Epidemiology Report

Report for the period January - December 2016, for the English Ambulance Services
FOREWORD

It is our pleasure to write the foreword to this third report from the Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) collaborative project.

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 (OHCA), 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.

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 OHCA.
2) **Early CPR**: Together with the Resuscitation Council (UK) and British Heart Foundation, NHS Ambulance Services trained nearly 200,000 people as part of the “Restart a Heart” initiative. Great work has also been undertaken by other organisations to promote immediate and effective CPR.
3) **Early defibrillation**: The Department of Health provided an additional £1 million pounds for the second year running, to increase the availability of defibrillators in our communities. The British Heart Foundation is funding work to develop a national database of public access defibrillators, so their location is more widely known, particularly to ambulance services.
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’.

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 OHCA. 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.

Professor Jonathan Benger, National Clinical Director for Urgent Care, NHS England  
Professor Huon Gray, National Clinical Director for Heart Disease, NHS England
MESSAGE FROM THE CHIEF INVESTIGATOR

The Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) registry has now been in existence for four years. In this time we have collected data on nearly 105,000 cases of OHCA where resuscitation was continued or commenced by ambulance service personnel. Data has been received from 10 ambulance services, borne out of the need to ensure all ambulance 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.

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. They were also useful to the Community Resuscitation Group and helped inform the consensus statement "Resuscitation to Recovery". 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. We welcome the new opportunity to facilitate the submission of ambulance quality indicators to NHS England and the expansion of the data set to include interventions which are critical to the chain of survival.

Analysis of data within the registry has been presented at the European Resuscitation Council (ERC) annual congress in Freiburg and Resuscitation Council (UK) annual Scientific Symposium. The first papers have been published in peer-reviewed journals, and research has also supported 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 you collect 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. EuReCa Two is collecting data over three months to further our understanding of the epidemiology and outcomes of OHCA. A summary of on-going collaborative work is included in sections 5.2 and 5.3 of this report.

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 OHCA and inform future practise to improve patient outcome.

Professor Gavin Perkins,
Chief Investigator, Out-of-Hospital Cardiac Arrest Outcomes Project

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ACKNOWLEDGEMENTS

We would like to acknowledge the following individuals in the clinical audit teams for their continued support in uploading data to the OHCAO registry:

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- Clare Bradley  North West
- Emma Cox
- Phillip King  South Central
- Patricia Bucher  South East Coast
- Nancy Loughlin  South Western
- Jenny-Lumley Holmes  West Midlands
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<tr>
<td>AED</td>
<td>Automated External Defibrillator</td>
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<td>ALS</td>
<td>Advanced Life Support</td>
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<tr>
<td>BHF</td>
<td>British Heart Foundation</td>
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<tr>
<td>CPR</td>
<td>Cardiopulmonary Resuscitation</td>
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<td>Cardiovascular Disease</td>
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<tr>
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<td>East of England Ambulance Service</td>
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<tr>
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<td>Emergency Medical Services</td>
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<tr>
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<td>European Registry for Cardiac Arrest</td>
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<tr>
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<td>North East Ambulance Service</td>
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<tr>
<td>ONS</td>
<td>Office for National Statistics</td>
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<tr>
<td>PAD</td>
<td>Public Access Defibrillator</td>
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<tr>
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<td>Pulseless Electrical Activity</td>
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<tr>
<td>pVT</td>
<td>Pulseless Ventricular Tachycardia</td>
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<tr>
<td>RCUK</td>
<td>Resuscitation Council (UK)</td>
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<tr>
<td>ROSC</td>
<td>Return Of Spontaneous Circulation</td>
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<td>South Central Ambulance Service</td>
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<td>South East Coast Ambulance Service</td>
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<td>SWAST</td>
<td>South Western Ambulance Service Trust</td>
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<tr>
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<td>Ventricular Fibrillation</td>
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<td>WMAS</td>
<td>West Midlands Ambulance Service</td>
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1 INTRODUCTION

Since the Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) registry was set up in 2013 the UK Governments have produced out-of-hospital cardiac arrest (OHCA) plans that highlight the need for a UK OHCA registry that gives ambulance services the ability to benchmark themselves against the rest of the UK. The OHCAO registry is working towards the inclusion of Wales and Northern Ireland. Scotland is developing an independent registry that will collaborate with OHCAO.
The OHCAO registry includes OHCA patients of any age where resuscitation is commenced or continued by the Emergency Medical Services (EMS). This is a summary report of the 2016 OHCA data contributed by the English ambulance services to the registry. Data for two services are not included in the analysis because at the time of producing this report they were not submitting data to the OHCAO registry. We present an overview of the results of the epidemiology of cardiac arrest, comparing data from each of the contributing services and benchmarking against national data where possible, and the data completeness for key variables collected (data quality).

Since its conception, the registry has received details of 104,426 OHCAcs, where resuscitation was attempted. A summary of the total number of cases submitted by all Ambulance Services is shown below.

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases</td>
<td>18,813</td>
<td>28,729</td>
<td>28,914</td>
<td>27,970</td>
<td>104,426</td>
</tr>
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</table>

NB: 2013 data complete from April onwards; Totals do not include from one service; 2015 data only includes 9 months data from one service; 2016 data does not include one service

In some figures we excluded data from individual ambulance services from the OHCAO ambulance service average, because the service does not currently collect that data or the data is missing for other reasons (e.g. the proportion of missing cases in the data submitted is too large to reliably report the variable).
2 Key Results for OHCA Registry in 2016

- During 2016 the ambulance services treated 27,970 OHCA cases, compared to 28,914 in 2015*
- 2.2% of OHCA patients were aged <15-years; 33.3% were aged 15-64-years; 64.5% were aged 65-years and over
- About 64% of the OHCA cases treated were male
- The proportion of all cases who received bystander CPR was 55.0% of all cases (range: 28.1% to 65.3%), and 62.3% of non-EMS witnessed cases (range: 28.1% to 70.8%)
- A public access defibrillator was used by a member of the general public in 2.9% of all patients (3.3% of non-EMS witnessed cases)
- EMS arrived within 8-minutes of 999 call for 50.6% of patients (range: 19.7%-68.5%); the median response time was 6.4 minutes (range: 4.6-8.4 mins)
- Ambulance services were successful in restarting 7,366 hearts (ROSC at hospital handover rate of 26.3% of patients treated)
- Ambulance services helped save 2,037 lives from cardiac arrest in 2016 (survival to hospital discharge rate of 7.3%)

* 2015 includes only 9 months data and 2016 has no data from one service
^ Ranges given are for individuals services
3 AMBULANCE SERVICE DATA 2016
3.1 **INCIDENCE AND DEMOGRAPHICS**

The English ambulance service serve a population of over 55 million people (excluding the Isle of Wight which serves around 140,000), with individual ambulance service population ranging from about 2.6 million to nearly 9 million. According to the Office for National Statistics (ONS), approximately 18% of the population is under 15 years of age and a similar proportion are aged 65 years or older. The land area covered by each service ranges from 620 sq. mi. (London) to 20,000 sq. mi. (South Western).

