Resuscitation Council UK

Executive summary of the main changes since the 2021 Guidelines

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Introduction

Guidelines 2025 have been developed as the result of a continuous process over the last four years led by the International Liaison Committee on Resuscitation (ILCOR). The Guidelines align with the rigorous approach taken by the National Institute for Health and Care Excellence (NICE), which includes:

- Systematic reviews using Grading of Recommendations Assessment, Development, and Evaluation (GRADE) methodology to grade the certainty of evidence and strength of recommendations. These reviews formed the basis of the ILCOR Consensus on Science with Treatment Recommendations (CoSTR) summary publications and the CoSTR postings on the ILCOR website.
- The involvement of stakeholders from around the world, including members of the public and cardiac arrest survivors.
- Collaboration with the European Resuscitation Council (ERC) and adaptation of the ERC Guidelines for use in the UK.
- Contact us to receive details of the guideline's development process.

Main changes in Resuscitation Guidelines 2025

The main changes in the Resuscitation Guidelines 2025 are summarised in the sections below.

Education

Resuscitation education should begin early, with awareness campaigns tailored to diverse communities and resuscitation training introduced in childhood from age 4-6, continuing annually in schools. Accredited training must be provided for all healthcare professionals, tailored to their role, setting, and patient population, while ambulance service call handlers should be trained in cardiac arrest recognition and telephone-assisted CPR. Teaching methods should include gamified learning, real-time feedback devices, Rapid Cycle Deliberate Practice, and flexible stepwise approaches. Ethical decision-making and team competencies should be embedded throughout education.

Technology-enhanced and workplace-based approaches are central to modern training. Online resources, augmented reality, and artificial intelligence can support flexible and engaging learning, while in-situ simulation, scripted debriefing tools, and concise team debriefings strengthen clinical application. Faculty development is essential, with structured programmes delivered by trainers with medical education expertise. In low-resource or remote settings, materials and campaigns should be adapted to the context, with distance or hybrid learning and low-cost manikins supporting accessible training.

Epidemiology of cardiac arrest

This section presents epidemiology and outcomes of cardiac arrest data drawn from UK studies, including both in-hospital and out-of-hospital settings.

Out-of-Hospital Cardiac Arrest (OHCA)

Around 115,000 OHCAs are reported to ambulance services annually, with resuscitation attempted in approximately 43,000 cases. Incidence ranges from 54 per 100,000 in England to 92 per 100,000 in Wales. Most occur at home, in men, and in adults aged over 65, with 80% of cardiac origin. Bystander CPR is provided in 60-73% of cases, though AED use remains under 10%. A shockable rhythm is seen in 15-22%. ROSC is achieved in about a quarter overall and in 50-57% of the Utstein group. Thirty-day survival is 9-10% overall and around 30% in the Utstein group. Outcomes are poorer in deprived, urban, and ethnically diverse areas. Paediatric OHCA is rare, with around 750-800 cases each year.

In-Hospital Cardiac Arrest (IHCA)

The incidence of IHCA is 0.9 per 1,000 admissions, equating to around 12,755 cases in 2023-24, including 200 in children. Half occur on wards, with others at presentation or in critical care. Among adults, initial rhythm is VF/VT in 18%, PEA in 52%, and asystole in 20%. ROSC is achieved in just over half, with survival to discharge at 26% overall (53% in VF/VT, 17% in PEA, 12% in asystole). In children, 69% achieve ROSC and 54% survive to discharge, with better outcomes in VF/VT and bradycardia. Data on longer-term and neurological outcomes remain limited.

Ethics

The 2025 ethics in resuscitation guidance emphasises early, person-centred conversations about emergency and future care, supported by clear documentation such as ReSPECT forms that are accessible across care settings. While final decisions in emergencies rest with the treating team, organisations should provide training, policies, and audit processes to ensure consistent practice. Families should be given the option to be present during resuscitation, with appropriate support.

Termination of resuscitation should consider patient values, the absence of reversible causes, and prolonged unsuccessful efforts. Ethical training, including the use of simulation, should be embedded in resuscitation education to prepare clinicians for complex decision-making.

Systems saving lives

The 2025 Systems Saving Lives guidance emphasises strengthening the chain of survival through advocacy, education, and system-wide coordination. Mandatory CPR training for schoolchildren, students, and drivers is recommended, with annual training starting from age four and supported by technology-enhanced methods and community initiatives. First responder systems linked to AED registries, alongside improved ambulance and hospital processes, are central to reducing time to CPR and defibrillation and improving outcomes. Regional networks should be used for post-arrest care, with hospitals adopting structured quality improvement and supporting family presence during CPR.

The guidance also highlights the need for comprehensive survivorship care, supporting both patients and co-survivors from discharge through long-term

recovery, with survivors engaged in policy and research. In low-resource settings, strategies should be adapted to local context, and international collaboration is encouraged.

Adult basic life support

The 2025 Adult Basic Life Support guidance reinforces that everyone can learn CPR and use an AED, with emphasis on early recognition of cardiac arrest, calling 999, and starting chest compressions immediately. New guidance advises calling 999 for any unresponsive person before assessing breathing, with ambulance service call handlers supporting recognition and CPR instructions. Chest compressions should be delivered at 100-120 min^{-1} to a depth of 5-6 cm, with minimal interruptions. Rescue breaths may be given if trained, but chest-compression-only CPR is recommended for untrained rescuers.

The role of ambulance service call handlers is highlighted, including guiding callers through CPR and AED use and linking with volunteer first responder systems and the nearest AED through the Circuit. Bystander CPR and early defibrillation remain critical, doubling to quadrupling survival chances, and rescuers are reassured that the risk of harm is very low. The guidelines also recognise that attempting resuscitation can be distressing for lay rescuers and recommend that systems provide support after such events.

Adult advanced life support

The 2025 Adult Advanced Life Support (ALS) guidance retains the core priorities of early recognition, high-quality chest compressions, rapid defibrillation, and prompt treatment of reversible causes, with greater emphasis on effective ventilation and correct pad placement. Adrenaline remains recommended early in non-shockable rhythms and after the third shock in shockable rhythms. Hospitals should strengthen systems to prevent in-hospital cardiac arrest through early warning scores, critical care outreach, and patient and family escalation systems. Out-of-hospital prevention focuses on identifying and managing cardiovascular risk factors, inherited conditions, and early warning symptoms, especially in younger patients.

ALS treatment should begin as early as possible in both in- and out-of-hospital settings, with trained teams, standardised equipment, and structured communication. Guidance includes detailed recommendations on defibrillation

strategies, airway management, drug use, and post-resuscitation arrhythmia care. Data-driven debriefing is encouraged to improve team performance, while extracorporeal CPR may be considered in specialist centres when conventional CPR fails. Emerging issues such as CPR-induced consciousness require careful management with sedation and analgesia.

Special circumstances

The 2025 special circumstances guidance reinforces that while standard ALS algorithms remain the foundation, clinicians must rapidly recognise and treat reversible causes beyond ischaemic heart disease. Key updates include greater emphasis on ethical preparedness, simulation-based education, and the selective use of extracorporeal CPR in refractory arrests, particularly in cases of hypothermia, thrombosis, or toxin exposure. Guidance also addresses contexts such as pregnancy (including resuscitative hysterotomy), obesity, haemodialysis, sport, and the operating theatre. Across all scenarios, the guidance highlights early recognition, context-specific action, multidisciplinary teamwork, and continuous system improvement as essential to improving outcomes.

Post-resuscitation care

The 2025 adult post-resuscitation care guidance emphasises immediate, structured management after ROSC, using an ABC approach with airway protection, controlled oxygenation, normocapnia, and blood pressure targets above 100 mmHg systolic or MAP 60-65 mmHg. Coronary angiography should be prioritised for patients with ST-elevation or a strong suspicion of occlusion, while whole-body CT is recommended to identify non-coronary causes. Fever prevention (≤ 37.5°C) is advised for comatose patients, with temperature control maintained for 36–72 h. Seizures should be treated with levetiracetam or sodium valproate, and neuroprotective drugs are not routinely recommended.

Multimodal neurological prognostication at ≥ 72 h post-ROSC combines examination, EEG, biomarkers, and imaging, with high specificity required to avoid false pessimism. Withdrawal of life-sustaining therapy must be separated from prognostication and based on wider clinical and patient factors. Early rehabilitation, structured follow-up within three months, and support for survivors and co-survivors are recommended. Organ donation should be considered in patients who progress to death after ROSC, and unexplained cardiac arrests

should be investigated with genetic and advanced cardiac testing. Regional networks are reinforced as key to optimising outcomes.

Paediatric life support (basic and advanced)

The G2025 Paediatric Guideline emphasises early recognition of critical illness in children using structured tools and timely ABCDE assessment, supported by clear team activation processes. It provides detailed recommendations for paediatric basic and advanced life support, including weight-based drug dosing, shock management, ventilation, arrhythmias, and the use of high-quality CPR with early defibrillation when appropriate. Extracorporeal CPR is highlighted for selected cases, with a strong focus on prevention, early intervention, and a family-centred approach.

Key updates include the addition of a new chapter on special circumstances in paediatric resuscitation and the inclusion of post-resuscitation care tailored to children. These sections extend the chain of survival, emphasising reversible cause identification, context-specific management (such as trauma, asthma, drowning, and hypothermia), and structured follow-up after resuscitation to support recovery and outcomes.

Newborn resuscitation and support of transition of infants at birth

The 2025 newborn resuscitation guidance focuses on supporting safe transition at birth with structured assessment, timely interventions, and clear team processes. Initial assessment now places less emphasis on skin colour, recognising its subjectivity and unreliability across different skin tones; heart rate, breathing, tone, and response to stimulation are prioritised instead. Airway management is strengthened with recommendations for two-person jaw thrust, early use of supraglottic airways, and video laryngoscopy where available. Adrenaline dosing intervals are standardised to every 4 min, while sodium bicarbonate is no longer recommended.

The guidance also extends beyond the birthing room, with out-of-hospital newborn life support now explicitly included. Practical recommendations are provided for home births, unexpected births outside hospital, and ambulance care, covering planning, equipment, thermal protection, airway support, vascular access, and safe transfer, with telemedicine support where feasible. Post-

resuscitation care highlights temperature control, glucose management, accurate documentation, early prognostic assessment, and family involvement. Decisions on withholding or discontinuing resuscitation should involve senior clinicians, guided by gestation, clinical response, and parental wishes, with palliative care offered when appropriate.

First aid

The 2025 Resuscitation Guidelines introduce first aid as a brand-new chapter, recognising it as the essential first link in the chain of survival. The guidance defines first aid as help provided by anyone, in any situation, and emphasises early help, scene safety, and structured assessment using the ABCDE approach. Clear expectations are set for first aid providers: call 999 promptly, only use equipment or medicines you are trained to use, and prioritise reassurance and safety until professional help arrives. Key emergencies covered include choking, life-threatening bleeding, drowning, chest pain, asthma, anaphylaxis, hypoglycaemia, opioid overdose, stroke, and trauma, with simple stepwise interventions such as recovery position, tourniquets, adrenaline autoinjectors, and naloxone use where appropriate.

The chapter also extends to environmental and situational emergencies such as heat stroke, hypothermia, snake bite, and concussion. First aid courses are encouraged to be inclusive, accessible, and tailored to the needs of communities, including low-resource and rural settings, while supporting bystanders to overcome fear, anxiety, and moral distress. This new addition reinforces that everyone has a role in saving lives, embedding first aid as an integral part of the UK’s resuscitation framework.

Future iterations

It is intended that there will continue to be a Guideline summary and update for courses every five years; however, the ILCOR evidence evaluation process will be continuous as evidence evolves. It is intended that the Resuscitation Council UK Guidelines will only change within the five-year cycle if there is a significant resuscitation intervention identified through the ILCOR process which affects outcome to a significant degree. These Guidelines 2025 will be implemented in courses from January 2026.

References

ERC Guidelines 2025: https://cprguidelines.eu/

International Liaison Committee on Resuscitation Consensus on Science and Treatment Recommendations: https://costr.ilcor.org

Downloads
Guidelines Equality Impact Assessment G2025198.71 KB

Resuscitation Council UK

Guidelines Process

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Global treatment recommendations

- The International Liaison Committee on Resuscitation (ILCOR) includes representation from the American Heart Association (AHA), the European Resuscitation Council (ERC), the Heart and Stroke Foundation of Canada (HSFC), the Australian and New Zealand Committee on Resuscitation (ANZCOR), the Inter-American Heart Foundation (IAHF), Indian Resuscitation Council Federation (IRCF), International Federation of Red Cross and Red Crescent, Resuscitation Council of Asia (RCA) and the Resuscitation Councils of Southern Africa (RCSA).
- ILCOR is organised into six Task Forces which cover the major domains of resuscitation science and practice – Basic Life Support, Advanced Life Support, Paediatric Life Support, Neonatal Life Support, First Aid and Education, Implementation and teams.
- ILCOR is responsible for the production of the International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations (CoSTR), which member organisations subsequently use to develop guidelines.
- ILCOR has continued with its commitment to a continuous evidence-evaluation process, which began in 2015, with topics prioritised for review by the task forces and with CoSTR updates published annually.
- For the 2025 CoSTR, the ILCOR task forces undertook three types of evidence evaluation: systematic reviews (n=96), scoping reviews (n=43), and evidence updates (112), which covered over 250 topics in total. Further information on the methodological approach is summarised in the Methodology and Conflict of Interest Management: 2025 International Liaison Committee on Resuscitation Consensus on Science with Treatment

Recommendations. This document also describes ILCOR's approach to managing conflict of interest.
- Treatment recommendations were developed based on findings from systematic reviews which were conducted in accordance with Grading of Recommendations Assessment, Development, and Evaluation (GRADE) methodology. The findings from each systematic review were presented to the task force, and the task force drafted the summary CoSTR. Each treatment recommendation indicated the strength of the recommendation and the certainty of the evidence.
- All ILCOR CoSTR updates were open for public comment before final publication.

European and UK Processes

The European Resuscitation Council (ERC) guidelines process

- The ERC guideline development process followed the principles of the Institute of Medicine Quality Standards for Clinical Practice Guidelines and the Guideline International Network Recommendations.
- Full information of the approach used are available in the Executive Summary of the ERC guidelines.
- In brief, guideline writing groups were appointed following review of conflict of interests, to ensure a balance of expertise, multi-professional representation, diversity and geography. Content experts from sister professional societies were also invited to participate. The ERC policy for management of conflict of interest was adhered to throughout the guideline development process.
- The ERC guidelines are based on the ILCOR 2025 CoSTR.
- For the ERC Guidelines, the ILCOR recommendations were supplemented by focused literature reviews undertaken by the ERC Writing Groups for those topics not reviewed in the 2025 ILCOR CoSTR.
- When required, the guidelines were informed by the expert consensus of the writing group's membership.
- The ERC guidelines were drafted and agreed upon by the Writing Group members before posting for a two-week public consultation period. Post consultation and review, revised guidelines were approved for publication by the ERC General Assembly.

Resuscitation Council UK (RCUK) guidelines process

- The RCUK guidelines are distilled from the ERC guidelines and, where necessary, supplemented by focused literature reviews. The RCUK Guidelines Working Group was established to review each section to ensure relevance and alignment to UK practice. Each section was reviewed by a working group including RCUK experts as well as representatives from other professional and public organisations. No further public consultation was carried out as there were no material changes, and the guidelines had already been subjected to public scrutiny as part of the ILCOR and ERC process. Guidelines were reviewed for adherence to current UK practice and to include specific UK systems. RCUK completed an impact assessment review on the final documents.
- The RCUK guidelines adhere to the principles outlined by the National Institute for Health and Care Excellence (NICE) Guidelines Development Process Manual, to ensure quality, consistency and transparency.
- The guidelines process includes:
    - Systematic reviews with grading of the quality of evidence and strength of recommendations.
    - The involvement of stakeholders from around the world, including members of the public, cardiac arrest survivors and stakeholder organisations.
    - An equality and impact assessment considering the UK context.

Equality Impact Assessment (EIA)

RCUK is committed to promoting equality, eliminating unlawful discrimination and actively considering the implications of its guidance for human rights. It aims to comply fully with the Equality Act (2010).

Download the Guidelines impact assessment.

References

ERC Guidelines 2025: https://www.erc.edu/science-research/guidelines/guidelines-2025/guidelines-2025-english

Downloads

Guidelines Equality Impact Assessment G2025198.71 KB

Resuscitation Council UK

Epidemiology of cardiac arrest Guidelines

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Introduction

The European Resuscitation Council (ERC) Guidelines cover the epidemiology and outcomes of cardiac arrest across Europe. This section presents equivalent data drawn from UK studies of the epidemiology of cardiac arrest in the in-hospital and out-of-hospital settings.

Data sources

- Information on the epidemiology and outcomes of out-of-hospital cardiac arrest in England (up to 2024 at the time of writing) and Wales (2015-2021) is collected by the Out-of-Hospital Cardiac Arrest Outcomes (OHCAO) registry. The registry, which is funded by Resuscitation Council UK and the British Heart Foundation, works closely with the Association of Ambulance Chief Executives National Ambulance Medical Directors Group and National Ambulance Research Steering Group.
- Scottish Ambulance Service, on behalf of the Delivery Group for Scotland's Strategy for Out-of-Hospital Cardiac Arrest 2021-2026, produces an annual out-of-hospital cardiac arrest report.
- Representatives from Northern Ireland Ambulance Service have made data available for the chapter authors.
- The British Heart Foundation provided information about The Circuit.
- Information on the epidemiology and outcomes of in-hospital cardiac arrest are provided by the National Cardiac Arrest Audit. This is a joint initiative between Resuscitation Council UK and the Intensive Care National Audit and Research Centre (ICNARC). The National Cardiac Arrest Audit (NCAA) receives data from 186 hospitals across the UK, including from 22 paediatric centres (correct as of March 2024). Overall data for in-hospital cardiac arrest are presented for 2023-2024, and paediatric-specific data for in-hospital cardiac arrest are presented for 2019-2024.
- Data about Donation after Circulatory Death (DCD) were provided by NHS Blood and Transplant and the Organ Donation and Transplantation Activity Data report.
- Data about peri-operative cardiac arrests are provided by the Royal College of Anaesthetists National Audit Project 7 (NAP7) Report. Data were collected between June 2021 and June 2022.

Out-of-hospital cardiac arrest

Where available, we have reported data from all areas of the UK in the following date ranges (unless otherwise specified):

- England (2024)

- Wales (Oct 2015 – Mar 2021)
- Scotland (April 2023 – March 2024)
- Northern Ireland (Jan 2024 – March 2025)

Numbers

- There are approximately 115,000 out-of-hospital cardiac arrests reported to the ambulance services in the UK each year.
- NHS ambulance services attempt resuscitation in around 43,000 people each year in the UK.

Annual incidence

- England: 54 per 100,000 people
- Northern Ireland: 60 per 100,000 people
- Scotland: 68 per 100,000 people
- Wales: 92 per 100,000 people

Demographics

- Most (98%) of out-of-hospital cardiac arrests occur in adults
- 70-80% occur at home
- 60-65% occur in men
- 55-65% occur in those aged 65 or over
- Approximately 80% of out-of-hospital cardiac arrests are due to a cardiac cause.

Median ambulance response times

- England: 7.2 minutes
- Northern Ireland: 9.4 minutes
- Wales: 8.9 minutes

Initial rhythm shockable

- England: 21.7%
- Northern Ireland: 18.4%
- Scotland: 20.4%
- Wales: 15.5%

Bystander witnessed arrests

- England: 50.5%
- Wales: 45.7%

Bystander CPR rates

- England: 72.6%
- Northern Ireland: 41.5% (Jan-Mar 2025 data)
- Scotland: 62.6%
- Wales: 64.3%

Bystander AED use rates

- England: 9.0%
- Northern Ireland: 8.0% (Jan-Mar 2025 data)
- Scotland: 10.3%
- Wales: 8.4%

Return of spontaneous circulation – overall

- England: 27.0%
- Northern Ireland: 23.8%
- Scotland: 26.5%
- Wales: 13.2%

Return of spontaneous circulation – Utstein Comparator Group

- England: 50.3%
- Scotland: 56.5%
- Wales: 28.0%

30-day Survival – overall

- England: 9.5%
- Northern Ireland: 6.5%
- Scotland: 9.6%

30-day Survival – Utstein Comparator Group

- England: 29.0%
- Scotland: 29.6%

Longer-term and functional outcomes

- There is currently no routinely collected or reported information about neurological outcomes, long-term outcomes or other quality of life measures in survivors.

Measures of inequalities

In the UK, out-of-hospital cardiac arrest is not distributed evenly across the population, with marked social and regional inequalities. In England, out-of-hospital cardiac arrest ‘hot spots’, areas with incidence above 60.2 per 100,000 per year and bystander CPR rates below 78.7% (the national medians), are more likely to be urban, densely populated, and socioeconomically deprived. These neighbourhoods tend to have higher proportions of residents in routine occupations, fewer in managerial roles, more people from ethnic minority backgrounds, more born outside the UK, and overall higher levels of deprivation. Across ambulance service regions in England, the proportion of hot spots varies widely, ranging from 5.1% to 48.2%.

Similar patterns are seen in Scotland, where people living in the most deprived areas are almost twice as likely to experience an out-of-hospital cardiac arrest as those in the least deprived areas, yet are less likely to survive to 30 days. Access to public-access Automated External Defibrillators (AEDs) also shows inequalities: the density of registered AEDs varies from 1.0 to 5.3 per 1,000 people across health boards, and deployment rates of public-access AEDs decrease as deprivation increases, despite similar rates of bystander CPR.

These disparities highlight the impact of social determinants on cardiac arrest outcomes and the importance of targeted community interventions to improve equity in survival.

Paediatric out-of-hospital cardiac arrest

Paediatric cases make up a very small proportion of out-of-hospital cardiac arrests. Across the UK, there are approximately 750-800 out-of-hospital cardiac arrests where the ambulance service attempted resuscitation each year. Incidence was 5.0 per 100,000 children (0-18 years) in England, 6.0 per 100,000 children (0-18 years) in Wales, 5.6 per 100,000 children (0-18 years) in Northern Ireland and 6.6 per 100,000 people (0-19 years) in Scotland.

In England, 30-day survival was 13.2%.

The Circuit – the national Public-access AED registry

- The Circuit is the national registry of public-access AEDs and is available to 999 call handlers at the time of the emergency call.
- Members of the public can see circuit-registered AEDs at Defib Finder.
- By mid-June 2025, there were 108,584 AEDs registered, and there had been 218,493 deployments or attempted deployments of Circuit-registered AEDs.
- Information about whether or not these AEDs reached the scene of an out-of-hospital cardiac arrest or were used is not yet available.

In-hospital cardiac arrest

Incidence/numbers

- There were 0.9 cardiac arrests per 1,000 admissions
- There were 12,755 cardiac arrests overall (2023-2024), of which approximately 200 were in paediatric patients (1,016 in the 5-year period 2019-2024).

Demographics – overall

- 62.6% male
- 68.5 years mean age
- 16.1% in non-white ethnicities

Demographics – paediatrics

- 54.2% male
- 57.1% aged < 1 years
- 38.0% in non-white ethnicities

Arrest location – overall

- 20.6% on presentation to hospital
- 51.7% in a general in-hospital location
- 11.4% in a treatment area
- 16.3 % in critical care or coronary care

Arrest location – paediatrics

- 32.8% on presentation to hospital
- 31.9% in a general in-hospital location
- 7.2% in a treatment area
- 28.1% in critical care

Initial rhythm – overall

- VF/VT: 18.1%
- PEA: 52.0%
- Asystole: 19.9%
- (Other/unknown: 10.0%)

Initial rhythm – paediatrics

- VF/VT: 6.0%
- Bradycardia: 22.8%
- Asystole and PEA: 57.6%
- (Other/unknown: 13.7%)

Clinical outcomes – overall

- 52.1% had return of spontaneous circulation > 20 minutes: 75.8% if the initial rhythm was VF/VT, 49.2% if it was PEA, 30.7% if it was asystole.
- 25.8% survived to hospital discharge: 52.9% if the initial rhythm was VF/VT, 17.1% if it was PEA, 11.5% if it was asystole.
- There is currently no routinely collected or reported information about neurological outcomes, long-term outcomes or other quality of life measures in survivors.

Clinical outcomes – paediatrics

- 69.2% had return of spontaneous circulation > 20 minutes: 78.1% if the initial rhythm was VF/VT, 89.4% if it was a bradycardia, 56.7% if it was all other non-shockable rhythms.
- 54.2% survived to hospital discharge: 62.1% if the initial rhythm was VF/VT, 74.7% if it was a bradycardia, 38.0% if it was all other non-shockable rhythms
- There is currently no routinely collected or reported information about neurological outcomes, long-term outcomes or other quality of life measures in survivors.

Withdrawal of Life Sustaining Treatment (WLST)

Among 28,438 out-of-hospital cardiac arrest patients admitted to 204 UK ICUs during 2010–2017, 10,775 (37.9%) had WLST, and of these, 59.4% occurred within 72 h of ICU admission.

Organ donation after death

- Organ donation from deceased patients can be either by Donation after Brain Death (DBD) or by Donation after Circulatory Death (DCD). DCD can be controlled (i.e. after planned withdrawal of life-sustaining treatment) or uncontrolled (after unexpected cardiac arrest where resuscitation was not successful or not indicated).
- In 2024-25, there were 1404 deceased donors, of which 728 were DCD donors and 676 were DBD donors. The average number of transplantable organs retrieved is 2.9 from DCD and 3.6 from DBD. For comparison, there were 969 living donors.
- As of 31 March 2025, there were 8,085 people on the waiting list for an organ transplant, a figure that rose from 4,248 on 31 March 2021.

Peri-operative cardiac arrest

- Incidence of peri-operative cardiac arrest is approximately 1 in 3,000 anaesthetics. This was around 1 in 8,000 anaesthetics in ASA 1-2 patients, and 1 in 1,200 anaesthetics in older, frailer patients (defined as age > 65 years and clinical frailty score > 5).
- 88% of peri-operative cardiac arrests occurred in adults.
- 2.8% of perioperative cardiac arrests occurred in the Emergency Department.
- The most common causes of peri-operative cardiac arrest were major haemorrhage (17%), bradyarrhythmia (9.4%) and cardiac ischaemia (7.3%).
- 56% patients were male.
- Median age was 60.5 years
- The ethnicity of patients having a peri-operative cardiac arrest was similar overall and across age groups to the general population, with no differences noted in the care provided to white and non-white patients.
- 74% were ASA 3-5.
- 60% were having major or complex surgery.

- 82% of initial rhythms during peri-operative cardiac arrest were non-shockable – PEA was the most common rhythm.
- 75% of patients survived the event, and 44% left the hospital alive, of whom 88% had a favourable neurological outcome.

Related content

Training for healthcare professionals

Quality Standards: CPR and AED training in the community

Resuscitation Council UK

Education Guidelines

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Resuscitation education tailored for specific groups of life-saving rescuers

- Educate all members of the community about sudden cardiac arrest awareness and cardiac arrest treatment, and consider the diversity of the target group.
- Introduce early resuscitation training starting in early childhood education (around 4-6 years of age) and incorporate annual resuscitation training into school curricula.

- Provide all healthcare professionals with accredited resuscitation training.
- Tailor the required CPR training to the provider's role, their specific setting, and/or specific patient populations.
- Train ambulance service call handlers in cardiac arrest recognition and telephone-assisted CPR guidance.

Educational methods to teach high-quality resuscitation competencies

- Use blended and self-directed learning to provide flexibility and accessibility for all learners of resuscitation.
- Consider gamified learning as a component of resuscitation training for all types of basic and advanced life support courses.
- Use real-time CPR feedback devices to improve chest compression skill acquisition and accuracy.
- Use Rapid Cycle Deliberate Practice as an effective learning strategy to master skills rapidly.
- Use spaced learning to improve acquisition and retention of competencies.
- Use stepwise approaches for structured skill acquisition. Strict adherence to a four-step approach is not always necessary.
- Healthcare professionals should consider using cognitive aids during resuscitation training to enhance protocol adherence. Bystanders should not use them, as this may delay critical actions.
- Integrate ethical training into healthcare professionals' resuscitation education.
- Regardless of the rescuer's background, basic life support education should include effective chest compressions, safe use of an AED, and ventilation of the lungs.
- Teach two-person ventilation when using a self-inflating bag and mask.
- Address the barriers in BLS training that rescuers might experience in performing CPR and factors increasing rescuers' willingness to perform CPR.
- Include training of team competencies in all life support courses (including non-technical skills and human factors during resuscitation).

Technology-enhanced learning (TEL) for resuscitation

- Use online learning modalities (e.g. podcasts, videos, social media) to provide flexibility in time and location for learners and to promote asynchronous learning.
- Use augmented reality for life support training, as it possibly adds value to the learning process.
- Consider applications and artificial intelligence, which might facilitate assessment and teaching during resuscitation courses.

Simulation-based resuscitation education

- Use high-fidelity manikins when training centres/organisations have the infrastructure, trained personnel, and resources available. Use low-fidelity manikins for standard advanced life support training where high-fidelity manikins are not available.
- Use in-situ simulation (at the workplace) as an option for CPR training where resources are readily available.
- Include the teaching of teamwork competencies in basic and advanced life support simulations.
- Consider the inclusion of a CPR coach as a member of the resuscitation team during CPR simulation.
- Use debriefing scripts to support instructors during debriefing after simulation.

Assessment in resuscitation education

- Use frequent formative assessments in all life support courses to provide instructors with information for targeted feedback and to support learning.
- Use checklists to support assessment decisions.

Feedback and debriefing in life support courses

- Ensure feedback is a two-way discussion between the giver and the recipient, driven by an authentic interest in the learner’s improvement.
- Consider using a concise team debriefing after cardiac arrest training for healthcare professionals to encourage routine clinical debriefings after real-

life resuscitations.

Faculty development

- RCUK recommends faculty development programs for all instructors teaching life support courses.
- Select trainers with medical education expertise to conduct faculty development programmes.
- Implement faculty development programs that enable participants to establish a positive learning climate, practice effective educative leadership, communicate learning goals, implement robust assessment and feedback strategies, and evaluate course programs for continuous improvement.

Effect of resuscitation education on outcome

- Healthcare professionals providing advanced life support to adults should attend accredited adult advanced life support training.
- Healthcare professionals providing advanced life support for newborns and babies should attend accredited neonatal resuscitation training courses such as Newborn Life Support (NLS) and Advanced Resuscitation of the Newborn Infant (ARNI).
- For healthcare professionals providing care for newborns and babies in out-of-hospital settings, we recommend participation in an out-of-hospital specialist course.
- Other accredited life support courses (e.g. paediatric life support) are recommended, even though the effect on patient outcomes is less clear.

