

# RESUSCITATION TO RECOVERY

A National Framework to improve care of people with out-of-hospital cardiac arrest (OHCA) in England

**Endorsed by the following professional organisations:**

Association for Inherited Cardiac Conditions

Association of Ambulance Chief Executives

British Association for Cardiovascular Prevention and Rehabilitation

British Cardiovascular Intervention Society

British Cardiovascular Society

British Congenital Cardiac Association

British Heart Rhythm Society

British Society of Rehabilitation Medicine

Chief Fire Officers Association

College of Paramedics

Faculty of Intensive Care Medicine

Faculty of Pre-Hospital Care

Intensive Care Society

Resuscitation Council (UK)

Royal College of Anaesthetists

Royal College of Emergency Medicine

Royal College of Nursing

Royal College of Paediatrics and Child Health

Royal College of Physicians

Society for Cardiothoracic Surgery in Great Britain and Ireland

**Supported by:**

Intensive Care National Audit & Research Centre (ICNARC)

National Audit of Cardiac Rehabilitation (NACR)

National Institute for Cardiovascular Outcomes Research (NICOR)

Out of Hospital Cardiac Arrest Outcomes (OHCAO) Registry

UK Rehabilitation Outcomes Collaborative (UKROC) Database

**Acknowledgement**

We acknowledge the excellent work undertaken by many charities in their efforts to provide equipment for resuscitation in the community, and training in cardiopulmonary resuscitation and the use of defibrillators. We are grateful for the support they provide to healthcare professionals in efforts to improve survival and clinical outcomes of patients with out of hospital cardiac arrest.

We would like to thank the British Heart Foundation for hosting the working group during the preparation of this report.

# Contents

---

**5 Foreword**

**6 Executive summary**

**8 Introduction**

**10 The chain of survival**

**11 Recognition of cardiac arrest by the public and ambulance call handlers**

**14 Importance of early CPR and the use of a defibrillator**

**16 Case study: Creating a nation of lifesavers**

**22 Case study: The survival academy**

**24 Assessment and triage of patients at the scene of the OHCA**

**26 Cardiac Arrest Centres (recognised centres of care)**

**28 Early triage and coordination (between emergency medicine/ cardiology/radiology/anaesthesia/intensive Care)**

**30 General and cardiothoracic intensive care**

**32 Step-down and the second phase of care**

**33 Rehabilitation**

**34 Long-term care for patients with continuing neurological impairment**

**35 Paediatric considerations**

**37 National data collection**

**38 Participation in research**

**39 References**

**42 Appendix one**

**43 Glossary**

**44 Members of the OHCA steering group**



## Foreword

**Cardiopulmonary resuscitation (CPR) is attempted in nearly 30,000 people who suffer out-of-hospital cardiac arrest (OHCA) in England each year, but survival rates are low and compare unfavourably to a number of other countries.**

The Cardiovascular Disease Outcomes Strategy (CVDOS), published by the Department of Health in 2013, highlighted the potential for many lives to be saved if CPR and early defibrillation were undertaken promptly and more often, and if the whole pathway of care from successful resuscitation to subsequent rehabilitation were improved. Much evidence exists regarding the best practice of CPR and use of public access defibrillators (PADs), which is published in national and international guidelines.

However, patient management following return of spontaneous circulation (ROSC) varies significantly. Greater uniformity of practice could improve survival rates and allow clinical services to be better aligned, whilst accepting that individual circumstances often dictate some variation. For these reasons, and in order to respond to the challenge set by the CVDOS, a Community Resuscitation Steering Group was established in 2013.

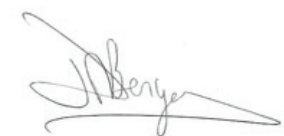
More recently, an OHCA steering group was convened in order to produce a single consensus document intended to describe and illustrate a good pathway of care for those who suffer OHCA and provide helpful guidance to the newly established Urgent & Emergency Care Networks in England. Where an evidence base or National Institute for Health and Care Excellence (NICE) accredited guidance exists, this has been accepted as best practice.

When good clinical evidence is lacking, the group has attempted to provide guidance based on expert consensus in order to contribute to improvements in survival rates from OHCA. We hope those reading this document, and particularly those involved in planning services for this important group of patients, will find it useful.



**Professor Huon Gray**

Chair of the OHCA Steering Group, England  
National Clinical Director for Heart Disease  
NHS England



**Professor Jonathan Benger**

National Clinical Director for Urgent Care  
NHS England





# Executive summary

## Ambulance Services in England attempt resuscitation in nearly 30,000 people suffering out-of-hospital cardiac arrest (OHCA) each year.

In the majority of these cases the primary cause of the arrest is an abnormality of the heart. Only 7–8% of people in whom resuscitation is attempted survive to hospital discharge. Survival can be increased significantly by the early use of cardiopulmonary resuscitation (CPR) and automated external defibrillators (AEDs) either by members of the public or the emergency services. Where AEDs are available for use by the public, they are referred to as public access defibrillators (PADs).

The chances of survival are very time-dependent; the longer the attempted resuscitation is delayed, the worse the outcome. In patients with a shockable heart rhythm, there is approximately a 10% reduction in survival for every minute's delay in providing defibrillation. However, the chance of survival can be increased two-to-threefold by the immediate provision of bystander CPR. The Cardiovascular Disease Outcomes Strategy, which was published by the Department of Health in 2013, indicates that more than 1,000 lives could be saved each year in England if more members of the public were trained in CPR and there was earlier and greater access to, and willingness to use, PADs.

Even when resuscitation is initially successful and there is a return of spontaneous circulation (ROSC), there is considerable variation in the further care of these patients. In part, this variation reflects the lack of scientific evidence regarding certain aspects of practice, and the consequent need for more research in this area of medicine. However, there is a growing professional consensus on the best care of these patients. A multidisciplinary approach based on the 'Chain of Survival' is needed to provide rapid and effective care and to give patients the best chance of recovery. Speed of effective action is essential in the early phase to maximise the chance of a good recovery, both for the heart and for the brain. Beyond the immediate resuscitation period a coordinated response between ambulance services and hospital specialties will increase the chances of a return to independent living, and where this is not possible, will also improve the care of those with incapacity and the experiences of patients and carers.

International and national guidelines for the care of patients with OHCA have been published and are continuously updated. This document aims to integrate the current recommendations and to describe the optimal clinical pathway for patients with OHCA. This can be used by Urgent and Emergency Care Networks, in Sustainability and Transformation Plans (STPs), and by local and regional healthcare systems to help save more lives.

Survival rates are much better in other 'exemplar' countries or regions, so networks can set clear levels of ambition. Several national initiatives are incorporated into this document as part of the systems approach to improving survival.

### In pursuit of this aim, a number of interventions are needed including, but not limited to, the following:

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

# Introduction

## In the UK there are more than 60,000 calls to the emergency services each year to attend a presumed fatality.

The ambulance services in England attempt resuscitation in almost 30,000 people suffering out-of-hospital cardiac arrest (OHCA) each year.<sup>1</sup> Return of spontaneous circulation (ROSC) is achieved in about 25% of these attempts. Resuscitation is not performed when it would be futile or inappropriate. In many of these cases, this decision is influenced by the lack of an attempt at resuscitation prior to the arrival of the emergency services.<sup>2</sup> At present, only about 7–8% of those in whom resuscitation is attempted survive to hospital discharge.<sup>1</sup> Other countries have shown that much better survival rates are possible.<sup>3</sup> As indicated in the Cardiovascular Disease Outcomes Strategy (CVDOS), which was published by the Department of Health in 2013, if the survival rate in England could be increased to between 10 and 11%, more than 1000 lives could be saved each year.<sup>4</sup>

Expertise within the OHCA Steering Group has been utilised to make consensus recommendations to inform the work of the Urgent and Emergency Care Networks, in Sustainability and Transformation Plans (STPs), and of local and regional healthcare systems in England.



The International Liaison Committee on Resuscitation (ILCOR) undertook a comprehensive evaluation of published evidence and produced an international Consensus on Science and Treatment Recommendations in 2015.<sup>5</sup> These informed the NICE-accredited Resuscitation Council (UK) guidelines published in October 2015.<sup>6</sup> In addition, NICE guidelines for care of the acutely ill patient (CG 50)<sup>7</sup> and management of ST-segment elevation myocardial infarction (STEMI) (CG167)<sup>8</sup> and the Resuscitation Council (UK) Quality Standards<sup>9</sup> include specific recommendations for victims of cardiac arrest. The Association of Ambulance Chief Executives, together with the Joint Royal Colleges Ambulance Liaison Committee, have produced UK Ambulance Services Clinical Practice Guidelines in 2016.<sup>10</sup>

This document aims to integrate these recommendations and to describe the whole clinical pathway for patients with OHCA. Where good scientific evidence exists for specific interventions aimed at improving survival, these are specifically referenced.<sup>11</sup> Where such evidence does not exist the group has made consensus recommendations, the intention being to describe a pathway of care that can be used by Urgent and Emergency Care Networks and local and regional healthcare systems to help save more lives. National initiatives to strengthen the community response to cardiac arrest have recently been summarised by members of the Community Resuscitation Steering Group (established following publication of the Cardiovascular Disease Outcomes Strategy) and are incorporated into this document as part of the systems approach to improving survival.<sup>1</sup>

**IF THE SURVIVAL RATE IN ENGLAND COULD BE INCREASED TO BETWEEN 10 AND 11%, MORE THAN 1000 LIVES COULD BE SAVED EACH YEAR**

### Approach to producing this document



National and international guidelines

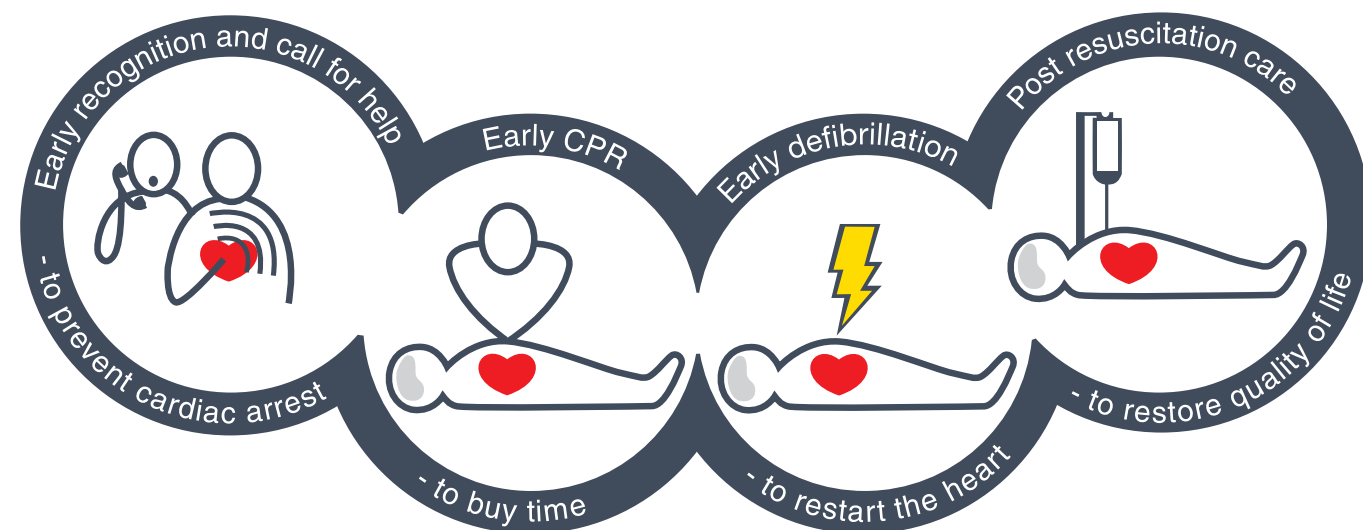


OHCA steering group recommendations



A National Framework to Improve Care of People with Out-of-Hospital Cardiac Arrest (OHCA) in England

## Chain of survival



### The 'Chain of Survival' concept is internationally recognised as summarising the important components of successful resuscitation.