Every year about 60,000 people sustain an OHCA in England and are attended by the EMS. Resuscitation is attempted in less than half of these cases, with non-resuscitation decisions being undertaken according to national guidance.\(^2\)

Internationally, cardiac arrest survival rates vary widely from 0.6% to 25%\(^3\).\(^4\). In England, survival to discharge rates have been reported at 7.9%\(^5\), and a doubling of this reported rate could save 2,000 lives a year.

In the OHCAO registry for the period 1 January 2016 to 31 December 2016, a total of 27,970 OHCAOs were attended and treated by the EMS; this figure is based on data from 9 English Ambulance Services. This is a decrease of about 3.3% on the 2015 figure of 28,914 which was based on data from 10 services.

Data from the Isle of Wight are not included in this report. We are currently working with them to start submitting data in the very near future. Data for one service in 2016 are also not included, but where relevant other year’s data are presented.

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\(^2\) Joint Royal College Ambulance Liaison Committee Recognition of Life Extinct (ROLE). 2006. [https://warwick.ac.uk/fac/med/research/hsri/emergencycare/prehospitalcare/jrcalcalcstakeholderwebsite/guidelines](https://warwick.ac.uk/fac/med/research/hsri/emergencycare/prehospitalcare/jrcalcalcstakeholderwebsite/guidelines)


3.1.1 Number of Resuscitations Attempted

In the period January 1 to December 31, 2016, the 9 services attempted or continued resuscitation on 27,970 cases, compared to 28,914 (10 services) in 2015. The numbers range from 1,686 in service J and 1,781 in service B, to 3,832 in service F and 4,432 in service A. The OHCAO average was 3,108 (median: 3,420). Figure 1 shows the variation between the services and the change in numbers submitted to the registry 2014-2016.

Figure 1: Number of resuscitations attempted cases by each ambulance service between 2014 and 2016
3.1.2 Incidence of Resuscitations Attempted

The variation in incidence of OHCAs, per 100,000 resident population, between the services is shown in Figure 2. The national median is 53.5 which is similar to that in 2015 (53.7). There is a large difference between the services ranging from 28.1 (service J) to 72.0 (service H). Adjusting for the size of the population makes it easier/more accurate to compare incidence across areas serving different size populations.

Figure 2: Comparison of Incidence (/100,000) of OHCAs where resuscitation was attempted, 2014-2016
3.1.3 Patient Demographics

Almost twice as many men as women suffer from cardiovascular disease (CVD) and they are also at greater risk of dying from CVD\textsuperscript{6}. The risk of dying from CVD also significantly increases with age in both sexes.

The age and sex distribution of OHCAO cases for 2016 is shown in Figure 3. In all age groups more men than women have an OHCA. There were 17,567 male and 9,937 female OHCAs reported to the OHCAO registry in 2016, giving a ratio of 1.77:1. In 2015 the ratio was 1.82:1 (N: males=17,626, females=10,237). The number of cases increased exponentially in both sexes after age 0-4 years.

Figure 3 also shows the incidence of OHCA. The incidence among males was on average twice that of females. Approximately 2.9% of OHCAs were aged under 20 years and 64.5% 65 years and over; the respective incidence rates were 5.4/100,000 and 160.2/100,000.

Figure 3: Number (top) and incidence (bottom) of resuscitation attempted cases age group and sex.
Age standardisation allows for direct comparisons of incidences between the different ambulance services when the size and age/sex distributions of the service populations differ. Age standardisation of the incidence, to the European Standard Population\textsuperscript{7}, for OHCAO data gave an overall figure of 43.7/100,000 for males and 20.2/100,000 for females, a ratio of 2.16:1. Table 1 shows the standardised figures for each ambulance service (2015 figures are presented for services D and G).

The figures indicate that the OHCA incidence in services A, B, F, and H among males is higher than areas covered by other services, whereas incidence in service J is lower. Similarly, for females incidence is also higher in these areas. The ratio of male:female incidence is consistently around 2.0, with the exception of service G.

Table 1: Comparison of crude and age/sex standardised OHCA incidence (/100,000) for all ambulance services

<table>
<thead>
<tr>
<th></th>
<th>Crude OHCA incidence</th>
<th>Standardised OHCA incidence</th>
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<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>A</td>
<td>64.6</td>
<td>36.1</td>
</tr>
<tr>
<td>B</td>
<td>85.5</td>
<td>48.8</td>
</tr>
<tr>
<td>C</td>
<td>63.4</td>
<td>37.8</td>
</tr>
<tr>
<td>D</td>
<td>58.9</td>
<td>34.1</td>
</tr>
<tr>
<td>E</td>
<td>64.4</td>
<td>35.1</td>
</tr>
<tr>
<td>F</td>
<td>85.7</td>
<td>45.6</td>
</tr>
<tr>
<td>G</td>
<td>65.9</td>
<td>44.5</td>
</tr>
<tr>
<td>H</td>
<td>85.7</td>
<td>45.6</td>
</tr>
<tr>
<td>I</td>
<td>69.7</td>
<td>35.9</td>
</tr>
<tr>
<td>J</td>
<td>50.9</td>
<td>30.0</td>
</tr>
</tbody>
</table>

3.1.4 Patient Clinical Characteristics

Figure 4 gives information on the initial aetiology of OHCA cases for each service compared to the OHCAO registry average for 2016. Cases are grouped into cardiac causes, which include cases where the cause is “unknown” or “unobtainable” (according to Utstein criteria), and non-cardiac causes. As expected, the significant majority of cases (75.8%) were of cardiac origin, which was lower than the figure for 2015 (79.2%). The proportion of OHCA cases that were of cardiac origin ranged between the services, from 56% to 98%.

The non-cardiac causes were trauma (2.5%), asphyxia (2.2%), drug overdose (1.5%) and submersion (0.3%).

In children under 20 years 58.9% (47.8% to 98.9%) were of cardiac aetiology, whereas in over 65-year-olds it was 78.2% (57.8% to 98.7%).