Resuscitation education in low-resource settings and remote areas

- Adapt educational approaches and materials, and awareness campaigns to the context and available resources.
- Consider distance learning, technology-enhanced learning, hybrid resuscitation training, and the use of low-cost (self-made) manikins.

Related content

Training for healthcare professionals
GIC (Generic Instructor Course)
ILSi (Immediate Life Support Instructor Course)
BLSi (Basic Life Support Instructor Course)
Restart a Heart

Resuscitation Council UK

Systems saving lives Guidelines

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ERC Authors: Semeraro F, Schnaubelt S, Olasveengen TM, Bignami EG, Böttiger BW, Fijačko N, Gamberini L, Hansen CM, Lockey A, Metelmann B, Metelmann C, Ristagno G, van Schuppen H, Thilakasiri K, Monsieurs KG, on behalf of the ERC Systems Saving Lives Collaborator Group.

The Chain of Survival

- The Chain of Survival is a concept that summarises the complex Systems Saving Lives approach. It is intended for everyone involved in resuscitation care, including laypersons, healthcare professionals, educators, and

stakeholders. The concept can be used for a variety of purposes, ranging from raising awareness to inclusion in educational materials.
- For simplicity and consistency, the four-link format is used by Resuscitation Council UK.
- For specific situations or target audiences, a multifaceted chain system (i.e. the basic Chain of Survival plus additional elements) may be applied.

The Formula of Survival

- The Formula of Survival depicts the overarching system behind a successful Chain of Survival and its underlying factors. It can be used to highlight the complex interaction of science, education and implementation to achieve optimal outcomes.
- The three interactive factors are: Science (referring to the continuous evaluation of evidence by the International Liaison Committee on Resuscitation [ILCOR] and the development of evidence-informed guidelines by the European Resuscitation Council); Education (referring to resuscitation training for those who may potentially, or actually take care of cardiac arrest patients, training that must be effective and up to date); and Implementation (referring to a well-functioning Chain of Survival at national, regional and local levels, potentially adapted to various resource settings).

Advocacy

- Multi-national collaborative bodies, national governments, local authorities, and relevant charities should advocate for policies that increase survival rates and improve the quality of life for cardiac arrest patients through the following actions:
    - Promotion of comprehensive policies/legislation: advocate for policies that increase survival rates, reduce inequalities, and enhance the quality of life for those affected by cardiac arrest.
    - Public awareness campaigns: increase public awareness through initiatives such as ‘World Restart a Heart’ and ‘Get Trained, Save Lives’.
    - Mandatory CPR training: Implement mandatory CPR training for children, students (e.g. Restart a Heart), and drivers.
    - Enhanced workplace preparedness: strengthen policies for workplace preparedness (e.g. Resus Ready).

    - Stakeholder engagement: collaborate with stakeholders to support cardiovascular health, and harmonise CPR policies.
    - CPR training at major sporting and large-scale events: offer free short CPR training sessions at major sporting events and other large-scale gatherings to raise awareness and increase knowledge among attendees.

Awareness campaigns and initiatives to promote CPR

- Community initiatives to promote the implementation of CPR should be endorsed and supported.
- Multi-national collaborative bodies, national governments, local authorities, and relevant charities should actively participate in World Restart a Heart (WRAH) to raise awareness of bystander CPR and the use of AEDs, train as many citizens as possible, and develop new and innovative systems and policies.

Young people learning CPR

- All school-aged children should receive CPR training every year.
- CPR education should start at an early age (around four years of age), progressing to comprehensive training that includes chest compressions by ages 10–12, ventilation by age 14, and AED usage by ages 13–16.
- Children who have been trained should be encouraged to educate family members and friends, aiming to teach at least ten others within two weeks. Take-home CPR training kits should be distributed to maximise the multiplier effect.
- CPR training should also be extended to higher education, particularly for healthcare and teaching students.
- Technology-enhanced learning (e.g. extended reality (XR), serious games, smartphone apps) should be incorporated to engage schoolchildren effectively and supplement traditional training methods.
- Ministries of education and policymakers should mandate BLS education in schools by law, supported by legislation, funding, and public awareness campaigns in every country.

Resuscitation in low-resource settings

- Experts from all resource settings are encouraged to investigate and report on populations, aetiologies, and outcomes of resuscitation, following established reporting standards such as the Utstein reporting template.
- Experts from all resource settings should be consulted regarding cultural differences and the regional and local acceptability, applicability, and implementation of guidelines and recommendations.
- All reports and research on resuscitation should include a brief section on the respective resource context, for example, the income classification setting.
- In situations where standard guidelines are not applicable, specific recommendations may be developed for low-resource settings (such as areas with limited funding, offshore environments or remote areas) concerning essential equipment, education, and procedures for managing cardiac arrest both during and after the event.

Social media

- Social media (SoMe) platforms could be used as research tools for data collection, analysis, education, awareness campaigns, communication, and information sharing on sudden cardiac arrest.
- SoMe platforms should be leveraged to support public awareness campaigns, disseminate knowledge on CPR for any age group, and foster community participation.
- SoMe platforms should be incorporated into CPR training programmes. Educational and healthcare institutions are encouraged to use concise, engaging videos, and interactive materials to reinforce learning and retention.
- Real-time engagement and feedback should be encouraged. Live question-and-answer sessions, interactive posts, and gamified learning should be used to increase engagement and knowledge retention in CPR training.
- The validation of SoMe content by experts should be promoted. Institutions are encouraged to ensure that educational materials shared on social media align with international CPR guidelines to prevent the spread of misinformation.
- SoMe-driven initiatives should be monitored and evaluated. Further research is needed to determine their impact on CPR training efficacy, bystander CPR

rates, and patient survival outcomes.

First responders

- Every healthcare system should implement a first responder programme.
- Registered first responders who are near a suspected OHCA should be notified by an ambulance service dispatch centre and dispatched to both public locations and private residences, in order to reduce the time to first chest compression and shock delivery, and to improve survival rates with favourable neurological outcomes.
- Systems that dispatch first responders should be linked to AED registries (i.e. The Circuit) and should prioritise both the physical safety and psychological support of first responders.
- App-based technologies, such as the GoodSAM platform, can facilitate the rapid identification and activation of nearby trained responders and AEDs, supporting earlier intervention and improved outcomes in OHCA.
- Cardiac arrest events should be reported to the Out-of-hospital Cardiac Arrest Outcomes (OHCAO) Registry in a standardised manner to monitor system performance and support continuous quality improvement.

Emergency Service response to cardiac arrest

- Ambulance services should use standardised algorithms or criteria to identify cardiac arrest promptly.
- Ambulance services should teach, monitor, and improve OHCA recognition in dispatch centres.
- Ambulance services should implement and evaluate dispatcher-assisted public-access AED systems, including linkage to AED registries.
- The use of locked or inaccessible AED cabinets is discouraged.
- All emergency service resources responding to OHCA should be equipped with a defibrillator.
- Ambulance services should organise prehospital critical care teams for adult and paediatric OHCA.
- Ambulance services should monitor and address low resuscitation exposure among personnel to ensure teams include members with recent experience and implement proper training to overcome low exposure.

- Ambulance service systems treating OHCA should implement system improvement strategies to enhance patient outcomes, as well as Termination of Resuscitation (TOR) rules to determine whether to stop resuscitation or continue during transport.
- Emergency medical dispatch centres should implement systems allowing call handlers to deliver CPR instructions for cardiac arrest patients.

In-hospital cardiac arrest management

- Hospitals should consider introducing a rapid response system (RRS).
- Hospitals should use system improvement strategies to enhance patient outcomes and contribute data to the National Cardiac Arrest Audit (NCAA).
- Hospitals should implement protocols for managing family presence during CPR and provide respective education for healthcare teams.
- Hospitals are encouraged to use the “Ten Steps Toward Improving In-Hospital Cardiac Arrest Quality of Care and Outcomes” framework to guide structured, system-wide improvements in resuscitation quality, outcomes, and team wellbeing.

Cardiac arrest centres (CAC)

- Adult patients with non-traumatic OHCA should be cared for at a CAC whenever possible and where such pathways exist.
- Healthcare systems should establish local protocols to develop and maintain a cardiac arrest network.

System performance improvement

- Organisations or communities that treat cardiac arrest should implement system improvement strategies to enhance patient outcomes.

Survivorship and co-survivorship

- Healthcare systems should create and implement policies for the care of cardiac arrest survivors and their co-survivors (i.e. those also impacted by the event) from pre-discharge to long-term follow-up. These policies should adopt a multidisciplinary approach, responsive to the needs of both survivors and co-survivors. Healthcare professionals should receive adequate training to support both the identification of needs and the provision of appropriate care.
- Multi-national collaborative bodies, national governments, local authorities, and relevant charities should support cardiac arrest survivor organisations, strengthening ties with healthcare systems, survivors, and co-survivors.
- Engaging in partnerships with organisations that have broader missions, such as cardiovascular healthcare organisations, can help address the diverse needs of survivors and co-survivors and optimise resource utilisation.
- Healthcare systems should actively engage cardiac arrest survivors, co-survivors, and the public as partners in policy development and research to reduce inequalities and enhance the quality, relevance, and integrity of outcomes.

New technologies and artificial intelligence

- Artificial intelligence (AI) and digital health technologies show potential to improve cardiac arrest outcomes but are not yet ready for routine clinical use, and their application should be limited to research or controlled settings.

Related content
Restart a Heart
Lifesaver learning
Guidance: Standard sign for AEDs

Resuscitation Council UK

Ethics Guidelines

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European Resuscitation Council Guidelines 2025 Ethics in Resuscitation. Resuscitation 2025;215 (Suppl 1):110734. https://doi.org/10.1016/j.resuscitation.2025.110734

Planning for emergency and future care and treatment

The conversation

- Discussions and recommendations about CPR are best made in the context of broader discussions and recommendations about emergency and future care planning.

- Emergency and future care planning conversations must be person-centred, realistic and individualised.
- Clinicians should integrate the following to achieve shared understanding:
    - Talk about the person's diagnosis and prognosis in a clear and honest manner; ensure their understanding and expectations are aligned with clinical understanding and expectations.
    - Seek and document information about the person's goals, values, and treatment preferences.
- Emergency and future care planning conversations can take place over multiple meetings and should be started early.
- All healthcare professionals can have a role in facilitating emergency care and treatment planning conversations. Where it is within their scope of practice, they should be willing to discuss emergency and future planning options with all people they care for, particularly those nearing the end of their lives, those with chronic health care conditions and those at risk of sudden deterioration or cardiac arrest.
- Supplemental materials and resources can help people better prepare and participate in emergency and future care planning conversations and should be provided wherever possible.
- It should be respected that a person has the right to refuse treatment.
- When a shared agreement about emergency treatment recommendations cannot be reached by those involved in a planning conversation, steps should be taken to rectify this, including seeking a second opinion, advice from a clinical ethical advisory group and/or legal advice.
- If the person who the planning relates to is unable to take part in a conversation, other appropriate representatives must be invited to contribute on their behalf.
- Emergency treatment plans and clinical recommendations should be reviewed regularly to ensure they remain relevant to the needs of the person they relate to and support their care goals.

The documentation

- Emergency care and treatment plans should reflect the contents and outcomes of a planning conversation.
- The written contents of an emergency care and treatment plan should be clear, concise and written in a way that is easily understood by all who read it.

- Use of a standardised emergency care and treatment plan, such as the Recommended Summary Plan for Emergency Care and Treatment (ReSPECT), is encouraged.
- The rationale informing recommendations should be documented. This might include, but is not limited to, the person's values and preferences, their diagnosis and prognosis or the likelihood of success of attempted CPR.
- Emergency care and treatment plans should be accessible across all care settings.
- Emergency care and treatment plans should be reviewed at the request of the person or those close to them, when a person's situation changes, or if the clinician thinks it would be appropriate. It is not necessary to repeat the discussion on every hospital admission, particularly if the person has expressed a definitive and informed view to refuse a treatment.

The interpretation

- Emergency care and treatment plans help provide immediate guidance and treatment recommendations to help guide decision-making in an emergency, documenting the person's voice and previous clinical reasoning. Clinical recommendations are not legally binding.
- The final decision regarding whether or not an emergency treatment is clinically appropriate and lawful rests with the healthcare professionals responsible for the person's immediate care at that time when treatment is provided, unless there is a legally binding document in place.
- Legally binding documents vary across the nations of the UK. Healthcare professionals should familiarise themselves with those in use in the nations in which they practice.

The implementation

- Healthcare organisations should have policies and procedures to govern and inform the use of emergency care and treatment plans.
- Healthcare organisations should provide clinicians with communication skills training to improve clinicians' skills and comfort in supporting patients to define care and treatment goals.
- Healthcare organisations should ensure staff receive training so they understand their roles and responsibilities in relation to emergency care and treatment planning, and how they should respond to medical emergencies.

- Healthcare organisations should have processes in place which ensure emergency care and treatment planning processes and education are audited to ensure they meet defined standards and undertake quality improvement projects when required.

Ethics of bystander and first responder involvement

- Ensure that bystanders are not forced or unduly compelled into performing CPR, respecting their personal autonomy in resuscitation decision-making, while acknowledging the 'duty to help'.
- Offer ethical guidance for navigating situations involving difficult or distressing interventions to reduce moral distress among bystanders and first responders.
- Healthcare systems should implement measures to facilitate psychological support for bystanders and first responders following out-of-hospital cardiac arrest (OHCA).
- Policy makers should provide guidance on the legal and ethical protection for bystanders to reduce hesitation due to fear of liability or moral responsibility.
- Healthcare systems should implement strategies to minimise the impact of biases in bystander intervention, ensuring that protected characteristics (e.g. age, sex, gender, ethnicity) or socio-economic status do not influence resuscitation decisions.

Family presence

- Resuscitation teams should offer the family of people who have had cardiac arrests the choice to be present during the resuscitation attempt.
- Healthcare systems should establish clear, contextualised, and culturally sensitive procedures for the involvement of family members.
- Healthcare systems should specifically train their teams to support family members during resuscitation.
- As far as reasonably practicable, healthcare systems should have a trained team member who can be designated to this task as part of the overall CPR strategy.

Termination of resuscitation (TOR)*

- Organisations caring for people who may have a cardiac arrest should implement criteria for the withholding and termination of CPR for both in-hospital cardiac arrest (IHCA) and out-of-hospital cardiac arrest (OHCA), taking into consideration the specific local, legal, organisational, and cultural context.
- Make a team-based decision to terminate resuscitation based on a holistic approach, considering patient values and preferences, and the combined picture of prognostic factors, including duration of CPR, the absence of reversible causes, and the absence of response to advanced life support.
- TOR rules may be used to aid decision-making for adult patients with OHCA following local validation and considering local values and preferences.
- TOR rules should not be used for in-hospital cardiac arrest (IHCA) and for paediatric or neonatal patients in any setting due to insufficient evidence.
- Clinicians should clearly document reasons for the withholding or termination of CPR, and these reasons should be audited by healthcare organisations.
- TOR should be carried out in a planned manner, and all team members should have the opportunity to be involved in decision-making. TOR may be considered when the patient has persistent asystole (from the time of confirmation of cardiac arrest), despite at least 45 minutes of advanced life support in the absence of any reversible cause, when no other clinical factors suggest against it.
- Persistently low end-tidal CO_2 ($ETCO_2$) is a strong prognostic marker that may be used to aid decision-making on top of other factors, but should not be used in isolation.
- Factors such as cardiac ultrasound, blood gases, and pupil reactiveness should not be used as the basis for terminating resuscitation.
- The team should conduct a debriefing immediately following termination of resuscitation.

*Guidance on withholding or discontinuing resuscitation in neonates is included in the 2025 Resuscitation Guidelines for Newborn resuscitation and support of transition of infants at birth.

Organ donation after cardiac arrest

- Systems that offer organ donation following cardiac arrest should ensure the development of transparent processes for the identification of potential donors, the obtaining of consent and organ preservation.

Ethics of education and systems

- Establish ethical reasoning as a core competency in resuscitation training to strengthen critical thinking, ethical judgment, and decision-making that respects patient autonomy, follows medical best practices, and aligns with societal values.
- Implement simulation-based ethics training to provide healthcare professionals with hands-on experience in ethically complex resuscitation scenarios, including cases involving communication and decision-making regarding advance care planning, DNACPR decisions and TOR decisions.
- Introduce ethical preparedness training for resuscitation providers to develop strategies for managing moral distress, addressing ethical dilemmas, and overcoming institutional constraints that impact decision-making in high-pressure situations.
- Standardise institutional policies on emergency and future care planning, CPR recommendations, and TOR by embedding structured ethical frameworks that provide clear, legally and professionally aligned guidance for resuscitation decisions.
- Develop formal training programs to equip healthcare professionals with the skills to navigate institutional constraints, legal uncertainties, and policy inconsistencies in ethically complex resuscitation cases.
- Ensure ethical considerations are embedded within resuscitation policies to promote patient-centred, transparent, and ethically sound decision-making at institutional levels.

Resuscitation research ethics

- Systems should support the delivery of high-quality emergency research, as an essential component of optimising patient-centred cardiac arrest outcomes.
- Regulatory and procedural barriers to high-quality emergency research related to consent models should be minimised. For observational research (e.g. in the context of registry data collection and/or DNA biobank data

sampling and analyses), we suggest consideration of a deferred consent model, with concurrent implementation of appropriate safeguards aimed at preventing data breaches and patient reidentification.

- Researchers should involve patients and members of the public as community advisors throughout the research process, including design, delivery and research dissemination.
- The use of a core outcome set, along with standardised corresponding terminology, should be harmonised across trials investigating clinical effectiveness.
- Communities or populations in which research is undertaken and who bear the risk of research-related adverse events should be given the opportunity to benefit from its results.
- Researchers should comply with best practice guidance to ensure the integrity and transparency of research, including study protocol registration, prompt reporting of results, allocation of authorship according to international criteria for authorship, and data sharing.
- Policies of governments, public health bodies, international societies, and non-profit organisations should aim to ensure that funding for cardiac arrest research is sufficient to effectively address the high societal burden caused by cardiac arrest-associated morbidity and mortality.
- Use of artificial intelligence (AI) in research should be regulated according to rigorous ethical and scientific safeguards for beneficence, autonomy/privacy and justice. As an example, development of new AI algorithms should be based on broad datasets in which the participants are representative of the broader population. from the general population, rather than datasets from socioeconomically privileged groups.

Related content
ReSPECT
Guidance: DNACPR and CPR decisions

Resuscitation Council UK

First Aid Guidelines

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Key points

- **Expectations of a first aid provider:** Always call for help early and, ideally, use a speakerphone, especially if alone. As a general principle, only use equipment and medications you have been trained to use.
- **Structured assessment:** Utilise an ABCDE approach to promptly identify and treat life-threatening conditions. ABCDE stands for A-Airway, B-Breathing, C-Circulation, D-Disability, E-Exposure.
- **Foreign body airway obstruction:** Use an escalating approach with cough, back blows and abdominal thrusts in adults who are choking.

- **Life-threatening bleeding:** an escalating approach with manual direct pressure and, thereafter, haemostatic dressing and/or tourniquets.
- **Drowning:** Offer flotation, remove the person from the water, and provide immediate care as needed, including preventing hypothermia.
- **First aid courses:** Tailor first aid courses to the needs of participants and settings and empower equity.

Introduction

- First aid is described as a helping behaviour by anyone, for any emergency condition, in any situation, including self-care. Its provision typically involves recognising, assessing, and prioritising needs, providing care within the provider's competencies whilst recognising their limitations, and seeking additional help such as activating the emergency services. All resuscitation, including basic and advanced life support, begins with first aid interventions: assessing scene safety, recognising decreased responsiveness or abnormal breathing, positioning the person appropriately, and responding to life-threatening conditions. First aid serves as a crucial first link in the chain of survival.

Guidelines

First aid courses

- First aid courses should be accessible to the widest possible audience and promote equal opportunities in both providing and receiving first aid.
- Course providers should tailor content based on the needs of participants, their context (low-resource settings, rural areas), sociocultural appropriateness and feasibility.
- Courses should include measures to help bystanders, lay rescuers and professional first aid providers to overcome fear, anxiety and moral distress during and after providing first aid.

Expectations of a first aid provider

- As a first aid provider, you may minimise further injury, improve health and prevent death by following these three key principles:

1. Check for scene safety.
2. Call 999.
3. Only use available equipment or medications you have been trained to use.

- There are occasions when a first aider may be directed to use equipment by the emergency services that they may not have previously had in-depth training on.

First aid kits

- All workplaces, leisure centres, public buildings, homes and cars should have first aid kits.
- Public first aid kits should be clearly marked and readily accessible.
- The content of the kits should be based on the setting, expected risks and the users.
- All first aid kits should be inspected regularly and properly maintained.

Cardiac arrest

- If you suspect a cardiac arrest, call 999 and follow the call handler's instructions on how to perform cardiopulmonary resuscitation (CPR).
- Saving a person's life is a priority, and first aiders should not be concerned about causing harm to the patient.
- Continue CPR: until professional help arrives and takes over (or tells you to stop), the individual becomes responsive (speaks, opens eyes, moves purposefully, or breathes normally), or the rescuer becomes exhausted.

Structured first aid assessment of a person appearing ill, injured or in shock (ABCDE)

- Pay immediate attention to safety, the responsiveness of the victim, and life-threatening bleeding.
- Use the ABCDE framework to structure your assessment of a person in need.

Recovery position

- Place adults and children with a decreased level of responsiveness who do NOT meet the criteria for CPR into a lateral (side-lying) recovery position.
- In cases of agonal breathing or trauma, do NOT move the person into the recovery position.

Use of pulse oximetry and use of oxygen for acute difficulty breathing

- If you are trained to deliver oxygen, then give oxygen to a person with difficulty breathing and/or looking cyanosed. Cyanosis can be recognised by blue tinges on the skin and lips (for darker skin tones, look for pallor or blue tinges inside the lips). Use a pulse oximeter to titrate the administered oxygen.
- Give oxygen via a simple face mask or non-rebreathing mask and then titrate the flow rate to maintain an oxygen saturation of between 94-98%.
- If the person has chronic obstructive pulmonary disease, titrate the oxygen flow to maintain oxygen saturation levels between 88-92%.
- In the presence of life-threatening hypoxaemia (oxygen saturation < 88%), in the out-of-hospital setting, give oxygen with a higher flow to everyone, including persons with chronic obstructive pulmonary disease having difficulty in breathing.

Medical emergencies

Anaphylaxis

- Suspect anaphylaxis if someone has:
  - Breathing difficulties that can range from noisy breathing (stridor) due to upper airway swelling to wheezing due to lower airway obstruction.
  - Flushing, rash (hives), cold or clammy skin or feeling faint.
  - Abdominal pain, vomiting, or diarrhoea.
  - A recent exposure to known food allergens or insect stings.
- Call 999.

- Ensure that the person is lying down unless there are breathing difficulties, in which case they may sit up with their legs extended.
- Remove the trigger if known and possible.
- Intramuscular adrenaline should be given (either self-administered or by trained individuals) as soon as possible via autoinjector into the outer thigh, which delivers the recommended dose.
- If symptoms persist five minutes after administration, give a second dose of adrenaline, ideally in the opposite leg.

Choking in an adult

- Suspect choking if a person is suddenly unable to speak or cough, particularly if eating.
- Ask the person: “Are you choking?”
- Encourage the person to cough.
    - If the person is unable to cough or the cough becomes ineffective, give up to five back blows.
    - If back blows are ineffective, give up to five abdominal thrusts.
    - If choking has not been relieved after five abdominal thrusts, call 999 and continue alternating five back blows with five abdominal thrusts until choking is relieved, or the person becomes unresponsive.
- Do NOT use blind finger sweeps to try and remove a foreign body from the mouth or airway.
- If the person becomes unresponsive, start CPR and ensure 999 has been called.
- Any person successfully treated for choking with abdominal thrusts or chest compressions should be evaluated by a healthcare practitioner since complications and injuries may occur.

Asthma

- If a person with asthma is experiencing breathing difficulties, a first aid provider should help them to use their own reliever inhaler, using a spacer device if one is available.

Chest pain

- Reassure the person and sit or lie them in a comfortable position.
- Call 999.
- Encourage and assist a person with cardiac sounding chest pain in self-administering 300 mg of aspirin (ideally chewable or dissolvable) as soon as possible, whilst awaiting emergency assistance (but not to adults with a known aspirin allergy).
- Assist a person with known angina to self-administer their nitroglycerine spray or tablets.
- Stay with the person until help arrives.

Hypoglycaemia (low blood sugar value)

- Suspect hypoglycaemia in someone with diabetes or chronic malnutrition AND sudden impaired responsiveness or behavioural change.
    - Give glucose or dextrose tablets (15-20 g) by mouth if the person is awake and able to swallow.
- If feasible, measure capillary blood sugar using a blood glucose meter and treat if low (a value less than 4.0 mmol L^{-1} or 70 mg dL^{-1}) and repeat measurement after treatment.
- If glucose or dextrose tablets are not available, provide other dietary sugars, such as a handful of sugary sweets or 50-100 mL of fruit juice or a sugar-containing drink.
- If oral glucose is not available, give a glucose gel (partially held in the cheek, and partially swallowed).
- Repeat giving oral glucose if the symptoms are still present and not improving after 15 min.
- For children who are uncooperative with swallowing oral glucose, but NOT unresponsive, consider administering half a teaspoon of table sugar (2.5 g) under the tongue.
- Call 999 if the person is/or becomes unresponsive, or the condition does not improve.
- Following recovery from symptoms (5-10 min after sugar intake), encourage the person to eat a light snack.
- In an unresponsive person, do not give oral sugar in any form due to the risk of aspiration; instead, call 999 and consider the recovery position.

Opiate/Opioid poisoning

- Suspect an opiate/opioid overdose if:
    - the person is breathing slowly
    - the breathing is irregular or absent
    - the person is extremely drowsy or unresponsive
    - the person has very small pupils.
- Call 999.
- If the person is unresponsive and not breathing normally, start CPR.
- Administer naloxone if you are trained.
- Reassess the person using the ABCDE approach.
- Follow the packaging instructions on when to give another dose of naloxone.
- The person should remain under observation until emergency assistance arrives.

Stroke

- Use a stroke assessment scale (such as FAST; Face, Arm, Speech, Time) to decrease the time to recognition and call 999 for help. Only give oxygen if you are trained in its use and the person is showing signs of hypoxia (blue tinges to the skin and lips or, for darker skin tones, look for pallor or blue tinges inside the lips).

Suicidal thoughts

- If you think a person might harm themselves, ask them if they are alright, how they feel and why. Ask them if they have suicidal thoughts.
- Assess the risk of suicide: did the person communicate about or make plans to take their own life?
- Explore the suicidal thoughts and listen to the individual in a non-judgmental way.
- If the person has made concrete threats or plans for suicide, tell them you are going to ask for help, and call 999.
- If these warning signs are not present, listen non-judgmentally and encourage seeking professional or other support (e.g. GP, suicide hotline such as Samaritans).

Trauma emergencies

Cervical spinal motion restriction

- Suspect a cervical spine injury in a person who fell or dived from a height, was crushed by machinery or a heavy object or was involved in a road traffic or a sporting accident.
- Minimise movement of the neck. If the person is awake and alert, encourage them to self-maintain their neck in a comfortable, stable position.
- Never force an uncooperative person into any position, as this may exacerbate an injury.
- If the person is unresponsive and lying on their back, kneel behind their head and immobilise their head and neck using the head or trapezius squeeze technique to maintain a neutral in-line position. Consider the need to open the person's airway using the 'jaw-thrust' technique. Airway opening, if required, always has priority over in-line immobilisation; using a jaw thrust manoeuvre should maintain a neutral position of the neck.
- If the person is unresponsive and is lying face down, check if their airway is open and hold their neck in a stable position. If you need to open their airway, ask others to help you carefully roll them as a unit onto their back, while keeping their neck in line with their body and as stable as possible. Then apply the head or trapezius squeeze.
- People responding who have specialised training (e.g. lifeguard, mountain rescue) may consider the selective use of spinal motion restriction devices and collars using their existing protocols.

Control of life-threatening bleeding

- Call 999.
- Apply firm, direct manual pressure to any bleeding injury site.
- Apply a standard or ideally a haemostatic dressing directly to the bleeding injury, then apply firm direct pressure, which may require at some sites the dressing to be packed into the wound. In the absence of any first aid dressings, any clean material can be utilised in this way, with an emphasis on stopping the bleeding.
- Once bleeding is under control, apply a pressure dressing.
- Apply a tourniquet as soon as possible for life-threatening extremity bleeding that is not controlled by direct manual pressure:
    - Place the tourniquet around the traumatised limb 5-7cm above the injury, but not over a joint.

- Tighten the tourniquet until the bleeding slows and stops. This may be painful for the person.
- Write the time the tourniquet was applied.
- Do not release the tourniquet. It should only be released by a healthcare professional.
- In some cases, you may need to apply a second tourniquet, above the first tourniquet, to control the bleeding.

Open chest wounds

- Call 999.
- Leave an open chest wound exposed to freely communicate with the external environment. Do not apply a dressing or cover the wound.
- If necessary, control localised bleeding with direct pressure.
- If you are trained and the equipment is available, apply a specialised non-occlusive or vented dressing, ensuring a free outflow of air when exhaling. Observe for air flow obstruction due to bleeding or clotted blood.

Preservation of an amputated body part

- Manage any severe bleeding first (see ‘Control of life-threatening bleeding’).
- Retrieve the body part as quickly as possible and keep it cold without allowing it to freeze:
  - Wrap the part in a sterile dressing or a clean cloth moistened with saline or water.
  - Place the wrapped part in a clean, watertight plastic bag or container.
  - Place the bag or container holding the body part inside another bag containing ice or ice water. If ice is unavailable, you can use a cooler or instant cold packs.
  - Keep the part cooled at all times. Avoid direct contact with ice or freezing. Label the container with the person’s name and the time the part was stored.
  - Transport the part with the injured person to the same hospital as quickly as possible.

Concussion

- Suspect a concussion if a person has difficulties with thinking/remembering, displays physical symptoms (headache, change in vision, dizziness, nausea or vomiting, seizures, sensitivity to light/noise), emotional changes or changes in behaviour (increased sleepiness, reduction in normal activities, loss of responsiveness, confusion).
- Remove the person from physical activities.
- Refer to a healthcare professional for assessment and further advice.

