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Practice Guideline

European Resuscitation Council Guidelines 2025 Adult Basic Life Support



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Abstract

The European Resuscitation Council has produced these ERC Guidelines 2025 Basic Life Support for adults based on the ILCOR Consensus on Cardiopulmonary Resuscitation Science with Treatment Recommendations published since 2021. The topics addressed include how to recognise cardiac arrest, alerting the emergency services, delivering chest compressions, performing rescue breaths, how to use an automated external defibrillator (AED) and safety considerations for rescuers. Quality of cardiopulmonary resuscitation (CPR) and the use of technology has been embedded into the relevant sections, rather than reported separately. The management of cardiac arrests in children, infants and neonates are described in the ERC guidelines 2025 Neonatal Life Support and Paediatric Life Support.

Keywords: Out-of-hospital cardiac arrest, Recognition of cardiac arrest, Cardiopulmonary resuscitation, Automated external defibrillator, Dispatcher-assisted CPR, Defibrillation

Introduction

These ERC Guidelines 2025 Basic Life Support (BLS) for adults have been written with reference to the International Liaison Committee on Resuscitation (ILCOR) Consensus on Science and Treatment Recommendations (CoSTR) for Basic Life Support.^{1–4} If no recent ILCOR recommendation was available, the ERC used findings from recently published studies to inform guideline recommendations, and when required, the Guidelines was informed by expert consensus.

BLS Writing Group members and the Guidelines Steering Committee agreed to this version, which was posted for public

comment between 5. and 30. May 2025. A total of 111 individuals submitted 114 comments, leading to 20 changes in the final version. The guideline was presented to and approved by the ERC Board and the General Assembly in June 2025. The methodology used for guideline development is presented in the Executive summary.⁵

For the purpose of these Guidelines, the term CPR relates to the specific technical skills of cardiopulmonary resuscitation (i.e. performance metrics of chest compression and ventilation), whilst resuscitation is used as a generic term covering the broader range of skills and interventions. The term bystander is used to describe rescuers who happen to be at the scene to provide help, and the term first responder is used for those who have additional training and are

Abbreviations: ERC, European Resuscitation Council, CoSTR, Consensus on Science with Treatment Recommendations, ILCOR, International Liaison Committee on Resuscitation, HCPs, Healthcare professionals, AI, Artificial Intelligence, CPR, cardiopulmonary resuscitation, BLS, Basic Life Support, AED, Automated external defibrillator, ALS, Advanced Life Support, ILS, Immediate Life Support, PBLs, Paediatric Basic Life Support, NLS, Newborn Life Support, VR, virtual reality, AR, augmented reality, VLE, virtual learning environment, EMS, Emergency Medical Services, HBB, Helping Babies Breathe, PAD, Public Access Defibrillator, RCT, Randomised controlled trial

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alerted to attend the scene of a cardiac arrest. Healthcare Professionals (HCPs) are those who work in any healthcare sector (prehospital or in-hospital). Laypeople are persons not working in the healthcare sector. Basic Life Support (BLS) is defined as initiating the chain of survival, early high-quality chest compression, effective ventilation, and the early use of an automated external defibrillator (AED). Any form of resuscitation beyond BLS is described generically as advanced life support (neonatal, paediatric, and adult life support). Where the term 'ALS' is used, this refers specifically to the ERC adult Advanced Life Support course. The writing group of these ERC Guidelines 2025 Basic Life Support for adults considered the recently introduced ERC approach to diversity, equality, equity, and inclusion (DEI) while writing these Guidelines, and applied it whenever possible, recognising and realising that this is a field for improvement in the production of evidence-informed guidelines (Fig. 1, Table 1).

Concise resuscitation guidelines for all responders

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 EMS** immediately if they are unresponsive
- Assess breathing
 - If you are unsure the call-taker 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 call-taker will assist you

Recognising cardiac arrest

- Ensure it is safe to approach.
- Suspect cardiac arrest in any person who is unresponsive (Fig. 2).
- Call your local emergency number 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.

ADULT BASIC LIFE SUPPORT KEY MESSAGES

GUIDELINES
2025
EUROPEAN RESUSCITATION COUNCIL®

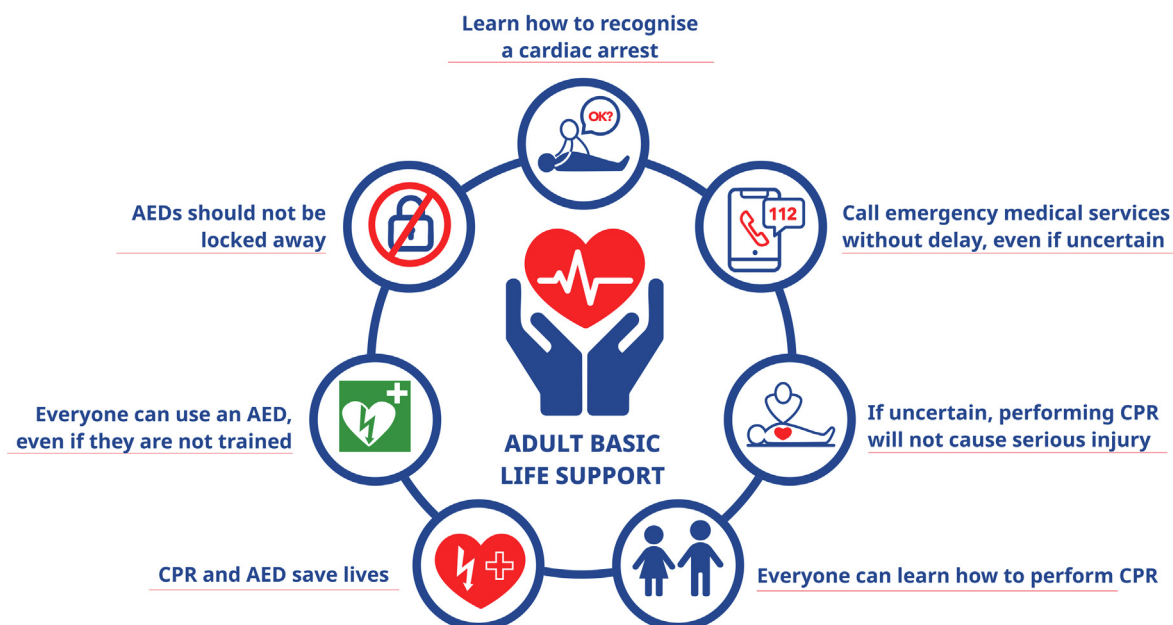


Fig. 1 – Adult Basic Life Support – key messages.

Table 1 – The major changes in the 2025 Guidelines for Adult Basic Life Support.

ERC Guidelines 2021	ERC Guidelines 2025
Changes to guidance	
The 2021 ERC BLS Guidelines emphasised recognising cardiac arrest in a person who is unresponsive and not breathing normally, before calling the local emergency services.	The 2025 ERC BLS Guidelines emphasises calling the local emergency services for any person who is unresponsive. 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 dispatcher will be able assist you in identifying abnormal breathing, if needed.
The 2021 ERC BLS Guidelines emphasised descriptions of slow or laboured breathing as indicators of abnormal breathing.	Exercise is a common precipitant of cardiac arrest. Early after the onset of cardiac arrest, athletes may display a near normal or panting breathing pattern.
New topics added in the 2025 ERC BLS guidance	
The role of the dispatcher was previously addressed in the Systems Saves Lives chapter, which addresses the role of dispatchers with respect to system performance and the cardiac arrest population.	The 2025 ERC BLS Guidelines include some detail of the role of dispatcher. The role of the dispatcher is critical to early recognition of cardiac arrest and initiation of CPR.
There are a few studies to indicate that head-up CPR might help improve patient outcomes. There has been growing interest within the resuscitation community about the potential benefits of head-up CPR.	Existing studies of head-up CPR include a bundle of interventions and are not limited to just positioning the patient in a head-up position. Evidence addressing the impact of head-up CPR without the other elements of the CPR bundle is lacking.
Psychological wellbeing of rescuers was not previously addressed within BLS guidance.	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 ERC BLS Guidelines now recognises that lay rescuers and bystanders may benefit from support.
CPR in obese patients was not previously addressed within BLS guidance.	There is a growing body of evidence exploring cardiac arrest management and outcomes in obese patients. The 2025 ERC BLS Guidelines advise that obese patients receive standard 30:2 CPR without modifications.
Topics removed from the ERC Guidelines 2025 BLS	
The 2021 ERC BLS Guidelines included guidance for modification of BLS in response to COVID-19.	BLS modifications for COVID-19 been removed from the BLS Guidelines. COVID-19 is now endemic in the community and this advice has been removed in line with national health policies. COVID-19 patients should be treated as any other patients. Modifications to CPR are no longer required.
The 2021 ERC BLS Guidelines included guidance for management of foreign body airway obstruction.	Management of foreign body airway obstruction has been relocated from BLS to the ERC Guidelines 2025 First Aid. ⁶

- If any person is unresponsive with abnormal breathing, cardiac arrest should be assumed.
- If you are uncertain, the call-taker will be able to assist you.
- If there is any doubt, assume cardiac arrest and start CPR (Fig. 3).

Alerting the emergency services

- If you have a mobile phone, activate speaker mode, call the local emergency number 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 to alert the local emergency service. Do this as quickly as possible.

- If they remain unresponsive and are not breathing normally when you return from summoning help, immediately commence CPR.

Role of the dispatcher

- Dispatchers should use standardised protocols to facilitate recognition of cardiac arrest.
- Once cardiac arrest is recognised, dispatchers should provide CPR instructions to all callers.
- Dispatchers 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 dispatchers should facilitate 30:2 CPR.
- Once CPR is underway, dispatchers should ask if there is an 'AED' or 'defibrillator' at the scene.

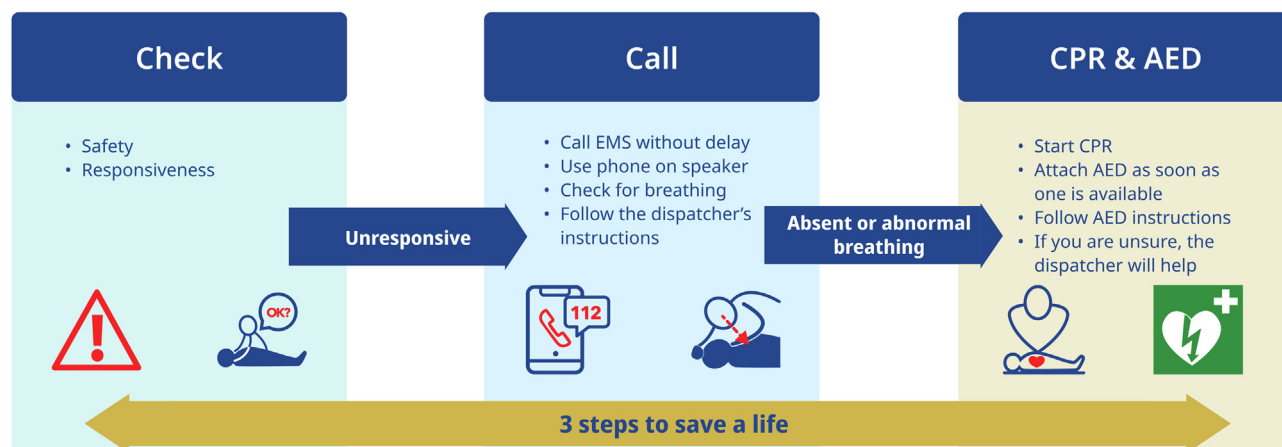


Fig. 2 – Three steps to save a life.

- If no AED is available at the scene, and more than one bystander is present, dispatchers should guide bystanders to the nearest AED.
- As soon as an AED is available at the patient, dispatchers should instruct the bystander to activate the AED and to follow the AED instructions.
- Where first responder systems have been implemented, dispatchers should activate registered community volunteer responders to the incident and to retrieve a nearby AED (Fig. 4).