![Figure 4: Initial aetiology of resuscitation attempted cardiac arrests for 2014-2016](image-url)
3.1.5 Initial Rhythm

Research shows a patient who is found by an ambulance service paramedic in a shockable rhythm (ventricular fibrillation or pulseless ventricular tachycardia (VF/pVT)) is more likely to achieve return of spontaneous circulation (ROSC) and to survive to hospital discharge with a favourable neurological outcome⁸,⁹.

About 19.8% of all OHCA cases were in shockable rhythm (range: 9.0% to 23.6%) (Figure 5), which is no different from that in 2015. It appears that significantly fewer OHCAs cases were in shockable rhythm in service B compared to the other services, who also had significantly more with an unknown rhythm. About 7.2% of OHCAs <20-years had a shockable rhythm, compared to about 18.2% of >65-year-olds.

Approximately half of all OHCA cases were in asystole (52.4%; compared to 48.1% in 2015). The proportion ranged from 46% to 74%. About 20.9% of patients were in pulseless electrical activity and 0.6% in bradycardia. An initial rhythm was not recorded in 6.3% of cases.

Figure 5: Comparison of initial rhythm in OHCAO cases in 2016

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3.1.6 Location of OHCA

OHCA event location plays a critical role in the eventual outcome for the patient. Whether an OHCA happens in the home or elsewhere and the neighbourhood characteristics of where it takes place, such as social deprivation, population density and ethnic make-up, impacts on the patient’s chances of survival. Events occurring in public places, such as the workplace, shops, and sporting/recreational facilities have a better outcome than those occurring in a residential setting. This is because in the former, OHCA events are more likely to be witnessed, more likely to have a prompt 999 call, more likely to have bystander CPR, and more likely to have an AED deployed.

Approximately 51% of OHCA occurred inside the home in 2016 (range: 15.6 to 84.9%), and 8.8% elsewhere (Figure 6). However, we were not able to categorise 40.2% of locations as home or non-home accurately; removing these from the analysis resulted in 85.2% occurring in the home.

The location (home, non-home, unknown) was defined by comparing the postcode of the EMS location of the OHCA and the patient’s home postcode. If postcodes were similar, the location was defined as “Home”, if not they were defined as “Non-home”. If the Utstein location was given, it was used to define location. For patients with incomplete home/event postcode data, the location was defined as “Unknown”. Therefore, even though services were able to provide an address for an OHCA event, if a postcode was not present we could not compare it with the provided patient’s postcode (if that was also present) to confirm if the event occurred at home or not. Future work, involving geocoding the OHCA location to provide a postcode and using the Ordnance Survey’s AddressBase to classify the postcode into a basic land and property unit will enable us to update this analysis. Provision of the Utstein location in addition to a full location address in future by all services will also help us in this analysis in future.

![Figure 6: Comparison of location of cardiac arrest in 2016](image-url)
3.2 Chain of Survival
The next section presents key performance information under the theme of the Chain of Survival. The Chain of Survival was first introduced over 40 years ago\textsuperscript{10}. It describes a sequence of four steps that, when all are in place, optimises the chance of survival (Figure 7).

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 defibrillation is delayed, chances of survival reduces by 10\%\textsuperscript{11}. Early defibrillation can triple a person’s chances of survival;
4. Post-resuscitation care

![Figure 7: Chain of survival](image-url)

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3.2.1 Early Recognition

Early recognition of an OHCA is essential to minimise the time in which the brain is without oxygen. If an OHCA is witnessed by a bystander the likelihood of the patient surviving to hospital handover and to hospital discharge is four times greater than in cases that are not witnessed. If an OHCA is witnessed by EMS personnel, the odds of survival were over seven times greater\textsuperscript{12,13}.

In 2016 about 43\% of OHCA cases were witnessed by a bystander and about a further 13\% witnessed by the EMS (Figure 8). However, about 35\% of cases were not witnessed at all. Corresponding figures for 2015 were 45\%, 13\% and 37\%, respectively. The proportion that were witnessed by EMS personnel ranged from 4.5\% to 19.7\%, and by a bystander from 24.2\% to 53.5\%.

Figure 8: Proportion of OHCA\textsuperscript{s} that were not witnessed, witnessed by Emergency Medical Services (EMS) or by a bystander in 2016


3.2.2 Early CPR

Brain tissue starts to die within 3 to 5 minutes after circulation stops, due to a lack of oxygen. Simply by providing early chest compressions, bystander CPR provides the blood flow needed to buy the time needed for the ambulance to arrive and provide care. Bystanders providing CPR and/or using a publically accessible defibrillator improves survival following OHCA. Early CPR can increase the odds of survival by up to five times\textsuperscript{14,15}.

About 62.3\% (range: 28.1\% to 74.6\%; median: 61.5\%) of OHCAs not witnessed by ambulance clinicians received bystander CPR (Figure 9). In 2015, the corresponding figure was 59.6\% (range: 31.7\% to 68.2\%). Recent analysis of the OHCAO data has also shown that since the registry began, bystander CPR rates have significantly increased, and that there was significant temporal variation\textsuperscript{16}. The 2016 figures are higher than those previously observed in different areas of the UK, which ranged from 19.6\% to 43.2\%\textsuperscript{17,18,19,20}. The majority of services have seen a small increase in bystander CPR rates.

![Figure 9: Bystander CPR rate in non-EMS witnessed cardiac arrests](image)

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\textsuperscript{17} Soo et al. (2001). Geographical distribution of cardiac arrest in Nottinghamshire. Resuscitation, 48, 137-47.

\textsuperscript{18} Ghose et al. (2010). Bystander CPR in south east Scotland increases over 16 years. Resuscitation, 81, 1488-91.


\textsuperscript{20} Moncur et al. (2016). Does the level of socioeconomic deprivation at the location of cardiac arrest in an English region influence the likelihood of receiving bystander-initiated cardiopulmonary resuscitation? Emerg Med J, 33, 105-08.
3.2.3 Public Access Defibrillator Usage

The earlier a shock is delivered to a victim the better their chances of survival, and use of a public access defibrillator (PAD) can improve survival with good neurological outcome of patients in shockable rhythms. A PAD was indicated as being used by a member of the general public in approximately 4.3% of all OHCA cases that were not witnessed by EMS personnel in the OHCAO registry (Figure 10); this analysis does not include data from four services (services B, D, E, J) who could not confirm whether a PAD was used or not. PADs were used significantly more in non-home locations (4.8%) than among OHCAs that occurred in the home (3.7%), which reflects their availability.