Environmental emergencies

Drowning

- If you are not trained in water rescue, do not enter the water, as you might risk drowning.
- If the person is awake and responsive, stay on land and reach out to the person through flotation devices, a lifebuoy, a rescue tube or other rescue equipment.
- Trained first aiders or lifeguards in the water or on a boat:
  - Call 999 before entering the water.
  - Provide a flotation device, lifebuoy, rescue tube or other rescue equipment.
  - Keep the person's head out of the water.
  - Assess if the person is unresponsive and not breathing. If feasible and safe (with an effective flotation device), provide five rescue breaths in the water as soon as possible.
  - Retrieve the person to land or a rescue boat as soon as possible.
- Once on land or a rescue boat, check if the person is unresponsive and not breathing.
- If so, immediately give five rescue breaths, then begin standard CPR.
- If an AED is available, dry the chest quickly and follow the device prompts to apply and use it.
- Continue CPR and AED use until the person shows signs of life or emergency assistance help arrives, and they take over.

Prevention of hypothermia

- **Insulation:** cover the person with dry blankets or clothing to minimise heat loss.
- **Wind protection:** shield the person from wind by using barriers or relocating them to a sheltered area.
- **Wet clothing removal:** gently remove wet clothing and replace it with dry garments to prevent further cooling.
- **Ground isolation:** place insulating materials, such as blankets or pads, between the individual and the cold ground to prevent direct contact.
- In settings where hypothermia might be common, implement tailored prevention plans and training for first aid providers.

Heat stroke

- Suspect heat stroke if the person shows signs of confusion, agitation, disorientation, seizures or unresponsiveness. This can occur in high ambient temperatures, especially during endurance sporting events:
    - Exertional heat stroke exhibits the same symptoms but can occur at any ambient temperature, especially during endurance sporting events. At such events, ensure adequate preparation and provide tools to support recognition (e.g. rectal temperature probes) and cooling (e.g. immersion ice-water baths).
- With suspected heat stroke, remove the person from the heat source and commence passive cooling by removing excess clothing and placing the person in a cooler/shaded location.
- Use any technique immediately available to provide active cooling. The gold standard is to use whole-body (neck down) cold water (1-26°C) immersion until the core temperature falls below 39°C.
- Alternatives include tarp-assisted cooling oscillation (TACO), ice sheets, commercial ice packs, a fan alone, a cold shower, hand cooling devices, cooling vests and jackets, or evaporative cooling (using mist and a fan).
- Where possible, monitor core temperature (rectal thermometer).
- If a core temperature cannot be obtained, continue cooling for 15 min or until neurological symptoms resolve, whichever is first.
- Remember: cool first, transfer second.
- Continue cooling as needed during transportation to a medical facility for further evaluation and treatment.

Snake bite

- The only indigenous, highly venomous snake in the UK is the Adder (also known as the European Viper), which has a haemolytic toxic venom.
- Call 999.
- Keep the person calm and at rest.
- Keep the bitten body part still and immobilise the affected limb, as this may slow the spread of venom.
- Remove tight clothes, rings or watches from the affected limb.
- Avoid harmful actions:
    - Do not apply a pressure dressing, ice, heat, or use tourniquets.
    - Do not cut the wound and never try to suck out the venom.

Related content

Guidance: Anaphylaxis

Downloads

Adult choking algorithm 2025 48.79 KB

Paediatric choking algorithm 202538.87 KB

Resuscitation Council UK

Adult basic life support Guidelines

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Key points

- Everyone can learn how to perform cardiopulmonary resuscitation (CPR).
- Train ambulance service call handlers in cardiac arrest recognition and telephone-CPR.
- Recognition of cardiac arrest can be challenging.

- If a person is found unresponsive, call 999 as soon as possible. Ideally, this should be carried out by a bystander, but if no one else is available you should make the call yourself before assessing whether breathing is normal.

- The ambulance service call handler will be able to assist you if you are uncertain.
- If a person is unresponsive with abnormal breathing, assume they are in cardiac arrest.
- Start chest compressions as soon as possible.
- Compress the chest at a rate of 100-120 min^{-1}.
- Compress to a depth of at least 5 cm, but not more than 6 cm.
- If providing rescue breaths, deliver just enough air to make the chest start to rise; avoid excessive ventilation.
- If you are unable to ventilate the chest, consider a foreign body airway obstruction.
- Anyone can use an Automated External Defibrillator (AED).
- AEDs should be widely available.
- Locations of AEDs should be prominently sign-posted with clear signage.
- AED signage should include a statement that no training is needed to use an AED.
- AEDs should be housed in unlocked cabinets.
- AEDs should be accessible 24 hours a day, 7 days a week.
- The risk of harm from CPR is low. Rescuers should not be concerned that they will cause serious injury if the person is not in cardiac arrest.

There are the following changes to the 2025 Adult Basic Life Support guidelines:

- Call 999 for any unresponsive person. Rescuers no longer need to confirm abnormal breathing before calling. Initiate the call first, then assess breathing while waiting for the call to be answered. The ambulance service call handler will be able to assist you in identifying abnormal breathing, if needed.
- Exercise is a common precipitant of cardiac arrest. The 2021 guidelines emphasised descriptions of slow or laboured breathing as indicators of abnormal breathing. For 2025, we recognise that early after the onset of cardiac arrest, athletes may display a near-normal or panting breathing pattern.

The following has been added to the 2025 Adult Basic Life Support guidelines:

- Details of the role of the ambulance service call handler: The role of the ambulance service call handler is critical to early recognition of cardiac arrest and initiation of CPR.
- There is increasing evidence that finding a person in cardiac arrest and attempting resuscitation is a potentially traumatic experience for many lay rescuers. The 2025 guideline now recognises that lay rescuers and bystanders may benefit from support.

Introduction

Guidelines 2025 continues to prioritise supporting members of our communities to have the confidence, knowledge and skills to act when someone sustains an out-of-hospital cardiac arrest. The principles of CPR remain the same, and there is an increased emphasis on the difficulty in recognising cardiac arrest and the role that the ambulance service call handlers can play in facilitating this.

The 2025 guidelines still emphasise that it is more important that people feel able to do something to help than become focused on small details or concerned about causing harm. No greater harm can occur than failing to act when someone requires CPR and defibrillation.

The community response to cardiac arrest remains critical to saving lives. Bystander CPR and use of an AED increase the chances of survival by two to four-fold and are a critical part of the UK government's strategies to improving survival from out-of-hospital cardiac arrest.

These guidelines are intended to support members of our communities who may be called upon to act in an emergency and to help save someone's life. This includes members of the public (including those activated by a smartphone app), children and family members, first responders, and those with a duty to respond (e.g. lifeguards, first aiders). They complement the Resuscitation Council UK Quality Standards for Cardiopulmonary Resuscitation and Automated External Defibrillation Training in the Community, which describe that when a cardiac arrest occurs, systems and education should be in place to ensure that:

- Cardiac arrest is recognised early.
- Help is sought – shout for nearby help and call 999.

- CPR is promptly started according to current guidelines.
- An AED is located, retrieved and used as early as possible.

Guidelines

If you encounter someone who appears to be unresponsive, follow the **3 steps to save a life**:

1. **Check**

   - Is it safe to approach?
   - Is the person conscious?

2. **Call** 999 immediately if they are unresponsive.

   - Assess breathing.
   - If you are unsure, the ambulance service call handler will assist you.

3. **CPR**: Start CPR immediately if they are **unresponsive with abnormal breathing**.

   - As soon as an AED is available, attach it and follow the AED instructions.
   - If you are unsure, the ambulance service call handler will assist you.

Recognising cardiac arrest

- Suspect cardiac arrest in any person who is unresponsive.
- Call 999 without delay.
- Assess their breathing while you wait for the call to be answered.
- Slow, laboured breathing, as well as other abnormal patterns such as agonal gasping or panting, must be recognised as signs of cardiac arrest.
- A short period of seizure-like activity may occur at the onset of cardiac arrest. Once the seizure stops, assess breathing.
- If any person is unresponsive with abnormal breathing, cardiac arrest should be assumed.
- If you are uncertain, the ambulance service call handler will assist you.
- If there is any doubt, assume cardiac arrest and start CPR.

Alerting the ambulance service

- If you have a mobile phone, activate the speaker function and call 999 without delay.
- Assess breathing while you wait for the call to be answered.
- If you are alone and do not have a mobile phone, or there is no mobile phone network/satellite connection, you can shout for help and then continue to assess breathing.
- If you think no one will come to help, then you will have to leave the person and call 999. Do this as quickly as possible.
- If they remain unresponsive and are not breathing normally when you return from summoning help, immediately start CPR.

Role of ambulance service 999 call handlers

- Emergency ambulance service call handlers should use standardised protocols to facilitate recognition of cardiac arrest.
- Once cardiac arrest is recognised, ambulance service call handlers should provide CPR instructions to all callers.
- The ambulance service call handler should assume the caller does not know how to perform CPR and provide chest-compression-only instructions. If the caller subsequently states they know how to perform rescue breaths, then the ambulance service call handler should facilitate 30:2 CPR.
- Once CPR is underway, the ambulance service call handler should ask if there is an “AED” or “defibrillator” at the scene.
- If no AED is available at the scene, and more than one bystander is present, the ambulance service call handlers should guide bystanders to the nearest AED.
- As soon as an AED is available at the scene, the ambulance service call handler should instruct the bystander to activate the AED and to follow the AED instructions.
- Ambulance service dispatch systems should integrate with a volunteer first-responder system to activate registered volunteer first-responders to the incident and to retrieve a nearby AED.

High-quality chest compressions

- Start chest compressions as soon as possible.

- Place the heel of one hand on the lower half of the sternum (“in the centre of the chest”).
- If you are unable to adequately visualise the sternum due to clothing, it is reasonable to displace or remove such garments so you can identify the correct anatomic landmark.
- Place the heel of your other hand on top of the first hand.
- Interlock your fingers of the hands to ensure that pressure is not applied over the ribs.
- Keep your arms straight.
- Position your shoulders vertically above the person’s chest.
- Compress to a depth of at least 5 cm, but not more than 6 cm.
- Compress the chest at a rate of 100–120 min^{-1} with as few interruptions as possible.
- Allow the chest to recoil completely after each compression; avoid leaning on the chest.
- CPR is most effective when performed on a firm surface. However, rescuers should not move a person from a ‘soft’ surface, e.g. a bed, to the floor. Start CPR on the bed and, if needed, compress the chest deeper to compensate for the soft mattress.

Rescue breaths

- If you have been trained to provide rescue breaths, alternate 30 chest compressions with 2 rescue breaths.
- When providing rescue breaths, deliver just enough air to make the chest start to rise; avoid excessive ventilation.
- If you are unable to ventilate the chest after two attempts, consider foreign body airway obstruction - see Guideline 2025: First Aid.
- If you are not trained to provide rescue breaths, perform continuous chest compressions without interruptions.

Using an Automated External Defibrillator (AED)

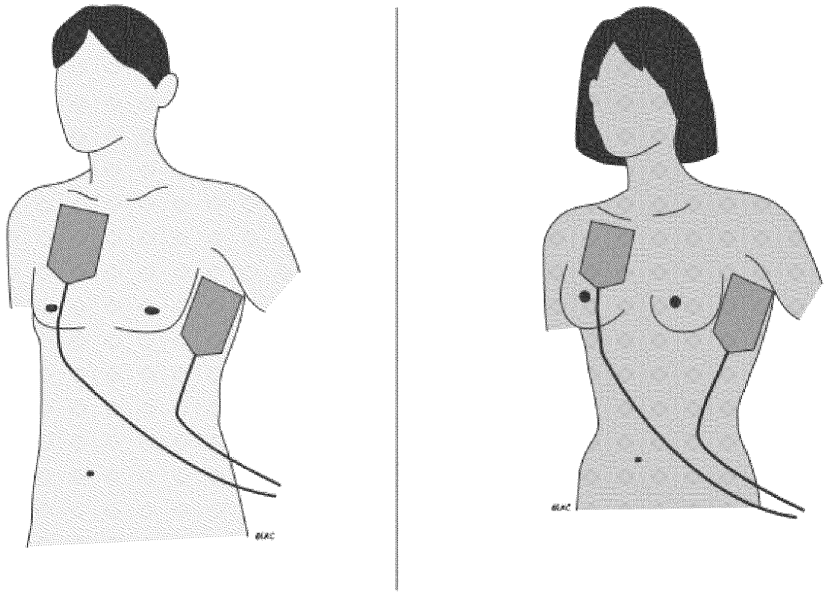
- Anyone can use an Automated External Defibrillator (AED).

How to find an AED

- Ensure that AED locations are indicated by clear signage.
- Signage should state that AEDs can be used by anyone and that no training is needed.
- AED locations may also be identified using electronic mapping systems available on some mobile phones and computer applications.
- The ambulance service should be able to direct callers to the nearest accessible AED during the 999 call. In the UK, this is facilitated by The Circuit, a national database of the location and availability of public-access AEDs. Circuit-registered AEDs local to your area can be located on Defib Finder.

When and how to use an AED

- Use an AED as soon as it is available.
- Open the AED case (if present). Some AEDs automatically turn on when opened. If not, identify the power button and turn it on.
- Follow the audio/visual prompts from the AED.
- Attach the electrode pads to the person’s bare chest according to the position shown on the AED (or AED pads).



- Removing a bra before defibrillation: Rescuers should prioritise correct pad placement and contact with bare skin. If this can be quickly achieved without removing the bra, then it is acceptable to keep the bra in place. If the bra interferes with correctly locating the pad position, then the bra should be removed. Rescuers should not be concerned about exposing the person's chest to apply the pads and should prioritise life-saving interventions.
- If more than one rescuer is present, continue CPR while the pads are being attached.
- Ensure that nobody touches the person whilst the AED is analysing the heart rhythm.
- If a shock is indicated, ensure that nobody is touching the person.
- Some AEDs (fully automatic AEDs) will deliver a shock automatically, while others (semi-automatic AEDs) will require the rescuer to press the shock button to deliver the shock.
- After the shock has been delivered, immediately restart chest compressions.
- If no shock is indicated, immediately restart chest compressions.
- Continue to follow the AED instructions.
- Usually, the AED will instruct the rescuer to perform CPR, then, after a set time interval, the AED will instruct the rescuer to pause CPR to undertake rhythm analysis.

Where to place AEDs

- AEDs should be placed in clear sight.
- AED cabinets should be unlocked and readily accessible 24 hours a day, 7 days a week, 365 days per year.
- Locations with a high population flow, such as airports, shopping centres and railway stations, should have on-site AEDs that are readily accessible for public use.
- Communities are encouraged to deploy AEDs in public spaces, particularly those with a higher incidence of cardiac arrest.
- AEDs should be registered with The Circuit, so that their location and availability information are available to the ambulance service during a 999 call.

Safety

- Ensure the safety of yourself, the person in cardiac arrest, and any bystanders.
- Lay people should start CPR for presumed cardiac arrest without concerns about harm to people not in cardiac arrest.
- The risk of infection to rescuers performing CPR is low.
- The risk of harm to rescuers from accidental shock during AED use is low.
- The risk of physical injury to the rescuer from performing CPR is low.
- Consider the wellbeing of laypeople and bystanders; offer them support. Resuscitation Council UK has a dedicated support page for anyone affected by cardiac arrest.

Downloads

Adult community BLS algorithm 2025 28.46 KB

Adult in hospital algorithm 2025 37 KB

Adult choking algorithm 2025 48.79 KB

Resuscitation Council UK

Adult advanced life support Guidelines

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Key points

- There are no major changes in these 2025 Adult Advanced Life Support (ALS) Guidelines since the previous ALS guidelines in 2021.
- Advanced Life Support interventions work best when started early.

- High-quality chest compressions with minimal interruption and early defibrillation remain priorities.
- Providing effective oxygenation and ventilation breaths are important during advanced life support and have a greater emphasis in these guidelines.
- Ensuring a correct initial defibrillator pad placement has a greater emphasis; the lateral (apical) pad should be placed below the armpit in the mid-axillary line.
- Identify and treat reversible causes of cardiac arrest without delay.
- When adrenaline is used, it should be given as soon as possible when the cardiac arrest rhythm is non-shockable, and after three defibrillation attempts for a shockable cardiac arrest rhythm.
- Patients with both in- and out-of-hospital cardiac arrest often have premonitory signs, and many of these arrests may be preventable.

Guidelines

Prevention of in-hospital cardiac arrest

- Shared decision making and advanced care planning, which integrates resuscitation decisions with emergency care treatment plans to increase clarity of treatment goals and also prevent inadvertent deprivation of other indicated treatments, besides CPR. These plans should be recorded in a consistent manner.
- Hospitals should use a track and trigger early warning score system for the early identification of patients who are critically ill or at risk of clinical deterioration.
- Hospitals should train staff in the recognition, monitoring and immediate care of the acutely ill patient.
- Hospitals should empower all staff to call for help when they identify a patient at risk of physiological deterioration. This includes calls based on clinical concern, rather than solely on vital signs.
- Hospitals should, where feasible, have systems that allow patients, families and carers to request an urgent clinical review if they are worried that the patient's condition is deteriorating (e.g. Martha's rule in England).
- Hospitals have a clear policy for the clinical response to abnormal vital signs and critical illness. This may include a critical care outreach service and/or emergency team (e.g. medical emergency team, rapid response team).

- Hospital staff should use structured communication tools to ensure effective handover of information.
- Patients should receive care in a clinical area that has the appropriate staffing, skills, and facilities for their severity of illness.
- Hospitals should review cardiac arrest events to identify opportunities for system improvement and share key learning points with hospital staff.
- Participation in a national cardiac arrest audit as a benchmark for local performance.

Prevention of out-of-hospital cardiac arrest

- Coronary heart disease (CHD) is the leading cause of sudden cardiac death (SCD), responsible for 80% of cases, particularly in older patients. Non-ischaemic cardiomyopathies contribute to 10-15% of SCD cases. In younger individuals, the main causes of SCD include inherited heart diseases, congenital heart defects, myocarditis, and substance misuse. In these patient groups, risk stratification is possible, and preventive treatments may be effective.
- Predicting SCD is challenging because most cases happen in individuals with undiagnosed heart disease. As a result, detecting early warning signs, implementing an efficient ambulance service system, and focusing on the prevention of cardiovascular disease (CVD) risk factors are crucial in the general population.
- Symptoms such as chest pain, syncope (especially during exercise, while sitting or supine), palpitations, dizziness or sudden shortness of breath that are consistent with cardiac ischaemia or an arrhythmia should be investigated.
- Overtly healthy young adults who have SCD can also have preceding signs and symptoms (e.g. syncope/pre-syncope, chest pain and palpitations) that should alert healthcare professionals to seek expert help to prevent cardiac arrest.
- Young adults presenting with characteristic symptoms of arrhythmic syncope should have a specialist cardiology assessment, which should include an electrocardiogram (ECG) and, in most cases, echocardiography, 24-hour ECG monitoring and an exercise test.
- Systematic evaluation in a clinic specialising in the care of those at risk for SCD is recommended for family members of young victims of SCD or those with a known cardiac disorder resulting in an increased risk of SCD.

- Identification of individuals with inherited conditions and screening of family members can help prevent deaths in young people with inherited heart disorders.
- Follow current national or international (e.g. European Society of Cardiology) guidelines for the diagnosis and management of syncope and arrhythmias.

Treatment of in-hospital cardiac arrest (IHCA)

- Start ALS as early as possible.
- Hospital systems should aim to recognise cardiac arrest, start CPR immediately, defibrillate rapidly (<3 min) for shockable rhythms, give adrenaline rapidly for non-shockable rhythms, and identify and treat reversible causes.
- All hospital staff should be able to recognise cardiac arrest rapidly, call for help, start CPR and defibrillate (attach an AED and follow the AED prompts, or use a manual defibrillator).
- Hospitals should adopt a standard 'Cardiac Arrest Call' telephone number (2222).
- Hospitals should have a resuscitation team that immediately responds to IHCAs.
- The hospital resuscitation team should include team members who have completed an accredited adult ALS course that incorporates teamwork and leadership training (e.g. RCUK ALS provider course).
- Resuscitation team members should have the key skills and knowledge to manage a cardiac arrest, including manual defibrillation, advanced airway management, intravenous access, intraosseous access, and identification and treatment of reversible causes.
- The resuscitation team should meet at the beginning of each shift for introductions and allocation of team roles.
- Hospitals should standardise resuscitation equipment.
- Termination of resuscitation rules (TOR) should not be used as a sole strategy for terminating an in-hospital resuscitation attempt.

Treatment of out-of-hospital cardiac arrest (OHCA)

- Start ALS as early as possible; ambulance service systems should be organised to provide a rapid ALS response with sufficient qualified personnel. This may include a pre-hospital critical care team.

- Adults with non-traumatic OHCA should be considered for transport to a cardiac arrest centre according to local protocols, and take into account which interventions can be provided on scene.
- Ambulance service systems should consider implementing validated criteria for the withholding and termination of resuscitation (TOR), taking into consideration specific local legal, organisational and cultural context.
- Ambulance service systems should monitor staff exposure to resuscitation, and low exposure should be addressed to increase the ambulance service team's experience in resuscitation.

Debriefing

Use data-driven, performance-focused debriefing of rescuers to improve CPR quality and patient outcomes.

CPR-induced consciousness

- Cardiopulmonary resuscitation-induced consciousness (without ROSC) is uncommon but increasingly reported. Rescuers may consider using sedative or analgesic drugs (or both) in small doses to prevent pain and distress to patients who are conscious during CPR.
- Neuromuscular blocking drugs alone should not be given to conscious patients.
- The optimal drug regimen for sedation and analgesia during CPR is uncertain. Regimens may be based on those used in critically ill patients and according to local protocols, such as small doses of fentanyl, ketamine and/or midazolam.

Defibrillation

Automated External Defibrillation (AED) versus manual defibrillation during ALS

- Manual defibrillators should only be used by rescuers who can quickly and accurately identify a cardiac arrest rhythm (within 5 s) and, if needed, deliver a safe shock with minimal interruption (aim for less than 5 s) to chest

compressions.

- Advanced Life Support providers must be proficient in using both an AED and a manual defibrillator.
- If an AED is already in use when ALS providers arrive, they should follow its shock prompts. When possible, they should transition to a manual defibrillator during a 2-minute CPR cycle.

Defibrillation strategy

- Continue CPR while a defibrillator is retrieved and pads applied. High-quality CPR improves the chances of successful defibrillation.
- Give a shock as early as possible when appropriate.
- Deliver shocks with minimal interruption to chest compressions and minimise the pre-shock and post-shock pause. This is achieved by continuing chest compressions during defibrillator charging, delivering defibrillation, aiming for an interruption in chest compressions of less than 5 s and then immediately resuming chest compressions.
- Immediate defibrillation of ventricular fibrillation (VF) of any amplitude (even fine VF) should be attempted.
- Immediately resume chest compressions after shock delivery. If there is a combination of clinical and physiological signs of return of spontaneous circulation (ROSC) such as return of consciousness, purposeful movement, a pulsatile arterial blood pressure waveform or a sharp rise in ETCO2, consider stopping chest compressions for rhythm analysis, and if appropriate, a pulse check.
- When using a defibrillator that displays the ECG with the motion artefact caused by chest compressions removed, the underlying cardiac arrest rhythm may guide the decision to perform a rhythm and pulse check every two minutes. If asystole is displayed, there would be no need to pause chest compressions for a rhythm check.

Safe and effective defibrillation

- Minimise the risk of fire by taking off any oxygen mask, e.g. nasal cannulae or bag-valve mask and by placing them at least 1 m away from the patient’s chest. When using a mechanical ventilator, oxygen exhaust from ventilation circuits should be directed away from the chest. A self-inflating bag or the ventilator circuit should remain attached to a supraglottic airway or tracheal tube.
- Charging the defibrillator in anticipation of each rhythm check may minimise hands-off time prior to shock delivery and is an acceptable alternative

strategy if delivered without prolonging the peri-shock pause.
- A shock with a manual defibrillator can be safely delivered without interrupting mechanical chest compression.
- Do not defibrillate during manual chest compressions (even when wearing clinical gloves), as that practice is not safe to the rescuer.

Defibrillation pads

- Antero-lateral pad position is the position of choice for initial pad placement. In particular, ensure that the lateral (apical) pad is positioned correctly (i.e. directly below the armpit in the mid-axillary line).
- Consider an antero-posterior pad position for vector change defibrillation following three failed shocks in cases of refractory shockable rhythms. The anterior pad is placed to the left of the sternum, avoiding as much breast tissue as possible. The posterior pad is placed at the same height, centred just medial to the left scapula.
- In patients with an implantable pacemaker/defibrillator (ICD), place the pad more than 8 cm away from the device, or use an alternative pad position.
- Consider an alternative pad position when the patient is in the prone position (e.g. bi-axillary).

Energy levels and number of shocks

- Use single shocks followed by a 2-minute cycle of chest compressions.
- The use of up to three stacked shocks may be considered only if initial ventricular fibrillation/pulseless ventricular tachycardia (VF/pVT) occurs during a witnessed, monitored cardiac arrest with a defibrillator immediately available, e.g. during cardiac catheterisation or in a highly monitored setting. For the purposes of adrenaline and amiodarone administration, the initial stacked shocks should be counted as the first shock in the ALS algorithm.
- Energy levels:
    - For biphasic waveforms (rectilinear biphasic or truncated exponential biphasic, but not pulsed biphasic), defibrillation shock energy levels for the first shock should be at least 150 J.
    - For pulsed biphasic waveforms, deliver the first shock at 130-150 J.
- If the first shock is not successful and the defibrillator is capable of delivering shocks of higher energy, it is reasonable to increase the energy for subsequent shocks.

- If the rescuer is unaware of the recommended energy settings of the defibrillator, for an adult, use the highest energy setting for all shocks.
- Use standard energy levels in obese patients.

Refractory ventricular fibrillation

- Consider escalating the shock energy after a failed shock.
- For refractory VF (defined as continuous VF after three consecutive shocks) and having ensured correct antero-lateral pad positioning, consider using a defibrillation vector change by using an alternative defibrillation pad position (e.g. antero-posterior). After a failed third shock, prepare to place a fresh set of pads in the anterior-posterior position at the time of the following rhythm check. Further optimise transthoracic impedance by shaving the anticipated areas of pad placement (if necessary).
- Dual (double) sequential defibrillation (DSD) involves using a combination of antero-lateral and antero-posterior pad positioning to discharge two shocks in close succession and has been advocated for use in refractory shockable rhythms. Given the practical challenges of using two defibrillators to deliver DSD and the limited evidence for its efficacy, the RCUK does not recommend its routine use.

Ventricular fibrillation waveform analysis for optimising shock success

- Rescuers should give defibrillation shocks according to AED prompts or use a manual defibrillator for ventricular fibrillation/pulseless ventricular tachycardia (VF/pVT) according to the ALS algorithm. There is currently no role for VF waveform analysis (e.g. based on amplitude) for identifying the optimal time for defibrillation.

Patients with actively discharging implantable cardioverter defibrillators

- Rescuers may sense a significant shock across their arms if a shock is delivered by an ICD while they are performing external chest compressions, even when wearing clinical gloves.
- If an ICD fails to terminate a shockable rhythm, conventional external shocks should be delivered, placing any defibrillation pad more than 8 cm from the defibrillator box.
- If the ICD is incorrectly detecting arrhythmias and shocking inappropriately, a magnet placed over the ICD can temporarily stop shocks but will not

disable pacing (if programmed).

Airway and ventilation

- During CPR, start with basic airway techniques and progress stepwise according to the skills of the rescuer until effective ventilation is achieved.
- Give the highest feasible inspired oxygen during CPR.
- Start effective ventilation breaths as soon as possible, ensuring the rate and tidal volume are appropriate to prevent both inadequate ventilation (hypoventilation) and excessive ventilation (hyperventilation).
- Deliver effective bag-mask ventilation breaths by optimising mask seal and airway patency, and if necessary, use a two-person technique for bag-mask ventilation.
- Give each inspiratory breath over 1 s to achieve a visible chest rise.
- Tracheal intubation should only be attempted by rescuers with a high success rate and with the use of continuous waveform capnography. The expert consensus is that a high tracheal intubation success rate is over 95% within two attempts at intubation.
- Aim for less than a 5 s interruption in chest compression for tracheal intubation.
- Use direct or video laryngoscopy for tracheal intubation according to local protocols and rescuer experience. In settings where videolaryngoscopy is immediately available, it is preferable to use videolaryngoscopy instead of direct laryngoscopy.
- A sustained $ETCO_2$ trace on waveform capnography must be used to exclude oesophageal placement of the tracheal tube.
- Once a tracheal tube or an SGA has been inserted, ventilate the lungs at a rate of 10 min^{-1} and continue chest compressions without pausing during ventilations. With an SGA, if gas leakage results in inadequate ventilation, pause compressions for ventilation using a compression-ventilation ratio of 30:2.
- If using mechanical ventilation, use a volume-controlled mode during chest compressions and set the ventilator to a tidal volume of 6-8 mL kg^{-1} (predicted ideal body weight), or to achieve a visible chest rise, the maximum inspired oxygen, a respiratory rate of 10 min^{-1}, an inspiratory time of 1–2 s, a positive end expiratory pressure (PEEP) 0-5 cm H_2O, the peak pressure alarm at 60-70 cm H_2O, and the flow trigger off. Ensure mechanical ventilation is effective, and if not, use manual ventilation.

- If standard airway management strategies (oropharyngeal airway and bag-mask/SGA/tracheal tube) fail during cardiac arrest, appropriately trained rescuers should attempt surgical cricothyroidotomy to enable oxygenation and ventilation.

Drugs and fluids

Vascular access

- Attempt intravenous (IV) rather than intraosseous (IO) access first, to enable drug delivery in adults in cardiac arrest.
- If IV access cannot be rapidly achieved within two attempts, it is reasonable to consider IO access as an alternative route for vascular access during adult cardiac arrest.

Vasopressor drugs

- Give adrenaline 1 mg as soon as possible for adult patients in cardiac arrest with a non-shockable rhythm.
- Give adrenaline 1 mg after the third shock for adult patients in cardiac arrest with a shockable rhythm.
- Repeat adrenaline 1 mg every 3-5 minutes whilst ALS continues.

Antiarrhythmic drugs

- Give amiodarone 300 mg IV for adult patients in cardiac arrest who are in VF/pVT after a total of three shocks have been given.
- Give a further dose of amiodarone 150 mg IV for adult patients in cardiac arrest who are in VF/pVT after a total of five shocks have been given.
- Give the first dose of amiodarone after three shocks, and the second dose after five shocks, irrespective of whether the shockable rhythms are sequential (refractory VF/pVT) or intermittent (recurrent VF/pVT).
- Lidocaine 100 mg IV may be used as an alternative if amiodarone is not available or a local decision has been made to use lidocaine instead of amiodarone. An additional bolus of lidocaine 50 mg can also be given after five defibrillation attempts.

