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Out of Hospital Cardiac Arrest Outcomes (OHCAO) Registry

Review of the first 5 years and forward strategy

OHCAO

Professor Sir Nilesh Samani
Medical Director, BHF

It is imperative for patients that clinical practice is driven by evidence. The current survival rates from out-of-hospital cardiac arrest presents the UK with a significant challenge and it essential that we monitor the impact of any changes to clinical practice.

Hence the British Heart Foundation are pleased to have co-funded this audit which allows Ambulance Services to invest in change in an informed way.

Dr Jasmeet Soar
Resuscitation Council (UK)

Having been involved since the project's inception and more recently as Steering Group Chair, I am hugely impressed by the project team's vision and productivity. OHCAO is a strong collaboration that already has a national and international profile in resuscitation. The registry and reporting structures already in place have formed solid foundations that will help the project grow and continue to have a major influence on resuscitation science, practice and policies. This work will help save more lives from cardiac arrest in the UK and globally.

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British Heart Foundation

Resuscitation Council (UK)

Funding for the OHCAO registry is generously provided by the British Heart Foundation and the Resuscitation Council (UK). The OHCAO registry is sponsored by the University of Warwick and supported by the National Association of Ambulance Medical Directors. We thank our funders, sponsor and ambulance service partners for their long lasting support.

FOREWORDS

Anthony Marsh

Chairman of the Association of Ambulance Chief Executives (AACE)

It is a pleasure to write this foreword celebrating the first 5 years of the OHCAO Registry. AACE are wholeheartedly committed to improving outcomes from out-of-hospital cardiac arrest and the data collected by the OHCAO registry has been central to this work. I look forward to the continued success of the OHCAO registry and thank my colleagues for their wholehearted support of this importance piece of work.

Professor Gavin Perkins

Chief Investigator, Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) Registry

The Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) registry has now been in existence for five years and we have collected data on nearly 105,000 cases. Our approach is driven by the chain of survival[1]. The chain identifies actions that make a difference to survival at different stages of out -of-hospital cardiac arrest (early access, early CPR, early defibrillation, early advanced care).

Establishing this successful registry is testament to a strong collaboration between the ambulance services' medical directors, clinical audit staff and ambulance crews and the ambulance service staff and academics who serve as members of the project team and oversight committee. Without the support, commitment and advice of our funders, the British Heart Foundation and the Resuscitation Council (UK), this venture would not have been possible.

In this document we showcase the work of the registry and how data has been used to inform quality improvement work, national and international epidemiological and research projects and in campaigns to increase the uptake of resuscitation training amongst the general public. I am delighted that the registry's value has been acknowledged in the home nations' governments' cardiac arrest strategy documents and that the registry has recently been invited to work with the ambulance services and NHS England to provide data for the national ambulance service quality indicators.

As we look forward to the next 5 years of the registry, we continue in our ambition to deliver and support work that makes a difference to people who have a cardiac arrest.

The chain of survival[1]


West Midlands Ambulance Service NHS
EMERGENCY AMBULANCE
Not all 999 calls
need an ambulance
but you'll still get our help
G-HWAA

Incidence of Out-of-Hospital Cardiac Arrest (OHCA) in the UK

Reducing premature death is a key priority for the NHS. Currently in the UK approximately 60,000 people sustain an out-of-hospital cardiac arrest (OHCA) annually[2,3] with around 28,000 people receiving a resuscitation attempt by UK ambulance services. This means that resuscitation is attempted in less than 50% of cases. Resuscitation is not attempted for reasons such as advanced directives declining cardiopulmonary resuscitation (CPR), or evidence of irreversible death.

The first national audits of OHCA in the UK in 2004-2006 and 2011 showed an unexplained inter-service variation in the proportion of resuscitation attempts, the rates of return of spontaneous circulation (ROSC) at hospital handover, and survival to hospital discharge. Current figures for ROSC at hospital handover range between 13-27%, and for patient survival to hospital discharge range from 2.2 to 12% in England[4].

The discovery of this variation sparked a desire to get a better understanding of resuscitation processes and OHCA outcomes across the UK.

Dr Julian Mark

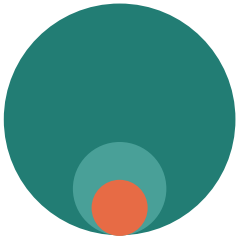
National Ambulance Services Medical Directors Group:

" The National Ambulance Services Medical Directors group (NASMeD) is delighted with the progress the registry has made over the last 5 years. It provides a solid foundation for collaborative work going forwards, to drive up standards of pre-hospital resuscitation and save more lives following cardiac arrest."