Figure 10: Proportion of public access defibrillation (PAD) usage in OHCAO registry (services B, D, E, J excluded)
3.2.4 EMS Response Time

Studies have shown that the chances of survival decrease significantly the longer it takes the EMS to arrive at the location of the OHCA\(^{21}\). Ambulance response times have long been known to be independently associated with defibrillation and survival in OHCAs. The recommended response time is 8-minutes\(^{22}\).

Figure 12 shows the proportion of cases treated by the response time of the EMS. The EMS response time was calculated from the supplied time of the EMS call and time the EMS vehicle stopped. Both are based on the information provided at the time of the 999 call.

Approximately 46.6% of OHCAO cases were reached within the 8-minute national target, and a further 13.4% of cases were witnessed by ambulance clinicians already at the scene when the patient arrested. Approximately 29.8% of cases were reached between 8 and 19-minutes. Similar patterns were observed for individual service data.

After 8-minutes there was an exponential decline in the proportion of cases, however, approximately 2% of cases were still not reached after 19-minutes. The reason for the latter is unknown. These could include cases where cardiac arrest was not recognised at the time of the emergency call leading to an initial lower response category. It is also possible that it includes patients who sustained a cardiac arrest after the initial 999 call was made. It may also be that the 999 call was made by a third party.

![Figure 11: Distribution of arrival time of Emergency Medical Services to OHCA events in 2016](image)


Table 2 compares data for 2016 with 2015. Where resuscitation was commenced or continued by EMS, the median response time was 6.5 minutes, compared to 6.1 minutes in 2015; with variation between the services. We observed a small decrease in the proportion of OHCA cases that were reached in the recommended time, and also witnessed by EMS, with variations between the services.

<table>
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<tr>
<th></th>
<th>Median EMS witnessed</th>
<th>Proportion of OHCAs reached within 0:01 to 8:00</th>
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<tbody>
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<td>A</td>
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<td>J</td>
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<tr>
<td>OHCAO</td>
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</tbody>
</table>

Table 2: Comparison of EMS response times 2015/2016 between services
3.3 OUTCOMES

Neurologically-intact survival from OHCA is regarded as an international benchmark of ambulance service effectiveness. The outcome measures in the OHCAO registry used to monitor the effectiveness are ROSC at hospital handover and survival to hospital discharge. For both ROSC and survival, variation between the services has been previously reported.

3.3.1 ROSC at Hospital Handover

In 2015 and 2016 almost 26.3% (median: 26.8%; 24.8% in 2015) of patients, where resuscitation was commenced or continued by ambulance staff, had achieved ROSC at hospital handover. However, one service was unable to provide ROSC information, and therefore, if we take this out of the analysis the figure increases to 27.7% with median of 26.9% (7,292 of 26,284; 2015 figure was 27.9%, median: 26.2%) (Figure 12). Again there was large variation between the services, with a range of 18.6% to 35.1%. The variation could reflect that some services are more selective on whom they attempt resuscitation.

Figure 12: Rate of ROSC at hospital handover, 2014-2016

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3.3.2 Survival to Hospital Discharge

In 2016, 2,037 of 26,284 (7.7%) OHCA patients survived to hospital discharge, similar to 7.8% in 2015 (Figure 13). As for ROSC, a significant proportion of survival data from two services was ‘missing’ or ‘unknown’, and these are not included in the national figure. There is some variation in survival rates between the services, the range being 5.6% to 9.2%.

Figure 14 shows the cumulative number of lives saved (survival to hospital discharge) between 2014 and 2016; a total of 6,150 lives have been saved.

Figure 13: Survival to hospital discharge rate in all EMS-treated cases, 2014-2016
Figure 14: Cumulative number of lives saved 2014 to 2016
In 2016, following all those patients that achieved ROSC at hospital handover (n=7,292), 1,881 cases or 25.8% survived to hospital discharge (Figure 15). This compares to the figure for 2015 of 26.1% (1,816 of 6,959 cases). The range between services was 18.1% to 30.6%.

Figure 15: Survival to hospital discharge rate in cases that achieved ROSC at hospital handover, 2014-2016
Previous studies have shown that survival rates are higher the earlier defibrillation is delivered, and the critical role bystanders and first responders play in delivering early defibrillation\(^2\). Figure 16 shows that if EMS arrive within the first two minutes, survival to discharge is the same irrespective of whether the patient receives any pre-EMS intervention or not. However, after two minutes the chances of survival begin to decrease, the decline is slower the more pre-EMS interventions occur, such that if a patient’s OHCA is witnessed by a bystander, they receive bystander CPR, are defibrillated by a bystander and the EMS arrival time is up to 16-minutes, then the odds of survival are three-times those of patients who receive no pre-EMS intervention.

The national picture is presented because of the incompleteness of PAD usage data across the ambulance services.

![Graph showing survival rates vs. EMS arrival time](image)

**Figure 16:** Trend of survival to hospital discharge in all non-EMS witnessed cases and Utstein groups with arrival time of EMS personnel in OHCAO registry in 2016

4 DATA COMPLETENESS OF OHCAO PRIORITY VARIABLES

Concentrating on the key variables that follow the chain of survival we can see where variation in data quality presents, allowing the OHCAO team to develop individual improvement plans with each site. During the data import process, the key variables are assessed as ‘valid’, ‘out-of-range’ or ‘missing’. A value is ‘missing’ if nothing has been entered into a field. A ‘valid’ and ‘out-of-range’ value is variable specific and depends on the type of variable, all possible entries being agreed on a service-by-service basis.

The OHCAO registry have identified seven key priority variable that each service is requested to provide high quality data for. These are:

- Who witnessed the OHCA occurrence
- Whether a bystander commenced CPR before the arrival of EMS
- Whether a PAD was used by a member of public before the arrival of EMS
- Whether a ROSC was achieved at any time during resuscitation
- Whether there was a ROSC at hospital handover
- Whether the patient survived to hospital discharge

Figure 1 summarises the proportion of each of these key core variables that contains a ‘valid’ entry, i.e. no missing or out-of-range data. The figure shows that for 2016 the data quality for some services was very good, above the national average for all the key variables. However, there is still room for improvement in other services.
Figure 17: Data completeness of key cardiac arrest variables
5 CURRENT RESEARCH, COLLABORATIONS AND DATA SHARING

Apart from providing the contributing ambulance services with annual epidemiological reports, the OHCAO projects team conducts and collaborates in research projects with colleagues from the ambulance service, the funders, the British Heart Foundation (BHF) and the Resuscitation Council (UK). We also share anonymised data with other researchers conducting high quality emergency care research, according to strict guidelines. Summaries of projects that have been progressing or set-up in 2016 are given below.