Thrombolytic drugs

- Consider immediate thrombolytic drug therapy when pulmonary embolism is the suspected or confirmed cause of cardiac arrest.
- In select patients with suspected pulmonary embolism, consider CPR for 60-90 min after administration of thrombolytic drugs.

Fluids

- Give fluids during CPR only if cardiac arrest is caused by hypovolaemia.
- Use either isotonic saline or balanced crystalloids for fluid infusion during CPR.

Other drugs

- Do not routinely give calcium, sodium bicarbonate or corticosteroids during cardiac arrest.

ALS in highly-monitored cardiac arrest, and physiology-guided CPR

- A sudden decrease in $ETCO_2$ may indicate a cardiac arrest or a very low cardiac output state.
- Consider starting chest compressions if the systolic blood pressure decreases and remains < 50 mmHg despite interventions.
- In adults undergoing continuous intra-arterial blood pressure monitoring, we suggest that adrenaline is initially given in small increments (e.g. 50-100 micrograms IV) rather than a 1 mg bolus. If a total of 1 mg has been given with no response, ensure that there is no extravasation and consider giving further IV adrenaline doses of 1 mg every 3-5 min.
- A pragmatic approach during physiology-guided CPR is to aim for a diastolic blood pressure of ≥ 30 mmHg (when using intra-arterial blood pressure monitoring) and an $ETCO_2$ ≥ 3.3 kPa (25 mmHg).

Waveform capnography during advanced life support

- Use waveform capnography to confirm correct tracheal tube placement during CPR.
- Use waveform capnography to monitor the quality of CPR.
- An increase in $ETCO_2$ during CPR may indicate that ROSC has occurred. However, chest compression should not be interrupted based on this sign

alone. Use a combination of clinical and physiological signs of ROSC (e.g. consciousness, purposeful movement, arterial waveform, rise in $ETCO_2$) before stopping chest compressions for rhythm analysis, and if appropriate, a pulse check.
- Do not use a low $ETCO_2$ value alone to decide if a resuscitation attempt should be stopped.

Use of ultrasound imaging during advanced life support

- Only skilled operators should use intra-arrest point-of-care ultrasound (POCUS).
- POCUS must not cause additional or prolonged interruptions in chest compressions.
- POCUS may help identify treatable causes of cardiac arrest, such as cardiac tamponade and tension pneumothorax.
- Right ventricular dilation in isolation during cardiac arrest should not be used to diagnose pulmonary embolism.
- Do not use POCUS for assessing contractility of the myocardium as a sole indicator for terminating CPR.

Devices

Mechanical chest compression devices

- Consider mechanical chest compressions only if high-quality manual chest compression is not practical or compromises provider safety.
- When a mechanical chest compression device is used, minimise interruptions to chest compression during device application by using only trained teams familiar with the device.

Resuscitative endovascular balloon occlusion of the aorta (REBOA)

- We do not recommend the routine use of REBOA for cardiac arrest unless being evaluated in a clinical trial.

Intra-arrest cooling

- We do not recommend intra-arrest cooling during advanced life support (unless there is severe hyperthermia).

Extracorporeal CPR

- Extracorporeal CPR (ECPR) may be considered as a rescue therapy for selected adults with IHCA and OHCA when conventional CPR is failing to restore spontaneous circulation, in settings in which this can be implemented.

Peri-arrest arrhythmias

- The 2025 ALS guidelines and algorithms focus on those arrhythmias that require immediate treatment before or after cardiac arrest.
- Rescuers should seek expert advice if the arrhythmia and/or life-threatening features persist.
- The assessment and treatment of all arrhythmias address the condition of the patient (stable versus unstable) and the nature of the arrhythmia. Persistent arrhythmias require careful evaluation, as they are often linked to underlying structural heart disease and may indicate unresolved issues such as myocardial ischaemia. In addition to an arrhythmia occurring immediately after ROSC, life-threatening features in an unstable patient include:
    - **Shock** – recognised by hypotension (e.g. systolic blood pressure < 90 mmHg) along with signs of compensatory mechanisms, such as increased sympathetic activity, and evidence of inadequate organ perfusion
    - **Syncope** – as a consequence of reduced cerebral blood flow.
    - **Heart failure** – manifested by pulmonary oedema (failure of the left ventricle) and/or raised jugular venous pressure (failure of the right ventricle).
    - **Myocardial ischaemia** – may present with chest pain (angina) or may occur without pain as an isolated finding on the 12-lead ECG (silent ischaemia).

Tachyarrhythmias

- Electrical cardioversion is the preferred treatment for tachyarrhythmia in the unstable patient displaying potentially life-threatening adverse signs or immediately after ROSC.

- Electrical cardioversion is recommended for stable patients with monomorphic VT who have structural heart disease or when it is unclear whether there is underlying heart muscle damage.
- Conscious patients require careful anaesthesia or sedation before attempting synchronised cardioversion; be aware of the risk of haemodynamic deterioration with anaesthesia/sedation.
- When cardioverting atrial or ventricular tachyarrhythmias, the shock must be synchronised to occur with the R wave of the ECG.
- For atrial fibrillation:
    - An initial synchronised shock at maximum defibrillator output, rather than an escalating approach, is a reasonable strategy based on current data.
- For atrial flutter and paroxysmal supraventricular tachycardia:
    - Give an initial shock of 70-120 J.
    - Give subsequent shocks using stepwise increases in energy.
- For ventricular tachycardia with a pulse:
    - Use energy levels of 120-150 J for the initial shock.
    - Consider stepwise increases in energy if the first shock fails to achieve sinus rhythm.
- If cardioversion fails to restore sinus rhythm and the patient remains unstable, give procainamide 10–15 mg kg^{-1} (maximum 1 g) over 20 min or amiodarone 300 mg intravenously over 10–20 min according to local availability and protocols, and re-attempt electrical cardioversion. The loading dose of amiodarone can be followed by an infusion of 900 mg over 24 h.
- Pharmacological treatment may be considered in haemodynamically stable patients with monomorphic ventricular tachycardia if there is an increased risk with sedation or anaesthesia.
- Consider digoxin or amiodarone for acute heart rate control in patients with AF and haemodynamic instability and severely reduced left ventricular ejection fraction (LVEF). For stable patients with LVEF < 40% consider digoxin or a beta-blocker to achieve a heart rate less than 110 min^{-1}.

Bradycardia

- If bradycardia is accompanied by adverse signs, give atropine 500 micrograms IV and, if necessary, repeat every 3–5 min to a total of 3 mg.
- If treatment with atropine is ineffective, consider second-line drugs. These include isoprenaline (5 micrograms min^{-1} starting dose), and adrenaline (2–10 micrograms min^{-1}).

- For bradycardia in patients with cardiac transplant or spinal cord injury, consider giving aminophylline (100–200 mg slow intravenous injection). Do not give atropine to patients with cardiac transplants; it can cause a high-degree atrioventricular block or even sinus arrest; use aminophylline.
- Consider giving glucagon if beta-blockers or calcium channel blockers are a potential cause of the bradycardia.
- Do not give atropine to patients with high-degree atrioventricular block and wide QRS. It is ineffective and may worsen the block.
- Consider pacing in unstable patients with symptomatic bradycardia refractory to drug therapies:
    - Establish early transvenous pacing in unstable patients with symptomatic bradycardia.
    - Consider transthoracic (transcutaneous) pacing as a bridge to transvenous pacing or when transvenous pacing is not readily available.
- Whenever a diagnosis of asystole is made, check the ECG carefully for the presence of P waves because, unlike true asystole, this is more likely to respond to cardiac pacing.
- If atropine is ineffective and transvenous/transcutaneous pacing is not immediately available, fist pacing can be attempted while waiting for pacing equipment.

Downloads

Adult ALS algorithm 202539.31 KB

Adult in hospital algorithm 202537 KB

Adult tachyarrhythmia algorithm V3 March 202677.05 KB

Adult bradyarrhythmia 202537.32 KB

Resuscitation Council UK

Special circumstances Guidelines

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General recommendation

- Initiate resuscitation following the standard ALS algorithm in cardiac arrest.
- Always address hypoxia, hypovolaemia, electrolyte disorders, hypothermia, cardiac tamponade, tension pneumothorax, thrombosis, and toxins.
- Where appropriate, prioritise treating reversible causes, even if chest compressions are briefly interrupted.

Guidelines: Special causes

Management and prevention of cardiac arrest due to anaphylaxis

For detailed management of anaphylaxis, refractory anaphylaxis, and peri-operative anaphylaxis, see RCUK's Emergency treatment of anaphylactic reactions: Guidelines for healthcare providers.

- Prompt recognition of anaphylaxis is crucial.
- Recognise anaphylaxis by the presence of airway, breathing, or circulation problems with or without skin and mucosal changes.
- Remove or stop the trigger if immediately feasible.
- Immediately inject intramuscular adrenaline 500 mcg (1 mg mL^{-1} concentration) at first suspicion of anaphylaxis and repeat if no improvement occurs within 5 min.
- Give an IV crystalloid fluid bolus early and monitor the response.

Hyper/hypokalaemia and other electrolyte disorders

Hyperkalaemia

- Shift potassium into cells
  - Give 10 units soluble insulin and 25 g glucose IV for treatment of moderate hyperkalaemia (6.0-6.4 mmol L^{-1}) and severe hyperkalaemia (> 6.5 mmol L^{-1}). Follow with 10% glucose infusion at 50 mL h^{-1} for 5 h if pre-treatment blood glucose < 7 mmol L^{-1}.
  - Give nebulised salbutamol (10-20 mg) for moderate and severe hyperkalaemia, as an adjunct to insulin-glucose therapy.
- Antagonise the effect of hyperkalaemia in:
  - **severe hyperkalaemia with ECG changes:** administer 10 mL of 10% calcium chloride IV over 5 min; if this is not available, give 30 mL of 10% calcium gluconate over 10 min.
  - **hyperkalaemic cardiac arrest:** administer 10 mL 10% calcium chloride IV and 50 mmol sodium bicarbonate IV, through separate lines or with a flush in between.

- Remove potassium from the body:
  - Give sodium zirconium cyclosilicate 10 g orally.
  - Consider dialysis for patients with refractory severe hyperkalaemia.
- Consider extracorporeal life support (ECPR) in accordance with local protocols if the initial resuscitation attempt is unsuccessful.

Hypokalaemia

- Treatment is guided by the severity of hypokalaemia and the presence of symptoms and/or ECG abnormalities.
- Where appropriate, replace potassium and correct magnesium deficit concurrently.
- Give 20 mmol potassium chloride IV/IO over 2-3 min, followed by 10 mmol over 2 min in hypokalaemic cardiac arrest, then monitor K^+ level and adjust infusion rate accordingly.

Hyperthermia, malignant hyperthermia and toxin-induced hyperthermia

Hyperthermia

- Measure core temperature to guide treatment.
- Move patient to a cool environment.
- Simple external cooling may involve conductive, convective and evaporative measures (See RCUK Guidelines 2025: First Aid).
- With heat syncope and heat exhaustion, quick removal to a cool place, simple external cooling and provision of fluids are sufficient.
- With heat stroke, prioritise active cooling methods that achieve the most rapid cooling rate, such as application of ice and cold-water immersion.

Accidental hypothermia, drowning

Accidental hypothermia

- Check vital signs for up to 1 min in an unconscious hypothermic patient.
- Measure core temperature with a low-reading thermometer to diagnose accidental hypothermia.

- Use the Swiss Staging System if core temperature cannot be measured.
  - Stage I (Mild): Conscious with shivering, estimated core temperature 35-32°C (95-90°F).
  - Stage II (Moderate): Impaired consciousness (e.g. confusion, lethargy), shivering may be decreased or absent, estimated core temperature 32-28°C (90-82°F).
  - Stage III (Severe): Unconscious, but vital signs (pulse, breathing) are present, estimated core temperature 28-24°C (82-75°F).
  - Stage IV (Deep): Vital signs are absent, estimated core temperature below 24°C (75°F).
- Transfer hypothermic patients with risk factors for imminent cardiac arrest and those in cardiac arrest directly to an ECPR centre for rewarming:
  - heart rate < 45 min^{-1}
  - systolic blood pressure < 90 mmHg
  - ventricular arrhythmia
  - core temperature < 30°C.
- Delay CPR or use intermittent CPR in hypothermic cardiac arrest patients with a core temperature below 28°C when immediate or continuous CPR is not feasible.
- Delay further defibrillation attempts if ventricular fibrillation (VF) persists after three shocks, until core temperature is > 30°C.
- Below 30°C, adrenaline will accumulate and may have more detrimental than beneficial effects. Give IV 1 mg adrenaline (1:10,000) once the core temperature reaches 30°C unless planning imminent initiation of ECPR. Increase administration intervals for adrenaline to 6-10 min if the core temperature is 30-35°C.
- Give a loading dose of 300 mg amiodarone if a shockable rhythm is present, but delay further doses until the core temperature exceeds 30°C.
- Consider using a mechanical CPR device if transport is prolonged or if there are difficulties with the terrain.
- Base in-hospital prognostication of successful rewarming on the Hypothermia Outcome Prediction after Extracorporeal Life Support (HOPE) score.
- Rewarm hypothermic arrested patients with veno-arterial extra-corporeal membrane oxygenation (VA-ECMO).
- Initiate non-extracorporeal life support rewarming if an ECPR centre cannot be reached within a reasonable time (e.g. 6 h).

Drowning

- Rescuers and first responders should prioritise their safety and use the safest rescue technique.
- Bystanders should call for professional help and use rescue techniques with which they feel confident, based on their competencies.
- First responders should use the rescue material and flotation devices they are trained to use.
- Spine immobilisation in water should not delay removing the victim from the water when resuscitation is required.
- Start with 5 ventilations using 100% oxygen when available, continue with standard CPR protocol.
- When delivering rescue breaths with a BVM, minimise ventilation pressures to avoid stomach inflation.
- Consider ECPR if initial resuscitation is unsuccessful, in accordance with local protocols.
- Follow the recommendations for hypothermia if hypothermia is recognised.

Thrombosis

Pulmonary embolism

- Consider pulmonary embolism in all patients with sudden onset of progressive dyspnoea and absence of known heart or pulmonary disease.
- Obtain 12-lead ECG (exclude acute coronary syndrome, look for right ventricle strain).
- Identify haemodynamic instability and high-risk pulmonary embolism.
- Perform bedside echocardiography, looking for RV distention and failure, together with any other possible causes of cardiac arrest.
- Initiate anticoagulation therapy (heparin 80 units kg^{-1} IV) during the diagnostic process, unless signs of bleeding or absolute contraindications.
- Confirm diagnosis with computed tomographic pulmonary angiography (CTPA).
- Consider surgical embolectomy or catheter-directed treatment as an alternative to rescue fibrinolytic therapy in rapidly deteriorating patients.

Cardiac arrest due to pulmonary embolism

- Low $ETCO_2$ values (< 1.7 kPa/13 mmHg) in the presence of confirmed tracheal intubation, appropriate minute volume and high-quality chest compressions may support a diagnosis of pulmonary embolism, although it is

a non-specific sign.

- Use fibrinolytic drugs for cardiac arrest when pulmonary embolism is the **suspected** cause of cardiac arrest.
- Use fibrinolytic drugs, surgical embolectomy, or percutaneous mechanical thrombectomy for cardiac arrest when pulmonary embolism is the **known** cause of cardiac arrest.
- In select patients with suspected pulmonary embolism, consider CPR for 60-90 min after administration of thrombolytic drugs.
- Consider ECPR as a rescue therapy for selected patients with cardiac arrest when conventional CPR is failing in settings in which it is implemented.
- Set up a multidisciplinary team for making decisions on the management of high-risk pulmonary embolism depending on local resources.

Coronary thrombosis

- Strengthen regional networks to ensure timely percutaneous coronary intervention (PCI).
- Transfer the patient to a centre with PCI capability and activate existing STEMI networks in case of ST-elevation or suspected ongoing ischaemia.
- In patients with sustained ROSC and ST-elevation on ECG:
  - Perform immediate coronary angiography (and PCI if required) within 120 min of diagnosis.
  - Consider fibrinolysis in pre-hospital and non-PCI-capable settings if a greater delay is expected.
- In patients with sustained ROSC and no ST-elevation on ECG:
  - Consider immediate coronary angiography (and PCI if required) if the patient is haemodynamically unstable or shows signs of ongoing ischaemia.
  - In stable patients without ischaemic signs, emergency cardiac catheterisation laboratory evaluation can be delayed if there is no estimated high probability of acute coronary occlusion.
  - Assess for non-coronary causes if the clinical context suggests an alternative aetiology of the arrest.
  - Unless ongoing resuscitation is considered futile, transfer patients without sustained ROSC with ongoing CPR to a PCI centre for consideration for angiography or ECPR, depending on available resources and team expertise.

Toxins

- Ensure your personal safety, as direct skin contact (e.g. mouth-to-mouth ventilation) might transmit toxic agents.
- Assess all patients in cardiac arrest for potential poisoning.
- Reduce absorption, consider using specific treatment measures as antidotes, decontamination and enhanced elimination.
- Administer antidotes, where available, as soon as possible.
- Be prepared to continue resuscitation for a prolonged period of time, as the toxin concentration may fall as it is metabolised or excreted during extended resuscitation measures.
- Consult regional or national poison centres for information on the treatment of the poisoned patient (e.g. Toxbase).

Traumatic peri-arrest and cardiac arrest

- Traumatic cardiac arrest is different from cardiac arrest due to medical causes; this is reflected in the treatment algorithm. Figure 1 [Adult traumatic cardiac arrest/peri-arrest] can also be used in a peri-arrest situation.
- The response to traumatic cardiac arrest is time-critical, and success depends on a well-established chain of survival, including focused pre-hospital and specialised trauma centre care.
- Early and aggressive management of reversible causes (e.g. haemorrhage control, airway management, chest decompression) is essential for survival. Focus on identifying and correcting reversible causes, but continue chest compressions unless they delay or preclude the correction of the former.
- Ultrasound aids in identifying the cause of cardiac arrest and guides resuscitative interventions.

Guidelines: Special settings

Cardiac arrest in the Cardiac Catheterisation Laboratory (CCL)

Download the Cath lab algorithm 2025

- Promote adequate training for CCL staff in resuscitation and consider periodic emergency drills.
- Ensure emergency equipment is readily available and functional.
- Plan elective procedures carefully to minimise potential complications and promote the use of safety checklists.

- Consider echocardiography in case of haemodynamic instability or suspected complications.
- Resuscitate according to the ALS algorithm, BUT modify:
  - Apply 3 consecutive shocks in case of an initial shockable rhythm.
  - Consider external or transvenous pacing for extreme bradycardia.
- Consider, in selected cases, depending on clinical context, team expertise and availability:
  - Mechanical CPR, if manual compression is not feasible or safe for the provider.
  - ECPR in selected patients with refractory cardiac arrest, especially if it allows for critical procedures to correct reversible causes.
  - Circulatory support devices, for selected patients in cardiogenic shock after achieving ROSC.

For detailed management of cardiac arrest in the cardiac catheter laboratory, see Joint British Societies' guideline on management of cardiac arrest in the cardiac catheter laboratory.

Cardiac arrest in the operating theatre

- Prevent and mitigate the risk of cardiac arrest through pre-operative screening and identification of high-risk patients, clear communication between surgeons and anaesthetists about potential critical procedures, and use of appropriate monitoring.
- Start chest compressions if the systolic blood pressure suddenly decreases below 50 mmHg, in association with a fall in $ETCO_2$, despite appropriate interventions.
- Inform the surgeon, anaesthetist and the operating room team of the cardiac arrest.
- Initiate high-quality chest compressions and adjust the height of the operating table to improve CPR efficiency.
- Ensure the airway is secure, review the $ETCO_2$ tracing, and deliver effective ventilation, administering 100% oxygen. Exclude unrecognised oesophageal intubation.
- Use ultrasound to guide resuscitation, addressing the reversible causes. Exclude tension pneumothorax.
- Consider early ECPR as therapy for selected patients when conventional CPR is failing.

- Trained healthcare professionals may consider open chest cardiac compression in specific cases as an alternative if ECPR is unavailable.
- Human factors are crucial to improve survival of intraoperative cardiac arrest; ensure familiarity with equipment, assign strategies and roles during surgical team time-outs and include perioperative cardiac arrest in multidisciplinary and interprofessional team training.
- The team leader should be ALS trained. If these skills aren't immediately available in theatre, a 2222 call should be placed to ensure the expertise is sourced.

Local anaesthetic systemic toxicity

- Stop the local anaesthetic if possible.
- Hyperventilate the patient to increase plasma pH if metabolic acidosis is present.
- Give a lower adrenaline dose (≤ 1 mcg kg^{-1} instead of 1 mg IV bolus).
- Give an initial intravenous bolus of 1.5 mL kg^{-1} 20% lipid emulsion followed by an infusion at 15 mL kg^{-1} h^{-1}.
- Boluses may be repeated twice (at 5 min intervals), and the infusion rate can be increased to 30 mL kg^{-1} h^{-1} if needed.
- Continue the infusion until the patient is stable or has received a maximum of 12 mL kg^{-1} of lipid emulsion.
- If ROSC has not been achieved at 5 min, double the rate of lipid infusion, and give a maximum of two additional lipid boluses at 5 min intervals until ROSC has been achieved.
- Consider prolonged resuscitation (> 1 h) and ECPR.
- Treat seizures by administering benzodiazepines.

Cardiac surgery

- Confirm cardiac arrest by clinical signs and pulseless pressure waveforms.
- Consider ultrasound to identify reversible causes.
- Provide up to 3 consecutive shocks in initial VF/pVT.
- Pause epicardial pacing to exclude an underlying shockable rhythm and then adjust to maximum output in asystole or extreme bradycardia.
- Perform re-sternotomy up to 10 days post-surgery within 5 min.
- Provide internal cardiac massage once the chest is reopened.

- Reduce IV adrenaline dose (0.05-0.1 mg).
- Consider ECPR for prolonged resuscitation or minimally invasive cases where reopening may be delayed.

Left ventricular assist device (LVAD) patients

- Immediately activate specialised teams for unresponsive LVAD patients.
- Troubleshoot device issues as a priority, following relevant protocols.
- Start CPR while simultaneously attempting to restore device function if multiple rescuers are available.
- Consider delaying CPR for up to 2 min to attempt device restoration if a single rescuer is present.

Cardiac arrest in sports

- Screening as primary prevention plays an important role, but remains controversial.
- All sports and exercise facilities should undertake a risk assessment which considers the likelihood and consequences of sudden cardiac arrest and put in place mitigation strategies to reduce the risk.
- Assume cardiac arrest if collapsed during, or just after sport.
- Gain immediate and safe access to the field of play.
- Awareness programs in sports events have proven to be feasible to raise awareness amongst target groups not yet involved with cardiac arrest.

Guidelines: Special patient groups

Asthma

- Treat life-threatening hypoxia with 100% oxygen.
- Check for evidence of pneumothorax and tension pneumothorax.
- Exclude anaphylaxis as a precipitating cause.
- Provide endotracheal intubation (due to high inflation pressures).
- Consider manual decompression and disconnection from ventilator to manage dynamic hyperinflation.
- Consider ECPR in accordance with local protocols if initial resuscitation efforts are unsuccessful.

Cardiac arrest in haemodialysis patients

- Assign a trained dialysis operative to operate the dialysis machine.
- Stop dialysis and return the patient's blood volume with a fluid bolus.
- Disconnect from dialysis machine (unless defibrillation-proof) and beware of wet surfaces.
- Leave dialysis access open and use it for drug administration.
- Dialysis may be required in the early post-resuscitation period.

Resuscitation in obese patients

- Obese patients should receive standard resuscitation treatment – no deviation from standard BLS and ALS is needed.

Cardiac arrest in pregnancy

- Consider pregnancy in any collapsed woman of childbearing age.
- Pregnant and peripartum women can deteriorate to cardiac arrest anywhere; medical facilities and services must be prepared for such events.
- Obstetric-specific early warning systems enable early recognition of deteriorating pregnant patients.
- Above 20 weeks gestation, relieve aortocaval compression as early as possible and maintain it throughout resuscitation. Manual left uterine displacement in maternal cardiac arrest is preferred over the lateral tilt, due to the practicalities of delivering chest compressions.
- Systematically address the 4Hs and 4Ts and seek pregnancy-specific causes of cardiac arrest, the 4Ps: **P**re-eclampsia and eclampsia, **P**uerperal sepsis, **P** lacental and uterine complications, and **P**eripartum cardiomyopathy.
- Resuscitative hysterotomy is a time-sensitive intervention. Preparation to perform the procedure should be undertaken early; it should be performed as soon as possible, at the site of cardiac arrest by a skilled team.
- Post-resuscitation care in pregnant and postpartum women requires a multidisciplinary approach.

Related content

Guidance: Anaphylaxis

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Traumatic cardiac arrest algorithm 202551.38 KB

Resuscitation Council UK

Post-resuscitation care Guidelines

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Key points

- After return of spontaneous circulation (ROSC), use an ABC approach.
- Insert an advanced airway (tracheal intubation when skills are available).
- As soon as SpO_2 can be measured reliably or arterial blood gas values are obtained, titrate the inspired oxygen to achieve an arterial oxygen saturation

of 94-98%, and ventilate lungs to achieve normocapnia.
- Aim for a systolic blood pressure > 100 mmHg or a mean arterial pressure > 60-65 mmHg.
- Prioritise immediate coronary angiography for patients with clear ST-elevation on the ECG or other high suspicion of coronary occlusion (e.g. haemodynamic and/or electrical instability).
- Actively prevent fever by targeting a temperature ≤ 37.5 °C for patients who remain comatose after ROSC from cardiac arrest.
- Use a multimodal strategy including clinical examination, electrophysiology, biomarkers, and imaging to predict good or poor neurological outcome.
- Perform functional assessments of physical and non-physical impairments before discharge to identify rehabilitation needs and refer to early rehabilitation if indicated.

Introduction

These guidelines are based on the 2025 European Resuscitation Council (ERC) and European Society of Intensive Medicine (ESICM) Guidelines for Post-resuscitation Care and relevant sections of the International Liaison Committee on Resuscitation 2025 Consensus on Science and Treatment Recommendations for Advanced Life Support. Refer to the ERC-ESICM 2025 Guidelines for the detailed supporting science.

The guidelines process includes systematic reviews, scoping reviews, and evidence update that have been undertaken by international experts. The ERC-ESICM Post-Resuscitation Care Writing Group comprised 14 individuals who were selected based on their expertise, ERC and ESICM representation, diversity and geographical location.

Guidelines

Immediate post-resuscitation care

- Post-resuscitation care is started immediately after sustained return of spontaneous circulation (ROSC), regardless of location.

Diagnosis of cause and complications of cardiac arrest

- Early identification of a non-coronary cause can be achieved by performing transthoracic echocardiography and a dual-phase whole-body computed tomography (CT) scan (including head, neck, chest, abdomen, pelvis, and CT pulmonary angiography) at hospital admission, before or after coronary angiography if indicated.
- Prioritise immediate coronary angiography for patients with clear ST-elevation on the ECG or other high suspicion of coronary occlusion (e.g. haemodynamic and/or electrical instability). Perform a head-to-pelvis CT scan (including CT pulmonary angiography) if coronary angiography fails to identify causative lesions.
- If there are signs or symptoms pre-arrest suggesting a non-coronary cause (e.g. headache, seizures or neurological deficits, shortness of breath or documented hypoxaemia in patients with known respiratory disease, abdominal pain), perform a dual phase whole body CT-scan (including CT pulmonary angiography).

Airway and breathing

Airway management after return of spontaneous circulation

- Airway and ventilation support should continue after ROSC is achieved.
- Patients who have had a brief period of cardiac arrest and an immediate return of normal cerebral function and are breathing normally may not require airway or ventilatory support, but should be given supplemental oxygen via a face mask if their arterial blood oxygen saturation is less than 94%.
- Patients who remain comatose following ROSC, or who have another clinical indication for sedation and mechanical ventilation, should have their trachea intubated if this has not been done already during CPR.
- Tracheal intubation (with or without drugs) should be performed only by experienced operators who have a high success rate.
- Correct placement of the tracheal tube must be confirmed with waveform capnography.
- In the absence of personnel experienced in tracheal intubation, it is reasonable to retain or insert a supraglottic airway (SGA) or maintain the

airway with basic techniques until personnel skilled in drug-assisted tracheal intubation are available.
- Post ROSC patients may require drug-assisted tracheal intubation; the same level of care should be provided as for any other critically ill patient with a physiologically or anatomically challenging airway in terms of skills of the provider, monitoring, and choice of drugs for induction, and maintenance of sedation.

Control of oxygenation

- Immediately after ROSC, use 100% (or the maximum available) inspired oxygen until the arterial oxygen saturation (SpO_2) can be measured and titrated reliably with pulse oximetry or the partial pressure of arterial oxygen (PaO_2) can be measured.
- As soon as SpO_2 can be measured reliably or arterial blood gas values are obtained, titrate the inspired oxygen to achieve an arterial oxygen saturation of 94-98% or arterial partial pressure of oxygen (PaO_2) of 10-13 kPa (75-100 mmHg). Be aware that pulse oximetry can overestimate the true oxygen saturation in people with darker skin tones, and low-flow states will cause low signal quality.
- Avoid hypoxaemia (PaO_2 < 8 kPa or 60 mmHg) following ROSC.
- Avoid hyperoxaemia following ROSC.

Control of ventilation

- Obtain arterial blood gases and use end tidal CO_2 in mechanically ventilated patients.
- Target normocapnia (a partial pressure of carbon dioxide of 4.7-6.0 kPa (35-45 mm Hg) in adults with ROSC after cardiac arrest.
- In patients with accidental hypothermia or treated with hypothermia, monitor $PaCO_2$ frequently, as hypocapnia may occur.
- In hypothermic patients, use consistently either temperature or non-temperature corrected blood gas values.
- Use a lung protective ventilation strategy aiming for a tidal volume of 6-8 mL kg^{-1} ideal body weight.

Circulation

Coronary reperfusion

- Emergent cardiac catheterisation laboratory evaluation (and primary percutaneous coronary intervention (PPCI) if required) should be performed in adult patients with ROSC after cardiac arrest of suspected cardiac origin with persistent ST-elevation on the electrocardiogram (ECG).
- In patients with ROSC after out-of-hospital cardiac arrest (OHCA) without ST-elevation on the ECG, cardiac catheterisation laboratory evaluation should be delayed unless the clinical context suggests a high likelihood of acute coronary occlusion.