Specifically, these involve early **recognition** that cardiac arrest has occurred, an immediate **call** to the emergency services, prompt initiation of **CPR** and **defibrillation**, followed by optimal **post-resuscitation care**. Although there is on-going research into different methods of resuscitation, current best practice as it applies to the first three links in the chain is widely agreed (though implementation presents many challenges) and is well covered in national and international guidelines to which this document refers.<sup>4,5,11</sup>

Components of post-resuscitation care that offer the best probability of survival are less well defined. These include the type of hospital to which the person should be taken, cardiac interventional procedures (including indications and optimal timing), the indications and aims of various medical interventions in the intensive care unit (such as temperature control), the indications for implantable defibrillators or cardiac resynchronisation devices, and optimal arrangements for cardiac and neurological rehabilitation.

## Recognition of cardiac arrest by the public and ambulance call handlers

### The cardinal clinical features that identify cardiac arrest are unconsciousness and absent or abnormal breathing.

A considerable amount of work has been done to promote public awareness of the concept of cardiac arrest and how to respond when someone collapses. However, this experience should be extended to ensure that more members of the public will feel able to start CPR should they witness a cardiac arrest or come across someone who has collapsed and shows no signs of life. Currently only 30-40% of victims of OHCA receive bystander CPR; as this intervention can treble survival, it is a key intervention in improving overall survival.

Ambulance call handlers are critical for co-ordinating the community and emergency medical services response to cardiac arrest. Computerised decision support software is used to aid the early diagnosis of cardiac arrest. When cardiac arrest is identified, the call handler will provide instructions on how to perform CPR and dispatch the emergency services. They may be able to provide information on the availability of a nearby defibrillator.

New operating models, currently being piloted by National Health Service (NHS) England, are designed to improve the emergency medical

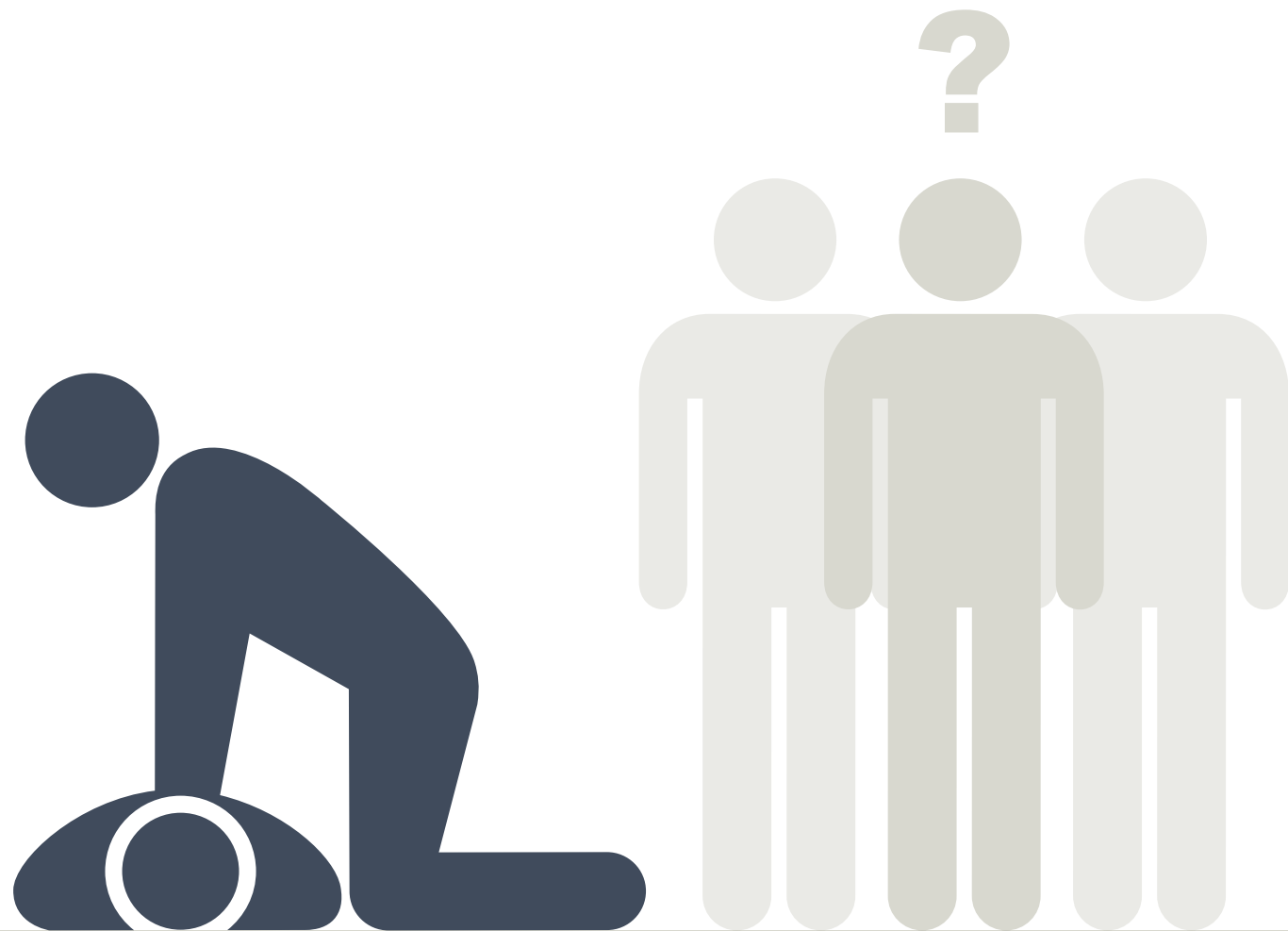


Ambulance control room staff provide 'telephone CPR' advice to callers

dispatcher's ability to recognise as quickly as possible that a patient is experiencing immediately life-threatening symptoms so that emergency resources may be dispatched with the minimum of delay.

We support the evaluation and improvement of the ability of telephone scripts used by ambulance call takers to identify those who have suffered an OHCA, in order to advise bystander CPR and ensure immediate dispatch of appropriate resources. Ambulance control room staff provide 'telephone CPR' advice to callers (Dispatcher Assisted CPR), from the time that cardiac arrest is identified until the ambulance arrives. Calls to 999 and 111 are recorded, facilitating case review and audit.

**CURRENTLY ONLY 30-40%  
OF VICTIMS OF OHCA  
RECEIVE BYSTANDER CPR**



**AS THIS INTERVENTION CAN  
TREBLE SURVIVAL, IT IS A KEY  
INTERVENTION IN IMPROVING  
OVERALL SURVIVAL**

**We recommend that data on the following are collected and used in continuous quality improvement initiatives at both service and individual dispatcher level, which aim to increase the number of cases of cardiac arrest identified and given timely CPR instructions:**

1. Proportion of emergency medical services (EMS) treated cardiac arrests identified during the initial 999 call
2. Proportion of EMS-treated cardiac arrests where CPR instructions are provided by the call handler
3. Proportion of EMS-treated cardiac arrests where telephone assisted CPR is performed

4. Time from receipt of the call to commencement of CPR
5. Time from receipt of the call to attachment to a defibrillator.



# Importance of early CPR and the use of a defibrillator

**Two of the most important factors influencing survival are the early use of effective CPR and early defibrillation. Defibrillation is achieved by the use of an automatic external defibrillator (AED).**

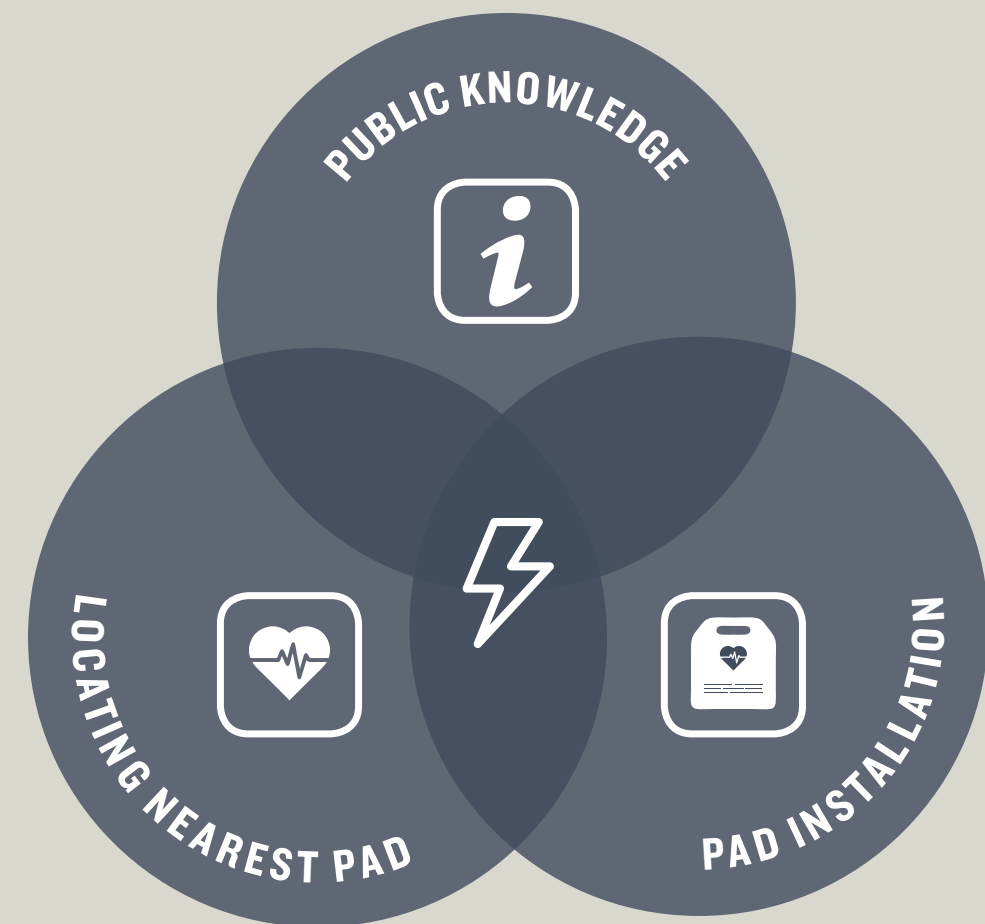
The emergency services bring these when called to a case of OHCA, but many of these devices are now positioned in places where they can be used by the general public and are referred to as public access defibrillators (PADs). The public can use these devices safely and effectively, even if they have had no or minimal training. Although the emergency services respond rapidly to a call, early use of CPR and defibrillation prior to the arrival of the emergency services considerably improves the chance of survival.

