Out-of-Hospital Cardiac Arrest Outcomes Registry Epidemiology Report, 2018

English Ambulance Services

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This publication has been produced to provide the Ambulance Services, the Association of Ambulance Chief Executives (AACE) and the National Ambulance Service Medical Directors (NASMeD) with an overview of out-of-hospital cardiac arrest epidemiology and outcomes in England. The views contained in this document are not necessarily those of Ambulance Service Trusts or any Government departments.

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FOREWARD

It is our pleasure to write the foreword to this fifth report from the Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) collaborative project. The NHS Long Term Plan[1] has highlighted the need for the registry to enable effective mapping of out-of-hospital cardiac arrest (OHCA) incidence that will help direct community CPR training initiatives to areas where they are most needed, and to allow the tracking of survival rates and target unwarranted variation.

Over the last 12 months we have seen further improvements to cardiac arrest pathways in England. The "Chain of Survival" drives our approach to out-of-hospital cardiac arrest, and forms the basis of the consensus guidance, 'Resuscitation to Recovery: A National Framework to improve the care of people with Out-of-Hospital Cardiac Arrest in England', which was published in March 2017.[2]

Key aspects of the Chain of Survival, and collaborative work undertaken, include:

1. **Early recognition**: The Ambulance Response Programme has raised the standards and expectations for a timely response for out-of-hospital cardiac arrest.[3]

2. **Early CPR**: Together with the Resuscitation Council (UK), British Heart Foundation and other organisations, NHS Ambulance Services again trained over 200,000 people as part of the "Restart a Heart" initiative (https://www.resus.org.uk/media/press-releases/rsah-2018-230000-new-uk-lifesavers/). Great work has also been undertaken by other organisations to promote immediate and effective CPR. In 2018, with the oversight of ILCOR, the first worldwide Restart a Heart Day took place (https://www.ilcor.org/world-restart-a-heart-2019/worldrestartaheart/).

3. **Early defibrillation**: The British Heart Foundation has joined forces with UK Ambulance Services, the NHS, Microsoft and Microsoft solutions provider to develop the National Defibrillator Network (The Circuit) to enable Ambulance Services and bystanders locate the nearest public access defibrillators.[4]

4. **Post resuscitation care**: 'Resuscitation to recovery' called for the development of consistent care pathways to ensure that patients with a return of spontaneous circulation receive the best treatment after arrival in hospital, through the establishment of 'cardiac arrest centres'.[2]

We thank all the many people who contribute to increasing the awareness of cardiac arrest, the importance of CPR and defibrillation, and the care of those who suffer an out-of-hospital cardiac arrest. To monitor progress,

and help drive improvement, it is crucial that we have good data, and we therefore commend this report and those who have contributed to it. Working together we can save more lives and reduce the devastation caused by sudden cardiac arrest.


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MESSAGE FROM THE CHIEF INVESTIGATOR

The Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) registry has now been in existence for six years. In this time we have collected data on over 164,000 cases of cardiac arrest where resuscitation was continued or commenced by ambulance service personnel. Data has been received from the 11 English Ambulance Services, borne out of the need to ensure all Trusts report data to a uniform and consistent standard.

We would like to thank Ambulance Services, their medical directors, clinical audit staff and the ambulance crews for their continued support and providing the data, and the ambulance service staff and academics who serve as members of the project team and oversight committee.

The quality, quantity and comparability of information available on OHCAO in England continues to grow. This in itself represents a real achievement, and testifies to the value of cooperation and coordinated actions of the Ambulance Services. Facilitation of the submission of Ambulance Quality Indicators to NHS England and the expansion of the data set to include post-ROSC interventions which are critical to the chain of survival have led to further improvements and completeness of data.

We are pleased that the findings from the OHCAO project last year were very useful to the Ambulance Services to highlight their performance in relation to the national picture. We remain committed to continuing to work with NHS England's National Clinical Directors to provide quality data on the epidemiology, process and outcomes from cardiac arrest.

Analysis of data within the registry has been presented at the European Resuscitation Council (ERC) annual congress in Bologna. Further papers have been published in peer-reviewed journals, and research continues to

support BHF and RCUK's annual Restart a Heart Day.

A strength of hosting a national registry for cardiac arrest are the opportunities for collaboration with other research groups so that the information collected is used effectively and widely for the benefit of patients. This has enabled continued UK participation in the European Registry for Cardiac Arrest (EuReCa) project. Members of the project team also attended an international meeting of worldwide cardiac arrest registries to discuss challenges faced in collecting, coding and analysing data, and consider possible opportunities for collaborative research. A summary of on-going collaborative work can be found on the project's website: https://warwick.ac.uk/fac/sci/med/research/ctu/trials/ohcao.

This report is designed to be accessible to the general reader but also strategically focused to serve each participating ambulance service. Whatever your perspective, we hope that our collective work will increase your understanding of out-of-hospital cardiac arrest (OHCA) and inform future practice to improve patient outcome.

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS


AMBULAN
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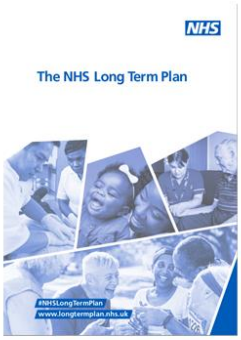
1 INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) is a significant public health issue in the UK. Every year there are nearly 40,000 OHCAs where resuscitation is commenced or continued by paramedics. Typically, less than 10% of OHCA patients survive to hospital discharge. However, if cardiopulmonary resuscitation (CPR) and defibrillation are provided quickly, alongside an effective system of care, the chances of an OHCA patient being resuscitated and having good neurological recovery increases significantly.

In order to improve systems of care and patient outcomes, it is essential to monitor performance, identify problems and successes and track progress. This can be achieved through a registry where all patients are enrolled to create a complete patient population. A registry can drive a quality agenda and fosters a culture of excellence in performance. Over the past five years UK Governments have produced OHCA plans that highlighted the need for a UK OHCA registry that gives Ambulance Services the ability to benchmark themselves against the rest of the UK.[2,5-7] The NHS Long Term Plan[1] also indicated the need for effective mapping of data on OHCA incidence to help direct community initiatives to areas where they are most needed, and outlined the need for a registry to track survival rates and target unwarranted variation. Currently, the Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) registry receives data on OHCAs that occur in England and Wales, and is working towards the inclusion of Northern Ireland. Scotland is developing an independent registry that will collaborate with OHCAO.

Further information about the OHCAO registry can be seen at the following website: https://warwick.ac.uk/fac/sci/med/research/ctu/trials/ohcao/.



This is a summary report of the 2018 OHCA data contributed by the English Ambulance Services to the OHCAO registry. We present an overview of the results of the epidemiology of cardiac arrest, benchmarked against national data where possible and the data completeness for key variables collected (data quality). The OHCAO registry includes OHCA patients of any age where resuscitation is commenced or continued by the EMS.

Since its conception, we have received details of 164,306 OHCAs from participating ambulance services. **Table 1** summarises the total number of cases submitted annually by all participating Ambulance services. Between April and December 2018 (for which data is available) ambulance services attended 60,694 OHCAs, of which 22,631 (37.3%) received resuscitation from paramedic staff. The monthly proportion of cases on which resuscitation attempts were made was highly variable between services, ranging from 24% to 56%.

Table 1:Summary of OHCA numbers submitted to the OHCAO registry

Year	Number of cases in OHCAO registry
2013	18,813
2014	28,723
2015	28,914
2016	27,970
2017	29,057
2018	30,829

2 HOW DOES OHCAO OPERATE?

The OHCAO registry was established in 2013 to investigate the epidemiology and outcome of OHCAs, and explore sources of variation in outcome. The registry is maintained by the Clinical Trials Unit within the Medical School at the University of Warwick. It is overseen by a multidisciplinary Steering Committee, chaired by Dr Jasmeet Soar (Consultant in Intensive Care Medicine and Anaesthetics, North Bristol NHS Trust; Resuscitation Council (UK)). The OHCAO registry incorporates both prehospital clinical and operational data, and survival to hospital discharge. Data was received from all English Ambulance Services in 2018.

2.1 ELIGIBILITY

The OHCAO registry has the following inclusion/exclusion criteria.

Inclusion criteria:

- Patients of all ages who suffer a documented cardiac arrest;
- Resuscitation is continued or commenced by EMS.

Exclusion criteria:

- Patients who suffer a cardiac arrest in a hospital facility where the ambulance service may be in attendance;
- Patients who suffer a cardiac arrest whilst being transferred between hospitals;
- Clear evidence of death defined by the Joint Royal College Ambulance Liaison Committee (JRCALC) recognition of life extinct (ROLE) criteria on arrival of EMS;
- Bystander suspected a cardiac arrest, where the patient is not in cardiac arrest on arrival of EMS, or no defibrillation prior to arrival, or no other evidence verifying a cardiac arrest state is present;
- Patients that achieve a return of spontaneous circulation (ROSC) prior to the arrival of EMS are not included in the registry unless they subsequently re-arrest in the presence of paramedics.

2.2 DATA CAPTURE

The registry is based on the internationally recognised Utstein template and definitions.

Participating EMS routinely collect source data from the 999 call to hospital transportation via Patient Report Forms (PRFs), as well as data related to survival status at hospital discharge. Each ambulance service has their own methods for case ascertainment, e.g. screening paper or electronic PRF databases for OHCA case records, dispatch codes, or related clinical or treatment terms. Identified cases are entered into a cardiac arrest database, cleaned and verified by trained members of the EMS clinical audit team. If the patient is conveyed to hospital the EMS collect data on survival at hospital discharge status directly from hospital emergency departments if data sharing protocols are in place. The data are uploaded by each service to the secure OHCAO server, transformed using service-specific rules and securely stored in the OHCAO registry at the University of Warwick.

Data submitted is divided into three types:

- Priority: Occurrence witness, Bystander CPR, Public Access Defibrillator Used, Initial Rhythm, ROSC at any time, ROSC at hospital handover, Survival to hospital discharge;

- Core: Patient Details, Date/time of event, Event location, Aetiology, Receiving hospital, Ambulance Stop time;
- Supplementary: Other information covering event including interventions, airway management, outcome and process.

2.3 DATA QUALITY

The OHCAO registry undergoes data quality control to ensure the accuracy of the data collected. Data quality checks are carried out at various stages within the registry. At the point of data upload the validity is checked against the agreed mapping and transformation criteria to ensure the data supplied fits that stored within the registry. A process is in place to carry out regular audits and quality control checks of the data throughout the year. Any queries with the data are immediately referred back to the relevant service. In addition, our statistician runs a series of logic checks on the data to ensure that it is correct, e.g. using the date of birth to calculate age and comparing it to the stated age.