High quality chest compressions

- Commence 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 persons 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. 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 ventilate the chest after 2 attempts, consider foreign body airway obstruction (see ERC Guidelines 2025 First Aid).⁶
- 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 (see Fig. 5).
- 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 phone and computer applications.
- The local emergency service should be able to direct callers to the nearest available AED.

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) and in Fig. 6.

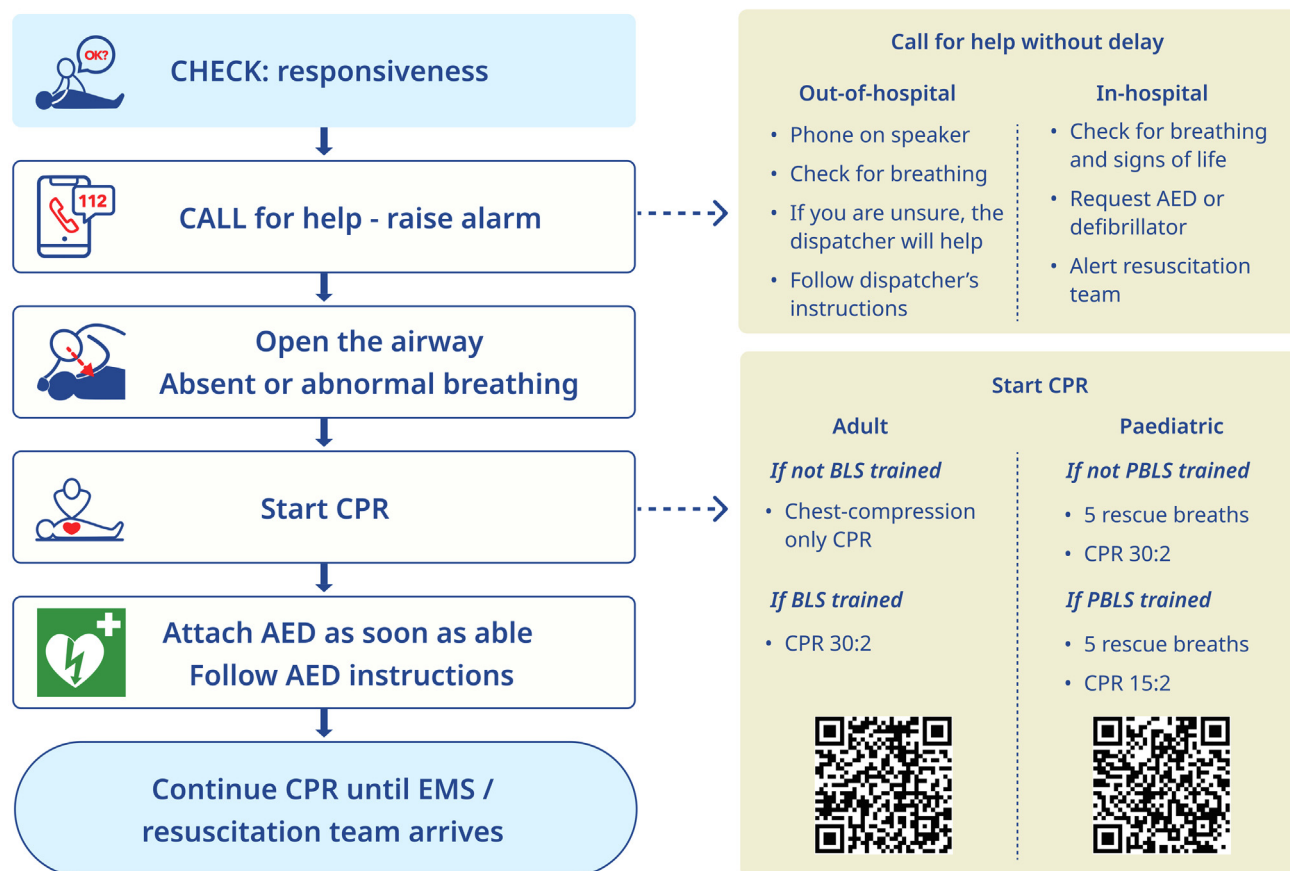


Fig. 3 – Universal BLS algorithm.

- If more than one rescuer is present, continue CPR while the defibrillation 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 CPR 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 available 24 h a day, 7 days a week, 365 days per year.
- Locations with a high population flow, such as airports, shopping centres and train stations should have on-site AEDs that are readily available 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 local emergency service, especially if they are linked to AED registries and first responder programmes.

Safety

- Ensure the safety of yourself, the person in cardiac arrest, and any bystanders (Fig. 7).

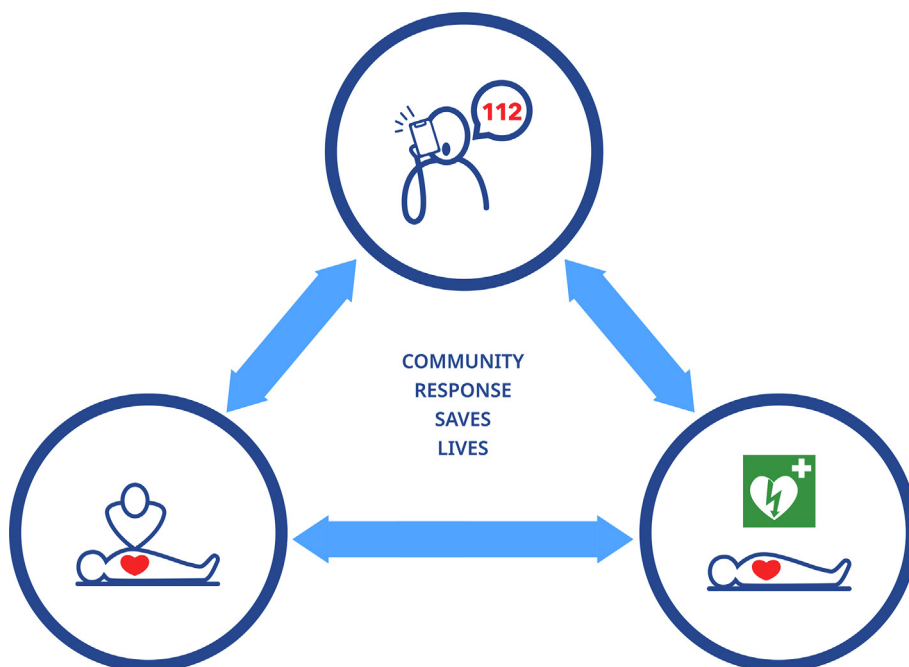
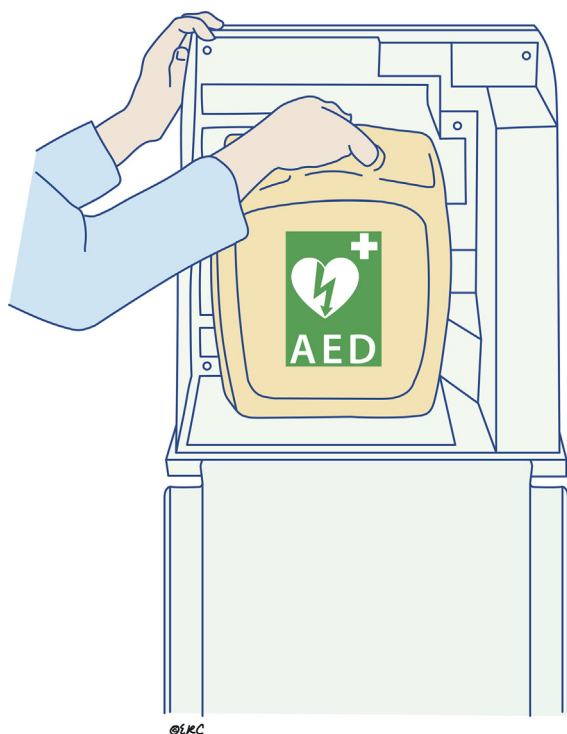


Fig. 4 – Community response.



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Fig. 5 – AED signage.

- The risk of physical injury to the rescuer, from performing CPR, is low.
- Consider the wellbeing of lay person and bystanders – offer them support).

Evidence informing the guidelines

Recognising cardiac arrest

The practical, operational definition of cardiac arrest is when a person is unresponsive and not breathing normally.⁷ Although unresponsiveness and abnormal breathing are present in other potentially life-threatening medical emergencies, they have very high sensitivity as diagnostic criteria for cardiac arrest.^{8,9} Using these criteria will over triage for cardiac arrest,¹⁰ however the small risk of commencing CPR in an unresponsive individual, who is not breathing normally but is not in cardiac arrest, is far outweighed by the increased mortality associated with delayed CPR for those in cardiac arrest.¹¹ The ERC acknowledges that confirming unconsciousness with abnormal breathing remains the primary barrier to recognition of cardiac arrest (Fig. 8a and Fig. 8b).^{12,13}

Abnormal breathing

The ERC Guidelines 2025 BLS continue to highlight the importance of recognising agonal breathing as a sign of cardiac arrest.¹² Agonal breathing is an abnormal breathing pattern. It is observed in 30–60 % of cardiac arrests,¹³ most commonly at the onset of cardiac arrest.¹⁴ It indicates the presence of residual brain stem function and is associated with improved outcomes.¹⁵

Agonal breathing is frequently misinterpreted as a sign of life.⁸ This presents a challenge to lay people, first responders, emergency medical dispatchers and HCPs. Common terms used by lay people

- Lay people should commence CPR for presumed cardiac arrest without concerns of harm to patients 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.

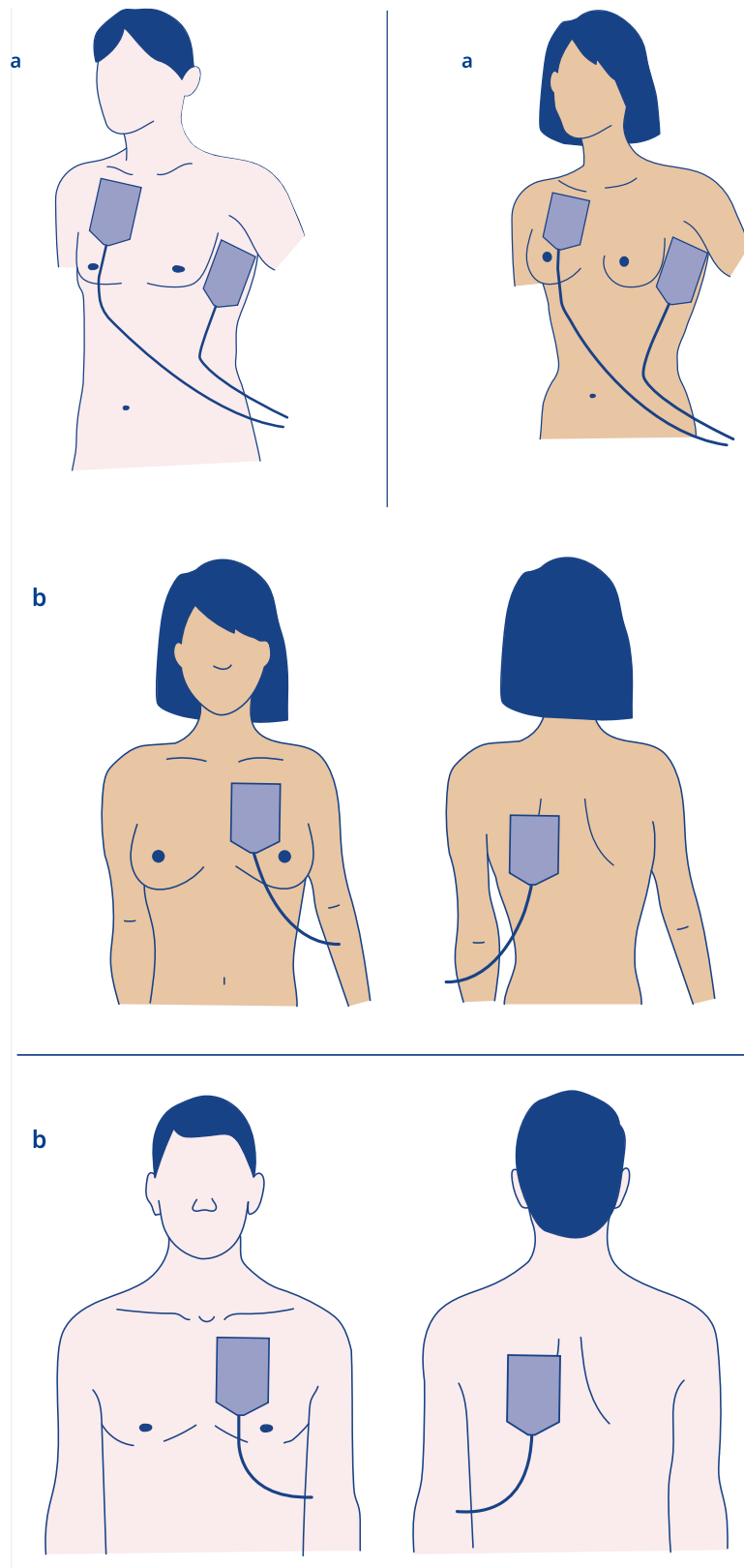


Fig. 6 – Anterior-lateral pad position (a) or anterior-posterior pad position (b).