Most episodes (around 80%) of OHCA occur in the home, highlighting the potential benefit of family members being trained in CPR; about 20% of OHCA occur in public places. Clear targets are needed to improve survival rates to ensure that more of the population will attempt 'bystander' resuscitation wherever the arrest occurs and that early use of a PAD occurs more frequently. Survival rates with early use of CPR and defibrillation can be as high as 40%, but PADs are used only in a small minority of cases.<sup>12,13</sup>

Unless a PAD is available immediately at the scene of the arrest, at least two individuals need to be involved when using a PAD during a resuscitation attempt. As a first priority, one bystander should perform CPR. If there is an additional bystander, they should be encouraged to locate and retrieve a PAD, usually on the advice of the ambulance service call handler.

#### Steps are needed to:

1. Increase public awareness of cardiac arrest and public willingness to attempt CPR.
2. Increase the number of people trained in CPR. Several charities have been very active in promoting and undertaking training of CPR skills, and the Department for Education has acknowledged the advantage of promoting these skills in schools. Unfortunately, unlike some other countries, such training of young people of school age is not compulsory. The OHCA Steering Group believes that training in CPR and AED awareness is an important component of the health education of all citizens and that all pupils at secondary school should be provided with opportunities to acquire these skills.<sup>14</sup> Refresher training should be offered regularly to all those who wish to be reminded of CPR techniques and how to use a defibrillator.
3. Increase the use of PADs. Emergency service call centres should help the individual making the call by both supporting them to undertake CPR and advising them of the location of the nearest available PAD.



#### Increasing the use of PADs

This requires increased public education and availability of PADs, as well as the ability to identify the location of a PAD



# CASE STUDY: CREATING A NATION OF LIFESAVERS

**The British Heart Foundation's (BHF) Call Push Rescue programme gives UK secondary schools free CPR training kits, enabling teachers, leaders and volunteers to lead training sessions. To date, nearly 1.5 million people have been trained thanks to BHF's investment.**

By learning these skills, bystanders become lifesavers; young people could save the life of their mum, dad, or friend if they have an out of hospital cardiac arrest. The programme was launched in October 2014 on European Restart a Heart Day, and is crucial to the BHF's vision to create a nation of lifesavers.

But we want to go further, and set a target of 5 million people trained by 2020. To achieve this, partnerships are crucial.

On Restart a Heart Day in 2014, we partnered with others to ensure young people were taught life-saving skills. We supported the charity Heartwize to ensure pupils across Leicestershire learned CPR and we partnered with the Yorkshire Ambulance Service (YAS) to create a mass training event that taught 12,500 children to save lives.

Then in 2015, fire and rescue services in Scotland and Greater Manchester joined our mission too; together we trained 30,000 more lifesavers.



In 2016, a coalition was formed between the Resuscitation Council (UK), the BHF, St John Ambulance, the British Red Cross and all of the UK's fourteen ambulance services. Using the model set up by YAS, the coalition agreed to challenge themselves to achieve a more ambitious target.

On the 18th of October this successful coalition trained 150,000 more young people in schools. There were coordinated events taking place in halls and clubs across all of the four nations.

The momentum to make the UK a nation of lifesavers is growing, but the job is far from over. This coalition of charities and ambulance services should not give up until every young person in the UK leaves school knowing how to save a life.

**“WE WANT TO SET A TARGET OF 5 MILLION PEOPLE TRAINED IN CPR BY 2020. TO ACHIEVE THIS, PARTNERSHIPS ARE CRUCIAL.”**

### 1. Improved education about the use of PADs

**i.** Poor public understanding of the word “defibrillator” and knowledge of the need for, and how to use, PADs limit their use.<sup>13</sup> In addition to CPR training, resuscitation training for the public should emphasise the need to retrieve and apply a PAD, and should incorporate training in their use.

**ii.** Members of the public should be reassured that they can use a PAD even without special training; each device provides clear written and verbal instructions on its use, and no harm can be done by following these.

**iii.** Numerous charities have made significant contributions to education and training in CPR techniques and the use of a PAD. In some regions, coordinated care between local heart specialists, the emergency services and schools, such as the joint project between the BHF and the Yorkshire Ambulance Service on European Re-start a Heart Day and the Leicestershire Heartwise programme in 2014, have concentrated on training pupils in these techniques. Many commercial organisations and civic centres have active training programmes and many public places; for example, stations, airports, universities, sports centres, stadia, now not only provide access to defibrillators, but have trained their staff in how to use them and have made them available for use by the public.

There are on-going studies on targeted training of families of individuals who have required resuscitation or who are at increased risk of needing CPR.

### 2. Increased availability of PADs

**i.** Increasing numbers of defibrillators have been funded from several sources; for example, charities, government, businesses, first responders, local communities, but there is still a lack of rapid access to a PAD in some large geographical areas, in some places with significant public footfall, and in some communities to which the response time of an emergency ambulance is likely to be long. There is a case for regarding PADs in a similar way to fire extinguishers so that, ideally, they are located in all public places and private or commercial venues that host large numbers of people, and in places or communities where predictable delay in the arrival of emergency services would be likely to compromise a person’s chance of survival from OHCA.

**ii.** Where new PADs are being purchased we recommend, whenever possible, that such devices are made available for public use and that the local ambulance service is informed of their location and accessibility.



**iii.** All PADs should be accessible on a 24-hour basis, which in many cases will involve the PAD being stored in an external cabinet. The Resuscitation Council (UK) recommends that, where possible, PADs should be available in unlocked cabinets.<sup>6</sup>

**iv.** Members of the public/organisations who own or who are responsible for a PAD, should be able to add details of their defibrillator to a local or national database and receive prompts to check the equipment regularly. Until these systems are in widespread use, the owners should contact the local ambulance services to log the device.

**v.** Support for this initiative should be sought from industry partners and they should be encouraged to provide additional educational and training resources.

### 3. Identification of PAD location

**i.** The presence and location of PADs is not always known, either to members of the public or ambulance services. All ambulance services should work with their local communities to identify and record the location of all PADs. Each ambulance service should have a regularly updated log of where all PADs are located in their region.

**ii.** There is a consensus that the development of a single national database of defibrillators would be extremely useful. Reliable information could then be made available to:

a) ambulance call-takers who, for all calls identified as cardiac arrest, should direct bystanders to the nearest PAD if one can be retrieved prior to ambulance arrival.

b) the public, through ambulance-led or other apps, to enable smart phone identification of the nearest PAD location.

There is on-going consideration of ways to make it much easier to identify where PADs are located. There are numerous existing mechanisms in place across the UK to map the location of defibrillators. Charities, ambulance services and other relevant organisations should work together to develop a single national database.

Improved signage relating to PADs may increase public awareness and make them more user-friendly; alternative, potentially more encouraging signage is being evaluated. The ambulance services must ensure a coordinated, rapid and consistent response to all OHCA calls, using all emergency services, community first responder schemes and encouraging members of the public to use PADs.

If, either on checking or during a resuscitation, a fault or failure is discovered with equipment (defibrillator, laryngoscope, endotracheal tube, oxygen delivery devices, vascular access devices etc.) it is vitally important that a report is sent to the Medicines and Healthcare products Regulatory Agency (MHRA) through the Yellow Card scheme for devices and medicines, as well as complying with local reporting requirements. Likewise, if an adverse drug reaction is suspected following the use of resuscitation drugs or a drug is suspected as being responsible for the cardiac arrest a report should be sent.

For reporting to be effective at a national level, MHRA need as much detail as possible, so a thorough investigation can be undertaken when indicated.

The link to reporting is:

<https://www.gov.uk/report-problem-medicine-medical-device>



**Recommended PAD Location Sign**

See Appendix One for more information on the new recommended defibrillator signs and posters and how to order them

## THERE IS ON-GOING CONSIDERATION OF WAYS TO MAKE IT MUCH EASIER TO IDENTIFY WHERE PADS ARE LOCATED

The Medical Priority Dispatch System and NHS Pathway protocols, which are the two dispatch protocols used by the ambulance services, have been updated to place more emphasis on early recognition of cardiac arrest and to encourage early bystander CPR. New operating models for ambulance dispatch that are currently being piloted by NHS England will concentrate on the early recognition of patients with immediately life-threatening symptoms and signs so that ambulance resources may be dispatched without delay. Whilst ambulance services clearly have the principal responsibility for responding to OHCA, they are working increasingly with other 'blue light' services (fire and rescue, police, coastguard) as well as community first responders to ensure appropriately skilled help arrives as quickly as possible. All emergency service personnel are trained in basic life support (BLS) and increasingly carry AEDs, and represent a resource that is currently being under-used.

We recommend that the 23 regional Urgent and Emergency Care Networks in England discuss with all relevant stakeholders, including medical charities, how they can contribute to increasing the number of people who are trained in CPR and the use of PADs. There are many examples of how this can be achieved. Greater knowledge of current local, regional and national programmes will lead to the spread of best practice. This effort requires both coordination between different emergency services and dialogue with national charities, local political organisations and the civic and commercial sectors.