Resuscitation attempts

- Resuscitation not attempted (60%)
- Resuscitation attempted (40%)

Resuscitation attempted and survival



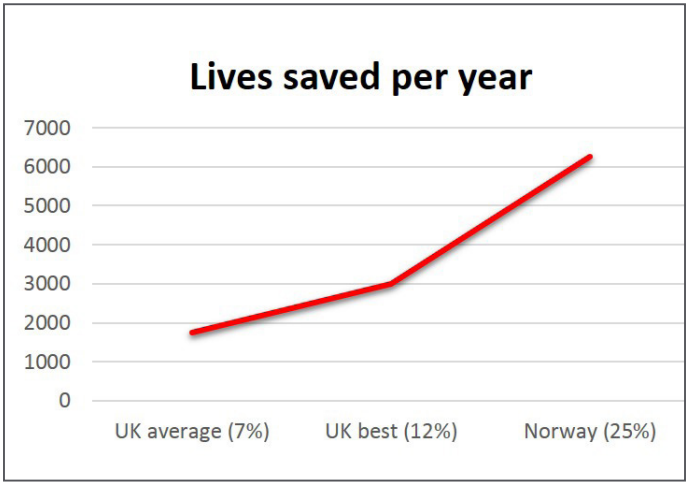
- Resuscitation attempted
- ROSC at hospital handover
- Survival to hospital discharge

Incidence of OHCA in the UK compared to other countries

In international comparisons with other developed countries, the UK findings for ROSC at hospital handover and for patient survival showed, even for the best recorded values, potential for improvement: The best OHCA survival rates worldwide are recorded in Norway (25%)[5], Seattle (21%)[6] and the Netherlands (21%)[7]. If survival rates in England were increased from overall average (around 7%) to that of the national best (12%), it is estimated that an additional 1250 lives would be saved each year. Improvement of survival to levels seen in the best performing health systems (e.g. 25% as is seen Norway) could save an estimated additional 4500 lives annually.

Internationally the necessity to collect OHCA data is also recognised. The US and European Resuscitation Academies and more recently the Global Resuscitation Alliance promote the mantra *"measure, improve, measure, improve …,"* reflecting the importance of continuous measurement to drive quality improvement.

In order to identify the key characteristics that contribute to better ambulance service outcomes, we need to understand the differences between ambulance services. To understand those differences, we need reliable and reproducible systems for collecting data on OHCA in the UK. These systems are developed by the OHCAO registry.



Development of the OHCAO Registry

As a consequence of both the large variability between ambulance service performance within the UK, and the potential to improve relative to internationally achieved outcomes, the Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) registry was established by Prof Gavin Perkins at the University of Warwick.

The OHCAO registry is a collaboration between the National Association of Ambulance Medical Directors (NASMeD), on behalf of the Association of Ambulance Chief Executives (AACE), the University of Warwick, British Heart Foundation (BHF) and Resuscitation Council (UK).

Funding is provided by the BHF and the Resuscitation Council (UK). The registry is sponsored by the University of Warwick and supported by the National Institute for Health Research (NIHR).

The project has been reviewed and approved by the Health Research Authority (13/SC/0361) and National Information Governance Board (ECC 8-04 (C)/2013) and data sharing agreements established with partner ambulance services.

Professor Gavin Perkins

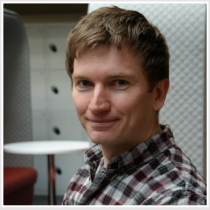
Dr Claire Hawkes

Dr Terry Brown

Dr Sukhi Dosanjh

Samantha Brace-McDonnell

Dr Chen Ji



Adrian Willis

Scott Booth

How does the OHCAO Registry work?

The OHCAO registry is designed as a prospective observational study. We collect annual OHCA data from UK NHS ambulance services. The first comprehensive data coverage from English ambulance services was achieved for the calendar year of 2014.

We collect data for adults and children who:

- have an OHCA
- are attended by an NHS ambulance service organised response
- and CPR is attempted.

The data we collect broadly covers system characteristics, ambulance service dispatch characteristics, patient characteristics, and ambulance service performance process variables. The main outcome variables are ROSC at hospital handover and survival to hospital discharge.

Data is cleaned and analysed on an annual basis and we use the data to produce yearly OHCA epidemiology and outcome reports for our participating ambulance services.