SEQUENCE / ACTION	TECHNICAL DESCRIPTION
SAFETY 	Make sure that you, the victim and bystanders are safe
RESPONSE Check for a response 	Shake the victim gently by the shoulders and ask loudly: "Are you all right?"
ALERT EMERGENCY SERVICES 	- If victim is unresponsive, ask a helper to call the emergency medical services or call them yourself - Stay with the victim if possible - Activate the speaker function or hands-free option on the telephone so that you can start CPR whilst talking to the dispatcher
AIRWAY Open the airway 	- If there is no response, position the victim on their back - With your hand on the forehead and your fingertips under the point of the chin, gently tilt the victim's head backwards, lifting the chin to open the airway
BREATHING Look, listen and feel for breathing 	- Look, listen and feel for breathing for no more than 10 seconds - A victim who is barely breathing, or taking infrequent, slow and noisy gasps, is not breathing normally
SEND FOR AED Send someone to get an AED 	- Send someone to find and bring back an AED, if available - If you are on your own, fetch an AED only if you can get and apply it within one minute; otherwise, start CPR immediately
CIRCULATION Start chest compressions 	- Kneel by the side of the victim - Place the heel of one hand in the centre of the victim's chest - this is the lower half of the victim's breastbone (sternum) - Place the heel of your other hand on top of the first hand and interlock your fingers - Keep your arms straight - Position yourself vertically above the victim's chest and press down on the sternum at least 5 cm (but not more than 6 cm) - After each compression, release all the pressure on the chest without losing contact between your hand and the chest - Repeat at a rate of 100-120 min⁻¹
COMPRESSION-ONLY CPR 	If you are untrained, or unable to give rescue breaths, give chest-compression-only CPR (continuous compressions at a rate of 100-120 min⁻¹)

Fig. 7 – BLS step by step.

COMBINE RESCUE BREATHING WITH CHEST COMPRESSIONS 	• If you are trained to do so, after 30 compressions, open the airway again, using head tilt and chin lift • Pinch the soft part of the nose closed, using your index finger and thumb of your hand on the forehead • Allow the victim's mouth to open, but maintain chin lift • Take a normal breath and place your lips around the victim's mouth, making sure that you have an airtight seal • Blow steadily into the mouth whilst watching for the chest to rise, taking about 1 second as in normal breathing. This is an effective rescue breath • Maintaining head tilt and chin lift, take your mouth away from the victim and watch for the chest to fall as air comes out • Take another normal breath and blow into the victim's mouth once more to achieve a total of two rescue breaths • Do not interrupt compressions by more than 10 seconds to deliver the two breaths, even if one or both are not effective • Then return your hands without delay to the correct position on the sternum and give a further 30 chest compressions • Continue with chest compressions and rescue breaths in a 30:2 ratio
WHEN AED ARRIVES Switch on the AED and attach the electrode pads 	• As soon as the AED arrives, switch it on and attach the electrode pads to the victim's bare chest • If more than one rescuer is present, CPR should be continued whilst the electrode pads are being attached to the chest
FOLLOW THE SPOKEN/ VISUAL DIRECTIONS	• Follow the spoken and visual directions given by the AED • If a shock is advised, ensure that neither you nor anyone else is touching the victim • Push the shock button as directed • Then immediately resume CPR as directed by the AED
IF NO SHOCK IS ADVISED Continue CPR 	• If no shock is advised, immediately resume CPR and continue as directed by the AED
IF NO AED IS AVAILABLE Continue CPR 	• If no AED is available, or whilst waiting for one to arrive, continue CPR • Do not interrupt resuscitation until: • A healthcare professional tells you to stop OR • The victim is definitely waking up, moving, opening eyes, and breathing normally OR • You become exhausted • It is rare for CPR alone to restart the heart. Unless you are certain that the victim has recovered, continue CPR • Signs that the victim has recovered • Waking-up • Moving • Opening eyes • Breathing normally

Fig 7. (continued)

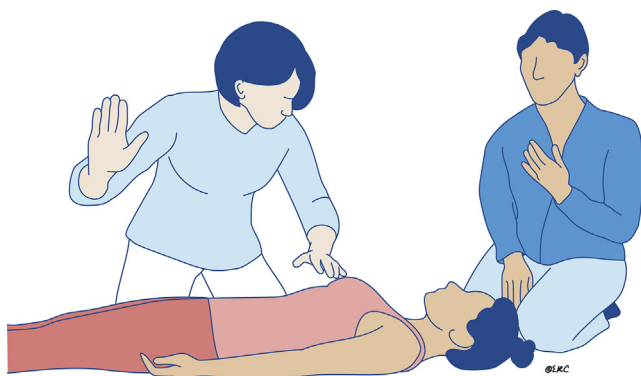


Fig. 8a – Safety.



Fig. 8b – Check.



Fig. 8c – Unconscious – Call.



Fig. 8d – Check for breathing – open the airway.

to describe agonal breathing include gasping, barely or occasionally breathing, moaning, sighing, gurgling, noisy, groaning, snorting, heavy or laboured breathing.^{13,16}

Misinterpretation of abnormal breathing remains the biggest barrier to recognition of cardiac arrest.^{9,13,17} Recognition of abnormal breathing as a sign of cardiac arrest will enable CPR to be started without delay. Failure to recognise cardiac arrest by dispatchers during emergency calls is also associated with decreased survival.^{18,19}

In addition to agonal breathing patterns, other abnormal breathing patterns have been described, particularly when cardiac arrest is associated with collapse whilst playing sport.²⁰ Athletes who sustain a cardiac arrest may continue breathing more regularly^{21–23} and/or have their eyes open following collapse.²⁴ This has prompted the ERC to include the descriptor of panting within the recognition of cardiac arrest section (Fig. 8c and Fig. 8d).

Seizures

Seizure-like movements of short duration among patients in cardiac arrest pose another important barrier to recognition of cardiac arrests. Seizures are common medical emergencies and are reported to constitute approximately 3–4 % of all emergency medical calls.^{25,26} However, only 0.6–2.1 % of these calls will be cardiac arrests.^{27–29} An observational study including 3502 OHCA identified 149 (4.3 %) individuals with seizure-like activity.²⁹ Patients in cardiac arrest who presented with seizure-like activity were younger (54 vs. 66 years; $p < 0.05$), were more likely to have a witnessed arrest (88 % vs 45 %; $p < 0.05$), more likely to present with an initial shockable rhythm (52 % vs. 24 %; $p < 0.05$), and more likely to survive to hospital discharge (44 % vs. 16 %; $p < 0.05$). A more recent study identified seizure activity in 59/465 non-traumatic OHCA (12.7 %) and also observed an association with improved outcomes.³⁰ Similar to agonal respiration, seizures complicate the recognition of cardiac arrest for lay people, first responders and HCPs (median time to dispatcher identification of the cardiac arrest; 130 s vs 62 s; $p < 0.05$).²⁹

Recognising cardiac arrest after a seizure episode when the person remains unresponsive with abnormal breathing is important to prevent delayed CPR. The risk of delaying CPR in cardiac arrest far outweighs any risk from performing CPR on a person who is not in cardiac arrest.

Alerting the emergency services

Whenever a person is found unresponsive, bystanders who have a mobile phone should call the local emergency number and activate speaker mode.³¹ While waiting for the call to be answered, the caller should continue to assess for the presence of abnormal breathing.

If the person is unresponsive and not breathing normally, commence CPR (30:2) immediately.¹² If there is any doubt about breathing status, the dispatcher will assist the caller to identify abnormal breathing.¹³ Callers should not delay contacting the emergency services to confirm the presence of abnormal breathing.

This recommendation is based on a recent ILCOR scoping review demonstrating that most cardiac arrests are initially recognised by the dispatcher during the call, rather than by bystanders at the scene.¹³ Prioritising calling local emergency services for all unresponsive patients will increase the number of calls made for patients not in cardiac arrest, however the majority of such unresponsive patients are likely to require assistance from the emergency services, even though they might not be in cardiac arrest. This approach is unlikely to adversely impact emergency service performance.³² Despite widespread availability of mobile phones, there will inevitably be circumstances where no mobile phone is available, or the mobile phone is not able to connect to any form of network. In these circumstances, a lone rescuer has two options – shout for help or leave the person in cardiac arrest to alert local emergency services.

If a lone rescuer believes there are people nearby, who will come to their assistance, it is reasonable to shout for help and commence CPR. However, if no-one responds to the call for help, then the lone rescuer will have to stop CPR and leave the person in cardiac arrest, to summon the local emergency services. There is currently no evidence addressing how long to continue CPR before leaving the person to alert the local emergency services. If the lone rescuer does need to leave the person in cardiac arrest to summon help, the ERC advises that this is done as quickly as possible (Fig. 8e).



Fig. 8e – Not breathing normally.

Role of the dispatcher

Dispatcher recognition of cardiac arrest

Prompt and accurate recognition of cardiac arrest is essential to initiating timely bystander CPR, including dispatch-assisted CPR and the appropriate emergency medical service (EMS) response.³³ Most cardiac arrests are not recognised by bystanders and are first recognised by the dispatcher during the call to the dispatch centre, emphasising dispatchers' critical role in facilitating recognition as quickly as possible.¹³ A diagnostic systematic review by ILCOR published in 2021 included 47 studies and reported wide variability in dispatchers' ability to recognise OHCA (sensitivities and specificities for OHCA recognition varied from 0.46 to 0.98 and 0.32 to 1.00, respectively). It was not possible to identify any differences in diagnostic accuracy between criteria or algorithms.¹⁰

A more recent ILCOR scoping review assessed 62 studies and found the most pertinent challenge to dispatcher-assisted recognition of OHCA is establishing whether or not the patient is breathing normally.¹³ Several strategies were studied, but no strategy performed better than the commonly used 'two-questions' strategies (i.e., "Is the person conscious?" and "Are they breathing normally?"). Although several strategies were tested, there were no randomised controlled trials (RCT) comparing different strategies. One of the included RCTs tested the addition of an artificial intelligence (AI) model but did not find this intervention improved dispatcher-assisted recognition of OHCA.⁷⁶

In accordance with ILCOR, the ERC continues to recommend dispatchers follow a standardised algorithm and/or standardised criteria to quickly identify if a patient is in cardiac arrest at the time of emergency call.¹² Further detail addressing how dispatch processes can improve outcomes from cardiac arrest can be found in the ERC Guidelines 2025 Systems Save Lives.³⁴

Dispatcher CPR instructions

Dispatch-assisted CPR is recommended for a person in cardiac arrest³³ and is widely implemented.^{35,38} Compared with no CPR instructions, dispatch-assisted CPR is associated with improvements in survival to hospital discharge (OR 1.67, 95% CI 1.39 to 2.0) and survival to hospital discharge with favourable neurological outcome (OR 2.21, 95% 1.44 to 3.40).³⁹

A 2024 ILCOR scoping review was unable to identify sufficient high-certainty evidence to recommend specific interventions to optimise dispatch-assisted CPR.³³ However, dispatch-assisted CPR studies addressing the impact of simple language to deliver CPR instructions suggest a reduction in time to first compression^{40–42} and an increase in CPR quality.^{43,44} Modifying the statement "Do you want to do CPR" to "We need to do CPR" increased the number of cases where CPR was actually performed,⁴⁵ however instructions to "Put the phone down" found no difference in the quality of CPR.⁴⁶

Although there is currently insufficient evidence to support any specific approach to dispatcher-assisted CPR instructions, the ERC continues to recommend that dispatchers provide CPR instructions for all patients in cardiac arrest.