In some parts of the country, there is increasing coordination between the ambulance, fire and rescue and police services to ensure that all emergency services can perform CPR and provide rapid access to defibrillation. We recommend that this approach is adopted throughout the country. In some areas, military services can also contribute very effectively to the network of emergency responders.

Ambulance services should maximise the use of community first responders and ensure optimal services for a good outcome, including four pairs of hands at every cardiac arrest, at least one paramedic to be directly involved, and the ability to discuss complex cases with, or request the presence at the scene of, a more senior clinician.



# CASE STUDY: THE SURVIVAL ACADEMY

“A ‘SURVIVAL ACADEMY NETWORK’ ENABLES US TO CREATE COMMUNITIES OF LIFESAVERS WITH THE SKILLS TO PERFORM CPR AND USE A DEFIBRILLATOR”

Peter O’Reilly  
Chief Fire Officer

**Working with North West Ambulance Service (NWS) and other partners, Greater Manchester Fire and Rescue Service (GMFRS) aims to improve survival rates from out-of-hospital cardiac arrest (OHCA) across Greater Manchester as part of a ‘Survival Academy Network’.**

The ultimate aim is to ensure that as many people as possible, across Greater Manchester become familiar with the delivery of cardiopulmonary resuscitation (CPR) and the use of public access defibrillators (PADs):

- GMFRS Emergency Response crews have been attending emergency cardiac arrest incidents to support NWS colleagues since September 2015. To date we have supported NWS at almost 3,000 incidents
- GMFRS firefighters train alongside NWS paramedics to be able to perform High Performance CPR and defibrillation, and create a culture of excellence
- We will be training all GMFRS staff and volunteers, and as many members of our communities as possible, to identify the signs and symptoms of cardiac arrest, perform basic life support techniques such as CPR, and use PADs
- We will increase the availability of public access defibrillators (PADs) by providing them at all GMFRS sites and encouraging businesses and commercial premises to provide them



## Assessment and triage of patients at the scene of the OHCA

**Once there is a ROSC, the ambulance service will need to assess the likely cause of the collapse. If consciousness has been regained the patient may be able to provide important information, but otherwise information should be sought from family members, work colleagues or other bystanders.**

Assessment must be accurate and complete and all relevant interventions should be undertaken to ensure, where possible, that the patient has been stabilised prior to transfer to hospital. As only a minority of patients with ROSC conveyed to hospital are alert and conscious, on-site airway management and other manoeuvres may be required to help stabilise the patient.<sup>15</sup>

All patients with ROSC should be taken to a designated 'cardiac arrest centre' that has expertise in the management of OHCA and has round-the-clock access to all relevant clinical services, including a cardiac catheter laboratory and an intensive care unit (ICU). Ambulance trusts should ensure that all staff are trained appropriately in the agreed protocols. The only exception to this is if the cardiac arrest is believed to be the result of trauma, in which case the patient should be conveyed according to major trauma protocols; usually to a major trauma centre. Some hospitals may be designated as both cardiac arrest and major trauma centres,

however in cases of traumatic OHCA it is trauma management that takes priority. In exceptional cases where a patient with ROSC is highly unstable or is judged to have a very poor prognosis due to pre-existing co-morbidities they may be conveyed not to the cardiac arrest centre, but to a nearer hospital for further stabilisation and assessment. Senior clinical support may usefully assist decision-making in these cases.

Except where the cardiac arrest is believed to be due to trauma, a 12-lead electrocardiogram (ECG) should be performed at the earliest opportunity, ideally before moving the patient from the scene. Ambulance clinicians are trained in ECG interpretation, including the recognition of STEMI and life-threatening arrhythmias.

If the ECG shows ST-segment elevation or left bundle branch block, then the cause of the arrest should be presumed to be an acute occlusion of a major coronary artery, and the emergency services should contact the local cardiac arrest centre to discuss coronary reperfusion therapy according to local protocol, usually with primary percutaneous coronary intervention (PPCI). Unless inappropriate, or otherwise not possible, the patient should be taken immediately to the on-call cardiac catheter laboratory at the cardiac arrest centre, where further assessment can take place and immediate PPCI can be offered if appropriate.<sup>16</sup> This requires coordination of care, not only between the ambulance and hospital services but also within hospital services.

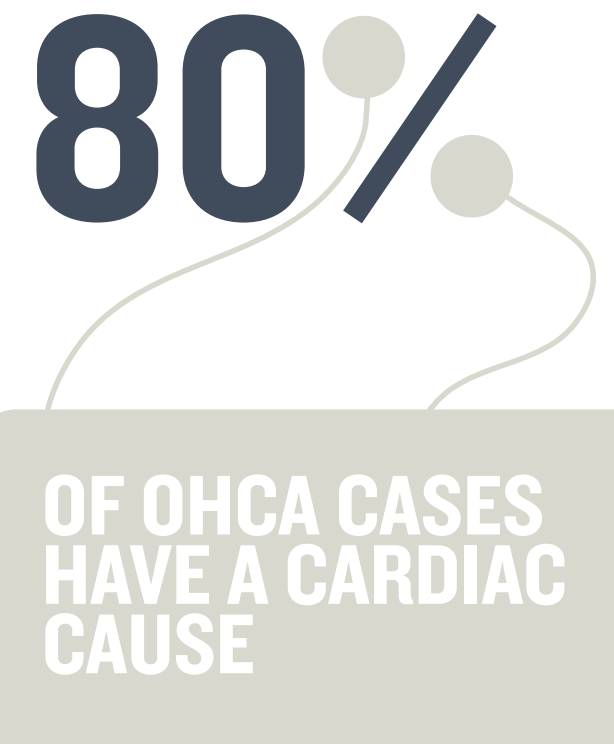
Therefore, protocols between front-line nurses, emergency physicians, cardiologists, intensive care physicians and anaesthetists need to be agreed. Such protocols should specify whether comatose patients are taken straight to the cardiac catheter laboratory or the ED. In cases of doubt, the patient should be taken to the ED resuscitation room.

Approximately 80% of OHCA cases have a cardiac cause. If the ECG shows evidence of ST-segment depression or is normal, then the patient should be taken to the protocol-designated place in the hospital, whether that is an ED, cardiac care unit (CCU) or a cardiac catheter laboratory.

The relevant department should be warned of the patient's imminent arrival. The hospital coordinator should direct the emergency services appropriately, according to regionally agreed arrangements.

In either ECG scenario, the patient should be conveyed to a 'cardiac arrest centre' that has expertise in the management of OHCA and has round-the-clock access to all relevant clinical services, including a cardiac catheter laboratory and an intensive care unit (ICU see below). Ambulance trusts should ensure that all staff are trained appropriately in the agreed protocols.

Consideration should be given to early transport to hospital (with on-going CPR) of those in refractory shockable rhythms (that is, after



administration of amiodarone and fourth shock), where additional skills and interventions may improve the chances of survival. Consideration should also be given to procedures to maintain normothermia prior to or during transfer.

The agreed service should be applied regardless of the age, background, sex, race or culture of the patient or geographical location of the OHCA, understanding that it may be necessary to take some patients to the nearest centre for stabilisation. Specific cultural sensitivities may need to be taken into account.

At all stages of resuscitation and post-resuscitation care it is important to try to ascertain any previously documented care plans or advance decisions or any wishes otherwise previously expressed by the patient regarding the receipt of CPR or other potentially life-sustaining treatments. This is to ensure, as far as possible, that any treatments provided do not conflict with the patient's known wishes or with clearly documented clinical recommendations that are relevant to the circumstances at the time.



# Cardiac Arrest Centres

(Recognised centres of care)

**All patients who have achieved ROSC following OHCA should be taken to a recognised centre of care where they can be assessed, triaged and treated as clinically appropriate, whatever the time of day.**

Regions should therefore designate the centres to be involved in the care of these patients after agreement with the relevant ambulance services and commissioners. The receiving hospitals should have a designated single point of call to aid the emergency services in deciding where the patient should be taken and to activate the relevant clinical teams to be ready to take over the care of the patient as soon as the ambulance arrives at the hospital.

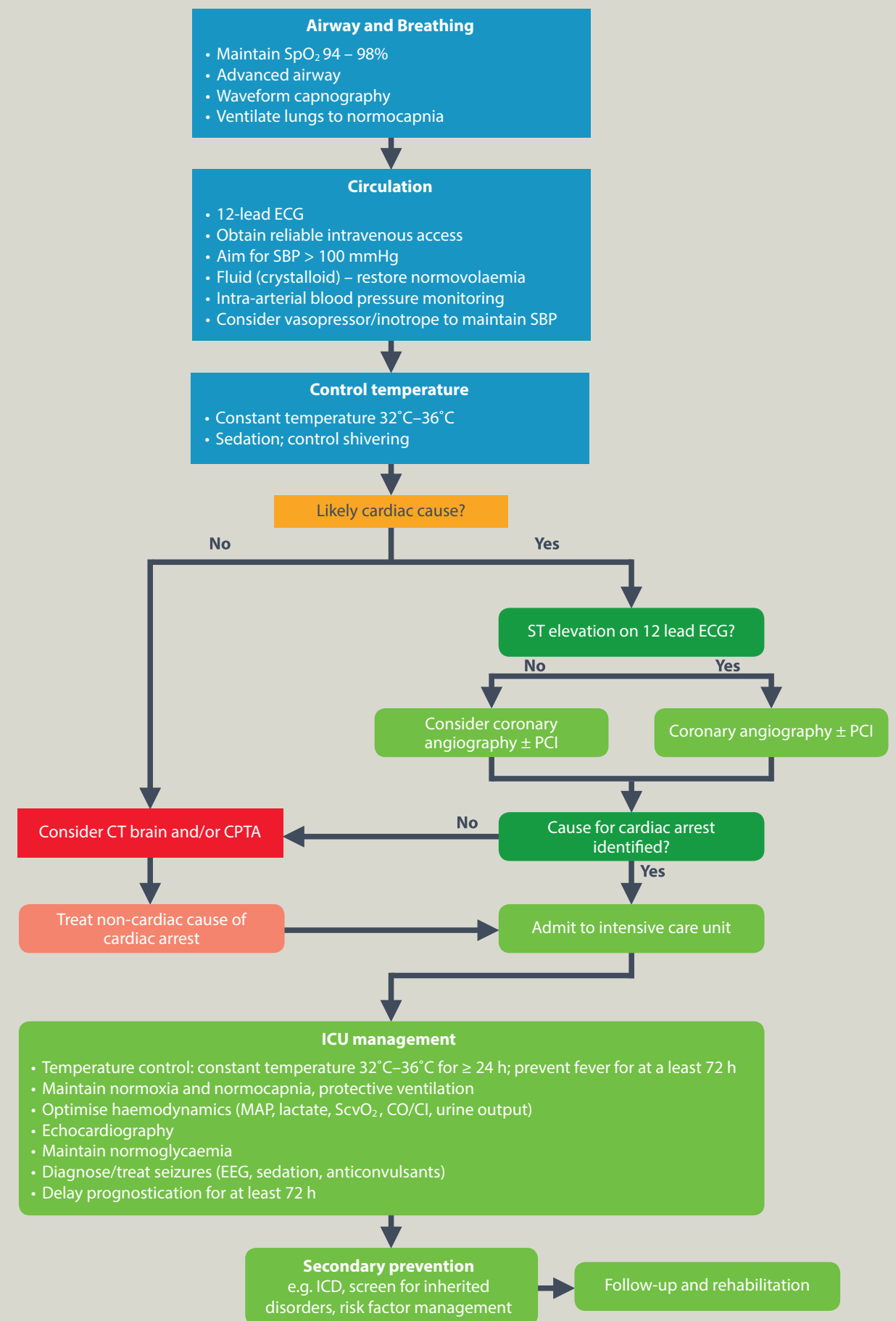
If a patient is taken to a hospital that is not a designated cardiac arrest centre, referral and transfer to a designated centre should be considered unless the patient is assessed and considered to be unfit for transfer or further treatment considered futile. Regional protocols should enable such a referral to be to a single point of contact within the regional or sub-regional centre, in a similar fashion to the current arrangements for STEMI and major trauma patients.

