RESUSCITATION 215 (2025) 110808

Available online at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Basic Life Support: 2025 International Liaison Committee on Resuscitation Consensus on Science With Treatment Recommendations

*Janet E. Bray Chair**, *Michael A. Smyth Vice Chair, Gavin D. Perkins, Rebecca E. Cash, Sung Phil Chung, Julie Considine, Katie N. Dainty, Vihara Dassanayake, Guillaume Debaty, Maya Dewan, Bridget Dicker, Natasha Dodge, Fredrik Folke, Takanari Ikeyama, Carolina Malta Hansen, Nicholas J. Johnson, George Lukas, Anthony Lagina, Siobhan Masterson, Peter T. Morley, Laurie J. Morrison, Ziad Nehme, Tatsuya Norii, Violetta Raffay, Giuseppe Ristagno, Aloka Samantaray, Federico Semeraro, Baljit Singh, Christopher M. Smith, Christian Vaillancourt, Katherine M. Berg Senior Editor, Theresa M. Olasveengen, on behalf of the Basic Life Support Task Force Collaborators*

Abstract
The International Liaison Committee on Resuscitation conducts continuous review of new, peer-reviewed published cardiopulmonary resuscitation science, and publishes more comprehensive reviews every 5 years. The Basic Life Support Task Force chapter of the *2025 International Liaison Committee on Resuscitation Consensus on Science With Treatment Recommendations* addressed all published resuscitation evidence reviewed by the Basic Life Support Task Force science experts since 2020. Topics addressed by systematic reviews in the last year include chest compression–only cardiopulmonary resuscitation, starting cardiopulmonary resuscitation with compressions or airway and breathing, chest compression and ventilation ratios, durations of cardiopulmonary resuscitation cycles, hand positioning during compressions, head-up cardiopulmonary resuscitation, ventilation feedback devices, and pad and paddle size and placement. Members from the Basic Life Support Task Force have assessed, discussed, and debated the quality of the evidence, based on Grading of Recommendations Assessment, Development, and Evaluation criteria, and their statements include consensus treatment recommendations. Insights into the deliberations of the task force are provided in the Justification and Evidence-to-Decision Framework Highlights sections. In addition, the task force lists priority knowledge gaps for further research.
Keywords: ILCOR, cardiopulmonary resuscitation, defibrillators, drowning, heart arrest, obesity

INTRODUCTION

This is the *2025 International Liaison Committee on Resuscitation* (ILCOR) *Consensus on Science With Treatment Recommendations* (CoSTR), from the ILCOR Basic Life Support (BLS) Task Force. All reviews conducted by the BLS Task Force in the last 12 months are included; reviews conducted and published since the 2020 publication are also summarized to provide a single reference document for readers. The BLS Task Force work presented here encompasses 33 questions reviewed in some capacity, including 22 systematic reviews (SysRevs). Draft CoSTRs for all topics evaluated with SysRevs were posted on a rolling basis on the ILCOR website.[1] Each draft CoSTR includes the data reviewed and draft treatment recommendations, with public comments accepted for 2 weeks after posting. The task force considered public feedback and provided responses. All CoSTRs are now available online, adding to the existing CoSTR statements.

Although only SysRevs can generate a full CoSTR and new treatment recommendations, many other topics were evaluated with more streamlined processes, including scoping reviews (ScopRevs) and evidence updates (EvUps). Good practice statements, which

* Corresponding author.
E-mail address: janet.bray@monash.edu (J.E. Bray).
https://doi.org/10.1016/j.resuscitation.2025.110808

represent the expert opinion of the task force in light of very limited or no direct evidence, can be generated after ScopRevs and occasionally after EvUps in cases where the task force thinks providing guidance is especially important. A separate article in this issue includes the full details of the evidence evaluation process.[2]

This summary statement contains the final wording of the treatment recommendations and good practice statements as approved by the ILCOR BLS Task Force as well as summaries of the key evidence identified. The year that treatment recommendations or good practice statements were generated or last updated by a SysRev is provided in parentheses. In cases where existing treatment recommendations have changed for 2025, the prior recommendations are also presented so the reader can easily see what has changed. SysRevs include evidence-to-decision highlights and knowledge gaps, and ScopRevs summarize Task Force insights on specific topics and include evidence-to-decision highlights if good practice statements are generated. Links to the published reviews and full online CoSTRs are provided in the corresponding sections. Evidence-to-decision tables for SysRevs are provided in Appendix A, and the complete EvUp worksheets are provided in Appendix B. A summary of treatment recommendation changes and knowledge gaps is provided in Appendix C.

Most topics are presented using the population, intervention, comparator, outcomes, study design, and time frame format. To minimize redundancy, the study designs have been removed from the text except in cases where the designs differed from the BLS standard criteria. The standard study designs included are randomized clinical trials (RCTs) and nonrandomized studies (non-RCTs, interrupted time series, controlled before-and-after studies, and cohort studies) were eligible for inclusion. Case series, case reports, animal studies, and unpublished studies (conference abstracts, trial protocols) were excluded. All languages were included, provided there was an English abstract.

Two nodal reviews that included the BLS Task Force can be found in other CoSTR sections (Family Presence During Resuscitation[3] in Education, Implementation, and Teams and Resuscitation of Durable Mechanical Circulatory Supported Patients[4] in Advanced Life Support). The following topics are addressed in this BLS Task Force CoSTR:

- Cardiopulmonary resuscitation (CPR) by rescuers wearing personal protective equipment (BLS 2003: SysRev 2023, EvUp 2025)
- Bystander (without dispatcher-assisted instructions) chest compression–only CPR versus conventional CPR (BLS 2100: SysRev 2025)
- Optimization of dispatcher-assisted recognition of out-of-hospital cardiac arrest (OHCA) (BLS 2102: ScopRev 2024, EvUp 2025)
- Optimization of dispatcher-assisted CPR (BLS 2113: ScopRev 2024, EvUp 2025)
- Dispatcher-assisted chest compression–only CPR versus conventional CPR (BLS 2112: SysRev 2025)
- Optimization of dispatcher-assisted automated external defibrillator (AED) retrieval and use (BLS 2120: ScopRev 2024)
- Drone AED delivery (BLS 2122: ScopRev, 2023 CoSTR summary; EvUp 2025)
- AED accessibility: locked cabinets (BLS 2123: ScopRev 2025)
- Starting CPR (compressions-airway-breathing [CAB] versus airway-breathing-compressions [ABC]) (BLS 2201: SysRev 2025)
- Compression-ventilation ratio (BLS 2202: SysRev 2025)
- Duration of CPR cycles (BLS 2212: SysRev 2025)
- Emergency medical services (EMS) continuous– chest compression CPR versus conventional CPR (BLS 2221: SysRev 2025)
- In-hospital continuous–chest compression CPR versus conventional CPR (BLS 2222: SysRev 2025)
- Hand position during compressions (BLS 2502: SysRev 2025)
- Head-up CPR (BLS 2503: SysRev 2025)
- Minimizing pauses in compressions (BLS 2504: SysRev 2022, EvUp 2025)
- Optimal surface for CPR (BLS 2510: SysRev 2024)
- Feedback for CPR quality (BLS 2511: ScopRev 2024)
- Passive ventilation techniques (BLS 2403: SysRev 2022, EvUp 2025)
- Real-time ventilation quality feedback devices (BLS 2402: ScopRev 2025)
- Paddle/pad size and placement in adults (BLS 2601: SysRev 2025)
- Removal of bra prior to defibrillation (BLS 2604: ScopRev 2025)
- Effectiveness of ultraportable/pocket AEDs (BLS 2603: ScopRev 2024)
- Immediate resuscitation in water or on boat in drowning (BLS 2702/2703: ScopRev 2021, SysRev 2023, EvUp 2025)
- Starting CPR (CAB versus ABC) in drowning (BLS 2704: ScopRev 2023, SysRev 2024, EvUp 2025)
- Chest compression–only CPR in drowning (BLS 2705: ScopRev 2023, SysRev 2023, EvUp 2025)
- Ventilation equipment in cardiac arrest following drowning (BLS 2706: ScopRev 2023, SysRev 2023, EvUp 2025)
- Prehospital oxygen administration following drowning (BLS 2707: SysRev 2023, EvUp 2025)
- AED use versus CPR first in drowning (BLS 2708: ScopRev 2023, SysRev 2023, EvUp 2025)
- Public access defibrillation (PAD) programs for drowning (BLS 2709: SysRev 2023, EvUp 2025)
- CPR during transport (BLS 2715: SysRev 2022, EvUp 2025)
- CPR in obese patients (BLS 2720: ScopRev 2025)

Readers are encouraged to monitor the ILCOR website[1] to provide feedback on planned SysRevs and to provide comments when additional draft reviews are posted.

SAFETY AND PREVENTION

CPR by Rescuers Wearing Personal Protective Equipment (BLS 2003: SysRev 2023, EvUp 2025)

A 2023 SysRev and 2025 EvUp examined the impact of rescuers wearing personal protective equipment on patient and CPR outcomes. The details of this review can be found in the SysRev,[5] the 2023 CoSTR summary[6,7] and on the ILCOR website.[8] The 2025 EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in any setting (in-hospital or out-of-hospital) with cardiac arrest (including simulated cardiac arrest)
- Intervention: CPR by rescuers wearing personal protective equipment
- Comparator: CPR by rescuers not wearing personal protective equipment
- Outcomes:
  - Critical: Survival to discharge, return of spontaneous circulation (ROSC)

– Important: CPR quality, time to the procedure of interest, and rescuer's fatigue and neuropsychiatric performance such as concentration and dexterity
- Time frame: May 23, 2022, to August 9, 2024

Summary of Evidence

The EvUp identified 4 additional studies.[9–12] Because the new evidence does not alter the current treatment recommendations, an update to the existing SysRev is not warranted.

Treatment Recommendations (2023)

We recommend monitoring for fatigue in all rescuers performing CPR (good practice statement).

We suggest increased vigilance for fatigue in rescuers wearing personal protective equipment (weak recommendation, very low–certainty evidence).

RECOGNITION AND EARLY ACCESS

Bystander Chest Compression–Only CPR (Without Dispatcher Assistance) (BLS 2100, SysRev 2025)

Rationale for Review

The previous SysRev[13] and existing ILCOR treatment recommendation were first published in 2017.[14,15] This topic was prioritized because it had not been reviewed since 2017. The SysRev was registered on Prospective Register of Systematic Reviews (PROSPERO) (CRD42024559318), and the full CoSTR for adults can be found on the ILCOR website.[17] To inform the provision of immediate bystander CPR, it was decided to examine this question without cases where dispatcher-assisted CPR (DA-CPR) instructions were provided. Four studies that included cases with DACPR and were previously included in this CoSTR[18–21] have been moved to the DA-CPR CoSTR.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children in any setting (inhospital or out-of-hospital) with cardiac arrest
- Intervention: Chest compression–only CPR without dispatcher assistance
- Comparator: Conventional CPR with compressions and ventilations without dispatcher assistance
- Outcomes:
  – Critical: Favorable neurological survival (as measured by Cerebral Performance Category [CPC] or modified Rankin Scale [mRS]) at discharge or 30 days and at any time interval after 30 days
  – Important: Survival to discharge or 30 days, survival to hospital admission, survival to any time interval after discharge or 30 days survival, ROSC, quality of life as measured by any indicator or score
- Study design: In addition to standard criteria, observational studies that reported only unadjusted data were excluded.
- Time frame: Because the search terms were revised,[17] the search was all years to October 21, 2024

Consensus on Science

No new studies that directly addressed this topic were found. The evidence remains 3 observational studies that compared bystander chest compression–only CPR with conventional CPR at a ratio of 15:2[22,23] and 30:2[24] in adults without DA-CPR instructions. Because 15:2 CPR is no longer recommended, all outcomes with these studies were downgraded for indirectness. No data was available from the included studies for the outcome of favorable neurological survival. Data for this outcome is drawn from a study of combined bystander-only CPR and DA-CPR with a high prevalence of bystander-only CPR.[19] The evidence is summarized in Table 1.

Table 1 – The Evidence Comparing Chest Compression–Only CPR With Conventional CPR Without Dispatcher Assistance.

Outcome (certainty of evidence)	Studies (patients)	Results
Favorable neurological function (very low–certainty evidence)	No studies without dispatcher assistance 1 cohort study of combined bystander (76% of cases) and DA-CPR (24% of cases) (4068 adult bystander-witnessed OHCAs)[19]	CCO-CPR, compared with 15:2 CPR, was associated with favorable neurological function (aOR, 2.22; 95% CI, 1.17–4.21)
Survival to hospital discharge or 30 d (very low–certainty evidence)	3 observational studies: 1 in adults[24] and 2 in all ages[22,23]	Adult study: higher survival to hospital discharge with CCO-CPR compared with 30:2 CPR (aOR, 1.60; 95% CI, 1.08–2.35)[24] All-age studies: no difference in survival to 30 d (aOR, 1.18; 95% CI, 0.89–1.56)[23] or hospital discharge (aOR, 1.32; 95% CI, 0.35– 4.94)[22] with CCO-CPR compared with 15:2 CPR
Survival to hospital admission (very low–certainty evidence)	1 observational study in all ages[23]	No difference with CCO-CPR compared with 15:2 CPR (aOR, 1.03; 95% CI, 0.86–1.23)
ROSC (very low–certainty evidence)	1 observational study in all ages[22]	No difference with CCO-CPR compared with 15:2 CPR (aOR, 1.02; 95% CI, 0.60–1.73)

aOR indicates adjusted odds ratio; CCO-CPR, chest compression–only cardiopulmonary resuscitation; CPR, cardiopulmonary resuscitation; DA-CPR, dispatcherassisted cardiopulmonary resuscitation; OHCA, out-of-hospital cardiac arrest; and ROSC, return of spontaneous circulation.

Treatment Recommendations (2025, Unchanged From 2017)

We recommend that chest compressions be performed for all adults in cardiac arrest (good practice statement). We suggest that bystanders who are trained, able, and willing, give chest compressions with rescue breaths for adults in cardiac arrest (weak recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is included in Appendix A.

In making these recommendations, the task force acknowledged the very low–certainty evidence in comparison with 15:2 CPR but placed greater emphasis on the need to give chest compressions in adult CPR and the potential to increase rates of bystander CPR with chest compression–only CPR or compression-focused CPR in adults.[20,25–27] The task force also considered the following:

- The existing evidence suggests chest compression–only CPR is comparable to 15:2 CPR in adults. Given the included studies were conducted without dispatcher assistance, it could be assumed that the CPR was performed by CPR-trained individuals or off-duty health care professionals.
- Three additional studies reported no difference in unadjusted patient outcomes between chest compression–only CPR and conventional CPR.[28–30] One of these studies, conducted in the 1980s, examined the impact of CPR quality. Using combined objective and subjective measures, this study reported higher unadjusted survival when 15:2 was performed correctly (good technique and effect), compared with incorrectly (31% versus 8%) or when compared with chest compression–only CPR (31% versus 20%).[30] Rates of correctly applied 15:2 were higher in bystanders who were health care professionals than in lay bystanders (58% versus 42%).[30]
- A pilot RCT, including high rates of DA-CPR, showed no difference in survival at 1 day between chest compression–only CPR and conventional CPR when delivered by trained laypersons.[31]
- Chest compression–only CPR is preferred by the public[32,33] and easier to learn and recall.
- A literature review reported that chest compression–only CPR results in a shorter time to initiate CPR and a higher total number of chest compressions.[34] However, as it continues, rescuers may experience fatigue, which can reduce the depth of compressions compared with those delivered in conventional CPR with pauses for breaths.[34]
- Opening the airway and delivering ventilations are technical skills, and bystanders, especially if untrained or minimally trained, are typically unable to deliver effective ventilations during simulated CPR.[35]
- Both types of CPR are better than no CPR, and both should be taught in BLS/CPR training.

Knowledge Gaps

- The effect on outcomes of chest compression–only CPR compared with 30:2 CPR without dispatcher assistance
- Data in children are needed.

Optimization of Dispatcher-Assisted Recognition of OHCA (BLS 2102: ScopRev 2024, EvUp 2025)

This topic was first reviewed in an ILCOR nodal SysRev in 2020,[36] with treatment recommendations for dispatcher-assisted recognition of OHCA published in the 2020 CoSTR.[37,38] In 2024, the BLS Task Force decided to conduct a ScopRev to examine the evidence for interventions aiming to optimize dispatcher-assisted recognition of OHCA, with an EvUp conducted in 2025. The details of this review can be found in the ScopRev,[39] in the 2024 CoSTR summary,[40,41] and on the ILCOR website.[42] The 2025 EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children who are in cardiac arrest outside of a hospital
- Intervention: Factors and interventions that improve dispatcher-assisted recognition of cardiac arrest
- Outcomes: Dispatcher-assisted recognition of cardiac arrest
- Time frame: June 2, 2023, to November 4, 2024

Summary of Evidence

The EvUp identified 2 additional studies.[43,44] The new evidence provided by these studies does not warrant a new SysRev.

Treatment Recommendations (2020)

We recommend that dispatch centers implement a standardized algorithm and/or standardized criteria to immediately determine if a patient is in cardiac arrest at the time of emergency call (strong recommendation, very low–certainty evidence).

We suggest that dispatch centers monitor and track diagnostic capability (good practice statement).

We suggest that dispatch centers look for ways to optimize sensitivity (minimize false negatives) (good practice statement).

The existing evidence did not support a good practice statement for interventions to improve dispatcherassisted recognition.

Optimization of Dispatcher-Assisted CPR (BLS 2113: ScopRev 2024, EvUp 2025)

This topic was last reviewed in an ILCOR nodal SysRev in 2019, with treatment recommendations for dispatcher-assisted recognition of OHCA published in the 2019 CoSTR summary.[45,46] In 2024, the BLS task force decided to conduct a ScopRev to examine the evidence for interventions to optimize DA-CPR instructions, with an EvUp conducted in 2025. The details of this review can be found in the ScopRev,[47] the 2024 CoSTR summary,[40,41] and on the ILCOR website.[48] The 2025 EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children with OHCA when DA-CPR is implemented
- Intervention: Interventions used in addition to DA-CPR
- Comparators: Nonmodified DA-CPR
- Outcomes: Any outcomes
- Time frame: May 17, 2023, to November 1, 2024

Summary of Evidence

The EvUp identified 9 additional studies.[49–57] The new evidence does not warrant a new SysRev.

Treatment Recommendations (2019 and 2024)

We recommend that emergency medical dispatch centers have systems in place to enable call handlers to provide CPR instructions for adult patients in cardiac arrest (strong recommendation, very low–certainty evidence).

We recommend that emergency medical dispatchers provide CPR instructions (when deemed necessary) for adult patients in cardiac arrest (strong recommendation, very low–certainty evidence).

The existing evidence did not support a good practice statement for interventions to improve DA-CPR instructions.

Dispatcher-Assisted Chest Compression–Only CPR (SysRev 2025)

Rationale for Review

The previous SysRev[13] and existing ILCOR treatment recommendation were first published in 2017.[14,15] This topic was prioritized for a detailed review because it had not been reviewed since 2017. The SysRev was registered on PROSPERO (CRD42024559318), and the full CoSTR can be found on the ILCOR website.[58]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children in any setting (inhospital or out-of-hospital) with cardiac arrest
- Intervention: Dispatcher-assisted chest compression–only CPR
- Comparators: Dispatcher-assisted conventional CPR with compressions and ventilations
- Study design: In addition to standard criteria, observational studies that reported only unadjusted data were excluded.
- Outcomes:
  - Critical: Favorable neurological survival (as measured by CPC or mRS) at discharge or 30 days and at any time interval after 30 days
  - Important: Survival to discharge or 30 days, survival to hospital admission, survival to any time interval after discharge or 30-days survival, ROSC, quality of life as measured by any indicator or score
- Time frame: Because the search terms were revised,[17] search was inception to October 21, 2024

Consensus on Science

Four RCTs[31,59–61] and 6 observational studies[18,19,62–65] were identified that compared dispatcher-assisted chest compression–only CPR with conventional CPR at a ratio of 15:2 or 30:2 in adults or all ages, with or without bystander CPR ongoing at the time of the call. As 15:2 CPR is no longer recommended, all outcomes were downgraded for indirectness. The overall certainty of evidence was rated as low to very low for all outcomes, primarily due to a very serious risk of bias. Because of this and a high degree of heterogeneity, meta-analyses were not performed. The evidence is summarized in Table 2.

Table 2 – The Evidence Comparing Dispatcher-Assisted Chest Compression–Only CPR With Conventional CPR.

Outcome (certainty of evidence)	Studies (patients)	Results
Favorable neurological function (very low–certainty evidence)	1 adult RCT[59] 4 observational studies: 1 study included adult bystander-witnessed DA-CPR cases[62]; 3 studies examined combined bystander CPR and DA-CPR in adults-witnessed[19,63] and all-age bystander-witnessed[65] cases	No difference compared with 15:2 2 studies of combined bystander and DA-CPR cases, reported higher odds with CCO-CPR compared with 15:2 (aOR, 2.22; 95% CI, 1.17–4.21)[19] or compared with combined 15:2 and 30:2 CPR (aOR, 1.12; 95% CI, 1.06–1.19)[65] 2 studies reported no difference compared with 30:2[62,63]
Survival to hospital discharge or 30 d (very low–certainty evidence)	3 RCTs: 2 in adults,[59,60] 1 in >8 y of age bystander-witnessed[61] 5 observational studies: 2 in all ages,[64,65] 2 in adults,[18,62] and 1 in adult-witnessed[63]	No difference in survival to hospital discharge compared with 30:2[62,63] 1 reported higher odds with CCO-CPR compared with C-CPR of either 15:2 or 30:2 (aOR, 1.05; 95% CI, 1.01–1.10)[65] 2 reported lower odds with CCO-CPR compared with either 15:2 (aOR, 0.69; 95% CI, 0.53–0.90)[64] or 30:2 CPR (aOR, 0.72; 95% CI, 0.59, 0.88)[62] 2 studies reported no difference with DA CCO-CPR compared with either 15:2[18] or 30:2[63]
Survival to hospital admission (low-certainty evidence)	4 RCTs: 3 in adults[31,59,60] 1 in >8 y of age bystander-witnessed[61]	No difference with DA CCO-CPR compared with either 15:2[60,61] or 30:2[31]
ROSC (very low–certainty evidence)	1 all-age observational study[65]	No difference compared with either 15:2 or 30:2 CPR

aOR indicates adjusted odds ratio; C-CPR, conventional CPR; CCO-CPR, chest compression–only CPR; CPR, cardiopulmonary resuscitation; DA, dispatcher-assisted; DA-CPR, dispatcher-assisted cardiopulmonary resuscitation; RCT, randomized controlled trial; and ROSC, return of spontaneous circulation.

Treatment Recommendations (2025, Unchanged From 2017)
We recommend that dispatchers provide chest compression–only CPR instructions to callers for adults with suspected OHCA (strong recommendation, low-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights
The complete evidence-to-decision table is provided in Appendix A.

In making these recommendations, the task force acknowledged the low-certainty evidence but strongly endorsed the 2020 CoSTR that all rescuers should perform chest compressions for all patients in cardiac arrest. The task force also considered the following:

- Bystander CPR more than doubles OHCA survival.[66] We placed a higher emphasis on the importance of providing high-quality chest compressions and increasing the overall rate of bystander CPR over providing rescue breaths.
- Increases in rates of bystander CPR and patient outcomes have been reported following the introduction of dispatcher-assisted chest compression–only CPR or compression-focused CPR in adults.[20,25–27] Using a chest compression–only CPR strategy may increase the willingness of bystanders to respond during a cardiac arrest.
- Most bystander CPR for adults is given with DA-CPR instructions, even in the presence of CPRtrained lay bystanders.[31]
- In making these recommendations, the task force took into consideration heterogeneity in the body of evidence, particularly related to implementation of DA-CPR. Despite this, most included studies suggested either a slight improvement in favor of dispatcher-assisted chest compression–only CPR or no difference in patient outcomes, regardless of patient population or comparison ratio.