Haemodynamic monitoring and management

- All patients should be monitored with an arterial line for continuous blood pressure measurements, and it is reasonable to monitor cardiac output in haemodynamically unstable patients.
- Perform echocardiography as soon as possible in all patients to detect any underlying cardiac pathology and quantify the degree of myocardial dysfunction.
- Avoid hypotension and target a mean arterial pressure (MAP) > 60-65 mmHg after cardiac arrest.
- Maintain perfusion with fluids, noradrenaline and/or dobutamine, depending on individual patient need for intravascular volume, vasoconstriction or inotropy.
- Do not give steroids routinely after cardiac arrest.
- Avoid hypokalaemia and hyperkalaemia, which are associated with ventricular arrhythmias.
- In select patient populations (e.g. Glasgow Coma Scale score ≥ 8 on hospital arrival, with ST-elevation myocardial infarction (STEMI) and < 10 minutes cardiac arrest), consider mechanical circulatory support (such as intra-aortic balloon pump, left-ventricular assist device or arterio-venous extra-corporal membrane oxygenation) for persisting cardiogenic shock from left ventricular failure if treatment with fluid resuscitation, inotropes, and vasoactive drugs is insufficient. Left-ventricular assist devices or arterio-venous extra-corporal membrane oxygenation should also be considered in haemodynamically unstable patients with acute coronary syndromes (ACS) and recurrent ventricular tachycardia (VT) or ventricular fibrillation (VF) despite optimal therapy.

Post-ROSC arrhythmias

- In patients with arrhythmia immediately after ROSC, follow the ALS guideline for peri-arrest arrhythmia.

- In patients with arrhythmia after ROSC, treat any potential underlying causes, such as coronary occlusion or electrolyte disorders.
- In patients with no arrhythmia after ROSC, do not routinely give anti-arrhythmic drug prophylaxis.

Disability (optimising neurological recovery)

Control of seizures

- Use electroencephalography (EEG) to diagnose electrographic seizures in patients with clinical convulsions and to monitor treatment effects.
- Use levetiracetam or sodium valproate as first-line antiepileptic drugs in addition to sedative drugs to treat seizures after cardiac arrest.
- Do not use seizure prophylaxis in post-cardiac arrest patients.
- Attempt a wake-up trial in patients with myoclonus and benign EEG background (days after arrest).

Temperature control

- Actively prevent fever by targeting a temperature ≤ 37.5°C for patients who remain comatose after ROSC from cardiac arrest.
- Comatose patients with mild hypothermia (32-36°C) after ROSC should not be actively warmed to achieve normothermia.
- We recommend against the routine use of prehospital cooling with rapid infusion of large volumes of cold intravenous fluid immediately after ROSC. Use surface or endovascular temperature control techniques when temperature control is used in comatose patients after ROSC.
- When a cooling device is used, we suggest using a temperature control device that includes a feedback system based on continuous temperature monitoring to maintain the target temperature.
- Prevent active fever for 36 to 72 h in post-cardiac arrest patients who remain comatose.

Other therapies to improve neurological outcome

- There is insufficient evidence to recommend the use of any specific neuroprotective drug for comatose survivors of cardiac arrest.

General intensive care management

- Do not use prophylactic antibiotics routinely in patients following ROSC. However, it is reasonable to have a low threshold for giving antibiotics when there is any clinical suspicion of pneumonia.
- Use short-acting sedative agents and daily sedation holds when treating post-cardiac arrest patients receiving mechanical ventilation; this may enable earlier clinical examination that is less confounded by sedation when assessing neurological recovery.
- We do not recommend systematic use of neuromuscular blocking drugs in comatose post-cardiac arrest patients.
- In patients with critical hypoxaemia and ARDS following cardiac arrest, the use of a neuromuscular blocker may be considered.
- Patients should be nursed 30° head-up.
- It is reasonable to start gastric feeding at low rates (trophic feeding) and increase as tolerated.
- Given the high incidence of upper gastrointestinal ulceration in post-cardiac arrest patients and the use of anticoagulant and antiplatelet drugs both pre- and post-arrest, use stress ulcer prophylaxis in post-cardiac arrest patients, especially in those with coagulopathy.
- Anticoagulation of post-cardiac arrest patients should be individualised and be based on general ICU recommendations.
- Use standard glucose management protocols for adults with ROSC after cardiac arrest.

Predicting neurological outcome

General guidelines

- In patients who are comatose after resuscitation from cardiac arrest, neurological prognostication should be performed using clinical examination, electrophysiology, biomarkers, and imaging, to both inform the patient's relatives and to help clinicians target treatments based on the patient's chances of achieving a neurologically meaningful recovery.
- No single predictor is 100% accurate. Use multimodal neuroprognostication strategies.
- When predicting poor neurological outcome, a high specificity and precision are desirable to avoid falsely pessimistic predictions. When predicting a good outcome, the aim is to identify those patients with a better potential for recovery. Since the consequence of a false prediction in this setting is less

severe, the predictive performance of the test is not as critical. Both predicting good and poor outcomes are important to reduce prognostic uncertainty.

- The clinical neurological examination is central to prognostication. To avoid falsely pessimistic predictions, clinicians should exclude potential residual effects of sedatives and other drugs that may confound the results of the tests.
- Index tests for neurological prognostication are aimed at assessing the severity of hypoxic-ischaemic brain injury. Neurological prognosis is one of several aspects to consider in discussions about an individual's potential for recovery.

Clinical examination

- Perform a daily neurological examination in patients who are unconscious after cardiac arrest.
- Clinical examination is prone to interference from sedatives, opioids or muscle relaxants. Potential confounding from residual sedation should always be considered and excluded.
- Consider neurological prognostication in patients who are not awake and obeying commands (Glasgow coma scale motor score < 6) at 72 h or later after ROSC
- In unconscious patients at 72 h or later after ROSC, the following tests may predict a poor neurological outcome:
    - The bilateral absence of the pupillary light reflex.
    - The bilateral absence of corneal reflex.
    - The presence of myoclonus within 96 h and, in particular, status myoclonus within 72 h.
- We also suggest recording the EEG in the presence of myoclonic jerks to detect any associated epileptiform activity or to identify EEG signs, such as background reactivity or continuity, suggesting a potential for neurological recovery.

Neurophysiology

- Perform EEG from day 1 after ROSC to predict outcome and detect seizure activity in comatose patients. Routine EEG or continuous EEG monitoring may be used.
- Suppressed background with or without periodic discharges and burst suppression on EEG ('highly malignant' patterns) are accurate indicators of a

poor prognosis. We suggest using these EEG patterns after 24 h from ROSC.
- The bilateral absence of somatosensory evoked cortical N20 potentials indicates poor prognosis after cardiac arrest.
- Always consider the EEG and somatosensory evoked potentials (SSEPs) results in the context of clinical examination findings and other tests. Always consider using a neuromuscular blocking drug when performing SSEP.

Biomarkers

- Use serial measurements of neuron-specific enolase (NSE) to predict outcome after cardiac arrest. Increasing values between 24 and 48 h or 72 h in combination with high values at 48 and 72 h indicate a poor prognosis.

Imaging

- Use brain imaging studies to predict poor neurological outcome after cardiac arrest. Ensure that the images are evaluated by someone with specific experience in these studies.
- Where specialist neuroradiology expertise is unavailable, consider telemedicine consultation for brain imaging interpretation.
- Use the presence of generalised brain oedema, manifested by a marked reduction of the grey matter/white matter ratio on brain CT, or extensive diffusion restriction on brain MRI to predict poor neurological outcome after cardiac arrest.
- Repeat the brain CT if the patient is unconscious at the time of prognostication (72-96 h after ROSC) and the first brain CT does not show signs of HIBI.

Multimodal prognostication

- Once major confounders have been excluded, start the prognostication assessment with an accurate clinical examination.
- In an unconscious patient at ≥ 72 h from ROSC, in the absence of confounders, poor outcome is likely when two or more of the following predictors are present: no pupillary and corneal reflexes at ≥ 72 h, bilaterally absent N20 somatosensory evoked potential (SSEP) wave at ≥ 24 h, highly malignant EEG at > 24 h, neuron specific enolase (NSE) > 60 mcg L^{-1} at 48 h and/or 72 h, status myoclonus ≤ 72 h, or a diffuse and extensive anoxic injury on brain CT/MRI. Most of these signs can be recorded before 72 h from ROSC; however, conclusions on prognosis will be made only at the time of

clinical prognostic assessment at ≥ 72 h.

Withdrawal of life-sustaining therapy

- Separate discussions around withdrawal of life-sustaining therapy and the assessment of prognosis for neurological recovery; withdrawal of life-sustaining therapy decisions should consider aspects other than brain injury, such as age, co-morbidity, general organ function and the patients' preferences.
- Allocate sufficient time for communication around the level-of-treatment decision within the team and with the relatives.
- After a decision on withdrawal of life-sustaining therapy, use a structured approach to shift from curative to end-of-life palliative care and consider organ donation.

Rehabilitation and follow-up after cardiac arrest

- Implement early mobilisation, delirium management and ICU diaries during hospitalisation.
- Provide information for patients and co-survivors.
- Perform functional assessments of physical and non-physical impairments before discharge to identify rehabilitation needs and refer to early rehabilitation if indicated.
- Provide cardiac rehabilitation as indicated by the cause of the cardiac arrest.
- Organise a follow-up of cardiac arrest survivors within three months after hospital discharge; screening for cognitive, physical, emotional problems, fatigue, and impact on life roles.
- Invite co-survivors to the follow-up; ask about emotional problems and impact on life roles.
- Undertake specialist referral and further rehabilitation as indicated.

Organ donation

- We recommend that all patients who have restoration of circulation after CPR and who subsequently progress to death be evaluated for organ donation.

- In comatose ventilated patients who do not fulfil neurological criteria for death, if a decision to start end-of-life care and withdrawal of life support is made, organ donation should be considered for when circulatory arrest occurs.
- All decisions concerning organ donation must follow local legal and ethical requirements.
- Cardiac arrest registries should report if organ donation after initial resuscitation from cardiac arrest occurred.

Investigating unexplained cardiac arrest

- Diagnostic testing of patients with unexplained cardiac arrest includes blood sample collection for toxicology and genetic testing, data retrieval from cardiac implantable electronic devices and wearable monitors, repeated 12-lead ECG and continuous cardiac monitoring, cardiac MRI, sodium channel blocker tests, and exercise testing.
- A confirmed diagnosis of a heritable condition should prompt targeted genetic testing.
- Long-term follow-up of unexplained cardiac arrest patients is recommended because of the high risk of recurrence of arrhythmia.

Cardiac arrest centres

- Adult patients with non-traumatic OHCA should be considered for transport to a cardiac arrest centre according to local protocols.
- Adult patients with non-traumatic OHCA should be cared for at a cardiac arrest centre whenever possible.
- Health care networks should establish local protocols to develop and maintain a cardiac arrest network.

Downloads

Adult post-resuscitation care 2025 80.92 KB

Adult neuroprognostication 35.79 KB

Adult post-cardiac arrest functional assessment-rehabilitation 2025 32.27 KB

Resuscitation Council UK

Paediatric Life Support (basic and advanced)

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Key points

- **Early recognition is crucial:** Timely identification of critically ill children is vital for the prevention of cardiac arrest. Use quick-look tools like the BBB-tool (Behaviour, Breathing, Body colour) or the Paediatric Assessment Triangle.

- **Team approach:** Request additional resources early and establish a team with clearly defined roles.
- **ABCDE assessment:** Immediately perform a structured ABCDE assessment on any child who appears critically ill or injured.
- **ABCDE management:** Open and maintain the airway. Provide adequate oxygenation and ventilation. Aim for adequate organ perfusion. Treat seizures and hypoglycaemia promptly.
- **Paediatric basic life support:** Check responsiveness. Call the ambulance service (out of hospital) or summon help (in hospital). Check breathing. Give five initial breaths. Start chest compressions. Use a compression-to-ventilation ratio of 15:2 if trained in paediatric basic life support; otherwise, use a ratio of 30:2.
- **Untrained rescuers:** Follow three simple steps to save a child's life: check-call- CPR. Follow the ambulance service call handler's advice.
- **Paediatric advanced life support:** Follow the PALS algorithm while considering and treating relevant reversible causes of cardiac arrest.
- **Special circumstances:** Modify your approach in some special circumstances, e.g. trauma or intoxication.
- **Post-resuscitation care:** Initiate post-resuscitation care immediately after ROSC. Implement individualised goals and bundled care.
- **Prognostication:** Use a multimodal approach to prognostication. Withhold prognostication for at least 72 h in comatose children.
- **Post-discharge care:** Discuss and plan post-discharge care for survivors. Follow-up care can help improve the long-term outcomes.
- **Family-centred approach:** Involve parents/persons with parental responsibility at all stages of care. Communicate with honesty and empathy while considering the needs of the family.
- **Systems:** Systems should aim to link all parts of the chain of survival and establish clear protocols for life-threatening conditions in children.

What is a Paediatric patient?

- Paediatric patients are defined as persons aged 0-18 years of age. In this guideline, we use the term 'children' to encompass all age categories. When distinguishing between age groups, e.g. for specific skills or techniques, we use the word 'infant' for neonates and children up to 1 year, the words 'child' for children aged 1-12 years and the word 'adolescents' for teenagers aged 13-18 years.

When should the PLS algorithms be used rather than the NLS algorithms?

- RCUK 2025 NLS guidelines can be used during neonatal unit and maternity unit stays, especially in preterm infants or term infants with primary respiratory problems.
- Use the RCUK 2025 NLS guidelines in out-of-hospital settings if the baby is less than 24 h old. In the absence of clear evidence, this is a pragmatic recommendation, and team skills and equipment should be considered.
- Using the RCUK 2025 PLS guidelines during the first hospital stay after birth can be considered in the following circumstances:
    - after cardiac surgery
    - in known cardiac arrhythmia
    - in other non-respiratory cardiac arrests.
- Organisations should develop local policies defining which guideline to use for which infants, applicable to the healthcare setting. Factors to take into consideration include:
    - individual NICU case-mix
    - algorithm familiarity and training
    - human and organisational factors.
- Teams should initiate effective resuscitation using the guideline they are most familiar with (NLS or PLS) across the team, summon appropriate help and switch guidelines if needed, in a timely, coordinated and well-communicated manner.
- These protocols should be incorporated into local resuscitation training programs.

When should the ALS algorithms be used rather than the PLS algorithms?

- If the rescuer considers a person to be an adult, they should use the adult algorithm; otherwise, they should use the paediatric algorithm.
- The differences in adult and paediatric resuscitation algorithms are primarily based on the distinct causes of cardiac arrest. However, if an adult person is mistakenly resuscitated using a paediatric algorithm, little or no harm will occur, as studies of aetiology have shown that the paediatric causes of arrest continue into young adulthood.

Weight and drug dosing in resuscitation

- While obtaining an accurate weight is important when calculating drug and fluid doses, weighing a child can be problematic in an emergency. The child's weight as reported by the parents/persons with parental responsibility is often the most accurate, and we recommend using this when available.
- When this is not available, a length-based method, corrected for body habitus, is generally more accurate than a formula for calculating actual body weight.
- For children with a **BMI in the normal range, actual body weight** should be used (as actual body weight will closely align with ideal body weight).
- For children with a **high BMI**, in most resuscitation situations, **ideal body weight** should be used. This is because using actual body weight may result in overdose and toxicity, particularly when using hydrophilic drugs (which do not distribute into excess fat tissue).
- Drugs used in resuscitation are mostly hydrophilic (e.g. adrenaline, calcium, potassium, salbutamol, magnesium, adenosine), with fewer being lipophilic (e.g. amiodarone). Therefore, it is important to adjust doses of most resuscitation drugs in obesity.
- Always refer to established paediatric emergency drug charts (e.g. Paediatric Emergency Chart) and guidelines for appropriate dosages and beware of exceeding adult doses.

Paediatric cardiac arrest

- Paediatric cardiac arrest is a rare event that can have devastating consequences for patients, their families and society.
- Even though cardiac arrest in children comprises a mere fraction of all cardiac arrests, their overall impact on society may be far-reaching, given the long-term consequences.
- These consequences may include increased lifelong healthcare costs and impaired ability to deal with daily life, which can limit participation in society during adulthood, including workforce participation.
- Despite some improvements in overall survival worldwide, the rate of survival with a good neurological outcome after paediatric out-of-hospital cardiac arrest (OHCA) remains poor, with major differences across Europe. This highlights the need for novel approaches to science, prevention, resuscitation and training.

- In adolescents, trauma, intoxications, and suicide attempts are among the leading causes of OHCA.
- Exercise-related paediatric OHCAs are rare but are associated with higher survival rates.
- Paediatric in-hospital cardiac arrest (IHCA) has better outcomes compared with paediatric OHCA.
- The main causes of paediatric IHCA are respiratory failure and shock. Common causes of peri-operative paediatric IHCA include hypoxia (e.g. airway management problems), bradycardia and haemorrhage.
- Paediatric IHCA is most common in neonates, infants, and children with complex chronic conditions, especially congenital heart disease.

Prevention

- The initial phase of prevention is most important, as cardiac arrest in children can be prevented by quick and effective treatment of a range of life-threatening illnesses.
- This approach is outlined in the prevention of cardiac arrest and special circumstances sections of these guidelines.

Prevention of cardiac arrest in children

- Cardiac arrest in infants, children and adolescents is most often secondary to progressive respiratory or circulatory failure, or to neurological emergencies and is not often due to primary cardiac causes. Therefore, for children, the recognition and proper management of critically ill children remains the best way to prevent cardiac arrest.

Recommendations for caregivers and other untrained rescuers

- All parents/persons with parental responsibility and caregivers should be encouraged to learn basic recognition of critical illness and injury and basic first-aid life-saving procedures.
- Simple recognition using triage tools and basic first-aid life-saving procedures should be taught to professional caregivers for children,

including child minders, schoolteachers, first responders, lifeguards and coaches/trainers of children and adolescents.

- Immediately call for medical help or call the ambulance service if a child has signs or symptoms that might indicate critical illness, such as those described in the BBB-tool (Behaviour-Breathing-Body colour), namely:
- **Behaviour:** A child who:
  - is not fully conscious or is difficult to rouse, floppy or rigid.
  - is having a seizure.
  - is confused, agitated, or interacting abnormally with the parents/caregivers.
  - is crying inconsolably.
  - is not able to move one or more limbs.
  - has severe pain or is unable to speak or walk, if previously able to do so.
- **Breathing:** A child who has difficulty breathing, such that they:
  - are unable to take a deep breath.
  - are working hard to take each breath (breathing fast, grunting, flaring of the nostrils, and indrawing between or under the ribs).
  - are making additional noises while breathing.
  - are breathing too fast, too slowly or irregularly, or stop breathing.
  - adopt an abnormal posture to aid breathing.
- **Body colour:**
  - The child's skin is cyanosed, mottled, abnormally pale or greyish. Look at the hand palms, soles of the feet and mucosal membranes, especially in children with dark skin tones.
- Parents/persons with parental responsibility of children with specific chronic conditions should have an emergency plan available for any sudden deterioration, and caregivers should be familiar with this and trained in initial life-saving procedures.

Recommendations for healthcare professionals

- Identify children with an increased risk of sudden cardiac arrest and formulate a care plan for these children.
- Use a dedicated quick-look tool (e.g. the above-mentioned BBB-tool or the paediatric assessment triangle) for the early recognition of a potentially critically ill child.
- Consider your own safety. Use appropriate personal protection equipment when indicated.

- Immediately perform an initial ABCDE assessment in any child who appears to be critically ill or severely injured. Initiate life-saving interventions as soon as a problem is identified.
- Activate additional resources (e.g. personnel, equipment) and establish a team with clearly defined individual roles and responsibilities as soon as possible.
- Use cognitive aids such as displayed algorithms and checklists to decrease cognitive load.
- Reassess the child after any intervention or when in doubt.
- Ask parents/persons with parental responsibility for an estimate of the child's weight or estimate this using length-based methods, which should ideally be corrected for body habitus.
- Use an individualised approach or modify interventions for children with chronic medical conditions or specific medical needs. Ask a parent/person with parental responsibility for relevant information about the condition if they have it.
- At all times, allow parents/persons with parental responsibility to stay with the child if this does not preclude their safety or the safety of the child or personnel.
- Include parents and those with parental responsibility in discussions and decision-making.
- Assign a dedicated team member to the care of parents/persons with parental responsibility, and ensure they are fully informed at all stages.

Recognition of the critically ill or injured child

- **Airway**
  - Check the patency of the airway and the presence of airflow using the look-listen-feel method.
  - Consider stridor or snoring to be a sign of partial airway obstruction.
  - Allow a conscious child to adopt the most comfortable position; do not force them to lie down.
- **Breathing**
  - Check for signs of respiratory insufficiency. Assess:
    - Work of breathing (respiratory rate, recession, grunting, nasal flaring, tracheal tug, positioning).
    - Effectiveness of breathing (chest expansion, character and strength of crying/speaking, auscultation (reduced air entry, symmetry, wheeze or crepitations), skin colour (cyanosis), arterial

oxygen saturation.
        - Systemic signs (heart rate, conscious level).
    - Monitor arterial oxygen saturation by pulse oximetry (SpO_2) continuously. Be aware that a pulse oximeter can be less reliable in children with darker skin tones or poor peripheral perfusion.
    - Monitor end-tidal carbon dioxide ($ETCO_2$) in all patients with an advanced airway (i.e. a tracheal tube or supraglottic airway device (SGA)). Consider capnography in patients with non-invasive ventilation.
    - Consider point-of-care ultrasound (POCUS) of the lungs and blood gas analysis.
    - Use multiple variables to recognise respiratory failure, as no single sign in isolation is indicative of this. Trends are more important than a single value.
- **Circulation**
    - Check for signs of cardiovascular insufficiency.
        - Cardiovascular signs (heart rate, pulse volume (peripheral and central), blood pressure, preload (jugular veins, liver span, crepitations).
        - Organ perfusion (capillary refill time, skin colour and temperature, urinary output, level of consciousness).
    - Attach an ECG monitor to assess the rhythm, and a non-invasive blood pressure (NIBP) monitor/device.
    - Consider serial lactate measurements if signs of shock are present.
    - Consider POCUS, which might help to distinguish the cause and type of shock.
    - Consider a 12-lead ECG.
    - Use multiple variables to recognise circulatory failure (shock) and the type of shock; no single sign in isolation is indicative of shock. Trends are more important than a single value.
- **Disability**
    - Check conscious level using the AVPU (Alert-Verbal-Pain-Unresponsive) scale, (paediatric) Glasgow Coma Scale (GCS) total score, or the GCS motor score, pupil size, symmetry, and reactivity to light and the presence of posturing or focal neurological signs.
    - Recognise seizures as a neurological emergency.
    - Check blood glucose.
    - Consider urgent brain imaging if neurological symptoms persist after ABC resuscitation.
- **Exposure**
    - Check body temperature.

- Undress the child and look for rashes, injuries and signs of physical child abuse and neglect.
- Look for signs and symptoms of potentially life-threatening conditions as described further below (e.g. anaphylaxis, sepsis).
- Try to identify any underlying conditions that might require a specific approach (e.g. intoxication, underlying chronic conditions).
- Use AMPLE (Allergy-Medication-Past History-Last Meal-Events) to quickly establish a basic medical history.
- Be alert to conditions in which cardiac arrest is imminent, such as:
  - airway obstruction
  - flail chest
  - silent chest
  - tension pneumothorax
  - massive haemorrhage
  - cardiac tamponade
  - intracranial hypertension
  - hypoglycaemia with coma
  - hypothermia
  - severe trauma
  - thrombosis.

Table 1: Approximate normal values for respiratory rate, heart rate and blood pressure. The values change continuously as the child grows. Use intermediate values for children between the specified ages in the table.

Age	1 month	1 year	2 years	5 years	10 years	18 years
Upper limit of normal range for RR	60	50	40	30	25	20
Lower limit of normal range for RR	25	20	18	17	14	12
Upper limit of normal range for HR	180	170	160	140	120	100
Lower limit of normal range for HR	110	100	90	70	60	60
p50 for systolic BP	75	95	98	100	110	120
p10 for systolic BP	55	75	77	80	85	105
p5 for systolic BP	50	70	73	75	80	90
p50 for MAP	55	70	73	75	75	75
p10 for MAP	45	55	58	60	60	65
p5 for MAP	40	50	53	55	55	60

RR = respiratory rate, HR = heart rate, BP = blood pressure, MAP = mean arterial pressure, p50/p10/p5 = 50th/10th/5th percentile of BP for the 50th percentile of the child's height at that age.

Table 2: Clinical signs of respiratory and circulatory failure.

- Individual deviations are common, especially in children with chronic medical conditions. Be aware that cardiovascular collapse can also occur suddenly without any preceding symptoms or signs. Always use multiple variables to diagnose failure.

	Compensated	Decompensated (risk of cardiorespiratory arrest)
Respiratory failure	• Tachypnoea • Increased work of breathing • Normal, increased or slightly decreased tidal volumes. • Wheezing • Mild to moderate hypoxaemia (e.g. SpO_2 90-93% breathing air) • Normocapnia or hypocapnia • Agitation	• Bradypnoea, irregular breathing • Decreasing work of breathing • Grunting • Diminished chest excursions and/or air entry (silent chest) • Severe hypoxaemia (SpO_2 < 90% breathing air) • Hypercapnia • Decreased level of consciousness
Circulatory failure (shock)	• Tachycardia • Impaired peripheral perfusion • Decreased peripheral pulsations • Normal blood pressure • Agitation	• Bradycardia • Diminished central pulsations • Hypotension • Decreased level of consciousness

Principles of the management of the critically ill or injured child

- **Airway**
  - Establish airway patency to allow adequate oxygenation and ventilation.
  - Open the airway and keep it open. Use adequate positioning of the head and body alignment (head tilt and chin lift or jaw thrust), and remove secretions and other obstructing materials by careful suctioning if necessary.

- Consider a nasopharyngeal or oropharyngeal airway of the appropriate size in children with a decreased level of consciousness.
- Use an appropriately sized supraglottic airway device (e.g. laryngeal mask, i-gel) when indicated.
- Intubate the trachea of a child, when indicated and only if competent and have the necessary drugs and equipment immediately available; use an intubation checklist:
    - Always have a plan for the unexpected difficult intubation (e.g. SGA insertion, additional expertise).
    - Pre-oxygenate the child before induction of anaesthesia, avoid distending the stomach.
    - Use sedative and neuromuscular blocking drugs with a rapid onset of action, unless the child is deeply comatose.
    - Do not use atropine as a routine pre-medication.
    - The oral route for tracheal intubation is preferable during emergencies.
    - Use video laryngoscopy or direct laryngoscopy for tracheal intubation, depending on local protocols and rescuer experience. Do not use equipment you are unfamiliar with.
    - Consider the use of apnoeic oxygenation, or high-flow nasal oxygen, to avoid hypoxia during the procedure.
    - Limit the number of attempts at intubation to 4. Where intubation has failed, focus on oxygenation and call for additional help.
    - Limit each attempt to 30-60 s. Monitor SpO_2, heart rate and blood pressure during intubation and stop the attempt immediately in case of bradycardia or oxygen desaturation. Immediately recommence bag-mask ventilation or insert an SGA to restore oxygenation.
    - Use cuffed tracheal tubes for all children (over 30 days corrected gestational age). Monitor and limit cuff inflation pressure according to the manufacturer’s recommendations.
    - Provide adequate analgesia and sedation during and after intubation.
    - Confirm tube placement clinically and using $ETCO_2$ monitoring (providers with expertise may use POCUS in addition). Monitor SpO_2 and $ETCO_2$ continuously in all children with an advanced airway. Confirm the tube position with X-ray as soon as practicable.
- Use a front-of-neck airway (e.g. cricothyroidotomy or surgical airway) only as a last resort option in a "cannot-ventilate-cannot-oxygenate” situation. This should be performed by an individual trained in invasive

airway techniques.

- In children with tracheostomies who develop difficulty breathing, suspect an obstruction of the tracheostomy tube:
  - Try to relieve the obstruction by suctioning the tracheostomy tube.
  - If a suction catheter cannot be passed, the tracheostomy tube should be removed immediately and replaced.
  - If a clean tube is not available, oxygen and ventilation via bag and mask should be given until the tube is cleaned and replaced.
  - **If the child's upper airway is patent**, it may be possible to provide oxygen and bag-mask ventilation via the nose and mouth whilst the tracheal stoma site is occluded.
  - **If the upper airway is not patent**, it may be possible to provide oxygen and bag-mask ventilation at the tracheostomy stoma site using a small face mask (or the end of an LMA used as a mask) over the stoma site.
  - In an emergency, tracheal intubation via the tracheostomy or upper airway (if patent) with a tracheal tube may be needed.
  - The National Tracheostomy Safety Project (NTSP) in the UK has developed specific emergency algorithms for children with tracheostomies, which should be followed.

- **Breathing**
  - Aim for adequate oxygenation and ventilation.
  - Initially give 100% oxygen for all children with respiratory, circulatory, or neurological failure.
  - Titrate the fraction of inspired oxygen (FiO_2) as soon as the SpO_2 can be monitored and avoid sustained readings of 100% (except in special circumstances, e.g. carbon monoxide intoxication, methaemoglobinaemia, cyanide poisoning or severe anaemia).
  - In previously healthy children aim for an SpO_2 of 94-98%. The goal is to achieve an SpO_2 of at least 94% with the lowest possible FiO_2.
  - Consider individualised targets for SpO_2 and $ETCO_2$ in children with specific conditions (e.g. cyanotic congenital heart defects, chronic respiratory failure).
  - Consider high-flow nasal oxygenation or non-invasive ventilation in children with hypoxaemia not responding adequately to conventional oxygen therapy.
  - Support inadequate spontaneous ventilation, using bag-mask ventilation as the first-line method:

        - Ensure correct head positioning, mask size and proper seal between the mask and the face.
        - Use a two-person approach (using both hands to hold the mask and to keep the airway open), especially if ventilation is difficult or when there is a risk of disease transmission. Consider airway adjuncts (e.g. oropharyngeal device).
        - Use an appropriately sized bag and sufficiently long inspiratory times to make the chest visibly rise (mild chest rise). Avoid hyperinflation and high peak inspiratory pressure.
        - Aim for a normal respiratory rate for the child's age (pragmatically use the following rates per minute: 25 in infants, 20 in children >1 y, 15 in children >8 y, 10 in children >12 y).
    - Consider the early insertion of an SGA or tracheal tube in cases when bag-mask ventilation does not improve oxygenation or ventilation, or when prolonged respiratory support is anticipated.
    - Check air leak, signs of aspiration, efficacy of ventilation in patients with SGA or tracheal tube.
    - In mechanically ventilated children:
        - Use tidal volumes of 6-8 mL kg^{-1} of ideal body weight and a respiratory rate at a low-normal range for the child's age.
        - Start with a positive end-expiratory pressure (PEEP) of 5 cm H_2O and adjust PEEP and FiO_2 to improve oxygenation, always titrating these to the minimum support needed to achieve the desired targets.
        - Individualise ventilator settings in specific conditions, seek the advice of a paediatric intensivist early if possible.
        - Minimise apparatus dead space, especially in infants.
        - Avoid both hyperventilation and hypoventilation. Monitor $ETCO_2$ and aim for normocapnia. Check partial pressure of carbon dioxide in arterial blood ($PaCO_2$) as soon as practicable to assess its relationship to $ETCO_2$.
    - Use **DOPES** to help identify the cause of a sudden, rapid deterioration in a ventilated child (e.g. bag-mask ventilation or mechanical ventilation):
        - **D**isplacement (mask, SGA, tracheal tube).
        - **O**bstruction (secretions, tube, circuit, airway – head position).
        - **P**neumothorax or other pulmonary pathology.
        - **E**quipment (disconnection, oxygen supply, tubing, valves, ventilator).