OHCAO Registry - Aims and Objectives

The overall aim of the OHCAO registry is to collect and summarise high-quality data to understand the epidemiology and outcomes of OHCA across the UK, supporting UK initiatives to improve OHCA outcomes.

Within this overall framework the OHCAO registry's objectives are:

1. To build strong partnerships with ambulance services across England, Wales, Northern Ireland and Scotland.
2. To optimise processes – both for data collection and, working with ambulance services, for reporting data.
3. To clean, analyse and summarise data, and to report results to ambulance services and funders.
4. To determine which factors influence survival from OHCA in the UK and explore the feasibility to include them in risk prediction models.
5. To support high-quality observational studies and randomised trials to strengthen the chain of survival in the UK by establishing strong partnerships with national and international collaborators in order to maximise the benefit of data submitted to OHCAO.

Objective 1:
Building strong partnerships with ambulance services

With support and guidance from the National Association of Ambulance Medical Directors (NASMeD), National Ambulance Service Research Steering Group and the National Ambulance Service Clinical Quality Group we have secured collaboration from all NHS Ambulance Services in England. The Welsh and Northern Irish Ambulance Services plan to contribute data soon and we have developed a good working relationship with the Scottish Ambulance Service.

Rachael Fothergill
London Ambulance Service NHS Trust

" I've been working with the OHCAO team since the registry was created. My experience with the registry comes from a range of perspectives: from that of a contributing individual ambulance service; at a national level through providing updates and facilitating discussions at the both the National Ambulance Services Research Group and the National Ambulance Services Clinical Quality Group, and as the ambulance service representative on the registry's Project Management Group.

From the beginning, the team at Warwick have been keen to involve ambulance services in the design of the registry, to make submissions to the database as straightforward as possible, and to ensure the outputs are meaningful.

As a result, the registry provides a comprehensive and valuable quality reporting tool and research resource".

ASSOCIATION OF AMBULANCE CHIEF EXECUTIVES


EMERGENCY DOOR
PARAMEDIC
NHS

Objective 2:
Optimising processes

The registry has developed a bespoke, secure web application and database. The web application allows a review of the quality of the data that is submitted by ambulance services. Once reviewed, data is imported to the OHCAO registry database. The database allows the team to process and report on key system, dispatch, patient, process and outcome variables.

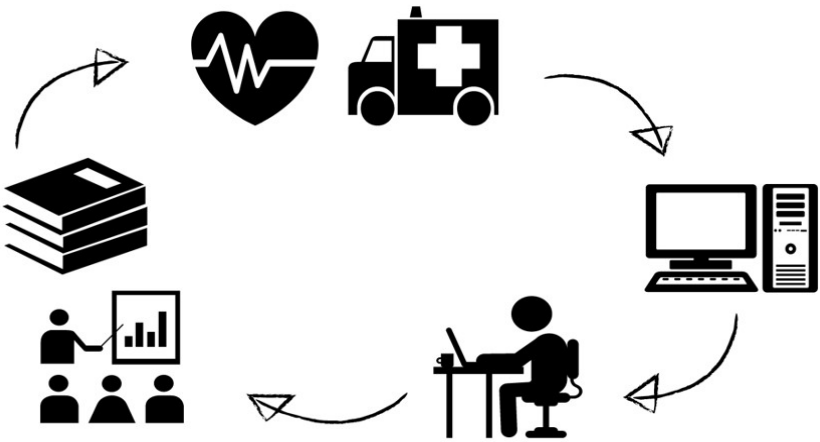
We have optimised processes for case ascertainment and outcome verification to reduce variation between the data that is submitted by the different services. We work closely with ambulance services to improve the quality of reported data to the registry and report on this annually.

We collaborated with the International Liaison Committee for Resuscitation to refine international standards to improve consistency of reporting of epidemiology and outcomes from international cardiac arrest registries. One result of this work are Utstein variables, which are standardised variables that ease international comparisons.

Prof Chris Jones

Deputy Chief Medical Officer/ Medical Director NHS Wales

" Gathering good quality data is a key first step in quality improvement. The OHCAO registry has made a great start in measuring outcomes and we look forward to future collaboration as we start on our journey to improve outcomes after cardiac arrest in Wales ".



Objective 3:
Reporting OHCAO Registry

Every year since 2014 we have produced annual reports on the epidemiology and outcome of OHCA in England. We provide ambulance services with their individual results and with overall national results. The ambulance services use these reports to compare their performance with the national average to understand their strengths and weaknesses, and to inform quality improvement initiatives.