2.4 MISSING DATA

The value of the OHCAO registry relies on the completeness of data capture. Missing data for OHCAO remains low for all core and priority variables (**Table 2**). However, there is variation between the services and therefore room for improvement. Periodic quality control checks and data verification activities ensure the long-term validity of registry data.

Table 2: Number and proportion of missing data for selected registry variables, 2018

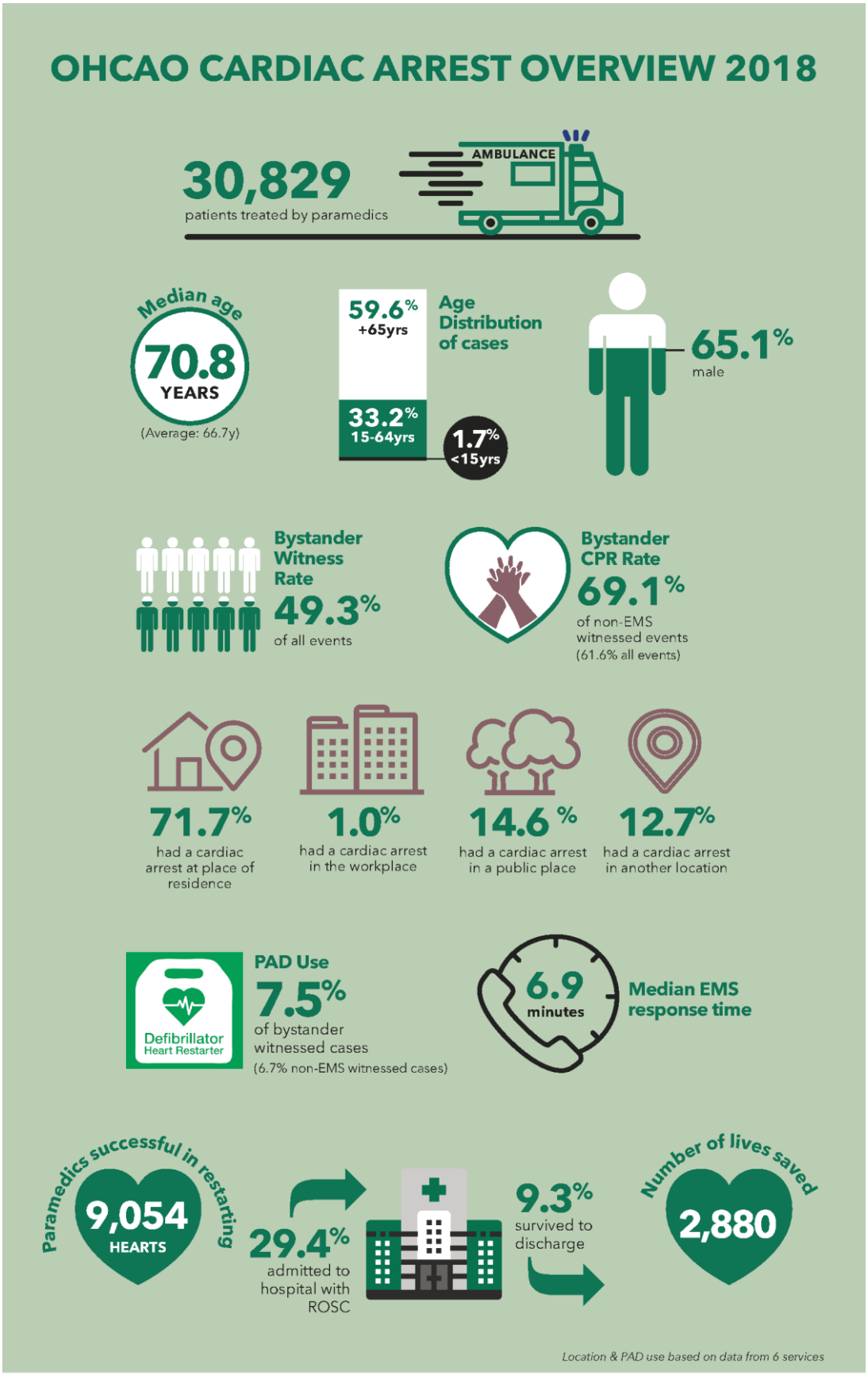
Key variable	OHCAO (number)	OHCAO (%)
Patient age	1,701	5.5
Patient sex	23	0.1
Arrest location	1,300	4.2
Witness status	141	0.5
Bystander CPR	119	0.4
Rhythm on arrival	1,013	3.3
EMS response time	1,108	3.6
Outcome at scene (ROLE)	4,300	14.0
ROSC at hospital handover	357	1.2
Hospital discharge status	942	3.1

2.5 ETHICAL REVIEW

In accordance with Information Governance the OHCAO registry has approval from the NHS Medical Research and Ethics Committee (MREC) and Confidentiality Advisory Group (CAG) to receive data without consent.

The National Research Ethics Service granted ethics approval (13/SC/0361). The study has received approval from the CAG Ethics and Confidentiality Committee (ECC8-04(C)/2013), which provides authorisation, on behalf of the Secretary of State, to lawfully hold identifiable data on patients where it is not practical to obtain consent. The study complies with the common law of duty of confidentiality owed by health professionals in regard to information provided by patients in the course of clinical care, and the principles of the General Data Protection Regulation. The CAG approval provides the Steering Committee with the authority to afford other researchers access to anonymised data in specific circumstance

3 ENGLISH AMBULANCE SERVICE DATA 2018



OHCAO British Heart Foundation Resuscitation Council (UK)

3.1 Incidence and Demographics

For the period 1 January 2018 to 31 December 2018 the registry received information on 30,829 OHCAs that were attended by the ambulance services in England. This is an increase of about 6.1% on the 2017 of 29,057 which was only based on data from 9 services. In the registry an eligible OHCA is defined as one where resuscitation was commenced or continued by the EMS.

During 2018 OHCAO treated 30,829 OHCA cases, compared to 29,057 in 2017

3.1.1 Incidence of all adult and paediatric events

Approximately 92.8% of OHCA events were defined as adults aged 15y and over (65.1% greater than 64 years), and 1.7% less than 15 years.

The crude incidence of OHCA has remained relatively constant over the lifetime of the registry. In 2018, the unadjusted incidence in OHCAO was 55.1 OHCA events per 100,000 population **(Figure 1)**. Compared to 2017, the incidence has increased by about 15.6% in paediatrics and 15.6% in adults (5.5% overall). However, care must be taken in interpreting these figures, because it could be related to the number of services submitting data to the registry, and completeness of data for age.

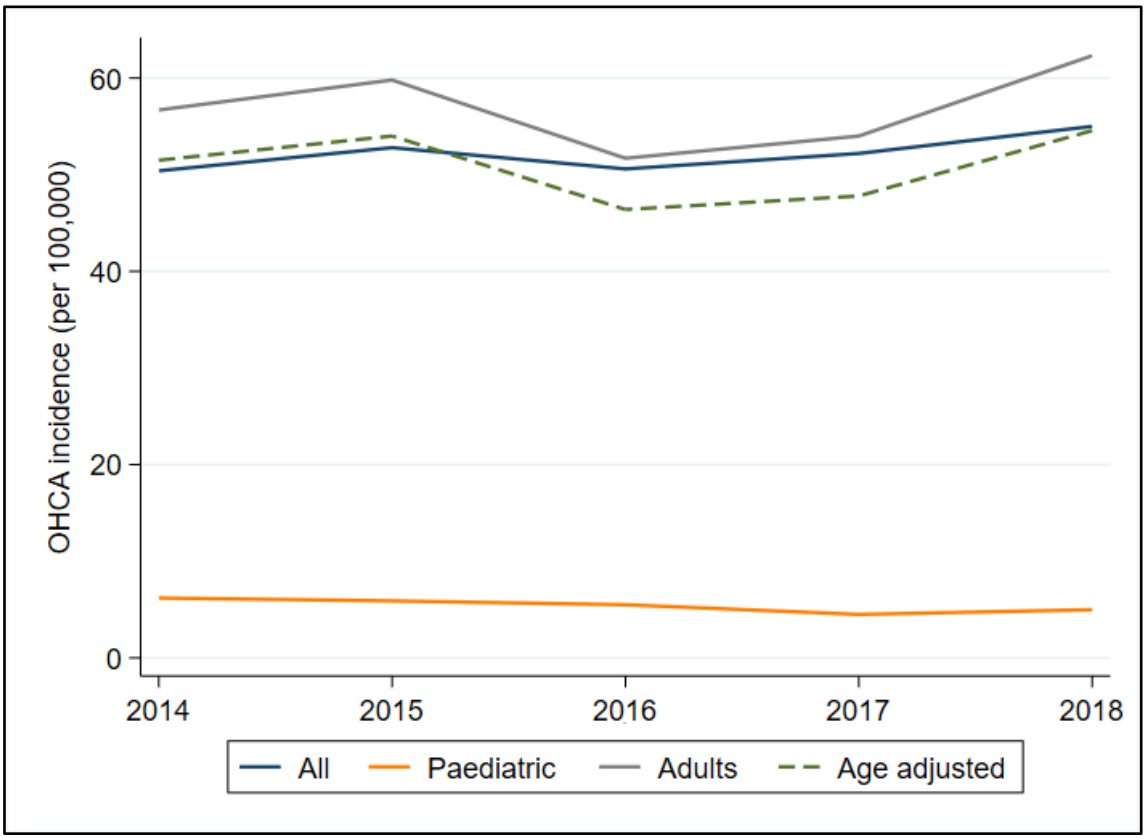


Figure 1: Crude incidence of all ages, adult, and paediatric EMS-attended OHCAs in England, and age-adjusted incidence rates of EMS-attended events (includes EMS-witnessed events).

Figure 2 compares the crude and age-adjusted incidence of OHCA events between the English ambulance services and that for England. The age-adjusted incidence for OHCAO was 54.7 per 100,000, a small decrease on the crude incidence. Age-adjusted incidence rates over the last 5 years have been relatively stable. The age-adjusted OHCA incidence rates for males and females during 2018 were 77.3 and 35.0 events per 100,000, respectively. For individual ambulance services the age-adjusted OHCA incidence ranged from 44.2 events per 100,000 (males: 62.3; females: 28.3) to 75.0 events per 100,000 (males: 102.5; females: 51.1).