Knowledge Gaps

- Studies in children
- The number of chest compressions that should be given, and for how long before ventilation instructions are introduced
- Whether resuscitation instructions should be modified in the context of different causes of arrest (eg, choking, drowning)
- The impact of prior CPR training

Optimization of Dispatcher-Assisted AED Retrieval and Use (BLS 2120: ScopRev 2024)

A 2024 ScopRev examined the evidence for a new BLS question on interventions to optimize dispatcher-assisted AED retrieval and use for OHCA. The details of this review can be found in the ScopRev,[69] the 2024 CoSTR summary,[40,41] and on the ILCOR website.[70]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children with OHCA
- Intervention: Dispatcher-assisted AED retrieval and use
- Outcomes: Any outcomes
- Time frame: All years to April 13, 2023

Treatment Recommendations (2024)
EMS implementing dispatcher-assisted public access AED systems should monitor and evaluate the effectiveness of their system (good practice statement).

Once a cardiac arrest is recognized during the emergency call and CPR has been started, dispatchers should ask if there is an AED (or defibrillator) immediately available at the scene and ask the caller to update them when one arrives (good practice statement).

If an AED is not immediately available and if there is more than 1 rescuer present, dispatchers should offer instructions to locate and retrieve an AED. Retrieval instructions should be supported, where resources allow, by up-to-date registries about public access AED locations and accessibility (good practice statement).

Once an AED is available, dispatchers should offer instructions on its use (good practice statement).

Drone Delivery of AEDs (BLS 2122: ScopRev 2023; EvUp 2025)

A ScopRev for 2023 and a 2025 EvUp examined the evidence on drone delivery of AEDs. The details of this review can be found in the ScopRev,[71] the 2023 CoSTR summary,[6,7] and on the ILCOR website.[72] The 2025 EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in OHCA
- Intervention: Drone-delivered AEDs
- Comparators: Standard EMS response times (or time for EMS-delivered AED), AEDs delivered by bystanders (or activated volunteer responders)
- Outcomes: Real-world/estimated feasibility, time gain of drone-delivered AEDs (compared with standard EMS delivery), predicted survival, predicted quality-adjusted life years gained, cost-effectiveness, and calculated proportion of defibrillation and survival compared with cases where AEDs are brought to the OHCA scene by standard means
- Time frame: December 1, 2022, to August 6, 2024

Summary of Evidence
The EvUp identified 11 additional studies.[73–83] The new evidence does not warrant a new SysRev. There is no existing treatment recommendation on this topic, and the current evidence does not support a new one.

AED Accessibility (Locked Cabinets) (BLS 2123: ScopRev 2025)

Rationale for Review
Rapid defibrillation is critical to improving patient outcomes because each minute of delay in attempting defibrillation reduces the chances of survival and good functional outcomes.[84–86] Concerns about theft, vandalism, and misuse of AEDs have led to the use of security measures, including using locked cabinets, to house these devices in public areas.[87–89] Given the lack of a comprehensive review of this approach, this topic was prioritized for review by the BLS Task Force. The full details of this review can be found in the ScopRev[90] and on the ILCOR website.[91]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in out-of-hospital settings
- Concept: The benefits and harms of placing AEDs in locked cabinets versus unlocked cabinets
- Context: Any locations where an AED is placed with the intention of the AED being publicly accessible for use
- Outcomes: Any outcome, including AED outcomes (eg, AED use, time to AED use, AED vandalism or theft)
- Time frame: All years to June 25, 2024

Summary of Evidence

Ten reports were included: 7 observational studies reporting rates of theft and vandalism,[92–100]1 survey reporting on harm to rescuers,[101] and 2 AED retrieval simulation studies.[92,93] Four studies were reported as conference abstracts[97–100] and 2 were letters to the editor.[94,96]

No study reported on the impact of locked AED cabinets on patient outcomes. Most studies reported low rates (<2%) of theft, missing AEDs, or vandalism and this occurred in locked and unlocked cabinets.[92–100] The only study comparing unlocked and locked cabinets showed minimal difference in theft and vandalism rates (0.3% versus 0.1%).[99] Two simulation studies showed significantly slower AED retrieval when additional security measures, including locked cabinets, were used.[92,93] A survey of first responders reported half (n = 25/50) were injured while accessing an AED that required breaking glass to access.[101]

Task Force Insights

An evidence-to-decision table is provided in Appendix A.

- While acknowledging that most of the data identified has not undergone peer review and there may be publication bias, reported rates of AED theft and vandalism were low across all studies, and thefts occurred in both locked and unlocked cabinets. AEDs reported as stolen may have been used in an emergency and not returned.
- To ensure EMS is activated for OHCAs, some systems use cabinets locked with a code obtained by calling EMS.[102] However, this may cause delays, particularly if a telephone is not readily available, and its impact requires further study.[103]
- The cost to replace stolen or vandalized AEDs may be a challenge in low-resource settings (eg, community groups with limited funding).
- We agree with the 2022 ILCOR scientific statement, which focuses on optimizing PAD and advises against using locked cabinets.[104,105] If locked cabinets are used, instructions for unlocking them need to be clear and ensure no delays in access.

Treatment Recommendations

We advise against using locked cabinets for public access defibrillator storage (good practice statement).

If locked cabinets are used for public access defibrillator storage, instructions for unlocking them must be clear and ensure minimal delays in access (good practice statement).

EMS should devise strategies to return public access defibrillators when used (good practice statement).

Knowledge Gaps

- Peer-reviewed research and human studies on this topic, particularly studies focusing on real-life retrieval and the impact of security strategies on delivery times and patient outcomes

BLS SEQUENCE

Starting CPR (CAB Versus ABC) in Adults (BLS 2201, SysRev 2025)

Rationale for Review

This was a nodal review with BLS and the Pediatric Life Support (PLS) Task Forces. The existing ILCOR treatment recommendation was last updated in 2020.[37,38] This topic was prioritized for a detailed nodal review because only EvUps had been done since 2020. The pediatric CoSTR, treatment recommendations, and evidence-to-decision table are reported on the ILCOR website[106] and in the PLS CoSTR section.[107] The SysRev was registered on PROSPERO (CRD42024583890), and the full CoSTR can be found on the ILCOR website.[106]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in any setting (inhospital or out-of-hospital) with cardiac arrest
- Intervention: Commencing CPR with compressions first (30:2)
- Comparator: Commencing CPR with ventilations first (2:30)
- Outcomes:
  - Critical: Survival with favorable neurological outcome at hospital discharge or 30 days, survival at hospital discharge or 30 days, survival with favorable neurological outcome to 1 year, survival to 1 year, event survival, any ROSC
  - Important: Time to commencement of rescue breaths, time to commencement of first compression, time to completion of first CPR cycle, ventilation rate, compression rate, chest compression fraction, minute ventilation
- Time frame: Because the search terms were revised, the search included all years to June 18, 2024

Consensus on Science

One new pediatric manikin simulation study[110] (published with corrections[111]) in addition to the 4 manikin simulation studies[112–115] found in the previous ILCOR reviews[37,38,116,117] were identified. Of the 5 manikin studies, 3 were randomized studies (1 in adult[114] and 2 in pediatric resuscitation[110,113]), and 2 were observational studies in adult resuscitation.[112,115]

No human studies were identified. Evidence was very low certainty for all outcomes, downgraded for very serious risk of bias and indirectness. Because of this and a high degree of heterogeneity, no meta-analyses could be performed, and individual studies are difficult to interpret. This evidence from the manikin studies is summarized in Table 3.

Prior Treatment Recommendations (2020)

We suggest commencing CPR with compressions rather than ventilations (weak recommendation, very low–certainty evidence).

Treatment Recommendations (2025)

The 2025 treatment recommendation in adults is unchanged from 2020. The pediatric treatment recommendation is reported in the PLS CoSTR section.[107]

In adults in cardiac arrest, we suggest commencing CPR with compressions rather than ventilations (weak recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is provided in Appendix A.

Please see the PLS section for evidence-todecision highlights for children. In making these recommendations for adults, the task forces considered the following:

Most of the existing evidence, all of very low certainty, suggests the following:

- Starting CPR with compressions first results in improvements in key elements of resuscitation, such as commencement of chest

Table 3 – Compressions First (CAB) Compared With Ventilations First (ABC): Summary of Findings of Manikin Studies.

Outcome (certainty of evidence)	Studies (participants)	Results for cardiac arrest scenarios
Time to commencement of chest compressions (very low)	1 crossover pediatric manikin RCT (159 two-person teams)[113] 1 adult manikin RCT (108 twoperson teams)[114] 2 adult manikin observational studies (33 six-person teams[112]; 40 single rescuers[115])	CAB sequence resulted in faster mean time to chest compressions: 19.3 ± 2.6 versus 43.4 ± 5.0 s ($P < 0.05$)[113]; 25 ± 9 versus 43 ± 16 s ($P < 0.001$)[114] CAB sequence was associated with shorter time to chest compressions: median = 16.0 (IQR = 14.0–26.0) versus 42.0 (IQR = 41.5–59.0) s ($P < 0.001$)[112]; and mean = 15.4 ± 3.0 versus 36.0 ± 4.1 s ($P < 0.001$)[115]
Time to commencement of rescue breaths/ventilations (very low)	1 crossover pediatric manikin RCT (159 two-person teams)[113] 1 adult manikin RCT (108 twoperson teams)[114]	CAB sequence resulted in later mean times to commencement of ventilations: 28.4 ± 3.1 versus 22.7 ± 3.1 s ($P < 0.05$)[113]; 43 ± 10 versus 37 ± 15 s ($P < 0.001$)[114] In the respiratory arrest scenario, CAB sequence resulted in faster mean time to commencement of ventilations: 19.1 ± 1.5 versus 22.7 ± 0.1 s ($P < 0.05$)[113]
Time to completion of first CPR cycle (30 chest compressions and 2 rescue breaths) (very low)	1 adult manikin RCT (108 twoperson teams)[114]	CAB sequence resulted in shorter mean times to completion of the first resuscitation cycle (30:2): 48 ± 10 versus 63 ± 17 s ($P < 0.001$)
Ventilation rate (very low)	1 crossover pediatric manikin RCT[110] (28 two-person teams)	In a sequence of delivering 5 rescue breaths before commencing chest compressions, ABC resulted in more ventilations delivered in the first minute of resuscitation: median 13 (IQR = 12–15) versus 10 (IQR = 8–10; $P < 0.05$)
Compression rate (very low)	1 crossover pediatric manikin RCT[110] (28 two-person teams) 1 adult manikin observational study teams (33 six-person teams)[112]	No difference in compression rate No difference in compression rate
Compression depth (very low)	1 crossover pediatric manikin RCT[110] (28 two-person teams) 1 adult manikin observational study teams (33 six-person teams)[112]	No difference in median compression depth No difference in compression depth
CCF (very low)	1 crossover pediatric manikin RCT[110] (28 two-person teams) 1 adult manikin observational study team (33 six-person teams)[112]	In a sequence of delivering 5 rescue breaths before commencing chest compressions, ABC resulted in lower median CCF 57% (IQR = 54–64) versus 66% (IQR = 59–68; $P < 0.001$) No difference in CCF
Minute alveolar ventilation in the first minute of resuscitation (very low)	1 crossover pediatric manikin RCT[110] (28 two-person teams)	In a sequence of delivering 5 rescue breaths before commencing chest compressions, minute alveolar ventilation in the first min of resuscitation was higher with ABC: median 370 mL (IQR = 203–472) versus 276 mL (IQR = 140– 360; $P < 0.001$)

ABC indicates airway-breathing-compressions; CAB, compressions-airway-breathing; CCF, chest compression fraction; IQR, interquartile range; and RCT, randomized controlled trial.

compressions, completion of the first cycle of compressions, and a higher chest compression fraction.

- Indirect evidence from before-and-after OHCA registry studies in adults suggests that switching from the ABC to CAB approach was associated with increased rates of bystander CPR[25] and improved patient outcomes.[25,118,119] Similar data on in-hospital cardiac arrest show conflicting evidence in patient outcomes.[120,121]
- While important uncertainties remain, in retaining this treatment recommendation in adults, the BLS task force also considered the following:
  - The benefits of a single training approach in adults
  - Effective chest compressions generate cumulative coronary perfusion pressure, which falls to near zero when compressions stop. Therefore, early effective chest compressions are vital to establishing and maintaining coronary perfusion pressure.[122]
  - Time to first compression is associated with better patient outcomes.[123]
  - Bystanders are typically unable to deliver effective ventilations during simulated CPR.[35]

– Due to the public's concerns with mouth-tomouth ventilation,[32] commencing CPR with airway and ventilations may result in no bystander CPR being provided.
– Evidence suggests that delivering the ABC approach leads to more errors in CPR,[113] that laybystanders prefer CAB, and that CAB is easier to learn and retain.[113]
– The delivery of non–mouth-to-mouth ventilation requires the retrieval and preparation of equipment (eg, bag-mask device, pocket mask), which, when multiple rescuers are present, can occur during chest compressions.

Knowledge Gaps

No human studies directly evaluate this question in any setting. Because different councils worldwide have adopted CAB versus ABC, comparative studies of different registries may provide evidence to answer this question.

Chest Compression–to–Ventilation Ratios (BLS 2202: SysRev 2025)

Rationale for Review

This was a nodal review with BLS and the PLS Task Forces. The previous SysRev[13] and existing ILCOR treatment recommendation was first published in 2017.[14,15] This topic was prioritized for a detailed review because it had not been reviewed since 2017. The SysRev was registered on PROSPERO (CRD42024559318), and the full CoSTR can be found on the ILCOR website.[124]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children in-hospital with cardiac arrest
- Intervention: Any CPR ratio delivered by EMS
- Comparators: Eligible comparator groups include a CPR ratio different from the one in the intervention arm delivered by EMS. Comparator groups that received no CPR or compared manual CPR with mechanical CPR were excluded from the review. Studies including automated CPR or any use of mechanical devices will only be included if administered to all treatment arms.
- Outcomes:
  – Critical: Favorable neurological survival (as measured by CPC or mRS) at discharge or 30 days and at any time interval after 30 days
  – Important: Survival to discharge or 30 days, survival to hospital admission, survival to any time interval after discharge or 30-day survival, ROSC, quality of life as measured by any indicator or score
- Study design: In addition to standard criteria, observational studies that reported only unadjusted data were excluded.
- Time frame: Because the search terms were revised, the search included all years to October 21, 2024

Consensus on Science

Eight studies examined the impact of the 2005 resuscitation guidelines, in which changes to compressionto-ventilation (CV) ratios were made in combination with other bundled interventions.[119,125–131] The studies consisted of 7 retrospective cohort studies,[119,125–130] and one prospective study.[131] No study included children. Evidence was very low–certainty in all cases.

For the critical outcome of favorable neurological survival at discharge or 30 days, we identified 2 cohort studies.[126,131] In 1 cohort study of 3960 initially nonshockable OHCA,[126] implementation of the 2005 resuscitation guidelines (including a CV ratio of 30:2) was associated with an improvement in neurologically favorable survival at hospital discharge (CPC score 1–2) compared with a prior period using a CV ratio of 15:2 (odds ratio [OR], 1.56; 95% CI, 1.11, 2.18). In another cohort study of 522 initially shockable OHCA,[131] being treated under the 2005 guidelines was associated with no change in neurologically favorable survival at 30 days (CPC score 1–2) compared with being treated with a CV ratio of 15:2 (OR, 0.50; 95% CI, 0.20, 1.25).

For the critical outcome of survival to hospital discharge or 30-day survival, we identified 6 cohort studies.[119,125–128,130] Because of heterogeneity, no metaanalysis was performed.

- **CV ratio 30:2 versus 15:2:** In 3 studies of OHCA with all rhythms, a CV ratio of 30:2 compared with 15:2 was associated with higher odds of survival in 2 studies (adjusted OR [aOR], 1.8; 95% CI, 1.2, 2.7[128]; aOR, 2.5; 95% CI, 1.4, 4.6)[127] but not in the third study (aOR, 1.42; 95% CI, 0.79, 2.57).[125] For OHCA with initially shockable rhythm, 1 study reported higher odds of survival to hospital discharge with a CV ratio of 30:2 compared with 15:2 (aOR, 1.62; 95% CI, 1.33–1.98), which became nonsignificant after adjustment for the temporal trend (aOR, 1.07; 95% CI, 0.71, 1.62).[130] In OHCA patients with initial nonshockable rhythm, a CV ratio of 30:2 compared with 15:2 was associated with higher odds of survival in one study (aOR 1.53; 95% CI, 1.14, 2.05),[126] but not in the other (aOR 1.19; 95% CI, 0.82, 1.73).[130]
- **CV ratio 50:2 versus 5:1:** A before-after study of 200 bystander-witnessed OHCA with initial shockable rhythms reported an improvement in survival to hospital discharge following the implementation of a bundled change in resuscitation practice consisting of a CV ratio of 50:2 compared with 5:1 (aOR, 2.17; 95% CI, 1.26–3.73).[119]

For the critical outcome of ROSC, one cohort study of 1243 OHCA patients found no change in the riskadjusted odds of ROSC with a CV ratio of 30:2 compared with 15:2 (OR, 1.31; 95% CI, 0.99, 1.73).[129]

Treatment Recommendations (2025, Unchanged From 2017)

We suggest a compression-ventilation ratio of 30:2 compared with any other compression-ventilation ratio in adult patients in cardiac arrest (weak recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is provided in Appendix A.

In making this recommendation, the task force placed a high priority on consistency with our prior treatment recommendations and the findings identified in this review, which suggest that the bundle of care, which included changing to a CV ratio of 30:2, resulted in more lives being saved. The task force also considered the following:

- All studies included in this review suffered from serious indirectness, where a change to CV ratio was delivered or introduced as part of a bundle of care that included other changes, such as increases in the duration of CPR cycles, removal of stacked shocks, removal of postshock rhythm checks and fewer interruptions to chest compressions. It is possible that the benefits observed in these studies are not related to a change in CV ratio.
- Future studies and reviews should focus on the benefit of higher CV ratios, compared with the current recommendation of 30:2.

Knowledge Gaps

- The impact of different ratios without any other concurrent changes in practice
- The benefit of higher CV ratios compared with 30:2
- The ability of those providing CPR to deliver 2 effective ventilations during the short pause in chest compressions during CPR
- Examination of the ratio-dependent tidal volume required to maintain oxygenation

Duration of CPR Cycles (BLS 2212: SysRev 2025)

Rationale for Review

This topic was last reviewed in detail[132] for the 2020 CoSTR,[37,38] and was prioritized for a detailed review because only EvUps had been done since 2020. The full CoSTR can be found on the ILCOR website.[133] Because there was no intent to publish this review outside of the 2025 CoSTR, PROSPERO registration was not completed.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in any setting (inhospital or out-of-hospital) with cardiac arrest.
- Intervention: Pausing chest compressions at another interval
- Comparators: Pausing chest compressions every 2 minutes to assess the cardiac rhythm
- Outcomes:
  - Critical: Survival with favorable neurological outcome at hospital discharge or 30 days; survival at hospital discharge or 30 days
  - Important: ROSC; coronary perfusion pressure, cardiac output
- Time frame: September 1, 2019, to September 22, 2024

Consensus on Science

No new clinical studies have been identified since the 2020 ILCOR SysRev.[37,38] The existing evidence consists of 2 RCTs (Table 4).[134,135]

Treatment Recommendations (2025, Unchanged From 2015)

We suggest pausing chest compressions every 2 minutes to assess the cardiac rhythm (weak recommendation, low-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is included in Appendix A.

These included trials were designed to address the question of CPR or defibrillation first and provide only indirect evidence for different CPR cycle durations.

In making the suggestion to pause chest compressions every 2 minutes to assess cardiac rhythm, we placed a high value on being consistent with previous recommendations in the absence of any convincing evidence indicating potential benefit from changing to CPR cycles of a different duration. The BLS Task Force acknowledges that every guideline change comes with significant risk and costs.

Knowledge Gaps

- Whether the optimal CPR interval between rhythm analyses differs between initial cardiac rhythms
- The impact of no-flow and low-flow time
- The impact of stopping CPR on the overriding goal of minimizing interruptions in chest compressions
- The relationship between rescuer fatigue, chest compression quality and the optimal interval for chest compression cycles, and whether this relationship varies based on the number of rescuers present

EMS Continuous–Chest Compression CPR vs Conventional CPR (BLS 2221: SysRev 2025)

Rationale for Review

The previous SysRev[13] and existing ILCOR treatment recommendation were first published in 2017.[14,15] This topic was prioritized for a detailed review because it had not been reviewed since 2017. The SysRev was registered on PROSPERO (CRD42024559318), and the full CoSTR can be found on the ILCOR website.[136]

Table 4 – Evidence Comparing Duration of CPR Cycles.

Study (design)	Participants (intervention)	Outcomes: RR (95% CI)	Certainty of evidence
3 min versus 1 min			
Wik 2003[134] (RCT)	200 adult OHCAs 3 min (intervention): immediate defibrillation (up to 3 stacked shocks) for VF/VT followed by 3 min of CPR regardless of postshock rhythm 1 min (comparator): immediate defibrillation (up to 3 stacked shocks) for VF/VT followed by 1 min of CPR for patients in refractory VF/VT, and 3 min of CPR for patients who were in nonshockable rhythms following initial 1–3 shocks	Compared with 1 min, there was no difference for 3-min duration: Survival to hospital discharge with favorable neurological outcome (absolute RR, 1.68; 95% CI, 0.85–3.32; $P = 0.13$) Survival to hospital discharge (absolute RR, 1.52; 95% CI, 0.83–2.77; $P = 0.17$) ROSC (absolute RR, 1.22; 95% CI, 0.92–1.50; $P = 0.16$)	Very low (downgraded for risk of bias and imprecision)
1 min versus 2 min			
Baker 2008[135]	202 adult OHCAs 1 min (intervention): stacked shocks (up to 3 in refractory VF/VT), 15:2 CPR and 1-min CPR cycles between defibrillation 2 min (comparator): single shock, 30:2 CPR and 2-min CPR cycles between defibrillation	Compared with 2 min, there was no difference for 1-min duration: Survival to hospital discharge (RR, 0.49; 95% CI, 0.23–1.06; $P = 0.06$) ROSC (RR, 0.95; 95% CI, 0.73–1.24; $P = 0.71$)	Very low (downgraded for risk of bias and imprecision)

CPR indicates cardiopulmonary resuscitation; OHCA, out-of-hospital cardiac arrest; RCT, randomized controlled trial; ROSC, return of spontaneous circulation; RR, relative risk; and VF/VT, ventricular fibrillation/ventricular tachycardia.

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children with out-of-hospital with cardiac arrest
- Intervention: Continuous chest compressions with or without ventilations delivered by EMS
- Comparators: Standard CPR, defined as any CV ratio delivered by EMS. Comparator groups that receive no CPR or compared manual CPR with mechanical CPR were excluded from the review. Studies including automated CPR or any use of mechanical devices were only included if administered to all treatment arms.
- Outcomes:
  - Critical: Favorable neurological survival (as measured by CPC or mRS) at discharge or 30 days and at any time interval after 30 days
  - Important: Survival to discharge or 30 days, survival to hospital admission, survival to any time interval after discharge or 30 days survival, ROSC, quality of life as measured by any indicator or score
- Study design: In addition to standard criteria, observational studies that reported only unadjusted data were excluded.
- Time frame: Because the search terms were revised, the search included all years to October 2024

Consensus on Science

We identified 1 cluster crossover RCT[137] and 3 cohort studies,[138–140] including 2 post hoc analyses of the earlier cluster RCT, providing low to moderate certainty of evidence (downgraded for indirectness and risk of bias). The evidence is summarized in Table 5.