Annual reports provide key information to ambulance services on a range of variables that influence OHCA outcomes. Factors include those that are prior to ambulance service intervention, such as location or bystander CPR, patient factors, such as age and sex, and ambulance service factors, such as ambulance service arrival time.

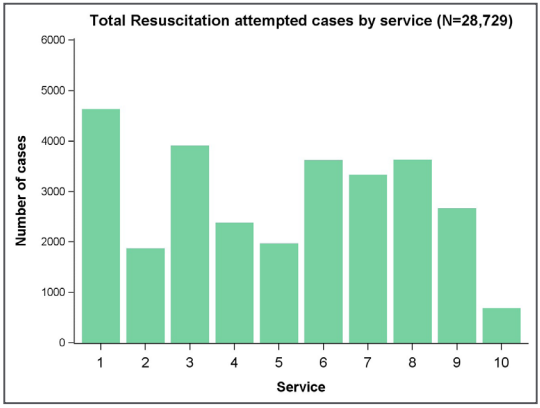
Submission of data to the UK OHCAO registry is supported by government policy documents and clinical quality guidelines from the Association of Ambulance Chief Executives (AACE) National Cardiac Leads and the Resuscitation Council (UK).

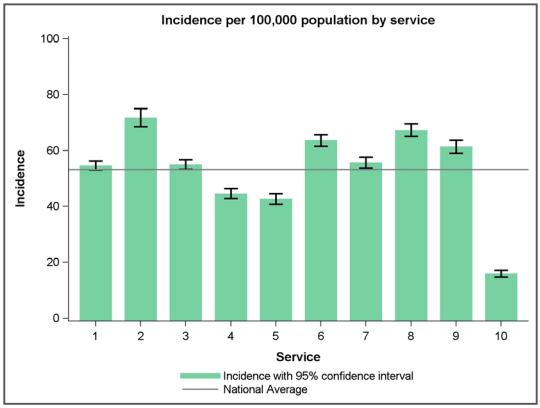
Our latest report and links to government policy documents are available on our website.
www.warwick.ac.uk/ohcao/publications

Objective 3:
Reporting OHCAO Registry data

We published a paper about the epidemiology and outcomes from out-of-hospital cardiac arrest (OHCA) in England during 2014.

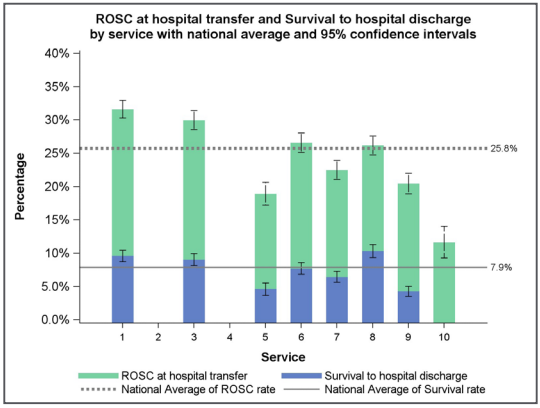
The key findings were that, in 2014, there were 28 729 OHCA cases treated by the the English ambulance services. The incidence was 53 per 100,000 of the resident population. The average (mean) age of someone having an OHCA was 68.6 years and 58.7% of them were men. Most cardiac arrests (83%) occurred at home, 52.7% were witnessed by either the ambulance service staff or a bystander. In those not witnessed by ambulance service staff, 55.2% received bystander cardiopulmonary resuscitation (CPR), whilst public access defibrillation was used rarely (2.3%).

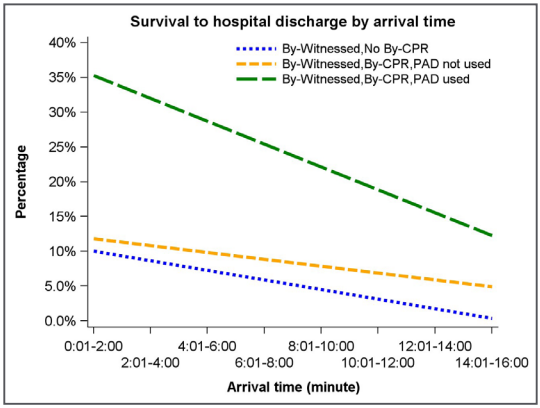




Over 60% of cardiac arrests were the result of an underlying cardiac problem. The initial heart rhythm was asystole in 42.4% of all cases and was shockable (ventricular fibrillation or pulseless ventricular tachycardia) in 20.6%. ROSC at hospital handover was evident in 25.8% (n = 6302) and survival to hospital discharge was 7.9%. Survival rates were highest amongst those who received bystander CPR and public access defibrillation.