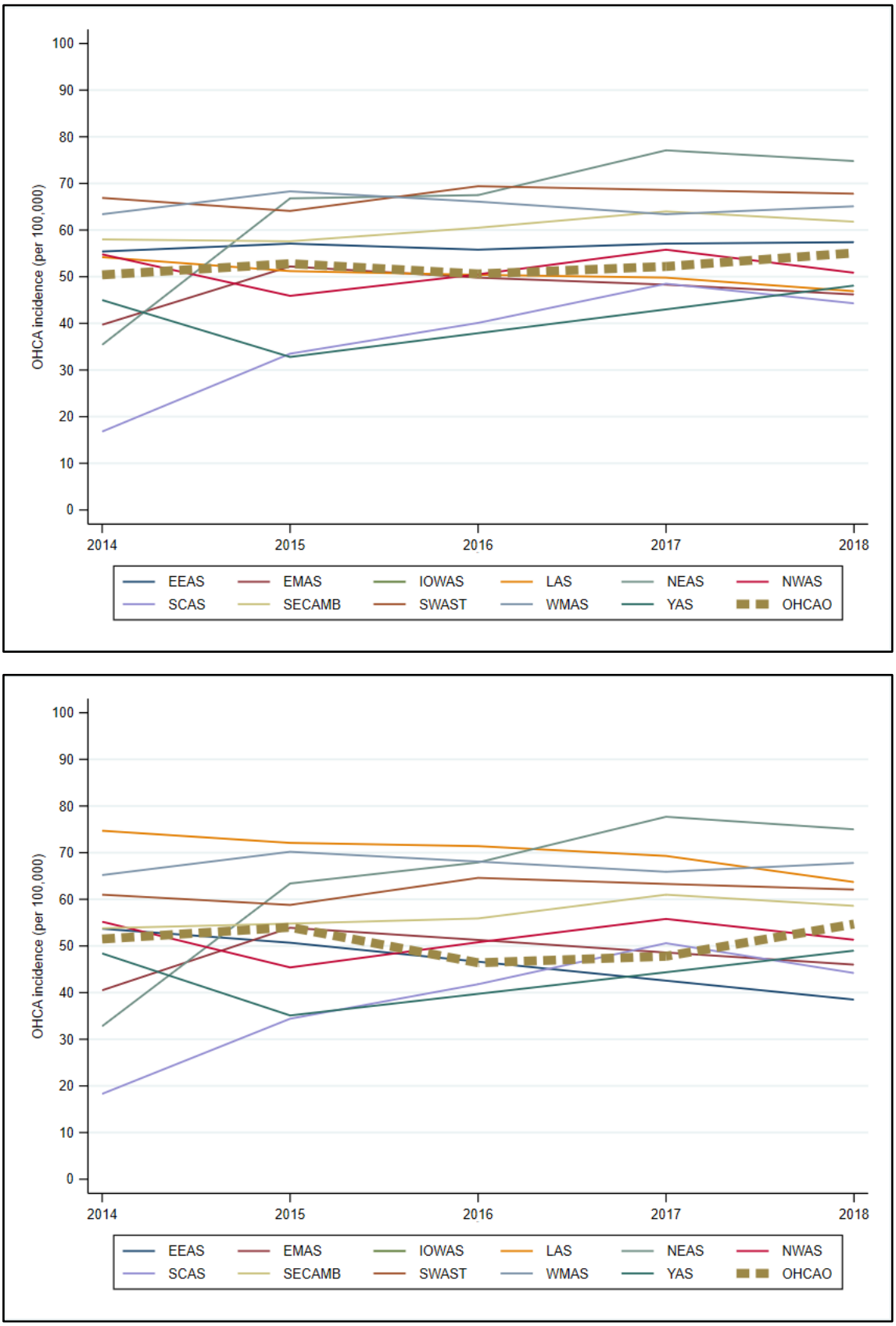


Figure 2: Crude (top) and age-adjusted (bottom) OHCA incidence of EMS-attended events across Ambulance Services.

3.1.2 Demographics of adults

The demographic profile of adult OHCA events has been consistent over the past four years in OHCAO. Attended events were predominantly male (65.2%). The median age of patients was 71 years. The age distribution varied significantly across the sexes **(Figure 3)**, with females having a higher median age of arrest than males (74.0 vs. 69.8 years).

In OHCAO 33.2% of OHCA patients were aged 15-64 years; 65.1% were aged 65 years and over

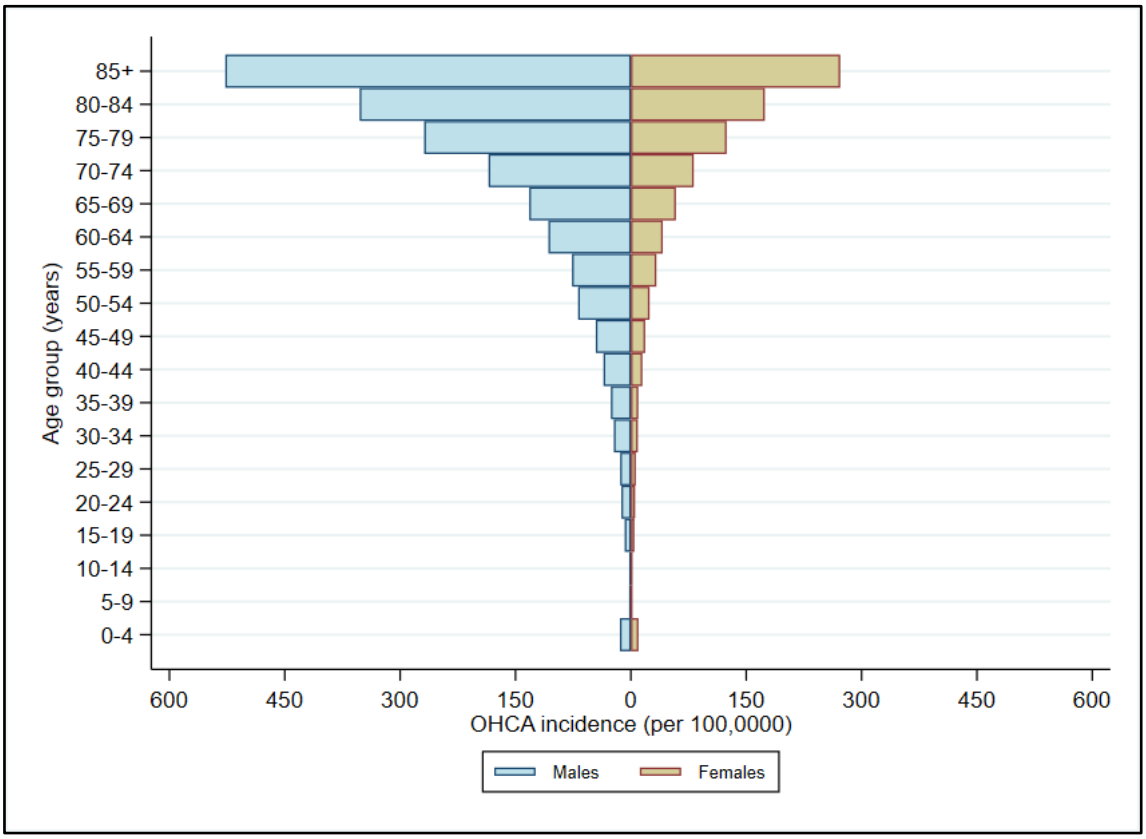


Figure 3: Age distribution of OHCA incidence of EMS-attended events in England, 2018

About 65.2% of the OHCAs treated were male

3.1.3 Aetiology for adults

The precipitating causes of OHCA events for adults are defined by paramedics and recorded directly from the patient care records. The aetiology of OHCA is presumed to be of cardiac origin, unless it is clearly described as otherwise.

In 2018, 83.6% of adult OHCAs receiving attempted resuscitation by EMS were presumed to be of medical/cardiac cause (**Figure 4**). Other frequent causes were: trauma (3.4%), drug overdose (2.1%) and asphyxia (2.8%).

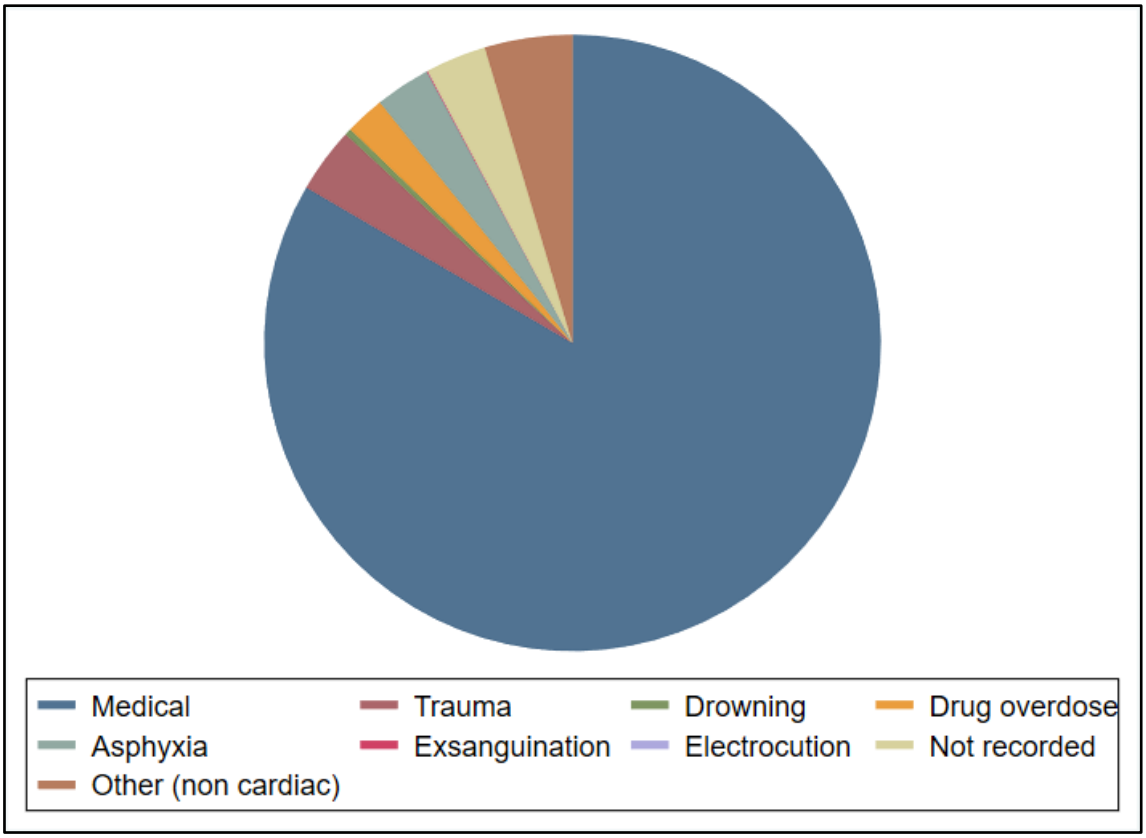


Figure 4: Adult precipitating events for EMS-attended events in England.