Prior Treatment Recommendations (2019)

We recommend that EMS providers perform CPR with 30 compressions to 2 breaths (30:2 ratio) or continuous chest compressions with positive-pressure ventilation (PPV) delivered without pausing chest compressions until a tracheal tube or supraglottic device has been placed (strong recommendation, highcertainty evidence).

We suggest that, when EMS systems have adopted minimally interrupted cardiac resuscitation, this strategy is a reasonable alternative to conventional CPR for witnessed shockable OHCA (weak recommendation, very low–certainty evidence).

Treatment Recommendations (2025)

During basic life support for adults in cardiac arrest, we recommend that EMS personnel use either a 30:2 CV ratio or continuous chest compressions with PPV (10/min) delivered without pausing compressions (strong recommendation, moderate-certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is provided in Appendix A.

The task force noted no high-certainty evidence to support the superiority of either continuous chest compressions or standard CPR for patient outcomes in OHCA and placed a high value on the importance of providing high-quality chest compressions and simplifying resuscitation logistics for EMS personnel.

Table 5 – The Evidence Comparing EMS Chest Compression–Only CPR With Conventional CPR.

Outcome (certainty of evidence)	Studies (patients)	Results
Favorable neurological function (moderate)	1 adult cluster RCT[137] randomized to either CCC with asynchronous PPV or standard CPR with a CV ratio of 30:2	No difference compared with 30:2
Survival to hospital discharge or 30 d (low to moderate)	1 adult cluster RCT[137] 3 observational studies: 1 compared minimally interrupted cardiac resuscitation with C-CPR (including a CV ratio of 15:2, stacked shocks, and postshock rhythm checks)[138]; 1 post hoc analysis of the Nichol cluster RCT[137] was restricted to sites in British Columbia[139]; 1 secondary analysis of patients enrolled into the ROC registry or either the ROC CCC, ALPS, or PART clinical trials were classified CCC with asynchronous ventilations or C-CPR (30:2)[140]	No difference compared with 30:2 Minimally interrupted cardiac resuscitation was associated with improved survival to hospital discharge (aOR, 3.0; 95% CI, 1.1–8.9).[138] A post hoc analysis of the Nichol cluster RCT[137] reported no significant difference in survival to hospital discharge.[139] The secondary analysis showed that CCC was associated with improved survival to hospital discharge when compared with standard CPR (aOR, 1.20; 95% CI, 1.04, 1.38). Further analysis showed when there was adherence to the intended strategy, CCC had significantly lower survival (aOR, 0.72; 95% CI, 0.64, 0.81), while in patients with the intended strategy, 30:2 had higher survival (aOR, 1.05; 95% CI, 0.90, 1.22).[140]
ROSC (low to moderate)	1 adult cluster RCT[137] 1 cohort study compared minimally interrupted cardiac resuscitation C-CPR (including a CV ratio of 15:2, stacked shocks, and postshock rhythm checks).[138]	No difference compared with 30:2 No difference compared with 15:2

ALPS indicates Amiodarone, Lidocaine, or Placebo Study; aOR, adjusted odds ratio; CCC, continuous chest compressions; C-CPR, conventional cardiopulmonary resuscitation; CPR, cardiopulmonary resuscitation; CV ratio, compression-to-ventilation ratio; EMS, emergency medical services; PART, Pragmatic Airway Resuscitation Trial; PPV, positive-pressure ventilation; RCT, randomized controlled trial; ROC, Resuscitation Outcomes Consortium; and ROSC, return of spontaneous circulation.

Changes made to the wording of the treatment recommendation were based on several factors. First, the existing wording was open to misinterpretation. Second, highest-quality evidence is a cluster RCT that compared a 30:2 ratio to ventilations at a rate of 10/min without pausing compressions across the first 3 resuscitation cycles (ie, 6 minutes of BLS resuscitation). After this time point, the study arms both switched to the same advanced life support (ALS) protocol, including the placement of an advanced airway and ventilations at a rate of 10/min without pausing compressions. Third, a growing body of evidence suggests that ventilation rates vary widely in both synchronous and asynchronous ventilations.[141] Additionally, substudies of the included cluster crossover RCT[137] suggest that a CV ratio of 30:2 may be harder to achieve in practice and could result in a higher degree of nonadherence compared with continuous chest compressions[140]; but when performed correctly, it may be associated with improved outcomes compared to compressions with asynchronous ventilations[140] and incorrect performance of 30:2.[142]

The task force removed the 2017 recommendation supporting systems that have implemented minimally interrupted cardiac resuscitation (ie, 200 compressions without ventilations) for witnessed shockable OHCA. This decision was made because the former recommendation was supported by a single retrospective study reporting adjusted estimates for the intervention,[138] with a serious risk of bias from uncontrolled confounding because the study implemented a bundle including other resuscitation practices. The task force also considered the following:

- Interruptions in chest compressions have been associated with poorer clinical outcomes in observational studies.[143] Pauses for ventilations are a significant source of interruptions in chest compressions and may negatively impact coronary and aortic blood flow.[144] Asynchronous PPV (continuous chest compressions with PPV delivered without pausing chest compressions) may achieve similar oxygenation without compromising chest compression quality.
- Although there was relative homogeneity in the continuous chest compressions strategies, there was heterogeneity in the use of ventilation strategies, including both asynchronous PPV and passive oxygenation (delivering oxygen during compressions without providing ventilation). The adequacy of ventilation was not assessed in any studies, although measures of chest compression quality (eg, chest compression fraction) were reported.

Knowledge Gaps

- The effect of delaying PPV during CPR
- The impact of different elements of minimally interrupted cardiac resuscitation (compressions, ventilation, delayed defibrillation) on patient outcomes
- The impact of adherence to continuous chest compressions or a CV ratio of 30:2 on patient outcomes

In-Hospital Continuous–Chest Compression CPR vs Conventional CPR (BLS 2222: SysRev 2025)

Rationale for Review

This was a nodal review with BLS and the PLS Task Forces. The previous SysRev[13] and existing ILCOR treatment recommendation was first published in 2017.[14,15] This topic was prioritized for a detailed review as it had not been reviewed since 2017. The SysRev was registered on PROSPERO (CRD42024559318), and the full CoSTR can be found on the ILCOR website.[145]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children in-hospital with cardiac arrest
- Intervention: Continuous chest compressions with or without ventilations delivered by in-hospital providers
- Comparators: *Standard CPR*, defined as any CV ratio delivered by in-hospital providers. Comparator groups that received no CPR or compared manual CPR with mechanical CPR were excluded from the review. Studies including automated CPR or any use of mechanical devices were only included if administered to all treatment arms.
- Outcomes:
  - Critical: Favorable neurological survival (as measured by CPC or mRS) at discharge or 30 days and at any time interval after 30 days
  - Important: Survival to discharge or 30 days, survival to hospital admission, survival to any time interval after discharge or 30 days survival, ROSC, quality of life as measured by any indicator or score
- Study design: In addition to standard criteria, observational studies that reported only unadjusted data were also excluded.
- Time frame: Because the search terms were revised, the search included all years to October 21, 2024

Consensus on Science

No new studies were identified. One single-center cohort study included in the previous review provided very low– certainty evidence (downgraded for risk of bias and very serious imprecision).[146] The study evaluated the effect of continuous mechanical chest compressions in adult patients admitted to an emergency department following OHCA. PPV without interruption of chest compressions after tracheal intubation was compared with interruption of chest compressions for one ventilation after every fifth chest compression (a CV ratio of 5:1) among patients admitted to a hospital emergency department after OHCA. No adjusted data were reported for favorable neurological survival at discharge or 30 days. For the critical outcome of survival, patients who received tracheal intubation with PPV during continuous compressions had increased adjusted survival to hospital discharge (aOR, 2.43; 95% CI, 1.15–5.12) and higher odds of ROSC (aOR, 1.62; 95% CI, 1.07–2.43) when compared with those who received mechanical chest compressions interrupted for ventilations at a ratio of 5 compressions to 1 ventilation.

Prior Treatment Recommendation (2019)

Whenever tracheal intubation or a supraglottic airway is achieved during in-hospital CPR, we suggest that providers perform continuous compressions with PPV delivered without pausing chest compressions (weak recommendation, very low–quality evidence).

Treatment Recommendations (2025)

In adults in cardiac arrest, in-hospital personnel should use either a 30:2 CV ratio or continuous chest compressions with PPV (10/min) delivered without pausing compressions (good practice statement).

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is provided in Appendix A.

In changing the recommendation to a good practice statement, the task force acknowledges the lack of evidence of this topic and no studies in children. The good practice statement removed reference to the advanced airway to fill the treatment gap and provide guidance for immediate CPR. The task force also considered the following:

- Interruptions in chest compressions have been associated with worse clinical outcomes in observational studies.[143] Pauses for ventilations are a significant source of interruptions in chest compressions and may negatively impact coronary and aortic blood flow.[144] PPV during chest compressions may achieve similar oxygenation without compromising chest compression quality.
- The only included study was conducted with a before-and-after design that, although adjusted for demographic and cardiac arrest characteristics, did not account for potential temporal differences in resuscitation efficiencies between study periods.
- Data on the same question in EMS found no highquality evidence to support the superiority of either continuous chest compressions or standard CPR for patient outcomes in OHCA.
- The task force also placed a relatively high value on providing high-quality chest compressions and simplifying resuscitation logistics for clinicians.
- Substudies of the included cluster crossover RCT[137] suggest that a CV ratio of 30:2 may be harder to achieve in practice and could result in a higher degree of nonadherence compared with continuous chest compressions[140]; but when performed correctly, 30:2 may be associated with improved outcomes compared to compressions with asynchronous ventilations[140] and incorrect performance of 30:2.[142]

Knowledge Gaps

- Effectiveness of continuous chest compressions with or without ventilations compared with standard CPR with a CV ratio, when delivered by in-hospital personnel
- The effect of delaying PPV during CPR
- The effectiveness of passive oxygenation during resuscitation
- The impact of adherence to chest compression– only CPR or a CV ratio of 30:2 on patient outcomes
- Evidence in pediatric patients

BLS COMPONENTS—COMPRESSIONS

Hand Position During Compressions (BLS 2502: SysRev 2025)

Rationale for Review

Hand positioning during compressions was last reviewed in detail for the 2020 CoSTR.[37,38] Since 2020, EvUps have identified evidence only from imaging studies. Because these studies contribute new indirect evidence, this topic was prioritized for review. The full CoSTR can be found on the ILCOR website.[147] Because there was no intent to publish this review outside of the 2025 CoSTR, PROSPERO registration was not completed.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in any setting (inhospital or out-of-hospital) with cardiac arrest
- Intervention: Any other location for chest compressions
- Comparators: Delivery of chest compressions on the lower half of the sternum
- Outcomes: Any clinical outcome
  - Critical: Survival to hospital discharge with good neurological outcome; survival to hospital discharge
  - Important: ROSC; blood pressure; coronary perfusion pressure; end-tidal carbon dioxide
- Time frame: October 1, 2019, to September 26, 2024

Consensus on Science

No studies reported the critical outcomes of favorable neurological outcome, survival, or ROSC. No new clinical studies have been identified since the 2020 ILCOR SysRev.[37,38] The existing evidence consists of 3 very low–certainty studies reporting on physiologic endpoints.[148–150] One crossover study in 17 adults with prolonged resuscitation from nontraumatic cardiac arrest 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 center of the chest, whereas arterial pressure during compression recoil, peak right atrial pressure, and coronary perfusion pressure did not differ.[150] A second crossover study in 30 adults observed no association between end-tidal carbon dioxide values and hand placement.[149] A further 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.[148]

Treatment Recommendations (2025, Unchanged From 2015)

We suggest performing chest compressions on the lower half of the sternum on adults in cardiac arrest (weak recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is provided in Appendix A.

No studies evaluated the effect of a specific hand position on shortor long-term survival after cardiac arrest, and only physiologic surrogate outcomes were evaluated.

Imaging studies were excluded from the current SysRev because they do not report clinical outcomes for cardiac arrest patients. However, they provide valuable indirect information. Recent studies indicate that, in most adults and children, the maximal ventricular cross-sectional area is located beneath the lower third of the sternum or the xiphisternal junction. Additionally, the ascending aorta and left ventricular outflow tract are positioned beneath the center of the chest.[151–157] The studies also highlight significant anatomical differences between individuals based on factors such as age, body mass index, congenital cardiac disease, and pregnancy. Consequently, no single hand-placement strategy may be universally optimal for chest compressions across all populations.[154,156,158,159]

In reaffirming the recommendation to perform chest compressions on the lower half of the sternum, we prioritized consistency with previous guidelines given the lack of compelling clinical evidence necessitating a change in approach.

Knowledge Gaps

- The effects of different hand positions during CPR on patient outcomes
- How to determine the optimal hand placement or compression point for individuals in cardiac arrest, particularly by leveraging physiologic feedback or incorporating insights from prior imaging

Head-Up CPR (BLS 2503: SysRev 2025)

Rationale for Review

This was a nodal review with BLS and the ALS Task Forces. The first SysRev with treatment recommendations for head-up CPR was published in the 2021 CoSTR.[160,161] Since 2021, the topic has been reviewed in EvUps, which identified new observational studies, and the SysRev was therefore updated for 2025. The SysRev was registered on PROSPERO (CRD42024541714), the full details of this review can be found in the SysRev,[162] and the full CoSTR can be found on the ILCOR website.[163]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in any setting (inhospital or out-of-hospital) with cardiac arrest
- Intervention: Head-up CPR or head-up CPR bundle (eg, head-up position, active compression/decompression, and an impedance threshold device)
- Comparators: Standard or chest compression–only CPR in supine position
- Outcomes:
  - Critical outcomes: Survival to hospital discharge with good neurological outcome, survival to hospital discharge, event survival, survival to 30 days, survival to 30 days with good neurological outcome
  - Important outcome: ROSC
- Time frame: July 22, 2021, to July 19, 2024

Consensus on Science

Two new observational studies were identified, adding to the single study identified in 2021.[164–166] All studies were from the same research group. Details of study designs and key findings are presented in Table 6. Evidence was deemed very low–certainty for all outcomes because of serious risk of bias, inconsistency, and imprecision.

Prior Treatment Recommendations (2021)

We suggest against the routine use of head-up CPR during CPR (weak recommendation, very low–certainty evidence).

We suggest that the usefulness of head-up CPR during CPR be assessed in clinical trials or research initiatives (weak recommendation, very low–certainty evidence).

Treatment Recommendations (2025)

We suggest against the use of head-up CPR or head-up CPR bundle during CPR except in the setting of clinical trials or research initiatives (weak recommendation, very low–certainty evidence).

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is provided in Appendix A.

In making this recommendation, the BLS Task Force recognized that the currently available evidence remains limited, highlighted by the absence of RCTs or observational studies with adequate comparisons. The comparator groups used in all 3 available studies are problematic (eg, earlier time frame), and some outcomes are reported without adjustment for known confounders or temporal trends. The implementation of the existing head-up CPR bundles requires the purchase of expensive equipment, which includes an automated head/thorax-up positioning device, a mechanical CPR device, and an impedance threshold device, as well as considerable training.

Although the intervention may sound simple, the included studies demonstrate the complexities. We did not find clinical evidence supporting a particular bundle approach or indicating that the sole use of head-up elevation is superior to other bundles without it. There is an indication that faster deployment of head-up CPR is associated with better neurological outcomes,[165] but this requires further study.

Knowledge Gaps

- High-quality evidence of the effect of head-up CPR or head-up CPR bundle is required.
- The optimal approach (eg, the angle and timing of head elevation) when head-up CPR is used

Minimizing Pauses in Compressions (BLS 2504: SysRev 2022, EvUp 2025)

A 2022 SysRev and 2025 EvUp examined the evidence on passive ventilation techniques. The details of the 2022 SysRev review can be found in the 2022 CoSTR summary[170,171] and on the ILCOR website.[172] The 2025 EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults in cardiac arrest in any setting
- Intervention: Minimizing pauses in chest compressions (higher CPR or chest compression fraction or shorter perishock pauses compared with control)
- Comparator: Standard CPR (lower CPR fraction or longer perishock pauses compared with intervention)
- Outcomes:
  - Critical: Survival to hospital discharge with good neurological outcome; survival to hospital discharge
  - Important: ROSC
- Time frame: June 1, 2021, to April 14, 2024

Summary of Evidence

The EvUp found 1 new study[173] directly relevant to the population, intervention, comparator, outcome, study design, and time frame and several studies with meaningful data on interruptions in cardiac arrest care.[140,173–176] However, these later studies were excluded because they did not address the prespecified outcomes of interest. This suggests a SysRev might be warranted in the future after revising the population, intervention, comparator, outcome, study design, and time frame question.

Treatment Recommendations (2022)

We suggest that CPR fraction and perishock pauses in clinical practice be monitored as part of a comprehensive quality improvement program for cardiac arrest designed to ensure high-quality CPR delivery and resuscitation care across resuscitation systems (weak recommendation, very low–certainty evidence).

We suggest that preshock and postshock pauses in chest compressions be as short as possible (weak recommendation, very low–certainty evidence).

We suggest that the CPR fraction during cardiac arrest (CPR time devoted to compressions) should be as high as possible and be at least 60% (weak recommendation, very low–certainty evidence).

Optimal Surface for Performing CPR (BLS 2510: SysRev 2024)

A 2024 SysRev updated the 2019 review[177] on the optimal surface for performing CPR. The full details of this review can be found in

Table 6 – Key Design Elements and Findings of Head-Up CPR Studies.

Study	Design (time frame), participants, intervention, comparator	Outcomes	Certainty of evidence
Pepe 2019[166]	Before-after study, 2014–2017: 2322 adult OHCAs (1356 intervention) Intervention: Head-up CPR bundle that included mechanical CPR and ITD; oxygen but deferred PPV for several minutes; a pit-crew approach for rapid placement of the mechanical CPR device; and subsequent placement of patient in a reverse Trendelenburg position (≈20°) Comparator: Mechanical CPR and ITD (data from same EMS)	Survival to hospital discharge with favorable neurological outcome: Unadjusted 35% to 40% intact neurological status in both groups (exact data and loss to follow-up not provided) Event survival: Unadjusted 17.9% (n = 144/806) versus 34.2% (n = 464/1356), $P < 0.001$	All outcomes: very low–certainty evidence (downgraded for risk of bias, inconsistency, and imprecision)
Moore 2022[165]	Prospective observational: Automated Controlled Elevation CPR Registry, 2019–2020: 5423 adult OHCAs (227 intervention) Intervention: Automated controlled head and thorax patient positioning device. Immediate elevation of head and midthorax to 12 cm and 8 cm, respectively, with conventional CPR for 2 min; followed by a gradual elevation of patient's head and torso during CPR over an additional 2-min period to a final head and thorax elevation of 22 cm and 9 cm, respectively. Comparator: Conventional CPR with supine position (data from 3 RCTs conducted between 2006 and 2015[167–169])	After propensity matching: Survival to hospital discharge with favorable neurological outcome: 5.9% (13/222) versus 4.1% (35/860); OR, 1.47 (95% CI, 0.76–2.82) Survival to hospital discharge: 9.5% (21/122) versus 6.7% (58/860); OR, 1.44 (95% CI, 0.86–2.44) ROSC: 33% (74/222) versus 33% (282/860); OR, 1.02 (95% CI, 0.75–1.49)	All outcomes: very low–certainty evidence (downgraded for risk of bias, inconsistency, and imprecision)
Bashista 2024[164]	Prospective observational: Automated Head/Thorax-UP Positioning Registry (2019–2021): 2232 adult nonshockable OHCAs (380 intervention) Intervention: Automated controlled head and thorax patient positioning device, immediate elevation of head and midthorax to 12 cm and 8 cm, respectively, with conventional CPR for 2 min; followed by a gradual elevation of patient's head and torso during CPR over an additional 2-min period to a final head and thorax elevation of 22 cm and 9 cm, respectively. Comparator: Conventional CPR with supine position (data from 2 RCTs conducted between 2006 and 2009[167,169])	After propensity matching: Survival to hospital discharge with favorable neurological outcome: 4.2% (15/353) versus 1.1% (4/353); OR, 3.87 (95% CI, 1.27–11.78) Survival to hospital discharge: 7.6% (27/353) versus 2.8% (10/353); OR, 2.84 (95% CI, 1.35–5.96) ROSC: 33% (118/353) versus 29% (101/353); OR, 1.25 (95% CI, 0.91–1.72)	All outcomes: very low–certainty evidence (downgraded for risk of bias, inconsistency, and imprecision)

CPR indicates cardiopulmonary resuscitation; EMS, emergency medical services; ITD, impedance threshold device; OHCA, out-of-hospital cardiac arrest; OR, odds ratio; PPV, positive-pressure ventilation; ROSC, return of spontaneous circulation; and RCT, randomized controlled trial.

the SysRev,[178] the 2024 CoSTR summary,[40,41] and on the ILCOR website.[179]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults or children in cardiac arrest (OHCA and in-hospital cardiac arrest)
- Intervention: The performance of CPR using a hard surface (eg, backboard, floor, or deflatable or specialist mattress)
- Comparators: The performance of CPR on a regular mattress or other soft surface
- Outcomes:
  – Critical: Survival with a favorable neurological outcome at hospital discharge/30 days; survival at hospital discharge/30 days
  – Important: Event survival; ROSC; CPR quality (eg, compression depth, compression rate, compression fraction)
- Time frame: September 17, 2019, to February 5,
- 2024.

Treatment Recommendations (2024)

We suggest performing chest compressions on a firm surface when possible (weak recommendation, very low–certainty evidence).

During in-hospital cardiac arrest, we suggest, where a bed has a CPR mode, which increases mattress stiffness, it should be activated (weak recommendation, very low–certainty evidence).

During in-hospital cardiac arrest, we suggest against moving a patient from a bed to floor to improve chest compression depth (weak recommendation, very low– certainty evidence).

During in-hospital cardiac arrest, we suggest in favor of either a backboard or no-backboard strategy, to improve chest compression depth (conditional recommendation, very low–certainty evidence).

Feedback for CPR Quality (BLS 2511: ScopRev 2024)

A 2024 ScopRev examined the wider literature on feedback for CPR quality during resuscitation. The details of this review can be found in the ScopRev,[180] the 2024 CoSTR summary,[40,41] and on the ILCOR website.[181]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children (excluding neonates) who are in cardiac arrest in any setting who are resuscitated by health professionals responding in a professional capacity
- Intervention: Real-time feedback and prompt devices regarding the mechanics of CPR quality (eg, rate and depth of compressions or ventilations)
- Comparators: No feedback or prompt devices or alternative devices
- Outcomes: Any outcomes or measure of CPR quality
- Time frame: All years to July 18, 2023. A gray literature search was performed in the Google search engine in addition to the standard databases.

Treatment Recommendations (2020)

We suggest the use of real-time audiovisual feedback and prompt devices during CPR in clinical practice as part of a comprehensive quality improvement program for cardiac arrest designed to ensure high-quality CPR delivery and resuscitation care across resuscitation systems (weak recommendation, very low–certainty evidence).

We suggest against the use of real-time audiovisual feedback and prompt devices in isolation (ie, not part of a comprehensive quality improvement program) (weak recommendation, very low–certainty evidence).

BLS COMPONENTS—VENTILATION

Passive Ventilation Techniques (BLS 2403: SysRev 2022, EvUp 2025)

A 2022 SysRev and 2025 EvUp examined the evidence on passive ventilation techniques. The details of this review can be found in the 2022 CoSTR summary[170,171] and on the ILCOR website.[182] The 2025 EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children with presumed cardiac arrest in any setting
- Intervention: Any passive ventilation technique (eg, positioning the body, opening the airway, passive oxygen administration, Boussignac tube, constant flow insufflation of oxygen) in addition to chest compressions
- Comparator: Standard CPR
- Outcomes:
  - Critical: Survival to hospital discharge with good neurological outcome; survival to hospital discharge
  - Important: ROSC
- Time frame: October 16, 2021, to July 5, 2024

Summary of Evidence

No new studies were identified, so a new SysRev is not warranted.