The use of video for dispatcher CPR instructions

Traditionally, dispatchers provide audio-only CPR instructions. Newly developed technology enables dispatchers to provide video CPR instructions through the caller's mobile phone. A recent scoping review and meta-analysis identified nine studies evaluating video instructions for simulated OHCA.³³ Compression fraction was

greater with video instructions,^{47–49} compression rates were higher with video-instructions,^{48–51} and there was a trend towards better hand-placement.⁴⁸ No difference was observed in compression depth or time to first ventilation, and there was a slight increase in the time it took to start CPR with video instructions. In a more recent retrospective study of adult OHCA, 1720 eligible OHCA patients (1489 and 231 in the audio and video groups, respectively) were evaluated. The median instruction time interval was similar (136 s in the audio group and 122 s in the video group); however, survival to discharge rates were 8.9 % in the audio group and 14.3 % in the video groups ($p < 0.001$). Good neurological outcome occurred in 5.8 % and 10.4 % in the audio and video groups, respectively ($p < 0.001$).⁵² RCTs testing the effect of live video streaming on outcomes are lacking^{1,3a}.

There is currently insufficient evidence to support the widespread implementation of video for dispatcher CPR instructions. The ERC recommends that where such technology is implemented that it should be in a highly controlled manner, and preferably as part of a formal research programme.

Dispatcher AED instructions

High survival rates have been observed following on-site AED use by bystanders, such as in casinos, airports, sports facilities and train stations.^{53–64} There is less evidence about dispatch instructions for AED retrieval and use, even though they are in widespread use.^{11,38} In a 2024 ILCOR scoping review there were no studies that addressed clinical outcomes attributable to dispatcher instructions for AED retrieval and use^{64a}. This review did not include studies of AED use by dispatched responders.⁴ In 2024, a before-and-after study reported that successful AED retrieval and pad placement following dispatcher instruction were associated with increased survival to hospital discharge and survival with favourable neurological outcome. AED shock delivery itself was not associated with any improvement in these clinical outcomes, either as a product of the few patients receiving a shock or because of unrecognised confounders.⁶⁵

There is limited evidence that volunteer responders—whether laypeople, first responders, or HCPs—who are alerted via mobile app or text message to bring an AED to the scene, improve survival. One RCT randomised 5989 lay volunteer responders dispatched through a text-message system and found bystander-initiated CPR was higher in the intervention group compared with the control group (62 % vs 48 %, $p < 0.001$).⁶⁶ One cluster-randomised stepped-wedge trial dispatched 5,735 volunteer responders to OHCA in private residences and found survival increased from 26 % to 39 % with improved neurologically favourable survival.⁶⁷ Several observational studies have found that activation of volunteer responders is associated with increased bystander CPR, bystander defibrillation, decreased time to defibrillation and improved survival.^{68–70} However, substantial heterogeneity in systems' structure and reporting, limits comparison between systems and transferability of results^{70a}. Furthermore, there is increasing interest in the use of drones to deliver AEDs to cardiac arrests. As these systems develop, it is reasonable for dispatchers to inform bystanders that additional help and/or an AED may be arriving on scene¹. In accordance with ILCOR, the ERC recommends that, after recognising cardiac arrest and starting CPR, dispatchers should ask if there is an AED on-scene. If there is not, and if there is more than one bystander on scene, dispatchers should offer instructions to locate and retrieve an AED, if one is available nearby.¹² The location and availability of AEDs should be

recorded in AED registries, and these registries should be integrated into dispatch systems to facilitate this.⁷¹

Use of technology to support dispatchers

The use of technology to support dispatchers is more completely addressed in the ERC Guidelines 2025 Systems Save Lives.³⁴ The overview below is included in the ERC Guidelines 2025 BLS to demonstrate how dispatchers might interact with technology during calls for cardiac arrest.

Closed-circuit television (CCTV)

A 2024 ILCOR scoping review identified two studies that explored how CCTV footage impacted dispatchers' understanding of the OHCA scene.¹³ One study suggested that a lack of situational awareness was a barrier to recognition and that live-stream video from the scene would improve the situational awareness.⁷² The second suggested that visual information from the scene would improve dispatcher understanding of the OHCA scene, which might, in turn, enhance communication, and improve dispatcher ability to coach bystanders and improve the quality of CPR.⁷³

Machine learning

A 2024 ILCOR scoping review identified six studies that explored how machine learning might improve recognition of cardiac arrest.¹³ Two of these studies assessed whether a machine-learning model could recognise OHCA using historical audio recordings of calls made to EMS.^{74,75} The first assessed how the machine learning model performed compared with dispatchers.⁷⁴ The machine learning model had higher sensitivity (72.5 % vs. 84.1 %, $p < 0.001$) but lower specificity (98.8 % versus 97.3 %, $p < 0.001$) and lower positive predictive value than dispatchers (20.9 % versus 33.0 %, $p < 0.001$). Time-to-recognition was shorter for the machine learning model compared with the dispatchers (median 44 s versus 54 s, $p < 0.001$).

The second study assessed the ability of a deep neural network model to detect OHCA through speech recognition.⁷⁵ The machine learning model recognised 36 % ($n = 305$) of the OHCA within 60 s with median time to recognition of 72 s (IQR, 40–132 s), whereas the dispatchers recognised 25 % ($n = 213$), median time to recognition was 94 s (IQR, 51–174 s). The machine learning model and dispatchers were equally effective at recognising OHCA at any time during the call. The machine learning model recognised 6 % ($n = 52$) of OHCA not identified by dispatchers, whereas dispatchers recognised 4 % ($n = 38$) of OHCA, not recognised by the machine learning model.

An RCT evaluated the impact of a machine learning cardiac arrest alert on dispatcher recognition of OHCA.⁷⁶ Dispatchers in one group were alerted when the machine learning model suspected an OHCA, while those in the other group followed normal protocols without a machine learning model alert. Dispatchers recognised 93.1 % of confirmed cardiac arrests in the alert group and 90.5 % of cardiac arrests in the no-alert group ($P = 0.15$). Cases with a machine-learning alert had a significantly higher sensitivity than cases without alerts for confirmed cardiac arrest (85.0 % vs. 77.5 %; $P < 0.001$) but lower specificity (97.4 % vs 99.6 %; $P < 0.001$) and lower positive predictive value (17.8 % vs. 55.8 %; $P < 0.001$). The study did not find a significant increase in dispatchers' ability to recognise cardiac arrest when using the machine learning algorithm. There is currently insufficient evidence that machine learning technologies improve patient outcomes. However, the

ERC recognises that this is a rapidly evolving area of research, and it may play a significant role in the future, as technology improves. The ERC recommends that where machine learning is embedded into dispatcher algorithms that it should be implemented in a highly controlled manner, and preferably as part of a formal research programme.

Smart devices to detect agonal breathing

ILCOR found only one proof-of-concept study using existing technology to detect agonal breathing.¹³ The study sought to determine if a smart speaker and mobile phone could be trained to recognise agonal breathing using calls recorded in the dispatch centre, compared with normal sleep sounds recorded in a sleep laboratory. The authors reported a sensitivity of 97.17 % (95 % CI: 96.79–97.55 %) specificity of 99.38 % (95 % CI: 99.20–99.56 %) and false positive rate of 0.22 %.⁷⁷ To date, there is no evidence that these technologies improve patient outcomes.¹³ There is currently insufficient evidence that using smart devices to detect agonal breathing improves patient outcomes. However, this technology may have a role to play if technology improves. The ERC recommends that use of smart devices to detect agonal breathing should only be implemented within a formal research programme.

Wearable devices

Wearable devices capable of detecting and monitoring a person's heart rhythm have been developed.⁷⁸ Some devices are able to detect abnormal and life-threatening heart arrhythmias or absence of a pulse, and automatically alert EMS. These technologies are currently being evaluated in experimental settings.⁷⁹ Recently, a commercially available smartwatch able to automatically detect pulselessness became available, bringing automated cardiac arrest detection outside the hospital for the first time.⁸⁰ Such devices can potentially reduce the interval from collapse to recognition of cardiac arrest and initiation of CPR and thus improve both care and outcomes in cardiac arrest, particularly among patients with unwitnessed cardiac arrest.⁸¹ However, there are currently no clinical studies showing the benefit of wearing these devices on clinical outcomes. Thus, there is currently no evidence to support the use of wearable devices to improve outcomes after cardiac arrest. The ERC recommends that use of wearable devices to detect life-threatening arrhythmias should only be implemented within a formal research programme.

High quality chest compressions

Chest compressions are a critical component of effective CPR, serving as the most accessible means of maintaining cerebral and organ perfusion during cardiac arrest. Their effectiveness depends on correct hand position and chest compression depth, rate, and degree of chest wall recoil. Pauses in chest compressions interrupt perfusion and must be avoided to minimise the risk of ischaemic injury.

Mechanical CPR falls outside the scope of BLS and is addressed in the ERC Guidelines 2025 Advanced Life Support.⁸²

Initiating CPR

The sequence for commencing CPR (compressions first versus breathing first) was updated by ILCOR in 2025.⁴ Five studies were

included.^{83–87} All of the studies were manikin studies, one of which employed a paediatric manikin.⁸⁷

Three adult manikin studies addressed time to first compression.^{83,85,86} A compression first approach resulted in shorter time to first compression. One adult manikin study addressed time to first ventilation.⁸⁵ A compression first approach resulted in a longer time to first ventilation. One adult manikin study addressed time to completion of first CPR cycle (30 chest compressions and 2 rescue breaths).⁸⁵ A compression first approach resulted in a shorter time to completion of first CPR cycle. One adult manikin study addressed the impact of compression first versus ventilation first approach on compression rate, compression depth and chest compression fraction.⁸³ This study found that choice of approach had no impact on chest compression rate, depth or chest compression fraction.

Following the ILCOR treatment recommendation, the ERC recommends a compression first approach.