3.1.4 Arrest location for adults

The location of where an OHCA event occurs has an impact on the likelihood an OHCA event is witnessed and whether the patient will receive bystander CPR, and has important implications on outcome. **Figure 5** presents the Utstein location for events in England in 2018 for adults from six services that provided this information. About 71.5% of cases were confirmed to have occurred in private residences and about 15.7% in a public place; the latter including industrial/workplaces (1.0%), sporting/recreational facilities (0.5%), streets or roads (8.2%), and public buildings (6.0%). A further 4.8% occurred in assisted living/nursing homes. A total of 18 cases occurred in educational institutions.

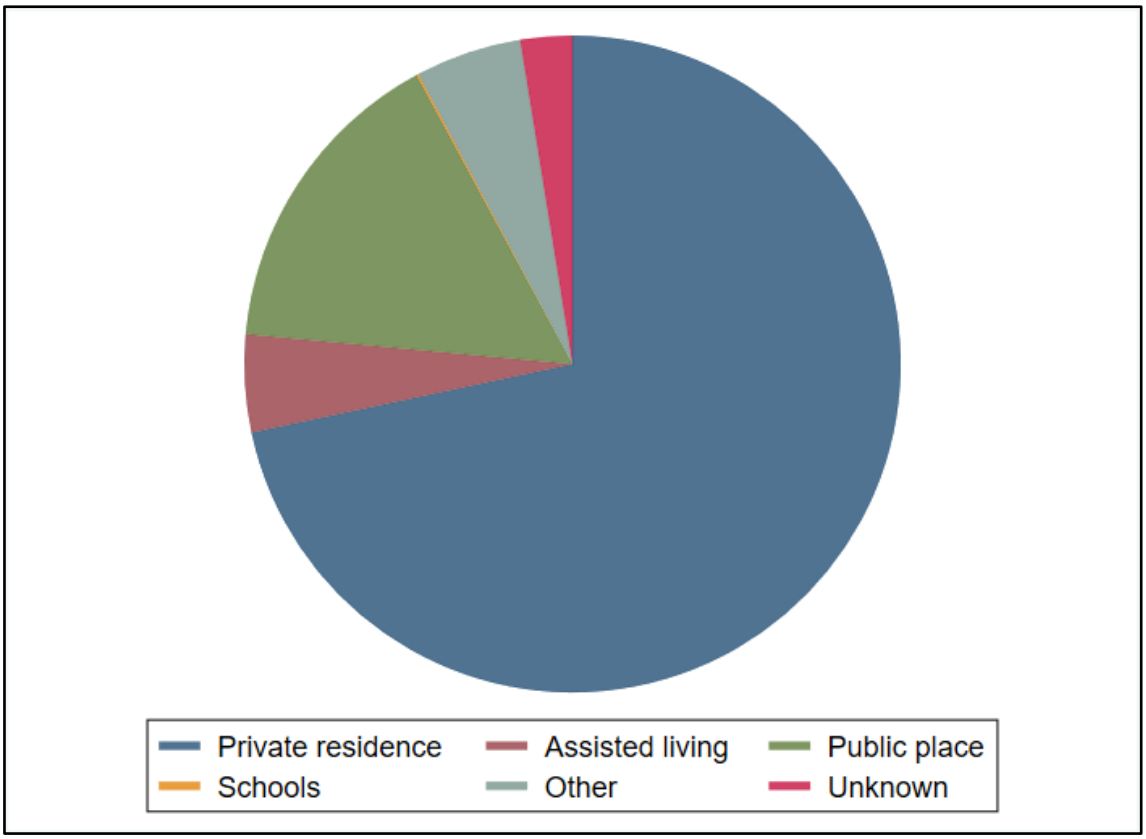


Figure 5: Utstein location of arrest for adult EMS-attended events in OHCAO.

3.2 CHAIN OF SURVIVAL

This section presents key performance information under the theme of the Chain of Survival. The Chain of Survival was first introduced over 40 years ago.[8] It describes a sequence of four steps that, when all are in place, optimises the chance of survival (**Figure 6**):

1. Early access and recognition: being able to recognise someone is in cardiac arrest and getting assistance;
2. Early CPR: performing chest compressions can keep their heart going until a defibrillator arrives;
3. Early defibrillation: for every minute the patient doesn't have a defibrillator attached to their chest, their chances of survival reduces by 10%. Early defibrillation can triple a person's chances of survival;
4. Early advanced care by paramedics: If CPR is started within 2 minutes, a defibrillator is placed on the chest in four minutes and a paramedic arrives in 8 minutes, a patient will have a 40% chance of survival.

Figure 6: Chain of survival.[8]

3.2.1 Bystander call for help

The NHS Ambulance Response Programme (ARP) showed that only 0.6% of 999 calls are for cardiac arrest, highlighting that this is a rare event that can be difficult to detect on the basis of limited information from a telephone call.[3,10] As the likelihood of survival is significantly associated with the ambulance response time[11,12], it is imperative that the dispatcher is able to identify an OHCA as soon as possible and assign an ambulance to respond. Results from the ARP indicated that the majority of OHCA calls (68%) were assigned to the descriptor Red1 (i.e. where patients illnesses or injuries are immediately life threatening). However, recently it was shown that systems could not identify an OHCA correctly in 25% of cases, which equated to about 7,500 treatable OHCAs in the UK per year[13], although inaccurate information being passed to the dispatcher by a third party may have been responsible for false negative OHCAs subsequently deteriorating to OHCA after triage.[14] A bystander witnessing an OHCA event and subsequently calling the dispatcher must provide accurate information to help identify that the patient is suffering an OHCA and this in turn influences the timing of dispatcher-assisted CPR instructions and response of EMS.

3.2.2 Emergency response to incident

The distribution of response times for OHCAs in England in 2018 is presented in **Figure 7**. Events that were witnessed by the EMS were assigned to have a response time of zero minutes. The median response time in OHCAO for EMS-treated events was 6.9 minutes (90th percentile time 16.0 minutes; non-EMS-witnessed events: median=7.5 mins; 90th percentile=16.9 mins). These times were higher than those noted in 2017 (All cases: median time 6.4 mins, 90th percentile 14.6 minutes; non-EMS-witnessed cases: median time 7.0 mins, 90th percentile 15.4 mins), despite the increasing demand on ambulance service.

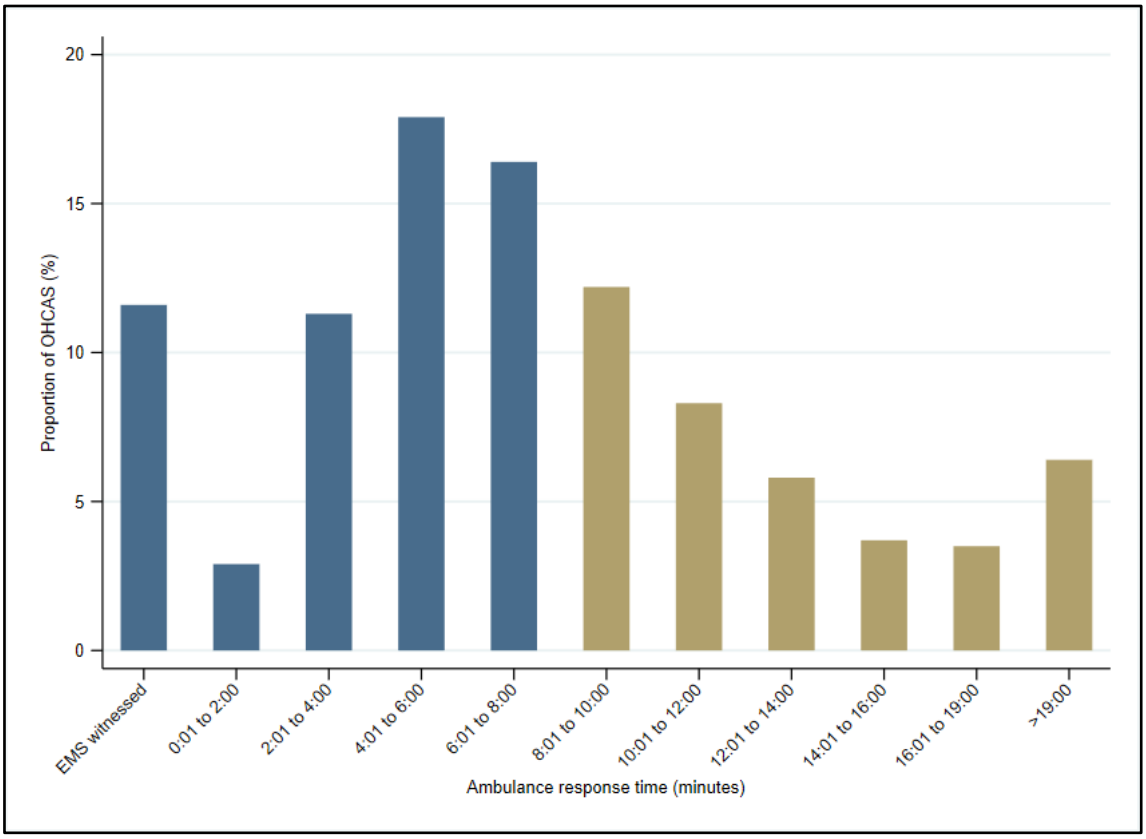


Figure 7: Distribution of time from call to arrival of EMS on scene (ambulance response time in EMS-treated population) in OHCAO compared to England (line).

EMS arrived within 8-minutes of 999 call for 60.2% of patients
The median response time was 6.9 minutes

3.2.3 Bystander CPR

Previous research clearly shows that in bystander witnessed events, effective bystander CPR increases the likelihood of an initial shockable rhythm and improves the chances of achieving ROSC at hospital handover, and survival to discharge. The proportion of cases that were witnessed by a bystander in OHCAO was 49.5%. In OHCAO, 61.4% of patients received CPR performed by bystanders (**Figure 8**). Of those events that were witnessed by a bystander, 73.8% received bystander CPR, compared to 72.8% of patients in 2017 and 70.3% in 2016. Of all non-EMS-witnessed events 69.1% received bystander CPR.