5.1 OHCAO TEAM RESEARCH PROJECTS

5.1.1 Temporal Trends in Bystander CPR Rates
This project investigates the trends in bystander CPR rates in England\textsuperscript{25}. The analysis shows significant temporal variability in OHCA incidence and bystander CPR rate by hour of the day, day of the week, and season. There is an increasing trend between 2013 and 2015 in the number of cardiac arrest cases receiving bystander CPR, which is encouraging and could be associated with national and local training initiatives. The OHCAO team collaborated with EMAS, SECAMB, SWAST and LAS on this project.

5.1.2 Neighbourhood Characteristics of High Risk Areas for OHCA
The aim of this research was to identify high risk communities in England with a high OHCA incidence and low bystander CPR rate. The results could inform the development of targeted training strategies\textsuperscript{26}. The study showed that the most deprived areas of England are at highest risk. The OHCAO team collaborated with EMAS, SECAS, SWAS and LAS on this project.

5.1.3 Attitudes to CPR and Defibrillator use Survey
An online survey was undertaken to determine the proportion of UK adults who were trained in CPR and/or PAD use\textsuperscript{27}. About 60\% said they had trained in CPR. People who had received training said they were more willing to act in the event of a cardiac arrest, both in performing CPR and also getting and using a PAD. The OHCAO team collaborated with BHF, RCUK, EMAS, SECAS and WMAS on this project.

5.1.4 Data Linkage with ONS
The aim of the project was to establish the feasibility of linking OHCAO data to the National Health Service (NHS) patient demographic data and Office for National Statistics (ONS) mortality data held on the NHS Personal Demographic Service (PDS) database\textsuperscript{28}. The project demonstrated linkage was

\textsuperscript{27} Hawkes et al. (2017). Attitudes to cardiopulmonary resuscitation and defibrillator use: a survey of UK adults in 2017. Submitted for publication.
feasible, improving demographic and mortality data quality and allowing analysis of 30-day survival status. The OHCAO team worked with collaborators from EMAS, SWAS and WMAS on this project.

5.1.5 Risk Prediction (Case-Mix) Models for OHCA
An aim of the OHCAO project is to explore the sources of variation in survival after OHCA. In this study we developed and validated risk prediction models for Return of Spontaneous Circulation (ROSC) at hospital handover and survival to hospital discharge using pre-EMS (Emergency Medical Services) intervention characteristics of OHCA. The developed models showed moderate performance and we will further improve them using new data and EMS intervention related variables. The OHCAO team collaborated with EMAS, SWAS and LAS on this project.

5.1.6 OHCA in Schools
The aim of this work is to investigate the incidence and location of OHCAs in relation to schools in the West Midlands. This project is being conducted by Dr Madeleine Benson with the assistance of the OHCAO team.

5.1.7 Pre-Hospital Adrenaline Administration for OHCA
The aim of this study is to use data from the OHCAO registry and a secondary analysis of data from the PARAMEDIC RCT to describe the epidemiology and outcomes for pre-hospital administration of adrenaline for OHCA patients in England and Wales between 2010 and 2015.

5.1.8 Sex Inequality in OHCA Resuscitation Attempts
This project aims to explore the difference in the number of resuscitation attempts observed between men and women suffering from OHCA, and whether they can be explained by differences in age/sex or disease distribution or establish that other factors may be involved. This analysis is being conducted by Dr James Mapstone from Public Health England (PHE).

5.2 Research Collaborations

5.2.1 EuReCa Two
This project is a collaboration with other European OHCA registries. It is collecting OHCA epidemiology, treatment and outcome data over 3 months (October to December 2017).

5.3 Data Sharing

5.3.1 Prehospital Critical Care for OHCA
Dr Johannes von Vopelius-Feldt from the University Hospitals Bristol NHS Foundation Trust, together with the Critical Care Teams in SWAS, NEAS, WMAS and SECAS, is using data from the OHCAO database to understand the effect of Critical Care Teams compared to advanced life support (ALS) on survival from OHCA.

5.3.2 Incidence, Outcomes and Predictors of OHCA at International Airports
The primary aim of this study is to determine the incidence and outcome from OHCA that occurred at international airports where resuscitation was attempted between 2013 and 2015 worldwide. The chief investigator is Siobhan Masterson (NUI Galway). A paper reporting the results of this study has been recently accepted for publication in Resuscitation (https://doi.org/10.1016/j.resuscitation.2018.03.024).

5.3.3 Paramedic 2 – The Adrenaline Trial
Data has been requested by the PARAMEDIC 2 team to supplement descriptive data on the trial’s population. The collaboration between OHCAO and Paramedic 2 will ensure efficiency in trial data collection as research paramedics will only collect data for cases not yet available in the OHCAO registry.

5.3.4 Improving the Use of Public Access Defibrillation in Volunteer Response to OHCA
This project is being carried out by Dr Chris Smith (University of Warwick), an NIHR Research Fellow undertaking a PhD. The three research questions he wishes to answer are:

- What is the effect of the GoodSAM volunteer first responder system on survival from OHCA in London?
- What is the potential for AED use in London for OHCA victims?
- What epidemiological factors predict AED use by GoodSAM responders?

5.3.5 Pre-Hospital Factors Affecting OHCA Post-Care in Kids (PRE-PACK)
This project is led by Dr Barney Scholefield (University of Birmingham/Birmingham Children’s Hospital). The aim of the study is to describe the epidemiology of children experiencing OHCA in England and Wales and to understand the factors affecting survival and outcome.
# 6 RECOMMENDATIONS

We endorse the key recommendations from the Resuscitation to Recovery national framework for OHCA in England\(^\text{30}\).