Surface on which chest compression is performed

ILCOR updated the CoSTR for performing chest compressions on a firm surface in 2024.⁸⁸ When chest compression is performed on a soft surface (e.g. a mattress), both the chest wall and the underlying mattress are compressed.⁸⁹ This has the potential to reduce chest compression depth. However, effective compression depths can be achieved on a soft surface, providing the CPR provider increases overall compression depth to compensate for mattress compression.^{90–96} ILCOR identified 17 studies addressing the importance of a firm surface during CPR. The studies were analysed by categories – floor versus firm hospital mattress, backboard versus hospital mattress, floor versus home mattress and other surface types. No studies reporting clinical outcomes were identified.⁸⁸

Two manikin RCTs^{97,98} compared chest compressions delivered on a hospital bed versus on the floor. Seven manikin RCTs^{90,99–104} compared chest compressions with and without a backboard on a hospital mattress. Two manikin RCTs compared chest compressions delivered on a normal bed versus on the floor.^{105,106} There was no difference in chest compression depth on a hospital bed or normal bed versus on the floor.⁸⁸ There was a small improvement in chest compression depth when using a backboard.⁸⁸ Two further manikin RCTs compared chest compressions delivered on a sports mattress, with and without a backboard,¹⁰⁷ and in a dental chair.¹⁰⁸ Chest compressions were shallower on both sports matting and in the dental chair.^{107,108}

Consistent with ILCOR, the ERC suggests performing chest compressions on a firm surface. For the in-hospital setting, if a mattress has a 'CPR mode' to increase mattress stiffness, it should be activated when performing CPR. Moving a patient from the bed to the floor is not recommended as it delays time to first compressions and increases the risk of injury to the rescuer. The ERC does not advocate using a backboard.

Hand position during chest compressions

The evidence for optimal hand position was reviewed by ILCOR in 2025.⁴ Only three studies were identified, none of which included the critical outcomes of favourable neurological outcome, survival, or ROSC. All the identified studies reported physiological endpoints only.^{109–111} Imaging studies were excluded from the ILCOR

systematic review as they do not report clinical outcomes for patients in cardiac arrest. However, such studies may provide supporting evidence addressing optimal hand position for chest compressions. This evidence indicates that, in most adults and children, the maximal ventricular cross-sectional area underlies the lower third of the sternum/xiphisternal junction, while the ascending aorta and left ventricular outflow tract underlie the centre of the chest.^{110,112–117} However, there will be variation in anatomy between individuals dependent upon age, body mass index, congenital cardiac disease and pregnancy. Consequently, one specific hand placement strategy might not provide optimal compressions for all persons.^{113,116,118}

The 2025 ILCOR systematic review identified one crossover study in 17 adults with prolonged resuscitation from non-traumatic cardiac arrest that observed improved peak arterial pressure during compressions and higher end-tidal carbon dioxide when compressions were performed on the lower third of the sternum compared with the centre of the chest. Arterial pressure during compression recoil, peak right atrial pressure, and coronary perfusion pressure did not differ.¹⁰⁹ A second crossover study in 30 adults observed no association between end-tidal carbon dioxide values and hand placement.¹¹¹ The remaining crossover study in 10 children observed higher peak systolic pressure and higher mean arterial blood pressure when compressions were performed over the lower third of the sternum compared with the middle of the sternum.¹¹⁹

Consistent with the ILCOR recommendation,⁴ the ERC continues to recommend performing and teaching that chest compressions be delivered ‘in the centre of the chest’, whilst at the same time demonstrating this position is on the lower half of the sternum (Figs. 8f–8h).

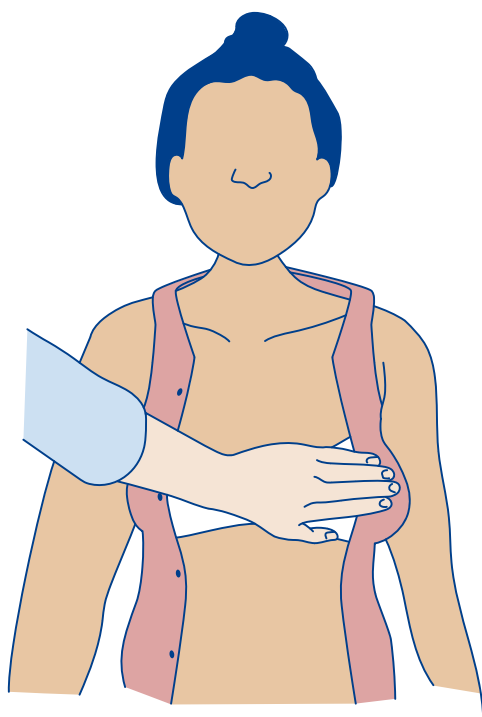


Fig. 8f – Hand in the centre of the chest.

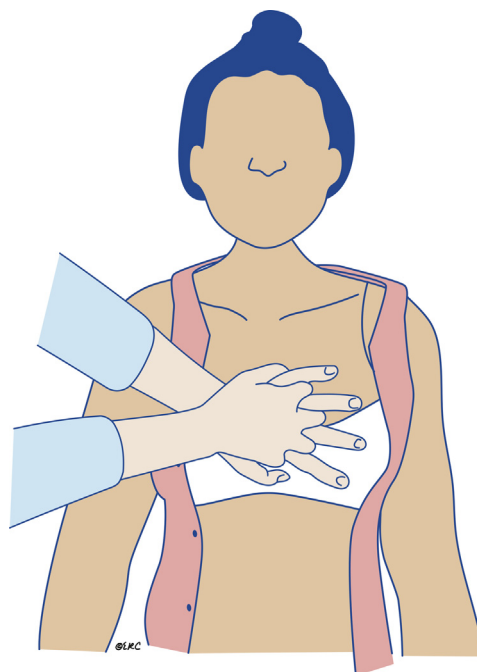


Fig. 8g – Both hands perform chest compressions.

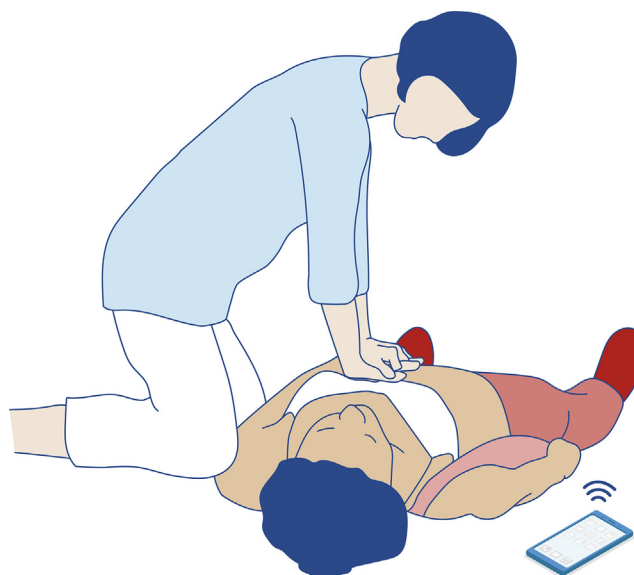


Fig. 8h – Arms straight, vertical above the victim.

Chest compression depth, rate and recoil

The ERC Guidelines 2025 BLS maintain the previous recommendations from 2021¹² and the previously published ILCOR scoping review.¹²⁰ This review included five observational studies that examined both chest compression rate and chest compression depth.^{121–125} One RCT,¹²⁶ one crossover trial,¹²⁷ and six observational studies^{123,128–132} examined chest compression rate only. One RCT¹³³ and six observational studies examined chest compression depth only,^{134–139} while two observational studies examined chest wall recoil.^{140,141} No studies were identified that examined different measures of leaning.

Consistent with ILCOR, the ERC continues to recommend a chest compression rate of 100 to 120 min⁻¹ and a compression depth of 5–6 cm (avoiding excessive chest compression depths greater than 6 cm), while avoiding leaning on the chest between compressions to allow full chest wall recoil.¹²

Consistent with ILCOR, the ERC continues to recommend a chest compression rate of 100 to 120 min⁻¹ and a compression depth of 5–6 cm (avoiding excessive chest compression depths greater than 6 cm), while avoiding leaning on the chest between compressions to allow full chest wall recoil.¹²

Minimising interruptions to chest compressions

Interruptions comprise pauses for rhythm analysis, charging the defibrillator, defibrillation, airway management, ventilation, pulse checks and any other unspecified interruption to chest compressions. The interval where chest compressions are not being performed is described as hands-off time. The chest compression fraction (CCF) is defined as the proportion of the CPR cycle devoted to compressions. Increasing hands-off time reduces the CCF. The evidence assessing the impact of interruptions to CPR was updated by ILCOR in 2025. One systematic review¹⁴² and six non-randomised studies^{143–148} were identified.⁴

A systematic review included eight studies indicating that feedback, both real-time and post-event, may be associated with a marginal improvement in CCF but was not associated with improved clinical outcomes.¹⁴² One RCT¹⁴⁹ and four observational studies^{150–153} suggested that real-time feedback did not improve CCF. Three observational studies suggested post-event feedback did lead to improved CCF (MD 7.11; 95 % CI, 5.85, 8.36) ($I^2 = 0\%$).¹⁴²

Six more recent observational studies suggested that interruptions had no impact on CCF,^{143,145,146} ROSC^{143,145,146} or survival to discharge.¹⁴⁶ Pre-charging the defibrillator while chest compressions were ongoing increased the CCF and may be associated with ROSC (adjusted OR 2.91; 95 %CI 1.09–7.8),¹⁴⁴ while placement of an advanced airway (tracheal tube or supraglottic airway) resulted in increased CCF (89.9 % vs 84.5 %) and ROSC (31.8 % vs 12.2 %).¹⁰⁸

ILCOR continues to recommend that pre- and post-shock pauses should be as short as possible. Furthermore, the CCF should be as high as possible, and at least 60 %.⁴ Consistent with the ILCOR recommendation, the ERC continues to recommend teaching that hands-off time should be minimised, and chest compression fraction should be maximised.

Compression-only CPR

The role of ventilation and oxygenation in the initial management of cardiac arrest remains debated. ILCOR last published a systematic review of continuous chest compressions (CCC) versus standard CPR in 2017.¹⁵⁴ ILCOR has since undertaken three different reviews addressing CCC by lay responders, EMS personnel and in-hospital clinicians.

A 2024 systematic review⁴ failed to identify any new studies addressing CCC by lay responders. The previous systematic review¹⁵⁴ included four relevant observational studies^{155–158} comparing CCC with CPR at a ratio of 15 compressions to two ventilations (15:2)^{155,156,158} or 30 compressions to two ventilations (30:2).¹⁵⁷ One of the identified studies reported an improvement in favourable neurological with CCC compared to 15:2.¹⁵⁸ In one adult

only study, survival to hospital discharge was higher for CCC than for 30:2.¹⁵⁷ However, in two all-age studies, one found there was no difference in ROSC or survival to discharge,¹⁵⁵ while the other reported no difference in survival to hospital admission or survival to 30 days,¹⁵⁶ when comparing CCC and 15:2.¹⁵⁶

A 2024 systematic review identified one RCT¹⁵⁹ and three cohort studies^{147,160,161} addressing CCC by EMS personnel.⁴ Two of the cohort studies^{147,161} were post-hoc/secondary analyses of previously published trials.^{159,162,163} The RCT failed to identify any difference in favourable neurological outcome, survival to hospital discharge or ROSC when comparing CCC and 30:2.¹⁵⁹

Secondary analysis of pooled trial data^{159,162,163} initially suggested CCC by EMS personnel may be associated with improved survival to hospital discharge.¹⁴⁷ However, when analysed by adherence to the intended treatment strategy, CCC were associated with a lower survival rate than 30:2.¹⁴⁷ The remaining observational study¹⁶⁰ failed to report favourable neurological outcome but concluded that minimally interrupted cardiac resuscitation was associated with improved survival to hospital discharge but found no difference in ROSC.