The proportion of cases who received bystander CPR in OHCAO was 61.4% of all cases, and 69.1% of non-EMS witnessed cases

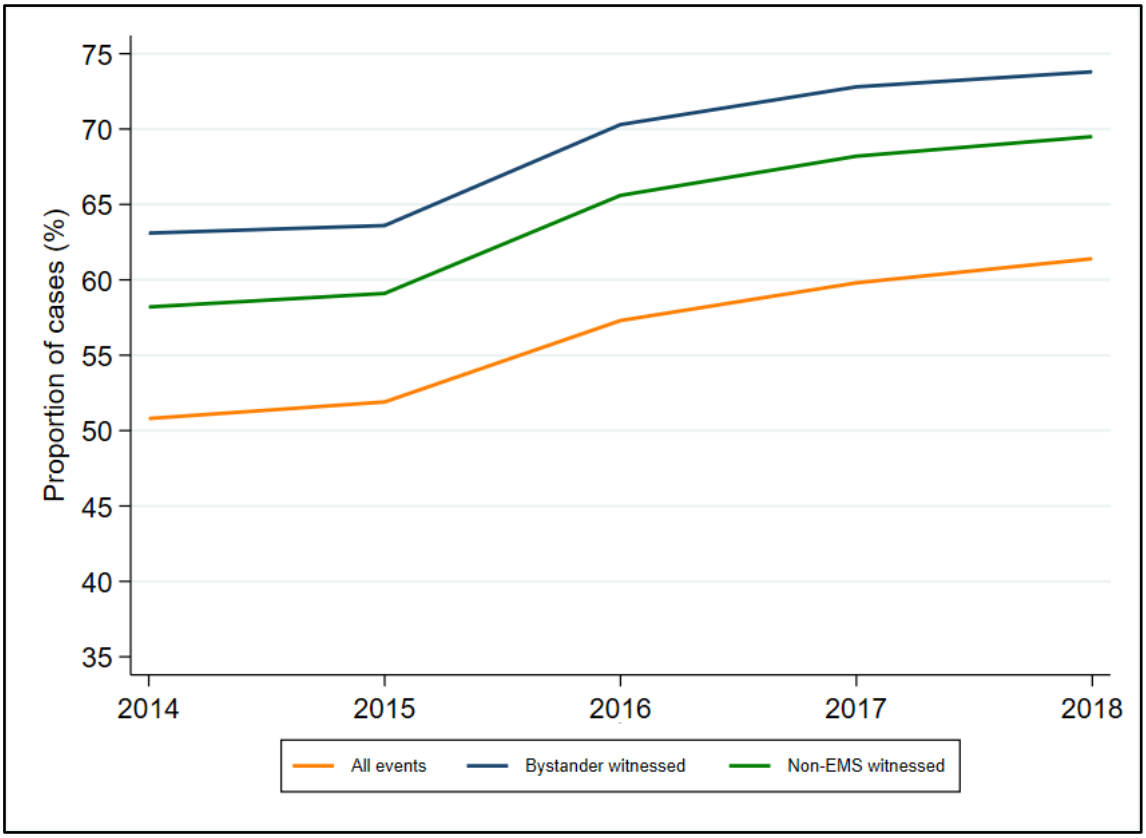


Figure 8: Bystander CPR rates in English EMS-treated events.

Public access defibrillation was used in 4.5% of all patients (5.0% of non-EMS-witnessed cases)

In 2018, 21.9% of the overall adult EMS-treated patient population presented to either EMS or a bystander, who made use of an automated external defibrillator (AED), in a shockable rhythm (ventricular fibrillation (VF) or ventricular tachycardia (VT)). The proportion of adults presenting in a shockable rhythm has fluctuated around 22% over the last 5 years (**Figure 9**).

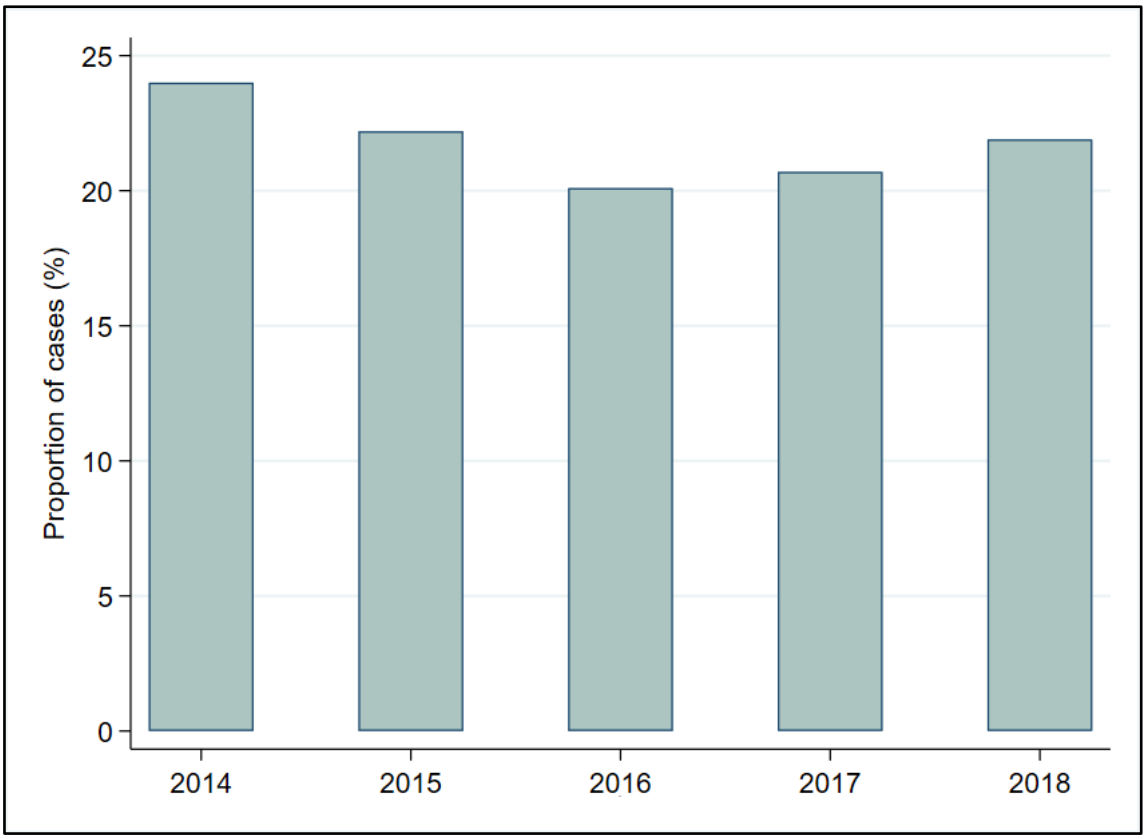


Figure 9: Proportion of adult English EMS-treated events presenting in a shockable rhythm.

3.3 Survival Outcomes

3.3.1 Scene outcomes in adults

Successful attempts at resuscitation following OHCA have been evaluated by the attainment of ROSC in the field and subsequent transport to hospital.

During 2018 the achievement of ROSC was highest amongst patients who arrested in the presence of EMS (41.8%). Bystander-witnessed OHCAs attained higher rates of ROSC than unwitnessed events (35.2% vs 18.8%). The proportion of cases transported to hospital with ongoing CPR also varied, 32.4% among EMS-witnessed events, 22.2% among bystander-witnessed, and 16.8% among unwitnessed cases.

Across the whole of England, ROSC (at hospital handover) was achieved in 29.8% of all cases, and the same of adults.

Over time the proportion of cases where resuscitation efforts were ceased at scene have shown an increasing trend (0.8% per year), and transportation to hospital with ongoing resuscitation a decreasing trend (2.6% per year; **Figure 10**). The proportion of cases that were transported from the scene with ROSC was 29.8%, which is a small increase on the previous year (29.1%); the four-year trend shows an increase of about 1.81% per year.

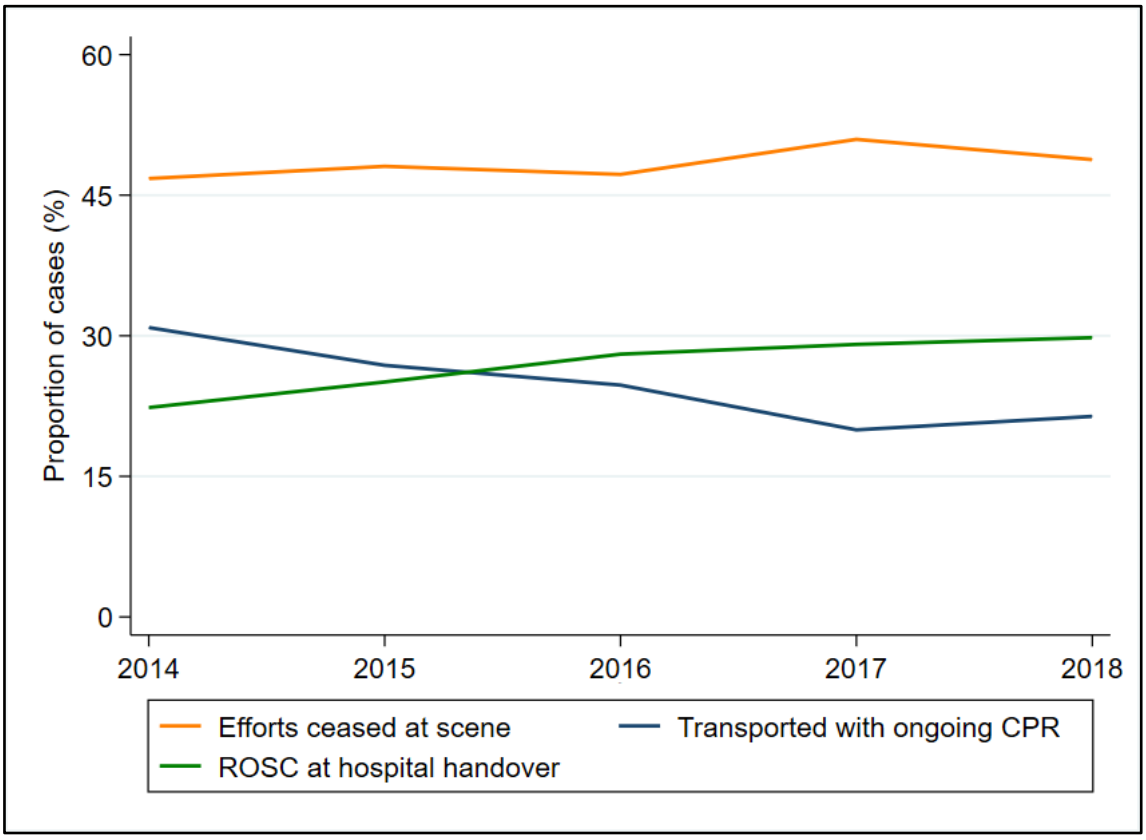


Figure 10: Scene outcomes for adult English EMS-treated events.

OHCAO were successful in restarting 9,037 hearts (ROSC at hospital handover rate of 29.8% of patients treated)

3.3.2 Adult survival from all-cause cardiac arrest

Unadjusted adult event survival from all-cause OHCA has **increased** modestly over the past 5 years, and survival to discharge remained relatively constant (**Figure 11**). In 2018, the rate of ROSC at hospital handover for adult EMS-treated events was 29.8% and discharged alive rate was 9.4%.