Such Cardiac Arrest Centres should have round-the-clock access to a cardiac catheter laboratory with availability of advanced circulatory support, for example intra-aortic balloon pump and/or other circulatory assist devices. There should be immediate access to computerised tomography (CT) scanning and echocardiography services.

The centre should have ICU services with the ability to provide targeted temperature management and a range of neurophysiological assessments on patients who remain comatose. Some designated centres will also have expertise in extracorporeal membrane oxygenation. The centre should have constant access to electrophysiology expertise.

**ALL PATIENTS WHO HAVE ACHIEVED ROSC FOLLOWING OHCA SHOULD BE TAKEN TO A RECOGNISED CENTRE OF CARE**

**Post Resuscitation Care Algorithm:** Post Resuscitation Care Guidelines (2015)  
Reproduced with kind permission from the Resuscitation Council (UK)





# Early triage and coordination

## (between emergency medicine/cardiology/radiology/anaesthesia/intensive care)

### Among hospitals offering interventional cardiology services, there is considerable variation in the number of patients surviving OHCA who are taken to the catheter laboratory for emergency angiography and possible percutaneous coronary intervention (PCI) of a culprit coronary lesion.

Where ST-segment elevation is present, NICE guidance<sup>7</sup> states that, unless there is a contraindication, such patients should go directly to the catheter laboratory for PPCI and that the persistence of unconsciousness per se should not be regarded as a reason for not pursuing the same pathway of care. Consideration should be taken of all the information available, including knowledge of any heart disease or other medical conditions, and details about the cardiac arrest. In some situations following such assessment, treatment will be considered futile. For the majority of patients, however, treatment should be considered as for any other individual suffering an STEMI.

In general, PCI procedures performed from the radial artery approach are preferred because of lower complication rates. A femoral artery approach will be needed in some cases, however, when radial access is not achievable or there is a likely need for a haemodynamic support device, such as an intra-aortic balloon pump or other circulatory assist device.

Where there is some doubt, other investigations might be needed prior to coronary angiography; for example, CT scan of the head to rule out sub-arachnoid haemorrhage or other neurological event, or echocardiography with or without CT pulmonary angiography to investigate the possibility of pulmonary embolism. Where the OHCA has resulted from trauma, whole body CT scanning should be considered. Where the cardiac arrest itself has led to a fall (including fall from standing at the point of collapse) head and cervical spine injury are important possibilities and CT scanning should be considered to assess for intracranial injury and cervical spine damage. CT scanning may also detect other non-cardiac causes of cardiac arrest (for example, ruptured aortic aneurysm) and injuries related to CPR (for example, broken ribs, haemothorax or pneumothorax). There may be signs of other acute conditions, such as a major haemorrhage or sepsis.

Early coronary angiography can be very useful, even if the procedure shows unobstructed coronary arteries or only minor coronary disease (when an acute coronary syndrome [ACS] is less likely), as the findings can help to direct immediate attention to other investigations to determine the cause of the event, although there is a need for additional research in this area. The caveat is that an abnormal coronary angiogram does not always imply an ACS and does not rule out other causes for the arrest.

Centres that treat these patients must have 24/7 support from intensive care services, which should be immediately available to provide support with airway management and invasive mechanical ventilation. Teams should have the expertise to use inotropic drugs and mechanical systems for haemodynamic support if needed. The ability to access emergency echocardiography around the clock is essential.

Although an area of continuing research, there is a growing consensus that patients without ST-segment elevation and without a clear non-cardiac cause for the OHCA should also be considered for early coronary angiography.<sup>17,18</sup> This group of patients includes those who have had an ACS, as well as others who have had a primary arrhythmic event or a potentially fatal arrhythmia as a consequence of another non-cardiac problem. There may be circumstances when immediate angiography is appropriate; for example, ROSC or a conscious patient who gives a clear history of an ACS with on-going pain and an ischaemic ECG. In those patients with time for a detailed assessment, full intensive care support may be considered more appropriate before the use of coronary angiography. However, an early coronary angiogram will help clarify the diagnosis and direct management. Given that the need for an angiogram is less immediate in such cases, each centre should have an agreed protocol for where the patient is assessed and triaged.

Unless there is a clear non-cardiac cause, a complicating factor or further treatment is considered to be futile, there should be an **early discussion between the ED or ICU physicians and the interventional cardiology team** as to the most appropriate timing of investigation; however, the expectation will be that early angiography is offered. European recommendations suggest that the preliminary clinical and imaging work-up should be completed within 2 hours so that a decision on coronary angiography can be taken.<sup>19</sup>

Irrespective of whether the patient is admitted directly to the ED or the cardiology unit, there should be coordination between the emergency, cardiology, radiology and intensive care services to ensure rapid assessment and treatment of these patients. A multidisciplinary team approach is essential. Other patients may have ROSC but show signs of other rhythm problems, such as haemodynamically important bradyarrhythmias (slow rhythms, for example heart block) or tachyarrhythmias (fast heart rhythms). Prompt triage to the cardiology service enables these to be assessed and treated appropriately.

**Urgent and Emergency Care Networks should establish, with designated provider hospitals and their commissioners, how patients are to be cared for so that a consistent approach is clearly defined and adopted.**

## General and cardiothoracic intensive care

**There should be an agreed protocol for the placement and care of patients following the initial assessment, early investigation and management in the ED, CCU and/or cardiac catheter laboratory.<sup>17,18</sup>**

The intravascular volume, haematological and metabolic status of the patient should be assessed and managed accordingly. Patients remaining unconscious after the ROSC and requiring mechanical ventilation will need to be transferred to a general or cardiothoracic ICU (CICU).

**PROGNOSTICATION OF NEUROLOGICAL OUTCOME IN COMATOSE POST-CARDIAC ARREST PATIENTS SHOULD GENERALLY BE DELAYED UNTIL AT LEAST 72 HOURS AFTER CARDIAC ARREST**

Centres that have both types of ICU should have an agreed policy to determine the optimal care of the patient and there should be a degree of flexibility between units, as well as other regional ICUs, when there is a shortage of intensive care beds. Specialised services should develop alongside each other in a collaborative manner. Some general ICUs do not currently manage certain patients, for example, those requiring haemodynamic support with an intra-aortic balloon pump. Whilst skills develop, the solution in these circumstances is either to manage the patient in a CICU, or in a general ICU with support from the local cardiology services. Some patients who have recovered consciousness may not need to be cared for in an ICU, although many will need that level of support.

The current consensus is for unconscious patients to be treated with targeted temperature management as early as possible at a constant temperature in the range of 32–36°C, according to local protocol. Patients typically have a temperature less than 36°C on arrival. If the local policy is to maintain temperature at 36°C, the patient's temperature should be allowed to rise passively and then actively managed at 36°C.<sup>20</sup> Passive measures such as anti-pyretics and tepid sponging are usually insufficient to hold the core temperature  $\leq 36^\circ\text{C}$  and active cooling is required for effective targeted temperature management. Pyrexia in these circumstances adversely affects good neurological recovery.



Patients remaining unconscious after the ROSC and requiring mechanical ventilation will need to be transferred to a general or cardiothoracic ICU (CICU).

Other acute hospital services should be available to provide radiological or other imaging investigations and renal support, and to manage other conditions such as major gastro-intestinal haemorrhage, acute abdomen and stroke. Many patients will develop pulmonary sepsis and intensive respiratory care may be required.

Prognostication of neurological outcome in comatose post-cardiac arrest patients should generally be delayed until at least 72 hours after cardiac arrest and after sufficient time has been given to enable full clearance of sedation and return to normothermia if patient cooling has been implemented. Apart from clinical examination and cerebral imaging (CT/magnetic resonance imaging) a number of

different neurological investigations should be available, along with the expertise to interpret the results. These include electroencephalography, somatosensory evoked potentials and biomarkers; for example, neuron specific enolase. Guidelines for prognostication have been published by the European Resuscitation Council and European Society of Intensive Care Medicine, and have been incorporated in the 2015 Resuscitation Council (UK) guidelines.<sup>21</sup>

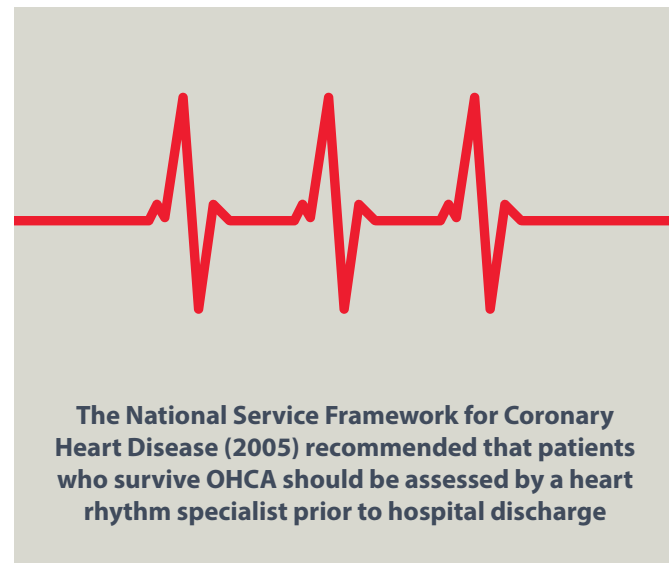
If clinical examination and appropriate investigations predict a poor outcome, such as death or severe neurological deficit, withdrawal of life-sustaining treatment (WLST) may be considered. We heard from patient and public representation just how important it is for there to be a full discussion about withdrawal of treatment and its timing with the family of, or those closest to, the person who has suffered OHCA. The wishes of the individual may be known to them, and there is a wide range of opinion about what constitutes an 'adequate' future quality of life. In short, the individual's, or their family's, willingness to accept neurological disability after OHCA will differ, and this information should be closely considered alongside assessments of medical prognosis. If a WLST decision is made, it is important to remember to consider organ donation. In 2014, 10% of patients dying after admission to UK ICUs following OHCA became solid organ donors.<sup>22</sup>

## Step-down and the second phase of care

**After patients have recovered to a level where intensive care support is no longer required, the patient should be transferred to a ward environment where requirements for continuing care can be met.**

Many will be referred to the CCU or a cardiology ward; some will need referral directly to a neurology ward or neurorehabilitation unit. There will be a need for on-going coordination between specialties in specific cases; for example, a patient recovering from a heart attack who needs on-going renal replacement therapy. In most patients who have had an ACS, further assessment of ventricular function and the potential for on-going myocardial ischaemia will be necessary.