        - **S**tomach/stacking/sedation (abdominal distention, stacked breaths or insufficient sedation).
- **Circulation**
    - Aim for adequate organ perfusion.
    - In the case of circulatory failure (shock), do not spend more than 5 min (or two attempts) to establish intravenous (IV) access. Competent providers should use POCUS to guide IV cannulation.
    - Establish intraosseous (IO) access as a rescue alternative if IV access fails or when the chances for a successful IV-cannulation are considered minimal:
        - Use an IO-needle of appropriate size.
        - Provide effective analgesia (e.g. intranasal ketamine) unless the child is comatose.
        - Use manual infusion or a high-pressure bag for fluid infusion.
        - Monitor for signs of extravasation and displacement.
    - Give one or more fluid boluses of 10 mL kg^{-1} in children in hypovolaemic, obstructive or distributive shock.
        - Use balanced isotonic crystalloids as the first-line choice of fluids. If unavailable, use normal saline, which may be the preferred fluid in diabetic ketoacidosis and severe traumatic brain injury.
        - Give repeated 10 mL kg^{-1} boluses, as necessary. A total of 40-60 mL kg^{-1} may be needed during the first hour of treatment of hypovolemic or distributive shock.
        - Reassess the child after each bolus, looking for signs of fluid overload or cardiac failure (e.g. lung crepitations, increasing liver edge, raised jugular venous pressure).
        - If the signs of shock recede, continue maintenance fluids and rehydration at a slower pace.
        - Consider vasoactive drugs and respiratory support if repeated fluid boluses are required.
    - Consider the need for fluids in cardiogenic shock on an individual basis. Fluids might still be needed, but should be given more cautiously, e.g. 5 mL kg^{-1} fluid bolus.
    - Assess the type of shock; POCUS may be of value for this.
    - Start vasoactive drugs early, as a continuous infusion via a central or peripheral line, and not later than after three to four fluid boluses (30-40 mL kg^{-1}):
        - Titrate the infusion rate according to clinical and other signs, not solely based on blood pressure targets, which may differ according to the pathology, age and response. Aim for the 5th percentile as a

minimum.
        - Use noradrenaline as a first-line vasopressor and adrenaline as a first-line inotrope. Use milrinone as a first-line inodilator.
        - Consider the use of POCUS, echocardiography, lactate and mixed venous oxygen saturation (SvO_2) to further guide clinical decision-making, if the expertise is available.
    - Treat arrhythmias if present.
    - Initiate other specific treatments according to the type of shock.
    - Seek expert advice on extracorporeal support (e.g. ECMO) in children with refractory shock or specific conditions (e.g. congenital heart disease).
- **Disability**
    - Aim for neuroprotection (see the section on post-resuscitation care).
    - Ensure adequate oxygenation, ventilation, and circulation.
    - Treat clinical and electroencephalographic seizures. Follow a time-critical protocol for the management of status epilepticus.
    - Treat hypoglycaemia, orally, if possible, with 0.3 g kg^{-1} glucose as soon as this is detected. If oral intake is not possible, give an IV bolus of 0.2 g kg^{-1} glucose (2 mL kg^{-1} 10% glucose) and re-check blood glucose after 5-10 min and repeat if necessary.
    - When IV glucose is not available, give glucagon as a temporary rescue measure: glucagon IM or SC, 0.03 mg kg^{-1} (or 1 mg if > 25 kg or 0.5 mg if < 25 kg) OR intranasally 3 mg if 4-16 yr.
    - Ensure (preferably continuous) analgesia and sedation in children with discomfort or pain. Anticipate and prevent hypotension.
    - Consider the possibility of paediatric stroke or neuroinfection and quickly seek expert help.
- **Exposure**
    - Avoid hypothermia and hyperthermia and start specific measures if present.
    - Consider antibiotics and/or antiviral medication if a bacterial or viral cause of critical illness is likely (e.g. in sepsis, meningoencephalitis, severe pneumonia).
    - Protect the best interests of the child according to the local ethical and legal policies in case of a suspicion of inflicted injury (child abuse and neglect).

Paediatric basic life support (PBLS)

Recommendations for untrained rescuers and dispatcher-assisted CPR

- If you encounter a child who appears to be unresponsive and you have no training in PBLS, ensure your own safety and that of the child and follow the **3 steps to save a life:**
  - **Check** if the child reacts to a non-painful stimulus.
  - **Call** the ambulance service immediately if the child does not react and follow the dispatcher's advice.
  - **CPR:** Start CPR immediately following the instructions of the dispatcher.

- Ambulance service call handlers should encourage bystanders to perform both rescue breaths and chest compressions in children of all ages. They should actively ask about signs confirming that the rescue breaths are effective (e.g. whether the chest rises and falls).
- Ambulance service call handlers should use a 30:2 ratio for CPR instructions with 5 initial rescue breaths for untrained bystanders or bystanders trained only in adult BLS.
- If the bystanders are not willing or able to perform rescue breathing, dispatchers should encourage compression-only CPR in all children.
- Ambulance service call handlers should instruct bystanders to use age-specific techniques for chest compressions and breathing in infants, children and adolescents.

Recommendations for PBLS in paediatric OHCA

- Ensure your own safety and that of the child.
- Use verbal and tactile stimulation to assess responsiveness. Do not use painful stimuli.
- Call, or have someone call, the ambulance service immediately, using speaker function of your mobile phone. Some ambulance services may enable you to use the video function of your phone when possible. Follow the advice of the dispatcher who can help you to recognise if you need to start CPR. If you are trained in PBLS, check the breathing as described below while waiting for the connection with the dispatcher.
- Use the head tilt chin lift manoeuvre to open the airway, assess breathing and look for signs of life for no longer than 10 s.

- Give five initial rescue breaths.
- Immediately proceed with chest compressions.
- Continue CPR. Use a compression-to-ventilation ratio of 15:2 if you are specifically trained in PBLS; otherwise, use a ratio of 30:2.
- Focus on consistently high-quality compressions and effective ventilations. Minimise chest compression pauses.
- If a second rescuer is available, they should call the ambulance service while the first rescuer starts CPR and then bring and attach an automated external defibrillator (AED) as soon as possible for children of all ages. Once attached, follow the instructions of the AED.
- If there is only a single rescuer, calling the ambulance service and starting CPR should be prioritised over fetching and attaching an AED.
- Do not interrupt CPR unless there are clear signs of life, or you are instructed to do so by the AED.
- In an unresponsive child who is clearly breathing effectively, keep the airway open by continued head tilt, chin lift or positioning the child in a recovery position, especially if there is a risk of vomiting, but not in trauma.
- Check the breathing continuously or at least every minute if the child is placed in a recovery position. If in doubt about the stability of the position or the quality of the breathing, turn the child onto their back and open the airway with the head tilt chin lift manoeuvre.
- **Airway and assessment of breathing:**
    - Keep the head in the neutral position in infants by slightly tilting the head and lifting the chin with two fingers on the chin bone without pressing on the soft tissues (head tilt chin lift manoeuvre). In older children, more head tilt will be needed. In adolescents, full extension of the head is needed as in adults.
    - Look for chest movement, listen and feel for the flow of air from the nose and/or mouth. If the chest is moving but there is no airflow, the airway is not open. Immediately try to improve the airway opening manoeuvre.
    - If you have any doubt whether breathing is normal, act as if it were not normal.
- **Rescue breaths without equipment:**
    - Ensure the airway is open and blow steadily into the child’s mouth (or infant’s mouth and nose) for about 1 s, sufficient to make the chest visibly rise and then allow the chest to fall back passively while you take your next breath.
    - If the chest does not rise, the airway may be obstructed:

        - Remove any visible obstruction in the mouth if it is easy to do so. Do not perform a blind finger sweep.
        - Reposition the head or adjust the airway opening method by further lifting the chin or tilting the head.
- **Chest compressions:**
    - Perform chest compressions on a firm surface if immediately available. Remove clothes only if they hinder chest compressions.
    - Perform chest compressions over the lower half of the sternum (breastbone) in all age groups.
    - Use the two-thumb encircling method for chest compressions in infants.
    - Use the one-hand or two-hand technique in children older than 1 year, or when unable to give high-quality chest compressions with the two-thumb-encircling technique.
    - Deliver high-quality chest compressions as defined by:
        - Rate of 100-120 min^{-1}.
        - Depress the chest by at least one third of the anteroposterior dimension. Use the adult depth recommendation of 5-6 cm in adolescents, and do not exceed a depth of 6 cm at any age.
        - Avoid leaning by releasing all pressure between compressions and allow the chest to rise again completely (chest recoil).
        - Do not interrupt chest compressions except when giving ventilations, or if you are instructed to do so by the AED.
- **Using an Automated External Defibrillator:**
    - Follow the instructions of the AED.
    - Apply the pads with minimal interruptions in CPR (one person applying the pads, a second performing CPR).
    - Activate the paediatric mode, if available, in all infants and children weighing less than 25 kg (i.e. approximately 8 years of age). In larger children and adolescents, use the AED in standard adult mode. If the AED does not have instructions for children, use it in standard adult mode.
    - Place adult-size pads as follows:
        - Use the anteroposterior position in infants and children weighing less than 25 kg: the anterior pad is placed mid-chest immediately left of the sternum, and the posterior pad on the back, placing the centre of the pad between the scapulae (shoulder blades).
        - Use either the anterolateral or the anteroposterior position in children weighing more than 25 kg and adolescents. In the anterolateral position, one pad is placed below the right clavicle

and the other in the left axilla. If the anteroposterior position is used in adolescents, avoid placing the pads over breast tissue.
    - Do not touch the patient while the AED is analysing the rhythm.
    - Restart chest compressions immediately after shock delivery.

Additional considerations for PBLS and IHCA

- In the hospital, healthcare professionals should call for the help of a colleague as soon as deterioration is detected and not wait for cardiac arrest.
- They should then check for breathing and other signs of life.
- If they suspect a cardiac arrest or a critical situation, one person should call the resuscitation or emergency medical team, while the other person starts CPR as described above, using a compression-to-ventilation ratio of 15:2.
- Competent providers should use bag-mask ventilation with oxygen.
- If starting ventilations is not immediately possible (e.g. bag-mask ventilation is not immediately available and there is a contraindication to mouth-to-mouth ventilation), start chest compressions immediately and add ventilations as soon as possible.
- Competent providers can also use a pocket mask for rescue breaths to ventilate larger children when a bag and mask is not available.
- Activate the CPR mode on the bed to increase the stiffness of the mattress (if the bed is equipped with this function).
- Over-the-head chest compressions can be used in certain specific situations, such as limited space or limited personnel.
- The anterolateral pad position can be used by competent providers in children ≤ 25 kg when using paediatric pads, provided these do not touch each other.
- A single rescuer without a mobile phone should perform CPR for 1 min before going to seek help.

Foreign body airway obstruction

- Suspect choking due to a foreign body if the child is unable to speak (children and adolescents) or cry aloud (infants or smaller children), especially during feeding, eating, or playing unsupervised.
- Call or have someone call the ambulance service as soon as possible.
- Encourage an older child or adolescent to cough.

- Give up to 5 back blows if coughing is not possible or becoming ineffective:
    - Turn the infant face down on your forearm with your forearm resting on your leg. Support the head of the infant with your hand. Try to hold the head below the level of the thorax. Give a sharp blow between the shoulder blades. Repeat up to 5 times or until the obstruction is relieved.
    - Lean children and adolescents forward and give blows between the shoulder blades. Repeat up to 5 times.
- Give up to 5 chest/abdominal thrusts if back blows are not effective:
    - In infants:
        - Turn the infant onto their back and lay them on your knees.
        - Use the two-thumb encircling technique to perform chest thrusts as advised for chest compressions, but compressing the sternum more sharply. Repeat up to 5 times or until the obstruction is relieved.
    - In children and adolescents:
        - Stand behind the child and put your arms around the upper part of their abdomen.
        - Lean them forward.
        - Clench your fist and place it between the navel (umbilicus) and the end of the breastbone (xiphoid).
        - Grasp your fist with the other hand and pull sharply inwards and upwards.
        - Repeat up to 5 times or until the obstruction is relieved.
    - If the child is still conscious, repeat the back blows up to 5 times, alternating these with up to five chest/abdominal thrusts.
    - Stop back blows or chest/abdominal thrusts immediately if at any time there are signs of relief of the obstruction (coughing, loud breathing or crying).
- Do not use blind sweeps to clear the obstruction from the mouth, but use a single sweep to remove a clearly visible obstruction.
- Call for help and the ambulance service as soon as practical (if you have not already done so), at the latest when the child loses consciousness.
- Start CPR immediately with five rescue breaths as soon as the child becomes unconscious.
- RCUK and ERC are unable to make a recommendation for or against the use of suction-based devices advertised and marketed for clearing a foreign body airway obstruction, because of insufficient evidence.

Paediatric advanced life support (PALS)

- Use a team approach, define clear roles for each team member, and train in simulated scenarios (i.e. the best way for your own team to resuscitate a child, including roles and sequences of action).
- Commence or continue with high-quality chest compressions and ventilations.
- Recognise cardiac arrest on clinical grounds (e.g. no signs of life) or based on monitored vital signs (e.g. ECG, loss of SpO_2 and/or $ETCO_2$, loss of pulsatile intra-arterial blood pressure trace).
- Importantly, chest compressions should also be started in children who become bradycardic (< 60 min^{-1}) with signs of poor perfusion despite adequate respiratory support, even if there is still a detectable pulse.
- Apply cardiac monitoring as soon as possible, if not already in place, using self-adhesive defibrillator pads as the first choice, as this allows for a shorter time to defibrillation in children who require it.
- Differentiate between shockable and non-shockable cardiac rhythms.

Non-shockable rhythms

- Non-shockable rhythms are bradycardia (with poor perfusion), pulseless electrical activity (PEA) and asystole.
- Obtain vascular access and give adrenaline IV/IO (10 mcg kg^{-1}, max 1 mg) as soon as possible, followed by a flush to facilitate drug delivery. Immediately attempt IO access if IV access is likely to be difficult.
- Repeat adrenaline IV/IO every 3-5 min (i.e. every other 2 min cycle) unless being guided by pulsatile intra-arterial blood pressure monitoring and the haemodynamic response.
- Reassess the cardiac rhythm every 2 min (< 5 s). If the rhythm has changed to an organised rhythm which could produce cardiac output, check for signs of life and feel for a central pulse (max. 5 sec).
- Change the person doing chest compressions at least every 2 min. Watch for fatigue and/or suboptimal chest compressions and switch rescuers earlier if necessary.

Shockable rhythms

- Shockable rhythms are pulseless ventricular tachycardia (pVT) and ventricular fibrillation (VF).
- As soon as identified, give one defibrillation shock (regardless of the ECG amplitude). If in doubt, consider the rhythm to be shockable.
- If using self-adhesive pads, continue chest compressions while the defibrillator is charging.
- Ensure that there is no leakage of oxygen around the chest during defibrillation. In small children, the self-inflating bag may be very close to pads; direct the oxygen away from the chest or disconnect the bag, if necessary, before charging the defibrillator. Do not disconnect the tracheal tube if a closed circuit is being used, e.g. during mechanical ventilation.
- Once charged, pause chest compressions, briefly check that the rhythm is still shockable (< 5 s) and ensure all persons are clear of the child before giving a single shock.
- Minimise pauses between stopping chest compressions, delivery of the shock and restarting chest compressions (< 5 s).
- Give one shock (4 J kg^{-1}, max. 120-200 J) and immediately resume CPR for 2 min.
- Reassess the cardiac rhythm:
    - If the rhythm changes to an organised rhythm which could produce a cardiac output, check for signs of life and feel for a central pulse (< 5 s) **OR**
    - If a shockable rhythm persists, give a 2nd shock (4 J kg^{-1}) and immediately resume CPR for 2 min, then reassess and continue to repeat this cycle.
- Give adrenaline (10 mcg kg^{-1}, max. 1 mg) and amiodarone (5 mg kg^{-1}, max. 300 mg) IV/IO immediately after the third shock. Flush after each drug. Lidocaine IV (1 mg kg^{-1}) might be used as an alternative if amiodarone is not available or a local decision has been made to use lidocaine instead of amiodarone.
- Give a second dose of adrenaline (10 mcg kg^{-1}, max 1 mg) and amiodarone (5 mg kg^{-1}, max 150 mg) IV/IO immediately after the fifth shock.
- Unless there are clear signs of life, adrenaline IV/IO should be repeated every 3-5 min (i.e. every other 2 min cycle) unless being guided by pulsatile intra-arterial blood pressure monitoring and the haemodynamic response.
- Change the person doing compressions at least every 2 min. Watch for fatigue and/or suboptimal compressions and switch rescuers earlier if necessary.
- CPR should be continued unless:

- An organised rhythm is recognised at a rhythm check; It is accompanied by signs of return of spontaneous circulation (ROSC), identified clinically (e.g. eye opening, movement, normal breathing) and/or by monitoring (e.g. $ETCO_2$, SpO_2, blood pressure, echocardiogram) and/or presence of a palpable central pulse.
- Perfusion is restored by extracorporeal cardiopulmonary resuscitation.
- Criteria for withdrawing resuscitation are met (see Ethics in Resuscitation Guideline).

Defibrillation during PALS

- Manual defibrillation is the recommended method for PALS. If this is not immediately available, an AED should be used.
- Proper planning before each defibrillation will minimise hands-off time.
- Pads should be positioned either in the anterolateral or the anteroposterior position:
  - Avoid contact between pads as this can cause charge arcing.
  - In the anterolateral position, one pad is placed below the right clavicle and the other in the left axilla.
  - In the anteroposterior position, the anterior pad is placed mid-chest, immediately left of the sternum, and the posterior pad in the middle of the back between the scapulae.
  - Use the anteroposterior position in infants and children (< 25 kg) who can easily be turned onto their side for pad placement and in whom the anterolateral position is more difficult to achieve without contact between the pads.
  - Use the anterolateral position in larger children, as this leads to less interruption of chest compressions than the anteroposterior position. Avoid breast tissue in adolescents.
- Defibrillation with self-adhesive pads is standard.
- Use 4 J kg^{-1} as the standard energy dose for the initial shocks. It seems reasonable not to use doses above those suggested for adults (120-200 J, depending on the type of defibrillator).
- Increase the energy dose stepwise, increasing up to 8 J kg^{-1} (max. 360 J) for refractory VF/pVT (i.e. more than five shocks are needed).
- Charge the defibrillator with the pads or paddles on the chest. Continue chest compressions while the defibrillator is charging when using pads.
- If any period of ROSC is achieved and the child goes back into a shockable rhythm, use the defibrillation energy dose that was previously successful.

Oxygenation and ventilation during PALS

- Effective oxygenation and ventilation combined with high-quality chest compressions are essential during CPR to generate sufficient coronary perfusion to restart the heart.
- Oxygenate and ventilate with a bag and mask, using 100% oxygen. Do not titrate FiO_2 during CPR.
- Intubate the child only if you are experienced and competent and have all the necessary equipment. If not, continue to ventilate using a bag and mask or insert a supraglottic airway (SGA). Ensure the chest rises during ventilation. If not, adjust the airway or ventilation technique.
- Use a tracheal tube or SGA if CPR is required during transport; when prolonged resuscitation is anticipated, or when it is impossible to ventilate with a bag and mask. Call for expert help if this is not already present.
- Do not interrupt chest compressions during airway management. Use $ETCO_2$ monitoring to ensure correct ventilation when a tracheal tube or SGA is in place.
- Avoid hypo- or hyperventilation.
- Give continuous chest compressions when the airway is managed with a tracheal tube or SGA and ventilate without pausing chest compressions. Pausing only briefly for each rhythm check.
- Ventilate at the lower limit of the normal rate for age, e.g. pragmatically use breaths min^{-1}: 25 (infants), 20 (> 1 y), 15 (> 8 y), 10 (> 12 y).
- If there is doubt about the effectiveness of ventilation (e.g. high air leak, diminished air entry into lungs) during continuous chest compressions, return to a chest compression to ventilation ratio of 15:2.
- For children who go into cardiac arrest on a mechanical ventilator, either disconnect the ventilator and ventilate with a self-inflating bag/anaesthetic circuit (depending on expertise) or continue to ventilate with the mechanical ventilator (ensuring the child is adequately ventilated). In the latter case, ensure that the ventilator is in a volume-controlled mode, that triggers and limits are disabled, and that the ventilation rate, tidal volume and FiO_2 are appropriate for CPR. There is no evidence to support any specific level of PEEP during CPR. Always consider ventilator dysfunction as a possible cause of cardiac arrest.
- Titrate FiO_2 to an SpO_2 of 94-98% after ROSC.

Measurable factors during PALS

- **Capnography:** Use $ETCO_2$ monitoring once a tracheal tube or an SGA is in place to assess the quality of chest compressions and to help verify ROSC.
- **Invasive blood pressure:** If a pulsatile intra-arterial line is in situ during CPR, monitor the diastolic blood pressure values in response to chest compressions and drugs (e.g. adrenaline). Aim for an intra-arrest diastolic blood pressure of at least 25 mmHg for infants and at least 30 mmHg for children and adolescents.
- **Point-of-care ultrasound:** Use POCUS only if you are competent in its use during CPR, and it does not compromise the quality of chest compressions.
- **Point-of-care blood analysis:** Check a minimum of glucose, potassium, haemoglobin, lactate and blood gas analysis, and treat as appropriate.

Reversible causes of paediatric cardiac arrest

- Seek and identify any reversible cause for cardiac arrest early and treat appropriately.
- Use the mnemonic ‘4H and 4T’

Table 3: Reversible causes of cardiac arrest

Consider	Identification	Treatment in cardiac arrest
Hypoxia	History/clinical exam/SpO_2 and/or PaO_2 pre-arrest or intra-arrest.	Ventilate with 100% oxygen. Insert an advanced airway if bag-mask ventilat Ensure adequate chest rise. Check for leaks, air entry, abdominal distentio breaths if an advanced airway is in situ.
Hypovolaemia	History (sepsis, haemorrhage, diarrhoea, anaphylaxis) POCUS.	• Fluid boluses 10 mL kg^{-1} isotonic crystallo products for major haemorrhage.
Hyper-/hypokalaemia and other metabolic derangements	Hyperkalaemia	
	History (massive haemolysis, tumour lysis syndrome, crush syndrome, acute or chronic renal failure, malignant hyperthermia, specific intoxications). Blood gas analysis with electrolytes.	In cardiac arrest with severe hyperkalaemia (> • give 0.1 unit kg^{-1} short-acting insulin (max mL kg^{-1} 10% glucose (max 250 mL) as an • an IV/IO infusion of a short-acting $beta_2$-ac (e.g. salbutamol 5 mcg kg^{-1}). • Consider extracorporeal potassium remova
	Hypokalaemia	
	History (diarrhoea, vomiting, diabetes insipidus, specific medications, hyperaldosteronism). Blood gas analysis with electrolytes.	In cardiac arrest associated with severe hypoka mmol L^{-1}), • give 1 mmol kg^{-1} (max 30 mmol) potassiu ^{1} for 10 min followed by the rest of the dos in 5-10 min. • Repeat, if necessary, until the serum potass mmol L^{-1}. Consider magnesium for concor hypomagnesaemia.
	Hypoglycaemia	

History and blood analysis.	• Give an IV bolus of 0.2 g kg^{-1} glucose (e.g. 2 mL kg^{-1} 10% glucose) and re-check blood glucose after 5-10 min. • Repeat if necessary.	
Other metabolic derangements		
History and blood analysis.	• Correct calcium, magnesium and other metabolic derangements.	
Hypo-or hyperthermia	Hypothermia	
	History/situation and core temperature.	Modify the PALS algorithm: • < 30°C: give a single dose of adrenaline un immediate initiation of extracorporeal life s maximum of three shocks if a shockable rh if this is ineffective, delay further attempts temperature > 30°C. • 30-35°C: adrenaline IV/IO every 8 min (6- dose amiodarone IV/IO after 8 min, norma defibrillation (every 2 min). • > 35°C: normal algorithm. • Consider transport to a centre for extracorp • > 32°C: warm using external rewarming m (hypothermia is unlikely to be the primary arrest). • < 32°C: use active external and internal rev including extracorporeal techniques.
	Hyperthermia	
	History and core temperature.	• External cooling. • If drug-mediated, consider antidotes or oth

Thromboembolism	History (children with indwelling central lines, cardiac conditions, cancer, recent trauma, recent surgery) and POCUS.	• Consider IV thrombolysis.
Tension pneumothorax	History (trauma, positive pressure ventilation, acute severe asthma exacerbation) Examine for symmetrical air entry and POCUS.	• Needle thoracocentesis/thoracostomy (trau
Tamponade	History (cardiac surgery, penetrating chest trauma, acute viral pericarditis) and POCUS.	• Pericardiocentesis/thoracotomy (trauma).

Extracorporeal CPR

- Consider extracorporeal CPR (ECPR) as an early intervention for selected infants and children with IHCA (e.g. children with cardiac conditions in the paediatric intensive care unit, perioperative children) and OHCA (e.g. a refractory shockable rhythm) in settings where resources allow ECPR.

Special circumstances

- This section outlines the approach to recognition and management in specific acute paediatric conditions to prevent cardiac arrest and the considerations and/or modifications that may be required to standard paediatric CPR.

Arrhythmias

- In children with **circulatory failure due to bradycardia:**
  - Seek the advice of a paediatric cardiologist early.
  - Improve oxygenation, ventilation, and circulation.
  - In patients with bradycardia and poor perfusion not responding to oxygenation and ventilation, start chest compressions.
  - Consider adrenaline as small IV bolus doses (e.g. 1-2 mcg kg^{-1}) or as a continuous infusion.

    - Consider transthoracic pacing only in specific cases of bradycardia (e.g. complete heart block, sick sinus syndrome).
    - Consider atropine only in specific cases of bradycardia (e.g. induced by increased vagal tone or by a cardiac conduction disease); dose IV atropine 20 mcg kg^{-1} (max. 0.5 mg).
- In children with **circulatory failure due to tachyarrhythmia:**
    - Seek the advice of a paediatric cardiologist early.
    - In patients with decompensated circulatory failure regardless of the origin of tachycardia (supraventricular or ventricular), perform immediate synchronised cardioversion starting with 1 J kg^{-1}, doubling the energy with each subsequent attempt up to a maximum of 4 J kg^{-1}. Have a 12-lead ECG running during the cardioversion attempt. If the child is not comatose, ensure adequate analgesia and sedation according to local protocols. Reassess signs of life and pulse after each attempt. While waiting for anaesthesia and the defibrillator, chemical cardioversion (see below) can be attempted, but it should not delay the cardioversion attempt.
    - In patients with narrow complex supraventricular tachycardia (SVT) who are not in decompensated circulatory failure:
        - Consider vagal manoeuvres (e.g. modified Valsalva or ice pack to the face).
        - Consider IV adenosine as a rapid flush of 0.1-0.2 mg kg^{-1} (max. 6 mg) via a large vein. Ensure a 12-lead ECG is running during the administration of adenosine.
        - If the SVT persists: give a second dose of 0.3 mg kg^{-1} (max. 12-18 mg) after at least 1 min.
        - Seek the advice of a paediatric cardiologist. Consider cardioversion or alternative medications (e.g. amiodarone), especially in children with sinus node disease, pre-excited atrial arrhythmias, a history of heart transplant or severe asthma.
    - In patients with a wide QRS tachycardia who are not in decompensated circulatory failure:
        - Try vagal manoeuvres, which might provide diagnostic insight (e.g. into an SVT with abnormal conduction).
        - Seek the advice of a paediatric cardiologist. Pharmacological treatment options include amiodarone, lidocaine, esmolol, magnesium sulphate, and procainamide.
        - In torsade-de-pointes VT, give IV magnesium sulphate 50 mg kg^{-1} (max. 2 g).

Asthma

- In children with **severe acute asthma** (critical asthma syndrome):
  - Give 100% oxygen.
  - Give (intermittent or continuous) short-acting $beta_2$-adrenergic agonists via pressurised metered-dose inhalers with a spacer or by nebulisation (e.g. salbutamol 100 mcg per dose at 4-10 puffs every 20 min or by nebulisation with 100% oxygen 2.5-5 mg in sterile 0.9% sodium chloride in a volume suitable for the type of nebuliser, run until empty).
  - Give inhaled ipratropium with $beta_2$-adrenergic agonists as required in the following doses:
    - 1 month to 5 years 125-250 mcg (max 1 mg day^{-1})
    - 6 to 11 years 250 mcg (max 1 mg day^{-1})
    - 12 to 17 years 500 mcg (max 2 mg day^{-1}).
  - Give prednisolone 1-2 mg kg^{-1} orally or IV (max. 40 mg) or dexamethasone 0.3-0.6 mg kg^{-1} (max. 16 mg) within the first hour.
  - Consider adding high-dose inhaled corticosteroids in a severe crisis.
  - Consider IV magnesium sulphate 40 mg kg^{-1} (max 2 g) over 20 min in children who fail to respond to initial treatment.
  - Consider a loading dose of IV short-acting $beta_2$-adrenergic agonists (e.g. 5-15 mcg kg^{-1} salbutamol over 10 min, max. doses of 250-750 mcg have been used) which may be followed by an infusion depending on clinical severity (e.g. salbutamol 1-2 mcg kg^{-1} min^{-1}). Monitor potassium levels, lactate, blood glucose and ECG.
  - Consider a trial of non-invasive ventilation provided the child still has sufficient respiratory drive.
  - Consider tracheal intubation and invasive ventilation (and anticipate potential serious side effects), or extracorporeal life-support in near-fatal asthma (e.g. exhaustion, severe hypoxia despite high flow oxygen and adequate medication).

