75-79	969	369	118	76	30
80-84	878	292	95	66	24
85+	1596	378	110	72	20
Unknown	287	44	14	10	19
Totals	9013	3308	1100	797	353[^] (11%)

[^] Survival to hospital discharge could not be confirmed for 90 patients.

Table A3: Utstein standardised template for reporting outcomes from out-of-hospital cardiac arrest

Population served		8,172,500 residents as of 31 December 2020						
Out-of-Hospital Cardiac Arrests attended		9,013						
Resuscitation attempted		Resuscitation not attempted						
3308	All cases	DNAR	Obviously dead	Signs of life				
	N=5631	456	2022	74				
Emergency Medical Dispatch		EMD (Call taker) ID CA		EMD (Call taker) CPR				
	Yes	No	Unknown	Yes	No	Unknown		
	7396	1445	67	2977	5156	776		
		All Locations	Greater Sydney & Central Coast	Rest of NSW				
Response time (All) N=9013		Median (IQR): 90th percentile	9 (6-14): 22	9 (6-12) : 18	10 (7-16): 27			
Response time (EMS-resuscitation only) N=3308		Median (IQR): 90th percentile	9 (6-12):17	8 (6-11): 15	9 (6-14): 22			
Location	Home	Public	Nursing	Medical facility	Other	Unknown		
	7085	1115	640	126	45	2		
Patient	Age (years)			Gender				
	Median (IQR)	Unknown	Male	Female	Unknown/Not recorded			
	70 (56-81)	287	5819	3141	53			
Witnessed	Bystander		EMS	Unwitnessed or unknown				
	2,490		722	5801				
Bystander response	Bystander CPR			Bystander AED				
	No bCPR / unknown		bCPR	Available	Shock	Unknown		
	5802		3211	258	127	0		
Aetiology	Medical	Trauma	Overdose	Drowning	Electrocution	Asphyxial ⁴		
	7619	502	313	79	9	491		
Patient outcomes reporting population		n	Any ROSC		Survived event		Survival 30 days	
			Yes	Unknown	Yes	Unknown	Yes	Unknown
EMS witnessed included	All EMS treated OHCA	3308	1100	0	807	0	345 (10.4%)	61
	Shockable bystander*	524	255	0	211	0	124 (25.0%)	26
EMS witnessed excluded	Shockable bystander CPR	631	297	0	242	0	140 (23.5%)	32
	Non-shockable witnessed	1014	315	0	217	0	45 (4.5 %)	21

AED indicates automated external defibrillator; bCPR, bystander cardiopulmonary resuscitation; CA, cardiac arrest; CPR, cardiopulmonary resuscitation; Defib, defibrillation; DNAR; do not attempt resuscitation; EMS; emergency medical services; ID, identified; ROSC, return of spontaneous circulation;

*Utstein comparator group (system efficacy).

³ Per bystander (noting that resuscitation was only commenced by EMS in 5 patients).

⁴ Including Asphyxia/Strangulation/Foreign body + Hanging.

Table A4: Missing or unknown data for selected registry variables (2020)

Variable	n	%	Variable	n	%
Patient age	44	1%	EMS response time	0	0%
Patient gender	53	1%	Outcome at scene	0	0%
Arrest location	2	0%	Event survival	0	0%
Witnessed status	96	3%	Survival to hospital discharge	90	3%
Bystander CPR	76	2%	Survival – 30 days	90	3%
Rhythm on arrival	81	2%			



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Glossary of terms, abbreviations and acronyms

AED	Automated external defibrillator	OHCA	Out-of-hospital cardiac arrest
APDC	Admitted patient data collection	PEA	Pulseless electrical activity
ARC	Australian Resuscitation Council	PHROR	Population health risks and outcomes register
CFR	Community first responder	RBDM	Registry of births deaths and marriages
CHeReL	Centre for health record linkage	REDCap	Research electronic data capture
CPR	Cardiopulmonary resuscitation	RFS	Rural Fire Service
EDDC	Emergency department data collection	ROSC	Return of spontaneous circulation
EMS	Emergency medical service	SA4	Statistical area 4
ETT	Endotracheal tube	SES	State Emergency Service
GRA	Global Resuscitation Alliance	VAO	Volunteer ambulance officer
HRIPA	Health records and information privacy Act	VF	Ventricular fibrillation
IHD	Ischaemic Heart Disease	VT	Ventricular tachycardia
MPDS	Medical priority dispatch system	WA	Western Australia
NSW	New South Wales		





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