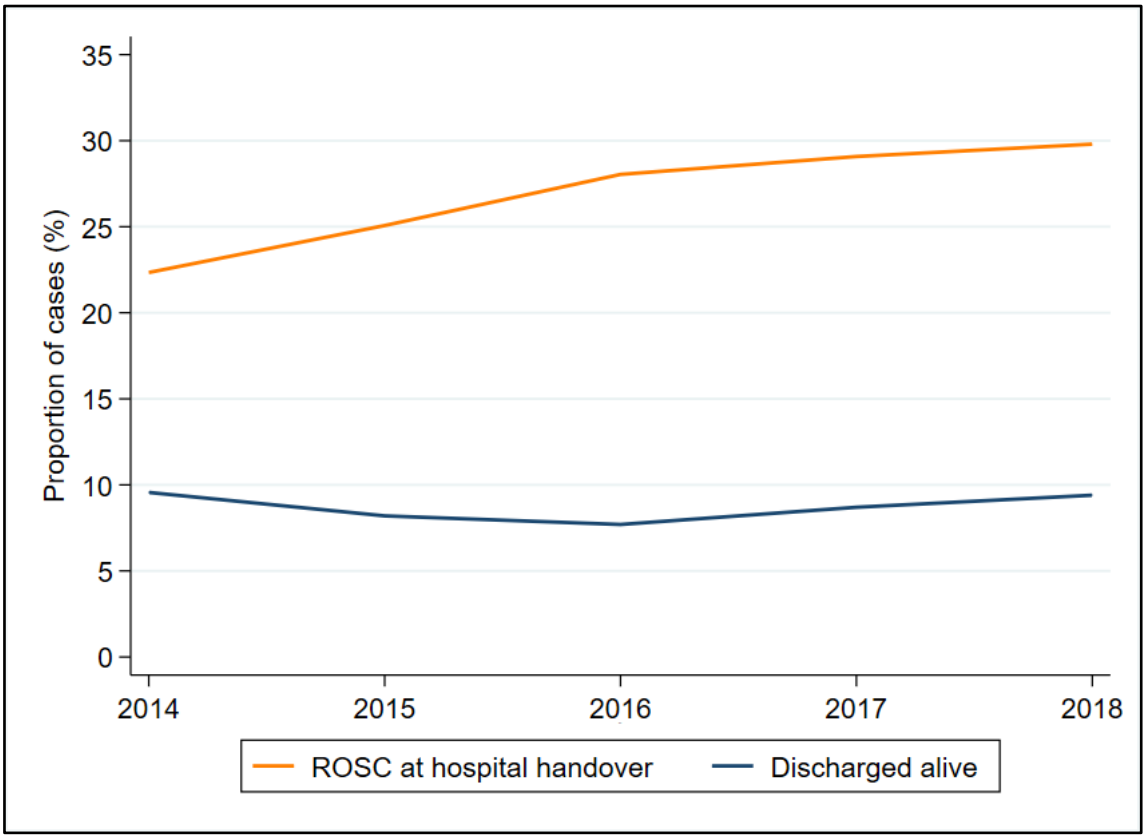


Figure 11: Unadjusted survival outcomes for all-cause adult English EMS-treated events.

3.3.3 Adult survival from shockable rhythms

Survival outcomes for patients presenting to EMS or bystanders in a shockable rhythm are consistently better than patients presenting in pulseless electrical activity (PEA) or asystole. A shockable rhythm is a strong predictor of OHCA survival. Outcomes for patients with shockable rhythms have improved over time (**Figure 12**). In 2018, the rate adult ROSC at hospital handover for patients presenting in a shockable rhythm was 52.2%. Of adult EMS-treated patients, 29.7% of events presenting in a shockable rhythm during 2018 were discharged alive (**Figure 12**; 2017: 27.0%). In contrast, 5.3% of adult patients who presented in PEA were discharged alive (2017: 4.5%), while few adults presenting in asystole (1.6%) were discharged alive (2017: 1.4%). This is the highest survival in shockable patients achieved by English ambulance services since the OHCAO project commenced monitoring OHCA patients.

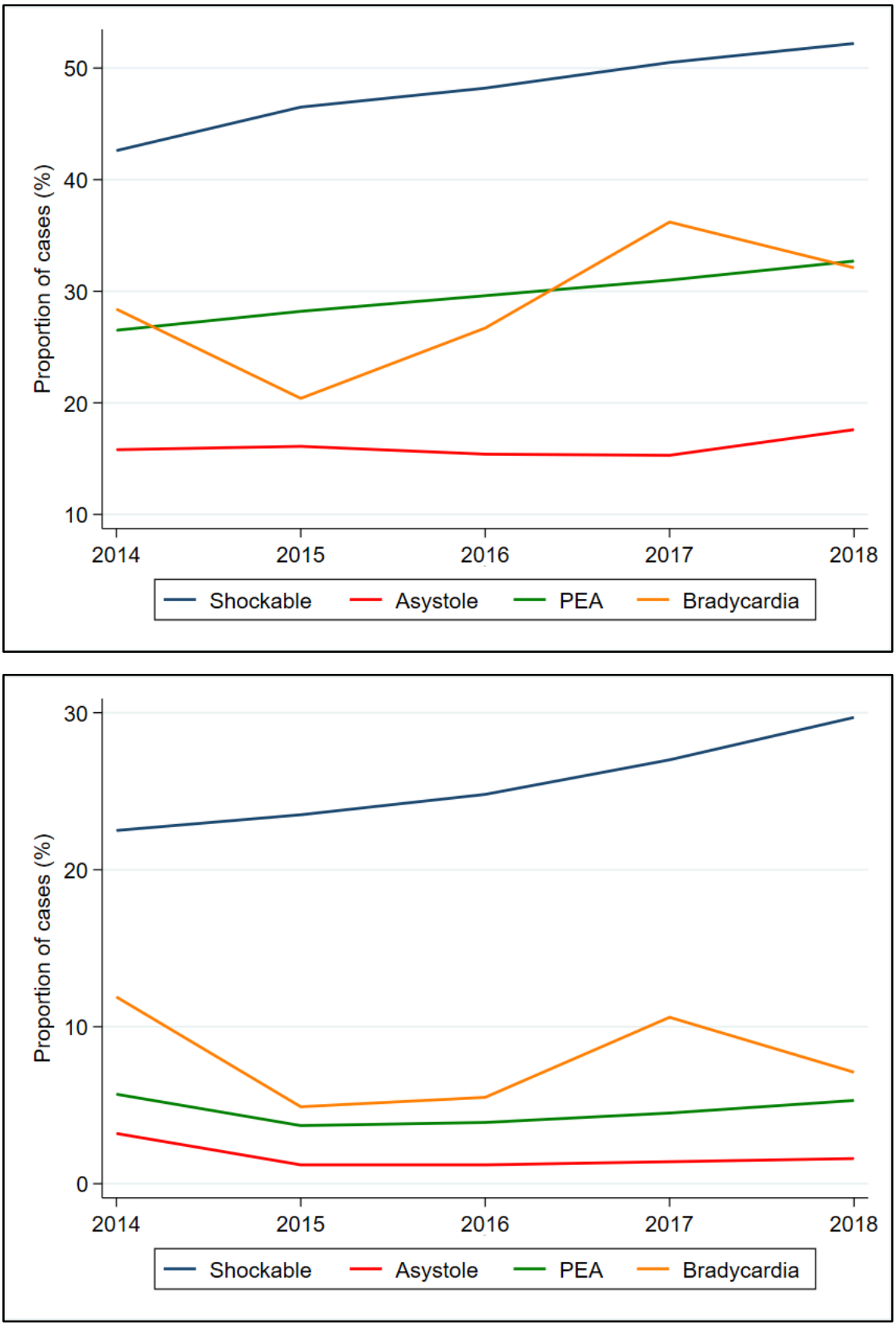


Figure 12: Unadjusted survival outcomes (Top - ROSC at hospital handover; Bottom - Discharged alive) for adult EMS-treated events according to presenting rhythm on arrival.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3.3.4 Adult survival from EMS-witnessed arrests

In 2018, for adult EMS-treated and witnessed events, the rate of ROSC at hospital handover was 41.8% and the rate of survival to hospital discharge was 19.6%. When considering events that presented in a shockable rhythm the event survival was 68.9% and the discharged alive rate was 53.1% (**Figure 13**). Figure 13 also compares outcomes in patients presenting in non-shockable rhythms.

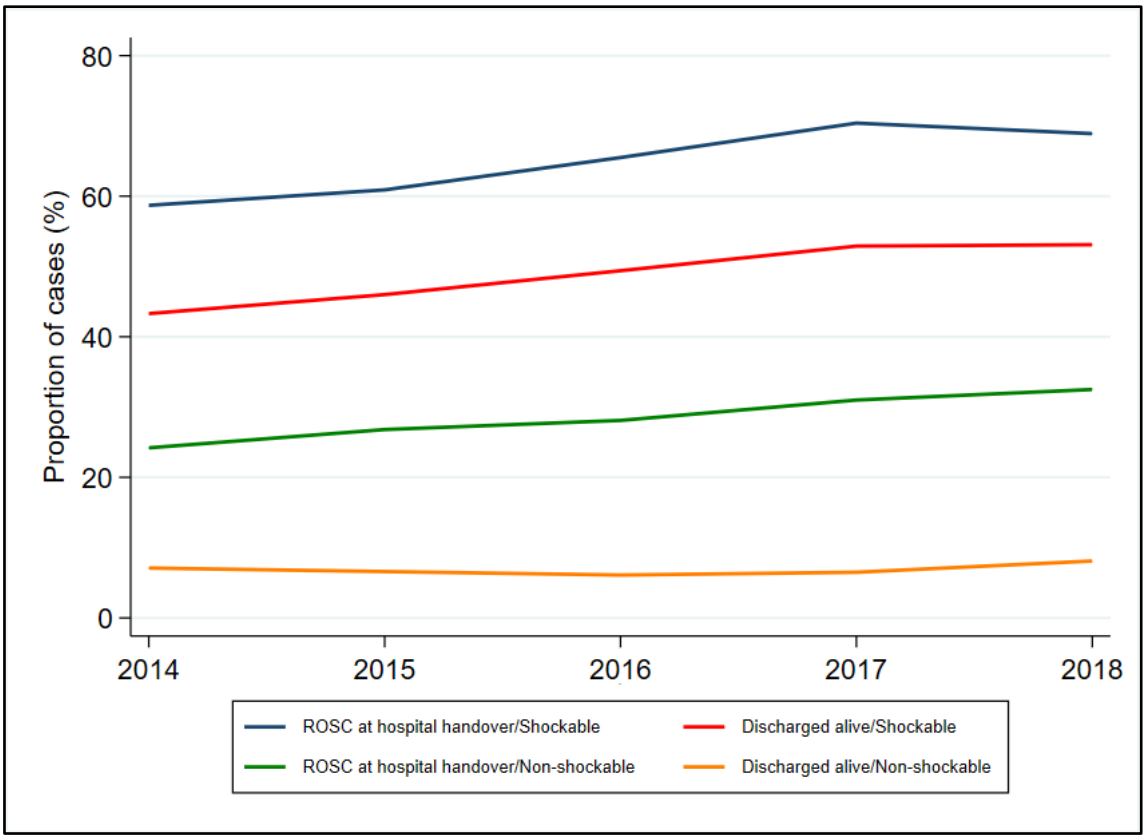

Figure 13: Unadjusted survival outcomes for adult EMS-treated and witnessed events with a shockable arrest rhythm.