Cardiac arrest in children with congenital heart disease

- Follow the standard PALS algorithm with additional considerations for pulmonary hypertension, obstructed cardiac shunt or if the child is attached to a defibrillator and has a witnessed shockable rhythm.

Pulmonary hypertension

- Suspect pulmonary hypertension in children with congenital heart disease or chronic lung disease, but also as a primary disease.
- Anticipate and prevent pulmonary hypertensive crises by avoiding triggers such as pain, anxiety, excessive tracheal tube suctioning, hypoxia, hypercapnia, and metabolic acidosis.
- Treat pulmonary hypertensive crises with a high concentration of oxygen, adequate ventilation, analgesia and sedation and with muscle relaxation as necessary.
- Search for and treat other possible reversible causes of increased pulmonary vascular resistance: inadvertent interruption of pulmonary hypertensive therapy, arrhythmia, cardiac tamponade, or drug toxicity.
- Consider inotropic and or vasopressor therapy to avoid or treat right ventricular ischaemia caused by systemic hypotension.
- Additional therapies, which are indicated if the crisis does not rapidly resolve or in the case of cardiac arrest, are inhaled nitric oxide (iNO) and/or intravenous prostacyclin.
- Consider extracorporeal life support if medical management is ineffective.

Cardiac arrest due to obstruction of a cardiac shunt

- Suspect acute obstruction due to thrombosis or mechanical kinking of connections between the systemic and pulmonary circulation in children with aortopulmonary shunts or ductus arteriosus stents as a cause of cardiac arrest.
- Give 100% oxygen to maximise alveolar oxygenation.
- Consider hypovolaemia and treat this with intravascular fluids if necessary.
- Ensure an adequate systemic blood pressure to optimise shunt and coronary perfusion pressure with vasoactive agents and inotropes.
- Ensure adequate anticoagulation, e.g. with a bolus of heparin 50-100 units kg^{-1} followed by a titrated continuous infusion.
- Call for immediate expert help and consider interventional catheterisation or surgery. In the direct post-operative period, immediate re-sternotomy may improve shunt perfusion.

Cardiac arrest in an ECG-monitored child attached to a defibrillator with a witnessed shockable rhythm

- As soon as a shockable rhythm is detected, give up to three quickly successive (stacked) shocks using the standard energy doses for the child's weight.
- Recharge the defibrillator and rapidly check for a rhythm change and signs of life after each defibrillation attempt and, if necessary, immediately give a further shock.
- Start chest compressions after the third defibrillation attempt and continue CPR for 2 min.
- If the child remains in a shockable rhythm, adrenaline and amiodarone would be given after the 5th shock, with a second dose of amiodarone after the 7th shock.

Cardiac arrest in the operating theatre

- Clarify roles and procedures during the team briefing before high-risk cases to enable coordinated actions should cardiac arrest occur.
- Treat pre-arrest states such as hypoxia and hypotension aggressively. Ventilate with 100% oxygen and give intravascular fluid and vasoactive agents.
- Recognise cardiac arrest early by continuous monitoring and a high index of suspicion, particularly during difficult airway management and massive bleeding.
- Start chest compressions if extreme bradycardia or hypotension (< 5th percentile for age) occurs suddenly despite interventions, or the waveform capnography suddenly decreases.
- Inform the whole operating team of the cardiac arrest.
- Call for help and for the defibrillator.
- Optimise the child's position and the height of the operating table to facilitate high-quality chest compressions.
- Ensure the airway is secure, review the $ETCO_2$ tracing, and deliver effective ventilation with 100% oxygen.
- Follow the general PALS algorithm and focus initially on the most likely reversible causes: hypovolaemia (haemorrhage, anaphylaxis), hypoxia, tension pneumothorax, thrombosis (pulmonary embolism) and toxic agents (medication).
- Use POCUS, when the equipment and expertise are available, to help identify the cause and guide resuscitation, provided this does not compromise the quality of the resuscitation.

- Consider causes specific to the operating room, such as gas embolism, bradycardia from axial nerve blocks, malignant hyperthermia, local anaesthetic overdose, and other drug errors.
- For hypotensive and/or bradycardic children in a pre-arrest state, give smaller incremental bolus doses of IV adrenaline initially (e.g. 1-2 mcg kg^{-1} intravenously). If the child progresses to cardiac arrest, give adrenaline according to the standard PALS algorithm.
- If the facilities and expertise are available and conventional CPR is failing, consider early ECPR or open chest cardiac compressions as an alternative if ECPR is unavailable.

Cardiac tamponade

- Suspect cardiac tamponade, especially after cardiac surgery, in penetrating chest trauma and pericarditis.
- Use clinical signs and POCUS to recognise cardiac tamponade, which is most common post-cardiac surgery, in penetrating chest trauma, and some viral illnesses.
- Perform urgent pericardiocentesis, mini-thoracotomy, resuscitative thoracotomy or re-sternotomy depending on the setting and available expertise.

Drowning

- Reverse hypoxia and treat respiratory failure early to prevent cardiac arrest following drowning.
- Manage cardiac arrest following drowning with standard PALS with additional attention to reversing hypoxia and hypothermia.
- Remove the child as quickly and safely as possible from the water.
- Do not enter the water unless you are trained to rescue a person from the water.
- Try to reach the child from the land and provide a flotation device such as a lifebuoy or other rescue equipment.
- Start ventilation in the water if you are trained to do so and have a floatation device, and the child is unconscious and not breathing.
- Start standard PBLS with five rescue breaths as soon as it is safe to do so (e.g. on land or on a boat).

- Give 100% oxygen as soon as it is available. Intubate the child if the expertise and equipment are available.
- Attach an AED after drying the chest. Uninterrupted CPR and oxygenation take priority over the AED.
- Assess ABCDE and stabilise the child if not in cardiac arrest. Prevent cardiac arrest by identifying and treating respiratory insufficiency and hypothermia.
- Rewarm a hypothermic child immediately and simultaneously with the stabilisation. Treat hypothermia in a child with an intact circulation as follows:
    - Monitor the core temperature with a thermometer suitable for low temperatures.
    - Handle the child gently in a horizontal position to reduce the risk of cardiac arrest (especially VF).
    - Start rewarming if < 35°C and rewarm at a rate of at least 1°C h^{-1}. Aim for normothermia but stop active rewarming at 35°C to avoid overshoot hyperthermia.
    - Use active external rewarming applied to the trunk (chest, abdomen, back and axillae - not the extremities) with e.g. a hot-air blanket, radiant warmer, warmed blankets or hot packs, applied according to the manufacturer's instructions.
    - Do not place warm devices directly on the skin to prevent burns. Avoid rubbing and massaging of the extremities.
    - Do not use a warm shower or warm water immersion for rewarming a child with a decreased level of consciousness.
    - Give warmed and humidified 100% oxygen and warmed IV/IO fluids (39-42°C) to prevent further heat loss and to compensate for the vasodilatation during rewarming, but avoid fluid overload by careful haemodynamic monitoring.
- Look for and treat a possible underlying cause of drowning (e.g. arrhythmia, epilepsy, intoxication, or trauma).
- Check blood glucose and electrolytes.
- Follow the PALS guideline modified for hypothermic arrest if cardiac arrest occurs (see below).
- Consider ECPR if conventional CPR is failing.

Hyperkalaemia

- Suspect hyperkalaemia in children with massive haemolysis (neonates), cellular lysis (tumour lysis syndrome, crush syndrome), in acute or chronic renal failure, malignant hyperthermia, or specific intoxications.
- Stop all exogenous sources of potassium, including fluids containing potassium, when hyperkalaemia is detected. Use normal saline if fluids are needed.
- If severe hyperkalaemia is confirmed (> 6.5 mmol L^{-1} or > 7.0 mmol L^{-1} in neonates younger than 96 h):
  - Treat the underlying cause if possible.
  - Administer rapidly acting insulin 0.1 units kg^{-1} (max. 10 units) with 10% glucose 5 mL kg^{-1} (max. 250 mL) over 30 min followed by a glucose-containing infusion. Check potassium and glucose every 15 min for 4 h.
  - Administer short-acting $beta_2$-adrenergic agonists preferably as inhalation/nebulisation (e.g. salbutamol 2.5-5 mg, repeat up to five times).
  - If inhalation is not possible, give short-acting $beta_2$-adrenergic agonists IV (e.g. salbutamol 5 mcg kg^{-1} over 5 min). Repeat if insufficient effect is seen within 15 min, up to a maximum total dose of 15 mcg kg^{-1}.
  - In patients with conduction abnormalities on the ECG, consider 10% calcium gluconate, 0.5 mL kg^{-1}, max. 30 mL.
  - Prepare a potassium removal strategy (e.g. binding agents, furosemide in well-hydrated children with preserved kidney functions, dialysis).
- For cardiac arrest caused by severe hyperkalaemia (usually above 6.5-7 mmol L^{-1}):
  - Give 0.1 unit kg^{-1} short-acting insulin (max 10 units) with 5 mL kg^{-1} 10% glucose (max 250 mL) as an IV bolus, followed by blood potassium and glucose monitoring and a glucose-containing infusion as needed. Higher concentrations of glucose solutions may be used via a central line (e.g. 2.5 mL kg^{-1} 20% glucose or 1 mL kg^{-1} 50% glucose).
  - Do not use calcium in children in cardiac arrest.
  - Continue high-quality PALS and consider ECPR.

Other metabolic derangements

- **Hypokalaemia:** give 1 mmol kg^{-1} (max 30 mmol) potassium at 2 mmol min^{-1} for 10 min, followed by the rest of the dose (if necessary) in 5-10 min in children with severe hypokalaemia (< 2.5 mmol L^{-1}) with life-threatening symptoms or in cardiac arrest. Repeat, if necessary, until the serum potassium is > 2.5 mmol L^{-1}. Follow this with an IV infusion (e.g. 0.5-1 mmol

kg^{-1} h^{-1}, maximum 20 mmol h^{-1}, depending on the potassium level for 1-2 h). Consider magnesium sulphate 30-50 mg kg^{-1} IV for concurrent hypomagnesaemia.

- **Hypoglycaemia:** Treat hypoglycaemia < 3.9 mmol L^{-1} with symptoms, or < 3.0 mmol L^{-1} if asymptomatic. Give a bolus of 0.2 g kg^{-1} IV glucose (e.g. 2 mL kg^{-1} 10% glucose) and re-check the glucose after 5-10 min. Repeat as needed.
- In other metabolic derangements (hypocalcaemia, hypercalcaemia, hypomagnesaemia, hypermagnesaemia): Correct the metabolic derangement during cardiac arrest, while continuing high-quality CPR. Consider extracorporeal life support.

Hyperthermia/heat stroke

- Identify patients with exertional or environmental hyperthermia or heat stroke (core temperature above 40°C, not due to fever) as soon as possible. Look for an elevated body temperature associated with confusion, agitation or disorientation, which can progress to coma and/or seizures.
- Remove the child from the heat source and/or stop exercise and loosen or remove clothing.
- If the temperature is above 40°C, start cooling aggressively, preferably using immersion up to the neck in cold/cool water.
- Call the ambulance service at the same time as initiating cooling.
- Monitor the core temperature to prevent overcooling. Aim to reduce this by about 0.1-0.2°C min^{-1}. If the core temperature cannot be measured, cool for 15 min or until neurological symptoms subside.
- Hydrate orally if possible, or intravenously. Give room-temperature intravenous fluids as an adjunct to cooling and avoid fluid overload.
- Monitor symptoms and vital signs, including mental status.
- Start resuscitation if circulatory collapse supervenes (often around 41°C) and follow the standard PALS guidelines while continuing cooling.
- Stop aggressive cooling (e.g. cold-water immersion) when core temperature reaches 39°C. Stop all active cooling at 38°C but continue to monitor core temperature.
- Stabilise the child according to the ABCDE assessment.
- All children with heat stroke should be admitted to a paediatric intensive care unit for continued monitoring in anticipation of sequelae and complications.

- In the case of malignant hyperthermia (MH), stop all potential triggering agents immediately (e.g. anaesthetics), cool the child actively, ensure adequate oxygenation and ventilation, correct severe acidosis and hyperkalaemia, and administer dantrolene.

Hypothermic cardiac arrest

- Individualise approaches depending on the cause of cardiac arrest: accidental hypothermia, or other possible causes such as drowning, suffocation, or intoxication.
- Start standard CPR in every case of hypothermic cardiac arrest as soon as possible (e.g. before full extrication from an avalanche or in the water).
- If standard CPR is not possible and the child is deeply hypothermic (< 28°C), consider delayed or intermittent CPR.
- Modify the standard PALS algorithm according to the core temperature. The revised Swiss Staging for Hypothermia can be used when the core temperature cannot be measured.
- Start rewarming the child as rapidly as possible while monitoring the core temperature as soon as this is practicable.
- Below 30°C, give a single dose of adrenaline unless planning immediate initiation of extracorporeal life support. Do not give amiodarone until the temperature is above 30°C. Prolong the administration intervals of resuscitation drugs while the core temperature remains between 30-35°C (e.g. adrenaline every 8 min, second dose of amiodarone after 8 min).
- Attempt defibrillation a maximum of three times if a shockable rhythm is present under 30°C. If this is ineffective, delay further attempts until the core temperature exceeds 30°C. Then use the standard sequence of defibrillation (every two minutes).
- Transport a child considered to have a chance of a favourable outcome from hypothermic cardiac arrest as soon as possible to an appropriate centre for extracorporeal life support.
- Extracorporeal life support is potentially indicated in all children with hypothermic cardiac arrest who do not achieve ROSC in the field.
- Hypothermic patients with risk factors for imminent cardiac arrest (e.g. P or U on the AVPU scale, associated trauma, ventricular arrhythmia, or hypotension) should also be transported to an extracorporeal life support centre.
- Stop resuscitation if ROSC is not achieved within 30 min when cardiac arrest is due to trauma or asphyxia (i.e. avalanche burial for > 60 min, core

temperature ≥ 30°C and an obstructed airway).

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Pulmonary thromboembolism

- Suspect PE in case of tachycardia, tachypnoea and hypoxia, especially in children with central lines, cardiac conditions, cancer, unilateral limb swelling, recent trauma/surgery, prior thromboembolism, anaemia and/or leucocytosis.
- Consider echocardiography if the expertise (e.g. a paediatric cardiologist) is available.
- For thrombolytic therapy, refer to local protocols and call for expert help. Consider systemic or catheter-directed administration of thrombolysis, which is more effective than systemic anticoagulation.
- Consider extracorporeal life support and surgical embolectomy when thrombolysis fails or the child progresses towards cardiac arrest.
- In cardiac arrest due to pulmonary thromboembolism, consider thrombolysis, e.g. IV alteplase 0.3-0.5 mg kg^{-1} (max 50 mg) over 2 min, which may be repeated after 15 min.

Seizures

- Monitor the time from the start of the seizures closely. Manage ABC, monitor vital functions and ECG. Consider possible causes for seizures (e.g. infection, intoxication, metabolic disorders, hypoxia, hypoglycaemia, hyperthermia, intracranial hypertension, channelopathies) and treat these appropriately. Anticipation is important when treating seizures, as several interventions may be necessary.
- Any seizure lasting 5 min or longer (status epilepticus) requires treatment with a benzodiazepine (first-line medication). Use the intravenous (IV) route if available. If an IV/IO access has not yet been established, use an alternative route (e.g. nasal, buccal or IM).
- If the seizures continue, give a second dose of a benzodiazepine IV or IO after 5-10 min and prepare to administer a second-line medication.
- If the seizures persist after two doses of the first-line medication (< 15-20 min from the start of the seizures), give levetiracetam IV or IO 40-60 mg kg^{-1} (max. 4.5 g) over 5 min (second-line medication). If levetiracetam is not available, give phenytoin IV 20 mg kg^{-1} over 20 min or phenobarbital IV 20

mg kg^{-1} (max 1 gram) by slow injection at a maximum rate of 1 mg kg^{-1} min^{-1} as a second choice instead. Do not use valproic acid where there is the potential for pregnancy.

- If the seizures continue for ≥ 30 min despite the administration of a second-line drug (refractory status epilepticus), prepare for intubation and refer the child to the paediatric intensive care team. If you are not ready for intubation and anaesthesia, then giving another, different second-line drug is an alternative.
- Start anaesthesia (e.g. with midazolam, ketamine, phenobarbital, thiopental, or propofol) within 40 min of the onset of seizures, with intubation and mechanical ventilation. Aim for termination of clinical seizures and burst suppression on electroencephalography (EEG). Monitor for respiratory and haemodynamic instability, metabolic disturbances, renal failure, rhabdomyolysis, and adverse drug effects.
- Seek the advice of a paediatric neurologist.
- Consider continuous EEG monitoring and brain imaging.

Shock

- In children with **septic shock**:
  - Obtain blood samples for blood culture and PCR (polymerase chain reaction) if possible, and start broad-spectrum antibiotics as soon as possible (within 1 h) after initial ABCDE management.
  - Consider hydrocortisone 1-2 mg kg^{-1} if the child is not responding to fluids and vasoactive support, and in children with specific pathologies (e.g. adrenal insufficiency) or who are receiving specific medications.
- In children with **cardiogenic shock**:
  - Seek the advice of a paediatric cardiologist early. Use echocardiography to guide treatment.
  - Start inotropic support and consider mechanical ventilation. Anticipate possible cardiac arrest during tracheal intubation, use medication with minimal cardiovascular side effects (e.g. use ketamine and avoid propofol).
  - Consider IV furosemide only in children without concomitant hypovolaemia.
  - Consider extracorporeal life support in refractory cardiogenic shock.
- In children with **haemorrhagic shock**:
  - Activate local protocols for massive haemorrhage and control bleeding using pressure and tourniquets as indicated.

- Minimise the use of IV crystalloid boluses (max. 20 mL kg^{-1}). Give blood products or full blood as soon as they are available.
- Use vasoactive drugs in fluid-refractory shock, especially when there is also a loss of sympathetic drive (e.g. during anaesthesia or analgesia and sedation), or in children with concomitant traumatic brain injury. Target MAP to above the 50th percentile to attain sufficient cerebral perfusion pressure in traumatic brain injury. Support cardiac function if this is necessary to achieve MAP above the threshold.
- Use a strategy that focuses on improving coagulation in children with severe blood loss.
- Use tranexamic acid as soon as possible (at least within 3 hours) in all children requiring transfusion after trauma or with life-threatening haemorrhage. Give a loading dose of 15-20 mg kg^{-1} (max. 1 g) IV over 10 min, followed by an infusion of 2 mg kg^{-1} h^{-1} (max. 1 g) for at least 8 h or until the bleeding stops.

Tension pneumothorax

- Suspect tension pneumothorax, especially in trauma, following central venous cannulation and during positive pressure ventilation.
- Use clinical signs to diagnose a tension pneumothorax. POCUS is helpful, but it is not necessary to make the diagnosis.
- Perform a needle thoracocentesis in the fourth or fifth intercostal space in the anterior axillary line or second intercostal space in the mid-clavicular line; followed by chest drain insertion usually in the axilla.
- In trauma, perform a finger thoracostomy in the fourth or fifth intercostal space in the anterior axillary line, followed by emergency chest drain insertion.
- Perform bilateral thoracostomies in traumatic cardiac arrest with or without signs of a tension pneumothorax.

Toxins

Prevention of Cardiac Arrest

- Provide supportive care based on the ABCDE approach to prevent cardiorespiratory arrest whilst awaiting toxin elimination. Look for evidence

of non-accidental injury.

- Provide early advanced airway management if decreased conscious level.
- Administer IV boluses of 10 mL kg^{-1} isotonic crystalloids for hypotension. Noradrenaline may be required if hypotension persists.
- Perform a 12-lead ECG in certain poisonings (e.g. antipsychotics, 3,4-methylenedioxymethamphetamine (MDMA) and other amphetamines) or in children with altered consciousness, abnormal heart rate or blood pressure. Cardiovert life-threatening tachyarrhythmias.
- Take blood for electrolytes, blood glucose and blood gas analysis and correct any abnormalities. Take blood and urine for toxicological analysis.
- Check for and correct hyperthermia (ecstasy, cocaine, salicylates) and hypothermia (ethanol, barbiturates).
- Take a thorough history (relatives, friends, ambulance crew) and perform a complete physical examination to identify diagnostic clues (e.g. odours, needle puncture marks, pupils, tablet residues).
- Administer antidotes, where available.
- Consult a regional or national poisons centre for information on treatment.

Cardiac Arrest

- Suspect toxic agents as an infrequent cause of cardiac arrest after more common causes have been excluded.
- Provide standard PBLS and PALS.
- Do not use mouth-to-mouth ventilation in the presence of chemicals such as cyanide, hydrogen sulphide, corrosives and organophosphates.
- Exclude all reversible causes of cardiac arrest, including electrolyte abnormalities, which can be indirectly caused by a toxic agent.
- Be prepared to continue resuscitation for a prolonged period while the toxin concentration falls.
- Consult regional or national poison centres for information on treatment.
- Consider ECPR for selected patients when conventional CPR is failing.

Traumatic cardiac arrest

- Identify and treat reversible causes to prevent cardiac arrest.
- Ensure proper team collaboration.
- Additional recommendations for PBLS in traumatic cardiac arrest:
    - Follow standard CPR, start by opening the airway and ventilating.

- Competent providers should open the upper airway with a jaw thrust and minimise spinal movement without hampering CPR.
- Stop significant external bleeding immediately with manual pressure, haemostatic dressing or tourniquet.
- Use an AED only if there is a high likelihood of a shockable rhythm (e.g. following electrocution).

PALS in traumatic cardiac arrest

- Professional rescuers should look for and treat reversible causes. Use the acronym 'HOTT' to identify reversible causes:
  - **H**ypotension
  - **O**xygenation (hypoxia)
  - **T**ension pneumothorax
  - cardiac **T**amponade
  - In cardiac arrest, treating these has priority, or should run concurrently with chest compressions and the administration of adrenaline IV/IO.
- Use POCUS when available to diagnose reversible causes.
- The optimal sequence of action will depend upon the setting and the number of rescuers, but consider:
  - Correct hypoxia. Open the airway using a jaw thrust manoeuvre and minimise spinal movement, without hampering CPR. Ensure adequate ventilation and intubate the child as soon as the expertise and equipment are available. Use an SGA if intubation is not possible.
  - Correct hypovolaemia with intravascular fluid replacement, including early use of blood products in haemorrhagic shock.
  - Perform bilateral thoracostomies in traumatic cardiac arrest with or without signs of a tension pneumothorax. Chest drain placement may be required to maintain patency of the tract.
  - Perform a resuscitative thoracotomy, if competent, for suspected cardiac tamponade. Otherwise, perform pericardiocentesis via a mini-thoracotomy or insert a wide-bore drain, preferably guided by POCUS.
- Attach an AED directly if there is a high likelihood of a shockable underlying rhythm, such as following electrocution or in cardiac contusion. Otherwise, HOTT has priority over the AED.
- High-quality resuscitation is the standard in cardiac arrest due to a medical cause coincidental to the trauma or to a non-hypovolemic, non-obstructive aetiology (e.g. isolated traumatic brain injury, cardiac contusion, or asphyxia) or due to electrocution.

Post-resuscitation care

- Post-resuscitation care starts immediately after return of spontaneous circulation (ROSC) is achieved.

Recommendations for healthcare providers in the pre-hospital setting and limited-resource healthcare

- The general ABCDE principles described in the section on the prevention of cardiac arrest also apply to post-resuscitation care.
- Ensure adequate oxygenation and ventilation.
- Intubate the trachea only if you are competent and equipped to do so safely.

- Always use anaesthetic drugs and muscle relaxants for intubation unless the child is deeply comatose (GCS 3). Provide 100% oxygen during intubation.
- Monitor $ETCO_2$ continuously if an advanced airway is in place.
- Titrate FiO_2 to achieve a peripheral oxygen saturation of 94-98% as soon as a reliable measurement is available. When ABG analysis is available, aim for normoxaemia.
- In the absence of ABG analysis, aim for a normal respiratory frequency for the child's age and mild chest rise (just visible).
- Monitor capnography and aim for normocapnia. When ABG analysis is available, confirm normocapnia.
- Use tidal volumes of 6-8 mL kg^{-1} of ideal body weight, and PEEP of 5 cm of H_2O for mechanical ventilation in previously healthy children.
- Use the minimum airway pressures needed to achieve oxygenation and ventilation goals, adjusting these in special circumstances (e.g. chronic lung disease).
- Check for signs of shock and treat it immediately if present. Treat shock with fluids, vasoactive drugs or inotropes or combinations of these.
- Aim for a systolic and mean arterial blood pressure above the 10th percentile for the child's age.
- Treat seizures immediately if they emerge.
- Check blood glucose after cardiac arrest and treat hypoglycaemia.
- Use analgesia and sedation to treat pain and discomfort after cardiac arrest in children of all ages. Avoid bolus medications that can cause abrupt fluctuations in blood pressure.

- Always treat hyperthermia or fever with active cooling.
- Try to establish the cause of cardiac arrest and treat it to avoid re-arrest.
- Enable parents/persons with parental responsibility or caregiver presence during the pre-hospital care or transport whenever this can be done safely.

Recommendations for healthcare providers in a hospital

- Use individualised goals and bundles of care rather than specific single targets during post-resuscitation care. Treat underlying disease(s) as well as post-cardiac arrest syndrome.
- Establish invasive arterial blood pressure monitoring and central venous access with (mixed venous saturation) SvO_2 measurement as a minimum in all sedated or comatose children.
- If no individualisation is needed, continue targeting normoxaemia, normocapnia, and maintain systolic and mean arterial blood pressure above the 10th percentile for at least 24 h after cardiac arrest.
- Use available non-invasive or invasive techniques to diagnose the probable cause of cardiac arrest as well as to make individualised decisions in the management of post-cardiac arrest syndrome.
- Diagnose, monitor, and treat pain, discomfort and delirium.
- Keep temperature control as an integral part of post-resuscitation care for at least 24 h after cardiac arrest. Avoid fever for at least 72 h.
- Prevent, diagnose, and treat acute kidney injury or renal failure.
- Optimise nutrition.
- Start rehabilitation early.
- Allow unrestricted access of parents/persons with parental responsibility and primary caregivers to the child as a part of family-centred care. Be sensitive to cultural and religious issues.
- Communicate clearly and honestly with parents/persons with parental responsibility while also paying attention to their understanding and needs; decision-making should be shared. Involve concerned stakeholders (e.g. extended family, religious support) in the communication.
- Seek the assistance of specialised multidisciplinary teams early (e.g. paediatric neurologists, psychologists, paediatric palliative care team, social workers and, if necessary, an interpreter) to address the needs and concerns of the child, parents, family and other caregivers.
- In case of sudden cardiac arrest, whether fatal or not, use a standardised diagnostic protocol to identify the cause. If the sudden cardiac arrest might have been due to an inherited condition, such as certain arrhythmias and

cardiomyopathies, ensure appropriate screening of family members to prevent sudden cardiac arrest in future patients.

Prognostication after cardiac arrest

- Avoid both false optimism and false pessimism, be honest, open and transparent.

Recommendations for healthcare providers

- Delay prognostication in children with a decreased level of consciousness or who are sedated for at least 72 h following cardiac arrest.
- Use a multimodal approach to prognostication. Accurate prognostication for both good and poor outcomes involves:
  - Pre-arrest: knowledge of the child's baseline health and neurological status.
  - The context of the cardiac arrest: e.g. location of the cardiac arrest, bystander BLS, first rhythm, cause of cardiac arrest and duration of the cardiac arrest.
  - Post-cardiac arrest care: a comprehensive assessment supplemented with repeated evaluations.
- Combinations and timing of investigations and signs predicting good outcomes differ from those predicting poor outcomes. No single modality can be used in isolation for prognostication with high accuracy.
- Use the suggested standardised minimal set of diagnostic modalities for better comparability and research.
- Visual aids and presentations might help parents/persons with parental responsibility to understand certain specifics of prognostication, enabling them to participate better in the decision-making.

Post-discharge care

- Assess outcomes with standardised measurements using validated instruments and involve paediatric psychologists, neurologists, rehabilitation physicians and/or intensivists in post-discharge care.

- Plan and discuss the post-discharge care with parents/persons with parental responsibility and caregivers before hospital discharge.
- Organise multidisciplinary post-discharge care to minimise the number of hospital visits for the child and family.
- Consider a virtual consultation when an on-site visit to an outpatient clinic is challenging due to financial, travel or work limitations.
- Screen patients, parents/persons with parental responsibility, and family members for symptoms of post-intensive care syndrome regularly and refer to a professional (e.g. psychologist) as soon as any physical or mental health issues arise.
- Seek and signpost supportive structures for patients and parents/persons with parental responsibility, such as parent groups, cardiac arrest survivors' groups and bereavement groups.

Downloads

Paediatric in-hospital BLS algorithm 2025 38.4 KB
Paediatric out-of-hospital BLS algorithm 2025 43.15 KB
Paediatric choking algorithm 2025 38.87 KB
Paediatric advanced life support algorithm 2025 66.13 KB
Paediatric arrhythmia algorithm 2025 51.67 KB
Paediatric emergency drug 2025 108.09 KB
RCUK Paediatric emergency algorithms and resources V6 998.57 KB

Resuscitation Council UK

Newborn resuscitation and support of transition of infants at birth Guidelines

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European Resuscitation Council Guidelines 2025 Newborn Resuscitation and Support of Transition of Infants at Birth. Resuscitation 2025;215 (Suppl 1):110766. https://doi.org/10.1016/j.resuscitation.2025.110766.

ERC Authors: Hogeveen M, Monnelly V, Binkhorst M, Cusack J, Fawke J, Kardum D, Roehr CC, Rüdiger M, Schwindt E, Solevåg AL, Szczapa T, te Pas A, Trevisanuto D, Wagner M, Wilkinson D, Madar J.

Key points

- It is reasonable for teams to initiate resuscitation of an infant outside the delivery area using the guideline most familiar to the team (either NLS or PLS) whilst summoning appropriate help and switching algorithm in a timely

fashion if necessary. It is vital for the whole team to be completely clear on the approach used.