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<th>Recommendation</th>
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<td>The internationally accepted ‘Chain of Survival’ should be more widely embedded in public consciousness and into clinical pathways and protocols.</td>
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<td>Greater awareness amongst the general public including young people of school age, on how to recognise and manage cardiac arrest through the use of CPR and PADs.</td>
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<td>Significant improvement of the systems and process used by ambulance services to identify and map the location of defibrillators in public and commercial locations.</td>
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<td>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.</td>
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<td>Clinical networks should work with the emergency services and voluntary sector to promote awareness of, and training in, CPR and the use of PADs.</td>
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<td>The current Resuscitation Council (UK) guidelines should be followed.</td>
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<td>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).</td>
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<td>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.</td>
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<td>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.</td>
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<td>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.</td>
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Data quality and 30-day survival for out-of-hospital cardiac arrest in the UK out-of-hospital cardiac arrest registry: a data linkage study

Sangaethana Rajagopala, Scott J Booth, Terry P Brown, Chen Ji, Claire Hawke, A. Nincock Sitwardena, Kim Kirby, Sarah Black, Robert Spaight, Imogen Gunson, Samantha J Bruce-McDonnell, Gavin D Perkins, on behalf of OHCAO collaborators

ABSTRACT
Objectives The Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) project aims to understand the epidemiology and outcomes of out-of-hospital cardiac arrest (OHCA) across the UK. This data linkage study is a subproject of OHCAO. The aim was to establish the feasibility of linking OHCA data to National Health Service (NHS) patient demographic data set (Office for National Statistics (ONS) data of death data held on the NHS Personal Demographic Service (PDS) database to improve OHCA patient demographic data quality and enable analysis of 30-day survival from OHCA. Design and setting Data were collected from January 2014 to 31 December 2014 as part of a prospective, observational study of OHCA attended by 10 English NHS Ambulance Services. 76 750 OHCA cases had resuscitation attempted by Emergency Medical Services and were included in the study. Data linkage was carried out using a data linkage service provided by NHS Digital, the national provider of health-related data. To assess data linkage feasibility a random sample of 312 cases was selected. The sample was securely transferred to NHS Digital to be matched using NHIS patient demographic data to return previously missing demographic data and provide ONS data of death data.

Results A total of 23 103 (80.5%) OHCA cases were matched to patients in the NHS PDS database. Using the linkage process, missing demographic data were retrieved for 1628 (72.7%) of 2296 OHCA cases that had previously incomplete demographic data. Returned ONS data of death data allowed analysis of 36-day survival status. The results showed a 36-day survival rate of 9.9%, reducing overall survival status from 41.5% to 0.5%.

Conclusions In this sample, data linkage between the OHCAO registry and NHS PDS database was shown to be feasible, improving demographic data quality and allowing analysis of 36-day survival status.

INTRODUCTION
Every year in the UK there are around 60 000 out-of-hospital cardiac arrests (OHCA) attended by Emergency Medical Services (EMS) of which approximately 25 000 have resuscitation attempted. This group suffers significant mortality and morbidity and improving outcomes from OHCA remains a worldwide research priority.

Collecting high-quality data is essential as this forms the basis of decisions that ultimately impact on changes in care and healthcare resource allocation. Since 2011, survival to hospital discharge rates for OHCA have been reported as part of the National Health Service (NHS) England Ambulance Quality Indicator (AQI), with significant variation reported ranging from 2.2% to 12.9%. Regional variation in survival rates has also been observed worldwide. Lafort et al highlighted that an important source of variation in reporting outcomes can be traced to the quality of data that results are based on. Collecting survival to discharge data in England is a challenging process for
Appendix 2: CPR Survey Paper

Disclaimer: The manuscript and its contents are confidential, intended for journal review purposes only, and not to be further disclosed.

URL: http://jaha-submit.aha-journals.org

Title: Attitudes to cardiopulmonary resuscitation and defibrillator use: a survey of UK adults in 2017

Manuscript number: JAHA/2017/008267

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Julia Williams, South East Coast Ambulance Service NHS Foundation Trust
Nigel Rees, Welsh Ambulance Service NHS Trust
Chen Ji, University of Warwick
**APPENDIX 3: Bystander CPR Paper**

*European Heart Journal - Quality of Care and Clinical Outcomes*

**Characteristics of Neighbourhoods with High Incidence of Out-of-Hospital Cardiac Arrest and Low Bystander Cardiopulmonary Resuscitation Rates in England**

---Manuscript Draft---

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Gavin Perkins |
APPENDIX 4: ERC CONFERENCE ABSTRACTS

AS5090
Improving data quality in a UK out-of-hospital cardiac arrest registry through data linkage between the Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) project and NHS digital
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4 South Western Ambulance Service NHS Foundation Trust, Egham, UK

Purpose: The Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) project is a national research database, which aims to understand the epidemiology and outcomes of out-of-hospital cardiac arrests (OHCA) across the UK. This study is a sub-project of OHCAO and aimed to establish the feasibility of linking OHCAO data to National Health Service (NHS) patient demographic data and Office for National Statistics (ONS) mortality data held on the NHS Personal Demographics Service (PDS) database, through the NHS Digital list cleaning service, to improve data quality and establish accurate 30-day survival from OHCA.

Materials and methods: Data collected from 1 January 2014 to 31 December 2014 were collected as part of a prospective, observational study of OHCA attended by ten English NHS Ambulance Services. 28,729 OHCA cases had resuscitation attempted by Emergency Medical Services and a randomly selected sample of 5,102 cases were randomly transferred to the NHS Digital list cleaning service to be matched using ONS patient demographic data to return previously missing data and provide ONS date of death data.

Results: A total of 80.5% of OHCA cases were matched to the NHS PDS database, with the patient’s NHS number being the best data point for a successful match. Using the linkage process, missing demographic data was retrieved for 72.7% of cases with incomplete data. Confirmation of 30-day survival improved by 37.6% with a reduction in unknown 30-day survival status from 44.1% to 8.5%.

Conclusions: This study shows the feasibility of linking data from the UK OHCAO project to NHS patient demographic and ONS date of death data, through the NHS Digital list cleaning service. Data linkage was shown to successfully improve the quality of OHCAO demographic data and establish 30-day survival status, demonstrating the potential to utilise data linkage methods to follow OHCA patients longitudinally.

http://dx.doi.org/10.1016/j.resuscitation.2017.08.096

AS5091
The feasibility of cardiopulmonary resuscitation attempts in nursing homes and primary care wards
Hedi Kangasniemi1,4, Pirttita Sitala1, Jarmo Heikkilä2,3, Timo Kankaanranta4,5, Ilkka Vikkula6, Eija Juntunen6, Arvi Viikinkallio7,8, Sanna Heppe8
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Purpose of the study: Discharging emergency medical service (EMS) to treat nursing home residents or determining patients in local hospitals is a growing phenomenon in Finland. We studied the epidemiology and the outcome after cardiac arrest (CA) in these situations [1,2].