Treatment Recommendations (2022)

We suggest against the routine use of passive ventilation techniques during conventional CPR (weak recommendation, very low–certainty evidence).

Real-Time Ventilation Quality Feedback Devices (BLS 2402: ScopRev 2025)

Rationale for Review

A growing body of evidence suggests ventilation parameters during resuscitation often fall outside guideline recommendations.[183,184] This review was prioritized because new devices are now available to help BLS personnel monitor and improve ventilation in real time. Ventilation parameters were not addressed in detail in our recent review of real-time feedback.[180] The full details of this review can be found in the ScopRev[185] and on the ILCOR website.[186]

Population, Intervention, Comparator, Outcome, Study Design, and Time Frame

- Population: Adults and children in any setting (outof-hospital or in-hospital) in cardiac arrest
- Intervention: Real-time ventilation quality feedback (eg, tidal volume, adequate ventilation, mask leak, ventilation rate)
- Comparators: No real-time ventilation feedback
- Outcomes: Any outcome
- Study designs: In addition to standard study designs, gray literature (Google Scholar, first 20 pages), letters to the editor, and conference abstracts were eligible for inclusion.
- Time frame: Inception to September 11, 2024. The gray literature was searched on November 4, 2024.

Summary of Evidence

The ScopRev[185] identified 19 relevant studies (1 RCT,[187] 1 before-after prospective study,[188] 2 observational studies,[190,191] 1 case series,[192] and 12 simulation studies[193–200,202–205]). Three of the simulation studies assessed pediatric scenarios.[197,203,205]

One RCT[187] and 1 prospective observational study[188] examined clinical outcomes with and without real-time feedback (Table 7). The RCT reported improved immediate-term patient outcomes with real-time feedback but no change in short-term outcomes.

The trial did not adjust for group differences or report ventilation quality.[187] The observational study found no change in patient outcomes but noted improved ventilation parameters with real-time feedback.[188] Most of the simulation studies showed improvements in ventilation quality.

Treatment Recommendations (2025)

There is currently insufficient evidence on real-time ventilation quality feedback devices to make a treatment recommendation.

Table 7 – Clinical Studies Examining Real-Time Ventilation Feedback Devices With Control Groups.

Author (year)	Study design (country)	Population	Participants	Intervention (control)	Outcomes (device versus no feedback)
Lee (2023)[187]	RCT (South Korea)	OHCA	BLS and ALS hospital personnel	Real-time visual ventilation feedback device using a flow sensor (n=63); no feedback (n=58)	Survival with good neurological outcome (11.1% versus 10.3%; $P = 0.77$) Survival to discharge (4.9% versus 8.6%; $P = 0.54$) 30-h survival (49.2% versus 46.5%; $P = 0.001$). ROSC (55.5% versus 36.2%; $P = 0.04$)
Drennan (2024)[188]	Prospective before-after (Canada)	OHCA	BLS and ALS EMS personnel	Real-time visual ventilation feedback device using a flow sensor (n=221); no feedback (n=191)	ROSC (27% versus 29%, $P =$ NS) Ventilation rate (12/min [IQR 10, 17] versus 14/min [IQR 11, 19]; $P = 0.04$) Rate in target range (53% ± 38 versus 29% ± 9; $P < 0.001$) Insufflation volume (401 mL [IQR 353, 472] versus 374 mL [IQR 274, 453]; $P = 0.06$) Volume in target range (28% ± 17 versus 21% ± 16; $P < 0.001$) Rate and volume in target range (19% ± 17 versus 7% ± 10; $P < 0.001$)

ALS indicates advanced life support; BLS, basic life support; EMS, emergency medical services; IQR, interquartile range; OHCA, out-of-hospital cardiac arrest; RCT, randomized controlled trial; and ROSC, return of spontaneous circulation.

Task Force Insights

The task force discussed the review findings and noted the following:

- Device registration with regulatory authorities alone does not provide evidence of device performance in real-world settings. As rescuer and patient factors influence high-quality ventilation, the current evidence is insufficient to demonstrate the clinical efficacy or effectiveness of real-time ventilation feedback devices.
- The lack of studies in humans, the significant heterogeneity between studies, and industry involvement in 7 included studies are all important limitations of the evidence.
- Many of the included studies inaccurately labeled inflation volume, the amount of airflow measured at the mask, or the advanced airway as *tidal volume*. We suggest using inspiratory volume rather than tidal volume for this measurement, because tidal volume represents the amount of air that moves in or out of the lungs with each respiratory cycle.

Based on this ScopRev, at this time there is insufficient evidence to pursue a new SysRev on this topic.

Knowledge Gaps

- High-quality prospective evidence in humans, including changes to ventilation variables and conducted independent of industry, that assess the clinical efficacy (ie, whether the devices work in optimal settings) or clinical effectiveness (real-world settings) of these devices
- Data in children

BLS COMPONENTS—DEFIBRILLATION

Pad/Paddle Size and Placement in Adults (BLS 2601: SysRev 2025)

Rationale for Review

This was a nodal review with BLS, PLS, and the ALS Task Forces. The existing ILCOR treatment recommendation was first published in 2010[206,207] and reviewed in a ScopRev for the 2020 CoSTR.[37,38] Publications found in EvUps and the publication of a cluster RCT[208] on pad placement prompted a nodal SysRev[209] with the BLS, PLS, and ALS Task Forces (PROSPERO registration CRD42024512443). The pediatric CoSTR, treatment recommendations, and evidenceto-decision table are reported on the ILCOR website[210] and in the PLS CoSTR section.[107] The CoSTR can be found on the ILCOR website.[211]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in any setting (inhospital or out-of-hospital) with cardiac arrest and a shockable rhythm at any time during CPR
- Intervention: The use of any specific pad size/orientation and position
- Comparators: Reference standard pad size/orientation and position
- Outcomes:
  - Critical: Survival with favorable neurological outcome at hospital discharge or 30 days; survival at hospital discharge or 30 days

– Important: ROSC; termination of ventricular fibrillation (VF); rates of refibrillation
- Time frame: All years to September 22, 2024

Consensus on Science

Two observational studies[212,213] and 1 RCT[208] were identified. Certainty of evidence was very low in all cases.

Pad Size. No studies compared the effects of different pad sizes with standard size for any critical outcomes or ROSC. One before-and-after study in OHCA reported no difference in defibrillation success with AEDs with large pad size (113 cm^2), compared with AEDs with small pad size (65 cm^2) (86% versus 88.8%; OR, 0.82; 95% CI, 0.42–1.60).[212] No studies were identified in the in-hospital setting.

Pad Positions. No RCTs were found that compared different pad placements for the initial defibrillation.

One prospective EMS cohort study[213] adjusting for known predictors found no significant difference in favorable neurological outcome at hospital discharge with initial anterior-posterior (AP) pad placement compared with initial anterior-lateral (AL) placement (aOR, 1.86; 95% CI, 0.98–3.51). There was also no difference in survival to hospital discharge (aOR, 1.55; 95% CI, 0.83–2.90) or in defibrillation success (VF termination at 5-second postshock: OR, 1.08; 95% CI, 0.61–1.91), although AP pad position was associated with higher ROSC rates after adjusting for known predictors (aOR, 2.64; 95% CI, 1.50–4.65).

Pad Positions for Refractory VF. One cluster RCT, which was stopped early because of the COVID-19 pandemic, compared vector-change defibrillation (a change to the AP position) with continuation of the standard AL position in 280 adult OHCA patients with refractory VF (ie, persistence of VF or pulseless ventricular tachycardia after 3 consecutive AL defibrillations).[208] This RCT reported higher adjusted survival to hospital discharge with vector change to AP pad position (21.7% versus 13.3%; adjusted risk ratio, 1.71; 95% CI, 1.01–2.88), but no difference in favorable neurological outcome at hospital discharge, (aOR, 1.86; 95% CI, 0.98–3.51).

The same RCT reported higher rates of termination of VF with vector change to AP pad position (79.9% versus 67.6%; adjusted risk ratio, 1.18; 95% CI, 1.03–1.36) but no difference in ROSC (35.4% versus 26.5%; adjusted risk ratio, 1.39; 95% CI, 0.97–1.99).

No studies were identified in the in-hospital setting.

Prior Treatment Recommendations (2010)

It is reasonable to place pads on the exposed chest in an AL position. An acceptable alternative position is AP. In large-breasted individuals, it is reasonable to place the left electrode pad lateral to or underneath the left breast, avoiding breast tissue. Consideration should be given to the rapid removal of excessive chest hair before the application of pads, but emphasis must be on minimizing delay in shock delivery.

There is insufficient evidence to recommend a specific electrode size for optimal external defibrillation in adults. However, it is reasonable to use a pad size greater than 8 cm.

Treatment Recommendations (2025)

For Defibrillator Manufacturers. There is insufficient evidence to recommend a specific pad or paddle size for optimal external defibrillation in adults (good practice statement).

Manufacturers should standardize adult pad or paddle placement in the AL position (good practice statement). One pad or paddle should be placed below the right clavicle, just to the right of the upper sternal border, and the other with its center in the left midaxillary line, below the armpit.

Manufacturers should provide clear instructions to ensure proper contact between the pad or paddle and the skin, along with diagrams that accurately show the ILCOR-recommended pad and paddle positions (good practice statement).

For AED Users. Follow the manufacturer's AED guidance and instructions for adult pad placement (good practice statement).

For Health Care Professionals Trained in Manual Defibrillation. In adults, place defibrillator pads or paddles in the AL position to optimize placement speed and minimize interruptions to chest compressions (good practice statement). One pad/-paddle should be positioned below the patient's right clavicle, just to the right of the upper sternal border. The other pad/paddle should be placed on the patient's left midaxillary line, below the armpit.

In adults, if the initial AL position is not feasible, consider using the AP pad position if trained (good practice statement). Place the anterior pad on the left side of the chest, between the midline and the nipple. For female patients, place the anterior pad to the left of the lower sternum, ensuring it avoids breast tissue as much as possible. The posterior pad should be placed on the left side of the patient's spine, just below the scapula.

Pad or paddle placement should avoid breast tissue (good practice statement).

For Health Care Professionals Trained in Vector Change. For adults in refractory VF (persistent VF after 3 defibrillations), consider changing pads to the AP pad position (good practice statement). Place the anterior pad on the left side of the chest, between the midline of the chest and the nipple. For female patients, place the anterior pad to the left of the lower sternum, ensuring it avoids breast tissue as much as possible. The posterior pad should be placed on the left side of the patient's spine, just below the scapula. This treatment recommendation does not replace the existing treatment recommendation on vector change and double sequential defibrillation for ALS clinicians.[6,7]

Justification and Evidence-to-Decision Framework Highlights

The complete evidence-to-decision table is provided in Appendix A.

The pediatric treatment recommendations are reported in the PLS CoSTR section.[107] In making these recommendations for adults, the task forces considered the following:

- All included studies were at serious risk of bias. No study reported patient outcomes for pad size, and no study compared the effects of different pad placements on patient outcomes except when being used for refractory shockable rhythms. However, defibrillator manufacturers may have proprietary data, and we encourage manufacturers to make this data public.
- In the absence of in-hospital cardiac arrest studies, this evidence could be applied to in-hospital cardiac arrest, with additional downgrading for indirectness.
- Lower transthoracic impedance results in higher current flow, possibly enabling higher defibrillation success. Observational studies in adults showed that transthoracic impedance was significantly higher with small-sized pads/paddles compared with large-sized pads/paddles.[212,214,215]

- A secondary analysis of the Double Sequential External Defibrillation for Refractory Ventricular Fibrillation trial[216] explored the relationship between vector change to AP placement and the type of VF (shock-refractory or recurrent) on patient outcomes. The study reported that vector change to AP placement, compared with continuation of AL positioning, was not superior for VF termination, ROSC, or survival for shock-refractory VF. For recurrent VF, vector-change defibrillation was superior for VF termination, but not for ROSC or survival.
- Paddles may still be in use in some low-resource ALS settings. However, the Task Force acknowledges that the AP position is not feasible with paddles and that paddle sizes are standard as provided by the manufacturer. The task force did not foresee future development in the use of paddles.
- AEDs have diagrams to guide users in correct pad positioning. However, there is wide variation in these diagrams, and evidence suggests that untrained bystanders fail to achieve accurate pad placement when guided by current defibrillation pad diagrams.[217]

Knowledge Gaps

- The impact of different pad positions in the first 3 shocks on patient outcomes
- The effect of different pad sizes on patient outcomes
- Optimal pad sizes and positions in children and inhospital settings
- The interaction between pad size and orientation

Removal of Bra for Pad Placement and Defibrillation (BLS 2604, ScopRev 2025)

Rationale for Review

The BLS Task Force prioritized this review because the topic is controversial and, to date, no comprehensive review has been undertaken. The full details of this review can be found in the ScopRev[218] and on the ILCOR website.[219]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in cardiac arrest
- Concept: Adverse events and outcomes associated with pad placement or defibrillation without removing the patient's bra/brassiere (including those with metal components)
- Context: In patients wearing a bra/brassiere in any setting (in-hospital or out-of-hospital)
- Time frame: All years to September 26, 2024; gray literature searched (Google Scholar, first 200 references) October 1, 2024.

Summary of Evidence

No studies reporting patient outcomes were identified. One animal study[220] and 2 simulation manikin studies[221,222] were included. The evidence is summarized in Table 8.

Table 8 – Summary of the Evidence on Bra Removal for Defibrillation.

Study details	Study design (publication type)	Intervention	Key findings
Di Maio 2015[220]	Porcine model (n = 4) with induction of arrhythmia and defibrillation by an AED Conference abstract	AED pads in direct contact with the metal wires of a bra placed on the pig Induction of VF and defibrillation with 200 J shocks	No scorching or burning of the bra or skin Poor pad placement did not pose a risk to the operator (risk type not specified) No arcing No redirection of the current 100% first shock success (no instances of refibrillation)
Kramer 2015[221]	69 randomly assigned undergraduate students: Simulation of OHCA with CPR and AED on male or female manikins (use of a wig, makeup, silicone breasts, frontopening brassiere, colorcoordinated women's clothing) Peer-reviewed article	Voice prompt AED guidance on opening the case, activating AED, positioning of pads, shock delivery, administering CPR	Female manikins less likely to be completely disrobed than the male manikins (42.4% versus 91.7%, $P < 0.001$) Male rescuers less likely to completely disrobe the female manikins than female rescuers were (13.3% versus 66.7%, $P = 0.002$) Opinions on removal of clothes: Thought they needed only to remove enough clothing to place the defibrillator pads according to instructions rather than ensuring the brassiere would not affect CPR Social norms Concerned for patient modesty Men did not want to remove more clothing than necessary
O'Hare 2014[222]	78 randomly selected untrained AED users: Simulation of resuscitation with AED use on manikins as either "female" (clothed in a front-opening hooded sweater with a bra) or "male" (no bra) Conference abstract	Removal of clothes (including bra) from the manikin guided by the AED voice prompt	No difference in time to place electrodes: 52 versus 49 s for female versus male manikin, respectively No difference in time to first shock: 79.5 versus 77 s for female versus male manikin, respectively 88.5% of the participants correctly placed the electrodes and delivered a shock (sex of manikin not specified)

AED indicates automated external defibrillator; CPR, cardiopulmonary resuscitation; OHCA, out-of-hospital cardiac arrest; and VF, ventricular fibrillation.

Task Force Insights

The evidence-to-decision table is included in Appendix A. The task force discussed the review findings and noted the following:

- Two included studies were published as conference abstracts by the same group of authors who were employed by a company that develops and manufactures AEDs.[5,6] A growing body of research has identified that women are less likely to receive CPR and defibrillation by the public.[223–225] Public opinion surveys show that some members of the public do not feel comfortable exposing women's breasts, and fear accusations of inappropriate touching and sexual assault.[226] These concerns may impact bystanders' willingness to perform CPR and defibrillation and explain why rates are lower in women. Whether it is necessary to remove such undergarments is unknown.
- This ScopRev demonstrated scant evidence on this topic. Peer review occurred for only 2 of the 3 included studies. We found no evidence reporting patient outcomes or any case studies reporting adverse events from defibrillation without removing a bra.
- Leaving the bra on could result in inaccurate pad placement, but routine removal could compromise timely defibrillation, particularly in bystander situations. Some AED's verbal and written instructions do not describe bra removal, so the public may not currently remove it to place pads.
- There are likely to be privacy and cultural issues associated with fully exposing a woman's chest. Some resuscitation groups are already actively training to keep the bra on to overcome hesitancy in bystanders. However, correct and timely pad placement must be a priority.
- Although insufficient studies were identified to support a more specific SysRev of defibrillation while wearing a bra at this time, the task force felt the need to highlight and address the inequality in AED application in women by making good practice statements to highlight this issue to the international community.

Treatment Recommendations (2025)

There is insufficient evidence to guide the routine removal of a bra, but it may not always be necessary to remove a bra for defibrillation. Pads must be placed on bare skin in the correct position, which may be possible by adjusting the bra's position rather than removing it (good practice statement).

Manufacturers should develop realistic manikins that reflect different body sizes that can impact pad placement (good practice statement).

Where possible, CPR training should cover defibrillation for patients wearing bras, focusing on correct pad placement and minimizing pauses in compressions (good practice statement).

Knowledge Gaps

- Whether removing a bra is necessary with modern bras, pads, and defibrillators
- Sex-specific barriers to high-quality CPR and defibrillation; listening to emergency calls may provide critical insights to address in public messaging and CPR training
- A better understanding of public opinions and sociocultural sensitivities related to exposing the chest

Effectiveness of Ultraportable AEDs (BLS 2603: ScopRev 2024)

A 2024 ScopRev examined the evidence on the effectiveness of ultraportable AEDs. The details of this review can be found in the ScopRev,[227] the 2024 CoSTR summary,[40,41] and on the ILCOR website.[228]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in OHCA
- Intervention: the use of an ultraportable or pocket AED
- Outcomes: all outcomes were accepted
- Time frame: 2012 to October 31, 2023. We did not search gray literature.

Treatment Recommendations (2024)

There is currently insufficient evidence on the clinical effectiveness of ultraportable or pocket AEDs to make a treatment recommendation.

SPECIAL CIRCUMSTANCES

OHCA Following Drowning

A 2021 ScopRev, 2023 SysRev, and 2025 EvUps examined the evidence on 7 drowning questions. For these questions the population and outcomes are the same across all subtopics, and interventions and comparators are detailed for each subtopic. The details of this review can be found in the ScopRev,[229] SysRev,[230] the 2023 CoSTR summary,[6,7] and on the ILCOR website.[231–235] The 2025 EvUps are provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in cardiac arrest following drowning
- Outcomes:
  - Critical: Survival to discharge or 30 days with favorable neurological outcome; survival to discharge or 30 days
  - Important: ROSC
- Time frame: April 25, 2023, to April 14, 2024

Immediate Resuscitation in Water or on Boat in Drowning (BLS 2702/2703: ScopRev 2021, SysRev 2023, EvUp 2025)

Intervention and Comparator

- Intervention: Immediate resuscitation in water or on boat
- Comparator: Delaying resuscitation until on land

Summary of Evidence

The EvUp identified no new studies. A SysRev is not warranted.

Treatment Recommendations (2023)

We suggest in-water resuscitation (ventilations only) may be delivered if rescuers, trained in this technique, determine that it is feasible and safe with the equipment available and the distance to land warrants its use (weak recommendation, very low–certainty evidence).

We suggest on-boat CPR may be delivered if rescuers trained in this technique determine that it is feasible and safe to attempt resuscitation (good practice statement).

If the rescuers feel that the application of immediate CPR is or becomes too difficult or unsafe, then the rescuers may delay resuscitation until on land (good practice statement).

CAB Versus ABC in Drowning (BLS 2704: ScopRev 2023, SysRev 2024, EvUp 2025)

A slight change to the 2023 treatment recommendation was made to align with the treatment recommendations for all cardiac arrest patients.

Intervention and Comparator

- Intervention: Resuscitation that incorporates a compression-first strategy (CAB)
- Comparator: Resuscitation that starts with ventilation (ABC)

Consensus on Science

No studies were identified that addressed the population, intervention, comparator, outcome, study design, and time frame question in the SysRev or the EvUp.

Prior Treatment Recommendations (2023)

We recommend a compression-first strategy (CAB) for laypeople providing resuscitation for adults and children in cardiac arrest caused by drowning (good practice statement).

We recommend health care professionals and those with a duty to respond to drowning (eg, lifeguards) consider providing rescue breaths/ventilation first (ABC) before chest compressions if they have been trained to do so (good practice statement).

Treatment Recommendations (2025)

We recommend a compression-first strategy (CAB) for laypeople providing resuscitation for adults in cardiac arrest caused by drowning (good practice statement).

Health care professionals and those trained and with a duty to respond to drowning (eg, lifeguards) should consider providing rescue breaths/ventilation first (ABC) before chest compressions (good practice statement).

Justification and Evidence-to-Decision Framework Highlights

There is no evidence-to-decision table because no evidence was identified. In making the good practice statements, the task force considered the following:

- The compression-first strategy for adults prioritizes simplicity and cohesiveness in training recommendations for laypersons, with the goal of faster initiation of resuscitation. We also considered the indirect manikin studies[110,112–115] published in the review of this question for all cardiac arrests (BLS 2202).
- The ventilation-first strategy for health care professionals and those with a duty to respond considers that indirect evidence from a study examining in-water ventilations may improve outcomes[236] and the specialized training of lifeguards and health care professionals (including cardiac monitoring and ventilation-delivery equipment). It is unclear if earlier ventilations improve outcomes once cardiac arrest has occurred or if the benefit is in preventing respiratory arrest from deteriorating into cardiac arrest.

Of note, no direct or indirect evidence is available to support any certain number of initial ventilations if lifeguards or health care professionals adopt a ventilationfirst strategy. Most importantly, resuscitation should not be delayed by either selected strategy.

Knowledge Gaps

There were no studies that directly evaluated this question. Further research, informed by the Utstein template for drowning, may usefully address this ongoing uncertainty.

Chest Compression–Only CPR in Cardiac Arrest in Drowning (BLS 2705: ScopRev 2023, SysRev 2023, EvUp 2025)

Intervention and Comparator

- Intervention: Chest compression–only CPR
- Comparator: Conventional CPR (compressions and ventilations)

Summary of Evidence

The EvUp identified no new studies. No SysRev is warranted.

Treatment Recommendations (2023)

For lay responders, the treatment recommendations for CPR in drowned OHCA patients who have been removed from the water remain consistent with CPR for all patients in cardiac arrest (good practice statement).

Adults: We recommend that bystanders perform chest compressions for all patients in cardiac arrest.

We suggest that bystanders who are trained, able, and willing to give rescue breaths and chest compressions do so for adults in cardiac arrest.

Children: We suggest that bystanders provide CPR with ventilation for infants and children younger than 18 years with OHCA.

We recommend that if bystanders cannot provide rescue breaths as part of CPR for infants and children younger than 18 years with OHCA, they should at least provide chest compressions.

For health care professionals and those with a duty to respond to drowning (eg, lifeguards), we recommend providing ventilation in addition to chest compressions if they have been trained and are able and willing to do so (good practice statement).

Ventilation Equipment in Cardiac Arrest Following Drowning (BLS 2706: ScopRev 2023, SysRev 2023, EvUp 2025)

Intervention and Comparator

- Intervention: Ventilation with equipment before hospital arrival
- Comparator: Ventilation without equipment before hospital arrival

Summary of Evidence

The EvUp identified no new studies. No SysRev is warranted.