Patients with ACS or established coronary artery disease should be considered for secondary preventive pharmacological treatment, such as platelet inhibitor therapy (often started at the time of PCI), a beta blocker, lipid lowering agents, an ACE-inhibitor or angiotensin-receptor blocker and, in those with poor ventricular function, an aldosterone antagonist. The latter group should be reassessed 8–12 weeks later to determine whether they are candidates for treatment with an implantable cardiac defibrillator or cardiac resynchronisation therapy. Depending on individual circumstances, other patients should be considered for appropriate imaging or for assessment by an electrophysiologist.



The National Service Framework for Coronary Heart Disease (2005) recommended that patients who survive OHCA should be assessed by a heart rhythm specialist prior to hospital discharge.<sup>23</sup>

This was to ensure that those at risk of recurrent cardiac arrest received prompt treatment to reduce that risk.

### **Inherited Cardiac Conditions (ICC)**

All adults or paediatric cardiac arrest survivors should be referred to a regional ICC service if a genetic cause of the cardiac arrest is suspected. Irrespective of survival their immediate family should also be referred for assessment to the regional ICC service. Depending on the protocol for referral to that service, some initial phenotypic screening may be arranged locally to facilitate optimal assessment when the family attends the ICC clinic.

## Rehabilitation

### **Psychological support**

Many family members and bystanders will find an OHCA distressing. Primary care and ambulance clinicians should be able to refer bystanders and family members to appropriate counselling or other support services. Health professionals may also find some circumstances distressing and their employing organisations should have appropriate support systems in place and ensure access to these when needed.

### **Cardiac and general rehabilitation**

Recovering patients should also be assessed by a cardiac rehabilitation team and offered a cardiac rehabilitation programme suited to their needs in line with NICE and professional society guidance.<sup>24,25</sup> Some patients will require intensive physiotherapy and other services to help them rehabilitate after a prolonged stay on ICU.<sup>26</sup>

### **Neurological assessment and neuro-rehabilitation**

Regardless of cardiac recovery, patients will fall into one of five neurological groups:

1. Early and good recovery
2. Survival but with minor neurological impairment
3. Survival but with moderate or severe neurological impairment which is considered likely to recover to a variable degree
4. Survival but with severe irreversible brain damage
5. Severe brain damage leading to death.

The majority of patients who survive fall into the first three categories. In the early stages of recovery, it might be impossible to differentiate groups 3 and 4. Many patients will have a minor degree of cognitive impairment which may or may not recover. Many patients may subsequently suffer from anxiety or depression and may need to be referred for psychological counselling or specific treatment.<sup>27</sup> Those with significant impairment should be assessed by a neurology team and referred to a neuro-rehabilitation team if appropriate. There is currently a shortage of neuro-rehabilitation services and each region should assess their current capacity and make a plan to build up to an appropriate level as necessary. Appropriate levels of physiotherapy, occupational therapy, speech and language therapy and neuropsychology services should be available on a daily basis for those who require them.

Severe hypoxic brain injury leads to diffuse and widespread neurological damage, resulting in a range of physical, cognitive, emotional, behavioural and psychosocial problems. A small number of patients in categories 3 and 4 will have more complex rehabilitation needs requiring assessment by a consultant in rehabilitation medicine and referral to a specialist (Level 1 or 2) rehabilitation service.<sup>28</sup> Patients who remain in a vegetative or minimally conscious state may present a range of complex clinical, ethical and legal issues and should be managed by teams with specific expertise in this area in accordance with the Royal College Guidelines for Prolonged Disorders of Consciousness.<sup>29</sup>



## Long-term care for patients with continuing neurological impairment

**There is a shortage of appropriate care for those who need continuing neurological and physical rehabilitation and long-term care for patients with significant neurological impairment.**

Urgent and emergency care networks should determine the current level of care and the demand that would be generated by providing optimal care, and make appropriate plans to address any shortfall. Hospital and social services should have a coordinated approach to allow timely discharge from hospital. This should be to an appropriate level of care with sufficient support from rehabilitation, physiotherapy and neuropsychology services.



## Paediatric considerations

**OHCA is much less common in children than in adults. In the US, the overall incidence in children is about 8 per 100,000 person-years, compared with 126 per 100,000 person-years for adults.<sup>30</sup>**

These estimates of occurrence vary with age: infants 72.1 per 100 000 person years, children up to 12 years of age 3.7 per 100 000 person years, and older children 6.4 per 100 000 person years. The incidence is similar in the UK.

The majority of paediatric OHCA follow a more prolonged physiological deterioration; for example, from respiratory causes or circulatory insufficiency, instead of a sudden primary cardiac arrest. Therefore, children with secondary cardiac arrests tend to have lower survival rates and poorer neurological outcomes compared with adults; although infants may fare slightly better than older children.

As there are relatively few primary cardiac arrests, the BLS sequence in children for those with healthcare responsibility differs from adult practice; that is, rescue breaths followed by chest compression (with a compression:ventilation ratio of 15:2 for trained responders). Subsequent advanced life support management is based on the ABCDE sequence of resuscitation, which is the same as that used in adults. The child should be taken to the nearest ED for stabilisation;

subsequently, there may be secondary transfer to a paediatric intensive care unit (PICU) facility, either in-house or to another hospital, depending on the clinical course and the cause of the arrest.<sup>31</sup> In the out-of-hospital setting, children with shockable rhythms, such as ventricular fibrillation or pulseless ventricular tachycardia, achieve higher survival rates and better neurological outcomes than those with asystole or pulseless electrical activity, as with adults.

The duration of cardiac arrest is a poor predictor of outcome in children,<sup>32</sup> therefore resuscitation is usually attempted in children unless they are clearly in an unsurvivable condition. In all but the most futile cases, there should be minimal delays in transferring the child, with on-going CPR, to the emergency department for specialised care.

**RESUSCITATION IS USUALLY ATTEMPTED IN CHILDREN UNLESS THEY ARE CLEARLY IN AN UNSURVIVABLE CONDITION. IN ALL BUT THE MOST FUTILE CASES, THERE SHOULD BE MINIMAL DELAYS IN TRANSFERRING THE CHILD, WITH ON-GOING CPR, TO THE EMERGENCY DEPARTMENT FOR SPECIALISED CARE**

**Congenital heart disease:**

Congenital heart disease is present in about 6–9 per 1,000 live births in the UK each year, with the effects of many of these conditions evolving over time; for example, atrial or ventricular septal defects. Antenatal screening has improved the outcomes for conditions previously considered lethal.<sup>33</sup> Many will require surgical or interventional treatment. A few children may present in cardiac arrest caused by a congenital heart condition. Residual cardiac surgical scars (for example, sternotomy or thoracotomy scar) or an obvious murmur after ROSC, may point to the presence of such conditions. Anomalous coronary artery anatomy can cause sudden cardiac arrest, with no prior warning or abnormal clinical signs.

There will be a higher incidence of shockable rhythms in children with a primary cardiac cause for their arrest, so a defibrillator must be applied immediately. Hospitals that are likely to respond to an arrest in a child should have appropriate paediatric equipment for resuscitation although, if not immediately available, 'adult' equipment can be used.

There are important genetic conditions seen in children (and adults), which include inherited heart rhythm disturbances; for example, long QT syndrome, Brugada syndrome, catecholaminergic polymorphic ventricular tachycardia, progressive cardiac conduction defect, or cardiomyopathies (such as hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy, familial dilated cardiomyopathy).<sup>34</sup> Therefore, a detailed family history can be important for the child's subsequent management after ROSC.

**Acquired conditions**

Some acquired conditions may cause cardiac arrest; for example, abnormal coronary arteries following Kawasaki disease (giant aneurysmal formation and at a later stage, coronary stenosis causing ischaemic heart disease in children and young people).<sup>35</sup> Myocarditis due to viral infection can present with cardiac arrest, hence a history of any recent or previous illnesses may be informative. Data about paediatric cardiac arrests are limited and should be included in national data collection systems.

# National data collection

## The use of national audit and benchmarking is essential to assess performance and to drive up the quality of care for patients following OHCA.

National audit programmes should provide feedback to those responsible for the care of patients and those who collect the data. There are already a number of registries that capture data on these patients. The existing national registries are specific to different steps in the Chain of Survival, and include only a sub-set of all OHCA patients. A linkage between these datasets is therefore considered essential. Commissioners should ensure that resource is provided with the expectation that:

1. All patients treated for OHCA by ambulance trusts should be entered on the OHCAO registry (currently funded by the BHF and the Resuscitation Council [UK])
2. All patients suffering in-hospital cardiac arrest that generates a team response should be entered on the National Cardiac Arrest Audit (NCAA) database, coordinated by the Resuscitation Council (UK) and the Intensive Care National Audit & Research Centre (ICNARC), especially as some of these patients will have been admitted after an out-of-hospital arrest.