Fewer than 1 in 10 patients survive an out of hospital cardiac arrest in England. The best performing emergency services report higher survival rates e.g. 21% in Seattle6. There is scope to improve outcomes from this important cause of death in the UK.





Objective 4:
Risk prediction models

One of the OHCAO registry's objectives is to explore the sources of variation in survival after OHCA. We developed and validated risk prediction models for ROSC at hospital handover and survival to hospital discharge using pre-ambulance service intervention variables. This includes the influence of area, patient and bystander characteristics on outcomes.

The application of these models in future epidemiology reports will allow adjustments for differences in the case mix of different ambulance services. This means that if the population covered by one ambulance service differs from another in, for example, age and health, this can be taken into account in the analysis. The case mix adjustment will allow fairer comparisons of outcomes between providers.

In future we plan to improve our models using new data and including ambulance service intervention related variables.

Dr Gareth Clegg

Associate Medical Director, Scottish Ambulance Service; Senior Lecturer, Resuscitation Research Group, University of Edinburgh

" There is wide variation in reported survival after cardiac arrest. Some of that variation may be explained by differences in the types of patients and circumstances when a cardiac arrest occurs. Risk adjustment models provide valuable insights in to such variation and allow for adjustment for baseline characteristics. This in turn allows more meaningful analysis of factors affecting survival rates."

Objective 5:
Research - High quality observational studies

The data collected by the OHCAO registry provides an excellent basis for all kinds of research. We conduct high-quality observational studies that help define the critical importance of key interventions and enhance our understanding of cardiac arrest.

Our observational studies have informed treatment recommendations and NICE accredited Resuscitation Council (UK) guidelines available on the Resuscitation Council (UK) website.

resus.org.uk/resuscitation-guidelines

The following pages summarise some of our projects that have been completed or are nearing completion.

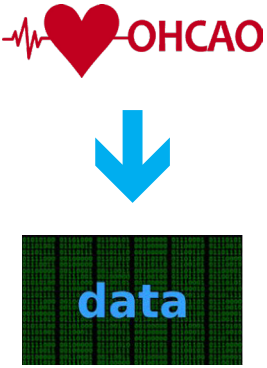
Research Projects - Highlights

1.Data Linkage Project

The aim of this 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. The project demonstrated linkage was feasible, improving demographic and mortality data quality and allowing analysis of 30-day survival status.

The OHCAO team worked with collaborators from East Midlands Ambulance Service, South Western Ambulance Service and West Midlands Ambulance Service on this project.

The results of this study also suggest the potential for the OHCAO registry to use data linkage for further avenues of OHCA research in the UK. Data linkage can be used to evaluate the complete patient care pathway by linking to existing routinely collected hospital data sources, such as treatment in coronary and intensive care units, and on to discharge from hospital. This helps to build a richer understanding of strengths and weaknesses of the patient pathway and allows us to build a more comprehensive picture of outcomes after cardiac arrest.



2. Attitudes to Cardiopulmonary

Resuscitation (CPR) and Public Access Defibrillation (PAD): a survey of the UK public

When person has an out of hospital cardiac arrest their best chances of survival are when a bystander performs CPR and uses a PAD. Campaigns encourage members of the public to train in resuscitation skills with the overall aim to increase the proportion of people in the UK with resuscitation skills. In May 2017, 2084 UK adults took part in a survey to help us discover how many people have trained in CPR or PAD use and how willing they are to act if they witnessed a OHCA. The OHCAO registry team worked with collaborators from The British Heart Foundation, London Ambulance Service, Welsh Ambulance Service, South East Central Ambulance Service and East of England Ambulance Service on this project.

One in 5 survey respondents said they had witnessed a cardiac arrest; 58% reported that they had received CPR training and 22% PAD training. Training made a difference in people's willingness to act. 74% of those trained in PAD use compared to 24% of those untrained said they would be willing to use one. For those trained in CPR, 76% were likely to perform CPR compared to 28% who were untrained. There is potential to increase survival rates through continuing attempts to improve public awareness and uptake of resuscitation skills training.