Treatment Recommendations (2023)

We recommend using mouth-to-mouth, mouth-to-nose, or pocket-mask ventilation by BLS providers and laypeople for adults and children in cardiac arrest caused by drowning (good practice statement).

We suggest that bag-mask ventilation can be used by lifeguards or other BLS providers with a duty to respond, on the condition that it is part of a competency-based training program with regular retraining and maintenance of equipment (good practice statement).

We recommend that health care professionals follow the ALS treatment recommendations for airway management for adults and children in cardiac arrest caused by drowning.

Prehospital Oxygen Administration Following Drowning (BLS 2707: SysRev 2023, EvUp 2025)

Intervention and Comparator

- Intervention: Oxygen administration before hospital arrival
- Comparator: No oxygen administration before hospital arrival

Summary of Evidence

The EvUp identified no new studies. No SysRev is warranted.

Treatment Recommendations (2023)

When available, we recommend trained providers use the highest possible inspired oxygen concentration during resuscitation for adults and children in cardiac arrest following drowning (good practice statement).

AED Use First Versus CPR First in Cardiac Arrest in Drowning (BLS 2708: ScopRev 2023, SysRev 2023, EvUp 2025)

Intervention and Comparator

- Intervention: AED administered before CPR
- Comparator: CPR administered before AED

Summary of Evidence

The EvUp identified no new studies. No SysRev is warranted.

Treatment Recommendations (2023)

We recommend that CPR should be started first and continued until an AED has been obtained and is ready for use for adults and children in cardiac arrest caused by drowning (good practice statement).

When available, we recommend an AED is used in cardiac arrest caused by drowning in adults and children (good practice statement).

PAD Programs for Drowning (BLS 2709: SysRev 2023, EvUp 2025)

Intervention and Comparator

- Intervention: PAD program
- Comparator: Absence of PAD program

Summary of Evidence

The EvUp identified no new studies. No SysRev is warranted.

Treatment Recommendations (2023)

This treatment recommendation is unchanged from the standing recommendation for all OHCAs.

We recommend implementing PAD programs for all patients with OHCA (strong recommendation, lowcertainty evidence).

CPR During Transport (BLS 2715: SysRev 2022, EvUp 2025)

A 2022 SysRev and 2025 EvUp examined the evidence on CPR during transport. The details of this SysRev can be found in the 2022 CoSTR summary[170,171] and on the ILCOR website.[237] The 2025 EvUp is provided in Appendix B.

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children receiving CPR following OHCA
- Intervention: Transport with ongoing CPR
- Comparator: Completing CPR on scene (until ROSC or termination of resuscitation)
- Outcomes:
  - Critical: Survival to hospital discharge with good neurological outcome; survival to hospital discharge
  - Important: Quality of CPR metrics on scene versus during transport (reported outcomes may include rate of chest compressions, depth of chest compressions, chest compression fraction, interruptions to chest compressions, leaning on chest/incomplete release, rate of ventilation, volume of ventilation, duration of ventilation, pressure of ventilation); ROSC
- Time frame: November 2020 to April 22, 2024

Summary of Evidence

The EvUp identified several studies,[238–247] including a protocol[248] and early results in abstract form[249] for a recently completed but not yet fully published RCT. This SysRev will be updated following the publication of the RCT.

Treatment Recommendations (2022)

We suggest that providers deliver resuscitation at the scene rather than undertake ambulance transport with ongoing resuscitation unless there is an appropriate indication to justify transport (eg, extracorporeal membrane oxygenation) (weak recommendation, very low–certainty evidence).

The quality of manual CPR may be reduced during transport. We recommend that whenever transport is indicated, EMS providers should focus on the delivery of high-quality CPR throughout transport (strong recommendation, very low–certainty evidence).

Delivery of manual CPR during transport increases the risk of injury to providers. We recommend that EMS systems have a responsibility to assess this risk and, where practicable, to implement measures to mitigate the risk (good practice statement).

CPR in Obese Patients (BLS 2720, ScopRev 2025)

Rationale for Review

This topic was prioritized for review by the BLS, the ALS, the PLS, and the Education, Implementation, and Teams Task Forces because of the increasing prevalence of obesity worldwide and the specific challenges in providing CPR to this patient cohort. This topic has not previously been reviewed by ILCOR. The full details of this review can be found in the ScopRev[250] and on the ILCOR website.[251]

Population, Intervention, Comparator, Outcome, and Time Frame

- Population: Adults and children in any setting (inhospital or out-of-hospital) with cardiac arrest
- Intervention: CPR (including mechanical and e-CPR) in obese patients (as defined in specific papers)

- Comparators: May have no comparator, comparator of nonobese patients, or compare modified CPR for obese patients with standard CPR
- Outcomes:
  - Critical: Survival to hospital discharge with good neurological outcome; survival to hospital discharge
  - Important: ROSC; CPR quality measures (chest compression rate, chest compression depth, ventilation rate, tidal volume, end-tidal carbon dioxide), CPR timing (time to commencement of rescue breaths, first compression, first defibrillation if shockable rhythm); CPR techniques (chest compressions, defibrillation, ventilation and airway management, vascular access and medications); health-related quality of life and CPR provider outcomes (safety, manual handling)
- Time frame: All years to October 1, 2024

Summary of Evidence

Thirty-six studies were included.[252–287] Definitions of *obesity* varied. Full reporting of the results can be found in the ScopRev.[250]

In adults, the association between obesity and neurological outcomes, survival to hospital discharge, longer-term survival (months to years), and ROSC was variable. In children, worse neurological outcomes, lower survival, and lower ROSC than normal-weight children were reported in 2 studies. Few studies reported resuscitation quality indicators, and no studies reported on adjustments to CPR techniques or outcomes for those providing CPR.

Task Force Insights

The task force discussed the review findings and noted the following:

- At the time of this review, there was no universal definition of obesity, so for the purposes of this ScopRev, obese was defined according to each individual study. There was wide variability in the definitions of obesity across the studies.
- In adults, the evidence of the impact of obesity on patient outcomes was conflicting.
- In children, 2 studies suggested that obese children had worse neurological outcomes, lower survival, and lower ROSC than normal-weight children.
- The variability in results does not suggest an urgent need to deviate from standard CPR protocols. Some evidence suggests CPR duration may be longer in obese adults, which may have staffing and resource implications.

Treatment Recommendations

Standard CPR protocols should be used in obese patients (good practice statement).

Knowledge Gaps

- Few studies of CPR in obese infants, children, and adolescents
- A standardized definition of obese, or populationspecific definition of obese, for the purpose of resuscitation research
- The true impact of obesity on CPR outcomes when other factors are accounted for
- The effect of obesity on CPR techniques (such as chest compressions, airway management and ventilation, and defibrillation), CPR quality, and time to and delivery of resuscitation interventions (such as vascular access and medications, use of mechanical CPR devices, or extracorporeal membrane oxygenation) in both adults and children
- Whether the degree of obesity influences CPR performance, outcomes following CPR (including health-related quality of life), or inclusion in CPR research
- The effect of patient obesity on outcomes of those providing CPR (eg, physical exertion, manual handling, fatigue)

Topics Not Included in the 2025 Review

- PAD programs (BLS 2121)
- CPR prior to defibrillation (BLS 2203)
- Check for circulation during BLS (BLS 2210)
- Timing of rhythm check (BLS 2211)
- Chest compression rate, depth, recoil (BLS 2501)

Topics Retired or Reposed

- Rescuer fatigue in chest compression–only CPR
- CPR before call for help
- Alternative compression techniques (cough, precordial thump, fist pacing)

Topics Moved to the First Aid Task Force

- Harm from CPR to victims not in arrest
- Foreign-body airway obstruction
- Resuscitation care for suspected opioid-associated emergencies
- Drowning factors related to survival

Disclosures

Writing Group Disclosures

Writing group member	Employment	Research grant	Other research support	Speakers' bureau/ honoraria	Expert witness	Ownership interest	Consultant/ advisory board	Other
Janet E. Bray	Monash University and Curtin University (Australia)	Australian Resuscitation Council†; Laerdal Foundation†; Heart Foundation of Australia†	None	None	None	None	Australian Resuscitation Council*	Elsevier†; Heart Foundation of Australia†

(continued on next page)

(continued)

Writing group member	Employment	Research grant	Other research support	Speakers' bureau/ honoraria	Expert witness	Ownership interest	Consultant/ advisory board	Other
Michael A. Smyth	University of Warwick (United Kingdom)	None	None	None	None	None	None	None
Katherine M. Berg	Beth Israel Deaconess Medical Center and Harvard Medical School	None	None	None	None	None	AHA/ILCOR†	None
Rebecca E. Cash	Massachusetts General Hospital	NIH†; Society for Academic Emergency Medicine Foundation†	None	None	None	None	American College of Emergency Physicians†; Prehospital Guidelines Consortium*; Air Methods Corporation†	Massachusetts General Hospital†
Sung Phil Chung	Gangnam Severance Hospital, Yonsei University (South Korea)	None	None	None	None	None	None	None
Julie Considine	Deakin University and Eastern Health (Australia)	None	None	None	None	None	None	None
Katie N. Dainty	North York General Hospital (Canada)	AMS Healthcare*; Canadian Institutes of Health Research*	None	None	None	None	Philips Healthcare*	North York General Hospital†
Vihara Dassanayake	University of Colombo (Sri Lanka)	None	None	None	None	None	None	None
Guillaume Debaty	University Hospital of Grenoble (France)	DGOS (national research grant)*; Advanced CPR solution*; Stryker*	None	None	None	None	None	None
Maya Dewan	Cincinnati Children's Hospital Medical Center	None	None	None	None	None	None	None
Bridget Dicker	Hato Hone St John; Auckland University of Technology (New Zealand)	Health Research Council New Zealand†	None	None	None	None	None	Auckland University of Technolgy (AUT)†; Hato Hone St John New Zealand*
Natasha Dodge	Monash University (Australia)	None	None	None	None	None	None	None
Fredrik Folke	Gentofte University Hospital, Hellerup (Denmark)	None	None	None	None	None	None	None
Carolina Malta Hansen	Copenhagen Emergency Medical Sevices (Denmark)	Laerdal Foundation†; Novo Nordisk Foundation†; Independent Research Fund Denmark†; Helsefonden†; Capital Region of Denmark Research Fund†; TrygFonden† Zoll†	None	None	None	None	Duke Clinical Research Institute†	ERC 2025 Guidelines writing group*
Takanari Ikeyama	Aichi Children's Health and Medical Center (Japan)	Japan Society for the Promotion of Science (JSPS)*	None	None	None	None	None	None
Nicholas J. Johnson	University of Washington	NIH†; American Heart Association†; Centers for Disease Control and Prevention†	None	None	None	None	None	None

(continued)

Writing group member	Employment	Research grant	Other research support	Speakers' bureau/ honoraria	Expert witness	Ownership interest	Consultant/ advisory board	Other
Anthony Lagina	Wayne State University	NIH*	None	None	2025 expert witness for defense, Aortic Dissection Case*	None	None	None
George Lukas	Monash Health (Australia)	None	None	None	None	None	None	None
Siobhan Masterson	HSE National Ambulance Service (Ireland)	None	None	None	None	None	None	None
Peter T. Morley	University of Melbourne and Royal Melbourne Hospital (Australia)	None	None	None	None	None	None	None
Laurie J. Morrison	St. Michael's Hospital and University of Toronto (Canada)	None	None	None	None	None	None	None
Ziad Nehme	Ambulance Victoria and Monash University (Australia)	National Heart Foundation†; National Health and Medical Research Council†	None	None	None	None	None	Rapid Response Revival†
Tatsuya Norii	The University of New Mexico	Japanese Association for Acute Medicine*	None	None	None	None	None	None
Theresa M. Olasveengen	Oslo University Hospital and University of Oslo (Norway)	None	None	None	None	None	Laerdal Foundation*	None
Gavin D. Perkins	Warwick Medical School and University Hospitals NHS Foundation Trust (United Kingdom)	BHF†; RCUK†; NIHR†	None	None	None	None	Elsevier†	University Hospitals Coventry and Warwickshire†
Violetta Raffay	European University Cyprus (Cyprus)	None	None	None	None	None	None	None
Giuseppe Ristagno	Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico (Italy)	None	None	None	None	None	Phillips North America LLC*	None
Aloka Samantaray	Sri Venkateswara Institute of Medical Sciences, Tirupati, India (India)	None	None	None	None	None	None	None
Federico Semeraro	Maggiore Hospital (Italy)	None	None	None	None	None	None	None
Baljit Singh	SS Tantia University, Sri Ganganagar (India)	None	None	None	None	None	None	None
Christopher M. Smith	Warwick Medical School	National Institute for Health Research†;	None	None	None	None	None	Resuscitation Council UK*

(*continued on next page*)

(continued)

Writing group member	Employment	Research grant	Other research support	Speakers' bureau/ honoraria	Expert witness	Ownership interest	Consultant/ advisory board	Other
	(United Kingdom)	British Heart Foundation[†]; Resuscitation Council UK[†]						
Christian Vaillancourt	University of Ottawa, Ottawa Hospital Research Institute (Canada)	None	None	None	None	None	None	None

This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $5000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $5000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

[*] Modest.

[†] Significant.

Reviewer Disclosures

Reviewer	Employment	Research grant	Other research support	Speakers' bureau/ honoraria	Expert witness	Ownership interest	Consultant/advisory board	Other
Adam Benson Clarke	Resuscitation Council UK (United Kingdom)	None	None	None	None	None	None	None
Michael Bradfield	Resuscitation Council UK (United Kingdom)	None	None	None	None	None	British Heart Foundation, Co-Chair of National Advisory Board for The Circuit (UK defibrillator database)[*]; Trustee, Dorset and Somerset Air Ambulance (UK)[*]; Trustee, MedicAlert UK Foundation[*]	Resuscitation Council UK (Director of Clinical and Service Development)[†]; Bournemouth University UK (Visiting Fellow)[*]; South Western Ambulance Service NHS Foundation Trust, UK (Paramedic)[*]
Jonathan Hulme	City and Sandwell Hospital (United Kingdom)	None	None	None	None	None	None	None
Atul Jindal	All India Institute of Medical Sciences (India)	None	None	None	None	None	None	None
Jhuma Sankar	All India Institute of Medical Sciences (India)	None	None	None	None	None	None	None

This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $5000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $5000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

[*] Modest.

[†] Significant.

ARTICLE INFORMATION

The European Resuscitation Council requests that this document be cited as follows: Bray JE, Smyth MA, Perkins GD, Cash RE, Chung SP, Considine J, Dainty KN, Dassanayake V, Debaty G, Dewan M, Dicker B, Dodge N, Folke F, Ikeyama T, Hansen CM, Johnson NJ, Lukas G, Lagina A, Masterson S, Morley PT, Morrison LJ, Nehme Z, Norii T, Raffay V, Ristagno G, Samantaray A, Semeraro F, Singh B, Smith CM, Vaillancourt C, Berg KM, Olasveengen TM. Basic life support: *2025 International Liaison Committee on Resuscitation* Consensus on Science With Treatment Recommendations. *Resuscitation* 2025;215 (Suppl 2):110808.

This article has been co-published in *Circulation*.

Acknowledgement

The writing group would like to acknowledge Jaylen I. Wright for his organizational and administrative assistance in preparing the manuscript.

Collaborators

The authors thank the following individuals (the Basic Life Support Collaborators) for their contributions: Stella Le, Lorena Romero, Ingrid Tjelmeland, Anne S. Noerskov, Anne Juul Grabmayr, Lawrence Oonyu.

Appendices A, B and C. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.resuscitation.2025.110808.

REFERENCES

1. International Liaison Committee on Resuscitation. ILCOR website. https://www.ilcor.org/. Accessed 10 January 2025.
2. Morley PT, Berg KM, Billi JE, et al. Methodology and conflict of interest management: 2025 International Liaison Committee on Resuscitation Consensus on Science With Treatment Recommendations. *Resuscitation* 2025;215 (Suppl 2):110814.
3. Greif R, Cheng A, Abelairas-Gómez C, et al. Education, implementation, and teams: 2025 International Liaison Committee on Resuscitation Consensus on Science With Treatment Recommendations. *Resuscitation* 2025;215 (Suppl 2):110807.
4. Drennan IR, Berg KM, Böttiger BW, et al. Advanced life support: 2025 International Liaison Committee on Resuscitation Consensus on Science With Treatment Recommendations. *Resuscitation* 2025;215 (Suppl 2):110806.
5. Chung SP, Nehme Z, Johnson NJ, Lagina A, Bray J, on behalf of the International Liaison Committee on Resuscitation ILCOR Basic Life Support Task Force. Effects of personal protective equipment on cardiopulmonary resuscitation quality and outcomes: a systematic review. Resusc Plus 2023;14:100398. https://doi.org/10.1016/j.resplu.2023.100398.
6. Berg KM, Bray JE, Ng KC, et al. and Collaborators. 2023 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Circulation 2023;2023(148):e187–280. https://doi.org/10.1161/CIR.0000000000001179.
7. Berg KM, Bray JE, Ng KC, et al. 2023 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Resuscitation 2023;195:109992. https://doi.org/10.1016/j.resuscitation.2023.109992.
8. Chung SP, Nehme Z, Lagina A, Johnson NJ, Bray J; on behalf of the International Liaison Committee on Resuscitation BLS Task Force. CPR by rescuers wearing PPE vs no PPE for cardiac arrest in adults and children Consensus on Science with Treatment Recommendations; 2023. https://costr.ilcor.org/document/cpr-by-rescuers-wearing-ppe-bls-tfsr. Accessed 10 January 2025.
9. Tangpaisarn T, Chaiyakot N, Saenpan K, et al. Surgical mask-to-mouth ventilation as an alternative ventilation technique during CPR: a crossover randomized controlled trial. Am J Emerg Med 2023;72:158–63. https://doi.org/10.1016/j.ajem.2023.07.046.
10. Starosolski M, Zysiak-Christ B, Kalemba A, Kapłan C, Ulbrich K. A Simulation study using a quality cardiopulmonary resuscitation medical manikin to evaluate the effects of using personal protective equipment on performance of emergency resuscitation by medical students from the University of Silesia, Katowice, Poland and non-medical personnel. Med Sci Monitor 2022;28:e936841–4. https://doi.org/10.12659/MSM.936844.
11. Sellmann T, Nur M, Wetzchewald D, et al. COVID-19 CPR—impact of personal protective equipment during a simulated cardiac arrest in times of the COVID-19 pandemic: a prospective comparative trial. J Clin Med 2022;11:5881. https://doi.org/10.3390/jcm11195881.
12. Cheng C-H, Cheng Y-Y, Yuan M-K, et al. Impact of personal protective equipment on cardiopulmonary resuscitation and rescuer safety. Emerg Med Int 2023;2023:9697442. https://doi.org/10.1155/2023/9697442.
13. Ashoor HM, Lillie E, Zarin W, ILCOR Basic Life Support Task Force, et al. Effectiveness of different compression-to-ventilation methods for cardiopulmonary resuscitation: a systematic review. Resuscitation 2017;118:112–25. https://doi.org/10.1016/j.resuscitation.2017.05.032.
14. Olasveengen TM, de Caen AR, Mancini ME, on behalf of the ILCOR Collaborators, et al. 2017 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations Summary. Circulation 2017;2017(136):e424–40. https://doi.org/10.1161/CIR.0000000000000541.
15. Olasveengen TM, de Caen AR, Mancini ME, on behalf of the ILCOR Collaborators, et al. 2017 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations Summary. Resuscitation 2017;2017(121):201–14. https://doi.org/10.1016/j.resuscitation.2017.10.021.
16. Deleted in proof.
17. Bray J, Cash R, Nehme Z, et al. Bystander (without DA-CPR) compression-only CPR compared with conventional CPR in adults Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/bystander-without-da-cpr-compression-only-cpr-compared-with-conventional-cpr-in-adults-bls-2220-tf-sr. Accessed 10 January 2025.
18. Olasveengen TM, Wik L, Steen PA. Standard basic life support vs. continuous chest compressions only in out-of-hospital cardiac arrest. Acta Anaesthesiol Scand 2008;52:914–9. https://doi.org/10.1111/j.1399-6576.2008.01723.x.
19. SOS-Kanto Study Group. Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study. Lancet 2007;369:920–6. https://doi.org/10.1016/S0140-6736(07)60451-6.
20. Iwami T, Kitamura T, Kiyohara K, Kawamura T. Dissemination of chest compression-only cardiopulmonary resuscitation and survival after out-of-hospital cardiac arrest. Circulation 2015;132:415–22. https://doi.org/10.1161/CIRCULATIONAHA.114.014905.
21. Iwami T, Kawamura T, Hiraide A, et al. Effectiveness of bystander-initiated cardiac-only resuscitation for patients with outof-hospital cardiac arrest. Circulation 2007;116:2900–7. https://doi.org/10.1161/CIRCULATIONAHA.107.723411.
22. Ong ME, Ng FS, Anushia P, et al. Comparison of chest compression only and standard cardiopulmonary resuscitation for out-of-hospital cardiac arrest in Singapore. Resuscitation 2008;78:119–26. https://doi.org/10.1016/j.resuscitation.2008.03.012.
23. Bohm K, Rosenqvist M, Herlitz J, Hollenberg J, Svensson L. Survival Is similar after standard treatment and chest compression only in out-of-hospital bystander cardiopulmonary resuscitation. Circulation 2007;116:2908–12. https://doi.org/10.1161/CIRCULATIONAHA.107.710194.
24. Bobrow BJ, Spaite DW, Berg RA, et al. Chest compression-only CPR by lay rescuers and survival from out-of-hospital cardiac arrest. J Am Med Assoc 2010;304:1447–54. https://doi.org/10.1001/jama.2010.1392.