3. All patients treated on an intensive care unit should be entered into the Intensive Care National Audit & Research Centre (ICNARC) Case Mix Programme
4. All patients recognised as having a primary cardiac cause for their arrest should be entered on the appropriate registries hosted by the National Institute for Cardiovascular Outcomes Research (Myocardial Ischaemia National Audit Project [MINAP], PCI, Adult Cardiac Surgery, Cardiac Rhythm Management)
5. All patients undergoing cardiac rehabilitation should be entered on the National Audit of Cardiac Rehabilitation (NACR). In collaboration with the British Association for Cardiovascular Prevention and Rehabilitation (BACPR), this dataset is integral to the minimum standards and the NACR/BACPR certification process.
6. All patients undergoing specialist neuro-rehabilitation should be entered on the UK Rehabilitation Outcomes Collaborative (UKROC) database.

The stakeholder national societies should seek to coordinate a linkage exercise between the registries to enhance support for the audit programmes at each step of the Chain of Survival and to capture national data to help with observational and international comparison research.

## Participation in research

**Although this framework is based on the current 2015 Resuscitation Council (UK) guidelines, there are still many uncertainties about methods of resuscitation and the effectiveness and cost-effectiveness of specific elements of the OHCA care pathway.<sup>36</sup>**

Only a very small proportion of the 2015 guideline recommendations are based on high-quality evidence that comes from well-designed randomised controlled trials. All ambulance services and hospital centres should contribute to national and international efforts to improve the evidence-base and to help shape future clinical guidelines. Research funding bodies should prioritise high-quality research in resuscitation science to help address important on-going uncertainties.



**RESEARCH FUNDING BODIES SHOULD PRIORITISE HIGH QUALITY RESEARCH IN RESUSCITATION SCIENCE TO HELP ADDRESS IMPORTANT ON-GOING UNCERTAINTIES**

## References

1. Perkins GD, Lockey AS, de Belder MA, Moore F, Weissberg P, Gray H, for the Community Resuscitation Group. National initiatives to improve outcomes from out-of-hospital cardiac arrest in England. *Emerg Med J* 2016;33(7):448–51. doi: 10.1136/emermed-2015-204847.
2. Rajagopal S, Kaye CR, Lall R, Deakin CD, Gates S, Pocock H, et al. Characteristics of patients who are not resuscitated in out of hospital cardiac arrests and opportunities to improve community response to cardiac arrest. *Resuscitation* 2016 Dec;109:110-115. doi:10.1016/j.resuscitation.2016.09.014.
3. Wissenberg M, Lippert FK, Folke F, et al. Association of national initiatives to improve cardiac arrest management with rates of bystander intervention and patient survival after out-of-hospital cardiac arrest. *JAMA* 2013;310:1377–84.
4. Department of Health. Cardiovascular Disease Outcomes Strategy. Improving outcomes for people with or at risk of cardiovascular disease. 5th March 2013. Available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/217118/9387-2900853-CVD-Outcomes\\_web1.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/217118/9387-2900853-CVD-Outcomes_web1.pdf) [accessed 5 September 2016].
5. Nolan JP, Hazinski MF, Aickin R, Bhanji F, Billi JE, Callaway CW, et al. Part 1: Executive summary: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Resuscitation* 2015;95:e1–31. doi: 10.1016/j.resuscitation.2015.07.039.
6. Resuscitation Council (UK). Resuscitation Council Guidelines 2015. Available at <https://www.resus.org.uk/resuscitation-guidelines/> [accessed 5 September 2016].
7. National Institute for Health and Care Excellence (NICE). Acutely ill adults in hospital: recognising and responding to deterioration. Clinical guideline 50; July 2007. Available at <https://www.nice.org.uk/guidance/cg50> [accessed 5 September 2016].
8. National Institute for Health and Care Excellence (NICE). Myocardial infarction with ST-segment elevation: acute management. Clinical guideline 167; July 2013. Available at <https://www.nice.org.uk/guidance/cg167> [accessed 5 September 2016].
9. Resuscitation Council (UK). Quality Standards. Available at <https://www.resus.org.uk/quality-standards/> [accessed 5 September 2016].
10. Association of Ambulance Chief Executives and Joint Royal Colleges Ambulance Liaison Committee. UK Ambulance Services clinical practice guidelines 2016. Available at <http://aace.org.uk/clinical-practice-guidelines/> [accessed 5 September 2016].
11. International Liaison Committee on Resuscitation (ILCOR). Available at <http://www.ilcor.org/home/> [accessed 5 September 2016].
12. Perkins GD, Travers AH, Berg RA, Castren M, Considine J, Escalante R, et al. Part 3: Adult basic life support and automated external defibrillation: 2015 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Resuscitation* 2015;95:e43–e69. doi:10.1016/j.resuscitation.2015.07.041.
13. Deakin CD, Shewry E, Gray HH. Public access defibrillation remains out of reach for most victims of out-of-hospital sudden cardiac arrest. *Heart* 2014;100(8):619–23. Available at <http://heart.bmj.com/content/100/8/619.long> [accessed 5 September 2016].



**14.** Böttiger BW, Bossaert LL, Castren M, Cimpoesu D, Georgiou M, Greif R, et al. Kids Save Lives - ERC position statement on school children education in CPR.: "Hands that help - Training children is training for life". *Resuscitation* 2016;105:A1–A3. doi: 10.1016/j.resuscitation.2016.06.005.

**15.** Deakin CD, Fothergill R, Moore F, Watson L, Whitbread M. Level of consciousness on admission to a Heart Attack Centre is a predictor of survival from out-of-hospital cardiac arrest. *Resuscitation* 2014;85(7):905–9. doi: 10.1016/j.resuscitation.2014.02.020.

**16.** Fothergill RT, Watson LR, Viridi GK, Moore FP, Whitbread M. Survival of resuscitated cardiac arrest patients with ST-elevation myocardial infarction (STEMI) conveyed directly to a Heart Attack Centre by ambulance clinicians. *Resuscitation* 2014;85(1):96–8. doi: 10.1016/j.resuscitation.2013.09.010.

**17.** Resuscitation Council (UK). Resuscitation Guidelines 2015. Post resuscitation care. Available at <https://www.resus.org.uk/resuscitation-guidelines/post-resuscitation-care/> [accessed 5 September 2016].

**18.** Nolan JP, Soar J, Cariou A, Cronberg T, Moulart VR, Deakin CD, et al. European Resuscitation Council and European Society of Intensive Care Medicine guidelines for post-resuscitation care 2015: Section 5 of the European Resuscitation Council Guidelines for resuscitation 2015. *Resuscitation* 2015;95:202–22. doi: 10.1016/j.resuscitation.2015.07.018.

**19.** Noc M, Fajadet J, Lassen JF, Kala P, MacCarthy P, Olivecrona GK, et al. Invasive coronary treatment strategies for out-of-hospital cardiac arrest: a consensus statement from the European association for percutaneous cardiovascular interventions (EAPCI)/stent for life (SFL) groups. *EuroIntervention* 2014;10(1):31–7. doi: 10.4244/EIJV10I1A7

**20.** Donnino MW, Andersen LW, Berg KM, Reynolds JC, Nolan JP, Morley PT, et al. Temperature management after cardiac arrest: An advisory statement by the Advanced Life Support Task Force of the International Liaison Committee on Resuscitation and the American Heart Association Emergency Cardiovascular Care Committee and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation. *Circulation* 2015;132(25):2448–56. doi: 10.1161/CIR.0000000000000313. Erratum in: *Circulation*. 2016;5;133(1):e13.

**21.** Sandroni C, Cariou A, Cavallaro F, Cronberg T, Friberg H, Hoedemaekers C, et al. Prognostication in comatose survivors of cardiac arrest: an advisory statement from the European Resuscitation Council and the European Society of Intensive Care Medicine. *Resuscitation* 2014;85(12):1779–89.

**22.** Nolan JP, Ferrando P, Soar J, Bengner J, Thomas M, Harrison DA, et al. Increasing survival after admission to UK critical care units following cardiopulmonary resuscitation. *Crit Care* 2016;20(1):219. doi: 10.1186/s13054-016-1390-6.

**23.** Department of Health. National Service Framework for Coronary Heart Disease. Chapter Eight: Arrhythmias and Sudden Cardiac Death; March 2005. Available at [http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Healthcare/Longtermconditions/Vascular/Coronaryheartdisease/DH\\_4117048](http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Healthcare/Longtermconditions/Vascular/Coronaryheartdisease/DH_4117048) [accessed 5 September 2016].

**24.** National Institute for Health and Care Excellence (NICE). Myocardial infarction: cardiac rehabilitation and prevention of further cardiovascular disease. Clinical guideline 172; November 2013. Available at <https://www.nice.org.uk/guidance/cg172> [accessed 5 September 2016].

**25.** British Association for Cardiovascular Prevention and Rehabilitation (BACPR). The BACPR standards and core components for cardiovascular disease prevention and rehabilitation 2012. Available at [http://www.bacpr.com/resources/15E\\_BACPR\\_Standards\\_FINAL.pdf](http://www.bacpr.com/resources/15E_BACPR_Standards_FINAL.pdf) [accessed 5 September 2016].

**26.** National Institute for Health and Care Excellence (NICE). Rehabilitation after critical illness in adults. Clinical guideline 83. Available at <https://www.nice.org.uk/guidance/cg83> [accessed 5 September 2016].

**27.** Lilja G, Nilsson G, Nielsen N, Friberg H, Hassager C, Koopmans M, et al. Anxiety and depression among out-of-hospital cardiac arrest survivors. *Resuscitation* 2015;97:68–75. doi: 10.1016/j.resuscitation.2015.09.389.

**28.** British Society of Rehabilitation Medicine (BSRM) 2015. Specialist neuro-rehabilitation services: providing for patients with complex rehabilitation needs. <http://www.bsrm.org.uk/downloads/specialised-neurorehabilitation-service-standards-7-30-4-2015-pcatv2-forweb-4-5-16.pdf>

**29.** Royal College of Physicians (Ed. Turner-Stokes L). Prolonged disorders of consciousness: National clinical guidelines. London, RCP, 2013. <https://www.rcplondon.ac.uk/guidelines-policy/prolonged-disorders-consciousness-national-clinical-guidelines>

**30.** Atkins DL, Everson-Stewart S, Sears GK, Daya M, Osmond MH, Warden CR, et al. Epidemiology and outcomes from out-of-hospital cardiac arrest in children: the Resuscitation Outcomes Consortium Epistry-Cardiac Arrest. *Circulation* 2009;119(11):1484–91. doi: 10.1161/CIRCULATIONAHA.108.802678.

**31.** European Resuscitation Council and the Resuscitation Council (UK). European Paediatric Advanced Life Support. Fourth edition, February 2016, ISBN 978-1-903812-32-7. Available at <https://www.resus.org.uk/publications/european-paediatric-advanced-life-support-manual/> [accessed 5 September 2016].