Similarly, a 2024 systematic review⁴ failed to identify any new studies addressing CCC in hospital. The previous systematic review¹⁵⁴ included a single observational study comparing continuous mechanical chest compressions (with asynchronous ventilation via a secure airway) and interrupted mechanical chest compressions (5 compressions to 1 ventilation via a secure airway), among patients admitted to the emergency department following OHCA.¹⁶⁴ Patients who received continuous mechanical CPR with asynchronous ventilation were more likely to achieve ROSC and more likely to survive to hospital discharge than patients who received interrupted mechanical chest compressions.¹⁶⁴

Finally, an ILCOR scoping review addressing continuous chest compressions and fatigue³ identified four manikin studies.^{165–168} One study¹⁶⁵ involved 84 lay persons comparing standard 30:2 CPR with CCC and reported no difference in the proportion of correct (rate and depth) compressions and no difference in the time to commencing chest compressions. They further reported a higher number of compressions with CCC and longer periods off the chest with 30:2. They also found no difference in the time to exhaustion or the level of exhaustion.¹⁶⁵ A larger study randomised 517 lay persons to different CPR protocols; 30 compressions:2 s pause (30c:2s), 50 compressions:5 s pause (50c:5s), 100 compressions:10 s pause (100c:10 s) and CCC. They reported a significant difference in the percentage of compressions with correct depth among the groups (30c2s, 96 %; 50c5s, 96 %; 100c10s, 92 %; CCC, 79 %; $p = 0.006$). They also reported a higher CCF in the CCC group and a greater frequency of pauses longer than 10 s in the 100c10s group.¹⁶⁷

A different study involving 124 HCPs randomised participants to perform CCC in one of two CPR positions – from the conventional position at the manikin's side or straddling the manikin.¹⁶⁶ They found no difference in compression rate, compression depth or fatigue (measured using participant blood pressure, heart rate and respiratory rate). However, the intervention period was only 4-min long.¹⁶⁶

Finally, one study recruited three male participants to perform CPR at altitude (3776 m) to assess the impact of performing CPR



Fig. 8i – If untrained or unable to do rescue breath, apply only chest compression.

in a low oxygen environment.¹⁶⁸ Physical exertion was measured using percutaneous arterial oxygen saturation and reported using the Borg scale, a subjective score of fatigue. Percutaneous oxygen saturations were reduced when performing CCC but not when performing 30:2 CPR. Self-reported fatigue was noted to be 'somewhat hard' or 'hard'.¹⁶⁸

The ERC supports the ILCOR recommendations that chest compressions are performed for all adults in cardiac arrest⁴. Where bystanders are trained, able, and willing to provide rescue breaths they should perform CPR with a ratio of 30 compressions to 2 ventilations. If they are not trained, able or willing they should deliver CCC. HCPs may perform either CPR with a ratio of 30 compressions to 2 ventilations, or CCC with asynchronous positive-pressure ventilations, until such time as the airway has been secured with a tracheal tube or supraglottic airway device. Once the airway has been secured, they should provide CCC with asynchronous ventilations (Fig. 8i).

CPR in patients living with obesity

The increasing prevalence of obesity worldwide and the challenges in providing CPR to this population prompted ILCOR to complete a scoping review in 2024.¹⁶⁹

Fifteen studies reported favourable neurological outcome data related to adults. Eight studies suggested obese patients had worse outcomes when compared with non-obese patients,^{170–177} six studies suggested there was no difference in favourable neurological outcome^{178–183} while one study suggested obese patients were more likely to have a favourable neurological outcome.¹⁸⁴

Twenty-two studies reported survival to hospital discharge data related to adults. Nine studies suggested obese patients had worse survival to discharge outcomes than non-obese patients,^{170–172,175,185–189} nine suggested there was no difference in survival to hospital discharge,^{178–181,190–194} while four studies suggested obese patients were more likely to survive to hospital discharge.^{195–198}

Six studies reported long-term survival data (months to years) related to adults. One study suggested obese patients had worse

outcomes than non-obese patients,¹⁷⁹ four suggested there was no difference in long-term survival^{170,182,183,199} while one study suggested obese patients were more likely to survive long-term.¹⁹⁵

Six studies reported ROSC data related to adults. Two studies suggested obese patients had lower rates of ROSC than non-obese patients,^{186,188} two suggested there was no difference in ROSC rates^{190,191} while one study suggested obese patients were more likely to achieve ROSC.¹⁹⁸ One study further reported a difference in outcomes dependent upon the underlying aetiology of cardiac arrest.²⁰⁰ In patients sustaining cardiac arrest of cardiac origin, ROSC was less likely in obese patients, whereas in cardiac arrest of non-cardiac aetiology, there was no difference in ROSC rates.²⁰⁰

The association between obesity and neurological outcomes, survival to hospital discharge, longer-term survival (months to years), and ROSC displayed considerable variation. Few studies reported resuscitation quality indicators, and no studies reported on adjustments to CPR techniques or provider outcomes. ILCOR and the ERC advise that standard CPR protocols should be used in obese patients.^{3a}

Head-up CPR

The updated ILCOR CoSTR for head-up CPR¹ found two new studies^{201,202} to supplement the single study²⁰³ identified in the former 2021 review. All three studies were undertaken by the same research group. The first study, a before-after study²⁰³ comprising 2322 adult OHCA, compared two CPR bundles. The first, an extended care bundle, comprising a pit-crew approach with rapid deployment of a mechanical CPR device, placing the patient in a head-up position ($\approx 20^\circ$), use of an impedance threshold device and deferring positive pressure ventilation for several minutes. The second bundle comprised mechanical CPR with an impedance threshold device alone. Following introduction of the extended care bundle, poorly described resuscitation rates increased and survival with favourable neurology was higher (17.9 % vs 34.2 %), however there was no difference in survival with favourable neurological outcome (actual numbers were not reported).²⁰³ The second study²⁰¹ compared outcomes for 227 patients resuscitated using the head-up CPR bundle with a propensity matched cohort of 860 supine patients drawn from three previous trials. Survival with favourable neurological outcome was higher in the head-up CPR group 5.9 % (13/222) versus 4.1 % (35/860); OR, 1.47 (95 %CI, 0.76–2.82).²⁰¹

The third study²⁰² compared outcomes for 353 non-shockable cardiac arrests resuscitated using the head-up CPR bundle with a propensity matched cohort of supine patients drawn from two previous trials. Survival with favourable neurological outcome was higher in the head-up CPR group 4.2 % (15/353) versus 1.1 % (4/353); OR, 3.87 (95 %CI, 1.27–11.78).²⁰²

Despite an apparent improvement in favourable neurological outcome associated with a head-up CPR bundle, there is currently insufficient evidence to indicate that routine use of head-up CPR, without the other elements of the described CPR bundle (mechanical CPR, impedance threshold device), is associated with improved outcomes. The head-up CPR bundle includes use of an automated head/thorax-up positioning device, a mechanical CPR device, an impedance threshold device and considerable investment in additional training. Consistent with ILCOR^{3a}, the ERC suggest against

routine use of head-up CPR in isolation, as we were unable to identify any evidence indicating head-up CPR, without a CPR bundle, leads to improved outcomes.

Use of CPR feedback devices

To improve CPR quality, key CPR metrics should be measured. CPR quality data can be presented to the rescuer in real-time and/or provided in a summary report at the end of a resuscitation. Three different types of feedback device were described, all for guiding chest compression: 1) digital audio-visual feedback including corrective audio prompts; 2) analogue audio and tactile 'clicker' feedback for chest compression depth and release; and 3) metronome guidance for chest compression rate.

The recent ILCOR CoSTR for feedback for CPR quality in real resuscitation³ comprised 60 manuscripts, 24 of which were published since 2020.²⁰⁴ Five themes were identified – system change/quality improvement, impact on patient outcomes, improved CPR quality without improved patient outcomes, CPR feedback as a generator of other CPR metrics and CPR feedback as a potential harm.²⁰⁴ Use of CPR feedback to improve system performance is addressed in the ERC Guidelines 2025 Systems Save Lives.³⁴ This section will address the impact of real-time CPR feedback devices on patient outcomes and CPR metrics.

Forty studies examined impact of real-time feedback on both chest compression quality and/or patient outcomes.^{125,127,133,139,142,145,149,153,205–236} Real-time feedback did not lead to improved ROSC,^{133,142,149,153,205,208,209,211,214–216,218–220,224,228,229,231,233,235} improved survival^{125,142,149,205,208,209,211,214–216,218,220,228,229,231,235} or survival with favourable neurological outcome.^{142,208,214,218,220,229}

Real-time feedback did improve chest compression quality. Six studies reported improved compliance with life support guideline recommendations,^{133,207,230,233,234,236} Two studies reported improved cardiac output.^{215,228} Multiple studies reported improved chest compression rate,^{125,139,142,145,153,205,208,213,214,216,219,223–227,231} chest compression depth,^{125,139,142,145,149,205,208,213,214,216,217,219,223–225,227} chest compression fraction,^{125,142,145,153,205,208,214,223–225} reduced hands-off time,^{139,209,225,227} reduced leaning,^{139,142,145,210,213,219,222,225} more appropriate ventilation rates,^{142,205,223,236} and increased EtCO₂.^{127,206,230,235,236} A single manuscript described cases where patients had died with visible damage to the chest wall caused by a feedback device.²³⁷

The ERC endorses the ILCOR recommendation against routine implementation of audiovisual feedback and prompt devices in isolation during chest compression, i.e. feedback devices are unlikely to improve clinical outcome for the patient directly in front of you.^{3a} Rather, feedback devices are best implemented as part of a comprehensive quality improvement programme after action, designed to elevate CPR quality across resuscitation systems (see ERC Guidelines 2025 Systems Saving Lives³⁴).

Rescue breaths

Ventilation during cardiac arrest is a critical aspect of cardiopulmonary resuscitation that influences outcomes.^{238,239} In the BLS context, ventilation may be provided by mouth-to-mouth, mouth-to-nose, mouth-to-stoma, mouth-to-mask or bag-valve-mask techniques. The ERC recommends that rescue breaths should have sufficient volume to cause the chest to rise visibly.²⁴⁰ Rescuers should aim for an inflation duration of about 1 s, with sufficient volume to make the chest begin to rise, but avoid rapid or forceful breaths. If

the rescuer is unable to make the chest rise, airway obstruction should be considered (see ERC Guidelines 2025 First Aid⁶). The maximum interruption in chest compression to deliver two breaths should not exceed 10 s.²⁴¹ These recommendations apply to all forms of ventilation during CPR when the airway is unsecured, including mouth-to-mouth and bag-valve-mask ventilation, with and without supplementary oxygen (Fig. 8j).

Ventilation feedback devices

There is a growing body of evidence to indicate that ventilation during resuscitation may not adhere to resuscitation guideline recommendations.^{242,243} Several real-time feedback devices have been developed to improve quality of ventilation during cardiac arrest. ILCOR undertook a scoping review to determine if there was sufficient evidence to recommend their implementation.²⁴⁴ Nineteen studies were identified, of which six were human studies^{218,245–248} and 13 were simulation studies.^{249–261}

Only two studies,^{218,245} one RCT²¹⁸ and two prospective observational studies,²⁴⁵ examined clinical outcomes with and without real-time feedback. The RCT reported improved higher rates of ROSC (55.5% versus 36.2%, $p=0.004$) with real-time feedback, but found no difference in survival with favourable neurological outcome (11.1% versus 10.3%, $p=0.77$).²¹⁸ The observational studies found no difference in either ROSC or survival to discharge; however, both reported improved ventilation parameters with real-time feedback.²⁴⁵ Most simulation studies suggested improved ventilation quality when real-time feedback devices were used. ILCOR have not made a recommendation or good practice statement. Based upon the ILCOR scoping review, it is the view of ERC that there is currently insufficient evidence to recommend routine use of ventilation feedback devices during CPR. The ERC also recognises that this is an evolving area of research, and it may play a role in the future, as technology improves. The ERC recommends that where ventilation feedback devices are implemented, it should only occur in a highly controlled manner, and preferably as part of a formal research programme.