3.4 Post-ROSC Care Bundle

Successful ROSC is the first step towards the goal of complete recovery from OHCA. The treatment received post-resuscitation influences significantly the overall outcome and particularly the quality of neurological recovery.[15] The post-resuscitation phase starts at the location where ROSC is achieved, once stabilised, the patient is transferred to the most appropriate high-care area (e.g. emergency room, cardiac catheterisation laboratory or intensive care unit) for continued diagnosis, monitoring and treatment. A post-ROSC care bundle of various components has been developed to improve outcome.[15] These include:

- 12-lead ECG taken post-ROSC
- Blood glucose recorded post-ROSC
- End-tidal CO2 reading/waveform recorded post-ROSC/continuously
- Oxygen administered post-ROSC continuously

- Systolic blood pressure reading recorded post-ROSC or, if unobtainable, presence of radial pulse documented
- Administration started of a 250ml bolus of saline fluids post-ROSC

The number of OHCAs who received the post-ROSC care bundle as a proportion of those that had achieved ROSC at any time on scene is reported quarterly (January, April, July, October) by each service; collection of this information began in April 2018. **Figure 14** shows that the proportion of cases who have achieved ROSC at any time on scene and receive the care bundle has increased in OHCAO and England as a whole. Information on the eligibility, exclusions and exceptions can be found in **Appendix 1**.

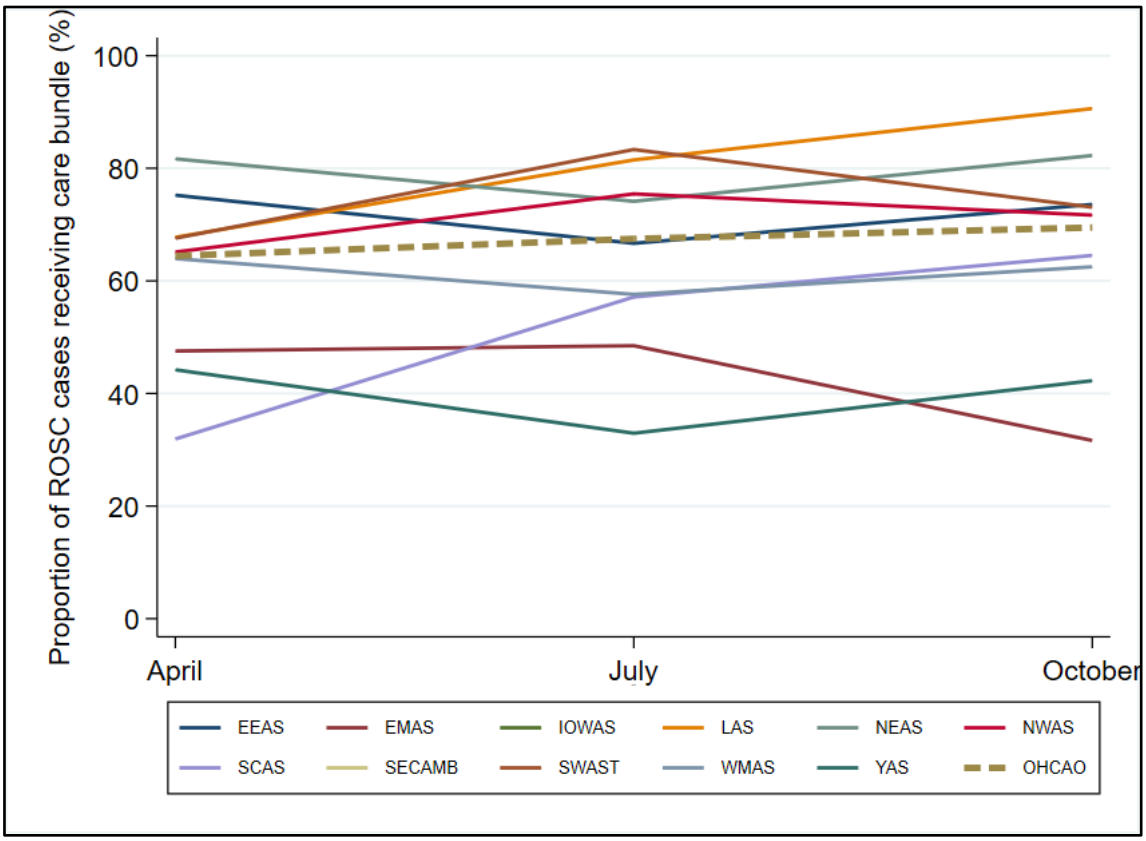

Figure 14: Variation between ambulance services in proportion of OHCA cases that have achieved ROSC anytime on scene and have received the post-ROSC care bundle

3.5 PAEDIATRIC EVENTS

3.5.1 Demographics for paediatrics

The frequency of EMS-attended paediatric events has remained relatively low over the last four years, with fewer than 1000 events per year (530 in 2018) in England. The median age of arrest was 6.3 months. During 2018, 383 of paediatric OHCA events occurred in children aged less than three years. The demographic profile of paediatric OHCA varies significantly across reporting years because of the small sample size. Attended events were predominantly male (59.6%). Significantly fewer paediatric patients received bystander CPR than adult patients during 2018 (48.7% of all cases, 52.2% of bystander witnessed cases).

3.5.2 Precipitating events for paediatrics

The pattern of precipitating events for paediatrics who suffer an OHCA is different from that of adults. In 2018, 74.3% of EMS-treated paediatric events were due to a presumed cardiac cause. Other precipitating events included: trauma (3.8%), drowning (1.9%), asphyxia (7.7%), and other non-cardiac cause (10.2%). Notably, paediatric cases rarely present in a shockable rhythm; in 2018, this proportion was 4.2%. Asystole was the most common presenting rhythm (73.8%).

3.5.3 Arrest location for paediatrics

About 84.9% of paediatric cases were confirmed to have occurred in private residences. However, fewer paediatric cases occurred in a public place (7.5%) compared to adults.

3.5.4 Paediatric survival from all-cause cardiac arrest

Amongst paediatrics, survival factors and outcomes differ from adults. In 2018, 114 (21.5%) paediatric EMS-treated patients survived the event and were admitted to hospital with ROSC (24.4% in 2017); 383 (72.3%) with ongoing resuscitation. There were 64 paediatric patients (12.1%) who were discharged alive (8.7% in 2017).

There were 33 EMS-witnessed paediatric events in 2018, 12 (36.4%) survived the event (achieved ROSC at hospital handover) but only 7 were discharged alive.

3.6 UTSTEIN PATIENT SUB-GROUP SURVIVAL

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

OHCA patients who are EMS-witnessed and present in a shockable rhythm are the most likely subgroup to survive an arrest. Data presented using the Utstein template permits the assessment of possible bystanders on outcomes, and focuses on survival within the following patient subgroup: (i) OHCA events of presumed cardiac origin; (ii) where EMS attempted resuscitation; (iii) where the arrest was witnessed by a bystander; and (iv) the presenting cardiac rhythm was shockable (VF or VT).

Figure 15 shows the total number of OHCA events in 2018 and progressively the breakdown of events according to EMS attempted resuscitation, precipitating event, witnessed status and presenting rhythm. In 2018, the OHCAO rate of survival to hospital discharge for the Utstein patient sub-group was 28.4%. In the previous year the figure was 26.2%.

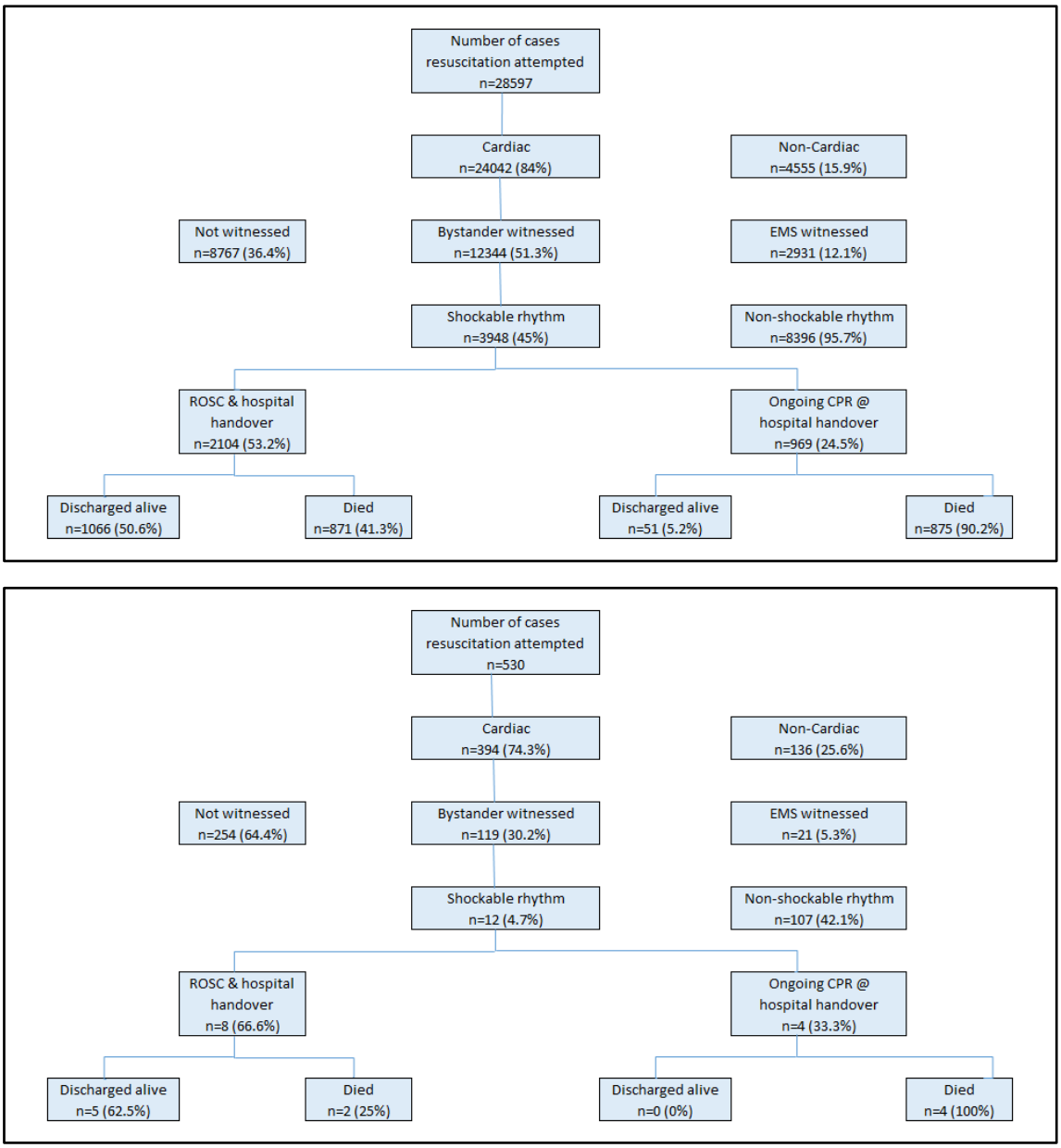

Figure 15: Survival outcomes for the Utstein patient sub-group for adults (top) and paediatrics (bottom)

OHCAO helped save 2,880 lives from cardiac arrest in 2018 (survival to hospital discharge rate of 9.5%)

4 RECOMMENDATIONS

We continue to endorse the key recommendations from the 'Resuscitation to Recovery' national framework for OHCA in England.