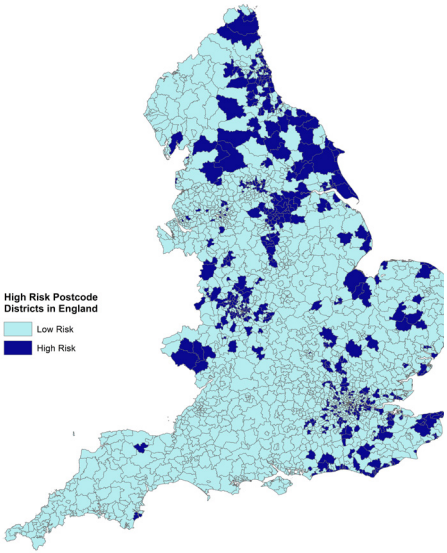
The results of this survey were used by the BHF to support the campaign for the 2017 Restart a Heart Day.

3. Bystander CPR by location

The community in which a person sustains an out-of-hospital cardiac arrest (OHCA) influences the likelihood that they will receive bystander CPR (BCPR) and ultimately survive. In this study we identified the characteristics and location of high risk communities in England with a high OHCA/ low BCPR incidence.

The analysis indicated that the most deprived areas of England were identified as high risk. These high risk areas were also more densely populated, had a lower proportion of people in managerial occupations and higher proportion in routine and manual occupations, and had a lower proportion of people of white ethnic background

We have identified several high risk areas of England that could be targeted for future initiatives; a special focus should be given to holiday destinations & town/city centres.



4. Bystander CPR trends

Bystander CPR (BCPR) more than doubles the chances of survival from OHCA. In the UK BCPR rates are variable and lower than those of other countries. When a person suffers an OHCA and if they receive BCPR will impact on their likelihood of surviving. We have evaluated the temporal variability in the frequency and rate of BCPR in England using data collected by the OHCAO registry.

We showed for the first time in England that BCPR rates are low during the night, increase steadily throughout the morning, remain constant during the afternoon, and then begin to decline during the evening. BCPR rates varied throughout the week, and generally were higher during the weekend. A distinct seasonal variation was observed. The trend of increasing BCPR is encouraging and likely to be associated with national and local initiatives to improve BCPR rates.

The OHCAO registry team collaborated with East Midlands Ambulance Service, South East Coast Ambulance Service, South Western Ambulance Service and London Ambulance Service on this project.

Research in progress

1.OHCA in schools

The aim of this work is to investigate the incidence and demographics of school-based OHCAs in the West Midlands with an automated external defibrillator (AED)on-site and the number of school-based AEDs that are known to West Midland Ambulance Service. This project is being conducted by Dr Madeleine Benson, with the assistance of the OHCAO registry team.

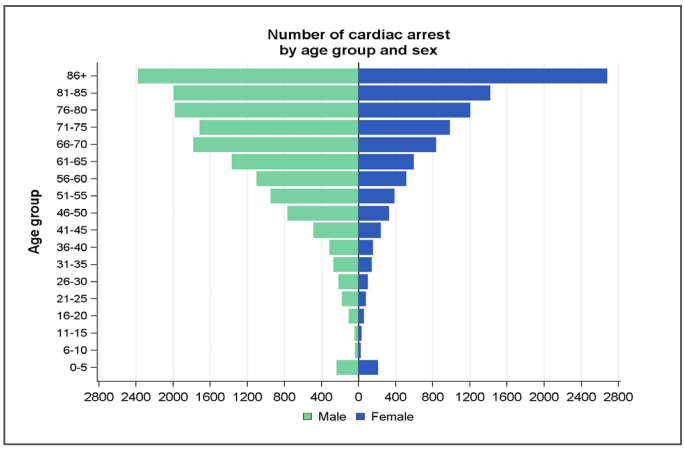
2. EuReCA Two

The aim of this study is to build on the work of EuReCa One and further improve understanding of OHCA incidence, management and outcome across Europe. This project is led by Jan-Thorsten Gräsner and Scott Booth is the UK national coordinator.

EuReCa TWO European Registry of Cardiac arrest

3. Gender inequalities in cardiac arrest resuscitation attempts in England

The aim of this project is to identify whether the difference observed in the 2014 OHCAO data between numbers of men and women can be explained by differences in their age distributions. This project is being led by Dr James Mapstone of Public Health England.



4. 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 Trial to describe the epidemiology and outcomes for pre-hospital administration of adrenaline patients in England and Wales between 2010 and 2015.

Future Research
Areas for future work include:

- Optimising the location of Public Access Defibrillators (PAD).
- Decisions about when to start and stop CPR.
- Airway interventions and drug use in cardiac arrest.
- Optimising communication strategies to increase uptake of bystander CPR training.