Compression to ventilation ratios

ILCOR updated the CoSTR for chest compressions-to-ventilation ratios in 2025,⁴ and identified seven retrospective cohort studies,^{262–268} and one prospective study,²⁶⁹ examining the impact of the changes in 2005, from 15 compressions to 2 ventilations (15:2) to 30 compressions to 2 ventilations (30:2).²⁷⁰ Two cohort studies reported favourable neurological outcomes following the switch from

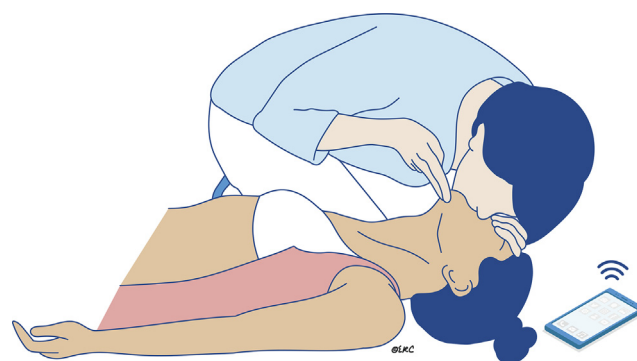


Fig. 8j – If trained and able provide rescue breaths with a compression-ventilation ratio of 30:2.

15:2 to 30:2.^{262,269} One study comprising 3960 non-shockable cases reported improved neurologically favourable survival at hospital discharge with 30:2 compared to 15:2.²⁶² However, a different cohort study comprising 522 shockable cases reported no difference in neurologically favourable survival (CPC score 1–2).²⁶⁹

Six cohort studies reported on survival to hospital discharge or 30-day survival.^{263–266} Three studies^{262,265,266} reported that 30:2 improved survival, whereas two studies found no difference in the odds of survival.^{264,268} An analysis of 200 bystander witnessed cardiac arrests with shockable rhythms reported an improvement in survival to hospital discharge with a compressions-to-ventilation ratio of 50:2 compared to 5:1.²⁶³ Consistent with ILCOR^{3a}, the ERC recommends a compression–ventilation ratio of 30:2 in adult patients in cardiac arrest.

Passive ventilation

Passive ventilation describes gas exchange secondary to recoil of the chest and lungs occurring during chest compressions. It has been suggested that passive ventilation may produce tidal volumes sufficient to provide adequate gas exchange during cardiac arrest.²⁷¹ ILCOR updated their 2022 systematic review in 2025 and did not identify any new studies.⁴

Three RCTs,^{272–274} one of which was a very small pilot study,²⁷⁴ and one observational study²⁷⁵ were identified. Meta-analysis of two of the RCTs^{272,273} suggested passive ventilation did not improve ROSC or survival to ICU discharge.² Based on the ILCOR review,^{3a} the ERC advises against the routine use of passive ventilation techniques during conventional CPR.

Using an automated external defibrillator (AED)

An automated external defibrillator (AED) is a portable, battery-powered device that includes adhesive defibrillation pads to attach to a patient's chest to detect the heart rhythm following suspected cardiac arrest. AEDs are accurate in their interpretation of the heart rhythm and are safe and effective when used by laypeople.²⁷⁶ If the rhythm is a shockable rhythm (ventricular fibrillation or pulseless ventricular tachycardia), an audible (and sometimes visual) prompt is given to the operator to deliver a direct current electric shock (defibrillation) to re-establish a coordinated heart rhythm.²⁷⁷

Among patients in a shockable rhythm, each minute delay to defibrillation is associated with 6 % higher probability of failure to terminate VF, and 3–6 % lower probability of survival to discharge.^{278–280} For other heart rhythms (including asystole and a normal rhythm), no shock is advised.

The probability of survival after OHCA can be markedly increased if patients receive immediate CPR and an AED is used.²⁸¹ AEDs make it possible for laypeople to attempt defibrillation following cardiac arrest many minutes before professional help arrives.²⁸¹ The highest survival rates following lay rescuer resuscitation have been reported after use of on-site AEDs such as at airports, casinos, sports facilities or train stations.^{55,282–285} A recent update of the 2020 systematic review by ILCOR identified one ILCOR scientific statement,²⁸⁶ one systematic review²⁸⁷ and four observational studies.^{288–290} The systematic review included 30 studies and reported that bystander CPR with use of an AED increased survival.²⁸⁷ One observational study reported improvement in favourable neurological outcome²⁹¹ while another suggested no difference in favourable neurological outcome.²⁸⁸ Similarly, one observational study reported improvement in ROSC²⁸⁹ while another suggested no difference in

favourable neurological outcome.²⁸⁸ The fourth study reported that annual rates of cardiac death reduced following implementation of a public access defibrillation (PAD) programme for patients under 65 years of age, but not for patients aged 65 or over.²⁹⁰ Based on the ILCOR CoSTR,³ the ERC recommends the implementation of public access defibrillation programmes, and recommends that public-access AEDs should be available for use 24 h a day, 7 days a week, be stored in locations easily accessible to the general public and in unlocked cabinets.

This section addresses defibrillation in the BLS context. More advanced concepts including synchronised cardioversion, vector change and dual sequence defibrillation can be found in the ERC Guidelines 2025 Adult Advanced Life Support.⁸² Wider systems considerations for the placement and deployment of Automated External Defibrillators are addressed in the ERC Guidelines 2025 Systems Save Lives.³⁴

Ultra-portable AEDs

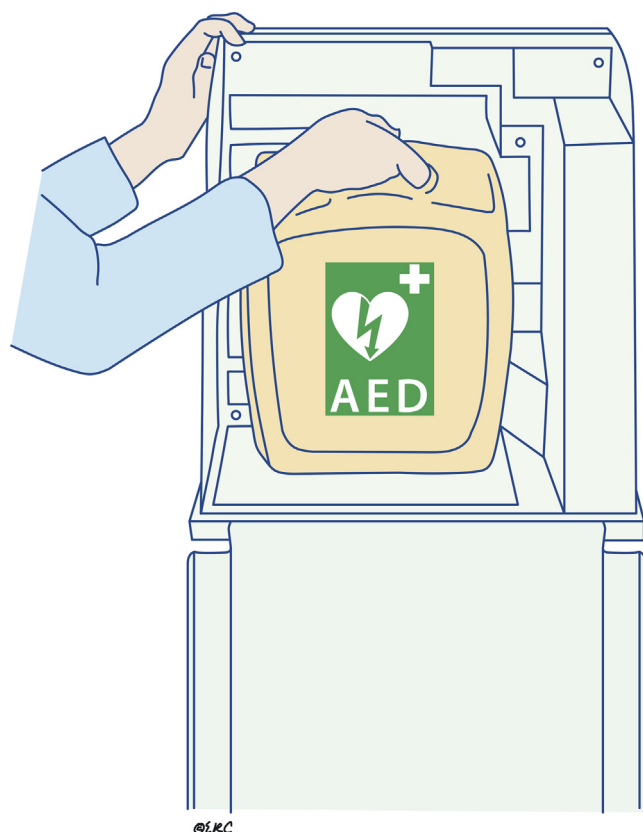
Several manufacturers have developed ultraportable or pocket AEDs for personal use or equipping community volunteer responders. This presents an opportunity to increase AED availability and consequently patient outcomes. However, these devices may be limited in the number and the energy of shocks they can deliver (e.g. restricted to up to 20 shocks and a maximum of 85 J). Although these devices may have been approved as safe to use, this does not provide evidence of device performance in real-world settings. Consequently ILCOR has reviewed the evidence of efficacy to inform implementation decisions.²⁹² The review identified three studies.^{293–295} One was an economic modelling suggesting ultraportable AEDs would reduce the annual risk of cardiac death and improve quality of life measures.²⁹³ One was a study protocol for a cluster RCT,²⁹⁴ while the third was an abstract publication describing preliminary data from the cluster RCT.²⁹⁵ There is currently insufficient clinical evidence to indicate ultraportable AEDs improve patient outcomes.³ The ERC is currently unable to recommend their adoption until high-certainty clinical data demonstrate improved patient outcomes with their use.

How to find an AED

All public access AEDs should be registered with the local emergency service. Such registries enable the dispatcher to identify the nearest available AED at the time of the emergency call.^{296–301} If more than one bystander is present at a cardiac arrest, the dispatcher is able to guide a bystander to locate and retrieve an AED. Prompting the bystander making the emergency call specifically about public-access AEDs on-site (i.e. immediately visible from the location at which the patient has collapsed) is another way in which an available AED can be retrieved and used for a patient. If the public-access AED is immediately adjacent to the patient, and time away from the patient can be minimised, it may be appropriate even for a lone rescuer to retrieve the device. The ERC recommends that local emergency services should maintain an accurate registry of AED locations.

Geolocation applications

Global positioning systems (GPS) in smartphones have enabled numerous apps to locate the user and display the location and availability of nearby AEDs.^{300–303} They often allow the user to add details about new AEDs and to provide data about missing or mal-



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Fig. 8k – Send for AED.

functioning AEDs. These apps can complement existing registries.^{300,301} The apps may be capable of providing walking directions to the AED and can be integrated with dispatch systems so that dispatchers can send a push notification to a mobile phone (or other smart device e.g. smartwatch) during an emergency to help guide a bystander to the nearest AED.^{300,303} The role of mobile phone technology as a tool to locate AEDs is described in more detail in the ERC Guidelines 2025 Systems Saving Lives.³⁴

AED signage (Fig. 8k)

Although several different AED signs are available, understanding of these signs' meaning is often lacking.^{304–306} Newer signs have been developed following public consultation,^{306,307} but evidence addressing how signs increase AED deployment is lacking. Furthermore, many AEDs have no signage at their location, or signs in the vicinity that could guide bystanders to its location.³⁰⁸ The ERC and ILCOR recommend that AED locations should be highly visible and easy to locate.^{3a} This includes clear signage at its location that is visible from a distance as well as signs in the vicinity of the AED that clearly direct bystanders toward its location. Signs should indicate what the AED is for, and that anyone can use the AED, even if they have not had previous training.

AED cabinets

Concerns about theft or vandalism have led to security measures, such as using locked cabinets, to house AEDs in public locations. Since each minute of delay in attempting defibrillation critically decreases the chance of survival, the additional time needed to access an AED in a locked cabinet may negatively impact patient

survival.³⁰⁹ A 2025 ILCOR scoping review assessed the benefits and harms of placing AEDs in locked cabinets versus unlocked cabinets.^{309a} There was limited evidence because only 10 studies were identified, some of which were simulation studies or conference abstracts.^{310–318} Taken together, a low risk of theft, missing AEDs or vandalism was reported (<2%). Furthermore, two simulation studies identified significantly slower AED retrieval when additional security measures, such as locked cabinets, were used.³¹⁰ A survey of first responders further reported that half of all injuries sustained while accessing an AED were incurred when attempting to break glass to access the AED.³¹⁹ Consistent with ILCOR, the ERC recommends that AED cabinets are not locked. If locks are necessary, unlocking instructions must be clear to prevent delays. Responsible systems should establish strategies for retrieving used public-access defibrillators.

Use of drones to deliver AEDs

Drones or unmanned aerial vehicles have the potential to speed up the delivery of an AED, especially for areas with longer response times. Evidence underpinning drone deployment of AEDs is currently lacking but real-world studies demonstrate feasibility of drone AED delivery, with a time advantage of 1–3min over ambulances observed in approximately 60% of cases. Mathematical modelling can be used to optimise the location of drones to improve the emergency response in OHCA. ILCOR performed a scoping review in 2023³ and an evidence update in 2024⁴ to investigate the feasibility and impact of drone delivered AEDs for OHCA response.^{319a} A total of 39 studies were included. Most of the studies were simulation studies or computer/prediction models. Only three studies reported drone AED delivery to real OHCA.^{320–322} There were no RCTs investigating drone AED delivery. The ERC recommends that where drone delivery of AEDs is possible, dispatchers should advise bystanders that a drone has been tasked to deliver an AED and provide basic instructions on retrieving the AED from the drone.