25. Bray JE, Deasy C, Walsh J, Bacon A, Currell A, Smith K. Changing EMS dispatcher CPR instructions to 400 compressions before mouth-to-mouth improved bystander CPR rates. Resuscitation 2011;82:1393–8. https://doi.org/10.1016/j.resuscitation.2011.06.018.
26. Kitamura T, Iwami T, Kawamura T, on behalf of the Japanese Circulation Society Resuscitation Science Study Group, et al. Nationwide improvements in survival from out-ofhospital cardiac arrest in Japan. Circulation 2012;126:2834–43. https://doi.org/10.1161/CIRCULATIONAHA.112.109496.
27. Malta Hansen C, Kragholm K, Pearson DA, et al. Association of bystander and first-responder intervention with survival after out-of-hospital cardiac arrest in North Carolina, 2010–2013. J Am Med Assoc 2015;314:255–64. https://doi.org/10.1001/jama.2015.7938.
28. Waalewijn RA, Tijssen JG, Koster RW. Bystander initiated actions in outof-hospital cardiopulmonary resuscitation: results from the Amsterdam Resuscitation Study (ARRESUST). Resuscitation 2001;50:273–9. https://doi.org/10.1016/s0300-9572(01)00354-9.
29. Panchal AR, Bobrow BJ, Spaite DW, et al. Chest compression-only cardiopulmonary resuscitation performed by lay rescuers for adult out-of-hospital cardiac arrest due to non-cardiac aetiologies. Resuscitation 2013;84:435–9. https://doi.org/10.1016/j.resuscitation.2012.07.038.
30. Van Hoeyweghen RJ, Bossaert LL, Mullie A, et al. Quality and efficiency of bystander CPR. Belgian Cerebral Resuscitation Study Group. Resuscitation 1993;26:47–52. https://doi.org/10.1016/0300-9572(93)90162-j.
31. Riva G, Boberg E, Ringh M, et al. Compression-only or standard cardiopulmonary resuscitation for trained laypersons in out-of-hospital cardiac arrest: a nationwide randomized trial in Sweden. Circ Cardiovasc Qual Outcomes 2024;17:e010027. https://doi.org/10.1161/CIRCOUTCOMES.122.010027.
32. Bray JE, Smith K, Case R, Cartledge S, Straney L, Finn J. Public cardiopulmonary resuscitation training rates and awareness of hands-only cardiopulmonary resuscitation: a cross-sectional survey of Victorians. Emerg Med Australas 2017;29:158–64. https://doi.org/10.1111/1742-6723.12720.
33. Cheskes L, Morrison LJ, Beaton D, Parsons J, Dainty KN. Are Canadians more willing to provide chest-compression-only cardiopulmonary resuscitation (CPR)?—a nation-wide public survey. CJEM 2016;18:253–63. https://doi.org/10.1017/cem.2015.113.
34. Min Ko RJ, Wu VX, Lim SH, San Tam WW, Liaw SY. Compression-only cardiopulmonary resuscitation in improving bystanders' cardiopulmonary resuscitation performance: a literature review. Emerg Med J 2016;33:882–8. https://doi.org/10.1136/emermed-2015-204771.
35. Beard M, Swain A, Dunning A, Baine J, Burrowes C. How effectively can young people perform dispatcher-instructed cardiopulmonary resuscitation without training? Resuscitation 2015;90:138–42. https://doi.org/10.1016/j.resuscitation.2015.02.035.
36. Drennan IR, Geri G, Brooks S, on behalf of the Basic Life Support (BLS), Pediatric Life Support (PLS) and Education, Implementation and Teams (EIT) Taskforces of the International Liaison Committee on Resuscitation (ILCOR), et al. Diagnosis of out-of-hospital cardiac arrest by emergency medical dispatch: a diagnostic systematic review. Resuscitation 2021;159:85–96. https://doi.org/10.1016/j.resuscitation.2020.11.025.
37. Olasveengen TM, Mancini ME, Perkins GD, on behalf of the Adult Basic Life Support Collaborators, et al. Adult basic life support: International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Resuscitation 2020;156:A35–79. https://doi.org/10.1016/j.resuscitation.2020.09.010.
38. Olasveengen TM, Mancini ME, Perkins GD, on behalf of the Adult Basic Life Support Collaborators, et al. Adult basic life support: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation 2020;2020(142):S41–91. https://doi.org/10.1161/CIR.0000000000000892.
39. Juul Grabmayr A, Dicker B, Dassanayake V, on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force, et al. Optimising telecommunicator recognition of out-of-hospital cardiac arrest: a scoping review. Resusc Plus 2024;20:100754. https://doi.org/10.1016/j.resplu.2024.100754.
40. Greif R, Bray JE, Djarv T, et al. 2024 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Circulation 2024;150:e580–687. https://doi.org/10.1161/CIR.0000000000001288.
41. Greif R, Bray JE, Djarv T, et al. 2024 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Resuscitation 2024;205:110414. https://doi.org/10.1016/j.resuscitation.2024.110414.
42. Malta Hansen C, Juul Grabmayr A, Dicker B, et al.; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Optimization of dispatcher-assisted recognition of out-of-hospital cardiac arrest: a BLS task force synthesis of a scoping review. 2024. https://costr.ilcor.org/document/optimization-of-dispatcher-assisted-da-recognition-of-ohca-a-scoping-review-bls-2102-scr. Accessed 10 January 2025.
43. Tangpaisarn T, Srinopparatanakul T, Artpru R, Kotruchin P, Ienghong K, Apiratwarakul K. Unrecognized out of hospital cardiac arrest symptoms during thailand's emergency medical services. Open Access Macedonian J Med Sci 2021;9:1–4. https://doi.org/10.3889/oamjms.2021.6867.
44. Saberian P, Sadeghi M, Hasani-Sharamin P, Modabber M, Baratloo A. Diagnosis of out-of-hospital cardiac arrest by emergency medical dispatchers: a diagnostic accuracy study. Australas J Paramed 2019;16:1–7. https://doi.org/10.33151/ajp.16.691.
45. Soar J, Maconochie I, Wyckoff MH, et al. 2019 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Circulation 2019;140:e826–80. https://doi.org/10.1161/CIR.0000000000000734.
46. Soar J, Maconochie I, Wyckoff MH, et al. 2019 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Resuscitation 2019;145:95–150. https://doi.org/10.1016/j.resuscitation.2019.10.016.
47. Dainty KN, Debaty G, Waddick J, on behalf of the International Liaison Committee on Resuscitation BLS Task Force, et al. Interventions to optimize dispatcher-assisted CPR instructions: a scoping review. Resusc Plus 2024;19:100715. https://doi.org/10.1016/j.resplu.2024.100715.
48. Dainty K, Debaty GVC, Smyth M, Olasveengen T, Bray J; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Interventions used with dispatcher-assisted CPR task force synthesis of a scoping review; 2024. https://costr.ilcor.org/document/optimization-of-dispatcher-assisted-cpr-instructions-a-scoping-review-bls-2113-scr. Accessed 10 January 2025.
49. Aranda-Garcia S, Barrio-Cortes J, Fernandez-Mendez F, et al. Dispatcher-assisted BLS for lay bystanders: a pilot study comparing video streaming via smart glasses and telephone instructions. Am J Emerg Med 2023;71:163–8. https://doi.org/10.1016/j.ajem.2023.06.035.

50. Barcala-Furelos R, Aranda-Garcia S, Otero-Agra M, et al. Are smart glasses feasible for dispatch prehospital assistance during on-boat cardiac arrest? A pilot simulation study with fishermen. Intern Emerg Med 2023;18:1551–9. https://doi.org/10.1007/s11739-023-03251-6.
51. Chen YJ, Chen CY, Kang CW, et al. Dispatchers trained in persuasive communication techniques improved the effectiveness of dispatcher-assisted cardiopulmonary resuscitation. Resuscitation 2024;196:110120. https://doi.org/10.1016/j.resuscitation.2024.110120.
52. Holzing CR, Brinkrolf P, Metelmann C, Metelmann B, Hahnenkamp K, Baumgarten M. Potential to enhance telephone cardiopulmonary resuscitation with improved instructions findings from a simulation-based manikin study with lay rescuers. BMC Emerg Med 2023;23:36. https://doi.org/10.1186/s12873-023-00810-0.
53. Ohk T, Cho J, Yang G, et al. Effectiveness of a dispatcher-assisted CPR using an animated image: simulation study. Am J Emerg Med 2024;78:132–9. https://doi.org/10.1016/j.ajem.2024.01.022.
54. Szollosi V, Horvath B, Nemeth D, Banfai-Csonka H, Betlehem J, Banfai B. A randomized controlled simulation trial comparing video-assisted with telephone-assisted and unassisted cardiopulmonary resuscitation performed by non-healthcare university students. Sci Rep 2023;13:14925. https://doi.org/10.1038/s41598-023-42131-z.
55. Takano K, Asai H, Fukushima H. Effect of coaching with repetitive verbal encouragements on dispatch-assisted cardiopulmonary resuscitation: a randomized simulation study. J Emerg Med 2022;63:240–6. https://doi.org/10.1016/j.jemermed.2022.05.010.
56. Wetsch WA, Ecker HM, Scheu A, Roth R, Bottiger BW, Plata C. Videoassisted cardiopulmonary resuscitation: does the camera perspective matter? A randomized, controlled simulation trial. J Telemed Telecare 2024;30:98–106. https://doi.org/10.1177/1357633X211028490.
57. Xu J, Qu M, Dong X, et al. Tele-instruction tool for multiple lay responders providing cardiopulmonary resuscitation in telehealth emergency dispatch services: mixed methods study. J Med Internet Res 2023;25:e46092. https://doi.org/10.2196/46092.
58. Cash R, Nehme Z, de Caen A, et al. on behalf of the International Liaison Committee on Resuscitation (ILCOR) Basic Life Support Task Force. Dispatcher-assisted compression-only CPR compared with conventional CPR in adults Consensus on Science with Treatment Recommendations; 2024. https://costr.ilcor.org/document/ dispatcher-assisted-compression-only-cpr-compared-with-conventional-cpr-in-adults-bls-2112-tf-sr. Accessed 10 January 2025.
59. Rea TD, Fahrenbruch C, Culley L, et al. CPR with chest compression alone or with rescue breathing. N Engl J Med 2010;363:423–33. https://doi.org/10.1056/NEJMoa0908993.
60. Hallstrom A, Cobb L, Johnson E, Copass M. Cardiopulmonary resuscitation by chest compression alone or with mouth-to-mouth ventilation. N Engl J Med 2000;342:1546–53. https://doi.org/10.1056/NEJM200005253422101.
61. Svensson L, Bohm K, Castren M, et al. Compression-only CPR or standard CPR in outof-hospital cardiac arrest. N Engl J Med 2010;363:434–42. https://doi.org/10.1056/NEJMoa0908991.
62. Goto Y, Funada A, Maeda T, Goto Y. Dispatcher instructions for bystander cardiopulmonary resuscitation and neurologically intact survival after bystander-witnessed out-of-hospital cardiac arrests: a nationwide, population-based observational study. Crit Care 2021;25:408. https://doi.org/10.1186/s13054-021-03825-w.
63. Javaudin F, Raiffort J, Desce N, on behalf of the GR-RéAC, et al. Neurological outcome of chest compression-only bystander CPR in asphyxial and non-asphyxial outof-hospital cardiac arrest: an observational study. Prehosp Emerg Care 2021;25:812–21. https://doi.org/10.1080/10903127.2020.1852354.
64. Wnent J, Tjelmeland I, Lefering R, on behalf of the national coordinators of EuReCa TWO and local contributors, et al. To ventilate or not to ventilate during bystander CPR A EuReCa TWO analysis. Resuscitation 2021;166:101–9. https://doi.org/10.1016/j.resuscitation.2021.06.006.
65. Kitamura T, Kiyohara K, Nishiyama C, et al. Chest compression-only versus conventional cardiopulmonary resuscitation for bystander-witnessed out-of-hospital cardiac arrest of medical origin: a propensity score-matched cohort from 143,500 patients. Resuscitation 2018;126:29–35. https://doi.org/10.1016/j.resuscitation.2018.02.017.
66. Sasson C, Rogers MA, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. Circ Cardiovasc Qual Outcomes 2010;3:63–81. https://doi.org/10.1161/CIRCOUTCOMES.109.889576.
67. Deleted in proof.
68. Deleted in proof.
69. Snow L, Whiting J, Olasveengen T, Bray J, Smith C, on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Optimization of dispatcher instruction for public-access automated external defibrillator retrieval and use: a scoping review. Resusc Plus 2025;25. https://doi.org/10.1016/j.resplu.2025.101005.
70. Smith CM, Snow L, Whiting J, Smyth M, Olasveengen T, Bray J; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Dispatcher instructions for public-access AED retrieval and/or use: a scoping review; 2024. https://costr.ilcor.org/document/optimization-of-dispatcher-assisted-pub-lic-access-aed-retrieval-and-use-a-scoping-review-bls-2120. Accessed 10 January 2025.
71. Kollander LJ, Kjærulf V, Bray J, Olasveengen TM, Folke F, on behalf of the International Liaison Committee on Resuscitation BLS Task Force. Drones delivering automated external defibrillators for out-of-hospital cardiac arrest: a scoping review. Resusc Plus 2025;21:100841. https://doi.org/10.1016/j.resplu.2024.100841.
72. Kollander LJ, Folke F, Bray J; on behalf of the International Liaison Committee on Resuscitation BLS Task Force. Drone AEDs task force synthesis of a scoping review. Published January 11, 2023. https://costr.ilcor.org/document/drone-aeds-bls-tf-scr. Accessed 10 January 2025.
73. Yukun J, Yanmang S, Yan W, Bei W, Shurui F. Improved immune algorithm for sudden cardiac death first aid drones site selection. Int J Med Inf 2023;173:105025. https://doi.org/10.1016/j.ijmedinf.2023.105025.
74. Starks MA, Chu J, Leung KB, et al. Combinations of first responder and drone delivery to achieve 5-minute AED deployment in OHCA. JACC Adv 2024;3:101033. https://doi.org/10.1016/j.jacadv.2024.101033.
75. Scholz SS, Wähnert D, Jansen G, et al. AED delivery at night–can drones do the Job? A feasibility study of unmanned aerial systems to transport automated external defibrillators during night-time. Resuscitation 2023;185:109734. https://doi.org/10.1016/j.resuscitation.2023.109734.
76. Schierbeck S, Nord A, Svensson L, et al. Drone delivery of automated external defibrillators compared with ambulance arrival in real-life suspected out-of-hospital cardiac arrests: a prospective observational study in Sweden. Lancet Digit Health 2023;5:e862–71. https://doi.org/10.1016/S2589-7500(23)00161-9.
77. Ren X, Li R. The location problem of medical drone vertiports for emergency cardiac arrest needs. Sustainability 2023;16:44. https://doi.org/10.3390/su16010044.
78. Purahong B, Anuwongpinit T, Juhong A, Kanjanasurat I, Pintavirooj C. Medical drone managing system for automated external defibrillator delivery service. Drones 2022;6:93. https://doi.org/10.3390/drones6040093.
79. Leith T, Correll JA, Davidson EE, et al. Bystander interaction with a novel multipurpose medical drone: a simulation trial. Resusc Plus 2024;18:100633. https://doi.org/10.1016/j.resplu.2024.100633.
80. Frigstad L, Furu V, Svenkerud SK, Claesson A, Andersson H, Granberg TA. Joint planning of drones and volunteers in emergency

response to outof-hospital cardiac arrest. Comput Ind Eng 2023;185:109648. https://doi.org/10.1016/j.cie.2023.109648.
81. Fischer P, Rohrer U, Nurnberger P, et al. Automated external defibrillator delivery by drone in mountainous regions to support basic life support - a simulation study. Resusc Plus 2023;14:100384. https://doi.org/10.1016/j.resplu.2023.100384.
82. Davidson EE, Correll JA, Gottula A, et al. Impact of drone-specific dispatch instructions on the safety and efficacy of drone-delivered emergency medical treatments: a randomized simulation pilot study. Resusc Plus 2024;18:100652. https://doi.org/10.1016/j.resplu.2024.100652.
83. Starks MA, Blewer AL, Chow C, et al. Incorporation of drone technology into the chain of survival for OHCA: estimation of time needed for bystander treatment of OHCA and CPR performance. Circ Cardiovasc Qual Outcomes 2024;17:e010061. https://doi.org/10.1161/CIRCOUTCOMES.123.010061.
84. Drennan IR, Lin S, Thorpe KE, Morrison LJ. The effect of time to defibrillation and targeted temperature management on functional survival after out-of-hospital cardiac arrest. Resuscitation 2014;85:1623–8. https://doi.org/10.1016/j.resuscitation.2014.07.010.
85. De Maio VJ, Stiell IG, Wells GA, Spaite DW, on behalf of the Ontario Prehospital Advanced Life Support Study Group. Optimal defibrillation response intervals for maximum out-of-hospital cardiac arrest survival rates. Ann Emerg Med 2003;42:242–50. https://doi.org/10.1067/mem.2003.266.
86. Nehme Z, Andrew E, Bernard S, Haskins B, Smith K. Trends in survival from out-of-hospital cardiac arrests defibrillated by paramedics, first responders and bystanders. Resuscitation 2019;143:85–91. https://doi.org/10.1016/j.resuscitation.2019.08.018.
87. O'Callaghan PA, Swampillai J, Stiles MK. Availability of automated external defibrillators in Hamilton, New Zealand. N Z Med J 2019;132:75–82.
88. Lac D, Wolters MK, Leung KHB, MacInnes L, Clegg GR. Factors affecting public access defibrillator placement decisions in the United Kingdom: a survey study. Resusc Plus 2023;13:100348. https://doi.org/10.1016/j.resplu.2022.100348.
89. Fortington LV, Bekker S, Finch CF. Integrating and maintaining automated external defibrillators and emergency planning in community sport settings: a qualitative case study. Emerg Med J 2020;37:617–22. https://doi.org/10.1136/emermed-2019-208781.
90. Oonyu L, Perkins GD, Smith CM, Vaillancourt C, Olasveengen TM, Bray JE, on behalf of the ILCOR BLS Task Force. The impact of locked cabinets for automated external defibrillators (AEDs) on cardiac arrest and AED outcomes: a scoping review. Resusc Plus 2024;20:100791. https://doi.org/10.1016/j.resplu.2024.100791.
91. Bray J, Oonyu L, Perkins G, Smith C, Vaillancourt C, Olasveengen T; on behalf of the International Liaison Committee on Resuscitation BLS Life Support Task Force. Accessibility of AEDs in locked cabinets: task force synthesis of a scoping review. Published October 7, 2024. Updated November 3, 2024. https://costr.ilcor.org/document/aed-accessibility-benefits-and-harms-if-locked-aed-cabinets-scoping-review-bls-2123-tf-scr. Accessed 10 January 2025.
92. Uhm TH, Kim JH. Factors affecting delivery time of public access defibrillator in apartment houses. Indian J Public Health Res Dev 2018;9:534–40. https://doi.org/10.5958/0976-5506.2018.01054.9.
93. Telec W, Baszko A, Dabrowski M, et al. Automated external defibrillator use in public places: a study of acquisition time. Kardiol Pol 2018;76:181–5. https://doi.org/10.5603/KP.a2017.0199.
94. Salerno J, Willson C, Weiss L, Salcido D. Myth of the stolen AED. Resuscitation 2019;140:1. https://doi.org/10.1016/j.resuscitation.2019.04.036.
95. Peberdy MA, Ottingham LV, Groh WJ, et al. Adverse events associated with lay emergency response programs: the public access defibrillation trial experience. Resuscitation 2006;70:59–65. https://doi.org/10.1016/j.resuscitation.2005.10.030.
96. Page G, Bray J. Unlocking the key to increasing survival from out-of-hospital cardiac arrest 24/7 accessible AEDs. Resuscitation 2024;199:110227. https://doi.org/10.1016/j.resuscitation.2024.110227.
97. Ludgate MB, Kern KB, Bobrow BJ, Ewy GA. Donating automated external defibrillators may not be enough. Circ Conf Am Heart Assoc 2012;126. https://doi.org/10.1161/circ.126.suppl_21.A39.
98. Benvenuti C, Burkart R, Mauri R. Public defibrillators and vandalism: myth or reality? Resuscitation 2013;1:S69.
99. Cheema K, O'Connell D, Herz N, et al. The influence of locked automated external defibrillators (AEDs) cabinets on the rates of vandalism and theft. Resuscitation 2022;175(Suppl 1):S80. https://doi.org/10.1016/s0300-9572(22)00530-5.
100. Brugada R, Morales A, Ramos R, Heredia J, De Morales ER, Batlle P. Girona, cardio-protected territory. Resuscitation 2014;85:S57. https://doi.org/10.1016/j.resuscitation.2014.03.144.
101. Ng JSY, Ho RJS, Yu J, Ng YY. Factors influencing success and safety of AED retrieval in out of hospital cardiac arrests in Singapore. Korean J Emerg Med Serv 2022;26:97–111. https://doi.org/10.14408/KJEMS.2022.26.2.097.
102. Didcoe M, Pavey-Smith C, Finn J, Belcher J. Locked vs. unlocked AED cabinets: the Western Australian perspective on improving accessibility and outcomes. Resusc Plus 2024;20:100807. https://doi.org/10.1016/j.resplu.2024.100807.
103. Bray JE, Perkins GD. Reply to locked vs. unlocked AED cabinets: the Western Australian perspective on improving accessibility and outcomes. Resusc Plus 2024;21:100838. https://doi.org/10.1016/j.resplu.2024.100838.
104. Brooks SC, Clegg GR, Bray J, on behalf of the International Liaison Committee on Resuscitation, et al. Optimizing outcomes after outof-hospital cardiac arrest with innovative approaches to public-access defibrillation: a scientific statement from the International Liaison Committee on Resuscitation. Resuscitation 2022;172:204–28. https://doi.org/10.1016/j.resuscitation.2021.11.032.
105. Brooks SC, Clegg GR, Bray J, on behalf of the International Liaison Committee on Resuscitation, et al. Optimizing outcomes after outof-hospital cardiac arrest with innovative approaches to public-access defibrillation: a scientific statement from the International Liaison Committee on Resuscitation. Circulation 2022;145:e776–801. https://doi.org/10.1161/CIR.0000000000001013.
106. Bray J, Dassanayake V, Considine J, Scholefield B, Olasveengen TM; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force and Paediatric Life Support Task Forces. Starting CPR (ABC vs. CAB) for cardiac arrest in adults and children Consensus on Science with Treatment Recommendations; 2024. https://costr.ilcor.org/document/ starting-cpr-abc-vs-cab-bls-2201-tf-sr. Accessed 10 January 2025.
107. Scholefield BR, Acworth J, Ng K-C, et al. Pediatric life support: 2025 International Liaison Committee on Resuscitation Consensus on Science With Treatment Recommendations. *Circulation*. 2025;152(suppl 1):S••• -S•••. https://doi.org/10.1161/CIR.0000000000001362.
108. Deleted in proof.
109. Deleted in proof.
110. Suppan L, Jampen L, Siebert JN, Zund S, Stuby L, Ozainne F. Impact of two resuscitation sequences on alveolar ventilation during the first minute of simulated pediatric cardiac arrest: randomized cross-over trial. Healthcare (Basel) 2022;10:2451. https://doi.org/10.3390/healthcare10122451.
111. Suppan L, Jampen L, Siebert JN, et al. Correction: Suppan et al. Impact of two resuscitation sequences on alveolar ventilation during the first minute of simulated pediatric cardiac arrest: randomized cross-over trial. Healthcare 2022, 10, 2451. Healthcare (Basel) 2022;11:1799. https://doi.org/10.3390/healthcare11121799.
112. Kobayashi M, Fujiwara A, Morita H, et al. A manikin-based observational study on cardiopulmonary resuscitation skills at the Osaka Senri medical rally. Resuscitation 2008;78:333–9. https://doi.org/10.1016/j.resuscitation.2008.03.230.