**32.** Nolan JP, Hazinski MF, Aickin R, Bhanji F, Billi JE, Callaway CW, et al. Part 1: Executive summary: 2015 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. *Resuscitation* 2015;95:e1–31. doi: 10.1016/j.resuscitation.2015.07.039.

**33.** NHS England. Update on neonatal and antenatal detection of congenital heart disease (CHD). Available at <https://www.england.nhs.uk/wp-content/uploads/2014/09/chd-5-230914.pdf> [accessed 5 September 2016].

**34.** British Heart Foundation. Inherited heart conditions. Available at [www.bhf.org.uk/heart-health/conditions/inherited-heart-conditions](http://www.bhf.org.uk/heart-health/conditions/inherited-heart-conditions) [accessed 5 September 2016].

**35.** Eleftheriou D, Levin M, Shingadia D, Tulloh R, Klein NJ, Brogan PA. Management of Kawasaki disease. *Arch Dis Child* 2014;99(1):74–83. doi: 10.1136/archdischild-2012-302841.

**36.** Petrie J, Easton S, Naik V, Lockie C, Brett SJ, Stumpfle R. Hospital costs of out-of-hospital cardiac arrest patients treated in intensive care; a single centre evaluation using the national tariff-based system. *BMJ Open* 2015;5(4):e005797. doi: 10.1136/bmjopen-2014-005797.

# Appendix One



Figure A: Recommended Defibrillator Sign

The British Heart Foundation and the Resuscitation Council (UK) have developed a new defibrillator location sign (Fig A), and an associated information poster (Fig B). The signs were designed after independent surveys of nearly 4000 members of the public and subsequent expert review from both organisations.

It is hoped that improved signage will increase awareness of defibrillators, those for public access, and encourage their use. The information poster re-inforces the key messages that anyone can use a defibrillator if needed, regardless of prior training or experience.



Figure B: Recommended Defibrillator Poster (to be used with the recommended Defibrillator Sign, see Figure A)

Both the PAD location sign and the information poster will be available from May 2017. More information will subsequently be available on the websites of the British Heart Foundation ([bhf.org.uk](http://bhf.org.uk)) and the Resuscitation Council (UK) ([www.resus.org.uk](http://www.resus.org.uk))

# Glossary

ACS	Acute coronary syndrome
AED	Automatic external defibrillator
BACPR	British Association for Cardiovascular Prevention and Rehabilitation
BLS	Basic life support
BHF	British Heart Foundation
CCU	Cardiac Care Unit
CICU	Cardiothoracic Intensive Care Unit
CG	Clinical guideline
CPR	Cardiopulmonary resuscitation
CT	Computerised tomography
ECG	Electrocardiogram
ED	Emergency department
EMS	Emergency Medical Services
ERC	European Resuscitation Council
ICC	Inherited cardiac conditions
ICU	Intensive care unit
ILCOR	International Liaison Committee on Resuscitation
MPDS	Medical Priority Dispatch System
MINAP	Myocardial ischaemia national audit project
NICE	National Institute for Health and Care Excellence
NHS	National Health Service
NSTEMI	Non-ST-segment elevation myocardial infarction
OHCA	Out-of-hospital cardiac arrest
OHCAO Registry	Out-of-Hospital Cardiac Arrest Outcomes Registry
PAD	Public access defibrillator
PCI	Percutaneous coronary intervention
PEA	Pulseless electrical activity
PPCI	Primary percutaneous coronary intervention
RC (UK)	Resuscitation Council (UK)
ROSC	Return of spontaneous circulation
STEMI	ST-segment elevation myocardial infarction
STPs	Sustainability and transformation plans
WLST	Withdrawal of life-sustaining treatment

# OHCA steering group

## (alphabetical order):

### Professor Jonathan Benger\*

National Clinical Director for Urgent Care, NHS England; Consultant in Emergency Medicine, University Hospitals Bristol NHS Foundation Trust  
**Email:** Jonathan.Benger@uwe.ac.uk

### Professor Stephen Brett

President, The Intensive Care Society; Professor of Critical Care, Imperial College London  
**Email:** stephen.brett@imperial.ac.uk

### Emma X Brown

Area Coroner for Birmingham and Solihull  
**Email:** Emma.X.Brown@birmingham.gov.uk

### Dr Gareth Clegg

Clinical Senior Lecturer, University of Edinburgh  
**Email:** Gareth.Clegg@ed.ac.uk  
 grclegg@gmail.com

### Professor Charles Deakin

Professor of Resuscitation and Prehospital Emergency Medicine, Southampton University; Divisional Medical Director, South Central Ambulance Service  
**Email:** charlesdeakin@doctors.org.uk

### Dr Mark de Belder\*

Consultant Cardiologist, The James Cook University, Middlesbrough; Honorary Reader, University College London  
**Email:** mark.debelder@stees.nhs.uk

### Dr Farzin Fath-Ordoubadi

Cardiac clinical lead for Greater Manchester and East Cheshire Strategic Clinical Network; Consultant Interventional Cardiologist, Manchester Royal Infirmary  
**Email:** Farzin.Fath-ordoubadi@cmft.nhs.uk

### Dr Rachael Fothergill

Head of Clinical Audit & Research, London Ambulance Service NHS Trust; Honorary Research Fellow, Clinical Trials Unit, Warwick University  
**Email:** rachael.fothergill@lond-amb.nhs.uk

### Professor Huon Gray Chair,\*

National Clinical Director for Heart Disease, NHS England; Consultant Cardiologist Southampton University Hospital  
**Email:** huon.gray@nhs.net

### Sue Hampshire\*

Resuscitation Council (UK)  
**Email:** sue.hampshire@resus.org.uk

### Cathryn James

Association of Ambulance Chief Executives  
**Email:** cathryn.james@aace.org.uk

### Catherine Kelly\*

Executive Director, Prevention, Survival and Support, British Heart Foundation  
**Email:** KellyC@bhf.org.uk

### Professor Nick Linker\*

President, British Heart Rhythm Society; Secretary-Elect, British Cardiovascular Society; Consultant Cardiologist, The James Cook University Hospital, Middlesbrough  
**Email:** nick.linker@nhs.net

### Trudie Lobban MBE\*

Founder and Trustee, Arrhythmia Alliance  
**Email:** trudie@heartrhythmalliance.org

### Professor Richard Lyon

Consultant in Emergency Medicine, NHS Lothian; Professor of Pre-hospital Emergency Care, University of Surrey  
**Email:** richardlyon@doctors.org.uk

### Dr Ian Maconochie

Consultant in Paediatric Emergency Medicine, Department of Paediatric Emergency Medicine, Imperial College NHS Healthcare Trust, Imperial College, London  
**Email:** ian.maconochie@imperial.nhs.uk

### Dr Julian Mark

Chair of the National Ambulance Services Medical Directors Group (NASMeD); Executive Medical Director, Yorkshire Ambulance Service  
**Email:** Julian.Mark@yas.nhs.uk

### Sarah Mitchell\*

Former Executive Director, Resuscitation Council (UK)  
**Email:** Sarah.Mitchell@resus.org.uk

### Prof Jerry Nolan

Past President, Resuscitation Council (UK); Honorary Professor of Resuscitation Medicine, University of Bristol  
**Email:** jerry.nolan@bristol.ac.uk  
 jerrynolan@me.com

### Judy O'Sullivan\*

Director of Services, Prevention, Survival and Support, British Heart Foundation  
**Email:** osullivanj@bhf.org.uk

### Professor Gavin Perkins\*

Chair, Resuscitation Council (UK) BLS/AED Committee; Professor of Critical Care Medicine, University of Warwick  
**Email:** G.D.Perkins@warwick.ac.uk

### Dr David Pitcher\*

Immediate Past President, Resuscitation Council (UK); Consultant Cardiologist (retired)  
**Email:** david.pitcher@resus.org.uk



**Professor Tom Quinn\***

Professor of Nursing/Associate Dean, Joint Faculty, Kingston University and St George's, University of London

**Email:** t.quinn@sgul.kingston.ac.uk

**Professor Simon Redwood**

Past President, British Cardiovascular Intervention Society; Professor of Interventional Cardiology, St Thomas' Hospital, London

**Email:** Simon.Redwood@gstt.nhs.uk

**Dr Paul Rocchiccioli**

Consultant Interventional Cardiologist, Golden Jubilee Hospital, Glasgow

**Email:** p.rocchiccioli@nhs.net

**Professor Kathy Rowan**

Director of Scientific & Strategic Development, Intensive Care National Audit and Research Centre (ICNARC)

**Email:** kathy.rowan@icnarc.org

**Michael Smyth**

Critical care paramedic, West Midlands Ambulance Service NHS Foundation Trust; Research Fellow, Clinical Trials Unit, University of Warwick

**Email:** M.A.Smyth@warwick.ac.uk  
mike.smyth@wmas.nhs.uk

**Dr Jasmeet Soar\***

Past President, Resuscitation Council (UK); Consultant In Anaesthetics and Intensive Care Medicine, Southmead Hospital, Bristol

**Email:** jasmeet.soar@nbt.nhs.uk

**Professor Lynne Turner-Stokes**

President, British Society of Rehabilitation Medicine; Director, UK Rehabilitation Outcomes Collaborative (UKROC)

**Email:** Lynne.turner-stokes@nhs.net

**Dr Clive Weston**

Clinical Lead, MINAP; Reader in Clinical Medicine, Swansea University Medical School

**Email:** c.f.m.weston@swansea.ac.uk

**Dr Matt Wise**

Consultant, Adult Critical Care, University Hospital of Wales, Cardiff

**Email:** mattwise@doctors.org.uk

*\*Member of the Community Resuscitation Steering Group*

**Other members of the Community Resuscitation Steering Group who have reviewed and/or contributed to this document:**

**Sara Askew**

British Heart Foundation

**Dr Mick Colquhoun**

Resuscitation Council (UK)

**Kathryn Elkington**

NHS Pathways

**Dr Carl Gwinnutt**

Resuscitation Council (UK)

**Steve Irving**

Association of Ambulance Chief Executives

**Dr Mona Johnson**

NHS Pathways

**Dr Mike Knapton**

British Heart Foundation

**Dr Andrew Lockey**

Resuscitation Council (UK)

**Dr Neil McGuire**

Medicines and Healthcare products Regulatory Agency

**Dr Fiona Moore**

Association of Ambulance Chief Executives

**Peter O'Reilly**

County Fire Officer and Chief Executive, Greater Manchester Fire and Rescue Service

**Dr Judith Rutter**

NHS Pathways

**Dr William Toff**

Senior Lecturer in Cardiology, University of Leicester

**Laura Wood**

Arrhythmia Alliance