Objective 5:
Establishing strong international partnerships

We are wholeheartedly committed to collaboration. We want to ensure that the data collected by the OHCAO registry is used for maximal patient benefit, nationally and internationally.

We are pleased to have had the opportunity to collaborate on international projects including:

- The European Registry of Cardiac Arrest (EuReCa) is a collaboration to study patterns of cardiac arrest and survival across Europe. Our first project, EuReCa One, received the Ian G. Jacobs Award for International Group Collaboration to Advance Resuscitation Science, from the American Heart Association in November 2017.
- The International Liaison Committee for Resuscitation study evaluating how treatments and outcomes from cardiac arrest vary around the world.

Jan-Thorsten Gräsner

Principle Investigator for EuReCA

"Collaboration is critical for getting the most out of observational data from cardiac arrest. Pooling the resources and expertise of registries across Europe helps us learn more about the causes of cardiac arrest and effectiveness of community and health service treatments. We welcome the UK OHCAO efficient and timely contributions to the European Registry for Cardiac Arrest (EuReCA) network and wish them well with their continuing endeavours to improve outcomes from OHCA".

Austrian Resuscitation Council
Bosnia-Herzegowina
Hungarian Resuscitation Council
Ceská resuscitační rada Czech Resuscitation Council
German Resuscitation Registry
Luxembourg Resuscitation Council
Malta
OHCAR
Emergency Medical Services Copenhagen
SWISSRECA
Portugal
ARREST
Italian Resuscitation Council
Finland
SIoRS
Greece
Norsk hjertestansregister
EuReZo-SK
OHCAO
CNR
OHSCAR
SVENSKA HJÄRT LUNGRÄDDNINGSREGISTRET

Objective 5: Supporting high-quality studies to strengthen the chain of survival; sharing data

We have established a system for sharing data. This system includes an independent Academic Oversight Committee to ensure fair and transparent handling of requests for collaboration and data sharing.

Current data sharing projects include:

1. Helping provide information on treatments given to patients participating in the PARAMEDIC2 trial.
2. Effects pre-hospital critical care teams have on patient survival from OHCA.
3. An evaluation of the GoodSAM first-responder system for victims of OHCA, and the potential for AED use within the system.
4. Incidence and outcomes of OHCA at international airports. Exploring what happens to people around the world who have a cardiac arrest at an airport.
5. Epidemiology and Outcome of cardiac arrest in children in the UK (PACK).

Dr Barney Scholefield
Birmingham Women's and Children's NHS Foundation Trust

" Its been great to have the opportunity to work with the OHCAO team to examine the epidemiology and outcome of cardiac arrest in children in the UK. The processes for sharing data has been efficient and its been a pleasure working with the team." (PACK Project)

PARAMEDIC2
The Adrenaline Trial

GoodSAM

PACK
Post cardiac Arrest Care in Kids

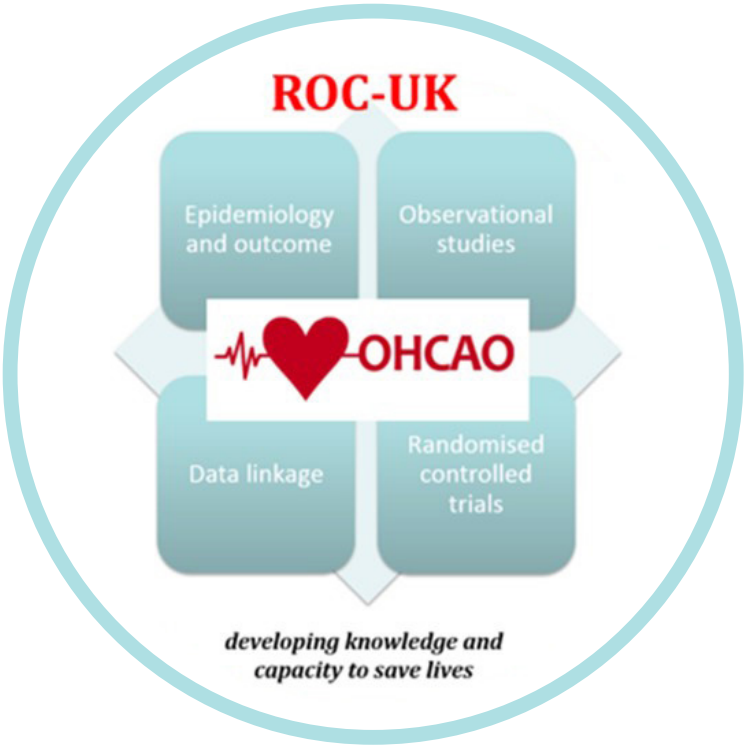
The OHCAO Registry's Future: ROC-UK

We remain committed to continuing to work with our partner ambulance services to collect and summarise high-quality data to support UK initiatives to improve outcomes from out of hospital cardiac arrest.