- The internationally accepted 'Chain of Survival' should be more widely embedded in public consciousness and into clinical pathways and protocols;
- Greater awareness amongst the general public including young people of school age, on how to recognise and manage arrest through the use of CPR and PADs;
- Significant improvement of the systems and process used by Ambulance Services to identify and map the location of defibrillators in public and commercial locations;
- Emergency responders (ambulance and fire services, police and community first responders) should collaborate to ensure that someone trained in resuscitation and equipped with a defibrillator can be at the scene of a cardiac arrest in the shortest possible time;
- Clinical networks should work with the emergency services and voluntary sector to promote awareness of, and training in, CPR and the use of PADs;
- The current Resuscitation Council (UK) guidelines should be followed;
- Each Urgent and Emergency Care Network in England should establish an effective and consistent pathway of care for those with OHCA, from the point of initial resuscitation to management within designated OHCA treatment centres (Cardiac Arrest Centres);
- Data should be submitted to the national Out-of-Hospital Cardiac Outcomes (OHCAO) Registry so that performance and progress towards improved survival rates can be monitored and unwarranted variation can be addressed; appropriate local resources must be allocated for these audit purposes;
- The management and outcomes of patients treated in hospital (from acute care through to secondary prevention and rehabilitation) should be captured through the relevant national registries; and
- Research to improve understanding of resuscitation is a national priority and should be funded and promoted; ambulance and hospital services should work closely together on collaborative projects.

Furthermore, we endorse the recommendations of the NHS Long Term Plan that data should enable the effective mapping of OHCA incidence that will help direct community CPR training initiatives to areas where they are most needed.

5 REFERENCES

1. NHS England. The NHS Long Term Plan. London: NHS England, 2019.

2. NHS England. Resuscitation to Recovery. London: British Heart Foundation, 2017.

3. Turner J, Jacques R, Crum A, Coster J, Stone T. Ambulance Response Programme: Evaluation of Phase 1 and Phase 2: Final Report. University of Sheffield: School of Health and Related Research (ScHARR). 2017.

4. BHF. The Circuit - the national defibrillator network. 2019. https://www.bhf.org.uk/how-you-can-help/how-to-save-a-life/defibrillators/ndn-the-circuit

5. Welsh Government. Out of Hospital Cardiac Arrest Plan: Improving the care of people with an out of hospital cardiac arrest (OHCA) in Wales. Cardiff: NHS Wales. 2017

6. Scottish Government. Out-of-Hospital Cardiac Arrest: A Strategy for Scotland. Edinburgh: The Scottish Government. 2015.

7. McManus DM Anderson C, Boyle M, et al. Community Resuscitation Strategy, Northern Ireland. Belfast: Northern Ireland Ambulance Service. 2014.

8. Newman MM. Chain of survival concept takes hold. Journal of Emergency Medical Services 1989, 14: 11-13.

9. Turner J, Jacques R, Crum A, Coster J, Nicholl J. Ambulance Response Programme: Evaluation of Dispatch on Disposition. Final Report. University of Sheffield: School of Health and Related Research (ScHARR). 2016

10. Hawkes C, Booth S, Ji C, et al. Epidemiology and outcomes from out-of-hospital cardiac arrest in England. Resuscitation 2017, 110: 133-140.

11. O'Keeffe C, Nicholl J, Turner J, Goodacre S. Role of ambulance response times in the survival of patients with out-of-hospital cardiac arrest. Emergency Medical Journal 2010, 28(8): 703-706.

12. Deakin C, England S, Diffey D. Ambulance telephone triage using 'NHS Pathways' to identify adult cardiac arrest. Heart 2017, 103: 761-765.

13. Hatton SJ. Identification of adult cardiac arrest using NHS Pathways. Heart 2017, 103(16): 1304.

14. Nolan J, Deakin C, Lockey A, Perkins G, Soar J. Post-resuscitation care. London: Resuscitation Council. 2015 (https://www.resus.org.uk/resuscitation-guidelines/post-resuscitation-care/)

15. NHS. Ambulance Quality Indicators: Clinical Outcomes specification (20190613 AmbCO specification). Available at: https://www.england.nhs.uk/statistics/wp-content/uploads/sites/2/2019/06/20190613-AmbCO-specification.pdf

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7 DEFINITIONS

Adults:	Patients aged 15 years or older, or where the age is missing/unknown
Asystole:	Absence of any cardiac activity
Defibrillation:	Providing an electrical shock to a patient in a shockable rhythm
Emergency medical services (EMS):	Denotes ambulance service paramedics
EMS response time (EMSRT):	The time from emergency call to arrival of EMS crew on scene
Paediatrics:	Patients aged less than 15 years
Presumed cardiac aetiology:	Cases where the cause of arrest is not due to a known precipitator (e.g. trauma, overdose poisoning, etc.), as reported on the PRF
Return of Spontaneous Circulation (ROSC):	Cases in which the resuscitation attempt results in a return of spontaneous circulation (i.e. detectable pulse) at any time
Survival to hospital discharge (or discharged alive):	Patients who are discharged alive from the hospital's acute care unit
Shockable Rhythm:	Rhythms which are appropriate to receive defibrillation, including ventricular fibrillation and pulseless ventricular tachycardia, by EMS or a bystander with a public automate external defibrillator
Utstein patient sub-group:	Patients whose arrest is medical, presumed cardiac, witnessed by a bystander, presents in a shockable rhythm and an attempt at resuscitation was made by EMS

8 ABBREVIATIONS

AED	Automated External Defibrillator
ARP	Ambulance Response Programme
BHF	British Heart Foundation
CAG	Confidentiality Advisory Group
CPR	Cardiopulmonary Resuscitation
EEAST	East of England Ambulance Service NHS Trust
EMAS	East Midlands Ambulance Service NHS Trust
EMS	Emergency Medical Services
ERC	European Resuscitation Council
EuReCa	European Registry for Cardiac Arrest
IOWAS	Isle of Wight Ambulance Service NHS Trust
JRCALC	Joint Royal College Ambulance Liaison Committee
LAS	London Ambulance Service NHS Trust
MREC	Medical Research and Ethics Committee
NEAS	North East Ambulance Service NHS Foundation Trust
NWAS	North West Ambulance Service NHS Trust
OHCA	Out-of-Hospital Cardiac Arrest
OHCAO	Out-of-Hospital Cardiac Arrest Outcomes
PAD	Public Access Defibrillator
PEA	Pulseless Electrical Activity
PRF	Patient Report Form
RCUK	Resuscitation Council (UK)
ROLE	Recognition of Life Extinct
ROSC	Return of Spontaneous Circulation
SCAS	South Central Ambulance Service NHS Foundation Trust
SECAmb	South East Coast Ambulance Service NHS Foundation Trust
SWAST	South Western Ambulance Service Trust NHS Foundation Trust
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia
WMAS	West Midlands Ambulance Service University NHS Foundation Trust
YAS	Yorkshire Ambulance Service NHS Trust

9 APPENDIX 1 - POST-ROSC CARE BUNDLE

First produced for April 2018 the following data is collected and published for January, April, July, and October.

- The number of patients who had resuscitation (Advanced or Basic Life Support) commenced/continued by Ambulance Service following an OHCA, and had ROSC on scene (R5n).
  Exclude Traumatic Cardiac Arrest, patients successfully resuscitated before the arrival of ambulance staff, ROSC achieved en-route or upon arrival at hospital, and patients aged less than 18 years.
- Of these patients, the number who received the post-ROSC care bundle (R5b).

If, for any component, no exceptions apply, and the component is not delivered, then the care bundle is not delivered, and the case should be included only in R5n. If each component is either met or has a valid exception, the care bundle is delivered, and the case should be included in R5b and R5n.

Equipment failure, or presence only of non-registered staff on-scene, are not acceptable exceptions for any of these post-ROSC care bundle components. If time of ROSC lost is unknown, it should be assumed that ROSC <10 minutes.

Table 3: Care bundle components for post-ROSC cases[15]

Component of post-ROSC care bundle	Exceptions
12 lead ECG taken post-ROSC	• Patient refusal • Patient re-arrested with ROSC <10 minutes in duration (If patient in arrest on arrival, should assume 12 lead ECG is post-ROSC)
Blood glucose recorded post-ROSC	• Patient refusal • Patient re-arrested with ROSC <10 minutes in duration • Blood glucose measured prior to ROSC and within normal range (If blood glucose pre-ROSC is below normal range then a subsequent blood glucose is required)
End-tidal CO_2 reading/waveform recorded post-ROSC/continuously	• Patient refusal • Patient re-arrested with ROSC <10 minutes in duration • Not required: no advanced airway in situ
Oxygen administered post-ROSC/continuously	• Patient refusal • Patient re-arrested with ROSC <10 minutes in duration • Not required: oxygen saturations were 94-98% (88-92% if chronic obstructive pulmonary disease)
Systolic blood pressure reading recorded post-ROSC or, if unobtainable, presence of radial pulse documented	• Patient refusal • Patient re-arrested with ROSC <10 minutes in duration
Administration started of a 250ml bolus of saline fluids post-ROSC	• Patient refusal • Patient re-arrested with ROSC <10 minutes in duration

- Not required: a systolic blood pressure >90 or presence of radial blood pressure is unobtainable, evidence of significant heart failure or hypervolaemia.
- All attempts to gain intravenous and intraosseous vascular access are unsuccessful