113. Lubrano R, Cecchetti C, Bellelli E, et al. Comparison of times of intervention during pediatric CPR maneuvers using ABC and CAB sequences: a randomized trial. Resuscitation 2012;83:1473–7. https://doi.org/10.1016/j.resuscitation.2012.04.011.
114. Marsch S, Tschan F, Semmer NK, Zobrist R, Hunziker PR, Hunziker S. ABC versus CAB for cardiopulmonary resuscitation: a prospective, randomized simulator-based trial. Swiss Med Wkly 2013;143:w13856. https://doi.org/10.4414/smw.2013.13856.
115. Sekiguchi H, Kondo Y, Kukita I. Verification of changes in the time taken to initiate chest compressions according to modified basic life support guidelines. Am J Emerg Med 2013;31:1248–50. https://doi.org/10.1016/j.ajem.2013.02.047.
116. Travers AH, Perkins GD, Berg RA, on behalf of the Basic Life Support Chapter Collaborators, et al. Part 3: Adult basic life support and automated external defibrillation: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation 2015;2015(132):S51–83. https://doi.org/10.1161/CIR.0000000000000272.
117. Perkins GD, Travers AH, Berg RA, on behalf of the Basic Life Support Chapter Collaborators, et al. Part 3: Adult basic life support and automated external defibrillation: 2015 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Resuscitation 2015;2015(95):e43–69. https://doi.org/10.1016/j.resuscitation.2015.07.041.
118. Pasupula DK, Bhat A, Siddappa Malleshappa SK, et al. Impact of change in 2010 American Heart Association cardiopulmonary resuscitation guidelines on survival after out-of-hospital cardiac arrest in the United States. Circ Arrhythm Electrophysiol 2020;13:e007843. https://doi.org/10.1161/CIRCEP.119.007843.
119. Garza AG, Gratton MC, Salomone JA, Lindholm D, McElroy J, Archer R. Improved patient survival using a modified resuscitation protocol for out-of-hospital cardiac arrest. Circulation 2009;119:2597–605. https://doi.org/10.1161/CIRCULATIONAHA.108.815621.
120. Mallikethi-Reddy S, Briasoulis A, Akintoye E, et al. Incidence and survival after in-hospital cardiopulmonary resuscitation in nonelderly adults: US experience, 2007 to 2012. Circ Cardiovasc Qual Outcomes 2017;10:e003194. https://doi.org/10.1161/CIRCOUTCOMES.116.003194.
121. Wang CH, Huang CH, Chang WT, et al. Outcomes of adults with in-hospital cardiac arrest after implementation of the 2010 resuscitation guidelines. Int J Cardiol 2017;249:214–9. https://doi.org/10.1016/j.ijcard.2017.09.008.
122. Nassar BS, Kerber R. Improving CPR performance. Chest 2017;152:1061–9. https://doi.org/10.1016/j.chest.2017.04.178.
123. Goh JL, Pek PP, Fook-Chong SMC, on behalf of the PAROS Clinical Research Network, et al. Impact of time-to-compression on out-of-hospital cardiac arrest survival outcomes: a national registry study. Resuscitation 2023;190:109917. https://doi.org/10.1016/j.resuscitation.2023.109917.
124. Nehme Z, Cash R, Dicker B, et al. Chest compression-toventilation ratios for cardiopulmonary resuscitation: a systematic review. Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/chest-compression-to-ventilation-ratios-for-cardiopulmonary-resuscitation-bls-2202-tf-sr. Accessed 10 January 2025.
125. Olasveengen TM, Vik E, Kuzovlev A, Sunde K. Effect of implementation of new resuscitation guidelines on quality of cardiopulmonary resuscitation and survival. Resuscitation 2009;80:407–11. https://doi.org/10.1016/j.resuscitation.2008.12.005.
126. Kudenchuk PJ, Redshaw JD, Stubbs BA, et al. Impact of changes in resuscitation practice on survival and neurological outcome after out-of-hospital cardiac arrest resulting from nonshockable arrhythmias. Circulation 2012;125:1787–94. https://doi.org/10.1161/CIRCULATIONAHA.111.064873.
127. Steinmetz J, Barnung S, Nielsen SL, Risom M, Rasmussen LS. Improved survival after an out-of-hospital cardiac arrest using new guidelines. Acta Anaesthesiol Scand 2008;52:908–13. https://doi.org/10.1111/j.1399-6576.2008.01657.x.
128. Sayre MR, Cantrell SA, White LJ, Hiestand BC, Keseg DP, Koser S. Impact of the 2005 American Heart Association cardiopulmonary resuscitation and emergency cardiovascular care guidelines on out-of-hospital cardiac arrest survival. Prehosp Emerg Care 2009;13:469–77. https://doi.org/10.1080/10903120903144965.
129. Hostler D, Rittenberger JC, Roth R, Callaway CW. Increased chest compression to ventilation ratio improves delivery of CPR. Resuscitation 2007;74:446–52. https://doi.org/10.1016/j.resuscitation.2007.01.022.
130. Deasy C, Bray JE, Smith K, et al. Cardiac arrest outcomes before and after the 2005 resuscitation guidelines implementation: evidence of improvement? Resuscitation 2011;82:984–8. https://doi.org/10.1016/j.resuscitation.2011.04.005.
131. Berdowski J, ten Haaf M, Tijssen JG, Chapman FW, Koster RW. Time in recurrent ventricular fibrillation and survival after out-ofhospital cardiac arrest. Circulation 2010;122:1101–8. https://doi.org/10.1161/CIRCULATIONAHA.110.958173.
132. Reynolds JC, Raffay V, Lang E, Morley PT, Nation K. When should chest compressions be paused to analyze the cardiac rhythm? A systematic review and meta-analysis. Resuscitation 2015;97:38–47. https://doi.org/10.1016/j.resuscitation.2015.09.385.
133. Smyth MA, Nishiyama C, Singh B, Olasveengen TM, Bray JE; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Duration of CPR cycles Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/duration-of-cpr-cyclesbls-2212-tf-sr. Accessed 10 January 2025.
134. Wik L, Hansen TB, Fylling F, et al. Delaying defibrillation to give basic cardiopulmonary resuscitation to patients with out-of-hospital ventricular fibrillation: a randomized trial. J Am Med Assoc 2003;289:1389–95. https://doi.org/10.1001/jama.289.11.1389.
135. Baker PW, Conway J, Cotton C, et al. Clinical Investigators. Defibrillation or cardiopulmonary resuscitation first for patients with out-of-hospital cardiac arrests found by paramedics to be in ventricular fibrillation? A randomised control trial. Resuscitation 2008;79:424–31. https://doi.org/10.1016/j.resuscitation.2008.07.017.
136. Nehme Z, Cash R, Dicker B, et al. Continuous chest compressions versus standard cardiopulmonary resuscitation for EMS: a Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/continuous-chest-compressions-ccc-versus-standard-cpr-for-ems-bls-2221-tf-sr. Accessed 10 January 2025.
137. Nichol G, Leroux B, Wang H, on behalf of the ROC Investigators, et al. Trial of continuous or interrupted chest compressions during CPR. N Engl J Med 2015;373:2203–14. https://doi.org/10.1056/NEJMoa1509139.
138. Bobrow BJ, Clark LL, Ewy GA, et al. Minimally interrupted cardiac resuscitation by emergency medical services for out-of-hospital cardiac arrest. J Am Med Assoc 2008;299:1158–65. https://doi.org/10.1001/jama.299.10.1158.
139. Grunau B, Singer J, Lee T, et al. A local sensitivity analysis of the trial of continuous or interrupted chest compressions during cardiopulmonary resuscitation: is a local protocol change required? Cureus 2018;10:e3386. https://doi.org/10.7759/cureus.3386.
140. Schmicker RH, Nichol G, Kudenchuk P, et al. CPR compression strategy 30:2 is difficult to adhere to, but has better survival than continuous chest compressions when done correctly. Resuscitation 2021;165:31–7. https://doi.org/10.1016/j.resuscitation.2021.05.027.
141. van Eijk JA, Doeleman LC, Loer SA, Koster RW, van Schuppen H, Schober P. Ventilation during cardiopulmonary resuscitation: a narrative review. Resuscitation 2024;203:110366. https://doi.org/10.1016/j.resuscitation.2024.110366.

142. Idris AH, Aramendi Ecenarro E, Leroux B, et al. Bag-valve-mask ventilation and survival from out-of-hospital cardiac arrest: a multicenter study. Circulation 2023;148:1847–56. https://doi.org/10.1161/CIRCULATIONAHA.123.065561.
143. Christenson J, Andrusiek D, Everson-Stewart S, et al. and the Resuscitation Outcomes Consortium Investigators. Chest compression fraction determines survival in patients with out-ofhospital ventricular fibrillation. Circulation 2009;120:1241–7. https://doi.org/10.1161/CIRCULATIONAHA.109.852202.
144. Berg RA, Sanders AB, Kern KB, et al. Adverse hemodynamic effects of interrupting chest compressions for rescue breathing during cardiopulmonary resuscitation for ventricular fibrillation cardiac arrest. Circulation 2001;104:2465–70. https://doi.org/10.1161/hc4501.098926.
145. Bray J, Cash R, Nehme Z, et al. Continuous chest compressions versus standard cardiopulmonary resuscitation for in-hospital CPR: a systematic review Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/continuous-chest-compressions-ccc-versus-standard-cpr-for-in-hospital-cpr-bls-2222-tf-sr. Accessed 10 January 2025.
146. Lee IH, How CK, Lu WH, et al. Improved survival outcome with continuous chest compressions with ventilation compared to 5:1 compressions-to-ventilations mechanical cardiopulmonary resuscitation in out-of-hospital cardiac arrest. J Chin Med Assoc 2013;76:158–63. https://doi.org/10.1016/j.jcma.2013.01.001.
147. Raffay V, Olasveengen TM, Bray J; on behalf of the International Liaison Committee on Resuscitation BLS Life Support Task Force. Hand position during compressions Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/hand-position-during-compressions-bls-2502-tf-sr. Accessed 10 January 2025.
148. Orlowski JP. Optimum position for external cardiac compression in infants and young children. Ann Emerg Med 1986;15:667–73. https://doi.org/10.1016/s0196-0644(86)80423-1.
149. Qvigstad E, Kramer-Johansen J, Tomte O, et al. Clinical pilot study of different hand positions during manual chest compressions monitored with capnography. Resuscitation 2013;84:1203–7. https://doi.org/10.1016/j.resuscitation.2013.03.010.
150. Cha KC, Kim HJ, Shin HJ, Kim H, Lee KH, Hwang SO. Hemodynamic effect of external chest compressions at the lower end of the sternum in cardiac arrest patients. J Emerg Med 2013;44:691–7. https://doi.org/10.1016/j.jemermed.2012.09.026.
151. Park M, Oh WS, Chon SB, Cho S. Optimum chest compression point for cardiopulmonary resuscitation in children revisited using a 3D coordinate system imposed on CT: a retrospective, cross-sectional study. Pediatr Crit Care Med 2018;19:e576–84. https://doi.org/10.1097/PCC.0000000000001679.
152. Papadimitriou P, Chalkias A, Mastrokostopoulos A, Kapniari I, Xanthos T. Anatomical structures underneath the sternum in healthy adults and implications for chest compressions. Am J Emerg Med 2013;31:549–55. https://doi.org/10.1016/j.ajem.2012.10.023.
153. Nestaas S, Stensaeth KH, Rosseland V, Kramer-Johansen J. Radiological assessment of chest compression point and achievable compression depth in cardiac patients. Scand J Trauma Resusc Emerg Med 2016;24:54. https://doi.org/10.1186/s13049-016-0245-0.
154. Lee J, Oh J, Lim TH, et al. Comparison of optimal point on the sternum for chest compression between obese and normal weight individuals with respect to body mass index, using computer tomography: a retrospective study. Resuscitation 2018;128:1–5. https://doi.org/10.1016/j.resuscitation.2018.04.023.
155. Kwon MJ, Kim EH, Song IK, Lee JH, Kim HS, Kim JT. Optimizing prone cardiopulmonary resuscitation: identifying the vertebral level correlating with the largest left ventricle cross-sectional area via computed tomography scan. Anesth Analg 2017;124:520–3. https://doi.org/10.1213/ANE.0000000000001369.
156. Holmes S, Kirkpatrick ID, Zelop CM, Jassal DS. MRI evaluation of maternal cardiac displacement in pregnancy: implications for cardiopulmonary resuscitation. Am J Obstet Gynecol 2015;213:401.e1–5. https://doi.org/10.1016/j.ajog.2015.05.018.
157. Cha KC, Kim YJ, Shin HJ, et al. Optimal position for external chest compression during cardiopulmonary resuscitation: an analysis based on chest CT in patients resuscitated from cardiac arrest. Emerg Med J 2013;30:615–9. https://doi.org/10.1136/emermed-2012-201556.
158. Saksobhavivat N, Phattharapornjaroen P, Suksukon P, et al. Optimal chest compression position for cardiopulmonary resuscitation determined by computed tomography image: retrospective cross-sectional analysis. Sci Rep 2023;13:22763. https://doi.org/10.1038/s41598-023-49486-3.
159. Park JB, Song IK, Lee JH, Kim EH, Kim HS, Kim JT. Optimal chest compression position for patients with a single ventricle during cardiopulmonary resuscitation. Pediatr Crit Care Med 2016;17:303–6. https://doi.org/10.1097/PCC.0000000000000658.
160. Wyckoff MH, Singletary EM, Soar J, et al. and the COVID-19 Working Group. 2021 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Neonatal Life Support; Education, Implementation, and Teams; First Aid Task Forces; and the COVID-19 Working Group. Resuscitation 2021;169:229–311. https://doi.org/10.1016/j.resuscitation.2021.10.040.
161. Wyckoff MH, Singletary EM, Soar J, et al. and Collaborators. 2021 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Neonatal Life Support; Education, Implementation, and Teams; First Aid Task Forces; and the COVID-19 Working Group. Circulation 2021;2022(145):e645–721. https://doi.org/10.1161/CIR.0000000000001017.
162. Norii T, Lukas G, Samantaray A, Yabuki M, Olasveengen T, Bray J, on behalf of the International Liaison Committee on Resuscitation (ILCOR) Basic Life Support Task Force. Effects of head-up CPR on survival and neurological outcomes: a systematic review. Resusc Plus 2025;25:101007. https://doi.org/10.1016/j.resplu.2025.101007.
163. Norii T, Lukas G, Samantaray A, Olasveengen TM, Bray JE; for the International Liaison Committee on Resuscitation (ILCOR) Basic Life Support Task Force. Effects of head-up CPR on survival and neurological outcomes: a Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/effects-of-head-up-cpr-on-survival-and-neurological-outcomes-bls-2020-tfsr. Accessed 10 January 2025.
164. Bachista KM, Moore JC, Labarere J, et al. Survival for nonshockable cardiac arrests treated with noninvasive circulatory adjuncts and head/thorax elevation. Crit Care Med 2024;52:170–81. https://doi.org/10.1097/CCM.0000000000006055.
165. Moore JC, Pepe PE, Scheppke KA, et al. Head and thorax elevation during cardiopulmonary resuscitation using circulatory adjuncts is associated with improved survival. Resuscitation 2022;179:9–17. https://doi.org/10.1016/j.resuscitation.2022.07.039.
166. Pepe PE, Scheppke KA, Antevy PM, et al. Confirming the clinical safety and feasibility of a bundled methodology to improve cardiopulmonary resuscitation involving a head-up/torso-up chest compression technique. Crit Care Med 2019;47:449–55. https://doi.org/10.1097/CCM.0000000000003608.
167. Aufderheide TP, Frascone RJ, Wayne MA, et al. Standard cardiopulmonary resuscitation versus active compression-decompression cardiopulmonary resuscitation with augmentation of negative intrathoracic pressure for out-of-hospital cardiac arrest: a randomised trial. Lancet 2011;377:301–11. https://doi.org/10.1016/S0140-6736(10)62103-4.

168. Kudenchuk PJ, Brown SP, Daya M, on behalf of the Resuscitation Outcomes Consortium Investigators, et al. Amiodarone, lidocaine, or placebo in outof-hospital cardiac arrest. N Engl J Med 2016;374:1711–22. https://doi.org/10.1056/NEJMoa1514204.
169. Aufderheide TP, Nichol G, Rea TD, on behalf of the Resuscitation Outcomes Consortium (ROC) Investigators, et al. A trial of an impedance threshold device in out-of-hospital cardiac arrest. N Engl J Med 2011;365:798–806. https://doi.org/10.1056/NEJMoa1010821.
170. Wyckoff MH, Greif R, Morley PT, et al. and Collaborators. 2022 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Circulation 2022;2022(146):e483–557. https://doi.org/10.1161/CIR.0000000000001095.
171. Wyckoff MH, Greif R, Morley PT, et al. 2022 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations: summary from the Basic Life Support; Advanced Life Support; Pediatric Life Support; Neonatal Life Support; Education, Implementation, and Teams; and First Aid Task Forces. Pediatrics 2023;151:e2022060463. https://doi.org/10.1542/peds.2022-060463.
172. Olasveengen T, Semeraro F, Bray J, et al. Minimizing pauses: systematic review; 2022. https://costr.ilcor.org/document/bls-358-minimizing-pauses. Accessed 10 January 2025.
173. Dewolf P, Wauters L, Clarebout G, et al. Assessment of chest compression interruptions during advanced cardiac life support. Resuscitation 2021;165:140–7. https://doi.org/10.1016/j.resuscitation.2021.06.022.
174. Lyngby RM, Händel MN, Christensen AM, et al. Effect of real-time and post-event feedback in out-of-hospital cardiac arrest attended by EMS — a systematic review and meta-analysis. Resusc Plus 2021;6:100101. https://doi.org/10.1016/j.resplu.2021.100101.
175. Leo WZ, Chua D, Tan HC, Ho VK. Chest compression quality and patient outcomes with the use of a CPR feedback device: a retrospective study. Sci Rep 2023;13:19852. https://doi.org/10.1038/s41598-023-46862-x.
176. Iversen BN, Meilandt C, Væggemose U, Terkelsen CJ, Kirkegaard H, Fjølner J. Pre-charging the defibrillator before rhythm analysis reduces hands-off time in patients with out-of-hospital cardiac arrest with shockable rhythm. Resuscitation 2021;169:23–30. https://doi.org/10.1016/j.resuscitation.2021.09.037.
177. Holt J, Ward A, Mohamed TY, et al. The optimal surface for delivery of CPR: a systematic review and meta-analysis. Resuscitation 2020;155:159–64. https://doi.org/10.1016/j.resuscitation.2020.07.020.
178. Dewan M, Schachna E, Eastwood K, Perkins G, Bray J, on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. The optimal surface for delivery of CPR: an updated systematic review and meta-analysis. Resusc Plus 2024;19:100718. https://doi.org/10.1016/j.resplu.2024.100718.
179. Dewan M, Perkins G, Schachna E, et al. on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Optimal surface for CPR: an updated systematic review and meta-analysis. Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/firm-surface-for-cpr-an-updated-systematic-review-bls-2510. Accessed 10 January 2025.
180. Masterson S, Norii T, Yabuki M, on behalf of the BLS ILCOR Task Force, et al. Real-time feedback for CPR quality – a scoping review. Resusc Plus 2024;19:100730. https://doi.org/10.1016/j.resplu.2024.100730.
181. Masterson S, Norii T, Ikeyama T, et al. on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Real-time feedback for cardiopulmonary resuscitation: task force synthesis of a scoping review; 2024. https://costr.ilcor.org/document/real-time-feedback-for-cpr-quality-scoping-review-bls-2511-scr. Accessed 10 January 2025.
182. Ristagno G, Nishiyama C, Ikeyama T, et al. Passive ventilation: a Consensus on Science With Treatment Recommendations; 2022. https://costr.ilcor.org/document/passive-ventilation-bls-352. Accessed 10 January 2025.
183. Benoit JL, Lakshmanan S, Farmer SJ, et al. Ventilation rates measured by capnography during out-of-hospital cardiac arrest resuscitations and their association with return of spontaneous circulation. Resuscitation 2023;182:109662. https://doi.org/10.1016/j.resuscitation.2022.11.028.
184. Vissers G, Duchatelet C, Huybrechts SA, Wouters K, Hachimi-Idrissi S, Monsieurs KG. The effect of ventilation rate on outcome in adults receiving cardiopulmonary resuscitation. Resuscitation 2019;138:243–9. https://doi.org/10.1016/j.resuscitation.2019.03.037.
185. Debaty G, Johnson NJ, Dewan M, Morrison LM, Bray JE. Ventilation quality feedback devices consensus on science with treatment recommendations: a scoping review. Resusc Plus 2025;26:101069. https://doi.org/10.1016/j.resplu.2025.101069.
186. Debaty G, Johnson NJ, Dewan M, Morrison LJ, Bray J; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Ventilation quality feedback devices: a scoping review: Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/ventilation-quality-feedback-devices-bls-tf-2402-scr. Accessed 30 March 2025.
187. Lee ED, Jang YD, Kang JH, et al. Effect of a real-time audio ventilation feedback device on the survival rate and outcomes of patients with out-of-hospital cardiac arrest: a prospective randomized controlled study. J Clin Med 2023;12:6023. https://doi.org/10.3390/jcm12186023.
188. Drennan IR, Lee M, Héroux J-P, et al. The impact of real-time feedback on ventilation quality during out-of-hospital cardiac arrest: a before-and-after study. Resuscitation 2024;204:110381. https://doi.org/10.1016/j.resuscitation.2024.110381.
189. Deleted in proof.
190. McCarty K, Roosa J, Kitamura B, et al. Ventilation rates and tidal volume during emergency department cardiac resuscitation. Resuscitation 2012;83:e45.
191. Lemoine F, Jost D, Tassart B, et al. 464 Evaluation of ventilation quality by basic life support teams during out-of-hospital cardiac arrest: preliminary results from a prospective observational study the vecars study. Resuscitation 2024;203:S215. https://doi.org/10.1016/s0300-9572(24)00746-9.
192. Gerber S, Pourmand A, Sullivan N, Shapovalov V, Pourmand A. Ventilation assisted feedback in out of hospital cardiac arrest. Am J Emerg Med 2023;74:198.e1–5. https://doi.org/10.1016/j.ajem.2023.09.047.
193. Charlton K, McClelland G, Millican K, Haworth D, Aitken-Fell P, Norton M. The impact of introducing real time feedback on ventilation rate and tidal volume by ambulance clinicians in the North East in cardiac arrest simulations. Resusc Plus 2021;6:100130. https://doi.org/10.1016/j.resplu.2021.100130.
194. D'Agostino F, Agro FE, Petrosino P, Ferri C, Ristagno G. Are instructors correctly gauging ventilation competence acquired by course attendees? Resuscitation 2024;200:110240. https://doi.org/10.1016/j.resuscitation.2024.110240.
195. Dinh AT, Eyer X, Chauvin A, et al. Evaluation of EOlifeX®, a ventilation feedback device during cardiopulmonary resuscitation in medical students training. Resuscitation 2023;192:S43. https://doi.org/10.1016/s0300-9572(23)00447-1.
196. Gould JR, Campana L, Rabickow D, Raymond R, Partridge R. Manual ventilation quality is improved with a real-time visual feedback system during simulated resuscitation. Int J Emerg Med 2020;13:18. https://doi.org/10.1186/s12245-020-00276-y.
197. Heo S, Yoon SY, Kim J, et al. Effectiveness of a real-time ventilation feedback device for guiding adequate minute ventilation: a manikin