How and when to use an AED

An AED should only be attached to a person who is unresponsive with abnormal breathing. CPR should not be delayed whilst locating and retrieving an AED, but as soon as an AED has been brought to the patient's side, it should be attached to the patient.³ If more than one bystander is present, one should continue CPR whilst the other attaches the defibrillation pads. Some devices will power on auto-



Fig. 8l – When AED arrives, continue chest compressions, while placing defibrillation pads.

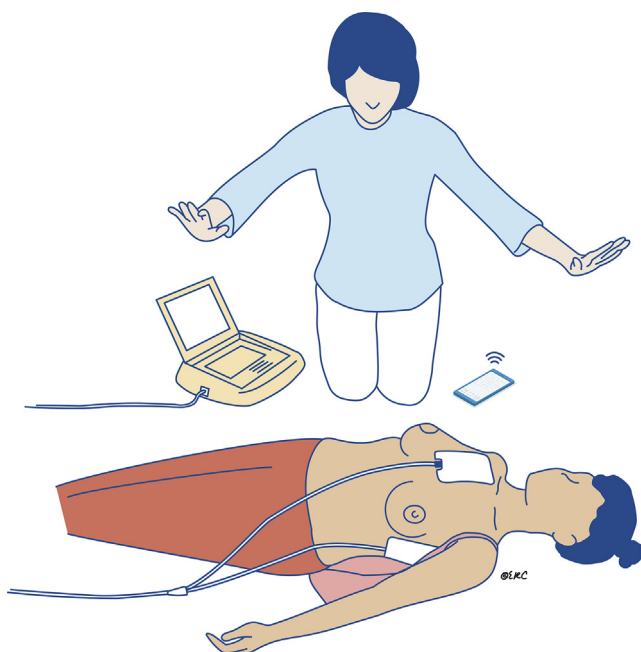


Fig. 8m – Follow the directions of the AED.

matically once their carrier/ case has been opened, whereas others may require the user to press a power on button. Most AEDs have voice $\pm$ visual prompts about where to locate the adhesive pads. Once the defibrillation pads are connected, no-one should touch the patient whilst the AED performs rhythm analysis. If the AED advises a shock, it will either give that shock itself (fully automatic AEDs) or prompt the user to press a shock button (semi-automatic AEDs). Some AEDs also provide guidance and feedback on quality chest compressions (Figs. 8l–8o).



Fig. 8n – If shock is indicated, deliver shock and continue chest compressions.

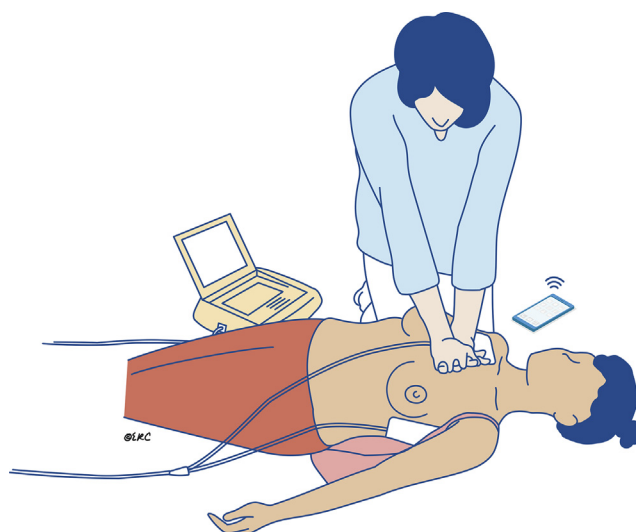


Fig. 8o – If a shock is not indicated, continue chest compressions.

Should chest compressions be performed before defibrillation? ILCOR has updated the 2020 CoSTR¹¹ addressing when to perform defibrillation twice since the last guidelines however no new studies have been identified.^{2,3} A 2020 systematic review by ILCOR¹ identified five RCTs^{323–327} comparing a shorter with a longer interval of chest compressions before defibrillation.¹ No clear benefit from additional CPR before defibrillation was found. Four studies reported no significant difference in favourable neurological outcome in patients who received a shorter period of CPR before defibrillation compared with a longer period of CPR.^{323,324,326,327} Five studies reported no significant difference in survival to hospital discharge in patients who received a shorter period of CPR before defibrillation compared with a longer period of CPR.^{324–327} Consistent with ILCOR, the ERC recommends CPR be provided until an AED arrives on site, is switched on and defibrillation pads are attached to the patient. Once the defibrillation pads are attached, the AED will analyse and, if indicated, a shock should be delivered without delay. Defibrillation should not be delayed to provide additional CPR.

Positioning of defibrillation pads

ILCOR undertook a systematic review addressing AED pad size and placement in 2024.⁴ Two observational studies^{328,329} and one RCT³³⁰ were identified. No studies addressed the impact of different pad sizes on ROSC, survival or favourable neurological outcome. One observational study reported no difference in defibrillation success when using large defibrillation pads.³²⁸

One prospective study³²⁹ found no significant difference in favourable neurological outcome, survival to hospital discharge or defibrillation success with initial anterior-posterior pad placement compared with initial anterior-lateral placement. However, anterior-posterior pad placement was associated with higher ROSC rates after adjusting for known predictors. The RCT³³⁰ addressed pad placement for refractory ventricular fibrillation, which is beyond BLS, and further information can be found in the ERC Guidelines 2025 Adult Advanced Life Support.⁸²

There is currently insufficient evidence to recommend a specific pad size or position for optimal external defibrillation in adults. ILCOR has issued a good practice statement that recommends following the manufacturer's AED guidance and instructions for adult pad placement⁴. The ERC endorses this recommendation.

For most manufacturers this will mean placing defibrillation pads on the front of the persons chest and their left side (the anterior-lateral position). One defibrillation pad should be positioned below the patient's right clavicle, just to the right of the upper sternal border. The other defibrillation pad should be centred on the patient's left mid-axillary line, below the armpit. Pad placement should avoid breast tissue if possible. This approach requires less manual handling so lowers the risk of manual handling injury to the rescuer, minimises the time needed to place defibrillation pads and therefore minimises interruptions to chest compressions.

For most manufacturers this will mean placing defibrillation pads on the front of the persons chest and their left side (the anterior-lateral position). One defibrillation pad should be positioned below the patient's right clavicle, just to the right of the upper sternal border. The other defibrillation pad should be centred on the patient's left mid-axillary line, below the armpit. Pad placement should avoid breast tissue if possible. This approach requires less manual handling so lowers the risk of manual handling injury to the rescuer, minimises the time needed to place defibrillation pads and therefore minimises interruptions to chest compressions.

The other possible position entails placing the defibrillation pads on the persons chest and back (the anterior-posterior position). Place the anterior defibrillation pad on the left side of the chest, between the midline and the nipple. For female patients, try to avoid as much breast tissue as much as possible. The posterior defibrillation pad should be placed on the left side of the patient's spine, just below the scapula. This approach requires more manual handling than the anterior-lateral position. If the anterior-lateral pad position is not feasible, then the rescuer can consider using the anterior-posterior pad position if trained (Fig. 6).

Removing a bra prior to defibrillation

Evidence indicates females in cardiac arrest are less likely to receive cardiopulmonary resuscitation and defibrillation from bystanders.^{331–333} This may stem from apprehension about exposing and touching a woman's chest and fears of being accused of sexual assault.³³⁴ To assess the impact of wearing a bra on defibrillation, ILCOR undertook a systematic review that identified two manikin studies^{335,336} and one animal study.^{337,338} The animal study suggested that a metal wire inside a bra did not adversely impact the defibrillation attempt nor cause any injury to the patient or rescuer.³³⁷ The manikin studies suggested female manikins were less likely to be exposed or disrobed,³³⁵ and time to defibrillation was longer with female manikins.³³⁶ No studies addressing ROSC, survival or favourable neurologic outcome were identified.^{338a}

AED adhesive pads should be placed onto bare skin. In people wearing bras, there is little evidence addressing whether the bra needs to be unfastened or cut-off, and no evidence that an underwire in a bra causes harm. ILCOR advises that there is insufficient evidence to guide the routine unfastening or cutting of a bra. Defibrillation pads must be placed on bare skin in the correct position, which may be possible by adjusting the position of the bra, rather than by unfastening or cutting it.

The ERC recommends that rescuers prioritise placing defibrillation pads in the correct location, and in contact with bare skin. If this

can be quickly accomplished without unfastening or cutting the bra then, it is acceptable to leave the bra in place. However, if the bra interferes with correctly locating the defibrillation pads, then the bra should be displaced to facilitate correct defibrillation pad application. Rescuers should not be concerned about exposing the persons chest to apply defibrillation pads. They should prioritise life-saving interventions over concerns for modesty.

The ERC further recommends that manufacturers of manikins should develop realistic manikins that reflect different body sizes and shapes. CPR training should incorporate pad placement in people wearing bras.

Where to place an AED in public

Evidence pertaining to geographical placement of AEDs can be found in the ERC Guidelines 2025 Systems Save Lives. The ERC recommends data informed AED placement considering historical OHCA rate, EMS response times and location of current AEDs.

Safety

Personal protective equipment (PPE)

The use of personal protective equipment during resuscitation plays an important role in protecting rescuers from potential exposure to infectious agents ILCOR completed a systematic review in 2023 including 17 simulation studies and 1 clinical study, concluding PPE was not associated with lower quality CPR or reduced survival.^{338a} A meta-analysis of six simulation-based randomised studies found no meaningful impact of personal protective equipment on the depth or rate of chest compressions in adult CPR. This was also the case in studies carried out during the COVID-19 pandemic, when personal protective equipment was widely used. However, rescuers wearing personal protective equipment reported feeling more fatigued. While personal protective equipment should be used when available—especially in settings with known or suspected infection risk—its use should not lead to unnecessary delays in starting chest compressions. The ERC recommends that regular training to facilitate timely donning and doffing of personal protective equipment is required, so that protection and prompt action can go hand in hand.³³⁹

Harm to people providing CPR

ILCOR performed a scoping review related to harm to people providing CPR and very few reports of harm from performing CPR and defibrillation were identified. Five experimental studies and one case report published since 2008 were reviewed. The five experimental studies reported perceptions in experimental settings during shock administration for elective cardioversion. The authors measured current flow and the average leakage current in different experiments to assess rescuer safety. Despite limited evidence evaluating safety ILCOR and ERC support the interpretation that the use of an AED is generally safe.^{11,270} The ERC consistent with ILCOR, recommend that rescuers perform chest compressions and use an AED as the risk of damage from accidental shock during AED use is low.

Unintentional injury from CPR to patients not in cardiac arrest

Lay people may be reluctant to perform CPR on an unresponsive person who is not breathing normally due to concern that performing chest compressions on a person who is not in cardiac arrest could cause serious harm. However, there is little evidence that CPR performed on a person not in cardiac arrest causes significant harm.

There is however significant concern that delays to CPR results in worse patient outcomes.³⁰⁹ The potential survival benefits of CPR initiated by lay persons for patients in cardiac arrest far outweigh the low risk of injury in patients not in cardiac arrest.

ILCOR recommends that lay persons, trained bystanders and first responders initiate CPR for presumed cardiac arrest without concerns of harm to patients not in cardiac arrest (good practice statement). The ERC guideline recommendations are consistent with the ILCOR treatment recommendations.

Safety of AEDs

Errors in AED use most commonly occur because of problems with how the operator interacts with the AED, rather than faults in or malfunction of the device itself, and include continuing CPR during rhythm analysis, not delivering a shock when instructed and premature removal of the AED.³⁴⁰

Simulation studies suggest that fully automatic AEDs increase safety, reduce error and shorten time to defibrillation compared to semi-automatic AEDs.^{341,342} The ERC recommends the use of AEDs as they are safe to use and present a low risk of injury to rescuers.

Declaration of competing interest

Declarations of competing interests for all ERC Guidelines authors are displayed in a COI table which can be found online at <https://doi.org/10.1016/j.resuscitation.2025.110771>.

Collaborators

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