Materials and methods: We conducted an Umbrella-style observational study between 1 June 2013 and 31 May 2014 in the county of Pohjanmaa, Finland. We included CA patients in nursing homes and local hospitals if EMS participated in the treatment. Primary outcome was survival to university hospital admission. Secondary outcomes were survival to hospital discharge and 30-day survival.

Results: A total of 355 consecutive CA patients were attended during the study period and 65 (18%) met the inclusion criteria. An EMS physician was present in 12 (18%) cases of cases. The most common primary rhythm was asystole (n = 26, 40%). Eight (12%) patients survived to university hospital admission and half of them (6%) survived to hospital discharge. Three of them had a neurologically favourable outcome: only two (3%) patients were alive 30 days after the event—both were less than 70 years old and presented with venricular fibrillation as the initial rhythm. Survival to hospital was more likely if EMS physician attended the case (26% vs. 6%, p = 0.006).

Conclusions: Resuscitation in nursing homes was found futile, as survival was low. Yet, some patients in local hospitals had a favourable outcome, and the EMS system seems to be able to recognize them and focus resources to provide the best possible treatment for these few patients.

References

http://dx.doi.org/10.1016/j.resuscitation.2017.08.097
Outcomes comparison between a community-wide bystander defibrillation program and dispatcher-assisted CPR in out-of-hospital cardiac arrest at public locations

Chih-Yien Wei 1,2,3, Chang-Liang Shih 1,2,3, Shih-Chieh Huang 1,2, Shu-An Ho 1,2, Yueh-Ning Liu 1,2, Bin-Chou Lee 1,2, Tseng-Liun Wang 1,2, Yen-Cheng Wang 1,2, Hsiou-Yi Hsiao 1,2, Yu-Wen Chen 1,2, Chao-Wei Hsu 1,2, Wei-Shu Lin 1,2, Chih-Hao Lai 1,2, Mei-Ren Yang 1,2, Matthew Hsu-Ming Ma 1,2, Patrick Chau-An Ko 1

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2 Ministry of Health, Taipai, Taiwan
3 Taipai City Fire Department, Taipai, Taiwan
4 Department of Emergency Medicine, Chang Gung Memorial Hospital, Taoyuan, Taiwan

Purpose: To compare the outcomes between a community-wide bystander defibrillation program and a dispatcher-assisted cardiopulmonary resuscitation (CPR) program in patients after out-of-hospital cardiac arrest at public sites.

Materials and methods: A prospective 2-year community-wide observational database collected from a OHCA e-Registry in a metropolitan area was studied. After a city-wide bystander defibrillation rescue program had been launched that strategically providing public access AEDs (automated external defibrillators) in designated locations that were also e-registered, and a DA-CPR program had been run. The survival outcomes of OHCA at public locations between the two program interventions were compared. Outcomes included 2-3 h of return of spontaneous circulation (ROSC) at hospital, survival to hospital discharge, and good CPR (Cerebral Performance Category Scale 1 or 2). All patients pre-hospital characteristics and outcome relations were evaluated and adjusted by regression analysis.

Results: The density of public AEDs distribution increased from 3.06 to 6.54 per square kilometers in the studied 2 years. Among a total of 6,350 OHCA, 627 patients occurred at public locations, including 23 patients (male 82%, witnessed arrest for 76%) received bystander aid by public AEDs plus CPR rescue and 241 patients (male for 64%, witnessed arrest for 63%) receiving dispatcher-assisted CPR. For these 28 patients, 53.6% (15/28) achieved pre-hospital ROSC at scene or during transport, 71.4% (20/28) achieved sustained ROSC after resuscitation at hospital, 57.1% (16/28) achieved survival-to-discharge and 37.1% (10/28) achieved survival-to-discharge and neurologically intact. All those 16 (100%, 15/16) survival-to-discharge patients achieved excellent neurological outcome of CPC 1 (CPC Scale 1). Those outcomes were significantly better (71.4 vs 43.2%, OR: 3.2 [95%CI: 1.4-7.0]) for sustained ROSC, (71.7 vs 23.8, OR: 3.8 [95%CI: 1.8-7.8]) for survival of discharge, and (57.1 vs 16.3, OR: 6.6 [95%CI: 2.9-14.3]) for good CPC and (100 vs 62.5% for good CPC among survival-to-discharge) compared to those 241 patients by dispatcher-assisted CPR rescue. In 28 patients by bystander defibrillation rescue only one was without pre-hospital ROSC, still achieved survival-to-discharge and good CPC.

Conclusions: For OHCA patients at public locations, we found that a community-wide bystander defibrillation program was associated with excellent neurological outcome of CPC 1 and survival to hospital discharge that were significantly higher than those associated with dispatcher-assisted CPR program.

http://dx.doi.org/10.1016/j.resuscitation.2017.08.101
are known to be associated with survival. Preexisting disorders that were not included in the analyses of this study may be involved in seasonal variations in survival of out-of-hospital cardiac arrest (OHCA).

https://doi.org/10.1016/j.resuscitation.2017.08.167

APD7

Improving the results of resuscitation through structural alterations

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Purpose of the study: Intensive efforts have been made in the last few years to improve the results of resuscitation in the region of East Tyrol, Austria. The changes will be highlighted by a comparison of two 7-year periods (2004–2009 versus 2010–2015).

Materials and methods: Resuscitation projects were intensified, and new intervention strategies were introduced for emergency care providers in their 7th year of school, and became obligatory for all schools in East Tyrol. The emergency medical service was expanded from 3 to 4 teams, which now cover the entire district. The introduction of a QM system in accordance with ISO 2001 and district-wide simulation training for emergency doctors were also introduced in the last few years. From 2011 onward, all patients who have undergone successful initial resuscitation are cooled to 33 degrees for 24h. Thirty-five public semi-automated defibrillators are available in the district, and 28 so-called first responders with defibrillators at home can be deployed immediately.

Results: Results are summarized in Table 1. The number of survivors increased from 7.4% to 12.9%. The number of patients who survived without relevant neurological damage could be increased markedly from 4.4% to 7.2%. The mean age of those who died in the hospital was as well as those who survived without damage decreased from one time period to the next (74 versus 66 years, and 74 versus 66 years, respectively). The three oldest patients who survived without damage were 86, 86, and 86 years old.