Our objectives for the next 5 years are to

- Summarise the epidemiology, treatments and outcomes from OHCA across the UK
- Produce reports to allow benchmarking and drive quality improvement
- Support high-quality observational studies and randomised trials to strengthen the Chain of Survival
- Encourage collaboration to maximise benefits from use of data submitted to OHCAO
- Facilitate data linkage to support a better understanding of the full patient pathway for cardiac arrest (prevention, event, recovery, rehabilitation)

We envisage the registry serving as a platform to establish a UK cardiac arrest research collaboration – Resuscitation Outcome Consortium – UK – to promote collaborative research amongst clinicians, patients to improve survival and outcomes after out of hospital cardiac arrest.



Acknowledgements

Partner Ambulance Services' Principal Investigators

Theresa Foster - *East of England*

Niro Siriwardena - *East Midlands*

Robert Andrews - *Isle of Wight*

Dr Rachael Fothergill - *London*

David Ratcliffe - *North West*

Dr David McManus - *Northern Ireland*

Dr James Ward - *Scotland*

Charles Deakin - *South Central*

Julia Williams - *South East Coast*

Andy Smith - *South Western*

Nigel Rees - *Wales*

Jenny Lumley-Holmes - *West Midlands*

Dr Julian Mark - *Yorkshire*

Steering committee – current

Funder representatives:

Sara Askew *(2017 – current) – Head of Survival at the British Heart Foundation*

Dr Jasmeet Soar *(Chair) (2013-current) - Resuscitation Council (UK)*

Members:

Prof Jonathan Benger *(2013-current) - National Clinical Director Urgent Care NHS England*

Ian Brodie *(2013-current) –Lay person/patient representative*

Dr Gareth Clegg *(2015-current) - Resuscitation Research Group lead; University of Edinburgh*

Prof Tim Coats *(2013-current) – Chair of Trauma Audit and Research Network*

Prof Matthew Cooke *(2013-current) - Regional Clinical Director (London) Emergency Care Improvement Programme*

Prof Charles Deakin *(2013-current) - Resuscitation Council (UK)*

Dr Martin Flaherty *(2017-current) - Association of Ambulance Chief Executives*

Dr Rachael Fothergill *(2013-current) - London Ambulance Service NHS Trust*

Dr Christopher Gale *(2013-current) – Myocardial Ischaemia National Audit Project (MINAP) Liaison*

John Long *(2013-current) - Lay person/patient representative*

Dr Julian Mark *(2015-current) - Executive Medical Director, Yorkshire Ambulance Service, Chair of NASMeD*

Dr James Mapstone *(2013-current) - Public Health England representative*

Prof Jerry Nolan *(2013-current) - National Cardiac Arrest Audit Chair*

Nigel Rees *(2016-current) - Head of Research and Innovation, Pre-Hospital Emergency Research Unit; Welsh Ambulance Services NHS Trust*

Prof Niro Siriwardena *(2013-current) - National Director of Ambulance Service Research Group*

Dr Andy Smith *(2016 –current) – Chair of National Ambulance Service Audit Group*

Dr James Ward *(2015-current) - Medical Director, Scottish Ambulance Service*

Steering Committee – previous

Victoria Gaffney *(2013-2015) - British Heart Foundation representative*

Prof Kevin Mackway-Jones *(2013-2016) – Chair of National Ambulance Service Audit Group*

Dr Fionna Moore *(2013-2017) - Ambulance Service Chief Executives Representative*

Julie Norris *(2013 – 2014) – Comprehensive Local Research Network (CLRN) representation, Worcestershire Acute Hospitals NHS Trust*

Judy O'Sullivan *(2015-2017) - British Heart Foundation Representative*

Dr Alison Walker *(2013 -2016) – Chair of National Association of Ambulance Services Medical Directors*

Richard Whitfield *(2013-2016) - Practice Research and Development Manager; Welsh Ambulance Services NHS Trust*

David Whiting *(2013-2016) - Ambulance Service Chief Executives Representative*

Acknowledgements cont'd

Operational staff (current)

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