simulation study. Medicina (Kaunas) 2020;56:278. https://doi.org/10.3390/medicina56060278.
198. Khoury A, De Luca A, Sall FS, Pazart L, Capellier G. Ventilation feedback device for manual ventilation in simulated respiratory arrest: a crossover manikin study. Scand J Trauma Resusc Emerg Med 2019;27:93. https://doi.org/10.1186/s13049-019-0674-7.
199. Kim JW, Park SO, Lee KR, Hong DY, Baek KJ. Efficacy of Amflow®, a real-time-portable feedback device for delivering appropriate ventilation in critically Ill patients: a randomised, controlled, crossover simulation study. Emerg Med Int 2020;2020:5296519. https://doi.org/10.1155/2020/5296519.
200. Lyngby RM, Clark L, Kjoelbye JS, et al. Higher resuscitation guideline adherence in paramedics with use of real-time ventilation feedback during simulated out-of-hospital cardiac arrest: a randomised controlled trial. Resusc Plus 2021;5:100082. https://doi.org/10.1016/j.resplu.2021.100082.
201. Deleted in proof.
202. Scott JB, Schneider JM, Schneider K, Li J. An evaluation of manual tidal volume and respiratory rate delivery during simulated resuscitation. Am J Emerg Med 2021;45:446–50. https://doi.org/10.1016/j.ajem.2020.09.091.
203. Wagner M, Gröpel P, Eibensteiner F, et al. Visual attention during pediatric resuscitation with feedback devices: a randomized simulation study. Pediatr Res 2022;91:1762–8. https://doi.org/10.1038/s41390-021-01653-w.
204. You KM, Lee C, Kwon WY, et al. Realtime tidal volume feedback guides optimal ventilation during simulated CPR. Am J Emerg Med 2017;35:292–8. https://doi.org/10.1016/j.ajem.2016.10.085.
205. Lemoine S, Jost D, Petermann A, et al. 411 Compliance with pediatric manual ventilation guidelines by professional basic life support rescuers during out-ofhospital cardiac arrest: a simulation study. Resuscitation 2024;203:S192. https://doi.org/10.1016/s0300-9572(24)00701-9.
206. Sayre MR, Koster RW, Botha M, on behalf of the Adult Basic Life Support Chapter Collaborators, et al. Part 5: adult basic life support: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation 2010;2010(122):S298–324. https://doi.org/10.1161/CIRCULATIONAHA.110.970996.
207. Koster RW, Sayre MR, Botha M, et al. Part 5: adult basic life support: 2010 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Resuscitation 2010;81:e48–70. https://doi.org/10.1016/j.resuscitation.2010.08.005.
208. Cheskes S, Verbeek PR, Drennan IR, et al. Defibrillation strategies for refractory ventricular fibrillation. N Engl J Med 2022;387:1947–56. https://doi.org/10.1056/NEJMoa2207304.
209. Ristagno G, Semeraro F, Raffay V, on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force Members, et al. Pad size, orientation, and placement for defibrillation during basic life support: a systematic review. Resusc Plus 2025;25(101030). https://doi.org/10.1016/j.resplu.2025.101030.
210. Lopez-Herce J, del Casillo J, Ristagno G, et al. Pad positions and size in pedatrics: a Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/paddle-pad-size-and-placement-in-infants-and-children-pls-4080-17-updated-systematic-review. Accessed 10 January 2025.
211. Ristagno G, Raffay V, Semeraro F, et al. Pad positions and size in adults: a Consensus on Science With Treatment Recommendations; 2024. https://costr.ilcor.org/document/pad-paddle-size-and-placement-in-adults-bls-and-als-sr-bls-2601. Accessed 10 January 2025.
212. Yin RT, Taylor TG, de Graaf C, Ekkel MM, Chapman FW, Koster RW. Automated external defibrillator electrode size and termination of ventricular fibrillation in out-of-hospital cardiac arrest. Resuscitation 2023;185:109754. https://doi.org/10.1016/j.resuscitation.2023.109754.
213. Lupton JR, Newgard CD, Dennis D, et al. Initial defibrillator pad position and outcomes for shockable out-of-hospital cardiac arrest. JAMA Netw Open 2024;7:e2431673. https://doi.org/10.1001/jamanetworkopen.2024.31673.
214. Kerber RE, Grayzel J, Hoyt R, Marcus M, Kennedy J. Transthoracic resistance in human defibrillation. Influence of body weight, chest size, serial shocks, paddle size and paddle contact pressure. Circulation 1981;63:676–82. https://doi.org/10.1161/01.cir.63.3.676.
215. Dalzell GW, Cunningham SR, Anderson J, Adgey AA. Electrode pad size, transthoracic impedance and success of external ventricular defibrillation. Am J Cardiol 1989;64:741–4. https://doi.org/10.1016/0002-9149(89)90757-1.
216. Cheskes S, Drennan IR, Turner L, Pandit SV, Dorian P. The impact of alternate defibrillation strategies on shock-refractory and recurrent ventricular fibrillation: a secondary analysis of the DOSE VF cluster randomized controlled trial. Resuscitation 2024;198:110186. https://doi.org/10.1016/j.resuscitation.2024.110186.
217. Foster AG, Deakin CD. Accuracy of instructional diagrams for automated external defibrillator pad positioning. Resuscitation 2019;139:282–8. https://doi.org/10.1016/j.resuscitation.2019.04.034.
218. Nørskov AS, Considine J, Nehme Z, on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force, et al. Removal of bra for pad placement and defibrillation – a scoping review. Resusc Plus 2025;22:100885. https://doi.org/10.1016/j.resplu.2025.100885.
219. Bray J, Noerskov A, Considine J, Nehme Z, Olasveengen T, Morrison L; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Removal of bra for pad placement and defibrillation: task force synthesis of a scoping review; 2024. https://costr.ilcor.org/document/removal-of-bra-for-pad-placement-and-defibrillation-scoping-review-bls-2604-tf-scr. Accessed 10 January 2025.
220. Di Maio R, O'Hare P, Crawford P, et al. Self-adhesive electrodes do not cause burning, arcing or reduced shock efficacy when placed on metal items. Resuscitation 2015;96:11. https://doi.org/10.1016/j.resuscitation.2015.09.026.
221. Kramer CE, Wilkins MS, Davies JM, Caird JK, Hallihan GM. Does the sex of a simulated patient affect CPR? Resuscitation 2015;86:82–7. https://doi.org/10.1016/j.resuscitation.2014.10.016.
222. O'Hare P, Di Maio R, McCanny P, McIntyre C, Torney H, Adgey J. Public access defibrillator use by untrained bystanders: does patient gender affect the time to first shock during resuscitation attempts? Resuscitation 2014;85:S49. https://doi.org/10.1016/j.resuscitation.2014.03.124.
223. Grunau B, Humphries K, Stenstrom R, et al. Public access defibrillators: gender-based inequities in access and application. Resuscitation 2020;150:17–22. https://doi.org/10.1016/j.resuscitation.2020.02.024.
224. Ishii M, Tsujita K, Seki T, on behalf of the Japanese Circulation Society with Resuscitation Science Study (JCS-ReSS) Investigators, et al. Sex and age-based disparities in public access defibrillation, bystander cardiopulmonary resuscitation, and neurological outcome in cardiac arrest. JAMA Netw Open 2023;6:e2321783. https://doi.org/10.1001/jamanetworkopen.2023.21783.
225. Munot S, Bray JE, Redfern J, et al. Bystander cardiopulmonary resuscitation differences by sex – the role of arrest recognition. Resuscitation 2024;199:110224. https://doi.org/10.1016/j.resuscitation.2024.110224.
226. Perman SM, Vogelsong MA, Del Rios M. Is all bystander CPR created equal? Further considerations in sex differences in cardiac arrest outcomes. Resuscitation 2023;182:109649. https://doi.org/10.1016/j.resuscitation.2022.11.015.
227. Debaty G, Perkins GD, Dainty KN, Norii T, Olasveengen TM, Bray JE, on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Effectiveness of

ultraportable automated external defibrillators: a scoping review. Resusc Plus 2024;19:100739. https://doi.org/10.1016/j.resplu.2024.100739.
228. Debaty G, Dainty K, Norii T, Perkins GD, Olasveengen T, Bray J; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Effectiveness of ultra-portable or pocket automated external defibrillator: task force synthesis of a scoping review. Published January 9, 2024. https://costr.ilcor.org/document/effectiveness-of-ultra-portable-or-pocket-automated-external-defibrillators-a-scoping-review-bls-2603-scr. Accessed 10 January 2025.
229. Bierens J, Abelairas-Gomez C, Barcala Furelos R, et al. Resuscitation and emergency care in drowning: a scoping review. Resuscitation 2021;162:205–17. https://doi.org/10.1016/j.resuscitation.2021.01.033.
230. Bierens J, Bray J, Abelairas-Gomez C, et al. A systematic review of interventions for resuscitation following drowning. Resusc Plus 2023;14:100406. https://doi.org/10.1016/j.resplu.2023.100406.
231. Barcala-Furelos R, Schmidt A, Webber J, Perkins G, Bierens J, Bray J; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Immediate resuscitation in-water or delaying until on land strategies for drowning Consensus on Science with Treatment Recommendations; 2022. https://costr.ilcor.org/document/immediate-resuscitation-in-water-or-delaying-on-land-in-drowning-bls-tf-sr. Accessed 10 January 2025.
232. Sempsrott J, Szpilman D, Liu L, Bierens J, Bray J, Perkins G; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Compression-only CPR vs standard CPR with compressions and ventilations following drowning: Consensus on Science With Treatment Recommendations; 2022. https://costr.ilcor.org/document/ chest-compression-cpr-versus-conventional-cpr-in-drowning-bls-tfsr. Accessed 10 January 2025.
233. Seesink J, Thom O, Johnson S, et al.; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Oxygen administration following drowning Consensus on Science With Treatment Recommendations; 2022. https://costr.ilcor.org/document/oxygen-administration-following-drowning-bls-856. Accessed 10 January 2025.
234. Beerman S, Mecrow T, Fukuda T, et al.; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. AED first vs CPR first for drowning: Consensus on Science With Treatment Recommendations; 2022. https://costr.ilcor.org/document/aed-first-vs-cpr-first-in-cardiac-arrest-following-drowning-bls-856. Accessed 10 January 2025.
235. Lagina A, Claesson A, Bierens J, et al.; on behalf of the International Liaison Committee on Resuscitation Basic Life Support Task Force. Public access to defibrillation following drowning Consensus on Science With Treatment Recommendations; 2022. https://costr.ilcor.org/document/implementation-of-pad-programs-for-drowning-bls. Accessed 10 January 2025.
236. Szpilman D, Soares M. In-water resuscitation–is it worthwhile? Resuscitation 2004;63:25–31. https://doi.org/10.1016/j.resuscitation.2004.03.017.
237. Smyth M, Smith C, Ristagno G, et al. Impact of transport on CPR quality: a Consensus on Science With Treatment Recommendations; 2022. https://costr.ilcor.org/document/ impact-of-transport-on-cpr-quality-bls-1509a. Accessed 10 January 2025.
238. Park HA, Ahn KO, Lee EJ, Park JO, on behalf of the Korean Cardiac Arrest Research Consortium KoCARC Investigators. Association between survival and time of on-scene resuscitation in refractory out-of-hospital cardiac arrest: a cross-sectional retrospective study. Int J Environ Res Public Health 2021;18:496. https://doi.org/10.3390/ijerph18020496.
239. Loaec M, Himebauch AS, Kilbaugh TJ, et al. Pediatric cardiopulmonary resuscitation quality during intra-hospital transport. Resuscitation 2020;152:123–30. https://doi.org/10.1016/j.resuscitation.2020.05.003.
240. Lee SGW, Hong KJ, Kim TH, et al. Quality of chest compressions during prehospital resuscitation phase from scene arrival to ambulance transport in out-of-hospital cardiac arrest. Resuscitation 2022;180:1–7. https://doi.org/10.1016/j.resuscitation.2022.08.020.
241. Jang DH, Jo YH, Park SM, Lee KJ, Kim YJ, Lee DK. Association of the duration of on-scene advanced life support with good neurological recovery in out-of-hospital cardiac arrest. Am J Emerg Med 2021;50:486–91. https://doi.org/10.1016/j.ajem.2021.09.006.
242. Holmberg MJ, Granfeldt A, Stankovic N, Andersen LW. Intra-cardiac arrest transport and survival from out-of-hospital cardiac arrest: a nationwide observational study. Resuscitation 2022;175:50–6. https://doi.org/10.1016/j.resuscitation.2022.04.020.
243. Grunau B, Kime N, Leroux B, et al. Association of intra-arrest transport vs continued on-scene resuscitation with survival to hospital discharge among patients with out-of-hospital cardiac arrest. J Am Med Assoc 2020;324:1058–67. https://doi.org/10.1001/jama.2020.14185.
244. Choi S, Kim TH, Hong KJ, et al. Comparison of prehospital resuscitation quality during scene evacuation and early ambulance transport in out-of-hospital cardiac arrest between residential location and non-residential location. Resuscitation 2023;182:109680. https://doi.org/10.1016/j.resuscitation.2022.109680.
245. Burns B, Hsu HR, Keech A, et al. Expedited transport versus continued on-scene resuscitation for refractory out-of-hospital cardiac arrest: a systematic review and meta-analysis. Resusc Plus 2023;16:100482. https://doi.org/10.1016/j.resplu.2023.100482.
246. Berry CL, Olaf MF, Kupas DF, Berger A, Knorr AC, Group CS. EMS agencies with high rates of field termination of resuscitation and longer scene times also have high rates of survival. Resuscitation. 2021;169:205–13. https://doi.org/10.1016/j.resuscitation.2021.09.039.
247. Belohlavek J, Smalcova J, Rob D, on behalf of the Prague OHCA Study Group, et al. Effect of intra-arrest transport, extracorporeal cardiopulmonary resuscitation, and immediate invasive assessment and treatment on functional neurologic outcome in refractory out-of-hospital cardiac arrest: a randomized clinical trial. J Am Med Assoc 2022;327:737–47. https://doi.org/10.1001/jama.2022.1025.
248. Burns B, Marschner I, Eggins R, on behalf of the EVIDENCE Investigators, et al. A randomized trial of expedited intraarrest transfer versus more extended on-scene resuscitation for refractory out of hospital cardiac arrest: rationale and design of the EVIDENCE trial. Am Heart J 2024;267:22–32. https://doi.org/10.1016/j.ahj.2023.10.003.
249. Dennis M, Burns B, Marschner I, Keech A. Abstract 4135335: a randomized trial of expedited intra-arrest transfer versus more extended on-scene resuscitation for refractory out of hospital cardiac arrest: the EVIDENCE Study. Circulation 2024;150:A4135335. https://doi.org/10.1161/circ.150.suppl_1.4135335.
250. Considine J, Couper K, Greif R, on behalf of the International Liaison Committee on Resuscitation Basic Life Support; Advanced Life Support; Paediatric Life Support; and Education, Implementation, and Teams Task Forces, et al. Cardiopulmonary resuscitation in obese patients: a scoping review. Resusc Plus 2024;20:100820. https://doi.org/10.1016/j.resplu.2024.100820.
251. Considine J, Couper K, Greif R, et al.; on behalf of the International Liaison Committee on Paediatric Life Support; and the Education, Implementation, and Teams Task Forces. Cardiopulmonary resuscitation in obese patients task force synthesis of a scoping review. Published October 13, 2024. Updated January 6, 2025. https://costr.ilcor.org/document/ bls-2720-cardiopulmonary-resuscitation-in-obese-patients-bls-tf-scr. Accessed 10 January 2025.
252. Danciu SC, Klein L, Hosseini MM, Ibrahim L, Coyle BW, Kehoe RF. A predictive model for survival after in-hospital cardiopulmonary

arrest. Resuscitation 2004;62:35–42. https://doi.org/10.1016/j.resuscitation.2004.01.035.
253. White RD, Blackwell TH, Russell JK, Jorgenson DB. Body weight does not affect defibrillation, resuscitation, or survival in patients with out-of-hospital cardiac arrest treated with a nonescalating biphasic waveform defibrillator. Crit Care Med 2004;32:S387–92. https://doi.org/10.1097/01.ccm.0000139460.25406.78.
254. Bunch TJ, White RD, Lopez-Jimenez F, Thomas RJ. Association of body weight with total mortality and with ICD shocks among survivors of ventricular fibrillation in out-of-hospital cardiac arrest. Resuscitation 2008;77:351–5. https://doi.org/10.1016/j.resuscitation.2007.12.014.
255. Wolff B, Machill K, Schumacher D, Schulzki I, Werner D. Early achievement of mild therapeutic hypothermia and the neurologic outcome after cardiac arrest. Int J Cardiol 2009;133:223–8. https://doi.org/10.1016/j.ijcard.2007.12.039.
256. Jain R, Nallamothu BK, Chan PS, on behalf of the American Heart Association National Registry of Cardiopulmonary Resuscitation (NRCPR) investigators. Body mass index and survival after in-hospital cardiac arrest. Circ Cardiovasc Qual Outcomes 2010;3:490–7. https://doi.org/10.1161/CIRCOUTCOMES.109.912501.
257. Srinivasan V, Nadkarni VM, Helfaer MA, Carey SM, Berg RA, on behalf of the American Heart Association National Registry of Cardiopulmonary Resuscitation Investigators. Childhood obesity and survival after in-hospital pediatric cardiopulmonary resuscitation. Pediatrics 2010;125:e481–8. https://doi.org/10.1542/peds.2009-1324.
258. Testori C, Sterz F, Losert H, et al. Cardiac arrest survivors with moderate elevated body mass index may have a better neurological outcome: a cohort study. Resuscitation 2011;82:869–73. https://doi.org/10.1016/j.resuscitation.2011.02.027.
259. Breathett K, Mehta N, Yildiz V, Abel E, Husa R. The impact of body mass index on patient survival after therapeutic hypothermia after resuscitation. Am J Emerg Med 2016;34:722–5. https://doi.org/10.1016/j.ajem.2015.12.077.
260. Geri G, Savary G, Legriel S, et al. Influence of body mass index on the prognosis of patients successfully resuscitated from out-of-hospital cardiac arrest treated by therapeutic hypothermia. Resuscitation 2016;109:49–55. https://doi.org/10.1016/j.resuscitation.2016.09.011.
261. Gupta T, Kolte D, Mohananey D, et al. Relation of obesity to survival after in-hospital cardiac arrest. Am J Cardiol 2016;118:662–7. https://doi.org/10.1016/j.amjcard.2016.06.019.
262. Meert KL, Telford R, Holubkov R, on behalf of the Therapeutic Hypothermia after Pediatric Cardiac Arrest (THAPCA) Trial Investigators, et al. Pediatric out-of-hospital cardiac arrest characteristics and their association with survival and neurobehavioral outcome. Pediatr Crit Care Med 2016;17:e543–50. https://doi.org/10.1097/PCC.0000000000000969.
263. Ogunnaike BO, Whitten CW, Minhajuddin A, et al. Body mass index and outcomes of in-hospital ventricular tachycardia and ventricular fibrillation arrest. Resuscitation 2016;105:156–60. https://doi.org/10.1016/j.resuscitation.2016.05.028.
264. Beckett VA, Knight M, Sharpe P. The CAPS Study: incidence, management and outcomes of cardiac arrest in pregnancy in the UK: a prospective, descriptive study. BJOG 2017;124:1374–81. https://doi.org/10.1111/1471-0528.14521.
265. Galatianou I, Karlis G, Apostolopoulos A, et al. Body mass index and outcome of out-of-hospital cardiac arrest patients not treated by targeted temperature management. Am J Emerg Med 2017;35:1247–51. https://doi.org/10.1016/j.ajem.2017.03.050.
266. Gil E, Na SJ, Ryu JA, et al. Association of body mass index with clinical outcomes for in-hospital cardiac arrest adult patients following extracorporeal cardiopulmonary resuscitation. PLoS One 2017;12:e0176143. https://doi.org/10.1371/journal.pone.0176143.
267. Jung YH, Lee BK, Lee DH, Lee SM, Cho YS, Jeung KW. The association of body mass index with outcomes and targeted temperature management practice in cardiac arrest survivors. Am J Emerg Med 2017;35:268–73. https://doi.org/10.1016/j.ajem.2016.10.070.
268. Shahreyar M, Dang G, Waqas Bashir M, et al. Outcomes of in-hospital cardiopulmonary resuscitation in morbidly obese patients. JACC Clin Electrophysiol 2017;3:174–83. https://doi.org/10.1016/j.jacep.2016.08.011.
269. Aoki M, Hagiwara S, Oshima K, et al. and the SOS-KANTO 2012 Study Group. Obesity was associated with worse neurological outcome among Japanese patients with out-of-hospital cardiac arrest. Intensive Care Med 2018;44:665–6. https://doi.org/10.1007/s00134-017-5042-3.
270. Wang CH, Huang CH, Chang WT, et al. Associations between body size and outcomes of adult in-hospital cardiac arrest: a retrospective cohort study. Resuscitation 2018;130:67–72. https://doi.org/10.1016/j.resuscitation.2018.07.006.
271. Chavda MP, Pakavakis A, Ernest D. Does obesity influence the outcome of the patients following cardiac arrest? Indian J Crit Care Med 2020;24:1077–80. https://doi.org/10.5005/jp-journals-10071-23665.
272. Wang C-H, Chang W-T, Huang C-H, et al. Associations between central obesity and outcomes of adult in-hospital cardiac arrest: a retrospective cohort study. Sci Rep 2020;10:4604. https://doi.org/10.1038/s41598-020-61426-z.
273. Chen CT, Lin MC, Lee YJ, et al. Association between body mass index and clinical outcomes in out-of-hospital cardiac arrest survivors treated with targeted temperature management. J Chin Med Assoc 2021;84:504–9. https://doi.org/10.1097/JCMA.0000000000000513.
274. Lee H, Oh J, Kang H, on behalf of the Korean Cardiac Arrest Research Consortium (KoCARC) Investigators, et al. Association between the body mass index and outcomes of patients resuscitated from out-of-hospital cardiac arrest: a prospective multicentre registry study. Scand J Trauma Resusc Emerg Med 2021;29:24. https://doi.org/10.1186/s13049-021-00837-x.
275. Lee SE, Kim HH, Chae MK, Park EJ, Choi S. Predictive value of estimated lean body mass for neurological outcomes after out-of-hospital cardiac arrest. J Clin Med 2021;10:71. https://doi.org/10.3390/jcm10010071.
276. Patlolla SH, Yaqoub L, Prasitlumkum N, et al. Trends and differences in management and outcomes of cardiac arrest in underweight and obese acute myocardial infarction hospitalizations. Am J Cardiovasc Dis 2021;11:576–86.
277. Schurr JW, Noubani M, Santore LA, et al. Survival and outcomes after cardiac arrest with VA-ECMO rescue therapy. Shock 2021;56:939–47. https://doi.org/10.1097/SHK.0000000000001809.
278. Swindell WR, Gibson CG. A simple ABCD score to stratify patients with respect to the probability of survival following in-hospital cardiopulmonary resuscitation. J Community Hosp Intern Med Perspect 2021;11:334–42. https://doi.org/10.1080/20009666.2020.1866251.
279. Wannasri T, Peonim V, Worasuwannarak W. Cardiopulmonary resuscitated complications encountered in forensic autopsy cases: a 5-year retrospective analysis in ramathibodi hospital. Indian J Forensic Med Toxicol 2021;15:4621–30. https://doi.org/10.37506/ijfmt.v15i3.16019.
280. Chavda MP, Bihari S, Woodman RJ, Secombe P, Pilcher D. The impact of obesity on outcomes of patients admitted to intensive care after cardiac arrest. J Crit Care 2022;69:154025. https://doi.org/10.1016/j.jcrc.2022.154025.
281. Aoki M, Aso S, Suzuki M, on behalf of the SOS-KANTO 2017 Study Group, et al. Association between obesity and neurological outcomes among out-of-hospital cardiac arrest patients: the SOS-KANTO 2017 study. Resusc Plus 2023;17(17). https://doi.org/10.1016/j.resplu.2023.100513.
282. Czapla M, Kwaśny A, Słoma-Krześlak M, et al. The impact of body mass index on in-hospital mortality in post-cardiac-arrest

patientsdoes sex matter? Nutrients 2023;15:3462. https://doi.org/10.3390/nu15153462.
283. Hjalmarsson A, Rawshani A, Råmunddal T, et al. No obesity paradox in out-of-hospital cardiac arrest: data from the Swedish registry of cardiopulmonary resuscitation. Resusc Plus 2023;15:100446. https://doi.org/10.1016/j.resplu.2023.100446.
284. Kojima M, Mochida Y, Shoko T, SAVE-J II study group, et al. Association between body mass index and clinical outcomes in patients with out-of-hospital cardiac arrest undergoing extracorporeal cardiopulmonary resuscitation: a multicenter observational study. Resusc Plus 2023;16:100497. https://doi.org/10.1016/j.resplu.2023.100497.
285. Kosmopoulos M, Kalra R, Alexy T, et al. The impact of BMI on arrest characteristics and survival of patients with out-of-hospital cardiac arrest treated with extracorporeal cardiopulmonary resuscitation. Resuscitation 2023;188:109842. https://doi.org/10.1016/j.resuscitation.2023.109842.
286. Wang YG, Obed C, Wang YL, et al. Factors associated with the clinical outcomes of adult cardiac and non-cardiac origin cardiac arrest in emergency departments: a nationwide retrospective cohort study from China. World J Emerg Med 2023;14:238–40. https://doi.org/10.5847/wjem.j.1920-8642.2023.044.
287. Lewandowski L, Czapla M, Uchmanowicz I, et al. Machine learning and clinical predictors of mortality in cardiac arrest patients: a comprehensive analysis. Med Sci Monit 2024;30:e944408. https://doi.org/10.12659/MSM.944408.