Table 1

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Resuscitated patients</td>
<td>130</td>
<td>130</td>
</tr>
<tr>
<td>Successful initial resuscitations</td>
<td>63 (47%)</td>
<td>63 (48%)</td>
</tr>
<tr>
<td>Died in the hospital</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Total survivors</td>
<td>107(82%)</td>
<td>107(82%)</td>
</tr>
<tr>
<td>Survived without damage*</td>
<td>6 (4.6%)</td>
<td>13 (9.8%)</td>
</tr>
<tr>
<td>Survival time (minutes)</td>
<td>1.6</td>
<td>3.6</td>
</tr>
</tbody>
</table>

* Glasgow outcome score 2,4.

Conclusion: The results are indicative of more efficient resuscitation and better post-emergency care after successful initial resuscitation.

The possible causes of these phenomena may be:

- Comprehensive training at compulsory schools, intensified training for teachers, and smooth cooperation between the Red Cross, the Red Cross Youth, and schools.
- Increased number of layperson resuscitations, first responders, and public semi-automated defibrillators.
- Intensified training for emergency physicians and better structuring of the resuscitation teams.
- Consistent coding of those who had undergone successful initial resuscitation.

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APD8

Temporal changes in bystander cardiopulmonary resuscitation rates in England

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Purpose of the study: Bystander CPR (CPR) are more than doubles the chances of survival from out-of-hospital cardiac arrest (OHCA). In UK, CPR rates are variable and lower than those of other countries. This study investigates the trends in CPR rates in England.

Materials and methods: The OHCAO registry collected details of 75,426 OHCA from English ambulance services between 2013 and 2015, where resuscitation was commenced or continued by EMS personnel in accordance with the local guidelines. We assessed temporal variation and time trends in incidence for OHCA and CPR.

Results: The odds of having an OHCA varied significantly by time of day and day of week, and there were monthly and seasonal variations.

CPR rates in bystander-witnessed events increased during the evening to about 10% and decreased to about 5% in the early hours. The odds of receiving CPR were significantly higher during the day compared to the night (OR: 1.2; 95%CI: 1.09–1.34), and during the summer compared to winter (OR: 1.2; 95%CI: 1.08–1.34), and during the autumn/winter compared to spring/summer (OR: 1.2; 95%CI: 1.08–1.34).

Conclusions: We have shown that the time in England significantly affects temporal variability in OHCA and CPR incidence. The trend of increasing CPR is encouraging and likely to be associated with national and local initiatives to improve CPR rates. However, there is still room for improvement in specific areas of the country, and a need for continued awareness programmes.

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School teachers profit by observing school children's basic life support training

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As part of a project, 3rd grade primary school children were trained in CPR and using an AED. We investigated the effect of CPR trainings of school classes had on the teacher, who was observing the training. The aim was to evaluate previous knowledge and its improvement, additionally changes in self-confidence of teachers to provide bystander CPR after observing the training were evaluated.

Methods: During the CPR training for pupils teachers were present. We asked primary school teachers to participate in a written survey regarding to the training of the pupils. The participants had to complete two surveys, one before and another after the training. In total 107 participants in our survey.

Results: 94% of 182 teachers felt confident to be able to teach CPR skills to children after they had observed the CPR training for kids. 53% felt fit to train CPR to children without any further actions, 41% with additional training. Furthermore there was a significant increase of confidence providing bystander CPR after attending the training as an observer (p<0.001). 53% completed their first aid training more than 5 years ago. There were partly significant improvements of knowledge in comparison with previous knowledge in CPR skills. 95% out of 181 teachers said, that CPR training for children does make sense.

Conclusions: As a result of watching pupils get taught in CPR, there was a significant improvement of teachers' knowledge about CPR. Furthermore there was an increase of confidence performing bystander CPR to necessary. After observing the training 95% classified CPR training for pupils as meaningful, 64% of the teachers were willing to train children in CPR.
APPENDIX 4: RESUSCITATION COUNCIL (UK) SYMPOSIUM POSTER

Risk Prediction Models for Out-of-Hospital Cardiac Arrest Outcomes in England

Introduction
- Out-of-Hospital Cardiac Arrest Outcomes (OHCA) project is a national research database.
- Recent studies in UK hospitals have highlighted the need for improved prediction models.

Data and Methods
- OHCA cases included all adults aged 16 or older. Data was collected between 2015 and 2016.
- The database included information on demographics, injury type, and area.
- Outcomes included survival to hospital discharge, survival to hospital discharge with good neurological function.

Results
- Out-of-Hospital Cardiac Arrest Outcomes (OHCA) project is a national research database.
- Recent studies in UK hospitals have highlighted the need for improved prediction models.

Discussion
- The survival model had high overall predictive accuracy and discrimination.
- The ROC model was more accurate and did not achieve good discrimination.
- Calibration of both models was poor. The calibration of both models was poor.
- The ROC model was more accurate and did not achieve good discrimination.

Conclusions
- Our risk prediction models have moderate performance for survival to hospital discharge. Further study is needed to improve models using new data and OHCA intervention variables.

References
Clinical paper

Epidemiology and outcomes from out-of-hospital cardiac arrests in England

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ABSTRACT

Introduction: This study reports the epidemiology and outcomes from out-of-hospital cardiac arrest (OHCA) in England during 2014.

Methods: Retrospective observational study from the national OHCA registry. The incidence, demographic and outcomes of patients who were treated for an OHCA between 1 January 2014 and 31 December 2014 in 10 English ambulance service (EMS) regions, serving 23 million people, were reported in accordance with Utstein recommendations.

Results: 28,729 OHCA cases of EMS treated cardiac arrests were reported (53 per 100,000 population in 10 years). The mean age was 56 years (+15 years) and 41% were female. Most (33%) occurred in a place of residence. 53% were witnessed by either the EMS or a bystander. In non-EMS witnessed cases, 55% received bystander CPR whilst public access defibrillation was used rarely (2%). Cardiac arrest was the leading cause of cardiac arrest (60%). The initial rhythm was asystole in 42% of all cases and was shockable (VF or VT) in 20%. Return of spontaneous circulation at hospital transfer was evident in 25.8% (n = 3,900) and survival to hospital discharge was 7.5%.

Conclusions: Cardiac arrest is an important cause of death in England. With less than one in two patients surviving there is scope to improve outcomes. Survival rates were highest amongst those who received bystander CPR and public access defibrillation.

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* A Spanish translated version of the abstract of this article appears in Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2016.10.030.
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APPENDIX 6: EUReCa ONE paper

Clinical paper

EUReCa ONE—27 Nations, ONE Europe, ONE Registry
A prospective one month analysis of out-of-hospital cardiac arrest outcomes in 27 countries in Europe

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* A Spanish translated version of the summary of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2014.06.004.

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