- The guideline acknowledges the paucity of resuscitation data available from extremely preterm infants, especially those < 25 weeks, and cautions that these guidelines are based upon evidence from predominantly older gestational ages, which limits applicability to extremely low gestational ages. However, these guidelines remain a reasonable approach to use for extremely preterm infants < 25 weeks.
- Telemedicine can provide remote advice, and health systems should consider how this can be used.
- Equipment should be easily accessible and organised in a standardised way; consider human factor elements when organising equipment and training to maximise efficiency and minimise time delays.
- Although recommendations about delayed cord clamping (DCC) have not changed significantly, there is even more emphasis on its importance for all newborn infants, especially preterm infants. In newborn infants needing resuscitation, if the cord is intact, resuscitation is impractical; clamp the cord for < 30 s to minimise delay to necessary interventions.
- The guideline reinforces not milking the cord in preterm infants < 28 weeks and focuses on trying to perform delayed cord clamping if possible. Cut cord milking is acknowledged as a reasonable alternative if > 28 weeks and DCC is not possible.
- There is a reduced emphasis on skin colour during initial assessment. This reflects the subjective nature of detecting cyanosis or pallor, especially in different skin tones.
- The guideline recognises the increasing role of ECG as a continuous method of HR evaluation, which is more precise than other methods. However, auscultation with a stethoscope remains a reasonable first option.
- Use the two-person method of airway support (jaw thrust) if sufficient providers are available, as this approach is more effective than the single-person technique.
- A supraglottic airway should be considered if face mask ventilation is ineffective.
- If there is no HR response, the chest is not moving with inflations despite airway opening techniques, increase inflation pressure.
- Reduce inflation pressure when chest movement and clinical improvement are seen.
- Use video laryngoscopy for tracheal intubation (if equipment and training allow). This reflects evidence of increased first attempt and increased overall success in tracheal intubation when video laryngoscopy is used. A

conventional direct laryngoscope should be available and remains a reasonable alternative.

- Apply an appropriately fitting nasal interface or a face mask connected to a device for providing positive pressure ventilation.
- CPAP and PEEP are now recommended at a level of 6 cm H_2O.
- This guideline acknowledges that CPAP may be considered in infants > 32 weeks GA with respiratory distress if they require supplemental O_2.
- Initial oxygen concentration according to gestation has been simplified:
    - Infants ≥ 32 weeks needing respiratory support: start with 21% O_2
    - Infants < 32 weeks: start with ≥ 30% O_2
- SpO_2 target ranges incorporating newer data from preterm infants, in addition to the established data from mostly term infants before DCC was standard practice, now result in a target range of acceptable SpO_2. Reduce O_2 if saturations exceed 95%.
- When chest compressions are performed, a supraglottic airway or tracheal tube should be considered, depending on training and experience.
- The time intervals of intravenous or intraosseous adrenaline have been simplified to giving every 4 min.
- Sodium bicarbonate has been removed from the 2025 guideline
- The guideline acknowledges the potential for harm from both hypoglycaemia and hyperglycaemia. There is greater emphasis on checking blood glucose during resuscitation and treating only if it is low, rather than empirical treatment of presumed hypoglycaemia during resuscitation. When hypoglycaemia is treated, the bolus dose of glucose is 200 mg kg-1 10% glucose (2 mL kg^{-1}), which aligns with the RCUK Paediatric Guideline.
- The guideline considers out-of-hospital births, especially when unexpected and/or preterm birth. It highlights key considerations and differences when managing newborns in this setting. It addresses the challenges of thermal care and describes differences in equipment and approach, including safe transfer to hospital.

Factors before birth

Risk factors

- Common factors associated with an increased risk of a need for stabilisation or resuscitation at birth.

Antepartum factors	Intrapartum factors
Fetal • Intrauterine growth restriction • < 37 weeks' gestation • Multiple pregnancies • Serious congenital abnormality • Oligo and polyhydramnios **Maternal** • Infection • Gestational diabetes • Pregnancy-induced hypertension • Pre-eclampsia • High BMI • Short stature • Preterm lack of antenatal steroids	• Evidence of fetal compromise • Meconium-stained amniotic fluid • Birth by vaginal breech • Forceps or vacuum delivery • Significant bleeding • C-section before 39 weeks • Emergency C-section • General anaesthesia • Out-of-hospital birth

Staff attending births in hospital

- Any infant may develop problems during birth. Local guidelines indicating who should attend deliveries should be developed, based on current understanding of best practice and clinical audit, and considering identified risk factors. As a guide:
    - An interprofessional team with appropriate experience and training in NLS proportionate to the expected risk should attend the birth.
    - Neonatal staffing levels should acknowledge the potential need to deliver unexpected support in the delivery room.
    - A process should be in place for rapidly mobilising extra team members with adequate resuscitation skills for any birth.

Telemedicine

- Consider the use of collaboration through telemedicine, as it facilitates providing remote advice.

Training and education

- Institutions or clinical areas where births may occur should provide sufficient opportunities and resources for healthcare professionals involved in neonatal resuscitation to receive regular training, maintaining up-to-date knowledge as well as technical and non-technical skills.
- The content and organisation of such training programmes may vary according to the needs of the providers and the local organisation.
- Undertake training at least once per year, to prevent skill decay, using standardised resuscitation training materials based on current national guidelines. Ideally, this should be supplemented with more frequent short-duration booster sessions (e.g. every 3-6 months).

Equipment and environment

- Regularly check all equipment to ensure it is ready for use.
- Ensure that equipment is easily accessible and organised in a standardised way.
- Consider human factors and non-technical skills when organising equipment to maximise efficiency and minimise time delays.
- Resuscitation should occur on a well-illuminated, flat resuscitation surface that can support thermal care (see thermal control).

Briefing and checklists

- Team briefing is important and should be performed before birth.
- The purpose of the briefing is to:
    - review available clinical information
    - assign roles and tasks
    - check equipment and presence of personnel
    - consider and plan an approach to cord management
    - prepare the family.
- Use a checklist and/or cognitive aid to facilitate all the above, reduce mental load, and enhance safety.

Thermal control

- Maintain the temperature of newborn infants between 36.5°C and 37.5°C.
- Monitor the infant's temperature regularly or continuously after birth.
- Record the admission temperature as a prognostic and quality indicator.
- Rewarm infants who are hypothermic after birth; avoid hyperthermia.
- In appropriate circumstances, therapeutic hypothermia may be considered after resuscitation (see post-resuscitation care).

Environment

- Protect the infant from draughts. Ensure windows are closed and air conditioning is appropriately programmed.
- In infants > 28 weeks, keep the delivery area at 23-25°C.
- In infants ≤ 28 weeks, keep the delivery area at > 25°C.

Newborn infants ≥ 32 weeks

- Dry the infant immediately after birth and remove wet towels.
- Cover the head with a hat, and the body with dry towels.
- Assess the baby with the umbilical cord intact, aim to provide ≥ 60 s delayed cord clamping.
- If no intervention is required, place the infant skin-to-skin with the mother if they desire, cover both with towels and remain vigilant for signs of airway obstruction.
- Ongoing careful observation of mother and infant is required, especially in more preterm and growth-restricted infants, to ensure they both remain normothermic.
- Consider the addition of a plastic bag/wrap alongside other measures if skin-to-skin care is not possible.
- Place the infant on a warm surface using a preheated warmer, if support of transition or resuscitation is required.

Newborn infants < 32 weeks

- Dry the infant's head and cover with a hat.
- Put the infant's body in a plastic (polyethene) bag or wrap without drying.
- Assess the baby with the umbilical cord intact, aim to provide ≥ 60 s delayed cord clamping.
- Consider the use of additional measures during delayed cord clamping to ensure thermal stability (e.g. increasing room temperature, warm blankets, and a thermal mattress).

- Use a preheated heat source (e.g. radiant warmer).
- Be careful to prevent hypothermia during skin-to-skin care during assisted transition, especially in the more preterm and/or growth-restricted infants.
- Consider the use of heated humidified respiratory gases for infants receiving respiratory support.
- Be aware of the risk of hyperthermia when multiple heat-preservation interventions are used simultaneously, especially while using a thermal mattress in hospital.

Management of the umbilical cord

Cord clamping

- Ideally, delayed cord clamping is performed in all births, for ≥ 60 s and after inflation of the lungs.
- Discuss how to facilitate delayed cord clamping with parents and obstetricians/midwives before birth.
- Perform thermal management, stimulation and initial assessment during delayed cord clamping whilst ensuring an open airway.
- Newborn infants without need for support: facilitate at least 60 s of delayed cord clamping; longer may be beneficial.
- Newborn infants in need of resuscitation: minimise any delay to necessary interventions and, if necessary, clamp the cord < 30 s.
- If stabilisation with an intact cord can be safely undertaken, longer delayed cord clamping is preferred, especially in infants < 34 weeks.

Cord milking

- Do not milk the cord in preterm infants < 28 weeks.
- Consider cord milking as an alternative in infants ≥ 28 weeks, but only if delayed cord clamping cannot be performed.

Initial assessment

- Perform initial assessment as soon as possible after birth, ideally during delayed cord clamping, stimulating, drying and wrapping to:
    - Identify the need for support and/or resuscitation.
    - Call for help if required or anticipated.

    - Aid decisions relating to the appropriateness and duration of delayed cord clamping.
- Assess:
    - breathing
    - heart rate (HR)
    - muscle tone.
- Provide thermal management and simulation during delayed cord clamping and assessment.
- Reassess breathing and HR every 30 s to assess any response and determine if further interventions are required.

Breathing

- Note the presence or absence of breathing.
- If present, note the rate, depth, symmetry, and work of breathing.

Heart rate

- Initial HR assessment can be performed with a stethoscope.
- Continuous HR assessment methods (pulse oximetry, electrocardiography (ECG)) are preferred when interventions are indicated or during stabilisation of preterm newborns.

Response to tactile stimulation

- Gently stimulate the newborn infant by drying and rubbing the soles of the feet or their back.
- Avoid more vigorous methods of stimulation, especially in preterm infants.

Muscle tone and pallor

- A very floppy infant is likely to need breathing support.
- Hypotonia is common in preterm infants.
- Do not use skin colour to assess oxygenation.
- Interpret pallor within the clinical context and ethnicity, as it may have several causes such as hypoxia, acidosis, blood loss, or chronic anaemia.

Actions according to initial assessment

- Based on the initial assessment, further actions can be implemented guided by the NLS algorithm.

Airway

- Ensure the airway is open and the lungs are inflated. Until the airway is opened, other interventions will be unsuccessful.
- Following initial assessment, start respiratory support if the infant is not breathing regularly or the HR is < 100 min^{-1}.

Position

- Place the newborn infant on their back with the head supported in a neutral position.
- Gently push the lower jaw forward with pressure from behind (jaw thrust) to open the airway.

Two-person method

- Use the two-person method of airway support (jaw thrust) as soon as sufficient people are available, as this approach is more effective than a single-person jaw thrust.

Single-person method

- May be necessary if there are insufficient people to complete a two-person manoeuvre.

Lung Inflation after airway opening

- If apnoeic, gasping or not breathing effectively, start positive pressure ventilation (PPV) as soon as possible to inflate the lungs; ideally within 60 s.

- Apply an appropriately fitting face mask or nasal prongs connected to a device for providing positive pressure ventilation.
- Give 5 inflations with an inflation time of 2-3 s:
  - Infants ≥ 32 weeks: starting inflation pressure 30 cm H_2O.
  - Infants < 32 weeks: starting inflation pressure 25 cm H_2O.
- Use O_2 blenders (if available) during resuscitation/stabilisation in the birth area.
- Infants needing respiratory support:
  - ≥ 32 weeks start at 21% O_2.
  - < 32 weeks start at ≥ 30% O_2.
- In infants needing positive pressure ventilation, if possible, start with PEEP at 6 cm H_2O.

Assessment

- During lung inflations: look for chest movement.
  - Visible chest movement during inflations indicates a patent airway and delivered volume.
  - Failure of the chest to move may indicate that the airway is not open, or that insufficient inflation pressure/volume is delivered.
- After lung inflations: check HR
  - An increase in HR within 30 s of positive pressure ventilation, or a stable HR > 100 min^{-1}, usually confirms adequate ventilation/oxygenation.
  - HR < 100 min^{-1} or decreasing usually suggests continued hypoxia and almost always indicates inadequate ventilation, in which case chest movement will be poor.

Has chest rise been seen after inflation breaths?

- **No**
  - Reapply face mask, repeat 5 inflation breaths and reassess.
  - If this does not work, use an alternative airway manoeuvre and reassess.
  - If alternative airway manoeuvres are unsuccessful, consider increasing inflation pressures and reassess.
- **Yes**
  - Proceed to ventilation breaths (30 min^{-1}) if the baby is not breathing.
- Ensure the airway is open and the lungs have been inflated before progressing further down the NLS algorithm.

Alternative airway opening techniques

- If one airway opening technique is unsuccessful (e.g. no chest movement and no increase in heart rate), use another and assess the effect of each airway technique by observing chest movement and assessing HR.

Airway adjuncts

- Use airway adjuncts if suitable equipment and personnel are available; if not, reapply face mask or nasal prong ventilation with a two-person manoeuvre if possible.

Supraglottic airway

- Consider using an appropriate size supraglottic airway (SGA):
  - When face mask ventilation is ineffective.
  - When a more definitive airway is required as an alternative to tracheal intubation.
  - Where tracheal intubation is not possible or deemed unsafe because of a congenital abnormality, a lack of equipment, or a lack of skill.
  - When chest compressions are performed.

Nasopharyngeal and Oropharyngeal airways

- Consider nasopharyngeal or oropharyngeal airways in specific clinical situations (e.g. micrognathia), especially when face mask ventilation may be difficult.
- Use oropharyngeal airways with caution in infants < 34 weeks. They might contribute to airway obstruction.

Suction

- Do not routinely suction meconium or amniotic fluid from the airway because it delays initiating ventilation.
- Consider physical airway obstruction if lung inflation is unsuccessful despite alternative airway opening techniques.
- Only perform oropharyngeal suction under direct vision.
- Rarely, with no response to inflations and no chest wall movement, an infant may require tracheal suctioning to relieve an airway obstruction below the vocal cords.

Tracheal tube

- If equipment and skills permit, consider tracheal tube placement:
  - When face mask or SGA ventilation are ineffective.
  - With prolonged ventilation.
  - When suctioning the lower airways (removal of presumed tracheal blockage).
  - When chest compressions are performed.
- When performing tracheal intubation:
  - Have a range of different-sized tubes available.
  - Use video laryngoscopy (VL) if available and skills allow.
  - Use a direct laryngoscope if VL is not available and skills allow.
  - Use exhaled CO_2 detection and clinical assessment to confirm tracheal intubation.
  - Be aware that exhaled CO_2 detection may be falsely negative in low or no cardiac output states at birth.
  - A respiratory function monitor may be used to monitor ventilation if equipment and skills are available.

Following alternative airway opening techniques

- Repeat inflation breaths after every airway opening technique if chest rise has not been seen previously.
- Reassess chest movement and HR until visible chest movement **or** HR response.
- If used, check with a respiratory function monitor that expired tidal volume is within the target range (4-8 mL kg^{-1}).

Breathing

- After successful inflation breaths, give ventilation breaths:
  - Use a face mask or nasal interface to ventilate the lungs when the newborn infant is not breathing effectively.
  - Give 15 ventilation breaths over 30 s using an inflation time of approximately 1 s.
  - Reassess breathing and HR after 30 s.

Is there a HR response?

- Continue uninterrupted positive pressure ventilation until the infant begins to breathe adequately and the HR > 100 min^{-1}.
- Reassess breathing and HR every 30 s, until the newborn infant is stabilised.

- Consider inserting an SGA or tracheal tube if apnoea continues.

If there is no HR response

- Call for help.
- Recheck equipment.
- If no chest rise, perform an alternate airway opening technique and consider increasing inflation pressures.
- Confirm effective ventilation during 30 s of ventilation breaths through observed chest movement or other measures of respiratory function.
- Re-assess HR and chest rise.
- If the HR remains < 60 min^{-1} after 30 s of ventilation breaths start chest compressions.
- If used, check with a respiratory function monitor that expired tidal volume is within the target range (4 to 8 mL kg^{-1}), depending on gestational age.
- Without adequate lung inflation, chest compressions will be ineffective.

Oxygen

- Consider pulse oximetry +/- ECG.
- Check O_2 and saturations every 30 s during resuscitation/stabilisation.
- Avoid SpO_2 < 80% and/or bradycardia at 5 minutes of age.
- Titrate inspired O_2 to achieve target SpO_2 between the 25th-75th centile.

Time from birth	Acceptable right-hand oxygen saturations
3 min	70–75%
5 min	80–85%
10 min	85–95%

Ventilation devices

- Use an appropriately sized face mask or nasal interface.
- Ensure effective seal with minimal force.

- Where possible, use a T-piece resuscitator capable of providing either CPAP or positive pressure ventilation + PEEP when giving ventilatory support, especially in the preterm infant.
- A bag-valve mask should be available as backup:
  - Take care not to deliver excessive volumes.
  - Be aware that CPAP might not be effectively delivered even when a PEEP valve is used.

Increasing inspiratory pressure

- If the airway is open but chest rise is poor, consider increasing inflation pressures by 2-5 cm H_2O incrementally. It is rare to need an inspiratory pressure of > 40 cm H_2O.
- Reduce inflation pressure when chest movement is seen and there is clinical improvement.

Continuous positive airway pressure (CPAP) and Positive end-expiratory pressure (PEEP)

- Use either a face mask or a nasal interface as the device-patient interface to deliver CPAP if spontaneously breathing or PEEP if not.
- Start with CPAP at 6 cm H_2O as initial breathing support in:
  - Spontaneously breathing infants < 32 weeks with respiratory distress.
  - Spontaneously breathing infants ≥ 32 weeks with respiratory distress requiring supplemental O_2.
- In infants needing positive pressure ventilation, start with PEEP at 6 cm H_2O.

Circulation

Chest compressions

- Start chest compressions if the HR is < 60 min^{-1} after at least 30 s of effective ventilation.
- When starting chest compressions:
  - Increase O_2 to 100%.
  - Call for experienced help if not already summoned.
  - Consider securing the airway and establish vascular access for drugs or intravascular volume.

- Use a 3:1 synchronised compression-to-ventilation ratio (C:V), aiming for 90 compressions and 30 ventilations (120 events) per min.
- Use the two-thumb, hands-encircling technique with overlapping or adjacent thumbs to deliver chest compressions.
- Compress to a depth of one-third of the anterior-posterior chest diameter.
- Allow full chest recoil between compressions.
- Reassess HR every 30 s.
- If HR remains < 60 min^{-1}, secure the airway with an SGA or tracheal tube (if competent and not already done) with minimal interruptions to ongoing chest compressions.
- After SGA placement or tracheal intubation, continue with the 3:1 C:V ratio.
- Titrate O_2 against the oxygen saturation once a reliable value is achieved.
- Discontinue chest compressions once the HR is > 60 min^{-1}; check for output (e.g. auscultation, pulse check, pulse oximetry, signs of life).

Vascular access

Umbilical Venous Access

- Use the umbilical vein as the preferred option for rapid emergency vascular access during resuscitation at birth.
- Perform emergency umbilical venous catheter (UVC) placement under clean rather than sterile conditions to ensure timely vascular access is secured.
- Consider the use of an emergency umbilical venous catheter for a few days after birth, as it may still be achievable.

Intraosseous Access

- Use intraosseous (IO) access as an alternative method of emergency vascular access for drugs/fluids if UVC access is not possible.
- Consider device-specific weight limitations for IO-related equipment.
- Ensure there is no extravasation when administering drugs/fluids.
- Do not aspirate from IO; even when correctly positioned, it is often not possible.

Drugs

- Resuscitation drugs may be considered where, despite adequate control of the airway, effective ventilation, and chest compression for at least 30 s, HR

remains < 60 min^{-1} and is not increasing.

Adrenaline

- UVC is the preferred route; IO is an alternative.
  - Give 20 mcg kg^{-1} (0.2 mL kg^{-1} of 1:10,000 adrenaline [0.1 mg mL^{-1}]).
  - Give subsequent doses every 4 min if HR remains < 60 min^{-1}.
- If no UVC or IO access but intubated:
  - Give intra-tracheal adrenaline at dose of 100 mcg kg^{-1} (1 mL kg^{-1} of 1:10,000 adrenaline [0.1 mg mL^{-1}]).
  - If HR remains < 60 min^{-1}, as soon as UVC or IO access is obtained, immediately give a dose via this route, irrespective of when the intra-tracheal dose was given.

Glucose

- If possible, check the blood glucose value during resuscitation.
- Give glucose 200 mg kg^{-1} (2 mL kg^{-1} of 10% glucose) if blood glucose is low (a commonly used threshold is 2.6 mmol kg^{-1}).

Intravascular volume replacement

- Give 10 mL kg^{-1} of group O Rh-negative blood or isotonic crystalloid solution if suspected blood loss or in a newborn infant unresponsive to other resuscitative measures.

Bicarbonate

- Bicarbonate is no longer recommended in resuscitation but may be considered as part of post-resuscitation care according to local protocols and practice.

In the absence of an adequate response

- Consider other factors which may impact the response to resuscitation, and may require addressing, such as the presence of pneumothorax, hypovolaemia, congenital abnormalities, and equipment failure.

Post-resuscitation care

- Once effective ventilation and circulation are established, a thorough reassessment should be undertaken and any issues addressed. This approach can also be used to maintain situational awareness as further resources arrive.
- Thermal care remains a priority for active monitoring and intervention.
- The family should be supported throughout the resuscitation and post-resuscitation processes.
- The infant should be cared for in or transferred to an environment in which close monitoring and anticipatory care can be provided.

Glucose management

- Measure blood glucose values early and regularly until they have stabilised in the normal range; especially in newborns resuscitated at birth, those at risk of hypoxic-ischaemic encephalopathy (HIE), and/or receiving intravenous glucose.
- Avoid hypoglycaemia, hyperglycaemia, and large swings in blood glucose.

Thermal care

- Monitor the infant’s temperature frequently or continuously after resuscitation.
- Maintain temperature between 36.5°C and 37.5°C and rewarm if the temperature is below this.

Therapeutic Hypothermia

- Consider inducing therapeutic hypothermia (33-34°C) after completion of resuscitation and detailed assessment of an eligible term infant with clinical, biochemical, and (if available) neurophysiological evidence of HIE.
- Use appropriate eligibility criteria and strictly defined protocols to guide the cooling process; inappropriate application of therapeutic hypothermia may be harmful.
- Arrange safe transfer to an appropriately equipped facility where monitoring and treatment can be continued.

- Monitor (rectal) temperature during transport and, if available, apply active cooling with a servo-controlled device while transferring the infant.

Oxygenation and ventilation

- Consider monitoring pre- and post-ductal oxygen saturations to identify pulmonary hypertension.
- Avoid hypoxia and hyperoxia.
- Avoid inadvertent hypocapnia during mechanical ventilation.

Documentation and prognostication

- Keep an accurate time-based record of the infant's clinical state, interventions and responses during resuscitation to facilitate retrospective review.
- Record time-based heart rate and breathing assessments.
- Record APGAR scores, including individual score components.
- Document all conversations with the parents.

Clinical team debriefing

Use performance-focused, interdisciplinary/interprofessional team debriefings following resuscitation or other non-routine situations to optimise individual and team performance as well as systems issues (e.g., emergency supplies, equipment).

Communication with the parents

Where intervention is anticipated

- The decision to attempt resuscitation of an extremely preterm or clinically complex infant should be taken in close consultation with the parents and senior clinicians, e.g. paediatricians, midwives, and obstetricians.

- Discuss the options, including the potential need and magnitude of resuscitation and the likely prognosis before birth, so that an individualised management plan can be agreed.
- Ensure concise and factual documentation of discussions is recorded in the mother's notes before birth and in the infant's notes after birth.

For every birth

- If parents want and resources allow, enable parents to be present during the stabilisation or resuscitation.
- Consider the views of the resuscitation team, parents and circumstances.
- Parental position or actions must not impede resuscitation.
- Ensure that parents are fully informed about the progress of the care provided to their infant.
- Identify a member of healthcare staff to support parents and be aware that witnessing the resuscitation of their infant will be distressing for them.
- Encourage parents to hold or touch their infant as soon as possible after resuscitation; this should be facilitated, especially when the resuscitation was unsuccessful.
- Provide an explanation of any procedures and why they were required.
- Facilitate further discussions later to enable parents to reflect and to aid their understanding of events.
- Provide additional support for parents following resuscitation at birth.

Out-of-hospital Birth and Newborn Life Support

Planned home births

- For planned homebirths, parents should receive documented, personalised care planning in the antenatal period. This should include:
  - Information about what the midwives will do if unexpected complications occur.
  - Information about what resuscitation can be provided compared to other birth settings.
  - Arrangements for conveyance to hospital if required.
  - Information that response times and transfer times are unpredictable and cannot be accurately stated ahead of time.
- Ideally, two trained midwives should be present at all home births.

- All midwives attending homebirths should have appropriate training in initiating Newborn Life Support.
- Have a minimum set of equipment of an appropriate size for the newborn infant available.
- Midwives attending home births should know how to call for help from emergency services should an unexpected situation arise.

Unexpected births outside the hospital

- Ideally, at least two double-crewed ambulances should be dispatched to all imminent births and babies born before arrival (BBA).
- Dispatch of team leaders, scene managers and enhanced or critical care resources should be considered if available.
- Pre-hospital clinicians should have access to a minimum set of equipment for newborns of all gestations to support thermal care and oxygenation.
- Pre-hospital clinicians should be prepared and trained to manage births out of hospital.

Out-of-hospital management (specific additional considerations)

Thermal control:

- Infants born unexpectedly outside the hospital environment are at higher risk of hypothermia and subsequent poorer outcomes.
- Thermal control measures should be used early and proactively, regardless of the perceived environmental temperature. These measures include thermal mattresses, blankets (warmed if possible), hats, foil blankets and bubble wrap.

Airway:

- Use a two-person technique as soon as there are enough resources on the scene.
- Supraglottic airways should also be considered early if minimal resources are on scene, to ensure optimal ventilation. They should also be considered to facilitate extrication and conveyance when ongoing resuscitation is required.

Breathing:

- Titrating oxygen is not possible with a self-inflating bag. Resuscitate in air, unless chest compressions are required, then use 100% oxygen.
- For babies < 32 weeks gestation, where possible, connect the self-inflating bag to oxygen from the start.

Circulation:

- Two-thumb, hand-encircling technique should be used where possible, but in some situations, including extrication, it may be more practical to use the two-finger technique.
- Intraosseous access is the first line for vascular access in an out-of-hospital setting, unless clinicians on scene have the necessary skills and equipment for umbilical venous access. IO access may be impractical in babies < 32 weeks.

Telemedicine:

- Where remote clinical advice lines are available, consider their use to support decision-making.

Post-resuscitation care:

- A thorough T(ABCDE)F assessment should be undertaken and any issues addressed. This approach can also be used to maintain situational awareness as further resources arrive.
    - Thermal care (T) remains a priority for active monitoring and intervention.
    - The Family (F) should be supported throughout the resuscitation and post-resuscitation processes.
- Temperature control measures should be adjusted to maintain the temperature between 36.5-37.5°C; measure the temperature of the baby regularly.
- Therapeutic hypothermia should not be started in an out-of-hospital setting.
- Any baby that has received resuscitation should be conveyed to hospital.
    - Thermal care of the baby should be maintained during conveyance.
    - National guidance around safe mother and baby transfer should be followed; this may involve a separate ambulance.

Withholding or discontinuing resuscitation in hospital

- When discontinuing, withdrawing or withholding resuscitation, care should be focused on the comfort and dignity of the infant and family and should ideally involve senior paediatric/neonatal staff.

Withholding resuscitation

- Decisions to withhold life-sustaining treatment should be made in advance of birth, together with parents, in the light of national evidence on outcomes if resuscitation and active (survival-focused) treatment is attempted.
- In situations where there is extremely high (e.g. > 90%) predicted neonatal mortality and unacceptably high morbidity in surviving infants, attempted resuscitation and active (survival-focused) management are usually not appropriate.
- Resuscitation is nearly always indicated in conditions associated with lower (e.g. < 50%) neonatal mortality and what is deemed to be acceptable morbidity. This will include most infants with congenital malformations and most infants > 24 weeks or above in high-resource settings with access to neonatal intensive care.
- In situations where there is high mortality (e.g. > 50%) and/or a high rate of morbidity, and where the anticipated burden of medical treatment for the child is high, parental wishes regarding resuscitation are usually supported. It may be appropriate to provide full resuscitation, to provide some measures (but withhold other interventions) or to provide comfort-focused care.
- **In babies < 25 weeks,** it may be appropriate to agree on the extent of resuscitation as the prognosis is much better for a baby that responds to thermal care, airway and breathing support, compared to needing this plus chest compressions and adrenaline.
- Provision of antenatal palliative care support can be beneficial to parents in the face of certain or uncertain poor outcomes.
- Resuscitation should usually be commenced in situations where there is uncertainty about the outcome and there has been no chance to have prior discussions with parents.

Discontinuing resuscitation

- If the HR remains absent despite resuscitation, review clinical factors, e.g. relevant antenatal history, presence/absence of dysmorphic features, gestation of the infant, duration and effectiveness of resuscitation, and the views of other members of the clinical team about continuing resuscitation.
- If the HR of a newborn infant remains absent for more than 20 min after birth despite the provision of all recommended steps and exclusion of reversible causes, consider stopping resuscitation.
- For preterm infants (particularly extremely preterm), it may be appropriate to discontinue resuscitation earlier than 20 min. The decision should be individualised.
- Where there is partial or incomplete HR improvement despite apparently adequate resuscitative efforts, the choice is much less clear. It may be appropriate to take the infant to the intensive care unit and later consider withdrawing life-sustaining treatment.
- Where life-sustaining treatment is withheld or withdrawn, infants should be provided with appropriate palliative (comfort-focused) care.

Additional out-of-hospital considerations when withholding or discontinuing resuscitation

- In most UK out-of-hospital settings, clinicians would not be expected to discontinue resuscitation.
- Enhanced or critical care resources may offer more advanced resuscitation interventions or, where appropriate, help to make resuscitation decisions either remotely or on scene.
- If a baby is born showing signs that they died in advance of birth (such as established maceration or rigor mortis), it is reasonable not to start or continue resuscitation.
- National guidelines relating to survival-focused care/comfort care should be followed.
- As with babies born in hospital, if gestation is unknown and the baby shows signs of life, or if asked by the parents to do so when at a gestation > 22 weeks and < 24 weeks, survival-focused care may be started.

Downloads

Newborn life support algorithm 2025 60.4 KB

Out-of-hospital newborn life support algorithm 2025 45.29 KB
Advanced resuscitation of the newborn infant algorithm 2025 39.94 KB
Minimum equipment for newborn resuscitation and the support of transition of infants at birth in the pre-hospital setting 207.19 KB